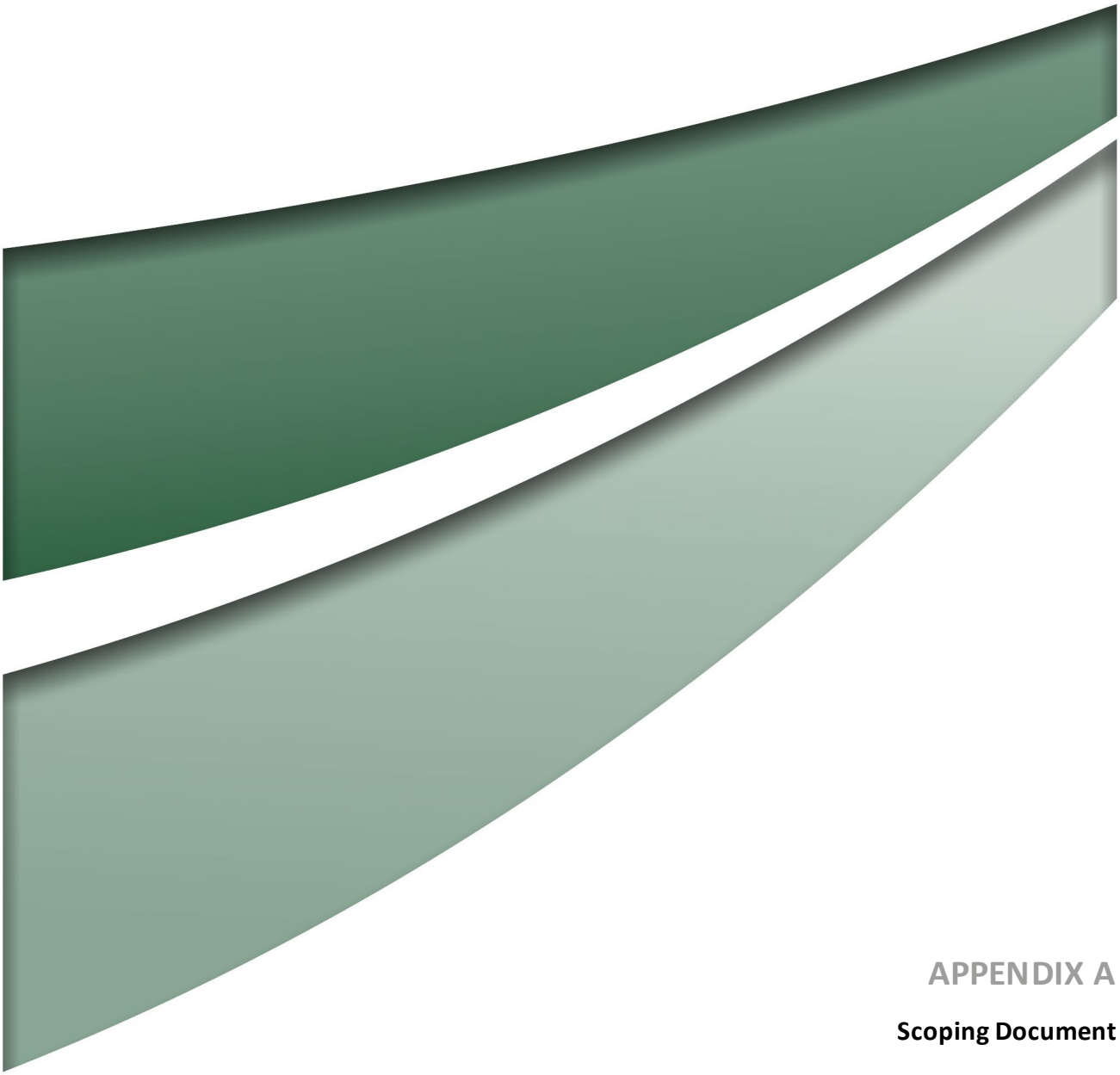


APPENDIX A

Scoping Document

ACT Government
Environment, Planning and Sustainable Development

Scoping Document

Under Division 8.2.2 of the *Planning and Development Act 2007*

APPLICATION NUMBER: EIS201900047		**DATE OF THIS NOTICE:** 16 January 2020	
DATE LODGED: 28 November 2019			
PROJECT: Redevelopment of the former Canberra Brickworks site, consisting of a mixture of parkland, residential, commercial and retail uses.			
IMPACT TRACK TRIGGER: Planning and Development Act, Schedule 4; Part 4.3 Items 1(a), 6 & 7			
BLOCK:	**SECTION:**	**DISTRICT/DIVISION:**	**LESSEE/LAND CUSTODIAN:**
1	102	Yarralumla	ACT Property Group
7	102	Yarralumla	TCCS – City Presentation
20	102	Yarralumla	TCCS – City Presentation
ADDRESS: Old Canberra Brickworks, Denman Street, Yarralumla			
PROPONENT: Doma Group			
APPLICANT: Umwelt (Australia) Pty Ltd			

SCOPING DOCUMENT

The planning and land authority (the Authority) within the Environment, Planning and Sustainable Development Directorate received your application under section 212(1) of the *Planning and Development Act 2007* (the PD Act) for Scoping of an Environmental Impact Statement (EIS) for the above proposed development. Pursuant to section 212(2) of the PD Act, the Authority has:

a) Identified the matters that are to be addressed by an EIS in relation to the development proposal; and

b) Prepared a written notice (the ***scoping document***) of the matters.

On 19 December 2017, a delegate of the Commonwealth Minister for the Environment and Energy determined the proposed action to be a controlled action under section 75 of the EPBC Act.

At the time of the controlled action decision, it was also determined that the assessment would be undertaken in accordance with Schedule 1 of the Bilateral agreement made under section 45 of the EPBC Act relating to environment assessment (2014).

This will enable the EIS to meet the impact assessment requirements under both Commonwealth and ACT Legislation. The project will require approval from the Commonwealth Minister for Environment and Energy under part 9 of the EPBC Act before it can proceed.

NB: The EIS must conform to the requirements of this scoping document. This document does not indicate approval or support in any way, nor does it indicate approval in principle.

ACT Government
Environment, Planning and Sustainable Development

Scoping Document

Under Division 8.2.2 of the *Planning and Development Act 2007*

TERM OF SCOPING DOCUMENT

Pursuant to section 213(2) of the PD Act, the proponent must give the draft EIS to the Authority by the end of the period of 18 months starting on the day the Authority gives the scoping document for the development proposal to the applicant.

FORM AND FORMAT OF EIS

The Authority requires that the proponent engage a suitably qualified independent consultant to prepare an EIS, OR the proponent submits, with the draft EIS, an independent review of the draft EIS undertaken by a suitably qualified consultant. The EIS must be in the following form and format:

- The EIS must be prepared in accordance with section 50 of the *Planning and Development Regulation 2008.*
- The EIS must be written in plain English and avoid the use of jargon as much as possible.
- The EIS is required to be provided in the same structure as described in this Scoping Document as closely as possible (e.g. executive summary, introduction, proposal details, legislative context, risk assessment, assessment of impacts, consultation, recommendations/mitigation, conclusion).
- A table that cross-references the EIS to the scoping document must be included in the EIS submission.
- The EIS must reference any figures or supporting information such as appendix and page number, table or figure.
- Additional technical detail, including relevant data, technical reports and other sources of the EIS analysis must be provided in appendices.
- A redacted version (in addition to the full version) of any reports containing restricted or sensitive information must be provided for public notification, such as a Cultural Heritage Assessment report.
- Maps, diagrams and other illustrative material should be included in the EIS to assist readers to interpret information.
- The EIS document sized A4 with maps and drawings in A4 or A3 format.
- The proponent must supply a copy of all draft EIS and revised EIS documents in electronic formats for circulation and web posting. These are to be supplied by email, USB, or another agreed method.
- Digital files must not exceed 20 MB each.
- The proponent must supply three hard copies of the draft EIS and two copies on individual USB's once it has been accepted for lodgement and three hard copies and three copies on individual USB's of the revised EIS once it had been accepted for lodgement.

COST OF PREPARATION OF EIS

The proponent is responsible for the preparation of the draft and revised EIS and any related applications and associated costs. This includes additional copies of the draft and revised EIS and other associated documents as required by the Authority from time to time.

NEXT STEPS

The proponent is now required to prepare a document (a ***draft EIS***) that addresses each matter raised in the scoping document for the proposal within the timeframe provided in this scoping document. Once the draft EIS has been accepted for lodgement, a public notification fee is payable for

notification, referrals and assessment to commence. After the notification period has closed, the Authority will provide comments and any public representations received for the proponent to address in preparing a ***revised EIS***, and any further instructions on the application.

If you have any queries about the requirements outlined in this scoping document, please contact Kristy Moyle to arrange a suitable time to discuss.

Delegate of the planning and land authority
Brett Phillips
Executive Group Manager
Planning Delivery Division
Environment, Planning and
Sustainable Development Directorate
Email: Brett.Phillips@act.gov.au

Contact
Kristy Moyle
Development Assessment Officer
Impact Assessment and Business Improvement
Environment, Planning and
Sustainable Development Directorate
Email: EPDImpact@act.gov.au
Phone: 02 6207 1923

GENERAL REQUIREMENTS FOR THE EIS

1. Cover Page

The cover page must clearly display the following:

- The name of the proposal (project title)
- The block identifier(s) and street address for the proposal
- The date of the preparation of the document
- Full name and postal address of the designated proponent
- Full name and postal address of the designated applicant
- Name and contact details of the person/organisation who prepared the documents (if different to the above)

2. Glossary

Provide a glossary of technical terms, acronyms and abbreviations used in the EIS.

3. Executive Summary

Provide a non-technical summary of the EIS including a description of the proposal, key findings and recommendations.

4. Introduction

Summarise the proposal background and justification for the proposal.

5. Proposal Details

5.1. Project Description

Provide a description of the proposal, including:

a) The objectives and justification for the proposal;

b) The location of the land to which the proposal relates, including detailed maps;

c) The division and/or district names and block and/or section numbers of the land under the *Districts Act 2002;*

d) If the land is leased – the lessee's name;

e) If the land is unleased or public land – the custodian of the land;

f) The purposes for which the land may be used;

g) A clear identification of all lands subject to direct disturbance from the proposal and associated infrastructure and geomorphic features such as waterways and wetlands. This is to be supported by a map showing all affected lands;

h) An outline of any developments that have been, or are being, undertaken by the proponent, or other person(s) or entities, within the proposal area and broadly in the region. Describe how the proposal relates to these developments;

i) A description of all the components of the proposal, including the proposal specifications, the predicted timescale for implementation (design, approvals, construction and operation) and project life;

j) A plan/description of the precise location of any works to be undertaken, structures to be built and all other elements of the proposal that may have relevant impacts; and

k) A description of the construction methodologies for the proposal.

5.2. Alternatives to the proposal

Provide details of any alternatives to the proposal considered in developing the proposal including a description of:

a) Any design and location alternatives to the proposal and provide reasons for selecting the preferred option with an analysis of site selection;

b) The criteria used for assessing the performance of any alternative to the proposal considered;

c) Any matters considered to avoid or reduce potential impacts prior to the selection of the preferred option; and

d) Details of the consequences of not proceeding with the proposal.

6. Legislative and Strategic Context

A description of the EIS process including any statutory approvals obtained or required for the proposal, and how the proposal is aligned with strategic priorities for the ACT.

6.1. Statutory requirements

The EIS must include information on statutory requirements for the proposal and how the proposal meets these requirements:

- *Planning and Development Act 2007*
- *Planning and Development Regulation 2008*
- *Environment Protection Act 1997*
- *Environment Protection Regulation 2005*
- *Nature Conservation Act 2014*
- *Tree Protection Act 2005*
- Other related statutory approvals

6.2. Climate change

The EIS must include information on how the proposal will reduce the risks from climate change impacts and include proposed adaptation measures to reduce vulnerability and increase resilience of the community and the Territory, particularly to the extreme events of heatwaves, droughts, storms with flash flooding and bushfires. The information must address impacts on the local microclimate and how it will avoid contribution to urban heat and positively contribute to urban cooling measures.

Additionally, the EIS must address the contribution the proposal will make to reducing greenhouse gas emissions and meeting the legislated target for a net zero emissions Territory (by 2045 at the latest).

Preparation of the EIS must consider relevant sections of the following ACT Government policies:

- ACT Climate Change Strategy 2019-2025
- Canberra's Living Infrastructure Plan: Cooling the City

6.3. Other requirements

The description must also include information on how each of the following has been considered in the preparation of the EIS and the development of the proposal:

- Territory Plan 2008
- ACT Planning Strategy
- National Capital Plan
- Relevant Environment Protection Policies and Separation Distance Guidelines for Air Emissions (https://www.environment.act.gov.au/environment/legislation_and_policies)
- Plans of Management for any public land
- Any relevant Master Plan
- Other relevant planning and environmental guidelines, action plans and management plans.

6.3.1. Ecologically sustainable development (ESD)

Provide a description of the proposed action in relation to the long-term and short-term considerations of economic development, social development and environmental protection. The proponent should ensure that the EIS adequately addresses the principles of sustainable development as defined by s 9 of the PD Act, especially the economic consequences of the environmental impacts from the proposed development.

6.3.2. Territory Plan strategic directions

A statement must be provided regarding the proposal's consistency with the principles in the Statement of Strategic Directions in the Territory Plan 2008 (Section 2.1 - Strategic Direction).

7. Risk Assessment

7.1. Risk Assessment Methodology

Provide a risk assessment in accordance with the Australian and New Zealand Standard for risk management AS/NZS ISO 31000:2009 *Risk Management – Principles and guidelines.* The proposed criteria for determining which risks are potentially significant impacts must be described.

The Preliminary Risk Assessment (PRA) submitted as part of the request for a scoping document must be revised to include, but not be limited to, the risks identified by the Authority in Table 1.

-Assessment guide-			
Provide a table with the headings below to describe the risks identified and the original risk rating without any mitigation strategies in place. This table format is one option, however alternative formats can be used provided the methodology is clearly described and in accordance with AS/NZS ISO 31000:2009 *Risk Management – Principles and guidelines*			
Risk	Likelihood	Consequence	Risk rating

The risks identified in Table 1 are based on the scoping document application and comments received from entities on the application. All of these risks are considered potentially significant (i.e. a medium risk level or above), and must be addressed in the EIS. Should any risk levels change during the preparation of the EIS or any new risks become apparent, these must be assessed and included with a justification in the EIS, and where relevant, the residual risk assessment.

Table 1 – Identified impacts and requirements to be addressed in the EIS

Environmental Theme	Risk identified	See section/s below for further detail
Planning and Land Status	• Sterilisation of surrounding land uses	8.2.1
	• Inconsistency with Yarralumla Neighbourhood Plan and Canberra Brickworks Conservation Management Plan	
Traffic and Transport	• Intensification of access road use during construction and the impact of heavy rigid vehicular movements on road surfaces	8.2.2
	• Inability to access the site if the Dudley Street access road is not constructed	
	• Increases in traffic flow on surrounding access roads and the potential for an increase in motor vehicle collisions and / or pedestrian injuries	
	• Damage to sensitive environmental and heritage items caused by construction vehicles accessing the site	
Utilities	• Impacts to existing and proposed utilities during construction and operation	8.2.3
	• Existing services do not have the capacity to service the site	
Materials and Waste	• Increased waste to landfill during construction and operation	8.2.4
	• Contaminants within stockpiles of soil and waste are dispersed into surrounding areas	
Soils and Geology	• Soil disturbance and imported fill leads to erosion and dispersion	8.2.5
	• Disturbance to identified Areas of Environmental Concern (AECs) expose lead and other potentially hazardous materials	
	• Widespread use of fill across the site results in the destabilisation / lack of density / compaction necessary for construction	
	• Construction and landscaping works impact upon / damage the Yarralumla formation	
Landscape and Visual	• Visual impact of the new precinct on the landscape	8.2.6
	• Vegetation removal negatively impacts upon the visual amenity of the locality	
Water Quality and	• Contaminants impact upon water quality as a result of soil disturbance	8.2.7

Environmental Theme	Risk identified	See section/s below for further detail
Hydrology	• Bioremediation failure results in leaching of contaminants into groundwater	
	• An increase in hard / impervious surfaces increases rates of overland rainwater flow	
Socio-economic and Health	• Intensification of the use of the precinct causes a loss of residential amenity	8.2.8
	• Inadequate attention to design and layout results in a lack of passive surveillance	
	• Potential risks to residents and passive users of the site as a result of exposure to contaminants (particularly lead and asbestos)	
	• Remediation works fail to adequately remove contaminants from the soil	
	• Potential for currently unknown contaminants to impact upon the health of residents and visitors to the precinct	
Climate Change and Air Quality	• Increases in the frequency and intensity of extreme climatic events expose future residents to risks associated with bushfire, flooding and temperature extremes	8.2.9
	• Intensification / construction of increased impervious areas causes a local increase in heat retention	
	• Additional residential and vehicular activities result in increases in greenhouse gas emissions	
	• A failure to properly position residential dwellings in the precinct may result in an over-reliance on heating and cooling	
Noise, Vibration and Lighting	• Construction works cause excessive levels of noise and impact upon residential amenity in and adjacent to the precinct	8.2.10
	• Construction works cause levels of vibration that impact upon residential amenity in and adjacent to the precinct	
	• Increases in residential activity lead to additional noise during operation in and adjacent to the precinct	
	• Increased levels of light impacting adversely on residential amenity in and adjacent to the precinct	

Environmental Theme	Risk identified	See section/s below for further detail
Hazard and Risk	• Bushfire threat to newly-built properties.	8.2.11
Ecology and Natural Environment	• Construction work and site disturbance impact Golden Sun Moth habitat.	8.2.12
	• Suitable offset areas are not available	
	• Removal of mature, hollow-bearing trees impacts upon the habitat and dispersal of arboreal species	
	• Delays in revegetation result in a net loss of canopy cover	
Heritage	• Construction and change of use detract from the heritage significance of the Brickworks and associated ancillary structures	8.2.13
	• Places listed on the ACT Heritage Register are damaged during construction	
	• Places listed on the ACT Heritage Register are damaged during ongoing residential and recreational use	
	• Unidentified heritage items are damaged during construction	
Matters of National Environmental Significance	• Construction impacts upon Golden Sun Moth habitat and any other matters of national environmental significance (MNES)	8.2.14
	• Proposal fails to comply with Commonwealth recovery plans or threat abatement plans	
	• Suitable offsets are unavailable to compensate for the impacts to Golden Sun Moth habitat	

8. Assessment of Impacts

Sufficient information is required to provide the Authority with an adequate understanding of the environmental impacts associated with the proposal.

Each potentially significant risk identified in Table 1 and in the proponent's PRA must be addressed, and structured, as set out in sections 8.1-8.2 below.

8.1. Standard requirements

8.1.1. Environmental conditions and values

Describe the environmental conditions and values for the environmental themes identified in Table 1. This section should discuss the baseline conditions for the area.

8.1.2. Investigations

Identify the findings and results of any environmental investigation in relation to the land to which

the proposal relates.

8.1.3. Impacts

Describe the environmental impacts associated with the construction and operation for the environmental themes identified in Table 1 and in the proponent's risk assessment (including cumulative, consequential and indirect effects) on physical and ecological systems and human communities. Particular emphasis should be placed on the potentially significant impacts identified in the risk assessment. Include a discussion of the timeframes of impacts i.e. short or long term, their nature and extent and whether they are reversible or irreversible, unknown or unpredictable. Include an analysis of the significance of the relevant impacts. Information must include any technical data and other information used or needed to make a detailed assessment of the impacts.

8.1.4. Mitigation

Discuss the proposed safeguards and mitigation measures that will be implemented to reduce the potentially significant impacts identified in Table 1 and the proponent's risk assessment. This is to include:

a) A description and an assessment of the proposed impact avoidance, mitigation or offsetting measures to deal with the environmental impact of the proposal, along with which stage the mitigation measures will be adopted

b) Any statutory or policy basis for the mitigation measures

c) An outline of an environmental management plan (EMP) that sets out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action, including any provisions for independent environmental auditing

d) The frequency, duration and objectives of monitoring proposed

e) The name of the agency responsible for endorsing or approving each mitigation measure or monitoring program

f) Any corrective actions should the mitigation measures fail

g) A description of the cost effectiveness of environmental mitigation or rehabilitation measures proposed and the expected or predicted effectiveness of those measures.

Offsets should directly contribute to the ongoing viability of protected matters impacted by the project and deliver an overall conservation outcome that improves or maintains the viability of protected matters as compared to what is likely to have occurred under the status quo, that is if neither the action nor the offset had taken place.

The offset package must provide compensation for any unavoidable impacts arising from the proposal on listed threatened species and communities. The offset package must include, but not be limited to, measures to address the long-term protection and management of relevant listed threatened species and communities at offset sites in the ACT (or surrounding area) and may also include management measures to improve the ecological values. Further information on the provision of Commonwealth offsets is detailed in the *EPBC Offsets Policy (2012)* available from: http://www.environment.gov.au/epbc/publications/epbc-act-environmental-offsets-policy

Describe the cost effectiveness of environmental mitigation or rehabilitation measures proposed and the expected or predicted effectiveness of those measures.

Note: Any EMP in relation to this project is to be made publically available on the proponent's website if the project is subsequently approved under the EPBC Act.

8.1.5. Residual risk

Provide a table that details the residual risk for potentially significant impacts identified in Table 1 and the proponent's risk assessment. A residual risk assessment is only required where the significance of impact is determined as medium or above. The calculation of the residual risk should take into account the implementation of mitigation or offsetting measures. A discussion of how the calculations were determined should also be included, including the expected or predicted effectiveness of the mitigation measures.

-Assessment Guide-				
Provide the residual risk assessment as set out in the table below.				
Risk identified in Section 7	**Original risk rating from items identified in 7**	**Residual likelihood**	**Residual consequence**	**Residual risk rating**

8.2. Detailed requirements

The following matters relate to Table 1 and must be addressed in detail in the EIS. Please note this is not an exhaustive list of matters that may be required to accurately detail the assessment scenarios.

8.2.1. Planning and Land Status

- Include a description of the planning context of the area where the project will be located.
- Describe the planning and development status of any land or project relevant to the proposal.
- Describe the planning permissibility of the proposed site in relation to the Yarralumla Precinct Map and Code. Provide a description of the differences in planning permissibility at the site of the proposed development and adjacent residential uses.
- Describe the proposal and it's consistency with the Yarralumla Neighbourhood Plan and the Canberra Brickworks Conservation Management Plan.
- Describe land use of the proposed land and any land to be affected (including, but not limited to, zoning, lessee(s) or custodian of the land, the permissibility of the proposed use defined in the Territory Plan).

8.2.2. Traffic and Transport

- Provide a Traffic Management and Control Plan detailing all safety measures to be implemented during construction. Include a detailed survey that shows each of the sensitive heritage assets that are known to occur on site. Provide details of how these assets will be protected during construction.
- Provide a Transport Impact Assessment.
- Describe arrangements for the transport of construction materials, equipment, products, and personnel during the construction phase of the development proposal.
- Include a description of the volume of traffic generated during construction.
- Investigate the impacts the proposal will have on traffic congestion and road safety and describe mitigation measures to reduce the impacts.
- Provide a Construction Management Plan (CMP) indicating the impacts of construction staging, heavy vehicle movements during construction, conflicts with vulnerable road users and potential environmental impacts.
- Investigate the impacts on the vehicular route chosen to transport oversized

equipment and accessories by heavy vehicles and describe mitigation measures to reduce the impacts.

- Identify and investigate each of the entrance/exit points to be utilised during construction to ensure the minimum stopping sight distances are achieved in accordance with any applicable standards.
- Investigate the impact of vehicular movement associated with residential use during operation, using the maximum proposed number of residential dwellings and commercial outlets.
- Provide an analysis of how the project maximises accessibility to a range of public transport options and any associated infrastructure.
- Indicate how the project is consistent with the approved Landscape Management Protection Plan (LMPP).

8.2.3. Utilities

- Describe any existing utilities located on the land subject to this proposal.
- Describe the capacity of existing water and sewage services and investigate whether the capacity is sufficient to service the new development.
- Provide details of any new or upgraded utilities, removal or realignments required as a result of this development.
- Provide details of any proposed alterations relocations and / or connections to existing gas services.
- Investigate potential impacts to existing infrastructure and provide mitigation measures to reduce the impacts.
- Provide details of any unlicensed regulated activities as defined under the *Utilities (Technical Regulation) Act 2014*
- Provide details of any potential impacts upon water assets as a result of levelling of the site.

8.2.4. Materials and Waste

- Describe all materials to be stockpiled on site.
- Investigate potential impacts of stockpiling materials, including any contaminated materials, and provide mitigation measures to reduce any impacts.
- Consider increases in residential and commercial waste to be generated during operation and potential impacts of this waste generation.

8.2.5. Soils and Geology

- Describe the soil and geology features of the area.
- Investigate the likely impact of construction and soil disturbance on the Yarralumla formation. Detail any mitigation measures required to minimise impact.
- Undertake a detailed contamination assessment of the 10 Areas of Environmental Concern (AEC) identified and in accordance with EPA guidelines.
- Describe the composition and source of all fill intended for use at the site.
- Provide details of any contaminants within fill to be used on site and identify additional areas of concern for assessment in accordance with Phase 2 investigations.
- Provide a Remediation Action Plan for the proposed remediation works in accordance with EPA guidelines.
- Describe any protocols necessary for soil compaction and soil compaction testing to

ensure stabilisation of fill on site.

- Provide a Sediment and Erosion Control Plan (SECP) and describe erosion impacts from construction and operation activities, especially during extreme weather and detail measures to reduce the impacts of sediment and erosion, including dust suppression.
- Provide an Unexpected Finds Protocol (UFP) for all earthworks and construction activities on site.

8.2.6. Landscape and Visual

- Undertake a visual assessment of the site and surrounds to describe the impact of the proposed development on the area.
- Visual assessment and impact analysis must provide perspectives of the site from all access ways and present a comparative assessment of existing and proposed views upon immediate surrounds, views along approach routes and any significant views/vistas.
- Identify landscape and visual impacts as a result of vegetation removal.
- Describe measures to be adopted to reduce any visual impacts.

8.2.7. Water Quality and Hydrology

- Undertake stormwater surface modelling to determine the impact of increased hard / impervious surfaces on overland flow volume and velocity.
- Investigate the impact of overland flow on water quality as a result of sediment and erosion entering drainage lines, waterways and road drainage infrastructure.
- Describe any mitigation measures required to prevent sediment and erosion from impacting on water quality.
- Consider the potential for bioremediation failure to result in contamination of surface and groundwater.
- Consider the potential for contaminants within soils to impact on water quality as a result of soil disturbance.

8.2.8. Socio-economic and Health

- Provide detailed prevention methods to protect residents and passive users of the site from being exposed to site contaminants.
- Consider the increase in vehicular movement, residential activity and commercial enterprise upon the amenity of surrounding residences. Provide mitigation measures to reduce any impacts.
- Provide details of how the precinct has been designed to achieve safety through passive surveillance.

8.2.9. Climate Change and Air Quality

- Consider the risks of extreme climatic events upon future residents and how the precinct has been designed to deal with climatic extremes.
- Consider the likely increase in heat retention as a result of increased concrete and hard, landscaped areas. Provide mitigation measures to minimise increases in temperature and promote cooling through design and landscaping.
- Investigate the impact of increasing residential and vehicular activities upon greenhouse gas emissions.
- Describe the design and layout of the site and provide details of building orientation

and materials to achieve solar passive design. Provide details of mitigation methods to reduce reliance on mechanical heating and cooling.

- Outline proposed climate change adaptation measures to reduce vulnerability and increase resilience of the community.
- Describe how the site design and landscaping will contribute to the 30% Urban Environment target for coverage, in accordance with Canberra's Living Infrastructure Plan: Cooling the City.

8.2.10. Noise, Vibration and Lighting

- Provide an acoustic report that considers the impact of construction activities and noise and vibration on nearby residential properties and provide details of mitigation measures.
- Consider the impact of increased residential and commercial activity upon nearby residential properties and provide details of mitigation measures.
- Include an acoustic assessment and any mitigation measures necessary to minimise the impact of construction and ongoing residential development upon adjacent residential areas.

8.2.11. Hazard and Risk

- Provide a bushfire assessment report that considers the bushfire attack level of the site and any necessary management of Inner Asset Protection Zones (IAPZ) within the site, in accordance with ACT Bushfire Management Standards.
- Consider the impact of managing the site as an IAPZ on any environmentally sensitive areas.

8.2.12. Ecology and Natural Environment

- Provide a description of the ecological values (including native vegetation, endangered ecological communities and potential threatened species) and their habitat on and adjacent to the site.
- Report on the presence of rare native plants that are possibly present, including Pale Flax Lily (Dianella longifolia), Matted Parrot Pea (Dillwynia prostrata), and Button Wrinklewort (Rutidosis leptorhnchoides).
- Provide maps showing the location of all habitat and overlay all aspects of the proposed development to show the extent of any impact.
- Consider offset requirements, and whether suitable offsets are available.
- Consider if offsetting is acceptable for the species affected and consider alternatives.
- Consider the impact of removing mature, hollow-bearing trees upon local and regional connectivity for arboreal species with a particular focus on woodland birds including the Diamond Firetail and Double Barred Finch.
- Consider the impact of weed species spread due to soil disturbance and any key habitat that is at risk of being affected. Provide mitigation measures.
- Provide details of mitigation measures to reduce the impacts identified on flora and fauna species in accordance with additional detailed assessment of both direct and indirect impacts.

8.2.13. Heritage

- Prepare a Research Design and Methodology for excavation of the seven areas of moderate and high archaeological potential and detail the findings of excavations.

- Provide an in-depth heritage assessment of the site:
  - Consider the impact of the redevelopment on the heritage character / significance of the Brickworks and associated ancillary structures.
  - Consider whether the elevations, colours and materials proposed for use in construction are sympathetic to the heritage character of the site.
  - Consider direct and indirect impacts on the known heritage values of the Precinct, spanning heritage buildings and features registered on the ACT Heritage Register, and any historical archaeological features and deposits identified through further research
- Develop a final Conservation Management Plan that considers the impact of the proposed redevelopment on core and supporting heritage items:
  - Survey and locate each item of heritage significance.
  - Describe the measures to be taken to prevent damage during construction.
  - Include a monitoring and evaluation framework to ensure that all items of heritage significance are protected during construction and operation and where impacts cannot be avoided present ways to minimise and mitigate heritage impacts.
  - Include an Unexpected Finds protocol for any additional items of heritage significance that may be identified during construction.

8.2.14. Matters of National Environmental Significance (MNES)

- Outline the impacts (including extent) to Golden Sun Moth habitat and any other MNES potentially impacted by the project.
- For the Golden Sun Moth (and any other matters identified as potentially impacted) provide a description of the relevant impacts of the action including:
  - a detailed discussion of known threats
  - a detailed assessment of direct and indirect impacts on areas of habitat and populations of listed threatened species during pre-construction, construction and operation
  - detailed information on the extent (in hectares) of known and potential habitat that occurs in the proposed site and surrounds which may potentially be impacted by the proposal
  - a detailed assessment of the nature and extent of the likely short term and long term relevant impacts
  - a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible.
- Outline how the proposal is consistent with any relevant Commonwealth recovery plans or threat abatement plans.
- Outline any offsets proposed to compensate for the impacts to MNES.

8.3 Entity requirements

The EIS must address the entities comments provide in Attachment A. If the issues raised by entities have been addressed in other sections of the EIS, this must be cross referenced.

9. Community and stakeholder consultation

9.1. Consultation must be undertaken with:

- Lease holders and land managers of land potentially impacted by the proposal;
- Any recreational groups which may be affected by the proposal;

- Any volunteer conservation, landscape management or land care groups active in the area who may be affected by the proposal; and
- Any local community and community groups.

9.2. Consultation methods

- Describe the community consultation undertaken (methodology and criteria for identifying stakeholders and the communication methods used).
- Provide details on the information provided during the community consultation process. A plain English statement explaining the proposal and conceptual drawings must be made available to the community and stakeholders.
- Consultation should occur as early as possible and avoid, or make allowances for public holidays, school holidays and the summer holiday (Christmas) shutdown period.

9.3. Consideration of community feedback

- Provide a summary of how the community and stakeholders responded to the proposal and the main comments raised.
- Describe how any concerns have been considered and identify any changes that have been made to the proposal.

9.4. Consideration of public representations from Draft EIS notification

- The revised EIS must include the representations received, issues raised in the representations and a response to the issues and values identified. The summary response must clearly identify the representation(s) to which the responses relate.

10. Recommendations

Provide a summary of commitments to avoid, mitigate and offset the potential significant impacts associated with the proposal.

Describe the monitoring parameters, monitoring points, frequency, data interpretation and reporting proposals.

11. Other relevant information

The proponent may wish to include issues outside the scope of the EIS as a separate section of the EIS. This allows the proponent to identify matters not required to be addressed in the EIS, but that would be subject to development assessment consideration and notification. This can provide additional context for members of the public regarding management of environmental issues, by ensuring that the public is aware that these issues will be addressed in the detailed design of the proposal.

12. References

A reference list using standard referencing systems must be included.

13. Required Appendices

13.1. Scoping document for the EIS

A copy of the final scoping document should be included in the EIS. Where it is intended to bind appendices in a separate volume from the main body of the EIS, the final scoping document should be bound with the main body of the EIS for ease of cross-referencing.

13.2. Scoping Document Reference

Include a table that cross-references the EIS to the scoping document. If the EIS addresses the scoping document in multiple places then this must be also referenced.

13.3. Proponent's Environmental History

Provide details of any proceedings under a Commonwealth or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against:

- The person proposing to take the action
- For an action for which a person has applied for a permit, the person making the application.

If the person proposing to take the action is a corporation, then provide details of the corporation's environmental policy and planning framework.

13.4. Information Sources

For information given the following must be stated:

- The author or any reports or studies
- The publication date
- The source of the information
- How recent the information is (i.e. when a study was conducted or when primary sources were produced)
- How the reliability of the information was tested
- What uncertainties (if any) are in the information

13.5. Study team

The qualifications and experience of the study team and specialist sub-consultants and expert reviewers must be provided.

13.6. Specialist studies

All reports generated based on specialist studies undertaken as part of the EIS are to be included as appendices.

13.7. Research

Any proposals for researching alternative environmental management strategies or for obtaining any further necessary information should be outlined in an appendix.

GLOSSARY

Controlled Action (EPBC): An action defined under the EPBC Act, s 67.

Development application (DA): Application for development as defined under the PD Act.

Environment: As defined under the *Planning and Development Act 2007* (the PD Act), each of the following is part of the environment:

(a) the soil, atmosphere, water and other parts of the earth;

(b) organic and inorganic matter;

(c) living organisms;

(d) structures, and areas, that are manufactured or modified;

(e) ecosystems and parts of ecosystems, including people and communities;

(f) qualities and characteristics of areas that contribute to their biological diversity, ecological integrity, scientific value, heritage value and amenity;

(g) interactions and interdependencies within and between the things mentioned in paragraphs (a) to (f);

(h) social, aesthetic, cultural and economic characteristics that affect, or are affected by, the things mentioned in paragraphs (a) to (f).

Environmental Impact Statement (EIS): As defined under the PD Act.

EPBC Act: *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)

Impact Track: An assessment track that applies to a development proposal defined under the PD Act, s 123.

Long term: Greater than 15 years duration.

Medium term: Greater than three (3) years to 15 years duration.

PD Act: *Planning and Development Act 2007* (ACT)

Regulated waste: waste defined under the *Environment Protection Act 1997*

Scoping: The process of identifying the matters that are to be addressed by an EIS in relation to the development proposal - see the PD Act, s 212 (2).

Short term: Zero to three (3) years duration.

Socio-economic: Involving both social and economic factors.

ATTACHMENT A

COMMONWEALTH GOVERNMENT REQUIREMENTS

The Department of Environment and Energy has identified that there are likely to be significant impacts on the following controlling provisions:

- listed threatened species and communities (sections 18 and 18A)

All matters of national environmental significance (MNES) protected under the triggered controlling provisions are potentially relevant, however the Department of the Environment and Energy considers that there is likely to be a significant impact on the following:

- Golden Sun Moth – *Synemon plana* (Critically Endangered)

Note that this may not be a complete list and it is the responsibility of the proponent to ensure any protected matters under this controlling provision are assessed for the Commonwealth decision-maker's consideration.

The Department of Environment and Energy has identified the following key risk is associated with the proposal:

- removal of 0.9 ha of Golden Sun Moth habitat

In addition, consideration must be given to Australia's obligations under international conventions, or management plans or principles of relevance to the action's controlling provisions. The international conventions, management plans and principles that must be considered in relation to this proposal include:

a. Listed threatened species and communities

   i. Australia's obligations under the Convention on Biological Diversity, the Convention on Conservation of Nature in the South Pacific (Apia Convention), or the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

   ii. any relevant recovery plans or threat abatement plans

   iii. any relevant strategic assessment reports

Commonwealth Listing Advice, Survey Guidelines and Referral Guidelines contain information on threatened species and ecological communities which may provide further support to proponents and ACT EPSDD in considering and evaluating the significance of residual impacts on the action's controlling provisions. These documents may be found in the Department of the Environment and Energy's Species Profile and Threats Database: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

ENTITY COMMENTS

ACT Emergency Services Agency

ACT Emergency Services Agency has provided the following advice:

The site area, Blocks 1, 7 & 20, Section 102, has been identified as being within the bushfire prone area and as such the landscape within the site boundary is required to be managed as an Inner Asset Protection Zone as per the ACT Bushfire Management Standards. Consideration is required as to the impact this would have on any identified environmentally sensitive areas which could potentially result in inconsistencies with land management.

ACT Health

ACT Health has provided the following advice:

- Due to potential contamination concerns, the HPS supports the contamination mitigation / management measures noted in the preliminary risk assessment. The measures include identifying and undertaking remediation of contaminated sites prior to general construction and to develop and implement an Unexpected Finds Protocol (UFP) for all earthworks and construction activities on site, including training personnel in UFP procedure.
- All prospective food businesses are required to submit food business registration and fit-out assessment applications (with suitably detailed plans) for each food business to the Health Protection Service (HPS) prior to construction.
- During the construction phase all reasonable and practicable measures are taken to suppress dust and minimise any other detrimental impacts to air quality.

ACT Heritage Council

The Heritage Council identifies the following heritage assessment requirements for inclusion in the EIS scoping document:

1. Further investigation of the heritage values of the Precinct.

Lovell Chen and Navin Officer Heritage Consultants (2016) identified seven areas of moderate and high archaeological potential within the Precinct (BRW1, BRW2, BRW3, BRW7, BRW10, BRW11 and BRW12), and recommended archaeological excavation of these areas to adequately assess their heritage significance. Further research is required of these areas, to inform the EIS and future planning and heritage approval applications. This further research must include:

(a) Preparation of a Research Design and Methodology for these areas, by a qualified archaeologist;

(b) Submission of an Excavation Permit application to the Council under Section 61E of the *Heritage Act 2004*;

(c) Archaeological excavation undertaken in accordance with any approval issued under Section 61F of the *Heritage Act 2004*; and

(d) Analysis of archaeological excavation results, in accordance with significance criteria set out in Section 10 of the *Heritage Act 2004* and the Council's *Heritage Assessment Policy*.

2. Assessment of the potential heritage impacts of proposed development.

The EIS should provide a detailed written description and mapping of the proposed development and provide an assessment of the potential heritage impacts of the proposal.

This impact assessment should include direct and indirect impacts on the known heritage values of the Precinct, spanning heritage buildings and features registered on the ACT Heritage Register, and any historical archaeological features and deposits identified through further research.

3. Recommended management in accordance with Heritage Act 2004 provisions.

Reflecting *Heritage Act 2004* provisions, where proposed development may diminish heritage significance values, reasonably practicable alternatives and measures to minimise heritage impacts

should be considered. Where impacts to heritage places and objects are identified and cannot be avoided, recommendations should be presented on ways to minimise and mitigate heritage impacts, reflecting the principles of the Burra Charter (Australia ICOMOS 2013) and related Practice Notes.

In addition, the Council also notes that two *Heritage Act 2004* approvals are required for the project in addition to planning approvals, being:

- A Conservation Management Plan approved by the Council under Section 61K of the Heritage Act 2004; and
- A Statement of Heritage Effect approved by the Council under Section 61H of the *Heritage Act 2004.*

It is noted that the 2010 CMP is currently being updated, the Council recommends that this be formally submitted for approval as soon as possible; as CMP outcomes must inform the detailed design for the development of the Precinct, and therefore must also inform the project EIS.

Conservator of Flora and Fauna

The scoping application document has identified most of the impacts likely to occur, including those to Golden Sun Moth present on the site. There are some impacts that still need to be included in the Scoping Document and addressed in the EIS process.

The specific items for inclusion are:

1. **Impacts to rare native plants**

   Rare native plants possibly occur on the site and the EIS should report on their presence. Some of the species possibly present include Pale Flax Lily (*Dianella longifolia*), Matted Parrot Pea (*Dillwynia prostrata*), and Button Wrinklewort (*Rutidosis leptorhnchoides*).

2. **Impacts to woodland birds**

   The Diamond Firetail and Double Barred Finch are regionally uncommon birds that have been recorded moving through the site. The site's location next to the Golf Course and near the lake mean that it has local connectivity value for woodland birds and other animals. The EIS should address impacts to connectivity, and landscaping should allow for continued small bird movement across the site.

Environment Protection Authority (EPA)

The following requirements will be required to be addressed in the EIS:

- The site must be assessed and remediated in accordance with the guidelines endorsed by the EPA by a suitably qualified environmental consultant.
- The adequacy of the assessment and remedial works must be independently audited by an EPA approved environmental auditor.
- Prior to the commencement of remediation works the remedial action plan (RAP) for the proposed remediation works must be reviewed and endorsed by the auditor with a copy of the RAP endorsement provided to the EPA.
- Prior to the commencement of development works Auditor interim advice indicating that the commencement of development will not impact on the on-going assessment and remedial works at the site must be reviewed and endorsed by the EPA.

- Prior to the area being used for other purposes the findings of the independent audit into the site's suitability for its proposed and permitted uses from a contamination perspective must be reviewed and endorsed by the EPA.

Icon Water

The levelling of the site, particularly to the east of Block 76, may potentially have an impact on Icon Water assets and impact on overall site drainage, largely influencing stormwater. However, it is assumed that during detailed design, such impacts should be resolved.

It is imperative that Icon Water assets are protected during any planned works and additional information will be provided to you as part of the external services plan in due course.

National Capital Authority

The NCA's interest in this project is for the land use to be consistent with the National Capital Plan (the Plan). Section 3.1 of the Plan identifies the Brickworks site as 'urban areas' in the General Policy Plan – Metropolitan Canberra. The proposed development in the Scoping Document is not inconsistent with the Plan.

Transport Canberra and City Services Directorate

Please include the following additional items within the EIS Scoping Document:

- A Transport Impact Assessment.
- A Construction Management Plan (CMP).
- Note: this report/plan is not related to a CEMP and should indicate the impact of construction staging (if any), heavy vehicle movements during construction, conflicts with vulnerable road users, and potential environmental impact as a result.
- Note: The internal road network must comply with the requirements of the Estate Development Code or provide adequate justification for the departures being sought. Additionally, the provision for compliant waste servicing throughout the estate needs to be considered at an early stage to ensure the road layouts and proposed access arrangements are suitable for the Territory waste contractor.
- LMPP approval from the Senior Manager, Place Coordination and Planning, TCCS. During construction, all existing vegetation (trees, shrubs and grass) located on the verge and unleased Territory land immediately adjacent to the development shall be managed, protected and maintained in accordance with the Landscape Management Protection Plan (LMPP) approved by the Senior Manager, Place Coordination and Planning, TCCS. This plan is to be implemented before the commencement of works, including demolition on the site and is to be in accordance with TCCS Guidelines for the Protection of Public Landscape Assets Adjacent to Development Works-REF-04.

Utilities Technical Regulation

Utilities Technical Regulation requests the following matters be covered in the scoping document for the EIS to identify potential impacts associated with utility infrastructure that may result from the development proposal and options for mitigating such impacts prior to a development application being lodged and any subsequent additional approvals required.

1. The capacity of the existing water and sewage lines to service the development, and if the capacity is found to be insufficient a study that provides details of proposed upgrades to ensure service to the Canberra Brickworks Precinct. The capacity study should also look at the existing water main at Denman Street and possible relocation to within the road verge. Proposed easements should be shown on associated plans. Proposals shall comply with the Water Utility *Developer Provided Assets - Water Supply and Sewerage Standard*. Proposed alterations and connections to existing services should be discussed with the water utility.

2. The proponent shall provide details on proposed alterations, relocations and/or connections to existing electricity services. These shall be determined in consultation with the Electricity Utility and must comply with the Utility's Service and Installation Rules. Specifically, the proponent is to detail the relocation of electricity services in order to service the proposed development. Relocation of existing electricity infrastructure to follow Denman Street / Quarry Street should be explored. All proposed electrical infrastructure and servicing easements is to be detailed on associated development plans.

3. The proponent shall provide details on proposed alterations, relocations and/or connections to existing gas services. These shall be determined in consultation with the Gas Utility and must comply with the Utility's Service and Installation Rules. All proposed gas infrastructure and servicing easements is to be detailed on associated development plans.

4. The proposed development includes water sensitive urban design as an impact mitigation and management measure, and a water body is shown in the Masterplan. Details of any unlicensed regulated activities as defined under the Utilities (Technical Regulation) Act 2014 should be provided. Such activities would include for example, rooftop generators (solar) over 200 kW, dams over 250 ML in capacity or with a dam height greater than 5 metres or any scale of stormwater harvesting or stormwater reuse schemes and would require a Regulatory Plan and an Operating Certificate (see https://www.accesscanberra.act.gov.au/app/answers/detail/a_id/2203/~/utilities-technical-regulation#!tabs-4).

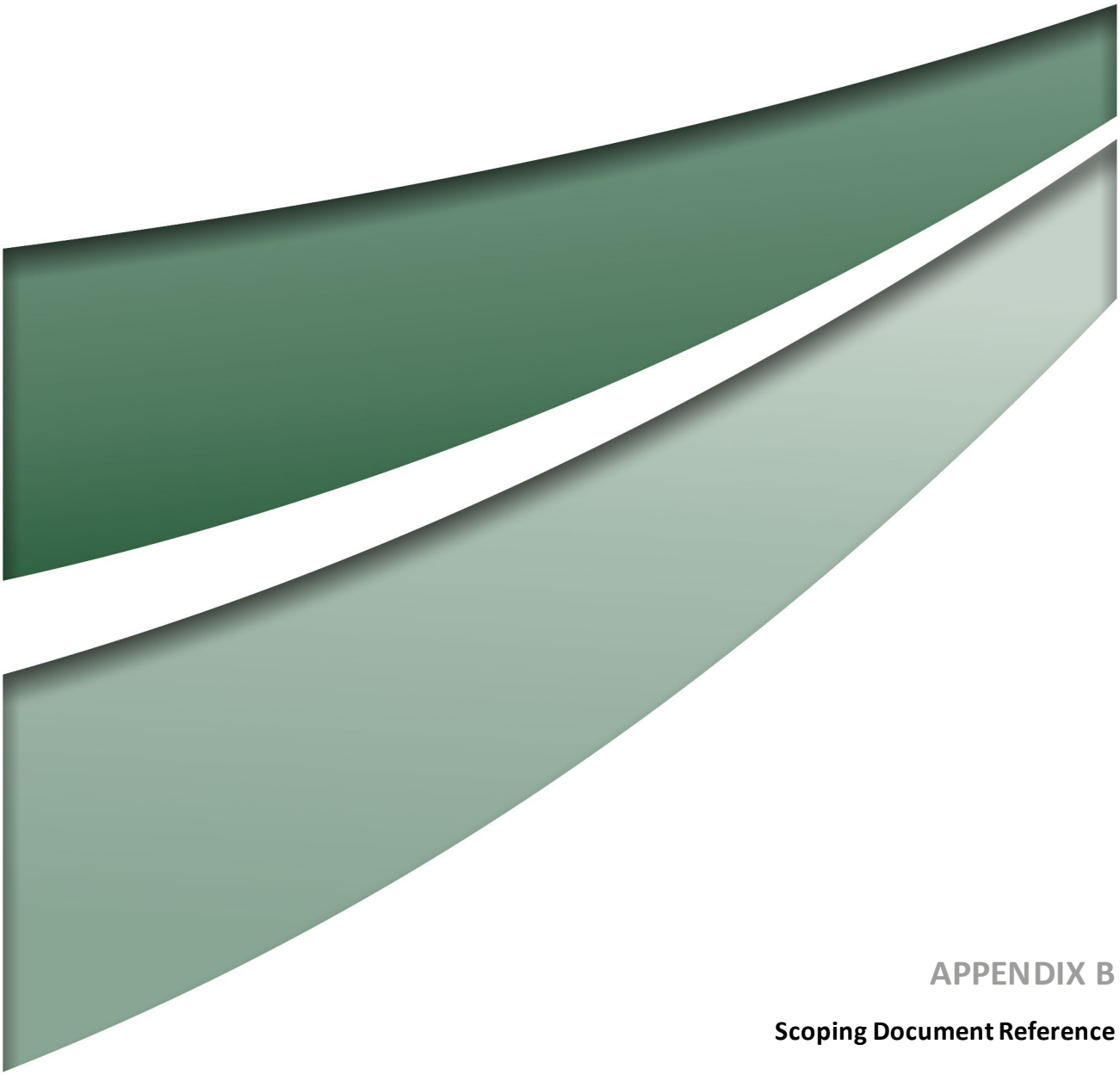
5. Solar generation must also comply with the Electricity Utilities requirements. Water reuse schemes are additionally subject to the *Utilities (Non-drinking Water Supply Code) Determination 2014*. A water reuse scheme may require licensing under the *Utilities Act 2000*. You are required to contact the ICRC to discuss the arrangements for this development and they will advise whether a licence is required.

The Utilities Act 2000 sets out several services relating to electricity networks, including connection services that require a licence. However, embedded networks under the National Electricity Rules are exempt from obtaining an operating certificate from the Technical Regulator and a licence from the ICRC. You are required to contact the ICRC to confirm any licensing requirements.

The Utilities Act 2000 sets out licensing requirements for a variety of utility services. Please contact the ICRC to confirm whether any services at the development require licensing.

EvoEnergy – Electricity

1. Canberra Brickworks precinct is presently supplied via 11kV overhead network. Depending on the calculated maximum load or demand from the development (calculation to be performed by the developer), an upgrade to the electricity network might be required. This can be further investigated and finalised at a later e.g. application stage.
2. Undergrounding of overhead or above ground utility electrical assets crossing over the precinct from Cotter Rd to Bentham St, can also be considered which will reduce bushfire risk, minimise impact on the environment, increase usable land area, and improve the aesthetics of the precinct.



APPENDIX B

Scoping Document Reference

Scoping Document Reference

Table B1 provides a detailed summary of the individual matters listed in the Scoping Document and identifies where each of these requirements has been addressed in this report and the accompanying technical studies.

Table B1 Scoping Document References

Requirement	Location in EIS
General Requirements	
Cover Page The cover page must clearly display the following: • The name of the proposal (project title). • The block identifier(s) and street address for the proposal. • The date of the preparation of the document. • Full name and postal address of the designated proponent. • Full name and postal address of the designated applicant. • Name and contact details of the person/organisation who prepared the documents (if different to the above).	**Cover Page**
Glossary Provide a glossary of technical terms, acronyms and abbreviations used in the EIS.	**Glossary**
Executive Summary Provide a non-technical summary of the EIS including a description of the proposal, key findings, and recommendations.	**Executive Summary**
Introduction Summarise the proposal background and justification for the proposal.	**Section 1.0**
Proposal Details	
Project Description Provide a description of the proposal, including: a) The objectives and justification for the proposal; b) The location of the land to which the proposal relates, including detailed maps; c) The division and/or district names and block and/or section numbers of the land under the *Districts Act 2002;* d) If the land is leased- the lessee's name; e) If the land is unleased or public land – the custodian of the land; f) The purposes for which the land may be used; g) A clear identification of all lands subject to direct disturbance from the proposal and associated infrastructure and geomorphic features such as waterways and wetlands. This is to be supported by a map showing all affected lands;	**Section 1.0** **Section 2.0**

Requirement	Location in EIS
h) An outline of any developments that have been, or are being, undertaken by the proponent, or other person(s) or entities, within the proposal area and broadly in the region. Describe how the proposal relates to these developments; i) A description of all the components of the proposal, including the proposal specifications, the predicted timescale for implementation (design, approvals, construction and operation) and project life; j) A plan/description of the precise location of any works to be undertaken, structures to be built and all other elements of the proposal that may have relevant impacts; and k) A description of the construction methodologies for the proposal.	
Alternatives to the proposal a) Provide details of any alternatives to the proposal considered in developing the proposal including a description of: b) Any design and location alternatives to the proposal and provide reasons for selecting the preferred option with an analysis of site selection; c) The criteria used for assessing the performance of any alternative to the proposal considered; d) Any matters considered to avoid or reduce potential impacts prior to the selection of the preferred option; and e) Details of the consequences of not proceeding with the proposal.	**Section 2.8**
Legislative and Strategic Context A description of the EIS process including any statutory approvals obtained or required for the proposal, and how the proposal is aligned with strategic priorities for the ACT.	**Section 3.0**
Statutory requirements The EIS must include information on statutory requirements for the proposal and how the proposal meets these requirements: • *Planning and Development Act 2007* • *Planning and Development Regulation 2008* • *Environment Protection Act 1997* • *Environment Protection Regulation 2005* • *Nature Conservation Act 2014* • *Tree Protection Act 2005* • Other related statutory approvals.	**Section 3.1**

Requirement	Location in EIS
Climate change The EIS must include information on how the proposal would reduce the risks from climate change impacts and include proposed adaptation measures to reduce vulnerability and increase resilience of the community and the Territory, particularly to the extreme events of heatwaves, droughts, storms with flash flooding and bushfires. The information must address impacts on the local microclimate and how it would avoid contribution to urban heat and positively contribute to urban cooling measures. Additionally, the EIS must address the contribution the proposal would make to reducing greenhouse gas emissions and meeting the legislated target for a net zero emissions Territory (by 2045 at the latest). Preparation of the EIS must consider relevant sections of the following ACT Government policies: • ACT Climate Change Strategy 2019–2025. • Canberra's Living Infrastructure Plan: Cooling the City.	**Section 12.0**
Other requirements The description must also include information on how each of the following has been considered in the preparation of the EIS and the development of the proposal: • Territory Plan 2008 • ACT Planning Strategy • National Capital Plan • Relevant Environment Protection Policies and Separation Distance Guidelines for Air Emissions (https://www.environment.act.gov.au/environment/legislation and policies) • Plans of Management for any public land • Any relevant Master Plan • Other relevant planning and environmental guidelines, action plans and management plans.	**Section 3.2** **Section 3.3**
Ecologically sustainable development (ESD) Provide a description of the proposed action in relation to the long-term and short-term considerations of economic development, social development and environmental protection. The proponent should ensure that the EIS adequately addresses the principles of sustainable development as defined by s 9 of the PD Act, especially the economic consequences of the environmental impacts from the proposed development.	**Section 3.4**
Territory Plan strategic directions A statement must be provided regarding the proposal's consistency with the principles in the Statement of Strategic Directions in the Territory Plan 2008 (Section 2.1- Strategic Direction).	**Section 3.3.2**

Requirement	Location in EIS
Risk Assessment	
Risk Assessment Methodology Provide a risk assessment in accordance with the Australian and New Zealand Standard for risk management AS/NZS ISO 31000:2009 *Risk Management -Principles and guidelines.* The proposed criteria for determining which risks are potentially significant impacts must be described. The Preliminary Risk Assessment (PRA) submitted as part of the request for a scoping document must be revised to include, but not be limited to, the risks identified by the Authority in Table1.	**Section 4.0**
Assessment of Impacts	
Planning and Land Status • Include a description of the planning context of the area where the project would be located. • Describe the planning and development status of any land or project relevant to the proposal. • Describe the planning permissibility of the proposed site in relation to the Yarralumla. • Precinct Map and Code. Provide a description of the differences in planning. • Permissibility at the site of the proposed development and adjacent residential uses. • Describe the proposal and its consistency with the Yarralumla Neighbourhood Plan and the Canberra Brickworks Conservation Management Plan. • Describe land use of the proposed land and any land to be affected (including, but not limited to, zoning, lessee(s) or custodian of the land, the permissibility of the proposed use defined in the Territory Plan).	**Section 5.0**
Traffic and Transport • Provide a Traffic Management and Control Plan detailing all safety measures to be implemented during construction. • Include a detailed survey that shows each of the sensitive heritage assets that are known to occur on site. Provide details of how these assets would be protected during construction. • Provide a Transport Impact Assessment. • Describe arrangements for the transport of construction materials, equipment, products, and personnel during the construction phase of the development proposal. • Include a description of the volume of traffic generated during construction. • Investigate the impacts the proposal would have on traffic congestion and road safety and describe mitigation measures to reduce the impacts. • Provide a Construction Management Plan (CMP) indicating the impacts of construction staging, heavy vehicle movements during construction, conflicts with vulnerable road users and potential environmental impacts. • Investigate the impacts on the vehicular route chosen to transport oversized equipment and accessories by heavy vehicles and describe mitigation measures to reduce the impacts. • Identify and investigate each of the entrance/exit points to be utilised during construction to ensure the minimum stopping sight distances are achieved in accordance with any applicable standards.	**Section 7.0**

Requirement	Location in EIS
• Investigate the impact of vehicular movement associated with residential use during operation, using the maximum proposed number of residential dwellings and commercial outlets. • Provide an analysis of how the project maximises accessibility to a range of public transport options and any associated infrastructure. • Indicate how the project is consistent with the approved Landscape Management Protection Plan (LMPP).	
Utilities • Describe any existing utilities located on the land subject to this proposal. • Describe the capacity of existing water and sewage services and investigate whether the capacity is sufficient to service the new development. • Provide details of any new or upgraded utilities, removal or realignments required as a result of this development. • Provide details of any proposed alterations relocations and / or connections to existing gas services. • Investigate potential impacts to existing infrastructure and provide mitigation measures to reduce the impacts. • Provide details of any unlicensed regulated activities as defined under the *Utilities (Technical Regulation) Act 2014*. • Provide details of any potential impacts upon water assets as a result of levelling of the site.	**Section 6.0**
Materials and Waste • Describe all materials to be stockpiled on site. • Investigate potential impacts of stockpiling materials, including any contaminated materials, and provide mitigation measures to reduce any impacts. • Consider increases in residential and commercial waste to be generated during operation and potential impacts of this waste generation.	**Section 8.0** **Section 18.0**
Soils and Geology • Describe the soil and geology features of the area. • Investigate the likely impact of construction and soil disturbance on the Yarralumla formation. Detail any mitigation measures required to minimise impact. • Undertake a detailed contamination assessment of the 10 AEC identified and in accordance with EPA guidelines. • Describe the composition and source of all fill intended for use at the site. • Provide details of any contaminants within fill to be used on site and identify additional areas of concern for assessment in accordance with Phase 2 investigations. • Provide a Remediation Action Plan for the proposed remediation works in accordance with EPA guidelines. • Describe any protocols necessary for soil compaction and soil compaction testing to ensure stabilisation of fill on site.	**Section 17.0** **Section 18.0**

Requirement	Location in EIS
• Provide a Sediment and Erosion Control Plan (SECP) and describe erosion impacts from construction and operation activities, especially during extreme weather and detail measures to reduce the impacts of sediment and erosion, including dust suppression. • Provide an Unexpected Finds Protocol (UFP) for all earthworks and construction activities on site.	
Landscape and Visual • Undertake a visual assessment of the site and surrounds to describe the impact of the proposed development on the area. • Visual assessment and impact analysis must provide perspectives of the site from all access ways and present a comparative assessment of existing and proposed views upon immediate surrounds, views along approach routes and any significant views/vistas. • Identify landscape and visual impacts as a result of vegetation removal. • Describe measures to be adopted to reduce any visual impacts.	**Section 9.0**
Water Quality and Hydrology • Undertake stormwater surface modelling to determine the impact of increased hard / impervious surfaces on overland flow volume and velocity. • Investigate the impact of overland flow on water quality as a result of sediment and erosion entering drainage lines, waterways, and road drainage infrastructure. • Describe any mitigation measures required to prevent sediment and erosion from impacting on water quality. • Consider the potential for bioremediation failure to result in contamination of surface and groundwater. • Consider the potential for contaminants within soils to impact on water quality as a result of soil disturbance.	**Section 10.0**
Socio-economic and Health • Provide detailed prevention methods to protect residents and passive users of the site from being exposed to site contaminants. • Consider the increase in vehicular movement, residential activity and commercial enterprise upon the amenity of surrounding residences. Provide mitigation measures to reduce any impacts. • Provide details of how the precinct has been designed to achieve safety through passive surveillance.	**Section 11.0**
Climate Change and Air Quality • Consider the risks of extreme climatic events upon future residents and how the precinct has been designed to deal with climatic extremes. • Consider the likely increase in heat retention as a result of increased concrete and hard, landscaped areas. Provide mitigation measures to minimise increases in temperature and promote cooling through design and landscaping. • Investigate the impact of increasing residential and vehicular activities upon greenhouse gas emissions.	**Section 12.0**

Requirement	Location in EIS
• Describe the design and layout of the site and provide details of building orientation and materials to achieve solar passive design. Provide details of mitigation methods to reduce reliance on mechanical heating and cooling. • Outline proposed climate change adaptation measures to reduce vulnerability and increase resilience of the community. • Describe how the site design and landscaping would contribute to the 30% Urban Environment target for coverage, in accordance with Canberra's Living Infrastructure Plan: Cooling the City.	
Noise, Vibration and Lighting • Provide an acoustic report that considers the impact of construction activities and noise and vibration on nearby residential properties and provide details of mitigation measures. • Consider the impact of increased residential and commercial activity upon nearby residential properties and provide details of mitigation measures. • Include an acoustic assessment and any mitigation measures necessary to minimise the impact of construction and ongoing residential development upon adjacent residential areas.	**Section 13.0**
Hazard and Risk • Provide a bushfire assessment report that considers the bushfire attack level of the site and any necessary management of Inner Asset Protection Zones (IAPZ) within the site, in accordance with ACT Bushfire Management Standards. • Consider the impact of managing the site as an IAPZ on any environmentally sensitive areas.	**Section 14.0**
Ecology and Natural Environment • Provide a description of the ecological values (including native vegetation, endangered ecological communities and potential threatened species) and their habitat on and adjacent to the site. • Report on the presence of rare native plants that are possibly present, including Pale Flax Lily (*Dianella longifolia*), Matted Parrot Pea (*Dillwynia prostrata*), and Button Wrinklewort (*Rutidosis leptorhnchoides*). • Provide maps showing the location of all habitat and overlay all aspects of the proposed development to show the extent of any impact. • Consider offset requirements, and whether suitable offsets are available. • Consider if offsetting is acceptable for the species affected and consider alternatives. • Consider the impact of removing mature, hollow-bearing trees upon local and regional connectivity for arboreal species with a particular focus on woodland birds including the Diamond Firetail and Double Barred Finch. • Consider the impact of weed species spread due to soil disturbance and any key habitat that is at risk of being affected. Provide mitigation measures. • Provide details of mitigation measures to reduce the impacts identified on flora and fauna species in accordance with additional detailed assessment of both direct and indirect impacts.	**Section 16.0**

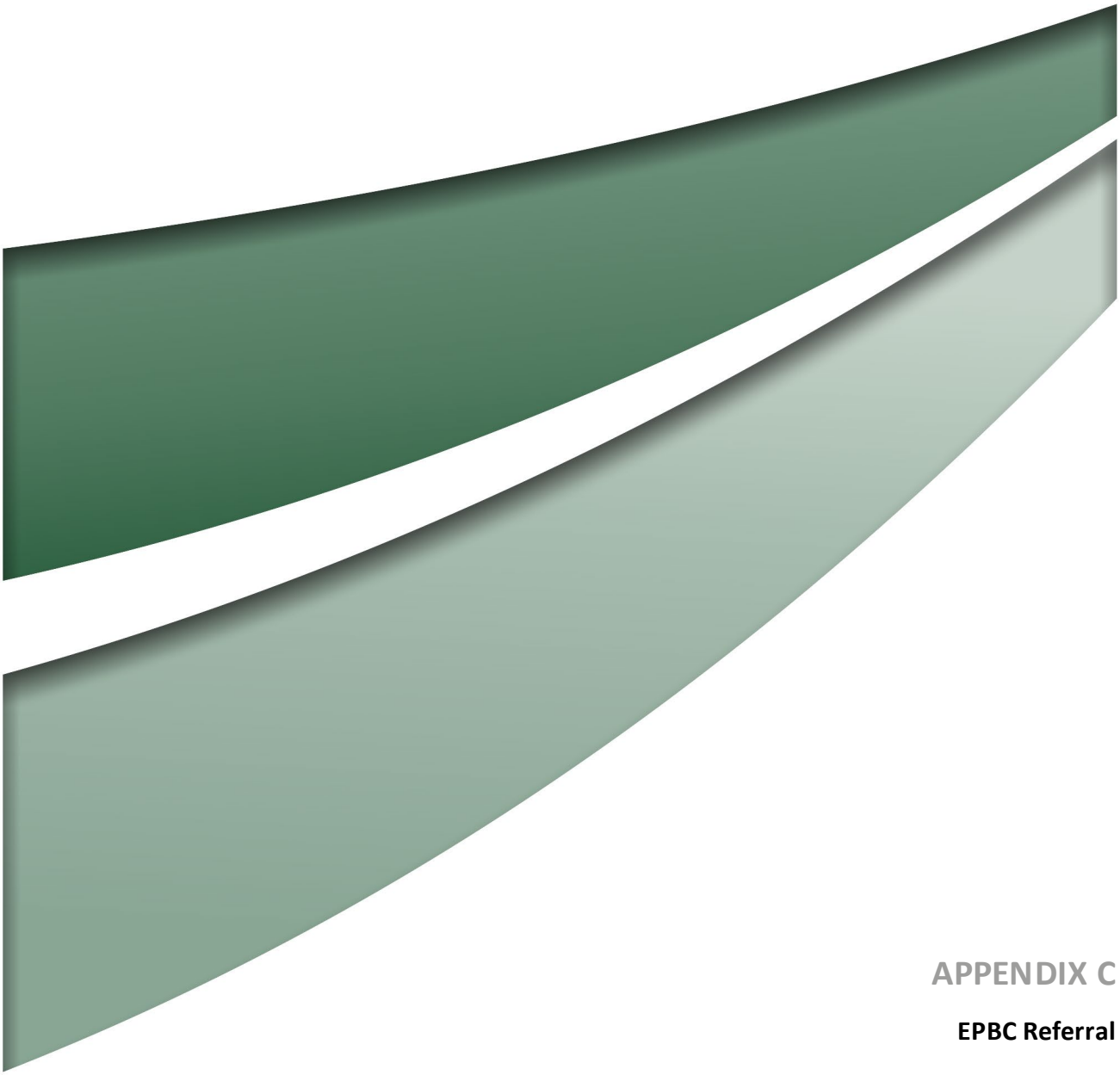
Requirement	Location in EIS

Heritage
• Prepare a Research Design and Methodology for excavation of the seven areas of moderate and high archaeological potential and detail the findings of excavations.
• Provide an in-depth heritage assessment of the site:
  ○ Consider the impact of the redevelopment on the heritage character /significance of the Brickworks and associated ancillary structures,
  ○ Consider whether the elevations, colours and materials proposed for use in construction are sympathetic to the heritage character of the site,
  ○ Consider direct and indirect impacts on the known heritage values of the Precinct, spanning heritage buildings and features registered on the ACT Heritage Register, and any historical archaeological features and deposits identified through further research.
• Develop a final Conservation Management Plan that considers the impact of the proposed redevelopment on core and supporting heritage items:
  ○ Survey and locate each item of heritage significance,
  ○ Describe the measures to be taken to prevent damage during construction,
  ○ Include a monitoring and evaluation framework to ensure that all items of heritage significance are protected during construction and operation and where impacts cannot be avoided present ways to minimise and mitigate heritage impacts.
  ○ Include an Unexpected Finds protocol for any additional items of heritage significance that may be identified during construction.
	Section 17.0

Matters of National Environmental Significance (MNES)
• Outline the impacts (including extent) to Golden Sun Moth habitat and any other MNES potentially impacted by the project.
• For the Golden Sun Moth (and any other matters identified as potentially impacted) provide a description of the relevant impacts of the action including:
  ○ a detailed discussion of known threats
  ○ a detailed assessment of direct and indirect impacts on areas of habitat and populations of listed threatened species during pre-construction, construction and operation detailed information on the extent (in hectares) of known and potential habitat that occurs in the proposed site and surrounds which may potentially be impacted by the proposal
  ○ a detailed assessment of the nature and extent of the likely short term and long term relevant impacts
  ○ a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible.
• Outline how the proposal is consistent with any relevant Commonwealth recovery plans or threat abatement plans.
• Outline any offsets proposed to compensate for the impacts to MNES.
	Section 16.4
	Section 16.5

Requirement	Location in EIS
Community and stakeholder consultation	
Consultation must be undertaken with: • Lease holders and land managers of land potentially impacted by the proposal; • Any recreational groups which may be affected by the proposal; • Any volunteer conservation, landscape management or land care groups active in the area • Who may be affected by the proposal; and • Any local community and community groups.	**Section 19.0**
Consultation methods • Describe the community consultation undertaken (methodology and criteria for identifying stakeholders and the communication methods used). • Provide details on the information provided during the community consultation process. A plain English statement explaining the proposal and conceptual drawings must be made available to the community and stakeholders. • Consultation should occur as early as possible and avoid, or make allowances for public holidays, school holidays and the summer holiday (Christmas) shutdown period.	**Section 19.2**
Consideration of community feedback • Provide a summary of how the community and stakeholders responded to the proposal and the main comments raised. • Describe how any concerns have been considered and identify any changes that have been made to the proposal.	**Section 19.3**
Consideration of public representations from Draft EIS notification The revised EIS must include the representations received, issues raised in the representations and a response to the issues and values identified. The summary response must clearly identify the representation(s) to which the responses relate.	**Section 19.4**
Recommendations • Provide a summary of commitments to avoid, mitigate and offset the potential significant impacts associated with the proposal. • Describe the monitoring parameters, monitoring points, frequency, data interpretation and reporting proposals.	**Section 21.0**
Other relevant information The proponent may wish to include issues outside the scope of the EIS as a separate section of the EIS, This allows the proponent to identify matters not required to be addressed in the EIS, but that would be subject to development assessment consideration and notification. This can provide additional context for members of the public regarding management of environmental issues, by ensuring that the public is aware that these issues would be addressed in the detailed design of the proposal.	**Section 20.0** **Section 22.0**
References A reference list using standard referencing systems must be included.	**Section 23.0**

Requirement	Location in EIS
Required Appendices	
Scoping document for the EIS A copy of the final scoping document should be included in the EIS. Where it is intended to bind appendices in a separate volume from the main body of the EIS, the final scoping document should be bound with the main body of the EIS for ease of cross-referencing.	**Appendix A**
Scoping Document Reference Include a table that cross-references the EIS to the scoping document. If the EIS addresses the scoping document in multiple places then this must be also referenced.	**Appendix B**
Proponent's Environmental History Provide details of any proceedings under a Commonwealth or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against: The person proposing to take the action • For an action for which a person has applied for a permit, the person making the application. • If the person proposing to take the action is a corporation, then provide details of the corporation's environmental policy and planning framework.	**Appendix D**
Information Sources For information given the following must be stated: • The author or any reports or studies • The publication date • The source of the information • How recent the information is (i.e. when a study was conducted or when primary sources were produced) • How the reliability of the information was tested • What uncertainties (if any) are in the information.	**Appendix F**
Study team The qualifications and experience of the study team and specialist sub-consultants and expert reviewers must be provided.	**Appendix E**
Specialist studies All reports generated based on specialist studies undertaken as part of the EIS are to be included as appendices.	**Appendix F**
Research Any proposals for researching alternative environmental management strategies or for obtaining any further necessary information should be outlined in an appendix.	**N/A**



APPENDIX C

EPBC Referral

Notification of
REFERRAL DECISION AND DESIGNATED PROPONENT – controlled action

Canberra Brickworks Precinct Development, Blocks 1, 7, and 20 Section 102 Yarralumla, ACT (EPBC 2017/8074)

This decision is made under section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

proposed action	To construct a residential development at the former Canberra Brickworks site in Yarralumla, ACT [See EPBC Act referral 2017/8074].
decision on proposed action	The proposed action is a controlled action. The project will require assessment and approval under the EPBC Act before it can proceed.
relevant controlling provisions	Listed threatened species and communities (sections 18 & 18A)
designated proponent	Canberra Brickworks Developments Pty Ltd ACN: 616 498 670
assessment approach	The project will be assessed under the assessment bilateral agreement with the Australian Capital Territory.
Decision-maker	
Name and position	Kim Farrant Assistant Secretary Assessments (NSW, ACT) and Waste Branch
Signature	
date of decision	19 December 2017

Title of Proposal - The Canberra Brickworks Precinct, Blocks 1, 7, and 20 Section 102, Yarralumla, ACT

Section 1 - Summary of your proposed action

Provide a summary of your proposed action, including any consultations undertaken.

1.1 Project Industry Type

Residential Development

1.2 Provide a detailed description of the proposed action, including all proposed activities.

The proposed action is the urban development of the Canberra Brickworks Precinct (CBP) at Yarralumla in central Canberra. The proposed action will include a maximum of 380 residential dwellings, surrounding re-purposed Canberra Brickworks buildings and recreational parkland. The re-purposed heritage buildings will include limited retail and commercial space including cafes, industrial crafts, and interpretive features focused on the history of the Canberra Brickworks.
The Canberra Brickworks is of heritage significance within the Australian Capital Territory (ACT), as one of three examples of industrial heritage in Canberra. The proposed action would see the majority of the ‘core’ and ‘supporting’ heritage elements and the essential industrial characteristics of the site retained, conserved, and sensitively re-used. This includes the Railway remnants, which are also recognised on the ACT Heritage Register.
Given the heritage value of the site, the residential development will be low density, with a focus on maintaining the urban parkland that fits in with the existing landscape and surrounding urban areas. The re-purposed Canberra Brickworks buildings will also include auxiliary facilities for residents, such as a gymnasium, swimming pools and gardens. The Master Plan for the development is attached.
The former quarry area will be used as urban parkland that is sensitive to the geological heritage values of the quarry, while allowing a recreational space that is linked to existing and proposed walking and cycle paths. The CBP encourages community access to the recreational parkland and play area with a focus on active travel options.
Associated with this proposed action is the construction of an access road, to the south of the CBP. This construction is not included as part of this Referral, as it is included in a separate Referral submitted by the ACT Government.

1.3 What is the extent and location of your proposed action? Use the polygon tool on the map below to mark the location of your proposed action.

Area	Point	Latitude	Longitude

Area	Point	Latitude	Longitude
Canberra Brickworks	1	-35.311407164046	149.09157359269
Canberra Brickworks	2	-35.311407164046	149.09157359269
Canberra Brickworks	3	-35.311407164046	149.09157359269
Canberra Brickworks Precinct	1	-35.306633756936	149.0925601121
Canberra Brickworks Precinct	2	-35.307566758303	149.09379057548
Canberra Brickworks Precinct	3	-35.308822599458	149.09356929324
Canberra Brickworks Precinct	4	-35.30895940015	149.09308984838
Canberra Brickworks Precinct	5	-35.309501128615	149.09304961524
Canberra Brickworks Precinct	6	-35.30951480858	149.0924125906
Canberra Brickworks Precinct	7	-35.309845863022	149.09239247403
Canberra Brickworks Precinct	8	-35.310031909552	149.09267075322
Canberra Brickworks Precinct	9	-35.310338338198	149.0924125906
Canberra Brickworks Precinct	10	-35.310661181409	149.09276798329
Canberra Brickworks Precinct	11	-35.311254881238	149.09218460283
Canberra Brickworks Precinct	12	-35.311142707872	149.09066915474
Canberra Brickworks Precinct	13	-35.311290448371	149.09030705652
Canberra Brickworks Precinct	14	-35.310819866583	149.08981755338
Canberra Brickworks Precinct	15	-35.31025625921	149.08920735083
Canberra Brickworks Precinct	16	-35.309813031237	149.08876478634
Canberra Brickworks Precinct	17	-35.30920564081	149.08842951021
Canberra Brickworks Precinct	18	-35.30854352533	149.08855020962
Canberra Brickworks Precinct	19	-35.307908764905	149.08892571888
Canberra Brickworks Precinct	20	-35.307399858554	149.08942192755
Canberra Brickworks Precinct	21	-35.307525717412	149.09010589085

Area	Point	Latitude	Longitude
Canberra Brickworks Precinct	22	-35.307427219192	149.09019976816
Canberra Brickworks Precinct	23	-35.307514773171	149.09135982356
Canberra Brickworks Precinct	24	-35.307202861688	149.09198343716
Canberra Brickworks Precinct	25	-35.306929254133	149.0919968482
Canberra Brickworks Precinct	26	-35.306945670612	149.09232541881
Canberra Brickworks Precinct	27	-35.306628284754	149.09256681762
Canberra Brickworks Precinct	28	-35.306628284754	149.09256681762
Canberra Brickworks Precinct	29	-35.306633756936	149.0925601121

1.5 Provide a brief physical description of the property on which the proposed action will take place and the location of the proposed action (e.g. proximity to major towns, or for off-shore actions, shortest distance to mainland).

The CBP is located in south-west Yarralumla, Canberra. It is surrounded by residential development to the north and east; open landscape to the south; and a landscape buffer to the Royal Canberra Golf Club to the west.

The site contains the former Canberra Brickworks, associated quarry, and railway remnants; open grassland occurs to the south, with planted landscape trees located throughout the quarry area and along the site boundaries. A small recycled timber furniture store currently operates from the Canberra Brickworks buildings otherwise public access is generally limited by fences that surround the property.

The CBP has a history of disturbance, predominantly associated with its 60 year history operating as a brickworks that sourced materials from a quarry on-site. There are no permanent watercourses in the site; however surface flows generally discharge into Lake Burley Griffin/Molonglo River and into the Murrumbidgee River.

The CBP is approximately seven kilometres from the Canberra Central Business District and two kilometres south of Lake Burley Griffin. It is adjacent to Government House (the official residence of the Governor-General of Australia).

Access to the CBP is currently limited to Denman Street, Yarralumla. It is proposed to construct

a secondary access road into the south of the CBP from Dudley Street. Access from Dudley Street is subject to a separate proposal being prepared and Referred concurrently by the ACT Government.

1.6 What is the size of the proposed action area development footprint (or work area) including disturbance footprint and avoidance footprint (if relevant)?

16.09 hectares

1.7 Is the proposed action a street address or lot?

Lot

1.7.2 Describe the lot number and title. Blocks 1, 7, and 20; Section 102 Yarralumla, ACT.

1.8 Primary Jurisdiction.

Australian Capital Territory

1.9 Has the person proposing to take the action received any Australian Government grant funding to undertake this project?

No

1.10 Is the proposed action subject to local government planning approval?

Yes

1.10.1 Is there a local government area and council contact for the proposal?

Yes

1.10.1.0 Council contact officer details

1.10.1.1 Name of relevant council contact officer.

Tegan Liston

1.10.1.2 E-mail

Tegan.Liston@act.gov.au

1.10.1.3 Telephone Number

(02) 6205 9649

1.11 Provide an estimated start and estimated end date for the proposed action.

Start date 06/2018

End date 12/2023

1.12 Provide details of the context, planning framework and State and/or Local government requirements.

The CBP encompasses Blocks 1, 7, and 20 Section 102, Yarralumla, ACT. As Territory Land any proposed development will require approval from the ACT Government Environment, Planning and Sustainable Development Directorate (EPSDD) in accordance with the *Planning and Development Act 2007* (ACT) (PD Act).

The proposed action triggers the need for an Environmental Impact Statement (EIS) under the PD Act as a result of potential impacts to protected species, potential impacts to ACT listed heritage matters, and as the CBP is included on the register of contaminated sites. The ACT EIS process under the PD Act has been accredited by the Commonwealth, in accordance with the bilateral agreement between the Australian and ACT Governments.

As an EIS is required under the PD Act and it can be assessed using an accredited assessment process, it is requested that the proposed action be assessed using this process. The EIS will include additional information as identified in this Referral, such that the Minister for the Environment has sufficient information to make a decision under the EPBC Act.

1.13 Describe any public consultation that has been, is being or will be undertaken, including with Indigenous stakeholders.

The CBP has been the subject of public interest for many years, and public consultation has been extensive and continues to occur. A Community Engagement Plan (Elton, 2017) (attached) has been prepared, and is continually being refined throughout the design stages. The consultation history (as summarised below), has provided Doma Group with a strong understanding of the general aspirations of the site and have assisted the development of the Master Plan.

The ACT Government, through the then Land Development Agency (LDA), began consultation in 2010. The following key themes for any potential future development of the CBP were identified (Elton, 2017):

- heritage conservation and preservation;

- development is appropriate for the location and surrounding landscape and uses;

- access and connectivity is maintained;

- preservation and maintenance of open space; and

- amenity and vibrancy.

In 2015, the LDA established a Community Panel to build on the key themes above to develop a list of objectives to guide the future development of the CBP. The Community Panel has played a key role in the tender phase of this Project and continues to be a key participant in the consultation process. The objectives raised by the Community Panel include the following (Elton, 2017):

- maintenance/enhancement of the unique heritage of the CBP;

- result in a quality development that showcases the heritage buildings;

- Pittman (Quarry) Park is readily accessible;

- maintain pedestrian/cycle networks;

- ensure minimal disruption to existing land users, especially residents;

- consider local environmental issues; and

- have a sustainable built form.

The latest Community Engagement Plan includes the following key elements:

- regular project updates to all stakeholders;

- broader updates provided through the website and social media;

- utilisation of existing marketing channels that were established by the LDA;

- alignment of communication with project program milestones;

- utilisation of a range of tools, including one-on-one meetings, monthly meetings with the Community Panel, email updates, website maintenance, public presentations and ‘pop-up’ information stalls, collection of ‘memories’ for the museum, and a quarry party following completion of Stage 1.

The first phase of the engagement milestones has been completed. The next phases will align with Project milestones, as detailed in the Community Engagement Plan.

Indigenous stakeholders identified as Representative Aboriginal Organisations (RAOs) were consulted via email and telephone as part of the Aboriginal Cultural Heritage Assessment (Navin Officer, 2014) in July and August 2014. A representative on one RAO (Buru Ngunnawal) attended the field survey. The Aboriginal Cultural Heritage Assessment concluded that no known Indigenous heritage sites occur and there are no areas of archaeological potential. The Cultural Heritage Assessment has been approved by the ACT Heritage Council on 11 September 2014 (Lovell Chen, 2016).

1.14 Describe any environmental impact assessments that have been or will be carried out under Commonwealth, State or Territory legislation including relevant impacts of the project.

There have been no environmental impact assessments completed for the CBP. This will occur as part of the EIS preparation for the development, under the bilateral agreement.

Numerous ecological surveys have occurred across the site and surrounding areas (including the proposed new access road works area). In particular, Umwelt (2015) completed an ecological assessment of the CBP, targeting the identification of protected species and communities under the EPBC Act and Nature Conservation Act 2014 (ACT) (NC Act). Of note, a total of 0.9 hectares of golden sun moth (Synemon plana) habitat was identified, and later confirmed (Biosis, 2017) to occur within the CBP. The impacts to golden sun moth as a result of the proposed action will be formally assessed in the EIS.

In addition to ecological assessments, the following assessment have been prepared that will inform the EIS:

- Detailed Engineering Survey (Lech Steger, 2014);

- Site Investigation – Traffic, Transport and Car parking (AECOM, 2106);

- Tree Management Report (dsb Landscape Architects, 2015);

- Bushfire Risk Assessment Report (ABPP, 2016);

- Detailed Environmental and Geotechnical Site Investigations (SMEC, 2016a);

- Groundwater Investigations (SMEC 2016a and SMEC, 2016b)

- Contamination Investigations: Phase I, Phase II, Remediation Action Plans;

- Aboriginal Cultural Heritage Assessment (Navin Officer, 2014);

- Historic Archaeological Investigations (Lovell Chen, 2016);

- Conservation Management Plan (GML, 2017).

1.15 Is this action part of a staged development (or a component of a larger project)?

No

1.16 Is the proposed action related to other actions or proposals in the region?

Yes

1.16.1 Identify the nature/scope and location of the related action (Including under the relevant legislation).

The proposed action requires the construction of an access road in the south off Dudley Street. This will serve the proposed new residential development and assist with addressing concerns raised by local residents regarding the impact of the development on infrastructure and has been developed with consideration of traffic assessments.

The construction of the access road is included in a separate Referral that is being prepared concurrently. The ACT Government is the proponent for the access road construction as it is linked to other required road upgrades in the area, which are required regardless of the proposed urban development of the CBP.

Furthermore, by allowing the access road to be constructed separately from the CBP, it may be complete prior to the commencement of construction of the CBP. This will allow construction traffic access along the new road, thereby avoiding residential streets, namely Denman Street.

Public consultation, particularly with the local Yarralumla residents (as described in Section 1.13) included both proposed actions.

Section 2 - Matters of National Environmental Significance

Describe the affected area and the likely impacts of the proposal, emphasising the relevant matters protected by the EPBC Act. Refer to relevant maps as appropriate. The interactive map tool can help determine whether matters of national environmental significance or other matters protected by the EPBC Act are likely to occur in your area of interest. Consideration of likely impacts should include both direct and indirect impacts.

Your assessment of likely impacts should consider whether a bioregional plan is relevant to your proposal. The following resources can assist you in your assessment of likely impacts:

• Profiles of relevant species/communities (where available), that will assist in the identification of whether there is likely to be a significant impact on them if the proposal proceeds;

• Significant Impact Guidelines 1.1 – Matters of National Environmental Significance;

• Significant Impact Guideline 1.2 – Actions on, or impacting upon, Commonwealth land and Actions by Commonwealth Agencies.

2.1 Is the proposed action likely to have ANY direct or indirect impact on the values of any World Heritage properties?

No

2.2 Is the proposed action likely to have ANY direct or indirect impact on the values of any National Heritage places?

No

2.3 Is the proposed action likely to have ANY direct or indirect impact on the ecological character of a Ramsar wetland?

No

2.4 Is the proposed action likely to have ANY direct or indirect impact on the members of any listed species or any threatened ecological community, or their habitat?

Yes

2.4.1 Impact table

Species	Impact
golden sun moth (Synemon plana)	The proposed action is expected to impact all

Species	Impact
	0.9 hectares of golden sun moth habitat located within the CBP. A full assessment of this impact against the EPBC Significant Impact Guidelines 1.1 (DoE, 2013) will be a part of the EIS. However, this is considered a significant impact as the habitat is small and fragmented (i.e. less than ten hectares) and according to the golden sun moth significant impact guidelines (DEWHA, 2009), any habitat loss is considered significant in such areas.

2.4.2 Do you consider this impact to be significant?

Yes

2.5 Is the proposed action likely to have ANY direct or indirect impact on the members of any listed migratory species, or their habitat?

No

2.6 Is the proposed action to be undertaken in a marine environment (outside Commonwealth marine areas)?

No

2.7 Is the proposed action to be taken on or near Commonwealth land?

No

2.8 Is the proposed action taking place in the Great Barrier Reef Marine Park?

No

2.9 Is the proposed action likely to have ANY direct or indirect impact on a water resource related to coal/gas/mining?

No

2.10 Is the proposed action a nuclear action?

No

2.11 Is the proposed action to be taken by the Commonwealth agency?

No

2.12 Is the proposed action to be undertaken in a Commonwealth Heritage Place Overseas?

No

2.13 Is the proposed action likely to have ANY direct or indirect impact on a water resource related to coal/gas/mining?

No

Section 3 - Description of the project area

Provide a description of the project area and the affected area, including information about the following features (where relevant to the project area and/or affected area, and to the extent not otherwise addressed in Section 2).

3.1 Describe the flora and fauna relevant to the project area.

The proposed action is located in an area that was formerly grazing land, prior to being the site of the Canberra Brickworks and associated quarry and railway. The CBP is surrounding by residential areas, and landscaped buffers to the Royal Canberra Golf Course, and Cotter Road, Dunrossil Drive, and Dudley Street.

Umwelt (2015) identified vegetation types within the CBP; however, all were highly modified and dominated by exotic species. The planted landscape trees (predominantly Pinus species) may provide opportunistic shelter for bird species, however they do not represent habitat for threatened bird species.

Small patches of exotic grassland near the entrance to the CBP are dominated by a weed of national significance: Chilean needlegrass (*Nassella neesiana*). This weed species is known to support golden sun moth, and has been confirmed as habitat for this critically endangered species (Biosis, 2017).

The areas of the quarry and historic landfill are highly modified and do not contain any natural features. The exotic composition of the vegetation provides limited opportunities for native species, and is unlikely to represent areas of importance.

3.2 Describe the hydrology relevant to the project area (including water flows).

Surface water flow has been significantly modified by the historic use of the site, especially relating to the quarry use and fill. There are no watercourses channels within the CBP. Surface water runoff from the site, drains to the north-east then via a drainage reserve through the Royal Canberra Golf Course into the Warrina Inlet of Lake Burley Griffin. The drainage reserve includes both piped infrastructure and overland flow path (SMEC, 2016a).

3.3 Describe the soil and vegetation characteristics relevant to the project area.

The site is on the Williamsdale soil landscape, which is characterised by undulating rises and local relief typically below ten percent in natural terrain. The majority of the CBP is comprised on natural silty clays, underlain by siltstone, sandstone, or Dacite bedrock. In locations which have been historically disturbed, the soils have been modified due to the typically hard-setting, erodible and potentially dispersive soil (SMEC, 2016a).

The CBP has been cleared of native vegetation and is dominated by highly modified dominated by exotic species (Umwelt, 2015). The area includes exotic pasture and landscape tree plantings including Algerian oak (*Quercus canariensis*) and *Pinus radiata* with numerous exotic trees and garden escapees. The exotic composition of the vegetation provides limited opportunities for native species.

3.4 Describe any outstanding natural features and/or any other important or unique values relevant to the project area.

There are no known outstanding natural features within the CBP.

The CBP contains sites of historic heritage value, linked to the industrial history of the site. Heritage value is particularly linked to the quarry, railway remnants, and core buildings of the Canberra Brickworks. These heritage values have been incorporated into the proposed action design so they can continue to play a role in the Canberra community.

The geological features exposed by the quarry also demonstrate key characteristics of the Yarralumla Formation and CBP site; providing an understanding of the natural landscapes of the area. The quarry appears to be little altered since the closure of the brickworks (GML, 2017).

3.5 Describe the status of native vegetation relevant to the project area.

Vegetation across the CBP has been heavily modified and is dominated by exotic species; including landscaping trees, garden escapees, and weeds. Areas near the site boundaries and in the quarry contain a planted overstorey – primarily *Pinus radiata*.

There are no areas of native vegetation present within the CBP. The vegetation within the CBP has no conservation significance.

3.6 Describe the gradient (or depth range if action is to be taken in a marine area) relevant to the project area.

The topography of the CBP is variable and has been significantly modified by quarrying and landfill.

The CBP ranges in elevation from approximately 570 metres above sea level to 590 metres above sea level and general slopes to the west-north-west. A small portion of the CBP, towards Dudley Street, slopes to the south and south-west.

3.7 Describe the current condition of the environment relevant to the project area.

The environment is highly disturbed within the CBP, primarily a result of the historic use of the site as a brickworks and associated quarry. All of the trees on site have been planted, and are primarily *Pinus* species.

3.8 Describe any Commonwealth Heritage Places or other places recognised as having heritage values relevant to the project area.

There are no Commonwealth Heritage Places within the CBP.

The Canberra Brickworks and the Canberra Brickworks Railway Remnants are both listed on the ACT Heritage Register and are recognised as the first industrial manufacturing facility within the ACT. The Canberra Brickworks has provided the base materials used in the construction of many of the early buildings in Canberra, thereby playing a key role in the characterisation of early urban development. There are several elements within the Yarralumla Brickworks site that remain as evidence of this historic use.

The proposed action has considered the heritage value of the property, and retained many of these elements for re-purposing whilst celebrating the history of the site. It has been guided by a Conservation Management Plan, which is currently being updated by GML.

Details of these heritage values and the relationship with the proposed action will be discussed in greater detail in the EIS.

3.9 Describe any Indigenous heritage values relevant to the project area.

There have been no sites of Indigenous heritage value recorded within the CBP, and the area does not contain locations of potential value (Navin Officer, 2014).

3.10 Describe the tenure of the action area (e.g. freehold, leasehold) relevant to the project area.

The Project Area is currently unleased Territory Land.

3.11 Describe any existing or any proposed uses relevant to the project area.

The land is currently CZ6 Leisure and Accommodation, with a small area of RZ1 Suburban in the north. The Canberra Brickworks buildings currently house a small recycled timber furniture retailer. The remainder of the land is unused.

The proposed action would result in low density housing, surrounding a re-purposed Canberra Brickworks that allows for small scale commercial and retail uses. The quarry will be used for recreation and amenity as urban parkland.

Section 4 - Measures to avoid or reduce impacts

Provide a description of measures that will be implemented to avoid, reduce, manage or offset any relevant impacts of the action. Include, if appropriate, any relevant reports or technical advice relating to the feasibility and effectiveness of the proposed measures.

Examples of relevant measures to avoid or reduce impacts may include the timing of works, avoidance of important habitat, specific design measures, or adoption of specific work practices.

4.1 Describe the measures you will undertake to avoid or reduce impact from your proposed action.

The environmental constraints and opportunities for development of the CBP have been considered during the development of the Masterplan by the ACT Government and the proponent. Further opportunities for avoidance of impacts are limited; however these will be reviewed and addressed in the EIS. Measures to minimise impacts will be described in detail in the EIS, which will be prepared under the bilateral agreement.

4.2 For matters protected by the EPBC Act that may be affected by the proposed action, describe the proposed environmental outcomes to be achieved.

Proposed environmental outcomes as a result of the proposed action will be described in detail in the EIS, to be prepared under the Bilateral Agreement.

Section 5 – Conclusion on the likelihood of significant impacts

A checkbox tick identifies each of the matters of National Environmental Significance you identified in section 2 of this application as likely to be a significant impact.

Review the matters you have identified below. If a matter ticked below has been incorrectly identified you will need to return to Section 2 to edit.

5.1.1 World Heritage Properties

No

5.1.2 National Heritage Places

No

5.1.3 Wetlands of International Importance (declared Ramsar Wetlands)

No

5.1.4 Listed threatened species or any threatened ecological community

Listed threatened species and communities - Yes

5.1.5 Listed migratory species

No

5.1.6 Commonwealth marine environment

No

5.1.7 Protection of the environment from actions involving Commonwealth land

No

5.1.8 Great Barrier Reef Marine Park

No

5.1.9 A water resource, in relation to coal/gas/mining

No

5.1.10 Protection of the environment from nuclear actions

No

5.1.11 Protection of the environment from Commonwealth actions

No

5.1.12 Commonwealth Heritage places overseas

No

5.2 If no significant matters are identified, provide the key reasons why you think the proposed action is not likely to have a significant impact on a matter protected under the EPBC Act and therefore not a controlled action.

It is believed that the Proposed Action will be considered a Controlled Action; and it is anticipated that it will be assessed under the bilateral agreement between the ACT Government and Commonwealth Government through an EIS.

Section 6 – Environmental record of the person proposing to take the action

Provide details of any proceedings under Commonwealth, State or Territory law against the person proposing to take the action that pertain to the protection of the environment or the conservation and sustainable use of natural resources.

6.1 Does the person taking the action have a satisfactory record of responsible environmental management? Please explain in further detail.

Doma Group is experienced with the process of preparing and submitting EPBC Referrals, having received an approval for the development of the Little National Hotel in Barton adjacent to a high conservation area.

Doma Group's main contractor, Bloc (ACT) Pty Ltd will be responsible for carrying out all works on site. Bloc have been assessed by International Certifications and found to comply with the requirements of ISO 14001:2004 Environmental Management Standard and ISO 9001:2008 Quality Management Systems – Requirements.

6.2 Provide details of any past or present proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against either (a) the person proposing to take the action or, (b) if a permit has been applied for in relation to the action – the person making the application.

Not applicable.

6.3 If it is a corporation undertaking the action will the action be taken in accordance with the corporation's environmental policy and framework?

Yes

6.3.1 If the person taking the action is a corporation, please provide details of the corporation's environmental policy and planning framework.

BLOC is committed to ensuring that all activities resulting from its business and operations are carried out in such a manner as to either eliminate, control, or minimise the impact on the immediate and wider environment. BLOC's principle environmental objectives are, as far as reasonably practicable, to:

- place the protection of the environment as one its highest priorities;

- maintain compliance with applicable environmental staturtory legal requirements;

- promote a positive culture of environmental awareenss; and

- strive for continual improvement in the prevention of pollution.

A number of actions are included in BLOC's Environmental Policy to achieve these objectives, these are detailed in the attached Environmental Policy document.

6.4 Has the person taking the action previously referred an action under the EPBC Act, or been responsible for undertaking an action referred under the EPBC Act?

Yes

6.4.1 EPBC Act No and/or Name of Proposal.

EPBC 2012/6606: Hotel and carpark development, Block 14 Section 22 Barton, ACT

EPBC 2014/7372: Residential and commercial development, Blocks 4 and 5, Section 38, Campbell, ACT

Section 7 – Information sources

You are required to provide the references used in preparing the referral including the reliability of the source.

7.1 List references used in preparing the referral (please provide the reference source reliability and any uncertainties of source).

Reference Source	Reliability	Uncertainties
Australian Bushfire Protection Planners (ABPP) (2014) 'Bushfire Risk Assessment Report: Canberra Brickworks and Environs', prepared for Land Development Agency.	High. This document was prepared specifically for this project	None known
AECOM (2016) 'Site Investigation - traffic, transport and car parking', published report prepared for Land Development Agency.	High. This document was prepared specifically for this project.	None known
Biosis (2017) 'Ecological Assessment Gap Analysis for the Canberra Brickworks (Blocks 1, 7 and 20, Section 102, Yarralumla)', letter, prepared for Doma Group.	High. This document was prepared specifically for this project	None known
Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009) Significant Impact Guidelines for the critically endangered golden sun moth (Synemon plana)	High. Guidelines compiled using source materials valid as at December 2009. These guidelines are still current.	None known
Department of Environment (DoE) (2013) 'Matters of National Environmental Significance. Significant Impact Guidelines 1.1 EPBC Act'	High. Guidelines compiled using source materials valid as at October 2009. These guidelines are still current.	None known.
dsb Landscape Architects (2010) 'Tree Assessment', final report, prepared for Land Development Agency.	High. This document was prepared specifically for this project by a suitably qualified company.	None known
Elton Consulting (Elton) (2017) Community Engagement Plan: Canberra Brickworks, DRAFT,	High. This document was prepared specifically for this project and was recently	The Community Engagement Plan is a draft. This is considered appropriate given

Reference Source	Reliability	Uncertainties
unpublished report prepared for Doma Group, Canberra (June, 2017).	updated (June, 2017).	the ongoing nature of the Project and need to update the communication plan accordingly. This is not considered an issue for this Referral as the most recent version of the document was used when preparing this Referral.
GML Heritage (2017) 'Canberra Brickworks Precinct: Conservation Management Plan', final draft report, prepared for Doma Group.	High. This document was prepared specifically for this project and was finalised recently (August, 2017).	None known
Leach Steger (2014) 'Detailed Engineering Survey', prepared for Land Development Agency, Canberra.	High. These plans have been prepared specifically for this project.	None known
Lovell Chen (2016) 'Archaeological Assessment: Canberra Brickworks and Environs, Denman Street, Yarralumla, Canberra', unpublished report prepared for Land Development Agency, Canberra.	High. This document was prepared specifically for this project within the last two years.	None known
Navin Officer (2014) 'Canberra Brickworks, Yarralumla, ACT: Stage 1 Aboriginal Cultural Heritage Assessment', unpublished report prepared for Land Development Agency, Canberra.	High. This document was prepared specifically for this project within the last three years.	Updated searches may be required as part of the EIS
SMEC (2016a) 'Canberra Brickworks: Detailed Environmental and Geotechnical Site Investigation', final report, prepared for Land Development Agency, Canberra.	High. This document was prepared specifically for this project and has been subject to an independent auditor's review.	Limitations are identified in the report and in the auditors report
SMEC (2016b) 'Canberra Brickworks: Groundwater Investigation-Addendum Report', final report, prepared for Land Development Agency, Canberra.	High. This document was prepared specifically for this project and has been subject to an independent auditor's review.	Limitations are identified in the report and in the auditors report

Reference Source	Reliability	Uncertainties
Umwelt (2015) 'Ecological Assessment at Revised Brickworks Project Area', briefing note, prepared for Land Development Agency, Canberra.	High. This document was prepared specifically for this project.	Report was prepared in 2015. Findings of this report will be supplemented by more recent surveys completed by Biosis (2017).
SMEC (2016a) 'Canberra Brickworks: Detailed Environmental and Geotechnical Site Investigation', final report, prepared for Land Development Agency, Canberra.	High. This document was prepared specifically for this project within the last year.	None known.
SMEC (2016b) 'Canberra Brickworks: Groundwater Investigation-Addendum Report', final report, prepared for Land Development Agency, Canberra.	High. This document was prepared specifically for this project within the last year.	None known.
Umwelt (2015) 'Ecological Assessment at Revised Brickworks Project Area', briefing note, prepared for Land Development Agency, Canberra.	High. This document was prepared specifically for this project within the last two years.	None known.

Section 8 – Proposed alternatives

You are required to complete this section if you have any feasible alternatives to taking the proposed action (including not taking the action) that were considered but not proposed.

8.0 Provide a description of the feasible alternative?

The environmental constraints and concerns of the public have been considered throughout the design stages of the proposed action.

The only feasible alternative remaining is to do nothing, and leave the site as status quo.

8.1 Select the relevant alternatives related to your proposed action.

Activities

8.9 Describe any public consultation that has been, is being or will be undertaken (including with Indigenous stakeholders).

The public consultation for the proposed action (including the excluding of alternatives) is described in Section 1.13. The consultation has resulted in a focus on celebrating the heritage values of the CBP and ensuring that the proposed action will not impact upon existing residents and infrastructure.

The Canberra Brickworks are currently not actively managed for its heritage value. As such, a status quo approach will not result in a celebration of the history of the site. The proposed action will result in the history of the Canberra Brickworks being the focus of a new residential area that is easily accessible to the Canberra community.

8.10 Describe any environmental impact assessments that have been, is being or will be carried out under Commonwealth, State or Territory legislation including relevant impacts of the project for the alternative.

Information as above, in Section 1.14.

8.12 Nominate any matters of National Environmental Significance that are likely to be impacted by this alternative proposal by ticking the relevant checkboxes.

8.13 Describe any impacts on the flora and fauna relevant to the alternative proposal.

The alternative will not result in any additional impacts on the flora and fauna within the CBP.

8.26 What are the proposed measures for any alternative action to avoid or reduce impact?

N/A as there would be no impacts under the alternative action.

8.27 Do you have another alternative?

No

Section 9 – Contacts, signatures and declarations

Where applicable, you must provide the contact details of each of the following entities: Person Proposing the Action; Proposed Designated Proponent and; Person Preparing the Referral. You will also be required to provide signed declarations from each of the identified entities.

9.0 Is the person proposing to take the action an Organisation or an Individual?

Organisation

9.2 Organisation

9.2.1 Job Title

Senior Development Manager

9.2.2 First Name

David

9.2.3 Last Name

Carey

9.2.4 E-mail

david@domagroup.com.au

9.2.5 Postal Address

PO Box 5419
Kingston ACT 2604
Australia

9.2.6 ABN/ACN

ABN

31616498670 - CANBERRA BRICKWORKS DEVELOPMENTS PTY LTD

9.2.7 Organisation Telephone

0262607750

9.2.8 Organisation E-mail

david@domagroup.com.au

9.2.9 I qualify for exemption from fees under section 520(4C)(e)(v) of the EPBC Act because I am:

Not applicable

Small Business Declaration

I have read the Department of the Environment and Energy's guidance in the online form concerning the definition of a small a business entity and confirm that I qualify for a small business exemption.

Signature:…… Date: ……

9.2.9.2 I would like to apply for a waiver of full or partial fees under Schedule 1, 5.21A of the EPBC Regulations

No

9.2.9.3 Under sub regulation 5.21A(5), you must include information about the applicant (if not you) the grounds on which the waiver is sought and the reasons why it should be made

Person proposing the action - Declaration

I, _____, declare that to the best of my knowledge the information I have given on, or attached to the EPBC Act Referral is complete, current and correct. I understand that giving false or misleading information is a serious offence. I declare that I am not taking the action on behalf of or for the benefit of any other person or entity.

Signature:…… Date: ……

I, _____, the person proposing the action, consent to the designation of _____ as the proponent of the purposes of the action describe in this EPBC Act Referral.

Signature:…… Date: ……

9.3 Is the Proposed Designated Proponent an Organisation or Individual?

Organisation

9.5 Organisation

9.5.1 Job Title

Senior Development Manager

9.5.2 First Name

David

9.5.3 Last Name

Carey

9.5.4 E-mail

david@domagroup.com.au

9.5.5 Postal Address

PO BOX 5419
Kingston ACT 2604
Australia

9.5.6 ABN/ACN

ABN

31616498670 - CANBERRA BRICKWORKS DEVELOPMENTS PTY LTD

9.5.7 Organisation Telephone

026207750

9.5.8 Organisation E-mail

david@domagroup.com.au

Proposed designated proponent - Declaration

I, _____, the proposed designated proponent, consent to the designation of myself as the proponent for the purposes of the action described in this EPBC Act Referral.

Signature:…… Date: ……

9.6 Is the Referring Party an Organisation or Individual?

Organisation

9.8 Organisation

9.8.1 Job Title

Environmental Scientist

9.8.2 First Name

Amanda

9.8.3 Last Name

Mulherin

9.8.4 E-mail

amulherin@umwelt.com.au

9.8.5 Postal Address

PO Box 6135

56 Bluebell Street
O'Connor ACT 2602
Australia

9.8.6 ABN/ACN

ABN

18059519041 - UMWELT (AUSTRALIA) PTY. LTD.

9.8.7 Organisation Telephone

0262629484

9.8.8 Organisation E-mail

reception@umwelt.com.au

Referring Party - Declaration

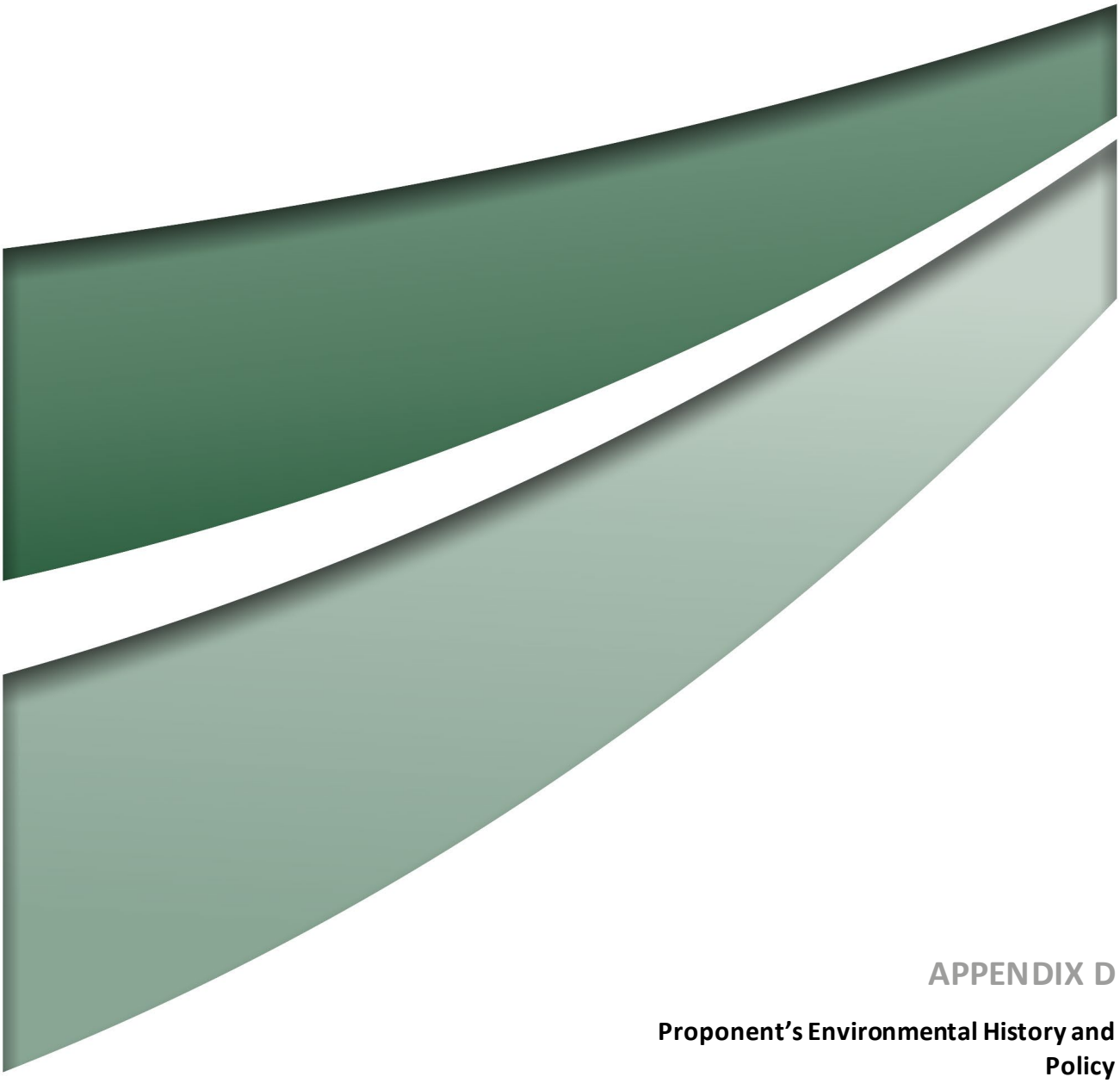
I, _____, I declare that to the best of my knowledge the information I have given on, or attached to this EPBC Act Referral is complete, current and correct. I understand that giving false or misleading information is a serious offence.

Signature:…… Date: ……

Appendix A - Attachments

The following attachments have been supplied with this EPBC Act Referral:

1. 7.2.202-environmental-policy.pdf
2. 8137_cbparea.zip
3. biosis_2017.pdf
4. bloc_act_pty_ltd_iso-14001-2004-jasanz_certificate_2016.pdf
5. draft_canberra_brickworks_cep.pdf
6. m_stage_1_acha.pdf
7. umwelt_2015.pdf



APPENDIX D

Proponent's Environmental History and Policy

Proponent's Environmental History

There are and have been no proceedings against the Proponent relating to the protection of the environment or the conservation and sustainable use of natural resources.

Environmental Policy Statement

DOMA

At DOMA, we are committed to ensuring that all activities resulting from our business / operations are carried out in such a manner to either eliminate, control, or minimise the impact on the immediate and wider environment.

"It is the policy of DOMA to continually improve its environmental management, to prevent pollution and to ensure that all workplaces are free of environmental incidents which impact on air, water, soil, natural resources, flora, fauna and people".

Environmental performance will be regularly reviewed, and targets and objectives are adjusted to maintain continual improvement.

Our principle environmental objectives are, in so far as is reasonably practicable, to:

- place the protection of the environment, as one of its highest priorities,
- maintain compliance with applicable environmental statutory legal requirements,
- promote a positive culture of environmental awareness, and
- strive for continual improvement in the prevention of pollution.

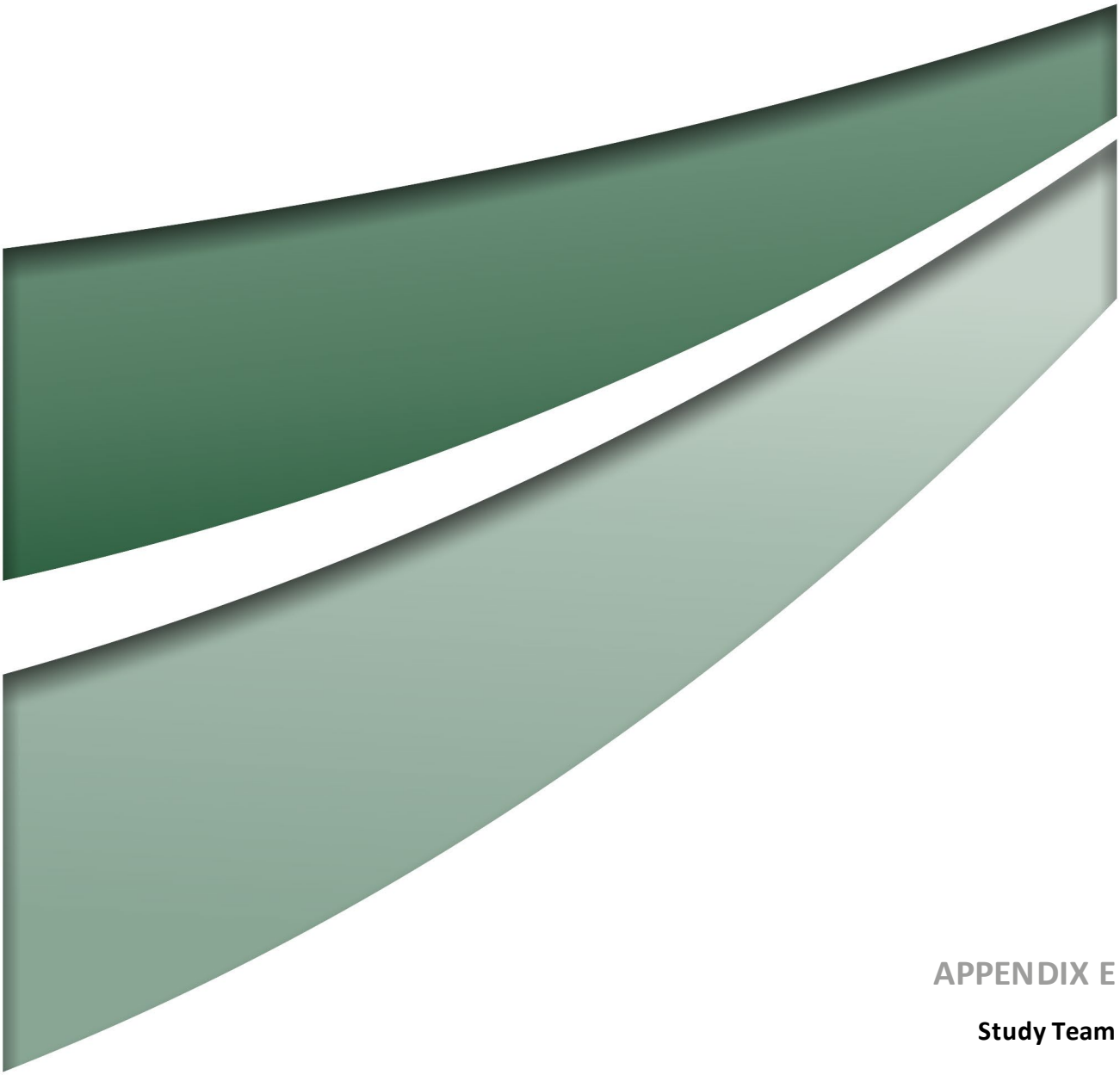
To achieve the environmental objectives DOMA shall:

- consider relevant health, safety and environment standards, codes, guides, and good practices in environmental procedures,
- operate in compliance with appropriate environmental laws and principles,
- establish and review environmental objectives and targets appropriate to the organisation's activities, products and services,
- provide training to ensure staff understand and implement this policy,
- provide on-going dialogue with DOMA staff, Employees, Client stakeholders and the community, as required, on this policy and its implementation, and
- make this policy available to those persons as listed above.

"DOMA recognises the co-operation of all Employees, Head Contractors and their Subcontractors and visitors while on DOMA sites is paramount to the success of DOMA's environmental endeavourers and the implementation of this Environmental Policy".

Director: Jure Domazet **Signature:** **Date:** 14/1/2020

4/3 Sydney Avenue Barton ACT 2600
PO Box 5419 Kingston ACT 2604
reception@domagroup.com.au
T +61 2 6260 7750
F +61 2 6260 7751
domagroup.com.au



APPENDIX E

Study Team

Study Team

The following consultants outlined in **Table E1** have contributed to the preparation of this EIS.

Table E1 Contributing Consultants Qualifications and Experience

Name and Company	Project Role	Qualifications	Years of Experience
Caitlin Adcock Umwelt, Principal Environmental Planner	Project Manager and Primary EIS Author	Bachelor of Town Planning Bachelor of Laws	10
Peter Cowper Umwelt, Senior Principal Consultant	Project Director and Technical Reviewer of Draft EIS	Bachelor of Natural Resources	25
Karina Carwardine Umwelt, Principal EIA	Project Director of EIS	Bachelor of Marine Biology	12
Bernie Cusack Sellick Consultants	Director and Principal Engineer Civil Engineer	Bachelor of Engineering	25
Tim Heffernan AECOM	Senior Transport Engineer Traffic and Transport specialist	Bachelor of Engineering Master of Engineering Bachelor of Commerce	10
John O'Brien Agon Environmental	ACT Manager Contamination specialist	Bachelor of Environmental Science Bachelor of Landscape Architecture	10
Marcus Graham Stewart Architecture	Practice Principal Landscape and Visual specialist	Bachelor of Applied Science in Environmental Design, Architecture Bachelor of Architecture Business and Practice of Architecture 1	25
Simon Green S4B Studio	Senior Electrical Engineer Electricity and communications utilities specialist	Bachelor of Engineering Masters of Design Science, Illumination Design	17
David Barratt Alluvium	ACT Regional Manager Hydrology specialist	Master of Applied Science Bachelor of Science	25
Linda Slechta Arup	Senior Consultant Climate Change and Air Quality specialist	Bachelor of Environmental Science	14

Name and Company	Project Role	Qualifications	Years of Experience
Ethan Monaghan-Pisano Arup	Consultant Sustainability and GHG Specialist	Masters of Environmental Engineering Flexible Appropriate Structure Transparent (FAST) Modelling Accredited	6
Rachel Jackson GML	Principal Heritage specialist	Masters of Heritage Conservation Bachelor of Design (Interior Design)	20+
Martin Rowney GML	Senior Associate Archaeologist specialist	Bachelor of Arts in Prehistoric and Historical Archaeology Honours in Prehistoric Archaeology Bachelor of Visual Arts, Sculpture	20+
Natasha Crook Umwelt	Spatial Analyst – Ecology Ecologist and GIS specialist	Bachelor of Science in Zoology Master of Environmental Management and Development Diploma of Spatial Information Services	8
Tim Procter Umwelt	Practice Lead Acoustic Engineer Noise specialist	Bachelor of Engineering	35+

APPENDIX F

Specialist Studies

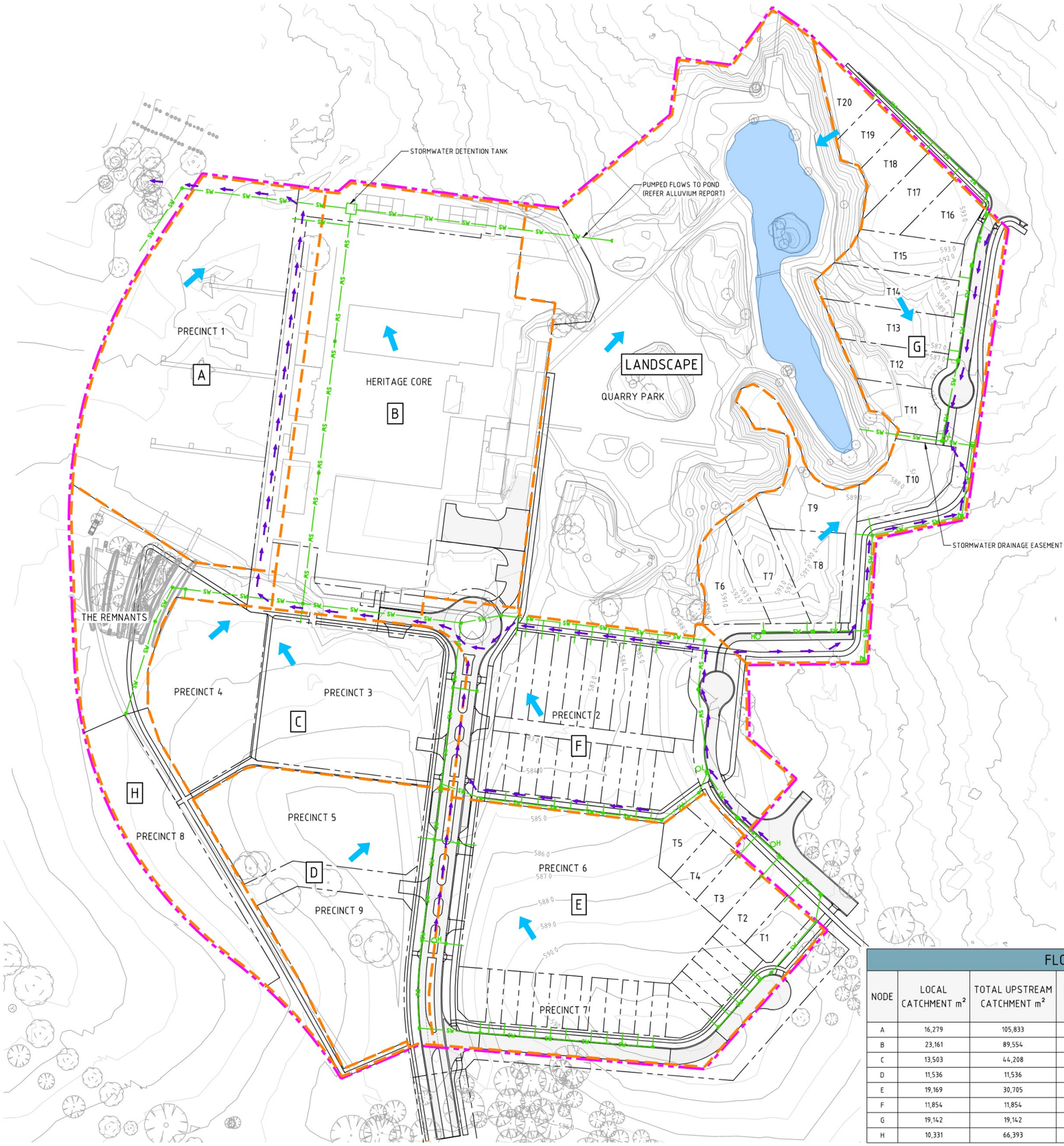
Specialist Report Index

Appendix	Reference	Status since Draft EIS	Replaced Reference (if applicable)
F1	Stormwater Master Plan (Sellick, 2021)	Updated	Stormwater Master Plan (Sellick, 2022a)
F2	Water and Sewer Master Plans (Sellick, 2021)	Updated	Water and Sewer Master Plans (Sellick, 2022b)
F3	Electrical Reticulation Plan (S4B, 2021)	Updated	Electrical Infrastructure Plan and Maximum Electricity Demand Calculations (S4B, 2022)
F4	Communications Infrastructure Plan (S4B, 2021)	Updated	No change to reference
F5	Traffic, Transport & Carparking (AECOM, 2016)	No Change	
F6	Access Rd & Dudley St Upgrade Prelim Sketch Plan Report (AECOM, 2017)	No Change	
F7	Kent St & Novar St Intersection Upgrade (AECOM, 2020)	No Change	
F8	Yarralumla Brickworks Traffic and Parking Report (AECOM, 2020)	No Change	
F9	Concept EDP - Gazetted Road Plan (Sellick, 2020)	Updated	No change to reference
F10	Tree Assessment Report and Update (dsb Landscape Architects, 2015, 2020)	No Change	
F11	Tree Protection Plan (McGregor Coxall, 2021)	Updated	Tree Protection Plan (McGregor Coxall, 2021b)
F12	Yarralumla Brickworks View Impact Studies (Stewart Architecture, 2020)	No Change	
F13	Final Concept Pond Design (Alluvium, 2016)	No Change	
F14	Yarralumla Brickworks stormwater treatment systems (Alluvium, 2021)	Updated	Yarralumla Brickworks stormwater treatment systems (Alluvium, 2022)
F15	Groundwater Investigation Addendum Report (SMEC, 2016b)	No Change	
F16	Community Engagement Plan (Elton Consulting, 2017)	No Change	

Appendix	Reference	Status since Draft EIS	Replaced Reference (if applicable)
F17	Canberra Brickworks and Environs Community Needs Assessment (SGS Economics & Planning, 2015)	No Change	
F18	Climate Adaption Plan and Greenhouse Gas Technical Memo (Arup, 2021a, 2021b)	No Change	
F19	Noise Impact Assessment (Umwelt, 2021a)	No Change	
F20	Bushfire Risk Assessment (ABPP, 2020)	No Change	
F21	Detailed Environmental and Geotechnical Site Investigation (SMEC, 2016a)	No Change	
F22	Prliminary Geotechnical Site Investigation (SMEC, 2013)	No Change	
F23	Stage 1 Environmental Site Assessment (Robson Environmental, 2015)	No Change	
F24	Concept EDP - Environmental Management and Protection Plan (Sellick, 2021)	Updated	Concept EDP - Environmental Management and Protection Plan (Sellick, 2022c)
F25	Canberra Brickworks and Environs Ecological Assessment (Umwelt, 2014)	No Change	
F26	Ecological Assessment at Revised Brickworks Project Area (Umwelt, 2015)	No Change	
F27	Golden Sun Moth Survey and Ecological Assessment of the Dudley Street Road Reserve (umwelt, 2016)	No Change	
F28	Ecological Assessment Gap Analysis for Canberra Brickworks (Biosis, 2017a)	No Change	
F29	Targeted Survey for GSM (Biosis, 2017b)	No Change	
F30	Offset Strategy Dudley Street Upgrade (Umwelt, 2018)	No Change	
F31	EPBC Offset Assessment Guide (Umwelt, 2020)	No Change	
F32	GSM Surveys Briefing Note (Umwelt, 2020)	No Change	

Appendix	Reference	Status since Draft EIS	Replaced Reference (if applicable)
F33	Canberra Brickworks Conservation Management Plan (Lovell Chen, 2010)	No Change	
F34	Aboriginal Cultural Heritage Assessment (Navin Officer Heritage Consultants Pty Ltd, 2014)	No Change	
F35	Conservation Development Strategy (Lovell Chen, 2015)	No Change	
F36	Statement of Heritage Effects (GML, 2017)	Replaced	Yarralumla Brickworks Heritage Impact Statement (Lovell Chen, 2022)
F37	Geotechnical Investigations SHE (GML, 2019)	No Change	
F38	Conservation Management Plan Vol 1 (GML, 2021), Conservation Management Plan Vol 2 (GML, 2021)	Updated	Canberra Brickworks Precinct Conservation Management Plan Final Report Vol 1 & 2 (GML, 2021a) and Approval (ACT Heritage Council, 2021)
F39	Archaeological Research Design (GML, 2020)	No Change	
F40	Preliminary (Environmental) Site Investigation Canberra Brickworks (SMEC, 2014)	No Change	
F41	Site Audit-Interim Audit Advice #7 (Geosyntec consultants, 2016)	No Change	
F42	Sampling, Analysis & Quality Plan SAQP (Aracdis, 2017)	No Change	
F43	Contamination Summary (Agon Environmental, 2020)	No Change	
F44	Uriarra Track View Study (SJB, 2020)	No Change	
F45	Waste Overview: Canberra Brickworks (Sellick, 2021)	New	
F46	Landscape Master Plan (DRAFT) (McGregor Coxall, 2021a)	New	
F47	Supplementary Bushfire Risk Assessment (ABPP, 2021) and Feedback Received from ACT Fire and Rescue	New	
F48	Canberra Brickworks Development: Backfilling of Old Quarry Area - Geological Fossil Study (ACT Geotechnical Engineers Pty Ltd, 2021a)	New	

Appendix	Reference	Status since Draft EIS	Replaced Reference (if applicable)
F49	Canberra Brickworks Precinct Archaeological Excavation Report and Statement of Heritage Effects Vol 1 and 2 (GML, 2022a)	New	
F50	Environmental Offsets Supplementary Report (Umwelt, 2023)	New	
F51	Supplementary Environmental Site Assessment (DRAFT) (Agon Environmental, 2021a)	New	
F52	Remediation Works Plan (Agon Environmental, 2021b)	New	
F53	Development Site Management Plan (DRAFT) (Agon Environmental, 2021c)	New	
F54	Community Engagement Summary (Doma, 2021)	New	
F55	Transport Summary Report - Yarralumla Brickworks (Calibre Consulting, 2022)	New	
F56	Canberra Brickworks Redevelopment - Quarry Pit Backfilling Guidelines for construction of controlled fill (ACT Geotechnical Engineers Pty Ltd, 2021b)	New	
F57	Public Lighting Plan (S4B, 2021b)	New	
F58	Canberra Brickworks Precinct Artefact Management Strategy (GML, 2022b)		



Status

NOT FOR CONSTRUCTION

DO NOT SCALE OFF DRAWINGS. VERIFY ALL DIMENSIONS ON SITE PRIOR TO WORK.
COPYRIGHT: The contents and information contained in this document are copyright of Sellick Consultants. Use or copy of this document in whole or part without written permission constitutes an infringement of copyright.

Rev	Description	Date	Drawn By
O	EIS COMMENTS ADDRESSED	19.10.2022	RT
N	EIS COMMENTS ADDRESSED	11.10.2022	RT
M	EDP SUBMISSION	20.07.2022	RT
L	EDP SUBMISSION	16.06.2022	RT
K	FOR EDP SUBMISSION	14.06.2022	RT
J	EDP SUBMISSION	10.06.2022	RT
I	EDP SUBMISSION	07.06.2022	RT

LEGEND

- HOLDING LEASE BOUNDARY
- PROPOSED BLOCK BOUNDARY
- EXISTING TREE TO BE REMOVED
- EXISTING TREE TO RETAINED
- PROPOSED CONTOUR
- EXISTING CONTOUR
- CATCHMENT BOUNDARY
- STORMWATER MANHOLE, SUMP
- STORMWATER PIPE
- STORMWATER MAIN TO BE DISCONNECTED
- OVERLAND FLOW PATH
- WATER QUALITY DEVICE
- L LOW POINT
- H HIGH POINT

FLOW ANALYSIS

NODE	LOCAL CATCHMENT m^2	TOTAL UPSTREAM CATCHMENT m^2	FLOW (20% AEP) (L/s)	PIPE SIZE (mm)	PIPE CAPACITY	FLOW (1% AEP (L/s)	GAP FLOW (L/s)
A	16,279	105,833	2593	1050	3231	5133	1902
B	23,161	89,554	2194	900	2162	4343	2181
C	13,503	44,208	1083	750	1344	2144	800
D	11,536	11,536	283	450	354	354	0
E	19,169	30,705	752	600	750	1489	739
F	11,854	11,854	1374	825	1723	2719	996
G	19,142	19,142	469	525	529	928	399
H	10,331	66,393	1627	825	1723	3220	1479

Scales

0 20 30 40 50m

1:1000 @ A1

sellick consultants
Est. 1965
canberra | sydney
ABN 82 634 296 629

Client Logo

DOMA

Original Size	A1	Drawn By DA	Drafting Check DCA
Date Plotted	21-Oct-22	Designed By AE	Design Check BC
Coordinate System	STROMLO GRID	Approved BC	Approved Date 16/12/2019
Height Datum	AHD	Approved Signature	

Project Name and Location

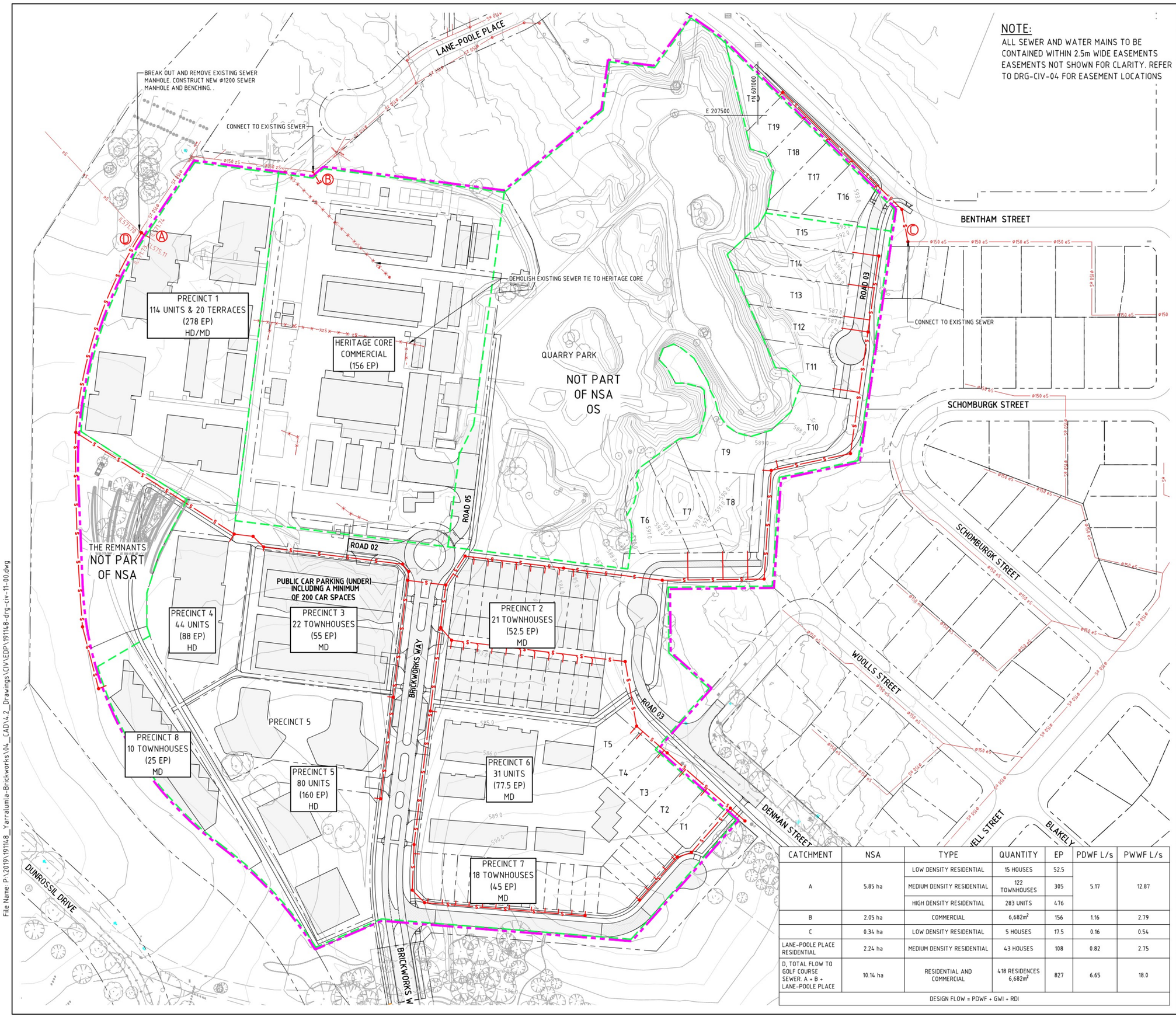
THE CANBERRA BRICKWORKS
BLOCKS 1,7 & 20 SECTION 102

Drawing Title

EDP
STORMWATER MASTER PLAN

Project Number	Type	Discipline	Drg No.	Sub-No.	Rev
191148	DRG	CIV	09	00	O

File Name: P:\2019\191148_Yarralumla-Brickworks\04_CAD\4.2_Drawings\CIV\EDP\191148-drg-civ-09-00.dwg



NOTE:

ALL SEWER AND WATER MAINS TO BE CONTAINED WITHIN 2.5m WIDE EASEMENTS EASEMENTS NOT SHOWN FOR CLARITY. REFER TO DRG-CIV-04 FOR EASEMENT LOCATIONS

CATCHMENT	NSA	TYPE	QUANTITY	EP	PDWF L/s	PWWF L/s
A	5.85 ha	LOW DENSITY RESIDENTIAL	15 HOUSES	52.5	5.17	12.87
		MEDIUM DENSITY RESIDENTIAL	122 TOWNHOUSES	305		
		HIGH DENSITY RESIDENTIAL	283 UNITS	476		
B	2.05 ha	COMMERCIAL	6,682m²	156	1.16	2.79
C	0.34 ha	LOW DENSITY RESIDENTIAL	5 HOUSES	17.5	0.16	0.54
LANE-POOLE PLACE RESIDENTIAL	2.24 ha	MEDIUM DENSITY RESIDENTIAL	43 HOUSES	108	0.82	2.75
D, TOTAL FLOW TO GOLF COURSE SEWER. A + B + LANE-POOLE PLACE	10.14 ha	RESIDENTIAL AND COMMERCIAL	418 RESIDENCES 6,682m²	827	6.65	18.0
DESIGN FLOW = PDWF + GWI + RDI						

Status

NOT FOR CONSTRUCTION

DO NOT SCALE OFF DRAWINGS. VERIFY ALL DIMENSIONS ON SITE PRIOR TO WORK. COPYRIGHT: The contents and information contained in this document are copyright of Sellick Consultants. Use or copy of this document in whole or part without written permission constitutes an infringement of copyright.

Rev	Description	Date	Drawn By
O	EIS COMMENTS ADDRESSED	11.10.2022	RT
N	EDP SUBMISSION	20.07.2022	RT
M	EDP SUBMISSION	16.06.2022	RT
L	FOR EDP SUBMISSION	14.06.2022	RT
K	EDP SUBMISSION	10.06.2022	RT
J	EDP SUBMISSION	07.06.2022	RT
I	FOR INFORMATION	02.06.2022	RT

LEGEND

- LEASE BOUNDARY
- PROPOSED BLOCK BOUNDARY
- EXISTING TREE TO RETAINED
- PROPOSED CONTOUR
- EXISTING CONTOUR
- CATCHMENT NODE
- CATCHMENT BOUNDARY
- SEWER MANHOLE, PIPE END CAP
- NEW SEWER MAIN
- EXISTING SEWER MAIN
- SEWER MAIN TO BE DISCONNECTED

Scales

0 20 30 40 50m

1:1000 @ A1

sellick consultants Est. 1965
canberra | sydney
ABN 82 634 296 629

Client Logo

DOMA

Original Size	A1	Drawn By: DA	Drafting Check: DCA
Date Plotted	11-Oct-22	Designed By: AE	Design Check: BC
Coordinate System	STROMLO GRID	Approved: BC	Approved Date: 16/12/2019
Height Datum	AHD	Approved Signature	

Project Name and Location

THE CANBERRA BRICKWORKS

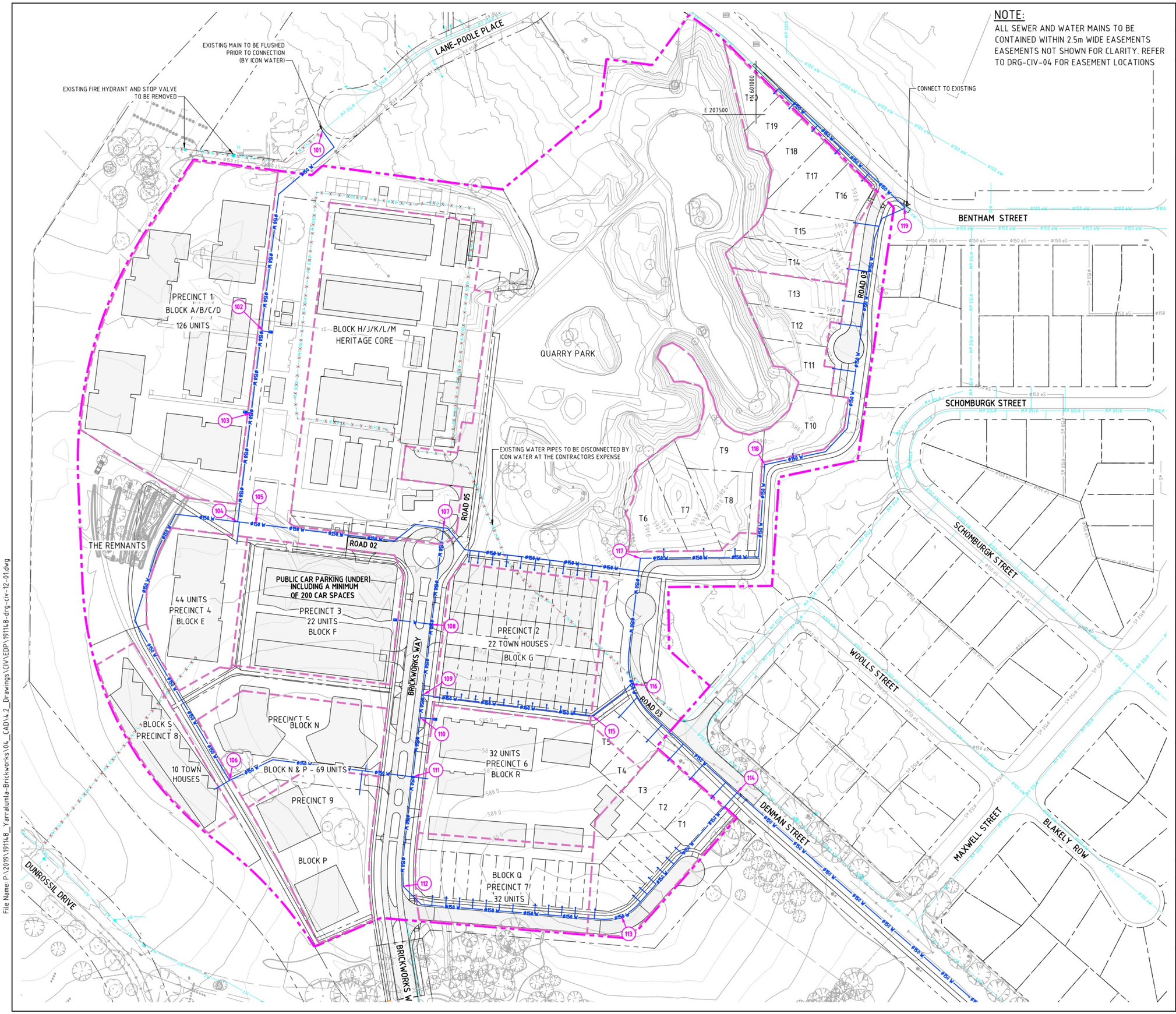
BLOCKS 1,7 & 20 SECTION 102

Drawing Title

EDP - SEWER MASTER PLAN

Project Number	Type	Discipline	Drg No.	Sub-No.	Rev
191148	DRG	CIV	11	00	O

File Name: P:\2019\191148_Yarralumla-Brickworks\04_CAD\4.2_Drawings\CIV\EDP\191148-drg-civ-11-00.dwg



Status

NOT FOR CONSTRUCTION

DO NOT SCALE OFF DRAWINGS. VERIFY ALL DIMENSIONS ON SITE PRIOR TO WORK.
COPYRIGHT: The contents and information contained in this document are copyright of Sellick Consultants. Use or copy of this document in whole or part without written permission constitutes an infringement of copyright.

Rev	Description	Date	Drawn By
O	EIS COMMENTS ADDRESSED	11.10.2022	RT
N	EDP SUBMISSION	20.07.2022	RT
M	EDP SUBMISSION	16.06.2022	RT
L	FOR EDP SUBMISSION	14.06.2022	RT
K	EDP SUBMISSION	10.06.2022	RT
J	EDP SUBMISSION	07.06.2022	RT
I	FOR INFORMATION	02.06.2022	RT

LEGEND

- LEASE BOUNDARY
- PROPOSED BLOCK BOUNDARY
- EXISTING TREE TO RETAINED
- PROPOSED CONTOUR
- EXISTING CONTOUR
- CATCHMENT NODE
- SUPPLY AREA BOUNDARY
- STOP VALVE, METER, HYDRANT
- STOP COCK
- PROPOSED WATER MAIN
- EXISTING WATER MAIN
- WATER MAIN TO BE DISCONNECTED

Scales

0 20 30 40 50m

1:1000 @ A1

sellick consultants
canberra | sydney
ABN 82 634 296 629

Client Logo

DOMA

Original Size	A1	Drawn By: DA	Drafting Check: DCA
Date Plotted	11-Oct-22	Designed By: AE	Design Check: BC
Coordinate System	STROMLO GRID	Approved: BC	Approved Date: 16/12/2019
Height Datum	AHD	Approved Signature	

Project Name and Location

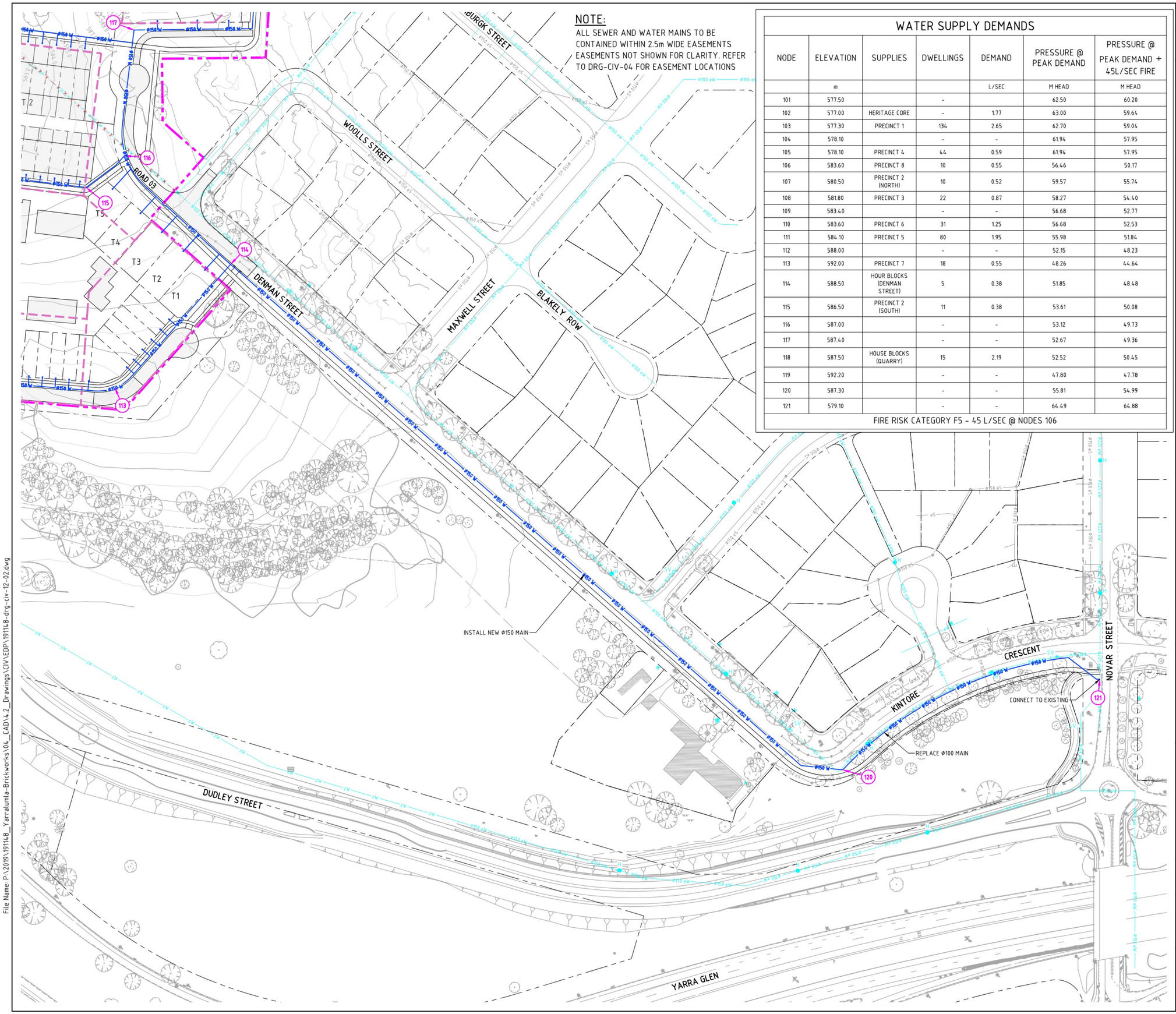
THE CANBERRA BRICKWORKS
BLOCKS 1,7 & 20 SECTION 102

Drawing Title

EDP - WATER MASTER PLAN
SHEET 1

Project Number	Type	Discipline	Drg No.	Sub-No.	Rev
191148	DRG	CIV	12	01	O

File Name: P:\2019\191148_Yarralumla-Brickworks\04_CAD\4.2_Drawings\CIV\EDP\191148-drg-civ-12-01.dwg



WATER SUPPLY DEMANDS

NODE	ELEVATION	SUPPLIES	DWELLINGS	DEMAND	PRESSURE @ PEAK DEMAND	PRESSURE @ PEAK DEMAND + 45L/SEC FIRE
	m			L/SEC	M HEAD	M HEAD
101	577.50		-		62.50	60.20
102	577.00	HERITAGE CORE	-	1.77	63.00	59.64
103	577.30	PRECINCT 1	134	2.65	62.70	59.04
104	578.10		-	-	61.94	57.95
105	578.10	PRECINCT 4	44	0.59	61.94	57.95
106	583.60	PRECINCT 8	10	0.55	56.46	50.17
107	580.50	PRECINCT 2 (NORTH)	10	0.52	59.57	55.74
108	581.80	PRECINCT 3	22	0.87	58.27	54.40
109	583.40		-	-	56.68	52.77
110	583.60	PRECINCT 6	31	1.25	56.68	52.53
111	584.10	PRECINCT 5	80	1.95	55.98	51.84
112	588.00		-	-	52.15	48.23
113	592.00	PRECINCT 7	18	0.55	48.26	44.64
114	588.50	HOUR BLOCKS (DENMAN STREET)	5	0.38	51.85	48.48
115	586.50	PRECINCT 2 (SOUTH)	11	0.38	53.61	50.08
116	587.00		-	-	53.12	49.73
117	587.40		-	-	52.67	49.36
118	587.50	HOUSE BLOCKS (QUARRY)	15	2.19	52.52	50.45
119	592.20		-	-	47.80	47.78
120	587.30		-	-	55.81	54.99
121	579.10		-	-	64.49	64.88

FIRE RISK CATEGORY F5 - 45 L/SEC @ NODES 106

Status

NOT FOR CONSTRUCTION

DO NOT SCALE OFF DRAWINGS. VERIFY ALL DIMENSIONS ON SITE PRIOR TO WORK.
COPYRIGHT: The contents and information contained in this document are copyright of Sellick Consultants. Use or copy of this document in whole or part without written permission constitutes an infringement of copyright.

Rev	Description	Date	Drawn By
O	EIS COMMENTS ADDRESSED	11.10.2022	RT
N	EDP SUBMISSION	20.07.2022	RT
M	EDP SUBMISSION	16.06.2022	RT
L	FOR EDP SUBMISSION	14.06.2022	RT
K	EDP SUBMISSION	10.06.2022	RT
J	EDP SUBMISSION	07.06.2022	RT
I	FOR INFORMATION	02.06.2022	RT

LEGEND

- LEASE BOUNDARY
- PROPOSED BLOCK BOUNDARY
- EXISTING TREE TO RETAINED
- PROPOSED CONTOUR
- EXISTING CONTOUR
- CATCHMENT NODE
- SUPPLY AREA BOUNDARY
- STOP VALVE, METER, HYDRANT
- STOP COCK
- PROPOSED WATER MAIN
- EXISTING WATER MAIN
- WATER MAIN TO BE DISCONNECTED

Scales

0 20 30 40 50m

1:1000 @ A1

sellick consultants
canberra | sydney
ABN 82 634 296 629

Client Logo

DOMA

Original Size	A1	Drawn By DA	Drafting Check DCA
Date Plotted	11-Oct-22	Designed By AE	Design Check BC
Coordinate System	STROMLO GRID	Approved BC	Approved Date 16/12/2019
Height Datum	AHD	Approved Signature	

Project Name and Location

THE CANBERRA BRICKWORKS

BLOCKS 1,7 & 20 SECTION 102

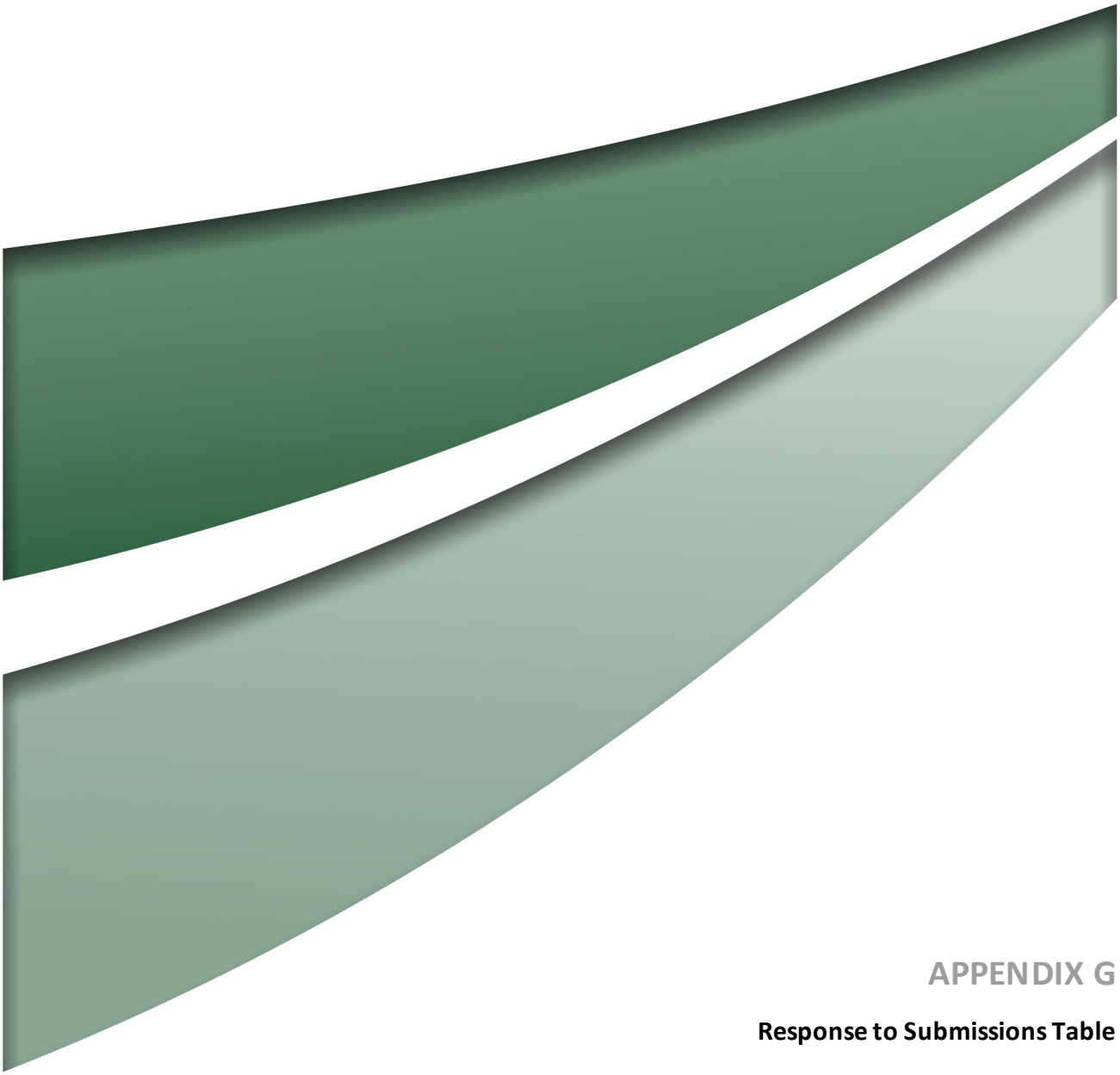
Drawing Title

EDP - WATER MASTER PLAN

SHEET 2

Project Number	Type	Discipline	Drg No.	Sub-No.	Rev
191148	DRG	CIV	12	02	O

File Name: P:\2019\191148_Yarralumla-Brickworks\04_CAD\4.2_Drawings\CIV\EDP\191148-drg-civ-12-02.dwg



APPENDIX G

Response to Submissions Table

Canberra Brickworks Redevelopment – Response to Section 224 Notice

Comment	Response	Reference in EIS
Attachment A		
2.0 Proposal Details		
2.1 Property Description Overview (Scoping Document reference 5.1) Provide details for all three blocks in Table 2.1 (pg 8). Block 20 Section 102 is not included.	Added 'Block 20 Section 102, Yarralumla' to Table 2.1.	Table 2.1, page 9
2.1 Property Description Overview (Scoping Document reference 5.1) Block 1 Section 102 is identified with the associated Rural Block number elsewhere in the document and therefore associated rural block number should be included in Table 2.1 as well.	Added 'Canberra Central: Registered Rural Block No: 764' to Table 2.1.	Table 2.1, page 9
2.1 Property Description Overview (Scoping Document reference 5.1) Identify in Table 2.1 that there is no current lease on any of the subject blocks and identify that land use purposes permitted by any relevant lease is not applicable.	Added required information to Table 2.1.	Table 2.1, page 9 and page 10
2.7 Construction Matters (SD ref 5.1 i)) Table 2.2 Indicative Timeframe – updates to the current indicative dates are required to ensure the EIS addresses the Scoping Document.	Updated required information in Table 2.2.	Table 2.2, page 20
2.8 Alternatives Considered (SD ref 5.2) The Master Plan has been further revised after 2020 and since the Draft EIS. Include the revised design in the revised EIS under 2.8.3 Design Amendments and provide details of the changes made.	Minor revisions to the EIS Masterplan were made following the Draft EIS in response to community and agency engagement, with discussion on these amendments already contained within Section 2.8.3. The sentence referring readers to Figure 2.2 (the current Masterplan for the Revised EIS) has been moved up to immediately follow the sentence on previous masterplans depicted in Figure 2.5 and Figure 2.6. Further, the labelling of Figure 2.6 clearly indicates the 2020 version of the masterplan is not current. Additional information on the revised masterplan and approvals processes has been provided in Section 1.2 Background.	Section 2.8.3, page 25. Label for Figure 2.6, page 27 Section 1.2, page5
4.0 Risk Assessment		
4.2 Risk Assessment (SD ref 7.1) Revise/check the proposed mitigation and management measures and the subsequent residual risk rating. Ensure all residual risk and associated mitigation measures are identified in the relevant Sections.	Checked. All proposed mitigation and management measures and the subsequent residual risk rating are reflected in both the risk table (Excel) and the relevant Sections.	
Site investigation T4 – The proposed mitigation measures has changed from the draft EIS and is not considered to demonstrate the reduction in impact level under the affected theme, 'Traffic and Transport'.	Reinstated previous mitigation measures, in both Section 4.0 (risk Excel doc) and main text Section 7.6.	Risk assessment, and Section 7.6, page 101
Site investigation B4 – The Biodiversity impact item relating to intrusive site investigations seems to be deleted from the theme 'Site Investigations'. The numbering (i.e. B4) seems to continue now under 'Offsets'. Please provide reasoning to why this has been removed.	B4 has been reinserted in the theme 'Site Investigations'. Remaining risks have been renumbered, from B5 through to B10, in Section 4.0, Section 16.0 and Section 20.0.	Risk assessment, Section 16.0, page 202 and pages 221-223, and Section 20.0, page 288
General Construction Activities G2 – The last sentence for the mitigation measures states '*The site foreman is to contact the EPA to discuss any proposed major changes to sediment*'. This response seems to be incomplete. Please finalise mitigation measures.	Adjusted cell size in Excel to enable all text to appear in printed area. Final sentence reads '*The site foreman is to contact the EPA to arrange a site inspection and endorsement of sediment and erosion control measures prior to works commencing.*'	Risk assessment

Comment	Response	Reference in EIS
Operational V6 – The response in relation to mitigation measures for V6, previously V4, has changed. Please provide a summary of why mitigation measures have been removed and demonstrate how the residual impact is still achieved.	The two mitigation measures that were listed under V6 (previously V4) are not applicable to the operation phase, as they are measures designed to reduce the visual impact during the design phase. Likely impacts and appropriate mitigation measures to be implemented in the design phase were included in the revised EIS risk assessment (V2 and V3). Through assessment in the EIS, it was determined that photomontages and a qualitative assessment were adequate to assess visual impacts, and a 'detailed visual impacts assessment' was not determined to be necessary. It should be noted that mitigation measures under V2 reflect the measures that were included in the previous V4, highlighting how the design is to incorporate and prioritise the importance of landscaping: '*Design and implement a considered landscape master plan that seeks to enhance amenity of the Proposal Area. Implement Garden City principles throughout the design process. Retain Tree 276 to protect local community amenity and history.*'	Risk assessment, V2 and V3
6.0 Utilities (SD ref 8.2.3)		
Stormwater Plan (App F01) – The stormwater plan does not depict the most recent layout. Please update as per the revised precinct layout. Note: Please also refer to Attachment B for EPSDD Water Policy division comments requesting additional information on the plans.	The Stormwater plan at Appendix F01 has been updated to the most recent precinct layout.	Appendix F01
Sewer and Water Master Plans (Appendix F02) - The Sewer and Water Master Plan does not depict the most recent layout. Please update as per revised precinct layout and increased expected yield. Note: Please also refer to Attachment B for ICON Water comments.	The Sewer and Water plans at Appendix F02 have been updated to the most recent precinct layout.	Appendix F02
10.0 Water Quality and Hydrology (SD ref 8.2.7)		
Stormwater Plan (App F01) – The Stormwater Plan does not depict the most recent layout. Please update as per the revised precinct layout. Note: Please also refer to Attachment B for EPSDD Water Policy division comments requesting additional information on the plans.	The Stormwater plan at Appendix F01 has been updated to the most recent precinct layout.	Appendix F01
12.0 Climate Change and Air Quality (SD ref 6.2 and 8.2.9)		
Some mitigation measures are still non-committal, eg, 'will be explored/considered OR the design proposal will incorporate design measures'. Please provide definite mitigation measures to ensure this impact is addressed.	The key commitment in this section is to achieve a five-star rating under the Green Star Communities v1.1 rating tool, demonstrated through project registration as a Green Star Communities project on 22 November 2019 (project number GS-4809C). Green Star Communities is an independent rating tool established by and independently assessed by the Green Building Council of Australia. The rating evaluates the sustainability attributes of the planning, design and construction of large-scale developments. Each project is based on a holistic set of distinct social, environmental and economic categories including climate adaptation and resilience. A 5 Greenstar Communities Rating is considered "Australian Excellence". The detail of how to achieve a five-star rating will be further refined through the detailed design of the project. The majority of mitigation measures identified in Section 12.0 are clear. The mitigation measures that are to be explored or considered in further detail include shade structures, vegetated pergolas, pavement colour, playground equipment materials and deciduous tree plantings. Each of these measures is considered to be appropriate as a standalone measure; however, the interrelated nature of these measures means that the most appropriate design element(s) need(s) to be considered in the context of the project-specific Climate Adaptation Plan, the ability to achieve the five-star Green Star Communities rating and the long-term management.	

Comment	Response	Reference in EIS
The Draft Landscape Master Plan (Appendix F46) appears to depict proposed canopy cover. However, there is no commitment to this in the mitigation measures identified. Please update the mitigation measures to reflect the landscape master plan.	The response in Table 12.2, Action 2 states that the Proposal will exceed these targets [30% canopy cover] through extensive landscaping and provision of parkland. Refer to the draft Landscape Master Plan provided in Appendix F46 in Appendix F.' Added 'as identified in the Draft Landscape Master Plan' under the first bullet of Section 12.5.4.	Section 12.5.4, page 162
13.0 Noise, Vibration and Lighting (SD ref 8.2.10)		
The authority's request to revise the EIS stated: '*A key recommendation of the Noise Impact Assessment was to develop a site-specific set of vibration criteria (by a suitably qualified Structural Engineer) for the heritage structures in the precinct. This was indicated as a mitigation measure in the EIS, but has not been listed in the recommendations list. Please confirm this is a commitment, and when it is proposed to be delivered*'. The commitment has now been included under Section 21 (Recommendations), in Table 21.1 under 'Noise, Vibration and Lighting'. However, in this section it has not been identified when it is proposed to be delivered. Please confirm when this is to be delivered.	Added 'prior to commencement of construction'. Measure now reads: • Develop site-specific vibration criteria for the heritage structures in the Proposal Area. These site-specific vibration criteria would be derived and recommended by a suitably qualified Structural Engineer prior to commencement of construction.	Table 21.1, page 301 under 'Noise, Vibration and Lighting'
14.0 Hazard and Risk (SD ref 8.2.11)		
Figure 14.1 does not show all inner asset protection zones (IAPZ) within the precinct, and it is unclear where the outer asset protection zone (OAPZ) boundaries are to the south-east. The Supplementary Bushfire Assessment Report at Appendix F47 recommends an 11m IAPZ. Update all relevant drawings to identify correct IAPZs. Note: ESA has confirmed that 11m IAPZ recommended in F47 is appropriate.	Figure 14.1 updated to reflect 11m IAPZ (not 10m IAPZ as shown previously).	Figure 14.1, page 184
The authority's request to revise the EIS stated: '*Consider the impacts to any environmentally sensitive areas within or just outside the site through the establishment and management of asset protection zones for bushfire protection*'. The Response to Submission Table (Appendix G of the Revised EIS) does not seem to provide any response to this item. Please summarise, in Appendix G, the consideration that was given to environmentally sensitive areas in relation to bushfire protection.	Umwelt has been unable to find this specific request in the letter dated 4 August 2021 and supporting attachments. The most closely related comment included is reference 27 which is as follows: '*Please indicate the location of Golden Sun Moth habitat in the area adjacent to the project area and consider the impacts to these areas from the establishment and management of APZs for bushfire protection.*' Umwelt considers the existing response to the above comment provides sufficient consideration to the golden sun moth habitat in relation to bushfire protection: '*Amended. Refer to Figure 16.1. No golden sun moth habitat is known to occur within the proposed APZs outside of the Proposal Area. It is also noted that these areas are already maintained for bushfire management purposes.*' Further, Umwelt notes there are no environmentally sensitive areas within the site that require additional bushfire protection measures. No changes made.	
16.0 Ecology and Natural Environment (SD ref 8.2.12)		
The scoping document requires the proponent to provide a statement on whether impacts are expected to be unknown, irreversible, or unpredictable. Please provide a statement to this effect for each MNES. Note: Please refer to comments provided by Department of Agriculture, Water and the Environment (DAWE) in Attachment B.	The first paragraph on page 211, above Table 16.3, states in relation to Golden Sun Moth habitat that 'This impact is known, irreversible and predictable, noting that the proposed development will require clearing of the entire Proposal Area.' Section 16.3.1 (page 209) states 'Other than the recorded presence of golden sun moth, it is considered that there is a low likelihood of occurrence for any other threatened species or ecological community listed under either the EPBC Act or the NC Act to occur within the Proposal Area. As such, only impacts to the golden sun moth are considered in further detail in Section 16.4 below. There are no other relevant MNES listed under the EPBC Act within the Proposal Area.' No changes made.	Pages 209, 211
Provide a map of offsite Golden Sun Moth (GSM) habitat overlayed with offsite works including APZs and the proposed footpath along southern side of Denman Street to demonstrate there will be no offsite impacts to GSM.	Figure 16.1 has been updated to show APZs. Design of the footpath has not been confirmed with TCCS, so will not be included in the scope of the EIS. References to a new footpath on Denman Street have been removed throughout the EIS.	Figure 16.1, page 212

Comment	Response	Reference in EIS
Provide further clarification and discussion on the Natural Temperate Grass (NTG) as per comments provided by DAWE. Note: Please refer to comments provided by DAWE in Attachment B.	As per the response to DCCEEW below, there is no NTG in the Project Area. As no native vegetation types persist in the Proposal Area, Umwelt is unable to provide further discussion within the EIS regarding the extent, condition, impacts, or mitigation measures on NTG. The *Offset Strategy: Dudley Street Upgrade and Canberra Brickworks Precinct Access Road Construction* (Attachment F30) is for a different project. The NTG identified is not applicable to the Canberra Brickworks Precinct Redevelopment. The road upgrade area detailed in this offset strategy is adjacent to the project area for this Canberra Brickworks Precinct Redevelopment. The report was provided as background information only, as a study that Umwelt had considered in its ecological assessment of the broader area. No changes made.	
[SD ref] 8.2.14 MNES		
The scoping document requires the proponent to provide a statement on whether impacts are expected to be unknown, irreversible, or unpredictable. Note: Please refer to comments provided by DAWE in Attachment B.	The first paragraph on page 211, above Table 16.3, states in relation to Golden Sun Moth habitat that 'This impact is known, irreversible and predictable, noting that the proposed development will require clearing of the entire Proposal Area.' Section 16.3.1 (page 209) states 'Other than the recorded presence of golden sun moth, it is considered that there is a low likelihood of occurrence for any other threatened species or ecological community listed under either the EPBC Act or the NC Act to occur within the Proposal Area. As such, only impacts to the golden sun moth are considered in further detail in Section 16.4 below. There are no other relevant MNES listed under the EPBC Act within the Proposal Area.' No changes made.	Pages 209, 211
Additional comments:		
1. Glossary - Update the page number to viii) as this is incorrectly identified as iv).	Updated.	Page viii
2. Planning and Land Stratus - Error - 5.2.2 Existing Environment - Paragraph 5, line 4 includes the statement '(refer to..)'. The figure number is missing (e.g. pg 57). Please correct. - Error - table 5.1 - Conserve Heritage places and Spaces – comments (Pg 61). The reference to the Heritage Section number at the end of the comment is incorrect, should be Section 17.0. Please correct.	Removed '(refer to)' from text in paragraph 5, line 4. Updated reference in Table 5.1 to 'Section 17.0'.	Paragraph 5, line 4 Table 5.1, page 67
3. Table number in text references are incorrect from Table 3.3. - Table 3.2, under 3.1.6 Heritage Act 2004 (page 32), is not referenced in the text and therefore all other references after this are incorrect. Please correct table references throughout the EIS and also check Tables index.	Updated references in EIS text to Table 3.3 through to Table 3.6. Checked tables index contains correct tables for Section 3.	Tables, Section 3.0 (pages 39-50)
4. In Section 12.4.4, paragraph 2, the reference to Section 12.4.4 is incorrect (should be Section 12.5.4). Please correct.	Updated reference to 'Section 12.5.4'.	Page 160
5. In Appendix G, reference 29, the response incorrectly refences where the excavation permit has been addressed (should be 17.3.1).	Updated reference to 'Section 17.3.1'.	Appendix G1, ref 29
6. Appendix F24 is not directly referenced under Section 8.3 (Investigations – Materials and Waste). The reference table in Appendix G identifies Appendix F24 as the response to the further information requested. Please outline this under Section 8.3 of the EIS.	Added 'Draft EDP: Environmental Management and Protection Plan (Sellick, 2022) prepared for Doma (refer to Appendix F24 in Appendix F)' to list of reports reviewed under Section 8.3.	Section 8.3, final bullet, page 106
7. Ensure all mitigation measures identified in the relevant Sections are included in the Summary of Environmental Management Commitments at 21.1 and vice versa.	A thorough comparison of mitigation measures listed in relevant Sections and measures included in the Summary at Section 21.1 was undertaken. No changes were required for the following Sections: • Section 5: Land Use and Planning • Section 6: Utilities • Section 11: Socio-Economic, Health and Recreation	

Comment	Response	Reference in EIS
	○ Several mitigation measures listed in Section 21.1 have already been completed and as such are not repeated as future mitigation measures in Section 11.5. These measures include establishment of a community and incorporating parkland into the design. ○ It was noted that while all mitigation measures are contained in Section 11.5, Section 11.6 and Section 21.1, they were not provided as a single list in Section 11.5. As the intent of Section 11.5 is to provide detailed discussion on the mitigation measures, the measures in Section 11.5 remain in sentence format as opposed to bullet format to provide further context to the measures and to engage the reader (avoiding list fatigue). The following changes have been made: Section 7: Traffic and Transport • The statement 'Further detailed traffic assessments and management plans would be provided at the DA stage and prior to construction, respectively' was moved above the operational commitments in Section 7.5, to enable this measure to flow and provide ease of comparison with the list order provided in Section 21.1. Section 8: Materials and Waste • It was noted that while the mitigation measures were contained in both Section 8.6 and Section 21.1, they were not provided as a single list in Section 8.5. This has been updated to repeat each list of mitigation measures in each location for ease of comparison. Section 9: Landscape and Visual • It was noted that while the mitigation measures were contained in both Section 9.5 and Section 21.1, the order was different and the wording slightly different. The text has been amended and the order of mitigation measures updated for ease of comparison between both Section 9.5 and Section 21.1. Section 10: Water Quality and Hydrology • It was noted that while the mitigation measures were contained within both Section 10.5 and Section 21.1, the order was different, the wording slightly different and some measures were in text as opposed to bullet format. The text has been amended and the order of mitigation measures updated for ease of comparison between both Section 10.5 and Section 21.1. Section 12: Climate Change and Air Quality • It was noted that while most mitigation measures were contained within both Section 12.5 and Section 21.1, the order was different, the wording slightly different and some measures were in text as opposed to bullet format. The text has been amended and the order of mitigation measures updated for ease of comparison between both Section 12.5 and Section 21.1. Section 13: Noise, Vibration and Lighting • It was noted that while most mitigation measures were contained within both Section 13.5 and Section 21.1, the order was different, the wording slightly different and some measures were in text as opposed to bullet format. The text has been amended and the order of mitigation measures updated for ease of comparison between both Section 13.5 and Section 21.1. Some measures in Section 13.5 remain in sentence format as opposed to bullet format to provide further context to the measures and to engage the reader (avoiding list fatigue). Section 14: Hazard and Risk • It was noted that while the mitigation measures were contained in both Section 14.5 and Section 21.1, the order was different and the wording slightly different. The text has been amended and the order of mitigation measures updated for ease of comparison between both Section 14.5 and Section 21.1. Specific inclusion of reference to 'cessation of works that could emit a spark' has been added as per comments by The Conservator or Flora and Fauna.	

Comment	Response	Reference in EIS
	Section 15: Soils and Geology • It was noted that while the mitigation measures were contained in both Section 15.5 and Section 21.1, the wording was slightly different. The text has been amended for ease of comparison between both Section 15.5 and Section 21.1. Section 16: Ecology and Natural Environment • Several mitigation measures listed in Section 21.1 have already been completed and as such are not repeated as future mitigation measures in Section 16.5. These measures include basing the impact assessment on site specific and recent environmental studies, taking a precautionary and risk-based approach to the impact assessment, completing a survey of all trees on site, and seeking approval for the removal of any trees identified within the design process. • Regarding the remaining mitigation measures, it was noted that while the measures were contained in both Section 16.5 and Section 21.1, the wording was slightly different. The text has been amended and the order of mitigation measures updated for ease of comparison between both Section 16.5 and Section 21.1. Section 17: Heritage • It was noted that while most mitigation measures were contained within both Section 17.5 and Section 21.1, the order was different, the wording slightly different and some measures were in text as opposed to bullet format. The text has been amended and the order of mitigation measures updated for ease of comparison between both Section 17.5 and Section 21.1. Section 18: Contamination • It was noted that while most mitigation measures were contained within both Section 18.5 and Section 21.1, the order was different, the wording slightly different and some measures were in text as opposed to bullet format. The text has been amended and the order of mitigation measures updated for ease of comparison between both Section 18.5 and Section 21.1. Some measures in Section 18.5 remain in table or sentence format as opposed to bullet format to provide further context to the measures and to engage the reader (avoiding list fatigue).	
8. All relevant maps to be consistent as per the revised Master Plan in the revised EIS.	All relevant maps have been updated as per the Masterplan in the Revised EIS. Please note that the Proposed Masterplan (Figure 2.2) was prepared at a point in time in response to community and agency consultation, with the documentation stating that the masterplan is subject to further design development (Section 2.5, page 16). Approval for detailed site layout, including building design and configuration, will be sought as part of the Development Approval stage. Development Approval is not being sought by the EIS. As such, building footprints as shown are indicative only, and figures in the appendices may indicate a slightly different building footprint as per the Estate Development Plan stage of works. Due to the ongoing nature of refinements to these layouts, while the attached plans have been updated to reflect the current layout, the EIS has retained its original mapping. No further changes proposed.	

Comment	Response	Reference in EIS
Attachment B		
Strategic Planning Division, EPSDD		
The Stormwater masterplan should show where overland flow paths are (with arrows or lines) and perhaps a table of subcatchments and flows for the 10% and 1% AEP storms (if available). Key pipeline locations and outlets would also be informative.	The Stormwater plan at Appendix F01 has been updated. Overland flow paths are shown by blue or purple arrows, and a table of flows provided which includes the 20% and 1% AEP storms. Stormwater pipes, manholes, and sumps are shown.	Appendix F01
An initial design certification / assurance around there being no trapped low points (other than the designated ponds), that there are positive overland flows paths throughout the development and that all habitable floor levels are at least 300mm above the 1% AEP (100 year) flood level across the site.	The Stormwater plan at Appendix F01 shows overland flow paths and stormwater infrastructure. Contours demonstrate there are no trapped low points other than the designated pond. It is expected that habitable floor levels will be at least 300mm above the 1% AEP; however, such certification is unable to be provided prior to design of the buildings. Should specification of a minimum floor level be required, it is anticipated this would be included in the development conditions prior to construction.	
ACT Fire and Rescue – ACT Emergency Services		
Please consider the information in the supplementary bushfire assessment report at appendix F47 that recommends and IAPZ of 11m to be appropriate.	Noted. Updated reference to IAPZ on page 183 and Figure 14.1 on page 184.	Page 183 and 184.
Department of Agriculture, Water and the Environment (DAWE), now Department of Climate Change, Energy, the Environment and Water (DCCEEW)		
The revised EIS notes a low likelihood of occurrence as no native vegetation types persist in the proposal area; however, the Offset Strategy (Attachment F30) identified 5 patches of Natural Temperate Grassland (NTG). In addition, the Offset Strategy states that 0.28 ha of NTG will be impacted by the proposed action, and 3.8 ha of NTG will be offset to compensate for this loss. Noting the inconsistency between the revised EIS and the Offset Strategy, the department request the proponent provide further clarification and discussion on the NTG in the EIS, including: • Extent and condition of the NTG within the project area • Potential direct and indirect impacts associated with the proposed action on NTG • Mitigation measures to minimise the impacts of the proposed action on the NTG • The significant residual impacts, including proposed measures to compensate for the loss of the NTG. This should identify the location, area (ha) and condition of the proposed offsets.	The *Offset Strategy: Dudley Street Upgrade and Canberra Brickworks Precinct Access Road Construction* (Attachment F30) is for a different project. The NTG identified is not applicable to the Canberra Brickworks Precinct Redevelopment. The road upgrade area detailed in the offset strategy is adjacent to the project area for the Canberra Brickworks Precinct Redevelopment. The report was provided as background information only, as a study that Umwelt had considered in its ecological assessment of the broader area. As no native vegetation types persist in the Proposal Area, Umwelt is unable to provide further discussion within the EIS regarding the extent, condition, impacts, or mitigation measures on NTG. No changes made.	
The scoping document required the proponent to provide a statement on whether impacts are expected to be unknown, irreversible, or unpredictable. Please provide a statement to this effect for each MNES.	The first paragraph on page 211, above Table 16.3, states in relation to Golden Sun Moth habitat that 'This impact is known, irreversible and predictable, noting that the proposed development will require clearing of the entire Proposal Area.' Section 16.3 (page 209) states 'Other than the recorded presence of golden sun moth, it is considered that there is a low likelihood of occurrence for any other threatened species or ecological community listed under either the EPBC Act or the NC Act to occur within the Proposal Area. As such, only impacts to the golden sun moth are considered in further detail in Section 16.4 below. There are no other relevant MNES listed under the EPBC Act within the Proposal Area.' No changes made.	Pages 209, 211
The department has considered the previous advice in regards to using the NSW Biobanking scheme to offset GSM habitat. This is still considered an appropriate option.	Noted.	
The department notes the response to submission table in Appendix G and the supplementary Bushfire Assessment Report (F47) and has no additional comments at this stage.	Noted.	

Comment	Response	Reference in EIS
The Conservator of Flora and Fauna, EPSDD		
The 2021 Addendum to the bushfire risk assessment is that ACT F&R wants assurance that the APZs can be managed appropriately by the land custodian under a Bushfire Operations Plan. The current condition of the area to be managed as parkland to the west of the estate up to the boundary of the golf course is heavily overgrown with dense vegetation and fallen trees, weeds, etc. Bringing this land into condition for ongoing management will be a significant undertaking and should be undertaken by the proponent. The area to be managed as parkland to the west of the estate should be cleared to an appropriate standard (to the satisfaction of the PCS Fire Management Unit) as part of the development at the developer's cost.	ACT F&R provided the following comment in relation to the supplementary bushfire assessment report: Please consider the information in the supplementary bushfire assessment report at appendix F47 that recommends and IAPZ of 11m to be appropriate. We note that the appropriate assurance is provided in this report at Appendix F47.	Appendix F47
An Estate Development Plan will need to include a Bushfire Management Plan as part of standard documentation which demonstrates the provisions of the technical studies and advice provided have been incorporated. The EDP is to include a Bushfire Management Plan which reflects the technical studies and the advice of the ESA (Fire and Rescue, and Rural Fire Service) and the PCD Fire Management Unit, which have been provided to date and any works which have been completed on the ground in the intervening period.	Noted. Included reference to EDP on page 186.	Page 186
The Revised EIS notes that appropriate precautions will be needed during construction to prevent the ignition of bushfires on higher fire danger days. The CEMP is the appropriate place for these controls to be embedded. The CEMP is to include provisions for the cessation of all works that could emit a spark (hot works including cutting, welding, grinding, rock excavation etc) under a declared Total Fire Ban (please note the fire danger rating system is currently under review).	Noted. This is covered under 'Observe seasonal and daily fire hazard warnings issued by the ACT ESA'. Included specific reference to cessation of works that could emit a spark in Section 14.5 and Section 14.6.	Section 14.5, page 186 and Section 14.6, page 187
Based on a tree perspective only the EIS appears to be extremely well considered and compiled. • …the tree assessment was consistent in tis descriptions and tree values with the opinions of the Tree Protection Unit office. • Factors such as required remediation of the site…would make it impossible to retain some regulated trees. In addition, many wildings have grown randomly across the site which now impact on the fabric of the heritage listed buildings. • While the EIS reports do not focus greatly on the status of regulated trees this is not a failure more so an acknowledgment of the Tree Protection Unit's recognition of issues related to the site. • The site contains a significant number of poorly maintained trees, declining radiata pines and woody weeds. As a result of the condition of the trees it was determined that there was not major objection to the Brickworks redevelopment proposal. The removal of any large regulated trees should always be on provision of new planting being incorporated in to the development which there are. Whilst the previous advice strictly related to tree health and condition it did not consider other tree benefits such as habitat which was outside the remit of the assessment. • The current advice maintains that there are no major concerns in relation to proposed tree removals as part of the redevelopment. The long term outcome of the development may provide a healthier treed landscape, benefitting the suburb into the future despite any objections which may arise. • The retention of existing pines within the quarry area is supported in addition to any proposed future tree plantings. It is acknowledged that the Royal Canberra Golf Course is in a process of undertaking a tree replacement process. The Canberra Brickworks site in many respects should also be considered as an adjunct renewal process as should urban open space which also contains s significant number of declining trees which require renewal.	Noted.	
Offsets The proponent has responded by providing an Environmental Offsets Supplementary Report that details the characteristics of the offset location and how these offset the on-site impacts. This report has addressed the previous Conservator comments.	Noted.	
Bushfire/GSM A bushfire risk assessment has also been provided. This report identifies the need to APZ's to the south and west of the development. This will require the removal of exotic trees and will not have a significant environmental impact.	Noted.	
ACT Heritage Council		
The Revised EIS has adequately addressed the heritage requirements of the Scoping Document, and is endorsed subject to conditions.	Noted.	

Comment	Response	Reference in EIS
The Revised EIS has adequately addressed the heritage requirements of the Scoping Document, and is endorsed subject to conditions. …the Council advises that the heritage requirements of the Scoping Document have been met subject to the following conditions: 1. Opportunities to avoid and minimise impacts to the BRW8 archaeological area must be considered, and adopted where reasonably practicable; 2. Prior to seeking development approval, Statement of Heritage Effect (SHE) application/s are to be submitted to the Council to seek approval under Section 61H of the *Heritage Act 2004* for any activities that may diminish the heritage significance of the place. This may include but is not limited to: interventions to heritage buildings and elements; insertion of new buildings and structures within the heritage area; infill of areas within the quarry; and impacts to identified archaeological features and deposits; 3. Future development application/s must be consistent with *Heritage Act 2004* requirements and the 2021 CMP, unless the proponent demonstrates to the Council's satisfaction that such outcomes are not reasonably practicable; 4. Future development application/s must include Statement/s of Consistency with *Heritage Act 2004* requirements, including conservation policies set out within the 2021 CMP; 5. Future development application/s must include detailed information on the proposed development and any activity that may diminish the heritage significance of the place, including but not limited to: interventions to heritage buildings and elements; insertion of new buildings and structures within the heritage area; infill of areas within the quarry; and impacts to identified archaeological features and deposits; and 6. Future development application/s must set out heritage interpretation outcomes to be delivered as part of each stage.	Conditions noted.	
Deed Management, EPSDD		
Provided TCCS have indicated in principle support for the proposed stormwater treatment (pumped upstream to sed basin/pond for treatment) prior to being discharged into their systems Deed Management have no further comments at this stage. We note there has not been any response to concerns raised with regard to this proposed treatment train. We will review the proposal further through the draft EDP and EDP DA processes should the EIS be supported.	Noted.	
ICON Water		
Analytical Services Team High level capacity assessment was completed based on the provided information. The results suggest the existing DN150 which is discharging to MOS trunk sewer is not sufficient to deliver the proposed foul flow. A section of main will require upgrade to DN225 if the development goes ahead. (shown in figure below) Please be aware that revising hydraulic capacity assessment is required when more information is available. 	Previous advice from ICON Water dated 10 July 2017 (Karl Danenbergsons, Principal Engineer Mechanical, Asset Assurance and Information) provided 'written approval to proceed on the basis of adopting 200L/EP/Day', which would 'remove the necessity for augmentation of this sewer in the short term due to the proposed brickworks development'.	

Comment	Response	Reference in EIS
Environment Team The site is comprised of fill from the previous brickworks with potential asbestos contamination being identified at discrete locations. This is more of a note to Icon Water workers to remain vigilant when doing works in the area for the presence of potential asbestos containing material and other contaminants.	Noted.	

Canberra Brickworks Redevelopment - Response to Submissions - Environment, Planning and Sustainable Development Directorate

Ref.	Heading	Comment	Response
1	Executive Summary	Please revise the executive summary ensuring it is a non-technical summary of the key findings and recommendations of the EIS.	Executive summary has been revised.
2	Project Description	Please provide relevant land tenure details, including the lessee's name for any of the subject blocks that are leased, and/or details of the relevant land custodian of any relevant unleased Territory land. Provide details of the land uses that are currently permitted by any lease that is relevant to the proposal.	Amended. Refer to Section 2.1.
3	Project Description	Please provide a clear outline of all land that is directly impacted by the proposal and associated infrastructure. In particular, please revise figure 6.3 and other relevant figures to outline the full extent of the proposed utilities (for example, the water main along Denman Street) and the proposed share path along the southern side of Denman Street (as referenced in section 7.4.2 of the EIS).	Amended. Refer to Section 2.7.2.
4	Project Description	Please provide a precited timeline for implementation (design, approvals, construction and operation) including an estimate of the project's life.	Amended. Refer to Table 2.2 in Section 2.7.1. It is noted that these timeframes are subject to change.
5	Alternatives to Proposal	Please provide details of design refinements/alterations that were made, including the reasons why they were made and why the proposal put forward was the preferred option. This should include any considerations that were made to avoid or reduce the ecological, heritage and contamination impacts - particularly matters of national environmental significance (MNES).	Amended. Refer to Section 2.8.3.
6	Assessment of Impacts - Mitigation measures / conclusions	The EIS must clarify measures that will be implemented to mitigate the environmental impacts as identified in the scoping document. In some sections, it is not clear whether the proposed mitigation measures will be adopted. Some examples are provided under each heading below (also see Recommendations), however please note, this is not an exhaustive list and all mitigation measures must be reviewed to ensure a firm commitment is made in mitigating the relevant impact in the revised EIS.	Amended. Section 21.1 provides a comprehensive summary of all environmental management commitments proposed to be adopted by the Proponent.
7	Assessment of Impacts - Mitigation measures / conclusions	The EIS must also provide a conclusion and residual risk assessment based on the mitigation measures proposed.	Amended. The residual risk assessment and conclusion of the EIS have been revised to ensure consistency.
8	Traffic and Transport	Please outline the likely construction access routes, traffic volumes, and the associated impacts - such as impacts to road surfaces, congestion, etc. Should any additional mitigation measures be proposed, these must also be discussed.	Amended. Refer to Sections 7.4 and 7.5, as well as Appendix F55 of Appendix F which contains an updated Transport Summary Report (Calibre Consulting, 2022). Primary access to the site will be via Dudley Street and the new Brickworks Way.
9	Traffic and Transport	Please outline how the project maximises accessibility to public transport routes, the surrounding path network and associated active travel infrastructure. Consideration should be given to the proposed path network within the project area.	Amended. Refer to Section 7.4.2.2. It is noted that TCCS has informed the Proponent that no bus services are to enter the Proposal Area. To mitigate this, the Proposal is committed to integrating the Yarralumla footpath network into to the CBP, as well as providing an extensive cycling network and bicycle parking.
10	Materials and Waste	Please describe materials likely to be stockpiled on site during construction and the proposed storage locations.	Materials likely to be stockpiled will include onsite fill and potential building materials. Contaminated fill would be stockpiled and managed according to EPA requirements. Indicative stockpile locations are included in the revised draft EMPP, provided in Appendix F24 in Appendix F.
11	Soils and Geology (including Contamination)	Please consider the impacts to the quarry and formation as a result of these alterations and provide firm measures to mitigate these impacts.	Amended. Refer to Section 15.4.3 and 17.4.2.3. All significant geological heritage formations will be preserved and access to the four key sites restricted to ensure long-term preservation.
12	Soils and Geology (including Contamination)	Please provide the SMP, UFP and RAP with the revised EIS.	Included. Refer to Appendices F52 and F53 of Appendix F. Please note that the UFP is contained within the SMP document.
13	Soils and Geology (including Contamination)	It is noted that the EIS proposes to manage the geotechnical risks associated with disturbing the fill material through an Environment Management and Protection Plan (EMPP). However, the protocols necessary for soil compaction are not outlined in the EIS. Please provide these details in the revised EIS. Further, section 21 (recommendations) of the EIS does not highlight that an EMPP will be developed or implemented. Please confirm whether an EMPP is proposed to be prepared prior to construction commencing.	Amended. Refer to Section 15.4.2 with fill and compaction protocols.
14	Soils and Geology (including	The EIS inconsistently indicates when an Erosion and Sediment Control Plan (ESCP) will be prepared and	Amended. A draft Environmental Management and Protection Plan (EMPP) has been prepared for the Proposal

Ref.	Heading	Comment	Response
	Contamination)	provided, with some sections stating one has been prepared as part of an EMPP, while others state it will be provided as part of the CEMP. Please clarify whether the ESCP will be provided as part of the revised EIS and/or resolve all inconsistencies.	(refer to Appendix F24 in Appendix F). The EMPP demonstrates the location of the sediment control pond, sediment control fencing and cut off drains. This will be reviewed and revised throughout construction in line with the development and implementation of the CEMP. A Sediment and Erosion Control Plan (ESCP) will also be included as a sub-plan to the CEMP to manage soil impacts during construction. The ESCP would be prepared prior to construction with the CEMP.
15	Water Quality and Hydrology	Please clarify all mitigation measures proposed to manage stormwater treatment, including whether the proposed water quality treatment strategy, as outlined in Appendix F14, will be adopted.	Amended. The strategies presented within the stormwater treatment systems report (Alluvium, 2022) will be adopted for the Proposal.
16	Water Quality and Hydrology	Please outline the likely quantity of water that will exit the site and any associated impacts (if any, noting the proposed retention and detention measures). Should additional mitigation measures be proposed to alleviate these impacts, they must be included in the revised EIS.	Amended. Refer to Section 10.4.1 and Appendix F14 of Appendix F. Post-development flows will be retarded back to pre-development using an on-site detention tank. A detailed surface water management strategy would be prepared prior to construction in order to achieve this outcome.
17	Climate change and Air Quality	It is noted the proposal includes the removal of a significant amount of vegetation and mature trees both on the subject site and on neighbouring blocks for bushfire management purposes. Please review the proposed measures to mitigate climate change (section 12.5) and visual (section 9.5) impacts considering how the site design and landscaping will contribute to the 30% tree canopy cover and 30% permeable surfaces in line with the ACT Climate Change Strategy and Canberra's Living Infrastructure Plan.	Amended. Refer to Table 12.2 in Section 12.4.3 and Section 12.5.4 in particular. A draft Landscape Master Plan is included in Appendix F46 of Appendix F. This draft plan demonstrates that the proposed landscaping of the CBP will substantially exceed the 30% canopy cover and 30% permeable surfaces targets.
18	Climate change and Air Quality	Provide further detail on the design, layout and orientation of buildings to demonstrate a reduction in the reliance on mechanical heating and cooling. In particular, it is noted that a key mitigation measure to reduce emissions is to "orientate units to be north facing to maximise the sun exposure in the winter and minimise exposure in the summer", however, several of the indicative apartment block layouts (particularly precincts 1, 4 and 7) appear to contradict this measure. Please review and provide evidence accordingly.	Amended. It is acknowledged that, due to the terrain and existing buildings within the CBP (that is, the Heritage Core), not all buildings will be north-facing. However, the Proponent is committed to achieving 5 Green Star rating. As such, buildings will be designed to encourage cross ventilation and natural warming. This will primarily be achieved through selection of materials and design features such as deeper balconies, shading structures, and placement of windows.
19	Climate change and Air Quality	Please clarify whether gas provision is to be only for commercial cooking and commercial fireplaces, or whether gas will be supplied to residences.	Amended. Refer to Section 6.4.1.4.
20	Climate change and Air Quality	Confirm whether electric vehicle charging stations will be available in public carparks.	Amended. Refer to 12.5.2. EV stations will be provided as part of the Proposal. At this stage, it is not confirmed whether these will be publicly accessible. The Proponent is open to working with the ACT Government in determining appropriate EV station locations.
21	Noise and Vibration	It is noted that a key recommendation of the Noise Impact Assessment is to develop a site- specific set of vibration criteria (prepared by a suitably qualified Structural Engineer) in relation to the heritage structures in the precinct. This was indicated as a mitigation measure in the EIS but has not been listed in the recommendations (section 21 of the EIS). Please confirm whether this is a commitment, and when it is proposed to be delivered.	Amended. This mitigation measure is now included in Section 21.1.
22	Noise and Vibration	Provide details of the noise impacts of any increased residential activity and commercial activities upon nearby residential properties, including any proposed mitigation measures.	Amended. Refer to Section 13.4.3.
23	Hazards and Risks	It is noted that asset protection zones (APZ) are proposed on unleased Territory Land outside of the project site. Please confirm each relevant land custodian is supportive of this arrangement and include any previous discussions/agreement.	Amended. Refer to Section 14.5. The Proponent has had ongoing discussions with the ESA and relevant land custodians.
24	Hazards and Risks	ACT Emergency Services Agency (ESA) comments indicate that the estate layout proposed as part of the EIS does not meet the relevant requirements of the ACT Bushfire Management Standards. Referring to ESA's entity comments attached, please review the proposed bushfire mitigation measures and estate layout accordingly and consider how this may impact on other matters.	Amended. Refer to Section 14.4.1. The masterplan has been revised to address these concerns. Appendix F47 of Appendix F provides a supplementary bushfire risk assessment and feedback received from ACT Fire and Rescue.
25	Ecology and Natural Environment	In addition to the comments provided on 'Climate Change and Air Quality' above, please highlight the indicative location, extent and species scheduled for replanting.	Amended. Refer to Section 9.4.1 and Appendix F46 of Appendix F.
26	Ecology and Natural Environment	Provide details in the EIS of any mature, hollow-bearing trees or other habitat trees proposed for removal as part of the works. In doing so, please consider the impacts the removal may have on the dispersal of arboreal species and habitat connectivity and any measures to mitigate these impacts.	Amended. Refer to Section 16.3.1.

Ref.	Heading	Comment	Response
27	Ecology and Natural Environment	Please indicate the location of Golden Sun Moth habitat in the area adjacent to the project area and consider the impacts to these areas from the establishment and management of APZs for bushfire protection.	Amended. Refer to Figure 16.1. No golden sun moth habitat is known to occur within the proposed APZs outside of the Proposal Area. It is also noted that these areas are already maintained for bushfire management purposes.
28	Ecology and Natural Environment	In line with both the EPBC and ACT environmental offsets policies, offset sites are to be suitably located. In most cases, this is required to be as close to the impact site as possible, unless it can be shown that a greater conservation benefit for the impacted protected matter can be achieved through an alternate method. Please demonstrate that direct offsets close to the area of impact or within the ACT were considered, and that the proposed method, through the Biodiversity Offsets Scheme, would deliver greater conservation benefits.	Amended. Refer to Appendix F50 in Appendix F and Section 16.5.1.
29	Heritage	As requested by the ACT Heritage Council, please provide details on the status of the Excavation Permit and findings from any excavations undertaken to date.	Amended. Refer to Section 17.3.1.
30	Heritage	It is noted that a Statement of Heritage Effects has been provided to consider the heritage impacts based on the adaptive re-use of the site. However, this report was developed in 2017 and was based on a previous master plan and site layout. The heritage impacts of the proposal as currently presented in the EIS must be considered.	Amended. Refer to Section 17.4.1.
31	Heritage	Please provide details from the final endorsed Conservation Management Plan, outlining the impacts to heritage items and relevant mitigation measures. The EIS must also provide a conclusion on how affective the mitigation measures are and determine a residual impact.	Amended. Refer to Section 17.4.1 and Section 17.5.1. The Risk Assessment has also been revised to reflect this.
32	MNES	Provide a statement as to whether any relevant impacts to Golden Sun Moth are likely to be unknown, unpredictable or irreversible. The EIS must also consider any indirect impacts associated with altered hydrological conditions.	Amended. Refer to Section 16.4.1.
33	MNES	Please outline how the proposal is consistent with any relevant Commonwealth recovery plans or threat abatement plans. Please refer to comments provided by the Department of Agriculture, Water, and the Environment for details.	Amended. Refer to Section 16.5.1.1.
34	Community Consultation	The EIS states that extensive community consultation has occurred over the project's life, with the Community Engagement Plan (Appendix F16) outlining consultation that was proposed to occur from 2017. Please provide further detail in the revised EIS of the communication methods used when consulting with the different stakeholders and the correspondence and information that was used in the consultation process.	Amended. Refer to Section 19.2 and Appendix F54 in Appendix F.
35	Community Consultation	Specify any leaseholders and land managers who may be impacted by the proposal and confirm how they were consulted.	Amended. Refer to Section 19.2 and Appendix F54 in Appendix F.
36	Community Consultation	Provide a summary of how the community responded during consultation (including main concerns) and how these were considered and reflected in design changes, where appropriate.	Amended. Refer to Section 19.3 and Appendix F54 in Appendix F.
37	Recommendations	As previously noted, many of the proposed mitigation measures and recommendations made in the EIS are not certain on whether they will be adopted and at what stage of the development. For example, "considering" or "exploring options" to mitigate an impact or adopting the measure "where possible or appropriate" is not considered to constitute a firm commitment. Please review all mitigation measures and clarify which mitigation measures will be implemented.	Amended. All proposed mitigation measures have been reviewed by the Proponent. Those mitigation measures that the Proponent proposes to commit to have been included in this EIS and are summarised within Section 21.
38	Recommendations	Additionally, some mitigation measures were not summarised in sections 20 and 21 of the EIS. Please ensure all mitigation measures and commitments are summarised in the list of recommendations.	Amended.
39	Required Appendices	In providing the Proponent's Environmental History, please detail Doma's environmental policy and planning framework.	Included. Refer to Appendix D.

Canberra Brickworks Redevelopment – Response to Submissions – Agencies

Ref	Entity	Comment	Response
1	Conservator of Flora and Fauna	Section 16.4.1.2, P.156-157: "Impact Assessment" Do the impacts in this section also take into account shading of any remaining habitat from newly built structures? If not, this should be taken into consideration (and/or made explicit in the document). "There is approximately 8.55 ha of golden sun moth habitat within and immediately surrounding the Proposal Area. This is within the context of a broader patch of semi-connected golden sun moth habitat that occurs within the Proposal Area, Cotter Road verges, North Curtin horse paddocks, Lady Denman Drive Verges, and Yarra Glen verges (Umwelt, 2018). Through the approved Dudley Street upgrade and Quarry Drive access road, this patch is expected to be reduced to 5.38 ha. The Proposal would result in the removal of all 1.58 ha of golden sun moth habitat present in the Proposal Area. This accounts for approximately 30% of the remaining semi-connected patch following construction of the Dudley Street upgrade and Quarry Drive access road." How was the 1.58ha calculated? If this 1.58ha further fragments the total area of habitat, then that should be accounted for in the offsetting strategy, particularly if the fragmentation leaves a very small patch (which would mean the remaining population in that patch would be at higher risk of extinction).	Amended. Refer to Appendix F50 of Appendix F, and Section 16.5.1. The Proposal has assumed impacts to the entire Proposal Area. The Proposal Area has been surveyed for golden sun moth multiple times - refer to Table 16.3 in Section 16.4.1.
2		Section 16.5.1, P.159: "There are currently no available offsets within the ACT for golden sun moth. This is due to a lack of available, unprotected habitat. The significant majority of golden sun moth habitat within the ACT is protected. The last available offset, the North Mitchell Grasslands, was acquired for the approved Dudley Street upgrade and Quarry Drive access road" This seems like a stretch without any sufficient data to back it up. Proponents need to justify this better, and conduct a more exhaustive evaluation of possible GSM offset sites in the ACT. Umwelt undertook work for the ACT Government in 2016/2017 exploring potential offset sites in the ACT (Umwelt (2017). Analysis Of Potential Offset sites Across the ACT, Prepared on behalf of ACT Environment and Planning Directorate. Canberra.) Potential sites from this report are identified below, noting that: 1. Yarralumla is managed by the NCA for National Capital Use under the National Capital Plan 2. Umbagong is a highly used recreational park so offset area might have to be small, protected areas within the park which could pose challenges for management and protection Lyneham Ridge is also NCA land…so the same restrictions apply as for (1). However, proponents should conduct a more in-depth and thorough suitability assessment of the sites below before seeking sites outside the ACT.	Refer to Appendix F50 of Appendix F, and Section 16.5.1. Extensive investigation and consultation has been carried to determine the most appropriate offsetting pathway for the project.
3		Section 16.5.1, P.159: "Consultation with DAWE (then DoEE) was undertaken in March 2018, in which it was advised that this approach would be considered acceptable in principle. Subsequent consultation with the ACT Offsets Team was undertaken in April 2018, also confirmed that this approach would be acceptable in principle." Irrespective of this in principle approval (which hasn't been verified with physical documentation e.g. email or otherwise), the ACT Offsets team doesn't have the authority to make these decisions. This authority lies with the Impact Assessment Team, and any decisions in this space should not be pre-empted by the proponent. Further, "in principle" is the key caveat here. Where offset sites are not available within the ACT, proximal and well-connected sites in NSW could be a suitable alternative. However, there is insufficient justification behind there being no sites available as GSM offsets in the ACT. Further, with the proposed offset site in NSW already being under conservation covenant, this proposed offset appears – on face value – to be lower value than finding lands in the ACT that are not in the reserve system.	Noted. Refer to Appendix F50 of Appendix F for further justification as to the approach adopted for the Proposal.

Ref	Entity	Comment	Response
4		Section 16.5.1, P.160: "The Proponent has secured 35 credits from the Wandiyali Restoration Trust (Credit register ID Robin Pty Ltd, Credit ID 549), with an option agreement for an additional 65 credits in place. Subject to the determination of this EIS, it is proposed that the requisite number of credits would be purchased in order to adequately offset the proposed impact to golden sun moth." This should be a final option considered by the proponent, after all options exhausted in the ACT. Further, no details about the proposed site at Googong are provided in the document in terms of what is meant by "good quality Golden Sun Moth habitat". Wandiyali Conservation Trust lands appear to already be under conservation covenant, which would protect them from development (thus management being "requirement of the BOS property owner, who must then manage the site under a Biodiversity Stewardship Agreement, which places a covenant over the land" has already been achieved?). Subsequently – from an ACT perspective – it is less valuable as an offset. In sum, there are compatibility issues between NSW biobanking rules and offsetting in the ACT that haven't been thoroughly considered. Effectively, ACT is sacrificing lands to development which ends up supporting management of NSW lands that are under a covenant), and that may not be proximal to the ACT (although, in this instance the proponents have managed to find a fairly close offset in NSW). Without a clear policy in the ACT that supports offsets in NSW, there are considerable risks shouldered by ACT Government.	Noted. Refer to Appendix F50 of Appendix F for further justification as to the approach adopted for the Proposal.
5		Section 16.6, P.161: Design: B5 Residual risk assessment does not take into consideration the fact that ACT Government does not have a policy that supports offsets in NSW, and that securing biobanking credits does not capture the proximity principle desired by ACT Government. These risks should be accounted for in the document.	Noted. However, it is considered that the Proposal is within sufficient proximity to the ACT. Refer to Appendix F50 of Appendix F for further discussion on the proposed offset site. It is considered that the absence of an ACT Government policy supporting NSW offsets is not a significant risk to the Proposal, noting that determination of offset requirements is made by DAWE in this particular instance. Through our consultation with DAWE, the proposed offset approach is considered to be acceptable.
6		Table 21.1, P.202: "Management Measures: Biodiversity" As for comments outline in Section 16.5.1 above. "Purchase adequate number of BOS credits to ensure impacts to golden sun moth are sufficiently offset." This should not be the only management strategy to offset GSM. This section should be altered to highlight that offsets in NSW (and associated purchasing of credits) is the last avenue that will be pursued by proponents after potential GSM sites in the ACT are exhaustively evaluated.	Amended. Refer to Appendix F50 of Appendix F, and Section 16.5.1.
7	Forests Fire and Roads PCS	The IAPZ is required wherever a OAPZ exists and the IAPZ within the future Brickworks Precinct Land is required.	An OAPZ and IAPZ is proposed for the Proposal. Refer to Section 14.4.1.
8		The response by the proponent to previously provided comments on the Bushfire Assessment at the Concept EDP phase have not satisfactorily been addressed. Comments currently being prepared on the EIS (by ACTF&R) will reflect recommendations for an edge road design solution. FFR PCS recommends that a redesign will be required to precincts located to the south and south-east of the site to meet agency and code requirements.	Amended. The Proponent has subsequently been in ongoing discussions with the ESA and F&R. The edge road design has been amended to address concerns relating to bushfire management. Refer to Section 2.8.3 and 14.4.1. A Supplementary Bushfire Risk Assessment is also included in Appendix F47 of Appendix F.
9		ACTGOV bushfire agencies (ACT PCS, Rural Fire Serv ice, Emergency Services Authority) have provided guidance and comment for the proponent. A thorough bushfire assessment and bushfire plan will still need to be completed to address the details. It is recommended that the proponent reconsider the design for fire protection to the south and south-east boundary of the site, the redesign is to adopt an edge road design solution that delivers an accessible IAPZ that provides a defensible space for protection to people and property from bush fire and reliable access for emergency vehicles. The edge road design is to designed in a way that is able to be endorsed and managed by TAMS as well as endorsed by ESA (ACTF&R).	Amended. Refer to Comment 8.
10	Impact Assessment Team	The site must be assessed and remediated in accordance with the guidelines endorsed by the EPA by a suitably qualified environmental consultant.	Noted.
11		The adequacy of the assessment and remedial works must be independently audited by an EPA approved environmental auditor.	Noted.

Ref	Entity	Comment	Response
12		Prior to the commencement of remediation works the remedial action plan (RAP) for these works must be reviewed and endorsed by the auditor with a copy of the RAP endorsement provided to the EPA.	Noted. A draft Remedial Works Plan (RWP) is included in Appendix F52 of Appendix F. The RWP will be submitted to the auditor prior to commencement of remediation works.
13		Prior to the commencement of development works Auditor interim advice indicating that the commencement of development will not impact on the on-going assessment and remedial works at the site must be reviewed and endorsed by the EPA.	Noted. Refer to Section 18.5.2.
14		Prior to the area being used for other purposes the findings of the independent audit into the site's suitability for its proposed and permitted uses from a contamination perspective must be reviewed and endorsed by the EPA.	Noted. Refer to Section 18.5.2.
15	NCA	NCA has no concerns with the current EIS application	Noted.
16	ACT Health	The HPS supports the mitigation/management measures for Areas of Environmental Concern detailed within sections 18.6 and 20.0 of the Draft EIS which includes the preparation of: a Sampling and Analysis Quality Program; implementation of a remedial action plan; environmental management plan; and construction environmental management plan (including an unexpected finds protocol) approved in accordance with EPA requirements. The site must be audited and approved for occupation by the EPA before completion of the project.	Noted.
17		The HPS support the undertaking of additional assessments of all AECs and any other discovered areas of contamination, including the asbestos dump, to ensure contaminants are managed appropriately. Where remediation action is required, it must be implemented as soon as possible before construction commences by appropriately qualified persons.	Noted.
18		The Draft EIS proposes the installation of rainwater tanks and retention and detention tanks for use within the proposed area for stormwater management. The HPS advises the applicant that all taps and outlets utilising storm or rainwater water are clearly labelled as being provided with non-potable water.	Noted.
19		The comments provided by the HPS to EPSDD on the EIS scoping document for the Canberra Brickworks Redevelopment on 18 December 2019 still apply.	Noted.
20	ACT Emergency Services	ACTF&R concerns with some inconsistencies in the southern edge of the development, particularly the lack of perimeter or edge road and the IAPZ. A perimeter road is required to comply with table 10 of the ACT Bushfire Management Standards and is an integral part of an IAPZ. A turning circle would also be required where dead ends are proposed. ACTF&R would not support the current layout of the proposal at EDP.	Amended. Refer to Comment 8. The Proposed masterplan has been amended in consultation with ESA and F&R to address this concern.
21		Flats and dwellings not more than one self contained unit high are classified as Fire Risk type F6. Minor shopping areas, Perimeter roads in Bushfire Prone areas, Flats and dwellings more than one self contained unit high are considered to be fire risk type FS. Buildings greater than 3 stories are considered to be higher risk residential areas and classified fire risk type F4. The proponents must seek clarification from ICON Water to determine the adequacy of existing infrastructure, including hydrant spacing, for the proposed development.	Noted. The Proponent commits to ongoing consultation with Icon Water. Icon Water have indicated that the proposed additional infrastructure is adequate for supporting the Proposal. Confirmation of hydrant spacing will be provided during the DA stage of the Proposal.
22		Due to the potential of fires occurring within rear lanes and unit complexes, and the inability to access hydrants from the street front, ACTF&R requires hydrant provision for rear lanes and unit complexes be consistent with the fire risk classification of the development as determined by ACTF&R. The location of hydrants in rear lanes and unit complexes should be designed to comply with Australian Standard 2419.1-(as referenced) as well as ACTF&R operational requirements. Performance based solutions for water supplies may also be accepted but will require in principal support from ACT Fire & Rescue Fire Safety Section.	Noted. Confirmation of hydrant spacing will be provided during the DA stage of the Proposal.
23		All roads and driveways for the development site must be suitably constructed to allow the access and egress of fire fighting vehicles, crews and equipment.	Noted.

Ref	Entity	Comment	Response
24		Driveway access and rear lanes must be constructed to provide vehicular access for emergency services in all developments where direct access to is not available from the street front. This is particularly important where garaging and rubbish services etc. are intended to be provided within a complex or at the rear of properties.	Noted.
25		Minimum access standards for unit complexes and rear lanes intended to be trafficable for emergency vehicles are to be in line with the rear lane requirements of Estate Development Code, Table 2A: Street network requirements - all estates except in industrial zones, where: Minimum access standards for unit complexes and rear lanes intended to be trafficable for emergency vehicles are to be in line with the rear lane requirements of Estate Development Code, Table 2A: Street network requirements - all estates except in industrial zones, where: • Minimum carriageway width of 5.Sm (5.0m where the lane is <60m in length), with verge of 1.Sm; • Pavement loading for driveways suitable to carry a 14 tonne appliance; • Minimum horizontal radius to accommodate a 12.Sm single unit truck; • The carriageway width measurement is not to include any designated car parking spaces, cycling lanes, indented car parking bays or medians; • Maximum longitudinal gradient of 12.5%; and • On street parking is prohibited.	Noted. This design detail will be confirmed during the DA stage.
26		Where buildings are greater than 3 stories high, the "Rosenbauer 42m Hydraulic Aerial Platform (HLP)" aerial appliance may be required to access the upper levels in an emergency.	Noted.
27		Turning circle, wall to wall measurement is the total minimum distance required to turn the HLP around. Kerb to Kerb is the road distance required but must have a minimum or 2.Sm clear on each side past the kerb with a rise of no more than 120mm.	Noted.
28		Appropriate access and a working footprint is required to at least one corner of all buildings to give the HLP access to two sides of a building. When set up, the HLP requires a working footprint of 12.Sm x 8m with a maximum gradient of 7 degrees and should not be further than 15m from the building wall. Potential point loads up to 25kN (within surface area of 0.5 m2) may be applied by the ground pads and must be taken into account for pavement loadings and particular care taken when in close proximity to basement or podium surfaces.	Noted.
29		ACTF&R Compressed Air Foam System (CAFS) 8000 fire appliances are specifically designed for the urban interface however can be used as a multi-functional vehicle. CAFS are predominantly used for asset protection from bushfire sources along the urban interface. The internal and perimeter roads of the development need to be designed to allow access for these vehicles. Specifications of Volvo FM9 CAFS 8000 is the large of the two vehicles can be found below in advice.	Noted.
30		This development is located inside the area declared by the ESA to be subject to the threat of bushfire. and require application of appropriate bushfire protection measures. Assessment of the proposal by an accredited Bushfire Consultant is required as part of the development application to demonstrate an appropriate level of protection relative to the hazard is provided.	Noted. The Proponent acknowledges that detailed bushfire assessments will be required for each component of the development during the DA stage.
31		ACTF&R has the following requirements in relation to the location of street furniture, landscaping, existing trees and tree planting. The following must be observed: •In ground and above ground hydrants, other water supplies and all services shut offs must not be impeded by street furniture, landscaping, trees or be covered by materials; •Hydrants should be clearly identified, easily accessible and not have vehicles parking over them; and •Street furniture, landscaping and trees must not impede the progress of emergency service vehicles attending the facility. The minimum height clearance for ACTF&R vehicles is 4.5 metres. Site maintenance should include pruning of any overhanging branches over driveways and pathways.	Noted. This design detail will be confirmed during the DA stage.
32		The location of the proposed development indicates that ACTF&R will be able to provide operational response to the area and its surrounds.	Correct. Consultation with ACT F&R has been ongoing. Refer to Section 14.0.

Ref	Entity	Comment	Response
33		ACTF&R pumper dimensions •Length: 8.1m •Width: 2.5m •Height: 3.2m •Weight: 14 tonnes •Turning Circle:18m	Note.
34		Compressed air foam system appliance: •Length: 10.5m •Width: 3.2m (with mirrors) •Height: 3.7m •Weight: 23 tonnes •Turning circle: 21.2m.	Noted.
35	Evo Energy	•Additional HV/LV conduits installed as per the below document. •Improved network ties within the precinct and through external network connection points for supply redundancy and reliability •Update of the maximum demand calculation sheet with attention to the Building / Block numbering system. This differs to information provided in the supporting map. Please revise so that the plan can be reviewed.	Amended. Refer to Appendix F3 of Appendix F.
36	Jemena Gas	On behalf of Evoenergy Gas, Jemena have reviewed the Draft EIS (EIS201900047) - Canberra Brickworks Redevelopment and have no comment to make.	Noted.
37	ACT Heritage Council	1. The Revised EIS is to be informed by the 2021 CMP, once approved by the Council under Section 61K of the Heritage Act. 2. The Revised EIS is to describe how the redevelopment is consistent with the 2021 CMP, in the form of a table analysing consistency with conservation policies.	Amended. Refer to Section 17.3.3 and 17.4.1. Also see updated Appendix F36 of Appendix F.
38		3. The Revised EIS is to be informed by the outcomes of the completed archaeological excavation, as approved under Section 61F of the Heritage Act 4. The Revised EIS is to identify the archaeological values of the Precinct, assess potential impacts to these values, and describe their appropriate management.	Amended. Refer to Section 17.3.1 and 17.4.1.1. Also see Appendix F58 of Appendix F.
39		5. The Revised EIS is to provide a more detailed description of the proposed redevelopment, including plans and documentation for all components that may damage significant fabric and diminish heritage values.	Amended. Refer to Section 17.4.1. As the Concept Design requires finalisation, the specific design impacts of the Proposal remain uncertain. That is, specific detail as to which elements will be directly impacted remains undetermined. However, in accordance with CMP (GML, 2021a), the Proponent commits to retaining and conserving core and supporting elements of the CBP. These elements will be restored in accordance with the conservation advice included in the CMP.
40		6. The Revised EIS is to describe alternatives considered and measures adopted to avoid and minimise the heritage impacts of the proposal.	Amended. Further discussion has been included in Section 2.8.3. Further management measures have been included in Section 17.5.
41		7. The Revised EIS is to describe Heritage Act requirements relevant to the proposal. 8. The Revised EIS is to describe how the proposal meets relevant Heritage Act requirements, in the form of a table analysing consistency with requirements.	Amended. Refer to Sections 3.1.6, 17.2.2, 17.3 and 17.4.1.
42		9. The Revised EIS is to included amended preliminary and residual risk assessments that consider additional heritage impacts to the proposal. 10. The Revised EIS is to further describe management measures to be adopted to avoid and minimise heritage impacts, within the residual risk assessment.	Amended.

Ref	Entity	Comment	Response
43		11. The 2017 SHE report is to be updated and amended to assess the heritage impacts of the contemporary 2021 redevelopment proposal.	Amended. Refer to the Heritage Impact Assessment (Lovell Chen, 2022) in Appendix F36 in Appendix F. The Proponent acknowledges that further SHEs will be required for approval by the ACT Heritage Council at later development assessment stages.
44		12. Informed by the above, the Revised EIS is to describe the heritage impacts associated with the construction and operation of the redevelopment, considering issues such as: a. The insertion of new buildings and elements within the heritage core precinct; b. The infill of areas within the quarry; c. Alterations to heritage buildings to allow for thier adaptive reuse; d. Construction impacts to archaeological areas; and e. The suitability of the architectural character of the redevelopment.	Amended. Refer to Sections 17.4.2 and 17.4.3.
45		13. The Revised EIS is to provide a more detailed descritpion of measures to be adopted to avoid and minimise heritage impacts.	Amended. Refer to Section 17.5.
46		Section 17.2.1 - Revision of the summary to reflect contemporary understanding of Aboriginal history and heritage.	Amended. Please note that this summary was taken from the Aboriginal Heritage Report included in Appendix F34 in Appendix F.
47		Section 17.2.2 - Revision of text and mapping for consistency with the ACT Heritage Register entries and the 2021 CMP, once approved by the Council.	Amended.
48		Section 17.3 - Revision of text to identify the heritage status of the geological features within the quarry.	Amended. Refer to Section 17.2.3.
49		Section 17.3 - Removal of the 2010 CMP as a study of relevance to the proposed redevelopment.	Amended. The Proponent has retained a copy of the 2010 CMP as an Appendix for transparency purposes.
50		Section 17.2.3 - Replace section with outcomes of archaeological excavation within the Precinct.	Amended.
51		Section 17.4.2.1 - Replace section with outcomes of geotechnical investigations within the Precinct.	These geotechnical investigations will not commence until later stages of the development application process. Outcomes will be provided at later assessment stages.
52		Section 17.5.1 - Amend reference to the 2010 CMP to the 2021 CMP, once approved by the Council.	Amended.
53		Amend references to ACT Heritage to ACT Heritage Council.	Amended.
54		Indigenous' should be amended to 'Aboriginal' throughout.	Amended.
55	ICON Water	From an environmental perspective there are no issues, as majority of our assets are located along the periphery of the site and will not be significantly impacted by the impending works. It is noted that some assets may be adversely impacted on Block 764 and 7 Section 102 and will need to be protected accordingly. The levelling of the site, particularly to the east of Block 76, may also have an impact on our assets and may affect overall site drainage, but largely impacting stormwater.	Noted.
56		High level capacity assessment was completed based on the provided information. The result suggests the existing DN150 which is discharging to MOS trunk sewer is not sufficient to deliver the proposed foul flow. A section of main may require upgrade to DN225 if the development goes ahead. (shown in the figure below)	Noted.

Ref	Entity	Comment	Response
57		There isn't many concerns with this water supply plan provided for the Canberra brickwork. This development got the primary feed through a new DN225 from and has two backup from the north with DN150. The fire risk is F5 (45L/s). All reticulation mains shown in the draft drawing is DN150, complies with the Icon Water's water mains size for F5. The reticulation system is lopped while 10 town houses on Block S will be serviced from a branch main. This is within Icon Water acceptable limit of 40 houses on DN150, hence it's acceptable. The connection of the existing DN100 on Fraser Place with the upgraded DN225 on Kintore Crescent is shown in the drawing 191148. This needs to be corrected. Please be aware that revising hydraulic capacity assessment for both water and sewer is required when more information is available.	Noted.
58		Any work(s) that is likely to impact on the Icon Water infrastructure must have Icon Water acceptance prior to any work being undertaken.	Noted. The Proponent commits to ongoing consultation with Icon Water.
59	DAWE	There are inconsistencies within the EIS and attachments thereto regarding impacts to GSM: - The impact assessment section of the EIS (EIS section 16.4.1) states 1.58 ha will be impacted - P.23 of the EIS states only 0.9 ha of GSM habitat is to be impacted - The offsets and mitigation section of the EIS (EIS section 16.5.1) states that 9.5 ha of offsets for GSM will be acquired Further clarity and consistency is required regarding the area of GSM habitat impacted and proposed offsets for GSM.	Amended. The Proponent confirms that 1.58 ha of GSM habitat will be impacted by the Proposal. Using the Commonwealt Offsets Assessment Guide, it has been calculated that 9.5 ha of offsets are rquired to address this impact. As the Proposal will be using the NSW Biodiversity Offset Scheme, this was then multiplied by the credit per hectare value to determine that the the 9.5 ha of offset area equated to 68 credits. Refer to Section 16.5.1 and Appendix F50 in Appendix F.
60		The scoping document requires the proponent to provide a statement on whether impacts are expected to be unknown, irreversible, or unpredictable. Please provide a statement to this effect for each MNES.	Amended. Refer to Section 16.4.1. The impact of the Proposal is known, irreversible and predictable, noting that the proposed development will require clearing of the entire Proposal Area.
61		Please provide a discussion on how the proposal is consistent with the relevant threat abatement plan.	Amended. Refer to Section 16.5.1.1.
62		The department notes that the impact section of the EIS states that 1.58 ha of GSM habitat will be impacted by the proposed action, however, the mitigation section states that 9.5 ha of offsets will be acquired for GSM habitat. Please provide further clarification/justification on the habitat to be offset.	Amended. Refer to Comment 50.
63	TCCS	1. A detail Traffic Impact Assessment report with updated land use and network information must be submitted at EDP stage.	Noted.
64		2. All public Roads to be designed and constructed to requirements of Estate Development Code (EDC) and TCCS Standards as these would be transferred to ACT Government in future.	Noted.
65		3. No public storm water network would be in the private Road unless easement to be created.	Noted.
66		4. No overland flow which come from public roads can't be go through the private Road.	Noted. Further hydrological modelling is proposed during the DA stage of the Proposal.
67		5. Maintenance access for the water quality pond to be shown on the stormwater master plan including Gross Pollutant Trap (GPT) as per TCCS Standard.	Maintenance access is to be achieved via public access. Detailed designs of the water quality pond are to be prepared at the DA stage of the Proposal. Refer to Appendix F14 of Appendix F.
68		6. To collect waste by ACT NO Waste the private Road satisfy the EDC requirements.	Noted.
69		7. Construction Environment Management Plan (CEMP) and Landscape Management and Protection Plan (LMPP) must be approved by the relevant authority and implemented at construction stage.	Noted.
70	Utilities Technical Regulation	1. The new 225 diameter water main asset and sewer assets proposed should be designed and constructed in consultation with Icon Water and to their requirements. The disconnection and removal of existing water mains, meters and reticulation, and removal of sewer as proposed should also be undertaken in consultation with Icon Water and to their requirements.	Noted. The Proponent commits to ongoing consultation with Icon Water.

Ref	Entity	Comment	Response
71		2. The undergrounding of the existing 11kV overhead line, new HV switching station, new underground HV supply & five substations proposed should be undertaken in consultation with Evoenergy and to their requirements. UTR understand that Evoenergy have suggested a number of improvements to the electricity reticulation plan. UTR also consider that it may be prudent to consider providing Electric Vehicle charging stations Utilities Technical Regulation for this development.	The Proponent has updated the Electricity Reticulation Plan in consultation with Evoenergy. Refer to Appendix F03 in Appendix F.
72	Climate Change Policy	where only 'consideration' has been given to address these requirements CC& ED believes a firm commitment to implementation would provide a better outcome for the community and allow review and assessment following submission of design documentation for development approval.	Amended. Refer to Section 21.1.
73		Table 12.1 ACT Climate Change Strategy Priorities in the draft EIS identifies several key priorities in the ACT Climate Change Strategy, and Canberra's Living Infrastructure Plan (LIP) and notes design considerations supporting these priorities. However specific details need to be provided on the extent of tree canopy coverage and permeable surfaces as per the tree canopy (or equivalent) and permeability targets contained in the LIP.	A Draft Landscape Master Plan has been included in the revised EIS. Refer to Appendix F46 in Appendix F. The Proposal will exceed both the 30% tree canopy cover and 30% permeable surfaces requirements.
74		Clarification is also required around the provision of gas outlined in Table 12.1. The CPD response notes "Use of gas has been minimised such that it is only provided for commercial cooking and fireplaces where no viable electrical alternative exists". CC&ED considers the use of gas fireplaces should be discouraged for residential properties.	Amended. Refer to Section 6.4.1.4.
75	Strategic Planning	Parts of the Canberra Brickworks Precinct are within an 800m walkable distance from a proposed stage 2B light rail stop. There is a need for the development to provide an easily accessible and direct network of pathways which connect residents to the light rail, and that link in with the existing active travel network.	Noted. The Proposal commits to providing an integrated footpath network across the Proposal Area that connects to surrounding pathways. Refer to Section 7.4.2.2.
76	Deed Management	This report identifies an IAPZ on the property boundary. Figure 2 of the Planning for Bushfire Risk Mitigation General Code identifies the inner asset protection zones begins from the property boundary outwards. This is inconsistent with the outcomes of the bushfire report which has IAPZ's identified on future proposed leased land.	Amended. Refer to Comment 8.
77		Relocating the IAPZ outside the property boundary on this edge may impact the GSM habitat and would likely need to be considered as part of this EIS.	There is no known GSM in this area. If required, further investigation can be carried out at the DA stage of the Proposal.
78		Figure 14.1 of the draft EIS does not show the IAPZ on Precinct 8 as per the bushfire risk assessment in F20, instead noting this area will be managed through an ACT Bushfire Operations Plan.	Noted. Refer of Section 18.5.2.
79		The Bushfire risk assessment does not reference the latest strategic bushfire management plan (SMBP V4). This should be referenced in the report and any updates made as a result of a review.	The Bushfire Risk Assessment and Supplementary Bushfire Risk Assessment (Appendices F20 and F47 in Appendix F) has been prepared in consultation with ESA and F&R. The Proponent acknowledges further bushfire assessments are required at the DA stage of the Proposal. The latest SMBP will be reviewed during this stage.
80		Query if the catchment model in this report is consistent with the concept EDP SW masterplan catchments. There appears to be differences between the documentation. This may impact the modelling regarding the preferred option. Suggest this be reviewed for consistency. A sensitivity analysis for the imperviousness of developed blocks may be useful to determine if future planning controls are required to ensure this level of imperviousness is obtained on blocks (if the outputs are highly sensitive to the level of imperviousness). This includes on site retention tank size suitability.	Amended. Both the stormwater master plan (Appendix F01 in Appendix F) and the Stormwater Treatment Systems Report (Appendix 14 of Appendix F) have been revised for consistency. Preliminary imperviousness calculations have been included in Attachment B of the revised Stormwater Treatment Systems Report.
81		It is not clear on the plans where the SW pump intercept would be located to divert SW from adjacent catchments to the pond – this is proposed to be somewhere on precinct 1 – is this outside of the heritage area/will this require a separate structure or be in an in ground pit? Having this community title SW asset located on a private crown lease may lead to a nuisance to future residents with regard to having to provide access for maintenance purposes (in particular if additional treatment/gpt's are provided). Suggest this be located in an accessible spot, preferably on future CT land.	Amended. Refer to Section 10.4.1. The stormwater pump is located to the north of the Proposal Area and will be on Community Title land.

Ref	Entity	Comment	Response
82		The reliance on diverted and pumped SW is not ideal, with catchment 1 being insufficient to maintain NWL or suitable changeover times on its own. Failure of the pumping system could lead to stagnation of the pond and other undesirable outcomes (loss of macrophyte planting around the pond, additional costs/time of re-establishment, failure to meet SW quality targets during down time etc). There does not appear to be any commentary on risk mitigation options to address risks (for example inclusion of a backup pump and system status monitoring)	Amended. The Proposal will also use on-site detention tanks to ensure flows are retarded back to pre- development condition. Refer to Section 10.4.1.
83		The proposal does not meet gross pollution removal targets and may require GP removal at the pumping site or elsewhere resulting in increased maintenance/nuisance to residents.	Acknowledged. It is considered that the proposed treatment system is adequate to for the purposes of the Proposal. A litter trap will also be installed to reduce the Gross Pollutant rate. Refer to Section 10.4.2.
84		There appears to be no documentation included in the submission giving consideration to the potential/suitability for ancillary onsite or offsite water treatment trains that remove/reduce the reliance of pumps for treating the estates SW.	Amended. Refer to Comment 73.
85		For example, there appears sufficient area to provide a swale/ low flow bio filtration between the heritage core and proposed precinct 1 to partially treat SW not diverted to the pond. This together with other passive options such as porous paving could provide a more robust treatment train and further improve overall water quality outcomes at the outfall.	It is Proposed that the Quarry Park be landscaped to encourage flow into the wetlands, away from the Heritage Core. This is demonstrated in the Stormwater Master Plan (refer to Appendix F01 in Appendix F). Further detail as to the landscaping of this area will be further assessed during the DA stage of the Proposal. Also refer to Comment 71.
86		Suitability of existing cut embankments is queried – are these cut embankments stable and suitable for future uses without further engineered retaining, In particular where they abut the boundary of a proposed lease. This may impact on the available area/detailed design for the pond/wetland/sed basin proposal in particular.	Amended. Refer to Section 15.4.2. The cut embankments will be made stable for future use.

Ref	Organisation / Person	Comment	Response
1	Karin Schulz	If the Doma developement enables gas to be installed it will be used in contravention to the aspirations of the ACT government in its agreement with The Smart Cities Plan (2016); AC T Climate C hange Strategy 2019 - 25; and National Climate Resilience and Adaptation Strategy (2015). Canberra's desire to be the leader and national example in ensuring its green energy target in the future is not compromised must be upheld in this high profile development of its historic precinct. It would jeopardise the future green investment in the precinct if its development doesn't completely aspire to meet the target of 100% 0 emissions in household and business infrastructure.	The Proponent understands and acknowledges concerns raised regarding the installation of gas into the proposed development. Evoenergy, Canberra's local energy distributor responsible for operating and maintain the gas distribution network infrastructure in the ACT, is committed to working with the ACT Government to transition the ACT's gas network to achieve the government's target of net zero emissions by 2045. Refer to Section 6.4.1.4.
2	Living Streets Canberra	The Transport Strategy 2020 is one of the 'other relevant planning and environmental guidelines, action plans and management plans' that falls within section 6.3 of the Scoping Document. The draft EIS needs amending to include information on how the Transport Strategy 2020 has been considered in the preparation of the EIS and the development of the proposal.	Amended. Refer to Section 3.3.11.
3		The document should mention that the vision for the CBP was agreed by the ACT Government and the CBP Community Panel in an Objectives document. Furthermore, many of the Objectives have parallels in the Strategic Directions of the Territory Plan (see section 3.3.2.1 of the draft EIS).	Amended. Refer to Section 19.1. However, it is important to note that while the Community Objectives have been used to guide both the tender process and subsequent design development, not all of these objectives were included in the final CDD. Furthermore, these objectives are not statutory planning or environmental requirements, and are therefore not relevant to the assessment included in this EIS.
4		The objectives highlighted in this section of the document also need to include three key objectives for the CBP: · being a showcase of global best practice measures and outcomes for sustainability, community focus, and resilience · demonstrating commitment to zero (or negative) greenhouse gas emissions - and note that zero net emissions by 2045 is legislated in the ACT	Refer to Comment 3.

Ref	Organisation / Person	Comment	Response
		· providing comfort and resilience in the warming climate	
5		This section also needs to more accurately reflect the importance of the Objective to: · demonstrating how active and public transport will be the attractive, safe (and perceived to be safe) and accessible transport choice in the Precinct	The Proposal seeks to deliver this objective. Refer to Section 7.4.2.2.
6		This section of the EIS refers to the upgrading of Dudley Street and construction of the access road for the CBP.	This is not applicable to the Proposal.
7		This work provides incomplete - and in some places dangerous and/or unprioritised - infrastructure for walking. Walking in the area could have been substantially improved by: '- maintaining the current alignment of the Uriarra Track. –Users value the historic alignment and maintaining this would continue to encourage walking. –Walking* is Australia's most common form of exercise, particularly for people over 35. Twice as many women walk* for recreation as men. '- using traffic lights instead of a roundabout for the intersection of the CBP Access Road with Dudley Street –Roundabouts as proposed are the only type of intersection where pedestrians get NO priority. '- providing safe routes prioritising pedestrians across roadways – by 'wombat' crossings (at Uriarra Track and the proposed bus stops) or traffic lights (at the Access Road/Dudley Street intersection and the Novar Street/Dudley Street intersection) - providing connected and generous, preferably separated, off road paths for walking and cycling along both sides of the streets in and servicing the CBP and its public transport stops: –wider paths than was planned for Dudley Street – see for example Austroads' Guide to Road Design Part 6A: Paths for Walking and Cycling (2016) and Municipal Infrastructure Standards (MIS) 05 –Active Travel Facilities –including a path to connect the proposed bus stop on the south side of Dudley Street to Kent Street –including a path to connect the bus stops to Denman Street and the Uniting Church there.	Noted. This is not applicable to the Proposal.
8		We note that the upgrade Dudley Street is being progressed in isolation of the work to upgrade the area of Novar Street/Kent Street bottlenecks to improve walking and cycling safety. This is the reverse of what should be happening. The design of the new bus stop on Dudley Street (already built by ACT Government) and associated infrastructure does not fulfil the objective for active and public transport to be the most attractive form of local transport: The new stops on Dudley Street will require walking some distance from CBP and through bush and, at night, under an unknown quantity and quality of lighting. This compares to bus stops at other higher density areas eg Wentworth Ave, where they are essentially at the door, in built-up areas with reasonable to good lighting. To reach the Dudley Street stops, we estimate that it would likely take an able-bodied adult about 15 mins walking from the centre of the CBP plus some extra time for crossing Dudley Street because of lack of a crossing. (We are also aware of a misleading statement (on page 53 of the draft EIS) that the Yarralumla shops and existing bus stops on Novar Street are only a 5-minute walk from CBP. This does not take account of the topography or the much longer walk required from most parts of CBP.)	Noted. This is not applicable to the Proposal.

Ref	Organisation / Person	Comment	Response
9		●The infrastructure being constructed for accessing the new bus stops on Dudley Street - and particularly for crossing Dudley Street and walking from the southern side to Novar/Kent Street and Deakin - give walking lowest priority of all transport modes. This in turn lowers the priority given to public transport. This is because the infastructure makes walking (and therefore public transport) neither convenient, safe (and perceived to be safe), nor easily accessible. To remedy this situation, there needs to be: –a pedestrian crossing between the two bus stops and/or traffic lights at the junction with the Brickworks access road so as to (a) allow people to cross Dudley Street, particularly during peak times when traffic is a moving car-park and (b) to signal to drivers that people crossing have priority. The pedestrian refuge that has been built does neither of these. –paths between: ▪the bus stop proposed for the southern side of Dudley Street and Kent Street for access to Deakin West, major destinations for employment, education, health facilities and services ▪the proposed bus stops and Denman Street	Noted. This is not applicable to the Proposal.
10		Without close, convenient, safe and attractive access to public transport, private vehicle traffic is likely to increase – with resultant increases in risks associated with traffic and climate change and air quality.	Noted. Refer to Section 7.4.2.2.
11		As required by the Scoping Document, this section needs to mention and address the ACT legislation for climate change: ● Climate Change and Greenhouse Gas Reduction Act 2010 ● Climate Change and Greenhouse Gas Reduction (Interim Targets) Determination 2018	Amended. Refer to Section 3.1.9.
12		This section needs to identify and address the risks associated with not prioritising active transport (particularly walking and public transport) on roads surrounding CBP (and particularly the Access Road, Dudley Street and Denman Street). This will add to the risks noted in the draft EIS. The problems with the Dudley Street upgrade are mentioned earlier in this submission (under 2.5 Associated Projects). The rapid population growth in Molonglo, the destinations of Deakin West as well as CBP, and increased traffic from Cotter Road into Dudley Street and Adelaide Avenue will exacerbate these problems. The risks include: ● vehicle crashes (with associated risk of injury and death, particularly when people walking are involved) ● increases in damage to the climate (from greenhouse gas emissions from private, hire and ride-share motor vehicles) ●increased health costs and effects (e.g. from warmer climate, air pollution, people having insufficient exercise because walking is difficult, inconvenient, perceived for be unsafe - people using the Uriarra Track having to give way to vehicles on the Access Road (contrary to the CBP Objectives and prioritising walking over motor vehicle transport) could be such a deterrent.) ● impact on adjacent residents, businesses and services (e.g. from traffic congestion and noise)	Noted. Active Transport has been prioritised within the Proposal Area. Areas outside of the Proposal Area are not applicable to the Proposal.
13		We note that the consequences of not mitigating or eliminating these risks could be major, catastrophic in the case of death and climate disruption. The EIS needs to better reflect that convenient, safe (and perceived to be safe) and attractive active travel connections to the CBP are needed. One issue that particularly need addressing is transport along Denman Street. Living Streets Canberra advocates for transport modes to be separated according to speed or to all travel at the slowest speed (walking). Theproposed shared path along Denman Street needs to be designed so that it meets the needs of both people using active transport of different speeds (walking, cycling and scooting) and visitors to the Uniting Church and church hall on that street. Alternatively, Denman St (and other streets) surrounding CBP	Noted. Active Transport has been prioritised within the Proposal Area. Areas outside of the Proposal Area are not applicable to the Proposal.

Ref	Organisation / Person	Comment	Response
		could be converted to a low-speed (i.e. no more than 30 km/h), shared streets. This could:	
14		● remove the need to build and maintain curbing, guttering and separated path(s) for walking and cycling, though this would need to be balanced against the significant nose-in car-parking (currently) used for the Uniting Church (which is also the de facto Yarralumla town hall) and that is likely to increase (as a result of the CBP) in the absence of highly convenient public transport ●help with the cultural change to make walking and cycling safe, convenient, attractive and obvious (consistent with CBP Objective 2.g.). Noting that the CBP is less than 2km from Yarralumla Primary School, this would be an excellent start on Safe Streets to School in Canberra and help Canberra to join the global move to low-speed streets in most urban areas. (These are campaigns that Living Streets Canberra supports.) ● help deter drivers from using it ('rat running') for accessing the Brickworks and parking on local streets instead of paying for parking inside CBP.	Noted. Active Transport has been prioritised within the Proposal Area. Areas outside of the Proposal Area are not applicable to the Proposal.
15		Landscape and Visual Walking is much more pleasant and safe (from a health perspective) if there is shelter from rain and sun, cooling in summer, and interesting and pleasant surrounds and views. Trees are vital for these things. This section therefore needs to recognise the risks associated with removal of most of the trees on the site and instead canvas retaining some of the better ones, at least until new trees can grow and provide the necessary amenity.	Amended. Refer to Section 9.4 and 12.4.4.
16		Climate Change and Air Quality Walking*, either on its own or for using public transport, helps reduce greenhouse gas emissions arising from private, hire and ride-share motor vehicles. However, walking is adversely affected by inclement weather - and this is becoming more extreme and frequent. Extreme heat is particularly dangerous for people walking. It can kill - in fact, more people in Australia die from extreme heat than any other natural 'event'. Consequently, various parts of the EIS must identify and mitigate all risks associated with not reducing – or even increasing – greenhouse gas emissions. This includes Sections 4 (Risk Assessment), 6 (Utilities), 7 (Traffic and Transport), 8 (Materials and Waste), 12 (Climate Change and Air Quality) and 16 (Ecology and Natural Environment).	The Proponent has sought to mitigate the effects of climate change through design. Refer to Section 12.5.
17	SEE Change	the EIS Scoping Document makes no direct mention of the Objectives agreed for the CBP	Amended. Refer to Section 19.1. However, it is important to note that while the Community Objectives have been used to guide both the tender process and subsequent design development, not all of these objectives were included in the final CDD. Furthermore, these objectives are not statutory planning or environmental requirements, and are therefore not relevant to the assessment included in this EIS.
18		•does not mention or address two key pieces of ACT legislation: oClimate Change and Greenhouse Gas Reduction Act 2010 oClimate Change and Greenhouse Gas Reduction (Interim Targets) Determination 2018 •does not raise connection to gas (section 6.4.1.4 under Utilities) as an issue for Climate Change (section 12).	Amended. Refer to Section 3.1.9.

Ref	Organisation / Person	Comment	Response
19		1.3 Objectives The document fails to mention that the vision for the CBP was agreed by the ACT Government and the CBP Community Panel in an Objectives document and that the Objectives formed a substantial part of the tender requirements to which the Proponent (Doma) responded. Furthermore, many of the Objectives have parallels in the Strategic Directions of the Territory Plan (section 3.3.2.1 of the draft EIS refers). The objectives highlighted in this section of the document also omit three key objectives for the CBP:	Amended. Refer to Section 19.1. However, it is important to note that while the Community Objectives have been used to guide both the tender process and subsequent design development, not all of these objectives were included in the final CDD. Furthermore, these objectives are not statutory planning or environmental requirements, and are therefore not relevant to the assessment included in this EIS.
20		•being a showcase of global best practice measures and outcomes for sustainability, community focus, and resilience •demonstrating commitment to zero (or negative) greenhouse gas emissions (including contributing to the ACT's self-sufficiency in renewable energy and not providing any infrastructure for use of fossil gas as a fuel) •providing comfort and resilience in the warming climate	Refer to Comment 19. The Proposal is committed to achieving a 5 star Greenstar rating.
21		demonstrating how active and public transport will be the attractive, safe (and perceived to be safe) and accessible transport choice in the Precinct	The Proposal seeks to deliver this objective. Refer to Section 7.4.2.2.
22		Justification This section of the document also fails to mention the history and status of the Objectives agreed between the ACT Government and the CBP Community Panel. The brief mention of the Community Panel in section 2.7.2 is insufficient and dislocated from this context and incorrectly states that the Community Panel was formed for the tender process.	Amended. Refer to Section 19.1.
23		Associated Projects We note that this section refers to the Dudley Street upgrade yet observe that it does not mention that Dudley Street is currently proposed to be the location of the closest public transport (bus) stops to the CBP rather than routing buses through CBP. This is relevant to the risks associated with both climate change and transport and to achieving the Objectives for the CBP.	Amended. Refer to Section 7.4.2.2.
24		The provision of a new bus stop on Dudley Street (already built by ACT Government) does not fulfil the objective for active and public transport to be the most obvious attractive form of local transport:	Noted. This issue cannot be resolved by the Proposal, noting TCCS request for no bus services to enter the Precinct.
25		•The stops on Dudley Street are some distance from CBP – through bush and unknown lighting – unlike bus stops at other higher density areas eg Wentworth Ave, where they are essentially at the door. To reach the stops, it would likely take an able-bodied adult some 15 mins walking from the centre of the CBP plus extra time for crossing Dudley Street because of lack of a crossing. (There is also a misleading statement (in the Land Use & Planning section) that the bus stop is only a 5-minute walk from CBP. While one could access the bus stop on Novar Street from one of the new houses to be built on the edge of CBP on Bentham Street, it would be a much longer walk from other parts of CBP particularly given the topography.) •The design of the bus stops and their access put active travel last and make it neither convenient, safe (and perceived to be safe), nor easily accessible. There needs to be a pedestrian crossing between the two bus stops and/or traffic lights at the junction with the Brickworks access road so as to (a) allow people to cross Dudley Street, particularly during peak times when traffic is a moving car-park and (b) to signal to drivers that people crossing have priority. The pedestrian refuge that has been built does neither of these. Furthermore, no provision has been made for paths between: othe bus stop proposed for the southern side of Dudley Street and Kent Street for access to Deakin West, major destinations for employment, education, health facilities and services othe proposed bus stops and Denman Street •There is currently no proposal for re-routing the Rapid bus services from Molonglo and Weston Creek along Dudley Street, which would allow people from those areas to catch the bus to Deakin West	Noted. This is not applicable to the Proposal.

Ref	Organisation / Person	Comment	Response
26		Construction Matters 2.6.3 Remediation and Earthworks This section does not mention how the development will minimise disturbance to the Precinct's current terrain, soil structure and hydrology. This is also not identified as a risk (and therefore not addressed) in Section 4 (Risk Assessment) or Section 15. Earthworks:	Amended. Refer to Section 2.7.4. Also refer to Section 9.4.2.2 and 15.4.
27		•require machines that currently use fossil fuels (with consequent damage to climate and air quality) •directly release greenhouse gases cause loss of nutrients, organisms, moisture and structure from the soil – these are finite, generally in short supply in Australia, and their loss reduces the ability of new vegetation to establish and thrive, particularly in a warming climate.	Amended. Refer to Section 12.4.2.3.
28		Alternatives Considered 2.7.2 Selection of the Preferred Option This section incorrectly states that the Community Panel was appointed for the tender process. The composition and history of the Community Panel would be better placed in Section 1, as indicated earlier in this submission.	It is the Proponent's understanding that a Community Panel was established during the tender process to assist in identifying community concerns from an early stage.
29		Legislative and Strategic Context •Climate Change and Greenhouse Gas Reduction Act 2010 •Climate Change and Greenhouse Gas Reduction (Interim Targets) Determination 2018	Amended. Refer to Section 3.1.9.
30		As required by the Scoping Document for the EIS, the EIS needs to say how it addresses this legislation and contribute to its implementation. The Scoping Document specifies that the EIS must, amongst other things, include the following specific climate change-related matters: (a) 6.2. Climate change (p. 2) The EIS must…must address the contribution the proposal will make to reducing greenhouse gas emissions and meeting the legislated target for a net zero emissions Territory (by 2045 at the latest).	This is addressed throughout Sections 3.0 and 12.0 of the EIS. The Proposal is seeking to achieve a 5 star Greenstar rating.
31		Consequently, other parts of the EIS must identify and mitigate risks associated with not reducing – or even increasing – greenhouse gas emissions. Sections 4 (Risk Assessment), 6 (Utilities), 7 (Traffic and Transport), 8 (Materials and Waste), 12 (Climate Change and Air Quality) and 16 (Ecology and Natural Environment) are particularly relevant here.	This is addressed throughout Section 12.0 of the EIS. The Proposal is seeking to achieve a 5 star Greenstar rating.
32		Risk Assessment 4.2 Risk Assessment This table and associated sections throughout the rest of the document need to be completed to include the risks associated with not delivering on missing elements from the Objectives document. It particularly needs to include the risks associated with increasing greenhouse gas emissions through use of fossil gas as a result of reticulating gas in the development. Some of the risk assessments seem low and/or inconsistent and/or out of date. They should be re-examined and rectified. For example:	Refer to Comment 19. The Proposal is committed to achieving a 5 star Greenstar rating.

Ref	Organisation / Person	Comment	Response
33		•Given the deficiencies with active (especially public) transport as a result of the lack of public transport into the precinct and the poor access to the Dudley Street bus stops (see earlier comments under 2.5 Associated Projects), it will not be the obvious, convenient, safe (and perceived to be safe), accessible and sustainable transport choice for travel to, from, and within the area – so its assessment under T2 and T8 as 'unlikely' before mitigation and 'remote' afterwards, and under CC4 as 'possible' before mitigation and 'unlikely' afterwards, is understated. •Where risks from greenhouse gas emissions have already been identified in the draft EIS, their assessment categories before and after mitigation are understated in light of the unfolding, accelerating and predicted consequences of damage to our climate. (For example, people, plants and animals are already dying and extreme weather and bushfires are already 'unprecedented'.) This is particularly so given the cumulative consequences of all greenhouse gas emissions. Also, in many places the assessment categories are inconsistent across risks. •Including '100% recycled air in majority of apartments' as the mitigation for poor air quality arising from bushfire smoke (CC11) appears to be inconsistent with the 'fresh' air needed to minimise spread of airborne disease and COVID-19 in particular.	Refer to Section 7.4.2.2. The Proposal will provide integrated active travel for the precinct. The nearest bus stop will be approximately 650m to the Proposal. Refer to Section 12.4.2.1 regarding proposed design measures in order to meet the 5 star Green Star rating.
34		Water Supply This section should canvas collection of rainwater from all buildings onsite (not just single dwellings as in section 6.4.1.2) and connection to toilets and other uses, as part reducing the risk of placing extra stress on existing water supplies and reticulation and demonstrating a commitment to the site being self-sufficient in water and to demonstrate global best practice (CBP Objectives 2.c.iv. and 3 refer). Also, contrary to the recommendation in Appendix F14 – Stormwater Treatment Systems not to connect water tanks to toilets, the ACT Government seeks connection of water tanks to toilets.1 Technology is readily available to switch from tank water to mains water.	Water tanks will not be connected for toilet flushing. Refer to Section 10.4.1.
35		Sewerage This section should canvas the risks associated with extending the sewerage network instead of treating and re-using the water and nutrients onsite, as part reducing the risk of placing extra stress on existing sewerage and water supply systems, depletion of nutrients, and demonstrating a commitment to the site having zero net pollutants, nutrients, water and waste and to demonstrate global best practice (CBP Objectives 2.c. i-iv. and 3 refer). This is already canvassed for the construction phase (section 8.4.1 of the draft EIS).	There will be sufficient capacity available for both water and sewerage management for the Proposal. The Proponent has undertaken on going consultation with key utility providers, including Icon Water.
36		Gas •the requirement in the Scoping Document for the EIS to say how the proposal will contribute to reducing greenhouse gas emissions and meeting the legislated target for a net zero emissions Territory by 2045 at the latest •the ACT legislation to reduce greenhouse gases •the ACT Climate Change Strategy •the CBP Objectives for the CBP to have zero (or negative) greenhouse gas emissions (including contributing to the ACT's self-sufficiency in renewable energy and not providing any infrastructure for use of fossil gas as a fuel) and to demonstrate global best practice (CBP Objectives 2.c.i. and 3 refer) Not reticulating gas in the CBP would be consistent with these moves to get the ACT off gas. Furthermore, there already viable alternatives to gasbecause new suburbs in Canberra are now being built without gas connections and people are shifting their homes and businesses (including restaurants) to being all-electric. Instead of 'keeping its options open', the Proponent should demonstrate its commitment to best practice and reducing greenhouse gas emissions and by advocating for CBP to be exempt from the ACT's current gas reticulation mandate.	Noted. Refer to Section 6.4.1.4 providing justificaiton as to the provision of gas infrastructure.

Ref	Organisation / Person	Comment	Response
37		Electricity This section should canvas generation of electricity onsite (e.g. via rooftop photovoltaics), as part reducing the risk of placing extra stress on existing electricity supplies and reticulation and demonstrating a commitment to the site CBP to have zero (or negative) greenhouse gas emissions (including contributing to the ACT's self-sufficiency in renewable energy and to demonstrate global best practice (CBP Objectives 2.c.i. and 3 refer)	This is addressed in Section 12.5.2.
38		Traffic and Transport This section needs to include and address the risks associated with active transport (particularly walking and public transport) not being prioritised on the Access Road, Dudley Street and Denman Street and the lack of public transport in the CBP. This will add to the risks noted in the draft EIS, including increases in damage to the climate (from greenhouse gas emissions), health (e.g. from warmer climate, air pollution, people having insufficient exercise), adjacent residents (e.g. traffic congestion and noise), vehicle crashes (with associated risk of injury and death, particularly for vulnerable road users such as people walking), and parking. The consequences could be major, catastrophic in the case of death and climate disruption. Details of the Dudley Street upgrade and the lack of public transport in the CBP are mentioned earlier in this submission under 2.5 Associated Projects. Furthermore, the rapid population growth in Molonglo, the destinations of Deakin West as well as CBP, and increased traffic from Cotter Road into Dudley Street and Adelaide Avenue mean that a long-term solution is needed for more sustainable and better integrated transport along these corridors. This must include public transport being the most attractive form of transport for people living in or travelling to the area, with Rapid and local bus services on Dudley Street and servicing CBP. Similarly, contrary to the CBP Objectives and prioritising walking over motor vehicle transport, the Uriarra Track (section 7.2.4.1 of the draft EIS) is being subordinated, with it being diverted and crossing the Access Road via a pedestrian refuge.	This is not applicable to the Proposal. Also refer to Comment 19.
39		The EIS needs to better reflect that convenient, safe (and perceived to be safe) and attractive active travel connections to the CBP are needed. This includes designing the proposed shared path along Denman Street so that it meets the needs of both people walking, cycling and scooting and visitors to the Uniting Church and church hall on that street. An alternative would be for Denman St (and other streets) surrounding CBP to be a low-speed (i.e. no more than 30 km/h), shared street. This could: •remove the need to build and maintain curbing, guttering and separated path(s) for walking and cycling, though this would need to be balanced against the significant nose-in car-parking (currently) used for the Uniting Church (which is also the de facto Yarralumla town hall) and that is likely to increase (as a result of the CBP) in the absence of highly convenient public transport •help with the cultural change to make walking and cycling safe, convenient, attractive and obvious (CBP Objective 2.g. refers). This would help Canberra to join the global move to low-speed streets in most urban areas as well as making a start on Safe Streets to School (noting that the CBP is less than 2km from Yarralumla Primary School) •help deter drivers from using it ('rat running') for accessing the Brickworks and parking on local streets instead of paying for parking inside CBP	Noted. Active Transport has been prioritised within the Proposal Area. Areas outside of the Proposal Area are not applicable to the Proposal.
40		Increase in Waste Quantities Demolition, excavation, and construction As well as looking for ways to re-use existing 'waste', this section should canvas specifying dimensions consistent with standard 'off the shelf' supplies, as a way of reducing the risk of increasing waste and demonstrating a commitment to the site having zero net waste and to demonstrate global best practice (CBP Objectives 2.c. i-iv. and 3 refer). Operation This section should canvas waste reduction and not just waste management. This would reduce the risk of increasing waste and demonstrating a commitment to the site having zero net waste and to demonstrate global best practice (CBP Objectives 2.c. i-iv. and 3 refer).	Amended. Refer to Sections 8.4.1.1 and 8.4.1.2.

Ref	Organisation / Person	Comment	Response
41		Landscape and Visual This section needs to recognise the risks associated with removal of hundreds (most) of the trees on the site. Rather than removing the trees at the start of the project, the EIS should canvas retaining good and reasonable quality trees, at least in the interim years, while new trees grow. This would provide visual amenity, protect landscape qualities, and maintain some shelter and cooling effect in summer.	Amended. Refer to Section 9.4.2.1. It is noted that tree removal will be required at the beginning of construction to ensure safety of construction workers, and to enable construction activities.
42		Climate Change and Air Quality These are largely missing from the draft EIS. Furthermore, there are two inaccuracies about how the proposal will reduce greenhouse gas emissions; these are in section 12.2.1. As well, the Proponent is targeting a Five Star Green Star Community rating yet is not clear in the draft EIS what climate change mitigation and adaptation measures will (or could) be taken to achieve the requisite scores to rate as a Five Star Green Star Community.	Amended. Refer to Section 12.4.2.
43		Existing Policy 12.2.1.1 ACT Climate Change Strategy 2019-2025 Contrary to what the draft EIS says on page 115, the CBP is not 'consistent with the Strategy as demonstrated by its plan…to reduce emissions and meet the target for net zero emissions by 2045…' 12.2.1.2 Canberra's Living Infrastructure Plan: Cooling the City The inconsistency under 12.2.1.1. is illustrated in the first row of Table 12.1 in the draft EIS:	The Proponent respectfully disagrees. The measures proposed in Section 12.5 are considered to be consistent with the ACT Climate Change Strategy, particularly through the Proposal's efforts to achieve 5 start Greenstar rating. It is noted that the Section this submission refers to is now in Section 3.3.8.
44		Reticulation of gas in CBP will not encourage a shift from gas to electricity – it will hinder it and increase greenhouse gas emissions. Similarly, the table does not accurately reflect the transport and waste problems raised earlier in this submission:	The Proponent understands and acknowledges concerns raised regarding the installation of gas into the proposed development. Evoenergy, Canberra's local energy distributor responsible for operating and maintain the gas distribution network infrastructure in the ACT, is committed to working with the ACT Government to transition the ACT's gas network to achieve the government's target of net zero emissions by 2045. Refer to Section 6.4.1.4.
45		The CBP is not currently accessible from major public transport routes. Furthermore, the current provisions being made for public transport do little to make public transport attractive and accessible and reduce reliance on private car use. Beyond the foreshadowed Operational Waste Plan, the draft EIS is yet to canvas ways of avoiding organic waste during ongoing operation of the CBP.	Refer to Section 7.4.2.2. The Proposal will provide integrated active travel for the precinct. The nearest bus stop will be approximately 650m to the Proposal. Once operational, the option to compost vegetation waste would be available to residents, where appropriate. Refer to Section 8.4.1.2.
46		Hazard and Risk This section needs amending to recognise the changing climate. Warming, longer summers, less rain, and more extreme weather all increase the consequent hazards and risks.	Amended Refer to Section 14.2.1.
47		Soils and Geology This section needs amending to recognise the risks associated with soil disturbance (earthworks) and contamination. Relevant soil disturbance issues are mentioned earlier in this submission, under 2.6 Construction Matters.	This is addressed in Section 18.4.
48		Ecology and Natural Environment This section needs to mention how climate change increases the risks, particularly for threatened species and communities. We note that some Golden Sun Moth habitat will be destroyed the proposed development, and that an offset arrangement has been agreed with the Wandiyali Restoration Trust in Googong. We also note that any loss of habitat is detrimental to critically endangered species and that offsets do not necessarily compensate for loss of habitat, particularly where the offset is distant relative to the critically endangered species living in the habitat being destroyed. The draft EIS recognises this in section 16.4.1.	Amended. Refer to Section 16.5.1 and Appendix F50 in Appendix F.
49		Contamination The EIS needs to provide both a detailed assessment of the ten areas of environmental concern (AEC) and a contamination Remediation Action Plan (RAP), with the AEC informing the RAP.	Amended. Refer to Section 18.4.1 and Appendix F52 in Appendix F.

Ref	Organisation / Person	Comment	Response
50	Friends of Grasslands	FOG has had a long standing interest in the Golden Sun Moth (GSM) population in the area of the Canberra Brickworks and Dudley St, and has provided comments on previous proposals relating to the Brickworks (8 July 2014, 20 March 2015, 1 November 2017). In those submissions (and in submissions on other developments in the area) we asked that all impacts on the GSM in this general area be considered and a strategic approach to the species conservation be taken. We are disappointed that this has been repeatedly ignored and these proposals are still being evaluated in a piecemeal fashion. In responding to this EIS, we note that the GSM habitat to be impacted is reported to be Chilean Needle Grass, and that the ACT Offsets Team has been consulted concerning the proposed offset site on Old Cooma Road, near Googong. In principle FOG is opposed to any development that impacts on threatened species or ecological communities. While we accept that some developments, for example the widening of Dudley St, might be essential, the current proposal does not fall into this category. The fact that there are no suitable GSM offset sites available in the ACT that could be used by this development also raises the question of why the impacts are not being avoided. On the assumption that the development will go ahead anyway, we reiterate the comment in our submission to the Commonwealth on EPBC Referral 2019/8449 last month, that the purchase of GSM credits from the NSW BioBanking scheme to offset losses in the ACT is of concern. How will a community organisation such as FOG have any surety that this offset will be effective? We again urge that information about the GSM offset credits are included on the ACT Government's Offsets Register in such a way that we can understand how the credits are ensuring no net loss of GSM across the landscape.	Amended. Refer to Section 16.5.1 and Appendix F50 in Appendix F.
51	Barbara Moore	In consideration that asbestos contamination is outside the scope of DA201900047, my further concern is to the lack of information at this stage available for public comment with regard to the environmental theme of Soils and Geology. In order to address the identified risks in Table1 (page 4 of the Scoping Document), the EIS is required to provide further detail to comply with section 8.2.5 (page 9 of the Scoping Document).	Amended. Section 15.4 has been amended to incorporate further analysis of potential impacts to the Proposal Area's soil and geology. The Proponent has recognised concern in relation to potential contamination by preparing a separate section within the EIS. Matters relating to contamination are addressed in Section 18.0. The EIS addresses all issues raised within 8.2.5 of the scoping report.
52		The EIS is supported by earlier surveys and reports, the most recent being the Arcadis Yarralumla Brickworks, ACT Data Review and Gap Analysis and Sampling, Analysis and Quality Plans in June 2017(SAQP). Further assessment of 10 Areas of Environmental Concern (AEC) was recommended.	Refer to Section 18.4.1. The extent of contamination is considered to be well understood within the Proposal Area. A Supplemnetary Environmental Site Assessment, Remediation Works Plan and Development Site Management Plan are now included in Appendices F51-F53 in Appendix F. These documents will be subject to approval by an independent auditor and EPA.
53		The Contamination Summary at F43, prepared by Agon Environmental Pty Ltd in May 2020 advises that a Sampling, Analysis and Quality Plan (SAQP) was due in December 2020. This assessment information is not notified in EIS201900047. It contains the essential data to inform the Site Management Plan (SMP) and Remedial Action Plan (RAP). Only documents with insufficient historical assessment have been notified.	See Comment 52.
54		•Investigate the likely impact of construction and soil disturbance on the Yarralumla formation. Detail any mitigation measures required to minimise impact; •Describe the composition and source of all fill intended for use at the site; •Provide details of any contaminants within fill to be used on site and identify additional areas of concern for assessment in accordance with Phase 2 investigations; •Describe any protocols necessary for soil compaction and soil compaction testing to ensure stabilisation of fill on site; •Provide a Sediment and Erosion Control Plan (SECP) and describe erosion impacts from construction and operational activities, especially during extreme weather and detail measures to reduce the impacts of sediment and erosion, including dust suppression; •Provide an Unexpected Finds Protocol (UFP) for all earthworks and construction activities on site.	Amended. Refer to Sections 15.4.2, 15.4.3, 18.2 and 18.4.1. The Proponent has committed to the preparation of a detailed SECP prior to construction commencing, as part of the CEMP. An Unexpected Finds Protocol is included within the Development Site Management Plan in Appendix F53 of Appendix F.

Ref	Organisation / Person	Comment	Response
55		The words describe, provide and detail confirm that response to those points were timely for this process and required for notification. Had the further SAQP due in late 2020 been notified then the data could have been used to meet the requirements of this Scoping Document. There is lack of regard and respect for community to make an informed representation to this draft EIS when essential documentation is not provided. Perhaps the information required to address the list at 8.2.5 will be submitted to the ACTPLA Assessment team during their considerations after the public notification time is finished. ACTPLA must hold the developer to account on our behalf.	Noted.
56	Eric Martin	It is pleasing to see that the CMP has been updated in 2021 and this will guide the proposed adaptive reuse of the former brickworks and the associated quarry. We note that there has been 8 of the 12 areas of sensitivity identified that will require further investigation. We trust that this investigation will occur soon so that the results will guide the outcome before designs are developed rather that the reverse process. It is critical that these guiding documents, the unanticipated finds protocol and the conservation policies within them are followed and statements of heritage effects will be prepared for the detailed design proposals in due course. It is pleasing to see that the Brickworks will be conserved and adaptively reused and become a centre piece for the propose development.	Noted.
57	Yarralumla Residents Association	1.INTRODUCTION (including Objectives) •Of the objectives highlighted in the EIS Final Draft, the biggest failure from the proposed design appears to be in relation to the provision of integrated and accessible transport systems. We understand that Transport Canberra knocked back a request for buses to be allowed to enter the CBP, which therefore prevents this objective from, being achieved. We do not believe the provision of a new bus stop on Dudley Street fulfills the objective for public transport to be the most attractive form of local transport.	Noted.
58		2.DETAILS •In line with the Chief Minister's commitment, the CBP development will have an absolute maximum of 380 dwellings, which according to Doma is estimated to yield a population of 965 people. While we are confident that the maximum of 380 dwellings will be adhered to, the estimated yield seems low. We understand that there will be a mix of 2-, 3- and 4-bedroom apartments and would expect the townhouses and 21 standalone houses to range between 2 and 4 bedrooms. We also understand that current plans indicate that only one of the 380 dwellings will have one bedroom. •The YRA supports the design to have the primary access from Dudley Street with no interlink from Bentham Street and Denman Street, although these streets will service a small percentage of dwellings.	Noted.
59		•We remain concerned about the provision of adequate car parking given the likely pressure on surrounding streets if there is insufficient public parking or the cost of the proposed paid parking deters workers and others going to the CBP from parking within the CBP. •A feature of the development is its focus on urban parklands, but no consideration has been given to visitor parking in calculating the number of required car parks. Without seeing detailed plans, we also do not know what public amenities such as park benches, drinking fountains, etc. will be provided in the parklands, and look forward to seeing further details in the EDP. •While we understand there is a timeframe for construction this does not appear in the EIS. Due to the inconvenience to neighbours and surrounding community, the construction timeframe should be as short as possible.	Amended. Additional Parking has been incorporated into the Proposal's design. Refer to Section 7.4.2.1. Indicative project timing has been provided in Section 2.7.1, however, we note that this is likely to change as the Proposal progresses. The Proponent is committed to providing adequate notification to surrounding residents regarding timing of the proposed work.

Ref	Organisation / Person	Comment	Response
60		•We note that matters relating to bush fire mitigation measures such as the management of the inner asset protection zones and the systems and implementation for adjacent lands is cited as a risk with potentially catastrophic consequences, albeit the risk is considered unlikely or remote. There is an assumption that outer asset protection zones are required and approved and that mitigation measures require collaboration with adjacent land users such as the ACT Government and the Royal Canberra Golf Course.	Noted.
61		•We would like to see the justification for allowing outer asset protection zones on ACT government land and the formalization of such collaborations. We are also concerned about the extent to which the development of the CBP will impact on adjacent lands and what has to date been public amenities. This includes the forest and the windbreak and sound break provided by the trees to the South and West of the CBP and the frequently used trail located on ACT government land between the CBP and the Royal Canberra Golf Course fence.	Refer to Section 14.4.1. The Proponent has had ongoing consultation with F&R and ESA. This consultation has resulted in design changes, particularly to the south-eastern corner of the Proposal, which has now incorporated an Inner Asset Protection Zone. The Outer Asset Protection Zone along the western boundary of the Proposal has been agreed to by F&R and ESA, and will be incorporated into their Operations Plan and managed as 'Parkland'. It is the Proponent's understanding that this vegetation would be modified to reduce potential fuel, but would not result in the substantial removal of trees. The Proponent does not intend for any visual changes to occur within surrounding wooded areas. Refer to Section 9.4.2.4.
62		Traffic and parking are referred to as major risks. However, we consider the absence of a bus stop within the CBP to be a major drawback and the decision to provide paid parking will no doubt lead additional congestion and a scramble for parking in nearby streets including Dunrossil Drive, Bentham Street, Denman Street and Lane-Poole Place. One of the mitigation measures is to provide what is referred to as “additional parking” and elsewhere there is a reference to the provision of “200 car spaces, which is in excess of the anticipated peak demand”. There are conflicting figures concerning the number of car parks and on page 75 of the EIS there is a reference to the provision of only “39 spaces in excess of the estimated peak demand”.	Amended. Refer to Section 7.4.2.1.
63		•A mitigation measure is to maintain public parking on site to reduce overflow on-street parking in neighbouring areas. This ‘reduce overflow” cannot be quantified, but human nature suggests that if someone is working an 8-hour shift at the CBP they will soon work out they can avoid parking fees by parking in neighbouring streets.	Noted. It is considered that the Proposal provides adequate public parking. Refer to Section 7.4.2.1.
64		•Doma cites concerns about the parking at the CBP being used as a park and ride location for employees in the Parliamentary Triangle, but the lack of convenient public transport within the CBP will reduce the appeal of this as a park and ride location. We also note that investigation has already commenced concerning the potential for a park and ride to service a new light rail stop near Kent Street that would possibly be accessible from Dudley Street, so utilizing the CBP as a park and ride location seems unlikely1.	Noted.
65		Given the list of mitigation measures to reduce various risks, we would expect that an ACT government department will audit the project to ensure that such mitigation measures are implemented and maintained.	Noted.

Ref	Organisation / Person	Comment	Response
66		•There is a misleading statement that the bus stop is only a 5-minute walk from the CBP. While one could access the bus stop on Novar Street from one of the new houses to be built on the edge of the CBP on Bentham Street, it would be a much longer walk for others, particularly given the topography. •We note with interest that further exploration of adaptable housing design is to be considered during the DA stage.	Amended. Refer to Table 5.1.
67		•Water Supply We note that a decision has been made, after reviewing alternatives, to install a new water main in Denman Street from Novar Street. The new water main is apparently to be installed by Icon Water within the existing verge. Given that this could also tie-in with the location of the shared pathway proposed for Denman Street, we recommend the projects be coordinated, particularly given the projected disruption to traffic and parking during construction.	Noted. The Proponent commits to ongoing consultation with Icon Water. Refer to Section 2.7.2.
68		Gas We note the proposal to connect gas to houses/townhouses, commercial cooking and fireplaces where no viable alternative exists. There obviously must be viable alternatives ince new suburbs in Canberra are now being built without gas connections. The requirement to connect gas appears to be contrary to government policy.	Refer to Section 6.4.1.4 for justification regarding gas connection.
69		•Electricity Given the potential noise from HV Switching Stations, substations should be located as far away from existing dwellings as possible. •Sewer Connection on Bentham Street located in the residential driveway of 46 and 48 Bentham. Direct consultation with the owners of these residences is obviously required.	Noted. Refer to Appendix F03 in Appendix F for Electrical Infrastructure Plan. Consultation with surrounding residents will be ongoing throughout construction.
70		7.TRAFFIC AND TRANSPORT •We are pleased that Doma has adhered to the community request that there be no direct road connection between the new access road and Bentham Street, Denman Street and Lane-Poole Place, albeit emergency vehicle access will have access. •The EIS notes that the risk of impact on adjacent residents, including traffic congestion, vehicle accidents, and parking issues is possible, and with major consequences. •All traffic reports indicate that roads in the nearby network are operating above their intended design volumes when compared to their road classification. This includes Dudley Street and Kent Street (between Dennison Street and Dudley Street). •Problems with queuing are highlighted in the 2015 AECOM report noting 192m (AM Peak) on the Cotter Road approach and 178m (PM Peak) on Dudley Street. •The upgrade to Dudley Street will not actually increase capacity since it remains one lane in each direction and the addition of vehicles from the CBP and sustained growth in demand from South Canberra means that construction of a Mint Interchange remains the only viable option for alleviating congestion near the main access to the CBP off Dudley Street and for the large volume of commuters travelling between the Cotter Road and Deakin. •We anticipate a substantial increase in traffic at the intersection of the Cotter Road and Dunrossil Drive, as driving from Civic (or from the nearest service station in Deakin) to the CBP will be an easier run if doing a U- turn at the Cotter Road/ Dunrossil Drive intersection, rather than contending with new lights on the Kent Street bridge and inevitable congestion on Dudley Street. This situation will not be resolved until a Mint Interchange or similar has been built to divert the large volume of commuters travelling between the Cotter Road and Deakin away from Dudley Street.	Noted. This issue is not applicable to the Proposal.

Ref	Organisation / Person	Comment	Response
71		We find it hard to believe that experts in the field who have been looking at the parking requirements for the Yarralumla Uniting Church still claim that the occasional heavy demand for parking in Denman Street is due to "infrequent weekday funerals and the large annual fete". As the YRA has pointed out on numerous occasions, the Yarralumla Uniting Church is the defacto Yarralumla Community Hall and is used constantly throughout the week. Having cars parked (nose-in) all the way up to Maxwell Street is not "infrequent". Similarly, the reference to suggest that the parking capacity near the Yarralumla shops is "adequate for normal demand" is ludicrous. Applying the current car parking code to the Yarralumla shops indicates a short fall of approximately 175 car spaces in the near vicinity. Although Bentham Street is not designed for safe nose-in parking on both sides of the street, the practice continues because the change to parallel parking would cause further reduction in the amenity of parking near the shops. Many patrons of the Yarralumla shops simply drive through to Deakin or Curtin when unable to find a parking spot, so the shops are losing business because of insufficient convenient car parking spaces.	Noted. It is considered that the Proposal provides adequate public parking. Refer to Section 7.4.2.1.
72		The ACT Government has also looked at the possibility of turning Bentham Street into a one-way street to ensure that the maximum number of car spaces near the shops could be maintained while maintaining safety. This issue has not been resolved. The small number of reported vehicle crashes is most likely because many of the small scrapes that occur in the vicinity of the Bentham Street shopping precinct go unreported.	Noted.
73		•Despite claiming that the CBP will provide open spaces and parklands, the calculation of car parking requirements does not include any car parks for visitors to the Quarry Park or Railway Remnants Park.	Noted. It is considered that the Proposal provides adequate public parking. Refer to Section 7.4.2.1.
74		•The number of cars allocated to private parking is above the requirements calculated in accordance with the relevant code. However, this can be easily explained by the requirements under the code to provide only two spaces/units for dwellings with two or more bedrooms. Given that Doma plans to build a significant number of 3- and 4-bedroom dwellings, it makes practical sense for Doma to provide a corresponding number of private car spaces to attract investors who want a four-car garage to accompany their four-bedroom apartment in what will be a prestige development. An increase in private parking spaces should not be used as rationale for reducing the number of public parking spaces that will also be used by workers at the CBP.	Noted. It is considered that the Proposal provides adequate public parking. Refer to Section 7.4.2.1.
75		•Any shortage of carparking for public visitors and workers will exacerbate the desire to park for free in nearby streets, particularly Dunrossil Drive, Bentham Street, Denman Street and Lane-Poole Place. The fact that public parking will be paid parking also boosts the incentive for workers to park in nearby streets for free. We believe there should be an even greater number of public parking spaces provided and that systems need to be put in place to reduce parking pressures on nearby streets. This could include mandating that employment contracts for employees of businesses within the CBP include the provision of free parking.	Noted. It is considered that the Proposal provides adequate public parking. Refer to Section 7.4.2.1.
76		•The bicycle parking requirements have been based on the Bicycle Parking General Code, which is clearly inadequate for this development. That Code does not have any requirement to provide bicycle parking for the proposed gym and extensive spa facilities, even though such facilities trigger substantial car parking requirements.	Noted. It is considered that the Proposal provides adequate bicycle parking. Refer to Section 7.4.2.1.

Ref	Organisation / Person	Comment	Response
77		Article 7.4.2 of the EIS notes the construction of a new path along the southern side of Denman Street to Novar Street. While the community is generally in favour of bike paths/shared paths connecting the existing network to the CBP, there is considerable concern about the precise location of a path along the southern side of Denman Street. A draft plan produced by Doma proposes the construction of a shared path located between the existing power poles and the road. The Doma proposal does not show any plans for kerbs or drains. As noted above, the frequency and volume of use of the Yarralumla Uniting Church means cars are frequently parked (nose-in) as far away from the church as the intersection with Maxwell Street. This has been exacerbated by the construction of the Dudley Street upgrade which has prevented users of the Church facilities to park on land adjacent to the church that had previously been accessible from Dudley Street, albeit not zoned for that purpose. The YRA recommends that any shared path on Denman Street be constructed on the Dudley Street side of the power poles to the greatest extent possible so that nose-in parking can be maintained for the full length of Denman Street. We believe there are viable solutions if land that belongs to the church needs to be used for such purpose. Options include giving the church access to the land adjacent to the church that has previously used as an informal carpark, by formalising access from Denman Street instead of Dudley Street.	The Proposal will seek to integrate its footpath with the surrounding existing footpath network. The precise location of the footpath is continuing to be investigated.
78		While the provision for EVs is welcome, there is no mention of car sharing facilities or taxi pick up and drop off points. The lack of convenient public transport options exacerbates the need for such facilities.	Amended. Refer to Section 7.4.2.2.
79		9.LANDSCAPE AND VISUAL •We are concerned about the location of buildings in Precinct 7 and 5 and the likelihood that they will be visible from the Cotter Road/ Dudley Street/ South Canberra. The forested area along the Cotter Road/ Adelaide Avenue/ Dudley Street/ Dunrossil Drive has, to date, been a visual and physical barrier between South and Inner South Canberra. While acknowledging the need for the removal of trees to create the new access road, we are concerned that buildings located on the Dudley Street/Cotter Road side of the Denman Street ridgeline will negatively change the landscape and view from the south. Our preference is that buildings in Precincts 7 and 5 be shifted towards the brickworks so that they are not visible from the southern approach.	It is considered unlikely that the Proposal will result in significant visual impacts to the south of the Proposal Area. Refer to Section 9.4.2.5.
80		•We acknowledge that many of the trees within the CBP have reached the end of their lives and that a large number must be removed. However, we hope that wherever possible healthy trees can be retained. One such tree is Tree 276 Cedar Deodora, marked for removal in the Tree Protection Plan (Appendix F11). This is an evergreen tree located between the established house at 17 Schomburgk Street and the proposed new house T11 on the Eastern side of the Brickworks. The reason given in the Tree Plan for not retaining the tree is that it is “within the building footprint”. The plans show that the “building footprint” would be the access path to/from Bentham Street for pedestrians and cyclists. There appears to be sufficient space for the access path to meander around either side of the tree and the tree itself is not close to the building footprint for the proposed house T11. We believe further investigation is required and any decision should justify why the path cannot be designed so that this particular tree is retained.	Tree 276 will be retained. Refer to Section 9.4.2.1.

Ref	Organisation / Person	Comment	Response
81		10. WATER QUALITY & HYDROLOGY •We note that surface water samples indicate that zinc is present in quantities that exceed the NEPM (2013) screening criteria for fresh water. Given that Doma's plans include gardens to supply both households and restaurants on site, we wonder what remediation may be required to ensure that any produce grown on site is guaranteed safe for human consumption.	The Proposal Area will be remediated to allow for human occupation. This will be subject to auditing and approval by the EPA. Refer to Section 18.5.2.
82		We note the recommendation (Appendix F14 – Stormwater Treatment Systems) not to connect water tanks to toilets due to very low reliability but given the availability of technology to switch from tank water to mains water and the fact that tanks are usually full when it rains, which coincides with when gardens need no water, all tanks should also be connected for toilet flushing for water conservation, as is also required under ACT government guidelines.	Water tanks will not be connected for toilet flushing. Refer to Section 10.4.1.
83		11. SOCIO-ECONOMIC, HEALTH AND RECREATION •The EIS report notes the various community and recreational facilities that are already available in Yarralumla, which only highlights the lack of a community hall. At present, the community hall function is covered by the heavily-used Yarralumla Uniting Church. When previous iterations for development of the CBP have been discussed, there have been many requests for any development at the CBP to include community facilities that could be used by dance group, choirs, yoga groups and other groups. The YRA is disappointed that no such community facilities are currently proposed in the plans for the CBP.	Noted. The provision of a community hall is not a requirement of the Proposal.
84		•The reference to the Community Needs Assessment report completed for a previous proposal in 2015 is misleading as there was significant community opposition to that proposal, not the least of which was that the Community Needs Assessment was seen as inadequate.	Noted. This report was prepared for the Land Development Agency, not the Proponent.
85		•The 33% increase in Yarralumla's population will undeniably put additional pressure on the Yarralumla shops, the Yarralumla Primary School and the Yarralumla Surgery, to name just a few of the amenities of the suburb that are already stretched to their limits. It should also be noted that if the development of Forestry Place, adjacent the CBP, proceeds as currently planned, the two projects combined will increase Yarralumla's population by 75%. Fortunately, the main access to the CBP will be via the new access road and we anticipate that many residents of CBP will see the Curtin Shops as an attractive alternative, particularly if driving. However, this will funnel additional traffic along the heavily used McCulloch Street, Curtin, creating other issues.	Noted.
86		•There is an assertion that the Yarralumla Surgery could provide services to the additional population generated by the CBP, but there is no evidence of discussion having taken place with the Yarralumla Surgery, which for a long time has had a policy of not taking on new patients due to being at capacity.	Noted. This issue is not applicable to the Proposal.
87		•The Yarralumla Primary School, as a bilingual education school, also sees extensive demand from outside the suburb and we understand that rezoning to prioritise residents of Yarralumla will have a flow on effect, preventing students from Deakin and Forrest being able to enrol at Yarralumla Primary School. This knock- on effect of the development does not appear to have been addressed.	Noted. This issue is not applicable to the Proposal.
88		•While social housing is not a requirement of this development, we understand this was in part due to the high proportion of social housing already present in Yarralumla. However, the cumulative effect of the combined 75% increase in population from both this development and Forestry Place (if it proceeds as currently proposed) will most likely lead to additional requirements for social housing elsewhere in Yarralumla to meet the ACT Government's targeted ratio for social housing in each suburb across the Act.	Noted. There is no requirement for the Proponent to provide social housing.

Ref	Organisation / Person	Comment	Response
89		13. NOISE, VIBRATION AND LIGHTING •The EIS refers to "Once operational, the CBP will utilise similar levels of lighting to any residential/commercial area in line with Australian standards". The difference here is the potential for negative impact on existing residents. For example, although Doma have assured that no lights will be installed for the tennis courts to prevent night-time playing that would disturb neighbours adjacent to the tennis courts and basketball court, there is no mention of this in the EIS.	Amended. Refer to Section 13.4.4.
90		Similar concerns have been raised about the impact of noise and light from a BBQ area that will have the potential to be accessed by hundreds of residents at the same time, located close to existing residents. These activities at the currently proposed locations risk escalation into disputes if not managed well in the noise and lighting management plans or usage policies for such facilities.	Amended. Refer to Section 13.4.4.
91		14. HAZARD AND RISK •Figure 14. 1 refers to the Requirement for Inner Asset Protection Zone for Precincts 7 and 5 to be met by Territory management of land to the south in accordance with ACT Bushfire Operation Plan. •It is not clear why public land is being used instead of requiring Doma to provide its own Inner Asset Protection Zone. Requiring Doma to provide an Inner Asset Protection Zone for Precincts 7 and 5 would also align with the Community Panel's objective (which the YRA fully supports) to shift buildings in Precincts 7 and 5 towards the brickworks and away from the current boundary line, which is on the Dudley Street side of the ridge.	Refer to Comment 61.
92		ABORIGINAL, EUROPEAN AND NATURAL HERITAGE •The YRA notes that the Geological Society of Australia has been a member of the Community Panel and that the ACT Heritage Council has reviewed the proposal. We understand that both groups have no objection to a section of the quarry being filled. This is despite community concerns that have previously been raised that filling in part of the quarry would be detrimental to the heritage values of the Quarry and seen as inconsistent with the Heritage Listing of the Quarry.	Noted. The heritage values of the Quarry will celebrated. Refer to Section 17.4.2.3.
93		CONTAMINATION •While contamination is of concern to the community, we understand any contaminants found will be dealt with in accordance with ACT government requirements. •We note the reference to the Remediation Action Plan that was to have been completed in 2020 (See page 180), but this does not appear to have been attached to the EIS.	Noted. The Remediation Works Plan is now included in Appendix F52 in Appendix F.
94		We look forward to seeing the Remediation Action Plan and addressing the effectiveness/viability of mitigation and management measures to be notified in the approval DA process.	Noted. The Remediation Works Plan is now included in Appendix F52 in Appendix F.
95		19. COMMUNITY AND STAKEHOLDER CONSULTATION •The Community Panel has functioned as a way to alert Doma and the SLA to issues that the community is likely to have issue with in relation to aspects of the proposal, giving Doma and the SLA an opportunity to amend or work out solid justification before going to the broader community. We would like to register our disappointment that TCCS has not had a seat at the table since so many of the issues that have been raised rely on input/response from TCCS. •The impact on the Curtin shops and access via McCulloch Street, Curtin appears to have been given very scant attention in the community consultation process, despite the Curtin Shops being the most convenient shopping location for most residents of the CBP.	Noted. It is considered that due to the central location of the Proposal, there will be multiple options for new residents to access services and shops.

Ref	Organisation / Person	Comment	Response
96		20. RESIDUAL RISKS AGAINST POTENTIALLY SIGNIFICANT IMPACTS •The EIS identifies increased public access to the CBP and the impact on traffic congestion and parking as a residual risk. We do not believe that this risk has been fully considered and anticipate that in years to come that Doma and residents of the CBP will join with the YRA and others in the community to push for the construction of a Mint Interchange to funnel the large volume of traffic that flows between the Cotter Road and Deakin. •The provision of additional parking is cited as a mitigation measure for the residual risk of parking issues, but the availability of free parking, particularly for workers within the CBP, will be a vital component to alleviate parking pressures on nearby streets such as Dunrossil Drive, Bentham Street, Denman Street and Lane-Poole Place.	Noted. This is not applicable to the Proposal. It is considered that the Proposal provides adequate public parking. Refer to Section 7.4.2.1.
97		21. RECOMMENDATIONS •Within the recommendations for mitigation of the impacts associated with the proposal a number of items in Table 21.1 start with "consideration", for example, "consideration of shade structures for playgrounds". While we understand that this is still a work in progress, the use of the term "consideration" suggests this item can be ignored as no actual commitment has been made.	Amended. Refer to Section 21.1 for a summary of commitments by the Proponent.
98		The YRA requests that the application be approved subject to the following:	-
99		Confirmation that Transport Canberra will not permit buses to route through the CBP.	Confirmed. Refer to Section 7.4.2.2.
100		Confirmation of plans for car sharing services and taxi access.	Confirmed. Refer to Section 7.4.2.2.
101		Consideration of a revised estimate of the population yield based on Doma's current plans for the number of 2-, 3- and 4-bedroom dwellings in any calculations.	Amended. Refer to Section 11.2.
102		No reduction in the number of required car parks for the public because of additional car parks being provided for private use.	It is considered that the Proposal provides adequate public parking. Refer to Section 7.4.2.1.
103		An increase in the number of required car parks and bicycle parks to account for the use of public parks.	Amended. Refer to Section 7.4.2.1.
104		Clarification of the actual number of additional public car parks in excess of the code requirements.	Amended. Refer to Section 7.4.2.1.
105		An increase in the number of bicycle parks to reflect practical implications of the large spa and gym facilities, even though such facilities do not require an allocation of bicycle parks under the current code.	The Proposal is being developed to encourage active travel through the area, the Proponent commits to ensuring additional parking allocations for bicycles over the required amount are provided. Refer to Section 7.4.2.1.
106		Formalisation of arrangements so that free parking is provided to workers within the CBP as a measure to mitigate workers parking for free in nearby streets.	The Proponent will require paid parking. The employment conditions of workers within the Proposal Area are not within the purview of the Proposal.
107		Confirmation of a time frame for all construction works to be complete.	Amended. Refer to Section 2.8.1. Note that these timeframes are indicative and will require review as the Proposal progresses.
108		Formalisation of agreements between Doma and the ACT Government and the Royal Canberra Golf Course clarifying the extent of the fire protection zones and each party's management commitment.	This will be formalised prior to construction of the Proposal.
109		Justification for the use of ACT Government land and the potential removal of additional trees for an outer protection zone.	Refer to Comment 61.
110		Consideration be given to current and future demand for carparking on Denman Street when designing the proposed shared path on Denman Street with the engagement of the community to achieve a viable and acceptable outcome.	Noted.
111		Coordination of the design and construction of the water main along Denman Street with the proposed share path and associated works such as kerbing, and with the engagement of the community to achieve a viable and acceptable outcome.	Confirmed. Refer to Section 2.8.2.
112		Car sharing services and taxi facilities be a requirement.	Confirmed. Refer to Section 7.4.2.2.

Ref	Organisation / Person	Comment	Response
113		Assurance that the ACT government will audit that risk mitigation measures are implemented and maintained.	Noted.
114		Retention of as many healthy trees as possibly, and in particular Tree 276 Cedar Deodora (See Tree Protection Plan), which would require modification to the design of a pathway.	Tree 276 will be retained. Refer to Section 9.4.2.1.
115		Confirmation that all water tanks will be connected for toilet flushing.	Water tanks will not be connected for toilet flushing. Refer to Section 10.4.1.
116		Confirmation of the measures to be taken to ensure acceptable water and soil quality and assurance that any produce grown within the CBP would be safe for human consumption.	The Proposal Area will be remediated to allow for human occupation. This will be subject to auditing and approval by the EPA. Refer to Section 18.5.2.
117		Confirmation of the mitigation measures to ensure activities such as tennis, basketball and any BBQ facilities or places likely to attract large groups of people within the CBP close to the boundary of the CBP do not have a negative impact on neighbours due to inappropriate lighting and noise.	The CBP will utilise similar levels of lighting to any residential/commercial area in line with Australian Standards and would include street lighting, pathway lighting within recreational and communal areas, and landscape feature lighting. No lighting will be installed at the proposed tennis courts in order to minimise impacts to surrounding residential properties. Refer to the Public Lighting Plan in Appendix F57 in Appendix F.
118		Relocation of buildings in Precincts 7 and 5 so that they are not visible from the southern approach.	The Proposed Masterplan has been revised to reduce the scale and bulk of buildings in Precincts 5, 6 and 7. Refer to Section 2.8.3 and Figure 2.2. In combination with the proposed landscaping of the Proposal Area, it is considered that there will be minimal visual impacts associated within the Proposal.
119	Conservation Council	The gas used in Canberra's buildings for heating, hot water and cooking is a fossil fuel, responsible for approximately 22 per cent of the ACT's direct greenhouse gas emissions. On the other hand, 100 per cent of the ACT's electricity comes from (or is offset by) renewable energy sources, making electric appliances clean to run, whereas gas appliances will always produce carbon emissions. A 2018 report found that "to continue to promote reticulated gas to new Class 1 dwellings is to lock most of those new home buyers into significantly higher energy costs for the medium to longer term", due to the energy efficiency of all-electric homes compared to dual-fuel homes and the capital cost implications of gas reticulation.2 Electric appliances (particularly heat pumps for water and space heating) are more efficient in their use of energy than any form of gas3,4, and can be powered by locally-installed rooftop solar photovoltaic panels. When coupled with energy-efficient design (such as passive solar orientation and thermal insulation and glazing) they can lower both energy demand and carbon emissions and be very low-cost for residents to operate.5,6 A solar-powered all-electric homecan save a new-home buyer up to $18,000 over 10 years compared with installing both electricity and gas (and no solar power).7 Electric heaters and cooktops also avoid the health and safety hazards that gas and wood-fired appliances introduce into homes and suburbs, particularly the impact of indoor and outdoor air quality on respiratory health.8,9 Reverse-cycle heat pumps can also be used to cool homes in summer and protect indoor air quality during bushfire and controlled burning smoke events, mitigating future climate change and air quality risks identified in Section 12 of Umwelt's Environmental Impact Assessment10 (the EIA). Additionally, induction cooktops include features such as automatic cut-out and no flames or fumes to pose health and safety hazards for children and the elderly.	Refer to Section 6.4.1.4 for justification regarding gas connection.

Ref	Organisation / Person	Comment	Response
120		The ACT Government has set a clear strategic direction to phase out the use of gas in buildings, with commitments to prevent new connections to the gas network within the next two years. All-electric buildings are already viable, energy-efficient and attractive to residents and occupants. Examples in Canberra include the Ginninderry residential estate, the Margaret Hendry School and a growing number of privately owned sustainable homes11. The ACT Government has additionally committed to making the expansion of the Canberra Hospital and all current and future greenfields developments (such as Jacka and Whitlam) all-electric.	Refer to Section 6.4.1.4 for justification regarding gas connection.
121		The EIA finds that "there are no known gas utility assets within the Proposal Area" apart from "a 63mm diameter gas main in Bentham Street and a 40mm diameter main in Denman Street". Evoenergy's revised gas network plan for 2021–26 "exclude[s] market expansion capex for and associated gas demand from [new ACT land] developments" and also excludes "market expansion capex for ACT infill developments after 2023", consistent with the ACT Government's commitments and strategic direction.12 Given the absence of gas mains at the Brickworks site, extension of gas infrastructure to the site may not be included in Evoenergy's network expenditure forecasts and costs may therefore fall to the developer / future homeowners.	Refer to Section 6.4.1.4 for justification regarding gas connection.
122		The Conservation Council contends that Doma should indeed directly influence the choice of energy-efficient appliances for heating and cooking in both private dwellings and commercial spaces and achieve greater ongoing emissions reductions from the precinct by simply not installing gas infrastructure to the precinct. Viable alternatives to gas appliances, for both residential and commercial applications (including commercial kitchens16,17 and fireplaces18), are readily available, efficient and cost-effective. Installing gas infrastructure and appliances in the Brickworks precinct now would be in direct contradiction with the ACT Government's clearly stated intention to phase out fossil gas. It would result in a significant cost burden on home buyers both in the immediate future for running costs and at some point in the medium term future to replace any gas appliances with electric as the phase-out of the gas network proceeds. There is an even greater imperative to ensure that all commercial and communal kitchens and large-scale heating, ventilation and air conditioning (HVAC) systems are all-electric from the outset, as these facilities are significantly more energy-intensive to operate and would require significant investment to retrofit in the future.	Refer to Section 6.4.1.4 for justification regarding gas connection.
123		In contrast, the Brickworks redevelopment offers Doma an excellent opportunity to demonstrate industry leadership in sustainable building, if it commits to going gas-free. Doma should take the initiative to educate potential buyers about the advantages (health, safety, efficiency, cost-savings and greenhouse gas emissions reductions) of all-electric homes, and capitalise on the marketing potential of aligning the development and the company with the Territory's sustainable development goals. Climate change is the most significant threat to the global community and the impacts of a changing climate are well upon us. Responding to climate change requires both adaptation (actions to adjust to changes that have happened and are predicted) and mitigation (actions to avoid and minimise further emissions). The ACT's per capita's emissions are nearly three times the global average19,20 and we have an obligation, consistent with the ACT's parliament's declaration of a climate emergency, to ensure a fast and efficient transition to clean energy. Any new substantial developments that persist in connecting to the gas mains and thereby locking in consumption of fossil gas are at odds with this obligation, and should not be approved.	Refer to Section 6.4.1.4 for justification regarding gas connection.

Ref	Organisation / Person	Comment	Response
124		• To ensure consistency with the ACT's Climate Strategy and the global climate science, DomaGroup should develop the Brickworks as an all-electric precinct and not install gas infrastructure • DomaGroup's marketing of the Brickworks precinct should include education about the benefits of all-electric buildings	Refer to Section 6.4.1.4 for justification regarding gas connection.
125		While the focus of this submission is to discourage Doma from installing gas, the Conservation Council also recommends that Doma ensures a high standard of energy efficiency and sustainable sourcing of materials used in the construction of all buildings.	The Proponent commits to achieving 5 start Green Star rating for the Proposal. Refer to Section 12.5.
126		Additionally, the Council recommends that Doma prioritise the incorporation of permeable surfaces, biodiverse urban greenery and water-sensitive landscaping and stormwater management, that considers climate resilience.	The Proponent has prioritised these features through provision of extensive parkland areas and landscaping. Refer to Section 9.5 and 12.5.
127		The precinct should also provide infrastructure (such as separated cycleways, street lighting, easily accessible bike racks and end-of-trip facilities for visitors, prioritisation of pedestrian access to all facilities) to encourage safe walking and cycling and connection to public transport services. Buildings should incorporate electric vehicle charging stations.	The Proposal has sought to encourage active travel through an integrated footpath network. Bicycle parking and EV stations will also be provided. Refer to Section 7.4.2.1, 7.4.2.2 and 12.5.2.
128		Waste management should include onsite composting of organic materials and the full range of source-separated recycling. Doma could also incorporate communal resources, such as a tool library, shared laundry and community food garden, that encourage reduced material consumption consistent with circular economy principles and reduction of scope 3 (embodied) emissions.	Once operational, the option to compost vegetation waste would be available to residents, where appropriate. Refer to Section 8.4.1.2. Communal landscaped areas and resources would be subject to further design investigation during the DA stages of the Proposal.
129		Finally, the Conservation Council supports the Friends of Grasslands in their call for a strategic approach be taken with regards to the conservation of species and representation of ecological communities across the ACT, rather than the piecemeal site by site consideration. We also share their concern that when offset sites cannot be found in the ACT, the impacts should be avoided. Offset credits should be clearly identified on the ACT Government's Offset Register.	Noted.
130	Inner South Canberra Community Council	Heritage (section 16 of EIS) The proposed development appears to protect and adaptively reuse all significant heritage on the site. We look forward to seeing more specific details of the adaptive reuse of the heritage build-ings, quarry and railway remnants in the Estate Development Plan and the Development Applica-tions. We will expect that Plan and the Development Applications to adhere to the heritage poli-cies and guidance within the Conservation Management Plan. The EIS indicates that training of all construction personnel will be undertaken before construction begins to ensure they are aware of the heritage sites to be protected, and that if vibration or other construction work threatens to cause damage the relevant machinery will be stopped and alternative equipment used. We under-stand that the Geological Society of Australia has no objection to a section of the quarry being filled (for residential development) in terms of its impact on geological heritage.	Noted.
131		Landscape and Visual Impacts (section 9 of EIS) A key issue is the impact of the proposed development on the vistas from surrounding areas into the Brickworks precinct. The most obvious impact will be on the vista from Dunrossil Drive to-wards the precinct, in particular towards the terraces that will be built in the south west of the site near Dunrossil Drive. We understand that the Governor General's office will require a fence and hedge at the boundary with the Brickworks precinct.	The Proposed Masterplan has been revised to reduce the scale and bulk of buildings in Precincts 5, 6 and 7. Refer to Section 2.8.3 and Figure 2.2. Fencing and landscaping will likely be required along the Proposal boundary, where appropriate, for sercurity purposes. In combination with the proposed landscaping of the Proposal Area, it is considered that there will be minimal visual impacts associated within the Proposal.

Ref	Organisation / Person	Comment	Response
132		There is an area of forest to the south of the ridge line, outside the Brickworks Precinct, which ap-pears from the Tree Assessment Report at Appendix F10 to consist mostly of high quality regu-lated trees. Consequently, Doma's landscape plans for the precinct, and the ACT Government's plans for man-agement of the forest between the precinct and Dudley Street, must ensure there continues to be a visual wooded buffer between the ridge line and the view corridors from the south and the west. It should be possible to achieve this while meeting the requirements of the bushfire management plan for the area.	Noted. The Proponent has no input as to the management of the wooded area outside of the Proposal Area.
133		In the Brickworks precinct as a whole, the proponent plans to remove several hundred trees. The ISCCC understands that many trees need to be removed because they are located on the building footprint, are in an area of proposed cut and fill, or are senescent. However, we would like to see quality specimens retained in other areas of the site to provide visual amenity, protect landscape qualities, and maintain a cooling effect in summer, especially as it may take several years for new trees to grow. We could see no reference in the Tree Assessment Report that some of the trees in the Brickworks precinct are part of the heritage-listed Westbourne Woods, yet the heritage listing for the Westbourne Woods indicates the woods extend from the lake through the Forestry pre-cinct and the Golf Course to the Brickworks.	The Proposal Area does not form part of the heritage-listed Westbourne Woods. The Proposal includes extensive landscaping and replanting to provide visual amenity. Refer to Section 9.4.1 for a summary of proposed species of trees to planted, as well as Appendix F46 in Appendix F for the draft Landscape Master Plan.
134		Bushfire management (section 14) The ISCCC understands that even though Doma is planning for an Inner Asset Protection Zone at the southern boundary of the Brickworks site, there may also be a need for a 10 metre Outer As-set Protection Zone on adjacent public land. As noted above, we are concerned about the extent to which the development of the Precinct will impact on adjacent lands, public amenity particu-larly in relation to the forest and windbreak and sound break provided by the trees to the South and West of the CBP and the frequently used trail located on ACT government land between the CBP and the Royal Canberra Golf Course fence.	The proposed IAPZ and OAPZ have been determined through consultation with F&R and ESA. The informal trail would be impacted by the Brickworks Way access road, being a separate project to that assessed in this EIS. The SLA has advised that a pedestrian refuge crossing arrangement or realignment of the track would be provided once the Proposal is operational. Refer to Section 7.2.4.1.
135		Matters of National Environmental Significance (sections 15.2.1, 15.3.1) We note that some Golden Sun moth habitat will be affected by the proposed development, but that an offset arrangement has been agreed with the Wandiyali Restoration Trust in Googong. The ISCCC is aware that a much larger area of Golden Sun moth habitat exists to the south, south east and south west of the Brickworks development and trusts that it will remain protected.	No impacts to golden sun moth outside of the Proposal Area is proposed by the Proponent.
136		Traffic and Transport (section 7 of EIS) The ISCCC is pleased that the Brickworks precinct has been designed so as to prevent rat-running from Cotter Road through the precinct to the rest of Yarralumla. The ACT Government's upgrading of Dudley Street and construction of Quarry Drive into the Brick-works site are well under way. Given rapid population growth in Molonglo and increased traffic from Cotter Road into Dudley Street and Adelaide Avenue, a long term solution is needed to bet-ter integrate transport along these corridors, specifically an interchange. It is ludicrous that many thousands of vehicle movements per week are being channelled along Dudley Street in Yarralumla when many of these drivers are heading to commercial premises in West Deakin and other parts of the inner south. The EIS identifies the impact of public access to the Brickworks precinct on traffic congestion and parking as a residual risk. We do not believe that this risk has been fully dealt with.	Noted. It is considered that the Proposal provides adequate public parking. Refer to Section 7.4.2.1. Further analysis has been provided in Sections 7.4.1 and 7.4.2.

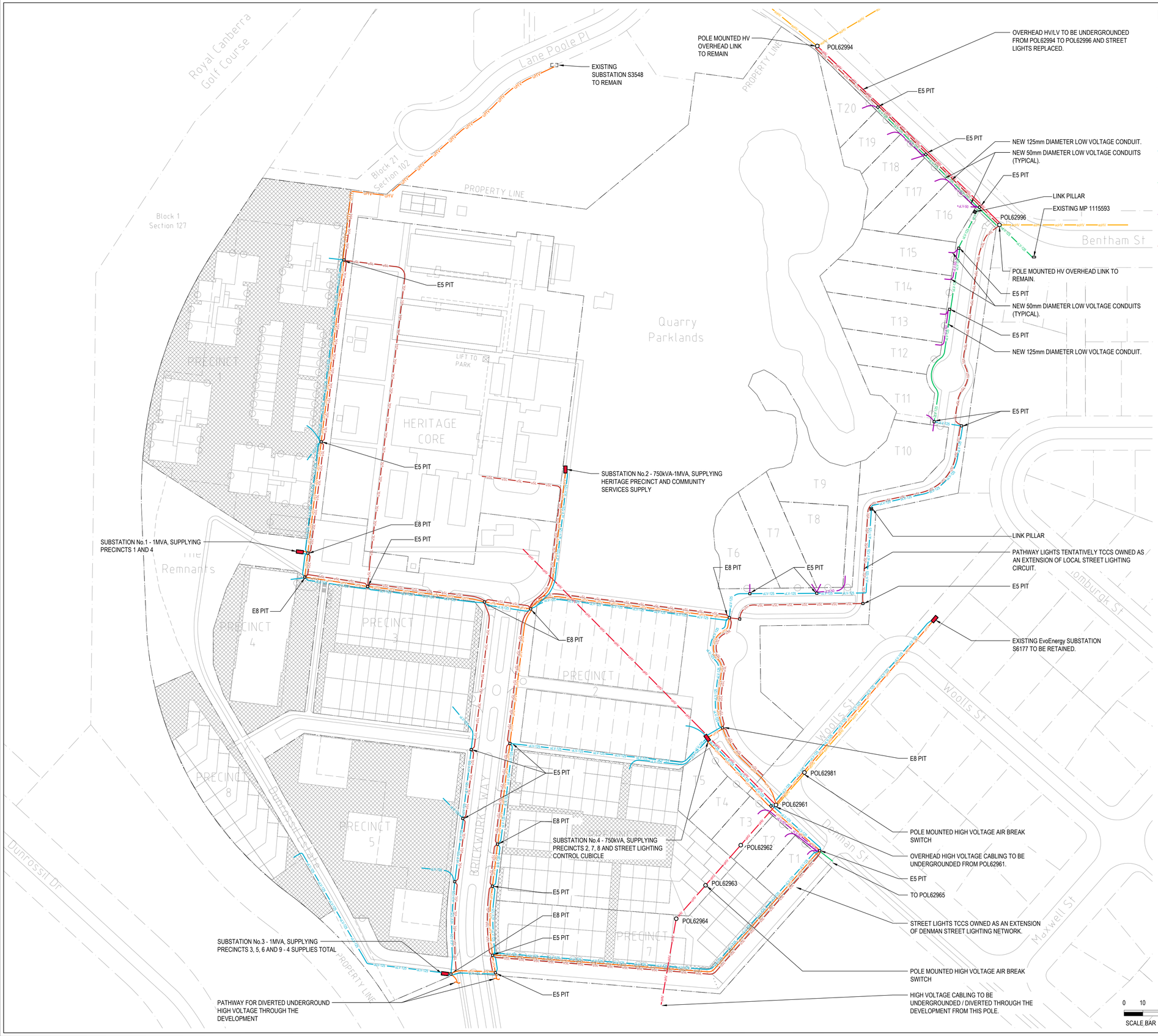
Ref	Organisation / Person	Comment	Response
137		We understand that Transport Canberra knocked back a request for buses to be allowed to enter the Canberra Brickworks Precinct (CBP). We do not believe the provision of a new bus stop on Dudley Street fulfils the objective for public transport to be the most attractive form of local transport. We are concerned about the provision of adequate car parking given the likely pressure on surrounding streets if there is insufficient public transport, public parking or if the cost of the proposed paid parking deters workers and visitors from parking within the precinct. The calcula-tion of car parking requirements does not include any car parks for visitors to the Quarry Park or Railway Remnants Park. There is also a need to ensure adequate active travel connections, including that the proposed shared path along Denman Street be designed in a way to meet the needs of both path users and visitors to the Uniting Church and church hall on that street.	Noted. It is considered that the Proposal provides adequate public parking. Refer to Section 7.4.2.1.
138		Climate Change mitigation and adaptation (section 12) Doma's consultant Bloc has produced a Climate Adaptation Plan to spell out how Doma will ad-dress climate change mitigation and adaptation. The ISCCC will monitor the extent to which the proposed actions are reflected in the Estate Development Plan and Development Applications. For example, Doma is targeting a Five Star Green Star Community rating, as foreshadowed in the Precinct Objectives in the tender process for the Brickworks redevelopment. It is not clear yet ex-actly what measures will be taken to achieve the requisite scores to rate as a Five Star Green Star Community. There is a reference to solar passive orientation and canopy cover, possible installa-tion of solar panels, and reuse of stormwater for irrigation. However, there is no reference to dou-ble-glazed windows and the proponents plan to connect the houses, townhouses/terraces and commercial buildings on site to the gas network, despite the ACT Government commitment to phase out gas. As noted in the section on Landscape and Visual Impacts, hundreds of mature trees will be re-moved, which is not consistent with the ACT Government's Living Infrastructure strategy. We un-derstand the proponent has made a commitment to plant many new trees in the precinct, but we have not seen a landscaping plan yet, which is needed if we are to have confidence that the new urban forest will be better than what is there now.	Proposed measures to facilitate the Proposal's 5 star Green Star rating are outlined in Section 12.5. Further design details will be determined during the DA stages of the Proposal. A draft Landscape Master Plan is now included in Appendix F46 in Appendix F.
139		Utilities (section 6) We note the proposal to connect gas to houses/townhouses, commercial cooking and fireplaces where no viable alternative exists. The stated intention to connect gas is contrary to ACT Govern-ment policy to phase out gas use. The proponent has indicated the Government made connection to the gas network a requirement in the tender process. If that is so, the Government should re-consider this requirement, to take into account the change in Government policy.	Refer to Section 6.4.1.4 for justification regarding gas connection.
140		Water Quality and Hydrology (section 10) It is pleasing to see in the EIS that the proposed lake in the quarry and other tanks on site will meet the majority of the irrigation needs of the precinct. We understand that surface water samples indicated that zinc was present in quantities that ex-ceeded the NEPM (2013) screening criteria for fresh water. Testing to date has indicated there is also cadmium, nickel and zinc in the groundwater, and it is not clear whether that is naturally oc-curring or results from industrial activity on the site. Further testing is needed to assess groundwa-ter contamination. Given that Doma's plan includes plans for gardens to supply both households and restaurants on site, remediation may be required to ensure that any produce grown on site is guaranteed safe for human consumption. Groundwater in core parts of the Brickworks site flows under the Royal Canberra Golf Course to Lake Burley Griffin, and so it is essential that an assess-ment is made of whether site disturbance will increase contaminated run-off to the Lake. We note the recommendation (Appendix F14 – Stormwater Treatment Systems) not to connect water tanks to toilets due to very low reliability but given the availability of technology to switch from tank water to mains water, all tanks should also be connected for toilet flushing in order to conserve water. Indeed, we understand that the ACT Government provides for water tanks to be connected to at least "toilet, laundry cold water, all external uses" (See Water efficiency - Build, buy or renovate (act.gov.au). High capacity water tanks connected to the maximum number of roofs would help the precinct get closest to water self- sufficiency.	The Proposal Area will be remediated to allow for human occupation. This will be subject to auditing and approval by the EPA. Refer to Section 18.5.2. Water tanks will not be connected for toilet flushing. Refer to Section 10.4.1.

Ref	Organisation / Person	Comment	Response
141		Socioeconomic and Health (section 11) As noted by the YRA in its submission, the 33% increase in Yarralumla's population arising from the Brickworks precinct development will undeniably put additional pressure on the Yarralumla shops, the Yarralumla Primary School and the Yarralumla Surgery, to name just a few of the amenities of the suburb that are already stretched. It should also be noted that if the development of Forestry Place, adjacent to the CBP, proceeds as currently planned, the two projects combined will increase Yarralumla's population by 75%.	Noted.
142		Community and stakeholder consultation (section 19) While the Community Panel has functioned as a way to alert Doma and the SLA to issues that the community is likely to have issue with in relation to aspects of the proposal, giving Doma and the SLA an opportunity to amend or work out solid justification before going to the broader commu-nity, it has been disappointing that TCCS has not had a seat at the table since so many of the issues that have been raised rely on input/response from TCCS. The impact on the Curtin shops and access via McCulloch Street, Curtin appears to have been given very scant attention in the community consultation process, despite the Curtin Shops being the most convenient shopping location for most residents of the Brickworks precinct.	Noted.
143		Contamination, Soils and Geology (sections 17 and 18) This EIS is non-compliant with the Scoping Document requirement to detail, describe, and provide information to ACTPLA for notification on Soils and Geology that would fully inform public repre-sentation to this process at this time. A Sampling, Analysis and Quality Plan (SAQP), scheduled to be undertaken in late 2020, is needed to assess the ten Areas of Environmental Concern (AEC). Data collected in the SAQP inform the Re-medial Action Plan (RAP) and the Environmental Management Plan (EMP). ACTPLA has advised at 20 July 2021 that that the RAP and EMP will be developed prior to the DA stage in accordance with EPA guidelines. However, these guidelines do not require documentation until that time or following approval prior to construction. Consequently, the EIS Assessment Re-view (EISAR) will be prepared and the Minister's decision will be taken without reference to essen-tial information and mitigation measures on contamination and soils at the site. Many questions remain unanswered.	Refer to Section 18.4.1. The extent of contamination is considered to be well understood within the Proposal Area. A Supplemnetary Environmental Site Assessment, Remediation Works Plan and Development Site Management Plan are now included in Appendices F51-F53 in Appendix F. These documents will be subject to approval by an independent auditor and EPA.
144		In order that transparency and accountability of government process be maintained throughout this assessment of environmental impact at the site, ISCCC requests that the final environmental assessment documents in regard to Soils and Geology be submitted to this process and that the public be allowed opportunity for comment. Apart from addressing contamination issues, such re-ports will also enable an assessment of whether the fill material to be used will be suitable for construction purposes. ACT Worksafe must also be included as an Entity to be consulted in relation to this EIS.	Noted.

umwelt
Environmental & Social Consultants

Umwelt (Australia) Pty Limited

T| 1300 793 267 E| info@umwelt.com.au www.umwelt.com.au



LEGEND

- uHV — NEW 2 x 150mm HIGH VOLTAGE UNDERGROUND CONDUIT + 1 x 63mm COMMUNICATIONS UNDERGROUND CONDUIT
- oHV — EXISTING HIGH VOLTAGE OVERHEAD TO BE UNDERGROUNDED / DIVERTED
- eoHV — EXISTING HIGH VOLTAGE OVERHEAD TO REMAIN AS IS
- uLV-125 — NEW 2 x 125mm LOW VOLTAGE UNDERGROUND CONDUIT
- uLV-125 — NEW 1 x 125mm LOW VOLTAGE UNDERGROUND CONDUIT
- uLV-50 — NEW 1 x 50mm LOW VOLTAGE UNDERGROUND CONDUIT
- uSL — NEW 1 x 63mm STREET LIGHTING UNDERGROUND CONDUIT

DRAWING TO BE PLOTTED IN COLOUR

0 10 20 30 40 50 60 70 80 90 100

SCALE BAR 1:1000 [m]

© Copyright of S4B Studio
Creative Engineering Solutions
ABN 95 144 688 945

All rights reserved. Figured dimensions shall be taken in preference to scaling. The Contractor shall check all dimensions on site prior to commencing work.

north

rev	description	date
P7	REVISED PRELIMINARY ISSUE	11.02.2022
P6	REVISED PRELIMINARY ISSUE	21.12.2021
P5	REVISED PRELIMINARY ISSUE	28.04.2021
P4	REVISED PRELIMINARY ISSUE	09.04.2021
P3	REVISED PRELIMINARY ISSUE	08.04.2021
P2	REVISED PRELIMINARY ISSUE	24.03.2021
P1	PRELIMINARY ISSUE	13.07.2020

revision

dwg no	title	rev
A-0271	MASTERPLAN	22

referenced drawings

architect

SJB Architects
Level 2
490 Crown Street
Surry Hills NSW
2010 Australia
T 61 2 9380 9911
F 61 2 9380 9922
www.sjb.com.au

client

DOMAGROUP

E admin@s4bstudio.com.au
T +61 2 9002 4200

Services 4 Buildings Pty Ltd
L5 / 309 George Street
Sydney NSW 2000
ABN 95144 688 942

S4Bstudio.com.au

project

YARRALUMLA BRICKWORKS

service

ELECTRICAL SERVICES

title

ELECTRICAL INFRASTRUCTURE PLAN

drawn	date	designed	date	scale
KT	18.06.20	SG	19.06.20	1:1000@A1

project no	drawing no	rev
S4B20002400	E-100	P7

MASTERPLANNING MAXIMUM DEMAND CALCULATION

Project Name:	Yarralumla Brickworks
Project No:	S4B20002400
Date:	11-02-2022

E admin@s4bstudio.com.au

Services 4 Buildings Pty Ltd
L5 / 309 George Street
Sydney NSW 2000
T +61 2 9002 4200

L4 / 60 Marcus Clarke Street
Canberra ACT 2601
T +61 2 6113 4900

ABN 95 144 688 942

S4Bstudio.comau

Block	Units / Area	Demand per unit / area	Total (kVA)	Comments
Precinct 1				
Apartments	114	3000	342	Allows for instantaneous electric hot water
Townhouses	20	5500	110	extra allowance for additional AC load.
Basement carparking	11500	15	173	
lifts	8	14	112	
Electric vehicle charging	57	3600	154	Allowance for 3.6kW standard charger for 50% of apartments @75% diversity
common areas				factored into the 15W/m for the carparking
			890	**kVA**
Precinct 2				
Terrace housing	21	5500	116	extra allowance for additional AC load.
carparking	45	15	24	from road hierarchy plan
lifts	0	14	0	walk ups
common areas				factored into the 15W/m for the carparking
			139	**kVA**
Precinct 3				
Terrace housing	22	5500	121	extra allowance for additional AC load.
carparking	7200	15	108	from road hierarchy plan
lifts	0	14	0	walk ups
common areas				factored into the 15W/m for the carparking
			229	**kVA**
Precinct 4				
Apartments	44	3000	132	assumed instantaneous hot water
carparking	88	15	46	average 2 per apartment
lifts	2	14	28	assumed 2 cores
Electric vehicle charging	22	3600	59	Allowance for 3.6kW standard charger for 50% of apartments @75% diversity
common areas				factored into the 15W/m for the carparking
			266	**kVA**
Heritage Core				
Retail precinct	4020	180	724	existing heritage precinct areas from DIS traffic study. Load increased to cater foor food retail and swimming pool/spa facility
EV fast chargers	3	50000	150	
external lighting	2000	3	6	estimated area
			880	**kVA**
Precinct 5				
Apartments	80	3000	240	assumed instantaneous hot water
carparking	163	15	86	from road hierarchy plan
lifts	4	14	56	assumed two cores, one lift per core
Electric vehicle charging	40	3600	108	Allowance for 3.6kW standard charger for 50% of apartments @75% diversity
common areas				factored into the 15W/m for the carparking
			490	**kVA**
Precinct 6				
Townhouses	31	6000	186	extra allowance for additional AC load.
carparking	75	15	39	from road hierarchy plan
lifts	2	14	28	assumed two cores, one lift per core
common areas				factored into the 15W/m for the carparking
			253	**kVA**
Precinct 7				
Townhouses	18	6000	108	extra allowance for additional AC load.
carparking	75	15	39	from road hierarchy plan
lifts	2	14	28	assumed two cores, one lift per core
Electric vehicle charging	9	3600	24	Allowance for 3.6kW standard charger for 50% of apartments @75% diversity
common areas				factored into the 15W/m for the carparking
			200	**kVA**
Precinct 8				
Townhouses	10	5500	55	extra allowance for additional AC load.
carparking	25	15	13	from road hierarchy plan
lifts	0	14	0	walk ups
Electric vehicle charging	5	3600	14	Allowance for 3.6kW standard charger for 50% of apartments @75% diversity
common areas				factored into the 15W/m for the carparking
			82	**kVA**
T2,3,4,5,6	10	5500	55	Stand alone house blocks
			55	**kVA**
T7-21	14	5500	77	Stand alone houses
			77	**kVA**
		Site total	**3560**	**kVA total**

Notes

Typical allowance of 3.0kVA per apartment to allow for electric instantaneous hot water
Typical allowance of 5.5kVA per townhouse/terrace house to allow for electric instantaneous hot water and increased AC loads
Basement carparks assumed to be 35m2/space

LEGEND

- NBN-P100 — 1 x NBN P100 WHITE COMMUNICATIONS CONDUIT
- NBN-P50 — 1 x NBN P50 WHITE COMMUNICATIONS CONDUIT
- NBN-P23 — 1 x NBN P23 WHITE COMMUNICATIONS CONDUIT
- eNBN — EXISTING NBN CONDUIT
- TA-100 — 1 x 100mm TRANSACT WHITE COMMUNICATIONS CONDUIT
- TA-50 — 1 x 50mm TRANSACT WHITE COMMUNICATIONS CONDUIT

DRAWING TO BE PLOTTED IN COLOUR

0 10 20 30 40 50 60 70 80 90 100

SCALE BAR 1:1000 [m]

© Copyright of S4B Studio
Creative Engineering Solutions
ABN 95 144 688 945

All rights reserved. Figured dimensions shall be taken in preference to scaling. The Contractor shall check all dimensions on site prior to commencing work.

north

rev	description	date
P3	REVISED PRELIMINARY ISSUE	21.12.2021
P2	REVISED PRELIMINARY ISSUE	08.04.2021
P1	PRELIMINARY ISSUE	13.07.2020

revision

dwg no	title	rev
A_0271	MASTERPLAN	19

referenced drawings

architect

SJB Architects
Level 2
490 Crown Street
Surry Hills NSW
2010 Australia
T 61 2 9380 9911
F 61 2 9380 9922
www.sjb.com.au

client

DOMAGROUP

E admin@s4bstudio.com.au
T +61 2 9002 4200

Services 4 Buildings Pty Ltd
L5 · 309 George Street
Sydney NSW 2000
ABN 95144 688 942

S4Bstudio.com.au

project

YARRALUMLA BRICKWORKS

service

ELECTRICAL SERVICES

title

COMMUNICATIONS INFRASTRUCTURE PLAN

drawn	date	designed	date	scale
KT	18.06.20	SG	19.06.20	1:1000@A1

project no	drawing no	rev
S4B20002400	E-200	P3

Canberra Brickworks Precinct, ACT

Site Investigation - Traffic, Transport & Carparking

Canberra Brickworks Precinct, ACT

Site Investigation - Traffic, Transport & Carparking

Client: Land Development Agency

ABN: 204 199 255 79

Prepared by

AECOM Australia Pty Ltd
Level 2, 60 Marcus Clarke Street, Canberra ACT 2600, Australia
T +61 2 6201 3000 F +61 2 6201 3099 www.aecom.com
ABN 20 093 846 925

12-Feb-2016

Job No.: 60427110

AECOM in Australia and New Zealand is certified to the latest version of ISO9001, ISO14001, AS/NZS4801 and OHSAS18001.

© AECOM Australia Pty Ltd (AECOM). All rights reserved.

AECOM has prepared this document for the sole use of the Client and for a specific purpose, each as expressly stated in the document. No other party should rely on this document without the prior written consent of AECOM. AECOM undertakes no duty, nor accepts any responsibility, to any third party who may rely upon or use this document. This document has been prepared based on the Client's description of its requirements and AECOM's experience, having regard to assumptions that AECOM can reasonably be expected to make in accordance with sound professional principles. AECOM may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified. Subject to the above conditions, this document may be transmitted, reproduced or disseminated only in its entirety.

Quality Information

Document Canberra Brickworks Precinct, ACT

Ref 60427110

Date 12-Feb-2016

Prepared by Tom McMahon

Reviewed by Tim Heffernan

Revision History

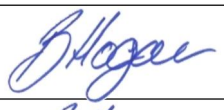
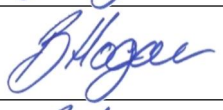
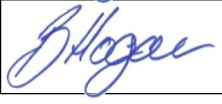
Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
1	25-November-2015	Initial Draft	Brendan Hogan Senior Traffic Engineer	
2	15-Dec-2015	Final	Brendan Hogan Senior Traffic Engineer	
3	02-Feb-2016	Final B	Brendan Hogan Senior Traffic Engineer	
3.1	12-Feb-2016	Final B	Brendan Hogan Senior Traffic Engineer	

Table of Contents

Executive Summary 1
1.0 Introduction 2
1.1 Background 2
1.2 Purpose of this Report 2
1.3 References 2
2.0 Existing Conditions 3
2.1 The Site and Environs 3
2.2 Road Network 4
2.2.1 Hierarchy 4
2.2.2 Yarralumla Road network 5
2.3 Traffic Volumes 6
2.4 Intersection Operation 7
2.5 Car Parking 11
2.5.1 Parking Supply and Restrictions 11
2.5.2 Parking Utilisation 15
2.6 Public Transport 16
2.7 Active Travel 17
3.0 Existing Capacity Constraints and Opportunities 18
3.1 Existing Capacity Constraints 18
3.2 Opportunities 18

List of Tables

Table 1 Level of Service Definition Table 9
Table 2 SIDRA Summary Table 10
Table 3 Public Transport Provision 16
Table 4 Bus Level of Service Summary 16
Table 5 Public Transport at Subject Site, Level of Service 17

List of Figures

Figure 1 Study Area 3
Figure 2 Road Classification Summary 5
Figure 3 Daily Traffic Volume and Speed Summary 6
Figure 4 Hopetoun Circuit Intersection Traffic Volumes 8
Figure 5 Novar Street, Kent Street and Cotter Road Intersection Traffic Volumes 9
Figure 6 On-Street Parking Restrictions 12
Figure 7 Yarralumla shops parking restrictions and Supply 13
Figure 8 Spot count of parking utilisation associated with church 14
Figure 9 Parking Utilisation on a Weekday 15
Figure 10 Parking Utilisation on a Weekend 15
Figure 11 Public Transport Routes 16
Figure 12 Active Travel Link 17

Executive Summary

The ACT Government, represented by the Land Development Agency (LDA) has briefed AECOM to prepare a traffic site investigation report for key sections of Yarralumla, ACT. The scope was reviewed by TAMS.

This investigation is intended to identify existing capacity within the existing suburb or Yarralumla and to provide sufficient data for any future impact assessment associated with the development.

The analysis and relevant discussion in this report allows the following conclusions to be made:

- Some links in the road network are currently operating near their intended design volumes when compared to the road classifications.
- The Hopetoun Circuit /Adelaide Avenue and Kent Street/Denison Street intersections are operating over capacity during peak periods.
- The Novar Street/Dudley Street/Kent Street/Adelaide Avenue roundabout is operating at capacity during peak periods.
- The parking associated with the shops operates at capacity on the weekend and operates over capacity during the working week.
- The public transport level of service is acceptable during the peak periods on a weekday, but is limited during off peak periods and on weekends.
- There is good provision for active travel within Yarralumla however there is limited connectivity between the local active travel network and on-road cycle lanes located on Adelaide Avenue.

1.0 Introduction

1.1 Background

The ACT Government, represented by the Land Development Agency (LDA) has briefed AECOM Australia Pty Ltd (ABN 20 093 846 925) to prepare a traffic, transport and parking investigation report for key sections of Yarralumla, ACT.

This investigation is intended to identify existing capacity within the existing suburb or Yarralumla and to provide sufficient data for any future impact assessment associated with the development.

1.2 Purpose of this Report

This report sets out an assessment of the existing transport conditions of the study area, including consideration of the following:

i key road accesses to the study area;

ii existing traffic volumes and any corresponding existing congestion issues;

iii existing car parking availability and utilisation;

iv existing public transport amenity in the study area;

v existing pedestrian and cycle infrastructure in the study area.

1.3 References

In preparing this report, reference has been made to the following:

- An inspection of the site and its surrounds;
- Transportation Research Board (TRB) Transit Capacity and Quality of Service Manual, Third Edition;
- Building Code of Australia (BCA);
- Traffic and car parking observations undertaken and as referenced in the context of this report;
- Other documents and data as referenced in this report.

2.0 Existing Conditions

2.1 The Site and Environs

The study area for this site investigation is bounded by Hopetoun Circuit to the east, Alexandrina Drive to the north, the brickworks site and the Dudley Street/Cotter Road intersection to the west and the Denison Street/Kent Street intersection to the south. The area of review related to transport is provided in Figure 1 below.

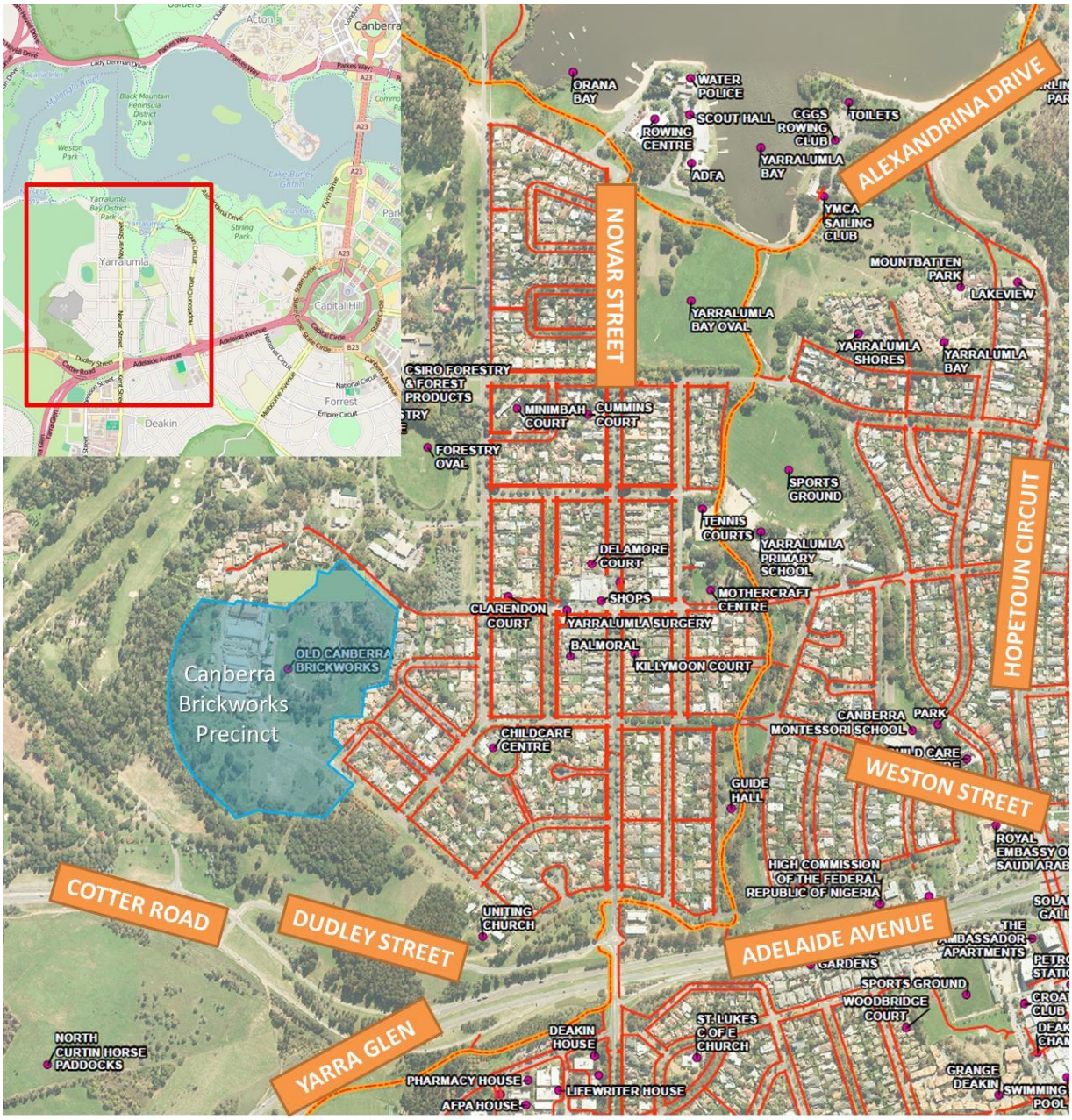


Figure 1 Study Area

2.2 Road Network

2.2.1 Hierarchy

The classification of roads in the ACT is based on a formal road hierarchy. The classification fundamentally relates to the predominant function of a road and to the extent it serves the two basic purposes of the road network – the movement of traffic and access to property. The road classifications used are outline below.

2.2.1.1 Arterial Roads

Arterial roads predominantly serve longer distance travel within a district and through traffic from one district to another. They include limited access roads and parkways (or freeways) having full access control and grade separated inter-sections. A small number have higher levels of property access for urban design reasons, for example Northbourne Avenue, or reflect the planning and design parameters of the time of their construction, for example, Limestone Avenue. Traffic capacity is a function of the design of the road rather than being constrained by environmental objectives.

2.2.1.2 Major Collector Roads

Major collector roads collect and distribute traffic within residential, industrial and commercial areas. They form the link between the primary network and the roads within local areas and should carry only traffic originating or terminating in the area. The volume of traffic carried is constrained by environmental objectives - safety and traffic noise - rather than road geometry and reflects the limited area that they serve. Direct property access is still permissible but the level of traffic may dictate that access and egress arrangements should be such that vehicles can exit properties in a forward direction.

2.2.1.3 Minor Collector Roads

Minor collector roads collect and distribute traffic from access streets, linking to the major collector roads within the neighbourhood. They can also provide secondary connections direct to the external arterial road network. Traffic volumes are compatible with direct property access.

2.2.1.4 Access Streets

Access streets are used where the residential environment is dominant, traffic is subservient, speed and traffic volumes are low and pedestrian and cycle movements are facilitated. The primary role of Access Streets is to provide direct property access. Access streets can link traffic from the local network (including rear lanes) to collector roads. In most case they will not have direct connections to Arterial roads.

2.2.2 Yarralumla Road network

Adelaide Avenue and Cotter Road are the arterial roads which feed traffic into Yarralumla. Novar Street and Hopetoun Circuit are the main north/south connections in the form of major collector roads. These then feed into the minor collectors which include Bentham Street, Weston Street and Schlich Street. A summary of the road classifications in the study area can be seen in Figure 2 below.

Figure 2 Road Classification Summary

The suitability of the existing road network to accommodate existing and potential future traffic is discussed in sections 2.3 and 2.4.

2.3 Traffic Volumes

Two forms of traffic surveys were undertaken by subcontractors on the week starting 2 November 2015. Intersection traffic volume counts were conducted at a number of locations to determine the peak periods of traffic and to allow for modelling of the current traffic conditions. Week long tube counts were also undertaken to determine average daily traffic volumes and average speed on key roads. A summary of the daily traffic volumes in the study can be seen in Figure 3 below.

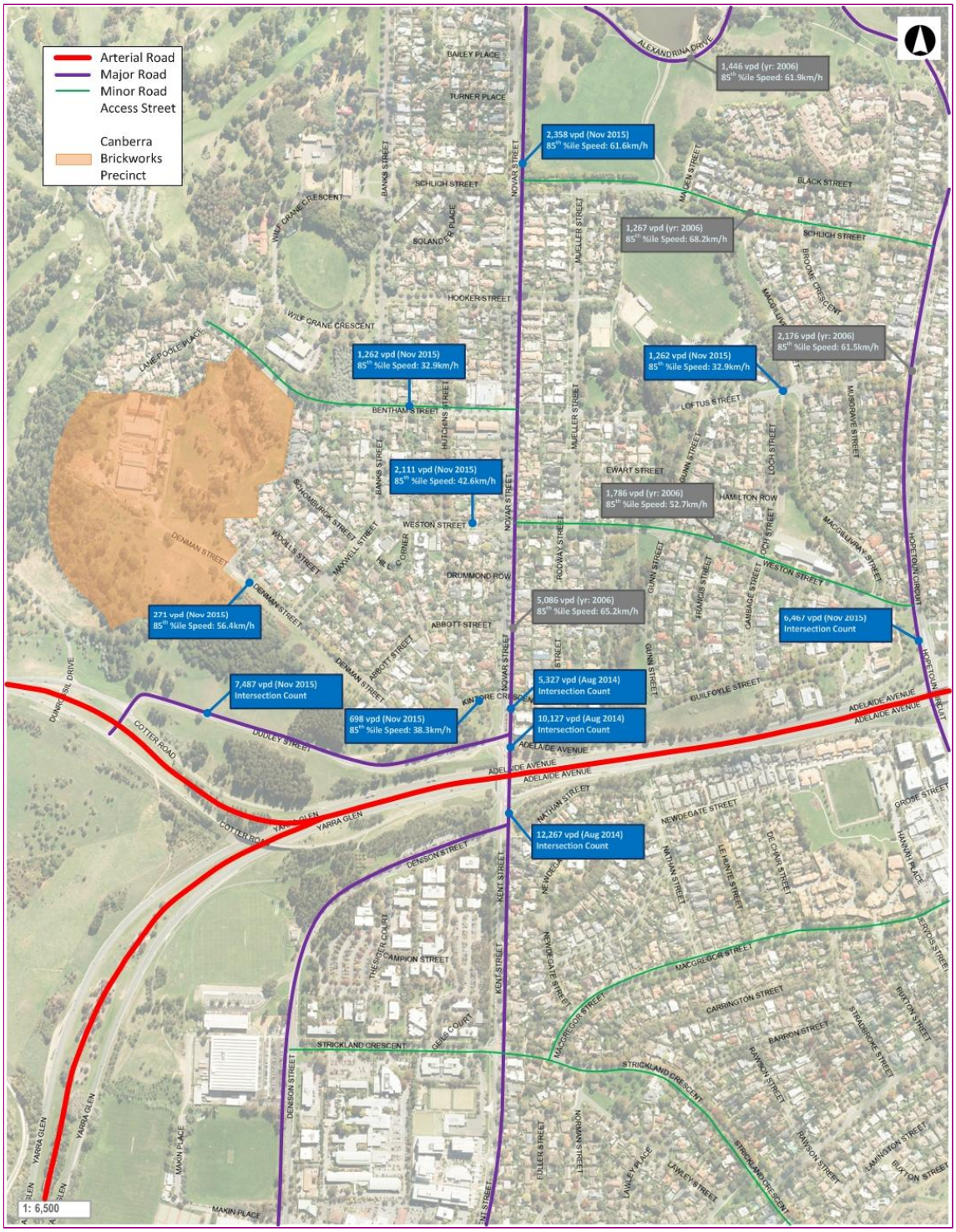


Figure 3 Daily Traffic Volume and Speed Summary

The figure above indicates that the road classifications in Yarralumla are good indicators as to the daily traffic volumes on the roads surveyed. Some access roads exceed the classification volume capacity in the vicinity of the shops, which would be primarily due to a higher number of short stay trips.

The traffic volumes displayed in grey are from 2006 Roads ACT data and in blue from a series of midblock and intersection counts undertaken by a subcontractor for AECOM. The midblock counts give full day traffic volumes and an 85th percentile speed. The intersection counts were undertaken to provide data for traffic modelling in SIDRA. For the purposes of an all-day traffic volume the peak hours noted in the intersection counts were converted into all-day volumes by applying a 15% volume factor in the peak hour. This conversion implies that for all traffic in a 24 hr period, approximately 15% occurs in the AM peak hour and 15% occurs in the PM peak hour.

Based on 2015 intersection counts at Weston Street and Hopetoun, Weston Street could be expected to carry between 2,500 and 3,000 vehicles per day (vpd).

2.4 Intersection Operation

A number of key intersections in Yarralumla were surveyed to determine peak hour traffic volume. These intersections were then modelled in SIDRA Intersection 6.1, under two networks based around Hopetoun Circuit and Novar Street/Kent Street. The following intersections were modelled:

- Hopetoun Circuit and Weston Street intersection
- Hopetoun Circuit and Hampton Street intersection
- Hopetoun Circuit and Adelaide Avenue Off Ramp intersection
- Novar Street and Kintore Crescent intersection
- Novar Street, Dudley Street, Kent Street and Adelaide Avenue On Ramp intersection
- Kent Street and Adelaide Avenue Off Ramp intersection
- Kent Street and Denison Street intersection
- Dudley Street and Cotter Road (Westbound) intersection
- Dudley Street and Cotter Road (Eastbound) intersection

A summary of the traffic survey approach volumes for the identified intersections can be seen in Figure 4 and Figure 5.

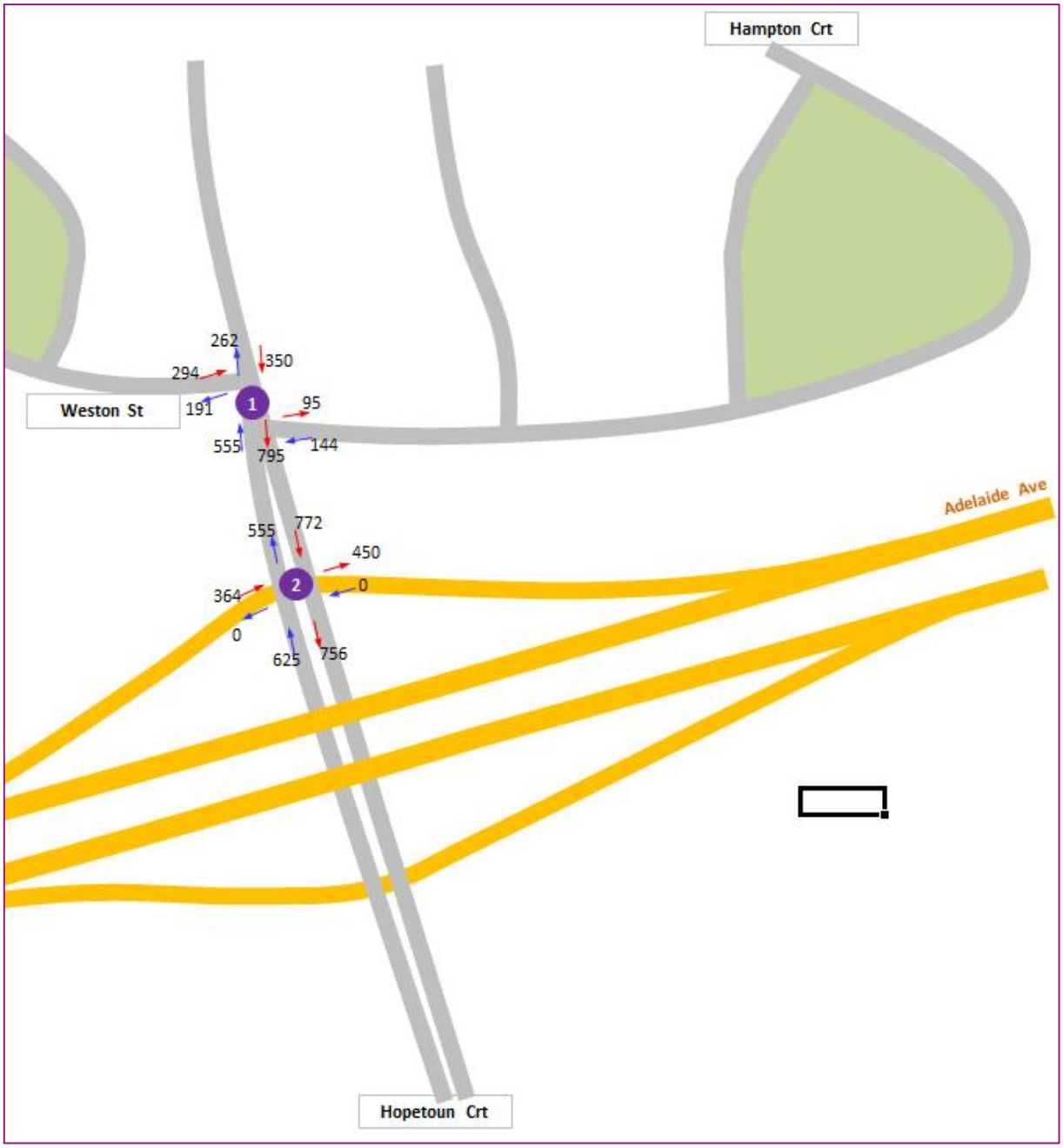


Figure 4 **Hopetoun Circuit Intersection Traffic Volumes**

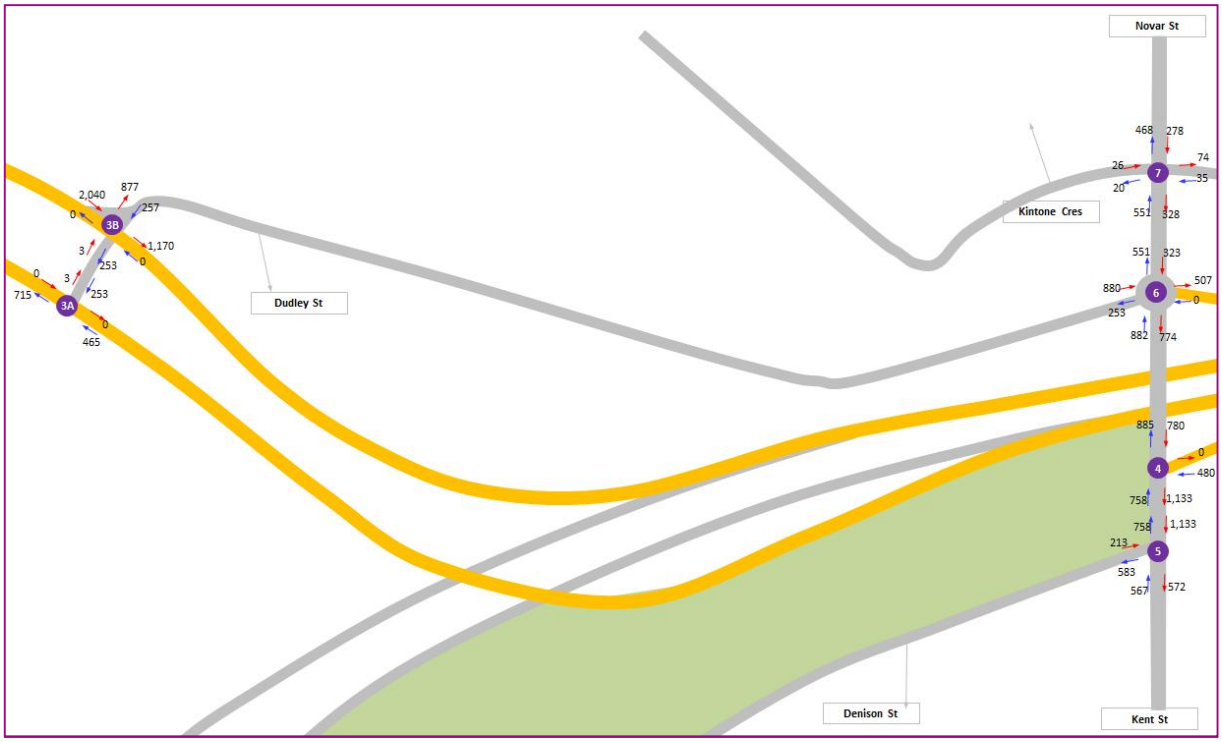


Figure 5 **Novar Street, Kent Street and Cotter Road Intersection Traffic Volumes**

A summary of the results from the modelling of these intersections in SIDRA can be seen in Table 2 below. See Appendix A for the full movement summaries and intersection layouts for each intersection.

Level of Service (LoS) is determined by the average delay for each vehicle. The range definitions for level of service can be seen in Table 1 below.

Table 1 **Level of Service Definition Table**

Level of Service	Average Delay / Vehicle (sec/veh)	Traffic Signals, Roundabouts
A	Less than 14	Good Operation
B	15 to 28	Good with acceptable delays and spare capacity
C	29 to 42	Satisfactory
D	43 to 56	Operating near capacity
E	57 to 70	At capacity; at signals incidents will cause excessive delays
F	>70	Roundabouts require other control mode

95th percentile queue indicates that 95% of the time the queue will be less than the indicated length.

Table 2 SIDRA Summary Table

Site	AM Peak Period				PM Peak Period			
	Degree of Saturation	Average Delay (secs)	Level of Service	95th %ile Queue	Degree of Saturation	Average Delay (secs)	Level of Service	95th %ile Queue
Hopetoun Circuit / Weston Street	0.501	3.5	A	18m	0.168	2.0	A	4m
Hopetoun Circuit / Hampton Street	0.345	2.1	A	11m	0.230	1.3	A	5m
Hopetoun Circuit / Adelaide Avenue Off Ramp	1.147	23.5	B	157m	0.643	6.2	A	29m
Novar Street/ Kintore Street	0.305	1.4	A	6m	0.206	1.2	A	3m
Novar Street/ Dudley Street/ Kent Street / Adelaide Avenue	0.773	18.1	B	81m	0.864	11.7	A	126m
Kent Street/ Adelaide Avenue Off Ramp	0.801	5.9	A	48m	0.643	4.5	A	24m
Kent Street/ Denison Street	0.622	4.5	A	39m	0.884	8.1	A	73m
Dudley Street/ Cotter Road (Eastbound)	0.887	20.4	B	192m	0.840	20.1	B	178m
Dudley Street/ Cotter Road (Westbound)	0.247	5.3	A	1m	0.661	5.2	A	1m

Overall, the average delays for the intersections were fairly low. This relates to an overall intersection level of service of A or B which would normally indicate good operation. However, some legs experience greater queuing and delays. Full movement summaries of the intersections are provided at Appendix A.

From the SIDRA results a number of key findings were identified. These include:

- The Hopetoun Circuit / Adelaide Avenue intersection in the AM peak experiences a 95th percentile queue of 157m on the Adelaide Avenue off ramp leg and a degree of saturation greater than 1. Although overall the intersection is operating at an acceptable Level of Service based on delays (LoS B in the AM Peak), the degree of saturation indicates that the Adelaide Avenue leg of the intersection is operating over capacity and intersection improvement measures should be considered.
- The Novar Street/Dudley Street/Kent Street/Adelaide Avenue roundabout in the AM peak experiences 95th percentile queues of 81m on Dudley Street and 70m on Novar Street. Similarly, in the PM peak a 95th percentile queue of 126m on the Kent Street approach is shown. Although overall the intersection is operating at an acceptable Level of Service (LoS B in the AM Peak), these queue lengths indicate that these movements within the intersection are operating close to capacity and intersection improvement measures would likely be necessary if significant increases in traffic volumes were expected.
- The Dudley Street/Cotter Road (Eastbound) intersection in the AM peak experiences a 95th percentile queue of 192m on the Cotter Road approach. Similarly, in the PM peak a 95th percentile queue of 178m on the northern Dudley Street approach as indicated. In both of these peak periods the indicated level of service for the intersection remains satisfactory (LoS C for the worst movement of each leg of the intersection).

- The Kent Street/Denison Street intersection in the PM peak experiences a 95th percentile queue of 73m on the Denison Street approach, due to the right turns. Additionally the right turn movement from Kent Street onto Denison Street has a 95th percentile queue of 40m. Although overall the intersection is operating at an acceptable Level of Service (LoS A), these results indicate that the queue for the right turn movement will affect the traffic flow of the through movements during the AM peak, due to insufficient storage. This intersection would require improvement measures if greater traffic volumes were expected along Kent Street.

Traffic heading through the Hopeton Circuit intersection from the CBP is expected to be limited. However, other traffic may divert with the perception that intersections closer to the Brickworks may become more congested.

2.5 Car Parking

A number of weekday and weekend spot counts were done to determine the key parking attractors, on-street parking utilisation and dedicated parking utilisation in Yarralumla.

The main parking generators in the study area impacting on the proposed development are the shopping centre and the Uniting church on Denman Street. The Yarralumla Primary school has its own short term parking demand and this has not been studied in detail.

The St Nicholas Greek-Australian Pre School & Child Care Centre has parking on-site. Parking was observed to be contained within the site throughout the day with Hill Corner used for peak pickup and drop off times. Few vehicles were observed to park along Maxwell Street associated with the centre.

Overflow parking at lunch times associated with the restaurant and café trade at the Yarralumla shops occurs on the adjacent streets and parking restrictions generally restrict short term parking to one side of these roads. This seems to work for normal demand.

The normal church parking demand is adequately catered for. There will be occasional heavy demand for infrequent weekday funerals and the large annual fete.

2.5.1 Parking Supply and Restrictions

Parking supply and restrictions have been focused around the two key generators within close proximity of the site. These are the Shops and Church.

Shops On-street

The locational requirements for various types of parking are outlined within the Parking and Vehicular Access General Code within the Territory Plan. For local centres, within Yarralumla parking should be accommodated onsite or within 200m. As such, a 200m oval radius from the central shop building has been included within the image. The actual 200m walking distances based on the path network are also shown and is the basis of the parking supply numbers.

A summary of the on-street parking restrictions observed on site can be seen in Figure 6.

Figure 6 On-Street Parking Restrictions

Onsite parking is available at the rear of buildings on 16 and 18 Bentham Street (south side between Novar and Hutchins St). This parking was observed to have some capacity. Visitors to these tenancies may be utilising parking on Bentham Street rather than parking at the rear. Mueller Street has a wider cross section (approx. 9.3m) which can accommodate parking on both sides of the road.

Within the 200m walkable distance area, there are approximately 70 spaces. These include un-restricted and time restricted parking. There are also approximately 25 time restricted no parking spaces along Novar Street and Bentham Street. These supply numbers do not include full time no parking zones or illegal parking.

Shops onsite supply and demand

A summary of the parking restrictions and onsite supply associated with the Yarralumla shops can be seen in Figure 7

Figure 7 Yarralumla shops parking restrictions and Supply

The wide variety of parking time restrictions seems overly complicated but has probably been developed over time in consultation with users and may well be very workable. It may be desirable to review and simplify.

Church

The available parking supply and restrictions associated with the Church can be seen in Figure 8.The peak period of parking associated with the church located on Denman Street was observed to be during mass on Sunday mornings. The peak demand results from a spot count during this peak utilisation period (9:30-10:30 AM on a Sunday) can be seen in Figure 10.

Figure 8 Spot count of parking utilisation associated with church

The majority of parked vehicles used the gravel car parking area directly in front of the church. While there was an increased number of vehicles parked on-street, the parking in the area was not over capacity and the parked vehicles did not present any hazards to other road users. The grass area to the east of the church was observed to be used as parking during this peak period as well as during the week. This usage is likely due to ease of access, as can be seen by the desire lines emanating from Dudley Street to the south. Given the parking utilisation observed and the existing desire lines, formalisation of this grass area as dedicated parking spaces may be beneficial to the operation of the site.

2.5.2 Parking Utilisation

The on-street parking utilisation throughout Yarralumla was, on average, very low. The preference of residents to park their vehicles in garages resulted in the observed parking levels on-street to be generally between 0 and 2 vehicles for any local access road. The three observed exceptions to this were the on-street parking in the vicinity of the shops, the on-street parking in the vicinity of the church during peak use periods and on-street parking adjacent to construction zones.

The parking utilisation of the shops onsite supply was at 95% or greater for all spot counts conducted, for both weekdays and weekends. The overflow parking associated with the shops is located primarily along Hutchins Street and Bentham Street west of the shop complex. The utilisation of the over flow parking was low on weekend days and high on weekdays, particularly during the lunch peak period. A summary of utilisation of parking associated with the shops which includes all available on-street parking within 200m walkable distance can be seen in Figure 9 and Figure 10.

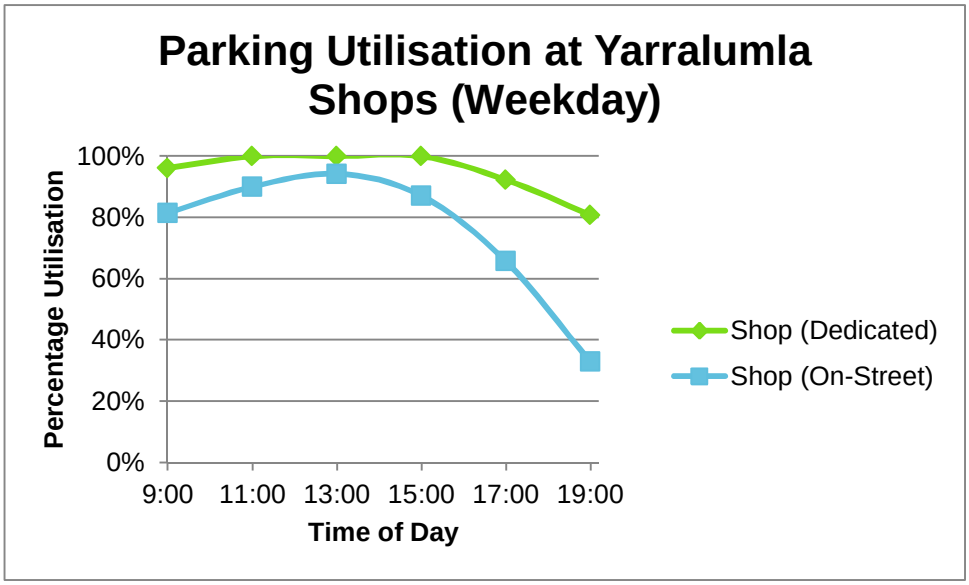


Figure 9 Parking Utilisation on a Weekday

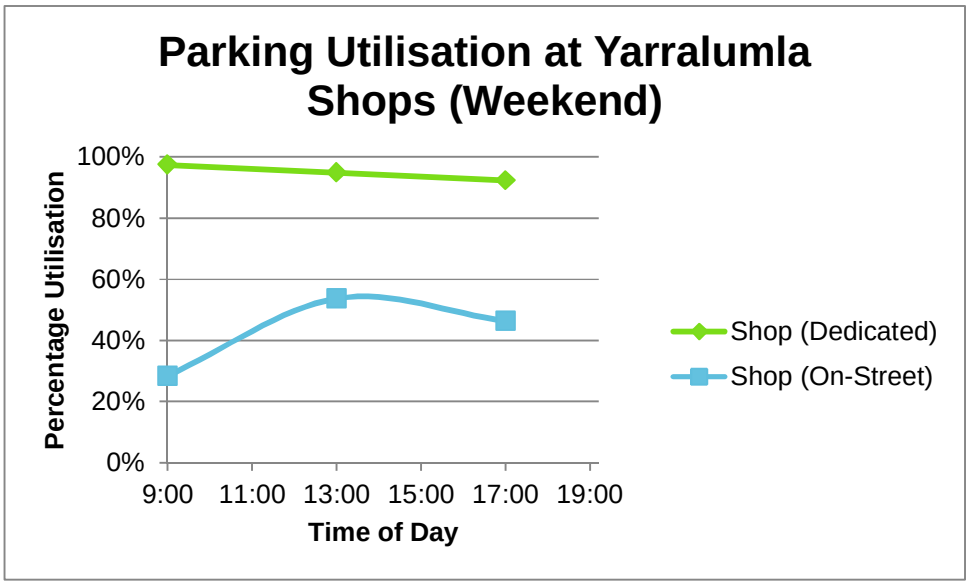


Figure 10 Parking Utilisation on a Weekend

The above graphs indicate that there is an adequate parking supply for weekend use, however the parking associated with the shops is over capacity during the working week. Based on site observations, there is limited available on-street supply during the weekday peak.

2.6 Public Transport

While there are a large number of bus routes which travel along Adelaide Avenue, there are currently no stops which give residents of Yarralumla access to these services. There is currently a single route which services Yarralumla, being 1 on a weekday or 932 on a weekend. Service 1 travels between Woden Town Centre and Dickson Group Centre and Service 932 travels between the Belconnen Town Centre and the Woden Town Centre. Within Yarralumla both routes travel along Novar Street, Schlich Street and Hopetoun Circuit. Whilst there are numerous services on the nearby Adelaide Avenue, there are no bus stops on Adelaide Avenue.

A summary of the bus route through Yarralumla can be seen in Figure 11.

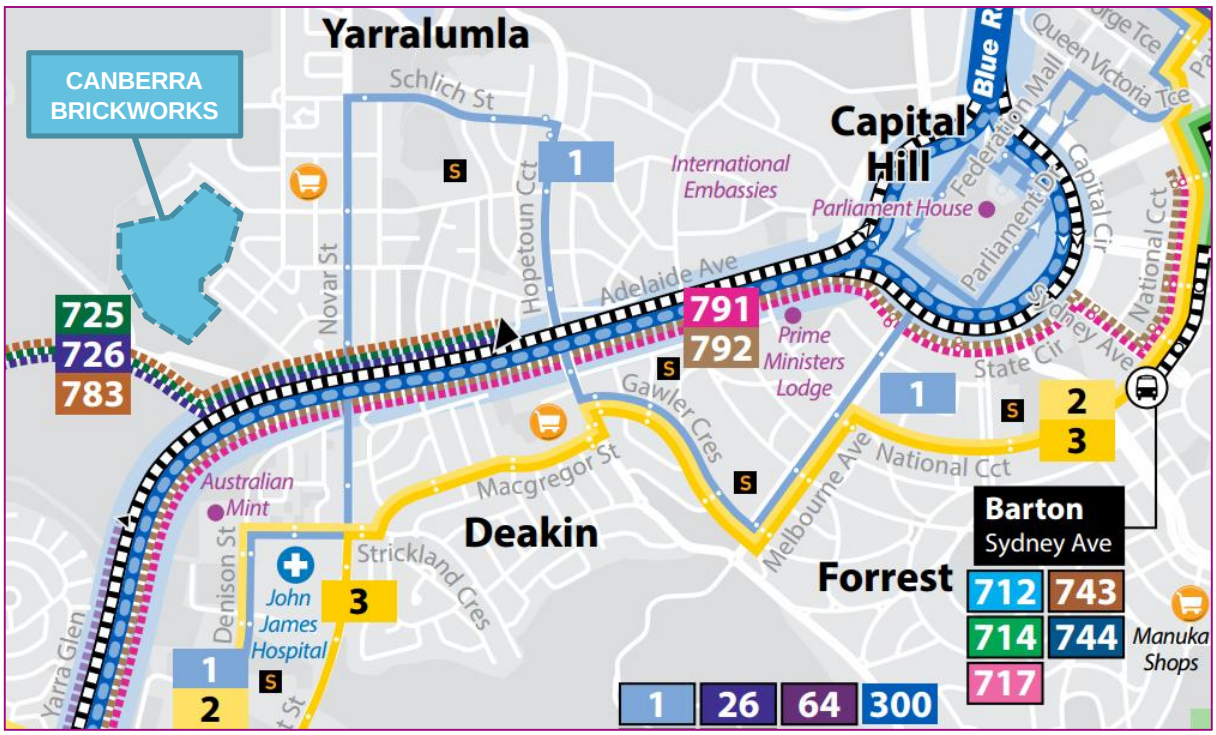


Figure 11 Public Transport Routes

A review of the public transport available in the vicinity of the site is summarised in Table 3.

Table 3 Public Transport Provision

Service	Route #	Route Description	Frequency (On/Off Peak)
Weekday Bus	1	Woden to Dickson	20 mins / 60 mins
Weekend Bus	932	Woden to Belconnen	60 mins / 60 mins

The level of service definitions for buses, as specified by the TRB in the Transit Capacity and Quality of Service Manual, can be seen in Table 4. These definitions help to indicate the quality of service for a specific area.

Table 4 Bus Level of Service Summary

LoS	Headway (Mins)	Vehicles/Hour	Comments
A	<10	>6	Passengers don't need schedules
B	10-14	5-6	Frequent service, passengers consult schedules
C	15-20	3-4	Maximum desirable time to wait if bus missed
D	21-30	2	Service unattractive to choice riders
E	31-60	1	Service available during hour
F	>60	<1	Service unattractive to all riders

A summary of the level of service for buses in the vicinity of the subject site can be seen in Table 5.

Table 5 Public Transport at Subject Site, Level of Service

Route #	Frequency (On/Off Peak)	Buses per Hour (On/Off Peak)	Level of Service (On/Off Peak)
1	20 mins / 60 mins	3/1	C/E
932	60 mins / 60 mins	1/1	E/E

The above table indicates that the bus service to the Yarralumla area is acceptable in the peak periods, but limited during off-peak and on weekends. The amenity of the bus service in the study area would be significantly improved by access to one or more of the routes which travel along Adelaide Avenue or diversion of bus routes via Dudley Street back to Adelaide Avenue. Dudley Street has legacy bus stops near the Uniting Church.

2.7 Active Travel

The existing path network was reviewed for the study area. The paths included shared paths, footpaths and recreational trails. A map of these is provided in Appendix B. A section showing the on-road connection is also provided in Figure 12.

The suburb has an excellent provision of footpaths with almost all verges containing paths. The quality of the paths is generally reasonable although there are isolated areas of cracking or level differences.

Major trip attractors of shops, schools and churches were reviewed for their travel patterns. The Yarralumla Primary school had a fairly dispersed pedestrian movement and the churches had relatively low pedestrian activity. Informal connections through the suburb along access trails were well worn especially closer to the lake.

No pedestrian or cyclist activity was noted to or from the Brickworks during the onsite observations.

On-road cycle lanes are provided along Cotter Road and Adelaide Avenue. There is limited connectivity between the local path network and on-road cycle lanes with only one direct connection near the eastern end of the on-ramp from Novar Street south of the intersection of Guilfoyle Street and Newman Street.

Figure 12 Active Travel Link

3.0 Existing Capacity Constraints and Opportunities

The analysis and relevant discussion in this report allows the following conclusions to be made:

3.1 Existing Capacity Constraints

- Constraints on the existing capacity of the road network are generally experienced in the weekday AM peak period (between 8:00am and 9:00am). Capacity issues were also identified in the weekday PM peak period (between 4:30pm-5:30pm).
- The following links in the road network are currently operating above their intended design volumes when compared to the road classifications:
  - Weston Street (west of Novar Street)
  - Hopeton Crescent (south of Weston Street)
  - Kent Street (between Dennison Street and Dudley Street)
  - Dudley Street
- The Hopetoun Circuit / Adelaide Avenue and Kent Street / Denison Street intersections are operating over capacity during peak periods. The intersection of Hopetoun Circuit / Adelaide Avenue will not be significantly impacted by the proposed development.
- The Novar Street / Dudley Street / Kent Street / Adelaide Avenue roundabout is operating at capacity during peak periods.
- The parking associated with the local shops typically operates at capacity on the weekend and operates over capacity during the weekday peak (11:00am – 4:00pm).
- The public transport level of service is acceptable during the peak periods on a weekday, but is limited during off peak periods and on weekends.
- There is good provision for active travel within Yarralumla however there is limited connectivity between the local active travel network and on-road cycle lanes located on Adelaide Avenue.
- The intersection of Dudley Street / Cotter Road (Eastbound) experiences significant queuing on the Cotter Road Approach in the AM (192m). In the PM peak, Dudley Street experiences queues (178m). In both peak periods, the indicated level of service for the intersection remains high (LoS C for the worst movement of each leg of the intersection). The intersection of Dudley Street / Cotter Road (Westbound) is operating effectively.

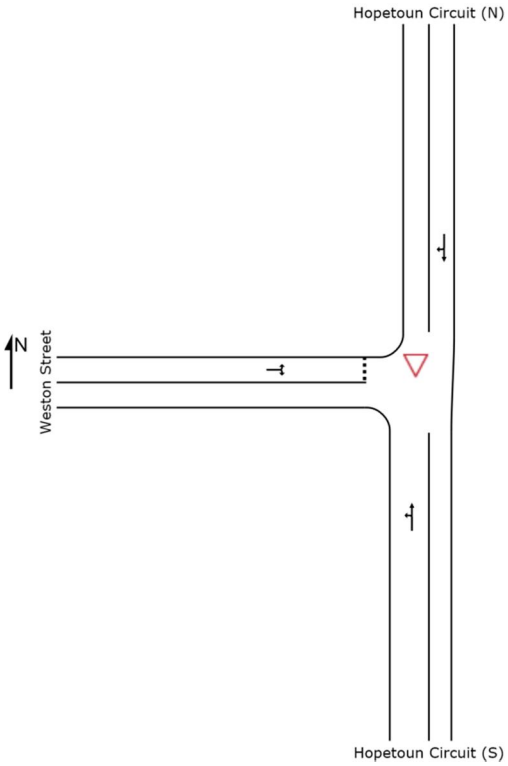
3.2 Opportunities

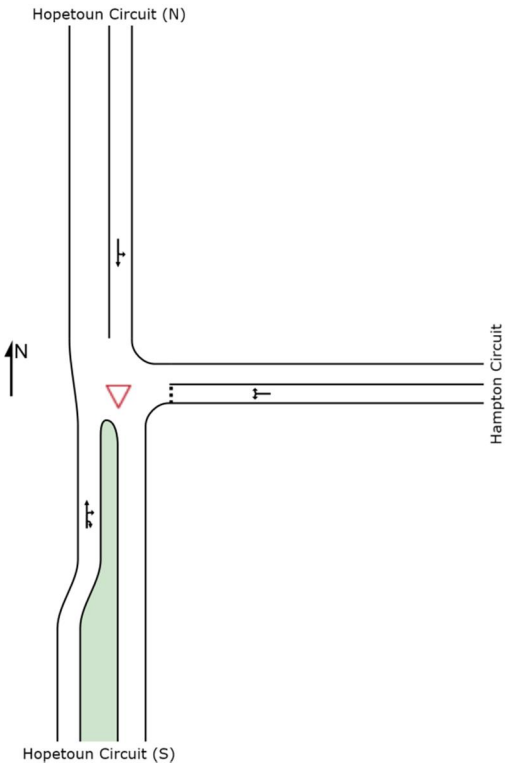
- Upgrades in the local road network, in particular regarding reducing traffic pressures on Dudley Street, Novar Street and Kent Street (north of Denison Street).
- Upgrades to intersections including:
  - Hopetoun Circuit / Adelaide Avenue
  - Novar Street / Dudley Street / Kent Street / Adelaide Avenue
  - Dudley Street / Cotter Road (Eastbound)
  - Kent Street / Denison Street
- Additional on-street parking on existing residential streets could be accommodated
- Improved public transport connection to Adelaide Avenue and Cotter Road bus routes (300, 791, 792, 725, 726, 783) for peak hour services
- Improvement to pedestrian and cycling connectivity, in particular the available cycle facilities between Yarralumla and the on-road cycle lanes on Adelaide Avenue.

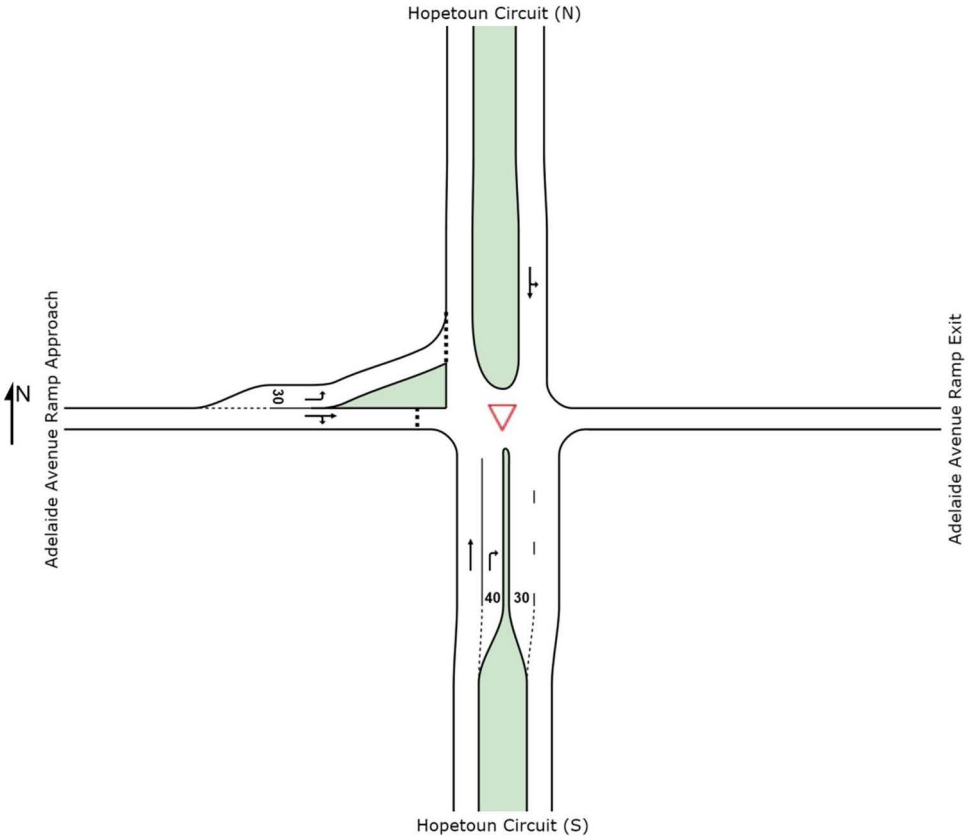
Appendix A

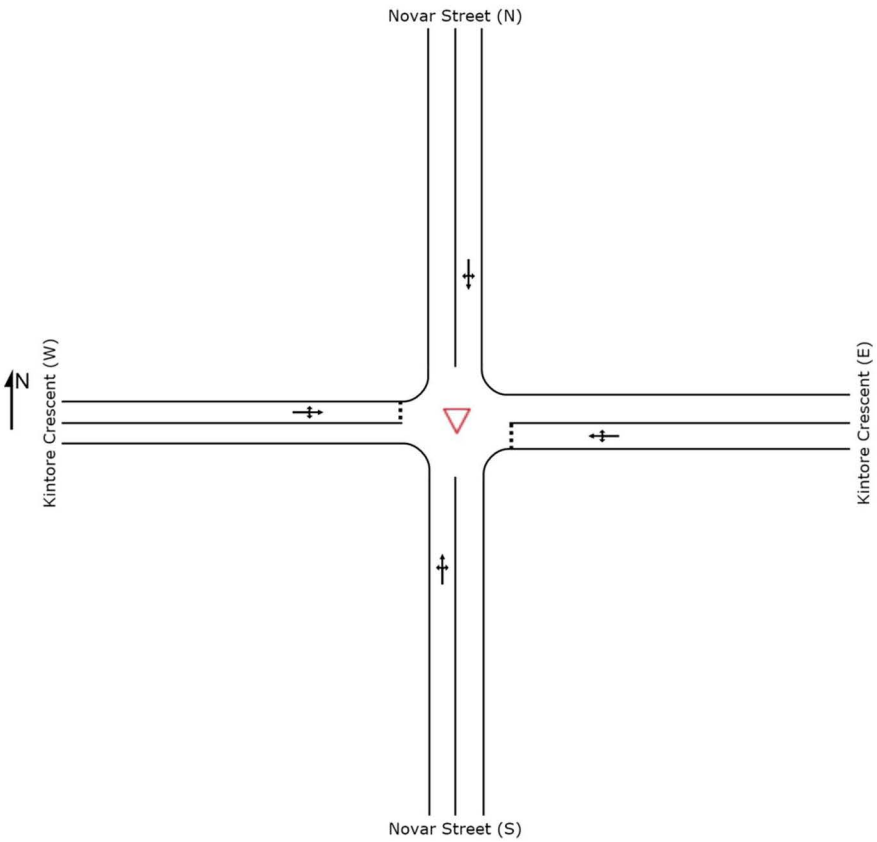
SIDRA Results

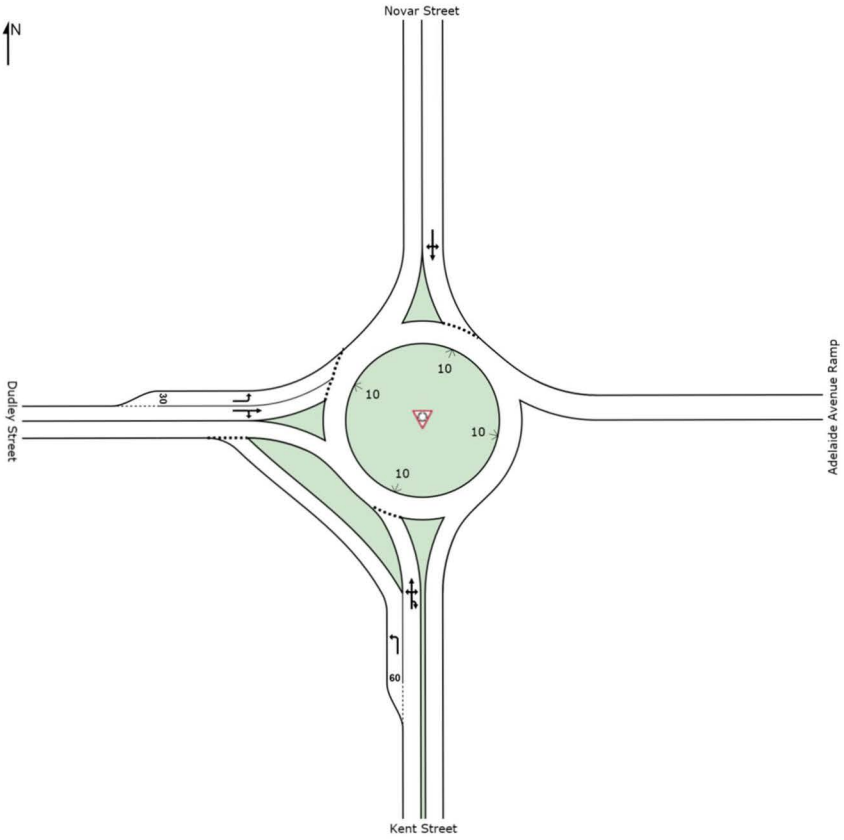
1.1 Intersection Layouts

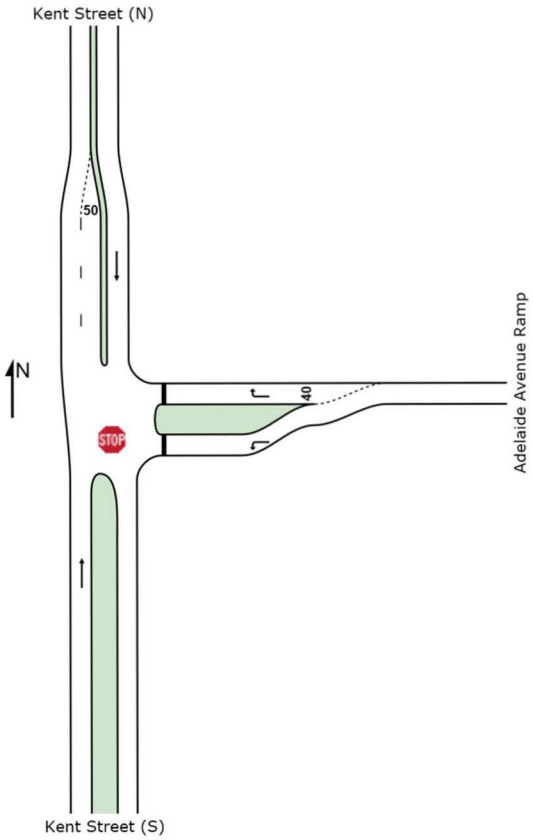


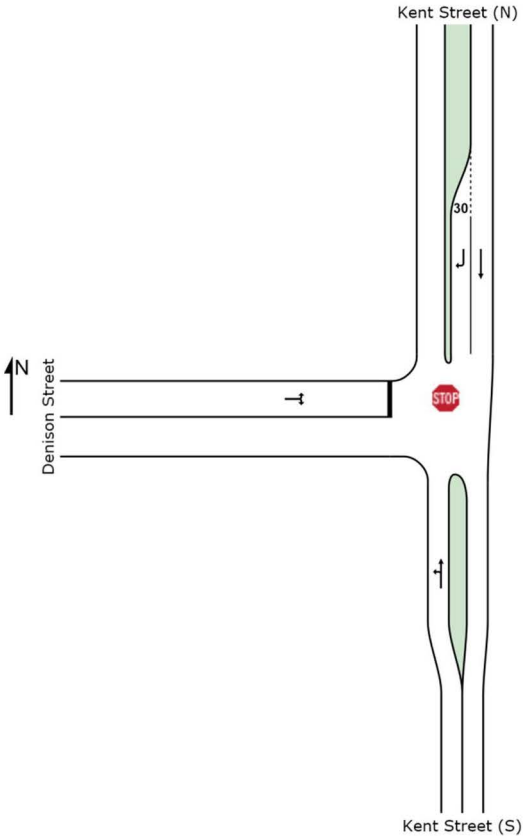


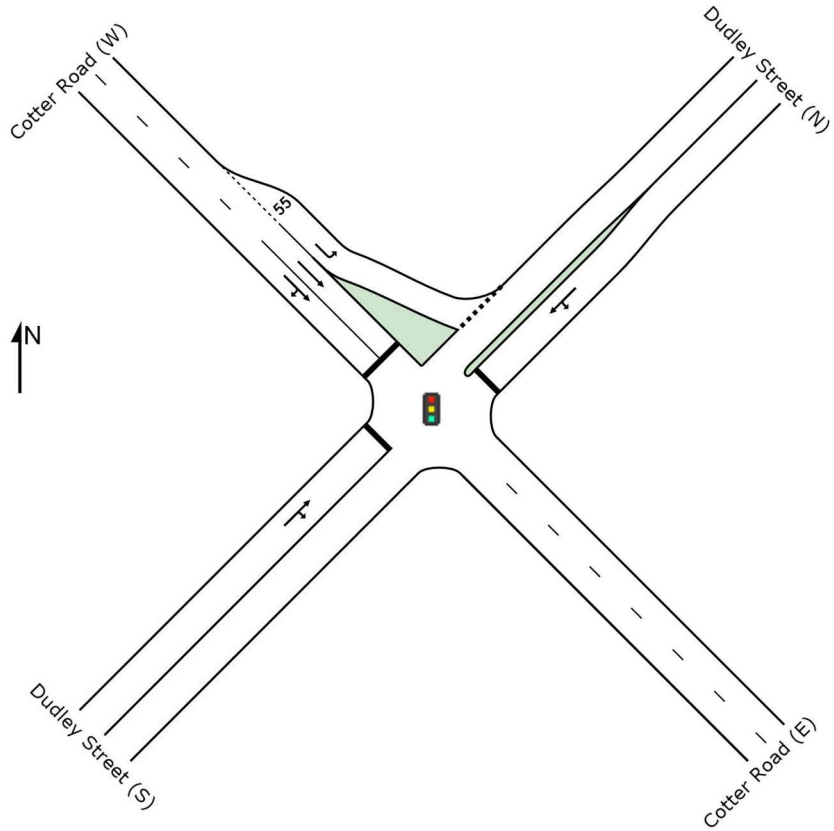

Hopetoun Circuit (N)
Adelaide Avenue Ramp Approach
Adelaide Avenue Ramp Exit
N
30
40
30
Hopetoun Circuit (S)

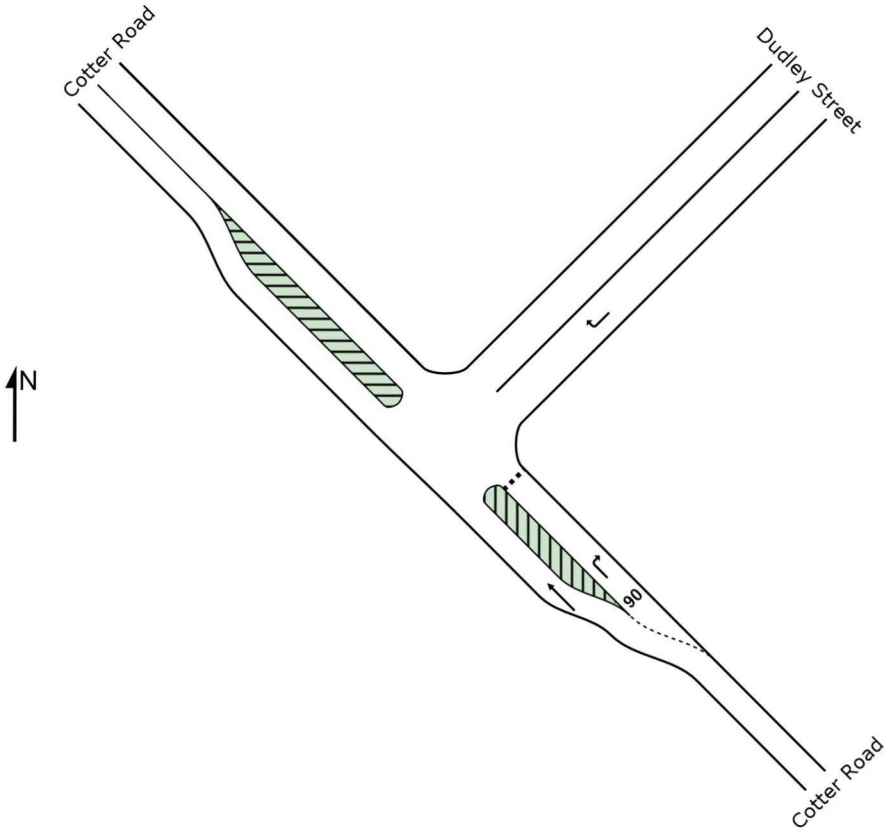

Novar Street (N)
Kintore Crescent (W)
Kintore Crescent (E)
N
Novar Street (S)


N
Novar Street
Dudley Street
Adelaide Avenue Ramp
Kent Street
30
10
10
10
10
60


Kent Street (N)
N
50
40
STOP
Adelaide Avenue Ramp
Kent Street (S)


Kent Street (N)
30
N
Denison Street
STOP
Kent Street (S)


Cotter Road (W)
Dudley Street (N)
55
N
Dudley Street (S)
Cotter Road (E)


Cotter Road
Dudley Street
N
90
Cotter Road

1.2 AM Peak Period, Existing Traffic

MOVEMENT SUMMARY

Site: Hopetoun/Weston AM

Network: Hopetoun AM

Hopetoun/Weston AM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Arrival Flows Total	Arrival Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hopetoun Circuit (S)													
1	L2	193	1.0	193	1.0	0.224	2.5	LOS A	0.0	0.0	0.00	0.22	18.7
2	T1	271	1.0	271	1.0	0.224	0.0	LOS A	0.0	0.0	0.00	0.22	55.8
Approach		463	1.0	463	1.0	0.224	1.0	NA	0.0	0.0	0.00	0.22	36.3
North: Hopetoun Circuit (N)													
8	T1	360	1.0	360	1.0	0.183	0.1	LOS A	0.1	0.7	0.03	0.01	58.7
9	R2	8	1.0	8	1.0	0.183	7.7	LOS A	0.1	0.7	0.03	0.01	53.2
Approach		368	1.0	368	1.0	0.183	0.3	NA	0.1	0.7	0.03	0.01	58.5
West: Weston Street													
10	L2	5	1.0	5	1.0	0.501	7.2	LOS A	2.6	18.4	0.68	0.97	33.9
12	R2	304	1.0	304	1.0	0.501	11.1	LOS A	2.6	18.4	0.68	0.97	20.4
Approach		309	1.0	309	1.0	0.501	11.1	LOS A	2.6	18.4	0.68	0.97	20.8
All Vehicles		1141	1.0	1141	1.0	0.501	3.5	NA	2.6	18.4	0.19	0.36	37.2

MOVEMENT SUMMARY

Site: Hopetoun/Hampton AM

Network: Hopetoun AM

Hopetoun/Hampton AM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Arrival Flows Total	Arrival Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hopetoun Circuit (S)													
2	T1	461	1.0	461	1.0	0.345	0.9	LOS A	1.6	11.1	0.29	0.15	41.0
3	R2	99	1.0	99	1.0	0.345	6.7	LOS A	1.6	11.1	0.29	0.15	42.7
3u	U	24	1.0	24	1.0	0.345	9.8	LOS A	1.6	11.1	0.29	0.15	41.0
Approach		584	1.0	584	1.0	0.345	2.2	NA	1.6	11.1	0.29	0.15	41.5
East: Hampton Circuit													
4	L2	149	1.0	149	1.0	0.137	6.1	LOS A	0.5	3.9	0.44	0.64	29.4
6	R2	2	1.0	2	1.0	0.137	11.0	LOS A	0.5	3.9	0.44	0.64	29.4
Approach		152	1.0	152	1.0	0.137	6.1	LOS A	0.5	3.9	0.44	0.64	29.4
North: Hopetoun Circuit (N)													
7	L2	1	1.0	1	1.0	0.179	2.5	LOS A	0.0	0.0	0.00	0.00	49.3
8	T1	359	1.0	359	1.0	0.179	0.0	LOS A	0.0	0.0	0.00	0.00	59.7
Approach		360	1.0	360	1.0	0.179	0.0	NA	0.0	0.0	0.00	0.00	59.5
All Vehicles		1096	1.0	1096	1.0	0.345	2.1	NA	1.6	11.1	0.21	0.17	39.2

MOVEMENT SUMMARY

Site: Hopetoun/Adelaide North AM

Network: Hopetoun AM

Hopetoun/Adelaide North AM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hopetoun Circuit (S)													
2	T1	389	1.0	389	1.0	0.195	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
3	R2	268	1.0	268	1.0	0.400	12.1	LOS A	2.1	14.6	0.74	0.97	39.2
Approach		658	1.0	658	1.0	0.400	4.9	NA	2.1	14.6	0.30	0.40	44.8
North: Hopetoun Circuit (N)													
7	L2	205	1.0	205	1.0	0.402	4.7	LOS A	0.0	0.0	0.00	0.15	51.6
8	T1	607	1.0	607	1.0	0.402	0.0	LOS A	0.0	0.0	0.00	0.15	55.0
Approach		813	1.0	813	1.0	0.402	1.2	NA	0.0	0.0	0.00	0.15	53.8
West: Adelaide Avenue Ramp Approach													
10	L2	195	1.0	195	1.0	0.173	7.2	LOS A	0.7	5.1	0.45	0.66	39.9
11	T1	1	1.0	1	1.0	1.147	217.0	LOS F	22.2	156.8	1.00	2.50	7.4
12	R2	188	1.0	188	1.0	1.147	200.6	LOS F	22.2	156.8	1.00	2.50	6.1
Approach		384	1.0	384	1.0	1.147	102.6	LOS F	22.2	156.8	0.72	1.57	9.3
All Vehicles		1855	1.0	1855	1.0	1.147	23.5	NA	22.2	156.8	0.26	0.53	23.6

MOVEMENT SUMMARY

Site: Novar/Kintore AM

Network: Novar/Kent AM

Novar/Kintore AM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Novar Street (S)													
1	L2	19	0.0	19	0.0	0.305	6.4	LOS A	0.8	5.8	0.16	0.10	46.0
2	T1	483	0.0	483	0.0	0.305	0.3	LOS A	0.8	5.8	0.16	0.10	54.0
3	R2	78	0.0	78	0.0	0.305	6.5	LOS A	0.8	5.8	0.16	0.10	45.6
Approach		580	0.0	580	0.0	0.305	1.3	NA	0.8	5.8	0.16	0.10	52.6
East: Kintore Crescent (E)													
4	L2	36	0.0	36	0.0	0.033	5.7	LOS A	0.1	0.9	0.37	0.56	29.0
5	T1	1	0.0	1	0.0	0.033	9.3	LOS A	0.1	0.9	0.37	0.56	34.7
6	R2	1	0.0	1	0.0	0.033	11.9	LOS A	0.1	0.9	0.37	0.56	37.1
Approach		38	0.0	38	0.0	0.033	5.9	LOS A	0.1	0.9	0.37	0.56	29.6
North: Novar Street (N)													
7	L2	5	0.0	5	0.0	0.145	6.5	LOS A	0.0	0.2	0.02	0.02	52.5
8	T1	285	0.0	285	0.0	0.145	0.0	LOS A	0.0	0.2	0.02	0.02	58.6
9	R2	2	0.0	2	0.0	0.145	8.0	LOS A	0.0	0.2	0.02	0.02	51.2
Approach		293	0.0	293	0.0	0.145	0.2	NA	0.0	0.2	0.02	0.02	58.3
West: Kintore Crescent (W)													
10	L2	8	0.0	8	0.0	0.062	6.5	LOS A	0.2	1.4	0.61	0.78	31.0
11	T1	1	0.0	1	0.0	0.062	9.1	LOS A	0.2	1.4	0.61	0.78	28.6
12	R2	19	0.0	19	0.0	0.062	12.3	LOS A	0.2	1.4	0.61	0.78	20.8
Approach		28	0.0	28	0.0	0.062	10.5	LOS A	0.2	1.4	0.61	0.78	25.1
All Vehicles		939	0.0	939	0.0	0.305	1.4	NA	0.8	5.8	0.14	0.11	51.5

MOVEMENT SUMMARY

Site: Novar/Dudley/On Ramp AM

Network: Novar/Kent AM

Novar/Dudley/On Ramp AM
Roundabout

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Kent Street													
1	L2	159	0.0	159	0.0	0.534	4.9	LOS A	5.7	39.6	0.34	0.52	35.0
2	T1	225	0.0	225	0.0	0.534	5.5	LOS A	5.7	39.6	0.49	0.58	30.4
3	R2	483	0.0	483	0.0	0.534	8.8	LOS A	5.7	39.6	0.49	0.58	45.7
3u	U	61	0.0	61	0.0	0.534	10.5	LOS A	5.7	39.6	0.49	0.58	30.4
Approach		928	0.0	928	0.0	0.534	7.4	LOS A	5.7	39.6	0.46	0.57	41.3
North: Novar Street													
7	L2	48	0.0	48	0.0	0.773	35.4	LOS C	10.0	69.9	1.00	1.35	22.6
8	T1	185	0.0	185	0.0	0.773	35.6	LOS C	10.0	69.9	1.00	1.35	8.8
9	R2	106	0.0	106	0.0	0.773	39.0	LOS C	10.0	69.9	1.00	1.35	8.8
Approach		340	0.0	340	0.0	0.773	36.6	LOS C	10.0	69.9	1.00	1.35	11.3
West: Dudley Street													
10	L2	355	0.0	355	0.0	0.612	17.8	LOS B	6.1	42.8	0.95	1.12	37.9
11	T1	2	0.0	2	0.0	0.763	21.4	LOS B	11.6	81.3	1.00	1.23	40.4
12	R2	569	0.0	569	0.0	0.763	24.7	LOS B	11.6	81.3	1.00	1.23	33.8
Approach		926	0.0	926	0.0	0.763	22.1	LOS B	11.6	81.3	0.98	1.19	35.3
All Vehicles		2195	0.0	2195	0.0	0.773	18.1	LOS B	11.6	81.3	0.77	0.95	32.7

MOVEMENT SUMMARY

Site: Kent/Off Ramp AM S1

Network: Novar/Kent AM

Kent/Off Ramp AM
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Kent Street (S)													
2	T1	798	0.0	798	0.0	0.405	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
Approach		798	0.0	798	0.0	0.405	0.0	NA	0.0	0.0	0.00	0.00	59.9
East: Adelaide Avenue Ramp													
4	L2	372	0.0	372	0.0	0.801	27.4	LOS B	6.8	47.7	0.91	1.43	27.3
6	R2	134	0.0	134	0.0	0.354	17.2	LOS B	1.3	9.2	0.76	1.05	34.2
Approach		505	0.0	505	0.0	0.801	24.7	LOS B	6.8	47.7	0.87	1.33	28.8
North: Kent Street (N)													
8	T1	821	0.0	821	0.0	0.432	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
Approach		821	0.0	821	0.0	0.432	0.0	NA	0.0	0.0	0.00	0.00	59.9
All Vehicles		2124	0.0	2124	0.0	0.801	5.9	NA	6.8	47.7	0.21	0.32	37.8

MOVEMENT SUMMARY

Site: Kent/Denison AM

Network: Novar/Kent AM

Kent/Denison AM
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Kent Street (S)													
1	L2	21	0.0	21	0.0	0.303	5.5	LOS A	0.0	0.0	0.00	0.02	54.3
2	T1	576	0.0	576	0.0	0.303	0.0	LOS A	0.0	0.0	0.00	0.02	58.9
Approach		597	0.0	597	0.0	0.303	0.2	NA	0.0	0.0	0.00	0.02	58.7
North: Kent Street (N)													
8	T1	600	0.0	600	0.0	0.446	0.8	LOS A	4.9	34.4	1.00	0.00	50.8
9	R2	593	0.0	593	0.0	0.622	9.7	LOS A	5.5	38.7	0.73	1.08	28.0
Approach		1193	0.0	1193	0.0	0.622	5.2	NA	5.5	38.7	0.87	0.54	37.9
West: Denison Street													
10	L2	222	0.0	222	0.0	0.336	11.9	LOS A	1.6	11.0	0.62	1.05	22.3
12	R2	2	0.0	2	0.0	0.336	81.5	LOS F	1.6	11.0	0.62	1.05	33.4
Approach		224	0.0	224	0.0	0.336	12.5	LOS A	1.6	11.0	0.62	1.05	22.5
All Vehicles		2014	0.0	2014	0.0	0.622	4.5	NA	5.5	38.7	0.58	0.44	40.2

MOVEMENT SUMMARY

Site: Dudley/Cotter(N) AM

Network: Novar/Kent AM

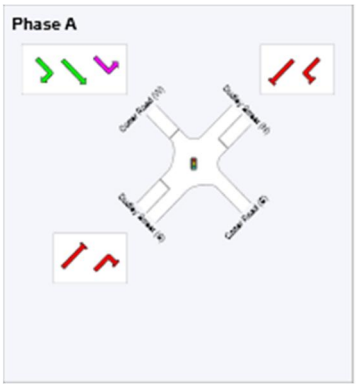
Dudley/Cotter(N) AM
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Practical Cycle Time)

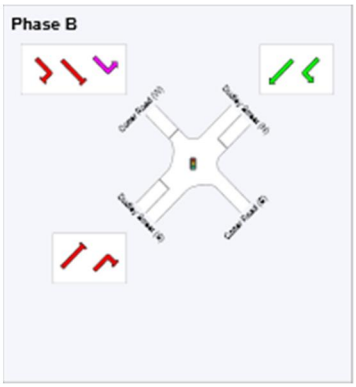
Movement Performance - Vehicles

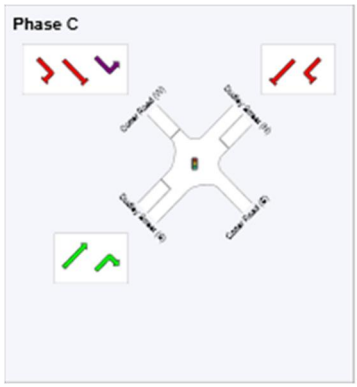
Mov ID	ODMov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Dudley Street (N)													
24	L2	3	0.0	3	0.0	0.783	36.2	LOS C	7.8	54.3	1.00	0.94	41.8
25	T1	240	0.0	240	0.0	0.783	30.7	LOS C	7.8	54.3	1.00	0.94	30.0
Approach		243	0.0	243	0.0	0.783	30.8	LOS C	7.8	54.3	1.00	0.94	30.2
NorthWest: Cotter Road (W)													
27	L2	967	0.0	967	0.0	0.616	7.8	LOS A	5.7	39.9	0.41	0.72	35.8
28	T1	1341	0.0	1341	0.0	0.887	27.6	LOS B	27.4	191.8	0.92	1.00	40.8
29	R2	1	0.0	1	0.0	0.887	33.3	LOS C	27.4	191.8	0.98	1.05	14.8
Approach		2309	0.0	2309	0.0	0.887	19.3	LOS B	27.4	191.8	0.70	0.88	40.0
SouthWest: Dudley Street (S)													
31	T1	2	0.0	2	0.0	0.015	27.1	LOS B	0.1	0.6	0.92	0.59	7.1
32	R2	1	0.0	1	0.0	0.015	30.9	LOS C	0.1	0.6	0.92	0.59	34.8
Approach		3	0.0	3	0.0	0.015	28.3	LOS B	0.1	0.6	0.92	0.59	20.3
All Vehicles		2556	0.0	2556	0.0	0.887	20.4	LOS B	27.4	191.8	0.73	0.89	38.6

Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	33	48
Green Time (sec)	27	9	6
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	33	15	12
Phase Split	55 %	25 %	20 %







MOVEMENT SUMMARY

Site: Dudley/Cotter(S) AM

Network: Novar/Kent AM

Dudley/Cotter(S) AM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Cotter Road													
22	T1	486	0.0	486	0.0	0.247	6.1	LOS A	0.0	0.0	0.00	0.59	59.7
23	R2	3	0.0	3	0.0	0.004	7.9	LOS A	0.0	0.1	0.33	0.58	59.6
Approach		489	0.0	489	0.0	0.247	6.1	LOS A	0.0	0.1	0.00	0.59	59.7
NorthEast: Dudley Street													
26	R2	266	0.0	266	0.0	0.132	3.8	LOS A	0.0	0.0	0.00	0.56	37.8
Approach		266	0.0	266	0.0	0.132	3.8	NA	0.0	0.0	0.00	0.56	37.8
All Vehicles		756	0.0	756	0.0	0.247	5.3	NA	0.0	0.1	0.00	0.58	55.5

1.3 PM Peak Period, Existing Traffic

MOVEMENT SUMMARY

Site: Hopetoun/Weston PM

Network: Hopetoun PM

Hopetoun/Weston PM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Arrival Flows Total	Arrival Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hopetoun Circuit (S)													
1	L2	139	1.0	139	1.0	0.168	2.5	LOS A	0.0	0.0	0.00	0.21	18.7
2	T1	208	1.0	208	1.0	0.168	0.0	LOS A	0.0	0.0	0.00	0.21	55.9
Approach		347	1.0	347	1.0	0.168	1.0	NA	0.0	0.0	0.00	0.21	37.0
North: Hopetoun Circuit (N)													
8	T1	179	1.0	179	1.0	0.093	0.1	LOS A	0.1	0.5	0.04	0.02	58.1
9	R2	7	1.0	7	1.0	0.093	6.8	LOS A	0.1	0.5	0.04	0.02	52.9
Approach		186	1.0	186	1.0	0.093	0.4	NA	0.1	0.5	0.04	0.02	57.8
West: Weston Street													
10	L2	11	1.0	11	1.0	0.165	5.3	LOS A	0.6	4.1	0.43	0.68	39.2
12	R2	131	1.0	131	1.0	0.165	6.8	LOS A	0.6	4.1	0.43	0.68	26.7
Approach		141	1.0	141	1.0	0.165	6.7	LOS A	0.6	4.1	0.43	0.68	28.4
All Vehicles		675	1.0	675	1.0	0.168	2.0	NA	0.6	4.1	0.10	0.26	40.1

MOVEMENT SUMMARY

Site: Hopetoun/Hampton PM

Network: Hopetoun PM

Hopetoun/Hampton PM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Arrival Flows Total	Arrival Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hopetoun Circuit (S)													
2	T1	345	1.0	345	1.0	0.230	0.3	LOS A	0.7	4.7	0.14	0.11	46.9
3	R2	44	1.0	44	1.0	0.230	5.4	LOS A	0.7	4.7	0.14	0.11	45.1
3u	U	24	1.0	24	1.0	0.230	7.3	LOS A	0.7	4.7	0.14	0.11	46.9
Approach		414	1.0	414	1.0	0.230	1.2	NA	0.7	4.7	0.14	0.11	46.5
East: Hampton Circuit													
4	L2	68	1.0	68	1.0	0.053	5.2	LOS A	0.2	1.5	0.29	0.53	30.6
6	R2	2	1.0	2	1.0	0.053	7.3	LOS A	0.2	1.5	0.29	0.53	30.6
Approach		71	1.0	71	1.0	0.053	5.3	LOS A	0.2	1.5	0.29	0.53	30.6
North: Hopetoun Circuit (N)													
7	L2	6	1.0	6	1.0	0.092	2.5	LOS A	0.0	0.0	0.00	0.02	48.9
8	T1	178	1.0	178	1.0	0.092	0.0	LOS A	0.0	0.0	0.00	0.02	56.8
Approach		184	1.0	184	1.0	0.092	0.1	NA	0.0	0.0	0.00	0.02	55.4
All Vehicles		668	1.0	668	1.0	0.230	1.3	NA	0.7	4.7	0.12	0.13	43.4

MOVEMENT SUMMARY

Site: Hopetoun/Adelaide North PM

Network: Hopetoun PM

Hopetoun/Adelaide North PM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hopetoun Circuit (S)													
2	T1	259	1.0	259	1.0	0.130	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
3	R2	155	1.0	155	1.0	0.125	7.0	LOS A	0.6	3.9	0.46	0.65	45.4
Approach		414	1.0	414	1.0	0.130	2.6	NA	0.6	3.9	0.17	0.24	50.2
North: Hopetoun Circuit (N)													
7	L2	80	1.0	80	1.0	0.187	4.7	LOS A	0.0	0.0	0.00	0.12	52.1
8	T1	299	1.0	299	1.0	0.187	0.0	LOS A	0.0	0.0	0.00	0.12	55.8
Approach		379	1.0	379	1.0	0.187	1.0	NA	0.0	0.0	0.00	0.12	54.7
West: Adelaide Avenue Ramp Approach													
10	L2	85	1.0	85	1.0	0.066	6.5	LOS A	0.3	1.9	0.34	0.57	40.8
11	T1	1	1.0	1	1.0	0.643	19.8	LOS B	4.1	28.9	0.80	1.12	36.7
12	R2	275	1.0	275	1.0	0.643	18.5	LOS B	4.1	28.9	0.80	1.12	31.6
Approach		361	1.0	361	1.0	0.643	15.7	LOS B	4.1	28.9	0.69	0.99	32.9
All Vehicles		1154	1.0	1154	1.0	0.643	6.2	NA	4.1	28.9	0.28	0.44	42.2

MOVEMENT SUMMARY

Site: Novar/Kintore PM

Network: Novar/Kent PM

Novar/Kintore PM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Novar Street (S)													
1	L2	19	0.0	19	0.0	0.180	6.5	LOS A	0.4	2.6	0.14	0.08	46.8
2	T1	294	0.0	294	0.0	0.180	0.3	LOS A	0.4	2.6	0.14	0.08	54.8
3	R2	31	0.0	31	0.0	0.180	7.0	LOS A	0.4	2.6	0.14	0.08	46.3
Approach		343	0.0	343	0.0	0.180	1.2	NA	0.4	2.6	0.14	0.08	53.6
East: Kintore Crescent (E)													
4	L2	25	0.0	25	0.0	0.029	6.0	LOS A	0.1	0.7	0.44	0.61	28.3
5	T1	1	0.0	1	0.0	0.029	7.7	LOS A	0.1	0.7	0.44	0.61	34.2
6	R2	2	0.0	2	0.0	0.029	10.0	LOS A	0.1	0.7	0.44	0.61	36.5
Approach		28	0.0	28	0.0	0.029	6.4	LOS A	0.1	0.7	0.44	0.61	29.6
North: Novar Street (N)													
7	L2	3	0.0	3	0.0	0.206	6.3	LOS A	0.0	0.3	0.01	0.01	52.7
8	T1	415	0.0	415	0.0	0.206	0.0	LOS A	0.0	0.3	0.01	0.01	59.1
9	R2	3	0.0	3	0.0	0.206	6.8	LOS A	0.0	0.3	0.01	0.01	51.4
Approach		421	0.0	421	0.0	0.206	0.1	NA	0.0	0.3	0.01	0.01	58.9
West: Kintore Crescent (W)													
10	L2	4	0.0	4	0.0	0.074	5.5	LOS A	0.2	1.7	0.56	0.77	32.2
11	T1	6	0.0	6	0.0	0.074	7.7	LOS A	0.2	1.7	0.56	0.77	29.8
12	R2	27	0.0	27	0.0	0.074	10.4	LOS A	0.2	1.7	0.56	0.77	22.0
Approach		38	0.0	38	0.0	0.074	9.4	LOS A	0.2	1.7	0.56	0.77	25.2
All Vehicles		831	0.0	831	0.0	0.206	1.2	NA	0.4	2.6	0.10	0.10	52.5

MOVEMENT SUMMARY

Site: Novar/Dudley/On Ramp PM

Network: Novar/Kent PM

Novar/Dudley/On Ramp PM
Roundabout

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Kent Street													
1	L2	616	0.0	616	0.0	0.864	9.6	LOS A	18.0	126.2	0.92	0.77	26.7
2	T1	197	0.0	197	0.0	0.864	10.5	LOS A	18.0	126.2	1.00	0.78	25.7
3	R2	466	0.0	466	0.0	0.864	13.8	LOS A	18.0	126.2	1.00	0.78	42.0
3u	U	1	0.0	1	0.0	0.864	15.5	LOS B	18.0	126.2	1.00	0.78	25.7
Approach		1280	0.0	1280	0.0	0.864	11.3	LOS A	18.0	126.2	0.96	0.77	34.3
North: Novar Street													
7	L2	56	0.0	56	0.0	0.623	11.7	LOS A	6.0	41.7	0.91	1.04	37.6
8	T1	168	0.0	168	0.0	0.623	11.9	LOS A	6.0	41.7	0.91	1.04	19.2
9	R2	225	0.0	225	0.0	0.623	15.3	LOS B	6.0	41.7	0.91	1.04	19.2
Approach		449	0.0	449	0.0	0.623	13.6	LOS A	6.0	41.7	0.91	1.04	22.9
West: Dudley Street													
10	L2	149	0.0	149	0.0	0.249	9.9	LOS A	1.8	12.7	0.86	0.84	45.3
11	T1	8	0.0	8	0.0	0.264	8.9	LOS A	2.1	14.8	0.88	0.82	49.1
12	R2	186	0.0	186	0.0	0.264	12.3	LOS A	2.1	14.8	0.88	0.82	43.5
Approach		344	0.0	344	0.0	0.264	11.2	LOS A	2.1	14.8	0.87	0.83	44.4
All Vehicles		2074	0.0	2074	0.0	0.864	11.7	LOS A	18.0	126.2	0.93	0.84	35.0

MOVEMENT SUMMARY

Site: Kent/Off Ramp PM S2

Network: Novar/Kent PM S2

Kent/Off Ramp PM S2
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Kent Street (S)													
2	T1	1199	0.0	1199	0.0	0.642	0.0	LOS A	0.0	0.0	0.00	0.00	59.7
Approach		1199	0.0	1199	0.0	0.642	0.0	NA	0.0	0.0	0.00	0.00	59.7
East: Adelaide Avenue Ramp													
4	L2	474	0.0	474	0.0	0.480	11.3	LOS A	3.4	23.9	0.57	1.01	40.7
6	R2	87	0.0	87	0.0	0.643	46.9	LOS D	2.3	15.8	0.95	1.11	19.0
Approach		561	0.0	561	0.0	0.643	16.9	LOS B	3.4	23.9	0.63	1.03	34.6
North: Kent Street (N)													
8	T1	361	0.0	361	0.0	0.182	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		361	0.0	361	0.0	0.182	0.0	NA	0.0	0.0	0.00	0.00	60.0
All Vehicles		2121	0.0	2121	0.0	0.643	4.5	NA	3.4	23.9	0.17	0.27	41.2

MOVEMENT SUMMARY

Site: Kent/Denison PM

Network: Novar/Kent PM

Kent/Denison PM
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Kent Street (S)													
1	L2	13	0.0	13	0.0	0.389	5.6	LOS A	0.0	0.0	0.00	0.01	54.5
2	T1	753	0.0	753	0.0	0.389	0.0	LOS A	0.0	0.0	0.00	0.01	59.4
Approach		765	0.0	765	0.0	0.389	0.1	NA	0.0	0.0	0.00	0.01	59.3
North: Kent Street (N)													
8	T1	564	0.0	564	0.0	0.283	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
9	R2	271	0.0	271	0.0	0.366	9.5	LOS A	1.9	13.1	0.69	0.92	29.1
Approach		835	0.0	835	0.0	0.366	3.1	NA	1.9	13.1	0.22	0.30	47.0
West: Denison Street													
10	L2	446	0.0	446	0.0	0.884	30.1	LOS C	10.5	73.4	0.92	1.80	11.9
12	R2	5	0.0	5	0.0	0.884	99.5	LOS F	10.5	73.4	0.92	1.80	21.6
Approach		452	0.0	452	0.0	0.884	30.9	LOS C	10.5	73.4	0.92	1.80	12.0
All Vehicles		2052	0.0	2052	0.0	0.884	8.1	NA	10.5	73.4	0.29	0.52	34.8

MOVEMENT SUMMARY

Site: Dudley/Cotter(N) PM

Network: Novar/Kent PM

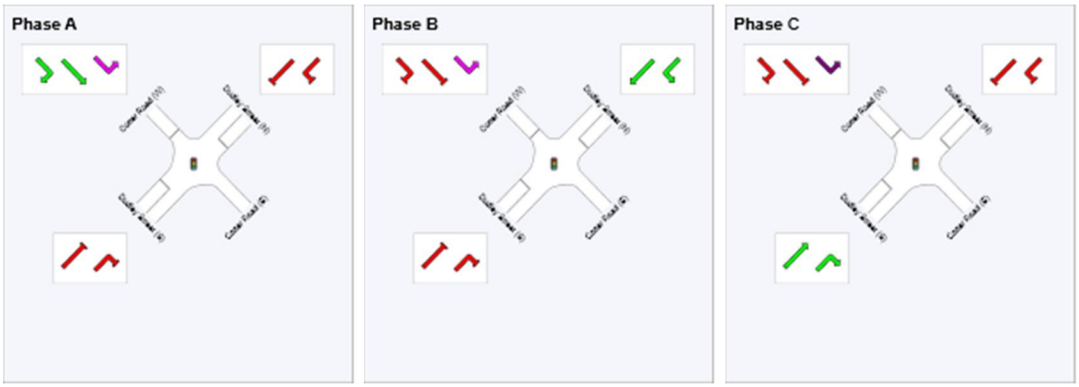
Dudley/Cotter(N) PM
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Dudley Street (N)													
24	L2	1	0.0	1	0.0	0.840	25.7	LOS B	25.4	177.9	0.94	0.96	47.5
25	T1	840	0.0	840	0.0	0.840	20.2	LOS B	25.4	177.9	0.94	0.96	36.3
Approach		841	0.0	841	0.0	0.840	20.2	LOS B	25.4	177.9	0.94	0.96	36.3
NorthWest: Cotter Road (W)													
27	L2	344	0.0	344	0.0	0.219	7.3	LOS A	1.3	9.1	0.25	0.67	37.4
28	T1	349	0.0	349	0.0	0.773	32.2	LOS C	5.7	39.8	1.00	0.89	37.7
29	R2	2	0.0	2	0.0	0.773	38.1	LOS C	5.7	39.8	1.00	0.89	12.9
Approach		696	0.0	696	0.0	0.773	19.9	LOS B	5.7	39.8	0.63	0.78	37.6
SouthWest: Dudley Street (S)													
31	T1	1	0.0	1	0.0	0.010	27.0	LOS B	0.1	0.4	0.92	0.58	6.9
32	R2	1	0.0	1	0.0	0.010	30.8	LOS C	0.1	0.4	0.92	0.58	34.5
Approach		2	0.0	2	0.0	0.010	28.9	LOS C	0.1	0.4	0.92	0.58	24.7
All Vehicles		1539	0.0	1539	0.0	0.840	20.1	LOS B	25.4	177.9	0.80	0.88	36.7

Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	13	48
Green Time (sec)	7	29	6
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	13	35	12
Phase Split	22 %	58 %	20 %



MOVEMENT SUMMARY

Site: Dudley/Cotter(S) PM

Network: Novar/Kent PM

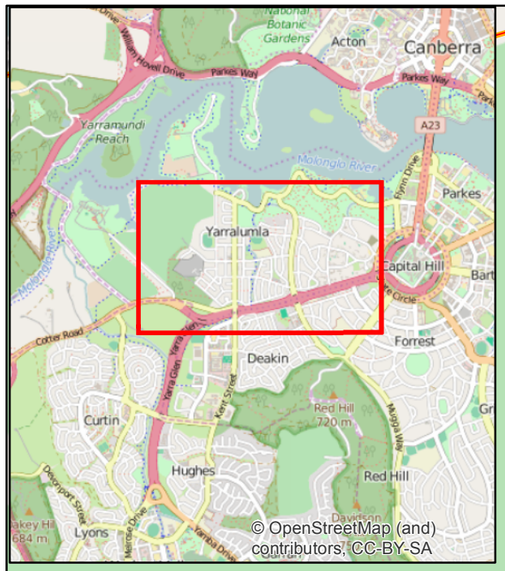
Dudley/Cotter(S) PM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Cotter Road													
22	T1	1302	0.0	1302	0.0	0.661	6.2	LOS A	0.0	0.0	0.00	0.59	59.5
23	R2	1	0.0	1	0.0	0.002	13.0	LOS A	0.0	0.1	0.62	0.68	51.1
Approach		1303	0.0	1303	0.0	0.661	6.2	LOS A	0.0	0.1	0.00	0.59	59.5
NorthEast: Dudley Street													
26	R2	842	0.0	842	0.0	0.417	3.8	LOS A	0.0	0.0	0.00	0.56	37.8
Approach		842	0.0	842	0.0	0.417	3.8	NA	0.0	0.0	0.00	0.56	37.8
All Vehicles		2145	0.0	2145	0.0	0.661	5.2	NA	0.0	0.1	0.00	0.58	54.8

Appendix B

Active Travel Maps



Off road path

Community path

Yarralumla Brickworks SIR

Community Paths

Source: TAMS

0 50 100 200 m

N

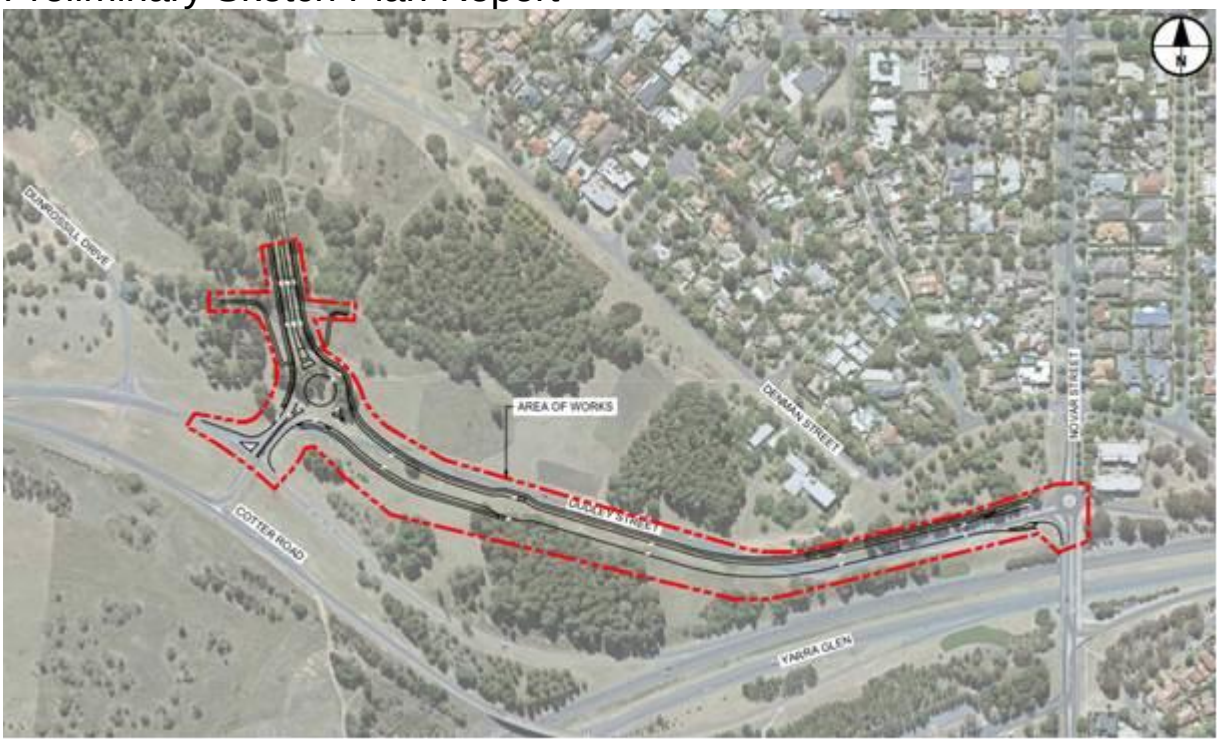
NOV 2015

60427110

© OpenStreetMap (and) contributors, CC-BY-SA

Canberra Brickworks Precinct Access Road and Dudley Street Upgrade

Preliminary Sketch Plan Report



D R A F T

CBP Access Road and Dudley Street Upgrade

Preliminary Sketch Plan Report

Client: Procurement and Capital Works

ABN: 66 676 633 401

Prepared by

AECOM Australia Pty Ltd
Level 2, 60 Marcus Clarke Street, Canberra ACT 2600, Australia
T +61 2 6201 3000 F +61 2 6201 3099 www.aecom.com
ABN 20 093 846 925

26-Jun-2017

Job No.: 60533438

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 AS/NZS4801 and OHSAS18001.

© AECOM Australia Pty Ltd (AECOM). All rights reserved.

AECOM has prepared this document for the sole use of the Client and for a specific purpose, each as expressly stated in the document. No other party should rely on this document without the prior written consent of AECOM. AECOM undertakes no duty, nor accepts any responsibility, to any third party who may rely upon or use this document. This document has been prepared based on the Client's description of its requirements and AECOM's experience, having regard to assumptions that AECOM can reasonably be expected to make in accordance with sound professional principles. AECOM may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified. Subject to the above conditions, this document may be transmitted, reproduced or disseminated only in its entirety.

D R A F T

Quality Information

Document CBP Access Road and Dudley Street Upgrade

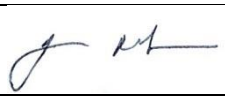
Ref 60533438

Date 26-Jun-2017

Prepared by Linda Mulyadi and Shane Wickramasinghe

Reviewed by Jane Peters

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	19 May 2017	Draft PSP Submission for Review	Jane Peters Project Manager	
B	23-Jun-2017	Draft Final PSP Submission	Jane Peters Project Manager	

D R A F T

Table of Contents

Executive Summary 1
1.0 Introduction 3
1.1 Background 3
1.2 Study Area 4
1.3 Project Scope of Works 4
2.0 Previous Studies and Concurrent Projects 6
2.1 Concept Design Report 6
2.2 Environmental Studies 6
2.3 Canberra Brickworks Estate Development 7
2.4 Geotechnical Investigations 7
2.5 Detailed Survey 7
2.6 Tree Assessment 7
3.0 Planning and Environmental Considerations 8
3.1 Land use zoning 8
3.1.1 Land Custodianship 8
3.1.2 Blocks 8
3.2 Planning Approval 9
4.0 Traffic Assessment 13
4.1 Roads and Traffic 13
4.1.1 Data Sources 13
4.1.2 Existing Road Network 13
4.2 Proposed Arrangement 14
4.2.1 General 14
4.2.2 Options Discussion 14
4.2.3 Roundabout Option 16
4.2.4 Intersection Option 17
4.2.5 Summary of Both Options 18
4.2.6 Wire Rope Barrier 18
4.2.7 Discussion and Recommendation 19
5.0 Stakeholder Consultation 20
5.1 Uniting Church 20
5.2 National Capital Authority 20
5.3 Land Development Agency 21
5.4 TCCS/ACTION 21
5.6 Utility Authorities 22
5.7 Inter-Directorate 22
5.8 Walter Burley Griffin Society 22
6.0 Road Alignment 23
6.1 Introduction 23
6.2 Design Standards and Criteria 23
6.3 Project Inputs and Assumptions 23
6.4 Cross Sections 23
6.4.1 Existing 23
6.4.2 Proposed 24
6.5 Horizontal Alignment 25
6.5.1 Dudley Street 25
6.5.2 Access Road 26
6.6 Vertical Alignment 26
6.6.1 General 26
6.6.2 Dudley Street 26
6.6.3 Access Road and Uriarra Track Crossing 26
6.7 Intersection Geometry 27
7.0 Utilities 28
7.1 Water 28
7.2 Sewer 28

D R A F T

7.3 Electrical 28
7.4 Gas 29
7.5 Communications 29
7.5.1 Optus 29
7.5.2 Telstra 29
7.5.3 iiNet (TransACT) 30
7.5.4 Government (SSICT or Icon) Fibre 30
8.0 Stormwater Management 31
8.1 Design Criteria 31
8.2 Cross Drainage 31
8.3 Stormwater pipe network 32
9.0 Pavements 33
9.1 Subgrade Conditions 33
9.2 Design Traffic Loading 33
9.3 Pavement Design Options 34
9.4 Whole of Life Costing 35
9.5 Summary of Adopted Pavement Designs 36
10.0 Other Design Issues 37
10.1 Public Transport 37
10.2 Shared paths and On-road cycle paths 37
10.2.1 Shared Paths 37
10.2.2 Uriarra Track 37
10.3 Landscape 38
10.4 Street Lighting 38
10.5 Earthworks 38
11.0 Construction Staging 40
11.1 General 40
11.2 Stage 1 40
11.3 Stage 2 40
11.4 Stage 3 40
12.0 Safety in Design Considerations 41
13.0 Opinion of Probable Costs 42
13.1 Assessment of Opinion of Probable Costs 42
14.0 Items to be Addressed in Detailed Design 45
14.1 Further Investigation 45
14.2 Risk Management 45
46
Appendix A – Feasibility Design Review 47
48
Appendix B – Planning Approvals Advice Memo 49
50
Appendix C – Stakeholder Consultation Minutes 51
52
Appendix D – Design Criteria Table 53
54
Appendix E – Utilities Correspondance 55
56
Appendix F – Site Visit Notes (Utilities) 57
58
Appendix G – Design Traffic Calculations 59
60
Appendix H – Full Depth Asphalt Calculations (CIRCLY) 61
62
Appendix I – Safety in Design 63
Appendix J
P50 and P90 Cost Estimate Risk Assessments A

D R A F T

Appendix K
Uriarra Track Crossing Options B-A

List of Figures

Figure 1	General area of site – including Canberra Brickworks and Dudley Street	3
Figure 2	Concept Design	6
Figure 3	Site Location	8
Figure 4	Zoning in the Proposal area	9
Figure 5	Cardno Access Road Concept Design	15
Figure 6	AECOM Design Options	15
Figure 7	SIDRA Layouts	16
Figure 8	Stormwater outlet with visible erosion at the Yarralumla Uniting Church	20
Figure 9	Doma Group Estate Access	25

List of Tables

Table 1	Blocks and Sections within which the Proposal is proposed	8
Table 2	Road Hierarchy	13
Table 3	Advantages and Disadvantages associated with the Roundabout Option	17
Table 4	SIDRA Results – Roundabout Option	17
Table 5	Advantages and Disadvantages associated with the Intersection Option	17
Table 6	SIDRA Results – Signalised Intersection Option	18
Table 7	Runoff Coefficients	31
Table 8	Catchments and Stormwater flows	31
Table 9	Projected design traffic loading	33
Table 10	Thickness designs for granular pavements, 20 year traffic load (all thicknesses in mm)	34
Table 11	Thickness designs for full depth asphalt pavements (all thicknesses in mm)	34
Table 12	Adopted Maintenance Strategy for Whole of Life Costing (40 years)	35
Table 13	Summary of Relative Costs – 40 Year Period	35
Table 14	High Level costs for Uriarra Track Options	38
Table 15	Bill of Quantities Summary for Draft PSP Design	42
Table 16	P50 and P90 Output Results	43
Table 17	Bill of Quantities Summary Package 1 – Access Road and Roundabout	43
Table 18	Bill of Quantities Summary Package 2 – Dudley Street Upgrade	44

D R A F T

Executive Summary

Introduction

The Land Development Agency (LDA) is currently facilitating the delivery of the Canberra Brickworks Precinct (CBP) Estate. The CBP Estate is located at Yarralumla on a 16 hectare site and is located 3.5 km from the Canberra CBD.

A new access road from Dudley Street is required to service the future development and an upgrade of Dudley Street is required to meet the current and future traffic volumes.

Procurement and Capital Works engaged AECOM in December 2016 to develop the Preliminary Sketch Plan design for the Canberra Brickworks Precinct (CBP) Access Road and Dudley Street Upgrade.

Description of Works

The works for this project is the preparation of a Preliminary Sketch Plan (PSP) design for the access road to the Canberra Brickworks development and the upgrade of the existing Dudley Street.

The main tasks involved with these works involve the review and confirmation of the concept design, production of the PSP design and construction cost estimate for the works to +/- 20% accuracy.

Key Design Elements

The Concept Design has been updated for the alignment of the access road in accordance with the Canberra Brickworks development plan. The alignment shift to the west is beneficial for a reduction in impacts to the environmental values within the site area.

Due to the earthworks required for the vertical alignment and consequently the constructability issues, it is not possible to only widen Dudley Street as originally anticipated in the Concept Design. Dudley Street will be constructed on a new alignment further to the south to avoid impacts on areas of Natural Temperate Grasslands and habitat for the Golden Sun Moth.

The upgrade of Dudley Street will provide a public transport bus route to service the Brickworks development.

On road cycling will be provided on the Access Road and on the upgraded Dudley Street and shared paths will be provided from the Estate on both sides of the Access Road to Dudley Street. A new shared off-road path will be provided on Dudley Street.

The new Access Road will provide access for construction vehicles and works during the Brickworks development to reduce impacts on the residential area in Yarralumla.

Planning Approvals

There are a variety of planning approvals which are required for this project. Territory Development approvals are required as the proposal is situated within land subject to the Territory Plan with the exception of the Dudley Street road reserve. A pre-application meeting and confirmation from ACTPLA is required for all permissible works and assessment processes associated with the proposal. Works approval from the NCA is required due to the Dudley Street road reserve being located within a Designated Area.

In addition, various environmental approvals are required for this project. This includes an assessment and approval under the EPBC Act, endorsement for ACT Government agencies which administer ACT environmental regulations, ecological assessment, environmental authorisation or environmental protection agreement as well as a draft construction environmental management plan.

Opinion of Costs

The opinion of probable costs for the works is $7.96M including a 30% contingency and 10% GST.

D R A F T

A P50 and P90 Cost Estimate has been undertaken to review and identify the level of inherent and contingent risk for the works and to confirm the level of contingency that should be applied at this stage of design.

The combined model (cost estimate and risk register) has been simulated with the output results summarised below. The @RISK Output Reports are included in Appendix J.

	BOQ	P50	P90
Base cost estimate	$ 5,568,855	$ 5,568,855	$ 5,568,855
Inherent risk		$ 55,604	$ 159,122
Contingent risk		$ 984,384	$ 1,818,541
Contingency (30%)	$ 1,671,450		
Total	**$ 7,240,305**	**$ 6,608,844**	**$ 7,546,518**
Contingency ($)	$ 1,671,450	$ 1,039,988	$ 1,977,663
Contingency (%)	30.0%	18.7%	35.5%

Issues to be addressed in Detailed Design

There are a few tasks which are outstanding and are required to be addressed in the next phase of the design. This includes further investigations such as stormwater modelling, update of the pavement design pending the receipt of the geotechnical investigation results, liaison and coordination with utility authorities and environmental studies for the EIS submission.

Potholing of existing utilities to determine protection and/or relocation requirements will be undertaken based on the draft PSP design.

The location and alignment of the Uriarra Track Crossing will be determined in the next phase of design pending input from the ACT Government circulation and the community feedback.

There are also risks which need to be considered in the next phase of the planning and design stage. The risks include coordination with Canberra Brickworks Estate Development, environmental planning approvals and the ability to stockpile and dispose excess fill.

D R A F T

1.0 Introduction

Procurement and Capital Works engaged AECOM in December 2016 to develop the Preliminary Sketch Plan design for the Canberra Brickworks Precinct (CBP) Access Road and Dudley Street Upgrade.

1.1 Background

The Land Development Agency (LDA) is currently facilitating the delivery of the Canberra Brickworks Precinct (CBP) Estate. The CBP Estate is located at Yarralumla on a 16 hectare site and is located 3.5kms from the Canberra CBD. The general area of the Brickworks site and the current alignment of Dudley Street is seen in Figure 1. It is envisaged that the CBP will have a development potential of 380 residential dwellings whilst retaining the historical value of the Canberra Brickworks site. Currently, there is only one residential access road to the CBP which is Denman Street. To cater for the development, a new access road to the CBP from Dudley Street is required together with upgrading Dudley Street which is at capacity under existing traffic use conditions.

Figure 1 General area of site – including Canberra Brickworks and Dudley Street

A Concept Design was undertaken in 2016 by Cardno to provide an alignment and concept road and intersection design and assessment of costs. The Concept Design investigated alignment options and intersection arrangements. A recommended alignment and roundabout intersection was proposed as the basis for the PSP design. The alignment was provided to the Tenderers for the Brickworks development.

During the initial stages of the project the proposals from tenderers for the Canberra Brickworks Development were received. The location of the access into the Brickworks site was moved to the west of the concept design. The access road alignment was redesigned to the west providing a more direct connection from Cotter Road. AECOM was requested to investigate the intersection options

D R A F T

with Dudley Street for the PSP design for the revised alignment of the access road into the new Estate Development.

1.2 Study Area

The proposed access road and Dudley Street is located in Yarralumla and is south of the Canberra Brickworks.

The site of the works is contained within the following Block and Sections:

- Block 3, Section 94, Yarralumla;
- Block 1, Section 127, Yarralumla;
- Block 1, Section 113, Yarralumla; and
- Block 1, Section 123, Curtin

The current land use zoning for the above Block and Sections is outlined in Section 3.0.

The following are close to the vicinity of the study area:

- Dunrossil Drive is situated to the west;
- Cotter Road/Yarra Glen and Adelaide Avenue to the south;
- Denman Street to the north; and
- Yarralumla Uniting Church to the north of Dudley Street.

1.3 Project Scope of Works

The scope of the works for this project is to prepare a Preliminary Sketch Plan (PSP) design for the access road to the Canberra Brickworks development and upgrade of Dudley Street based on the Concept Design developed in 2016.

The PSP design required a review of the Concept Design completed by Cardno to consider the proposed road cross sections with regard to the functionality of Dudley Street, the role of NCA in the acceptance of the designs and the requirement for construction staging and use of the existing pavement in our design.

The project deliverables and the three primary tasks are:

- Review and Confirmation of the Concept Design;
- Production the PSP designs; and,
- Construction cost estimate for the works to +/- 20% accuracy.

The scope of works included for the design of the CBP access road and Dudley Street upgrade include:

- Review of the existing documentation including studies and design documentation for the adjacent estate development;
- Design of new access road off Dudley Street and the upgrade of Dudley Street to a Major Collector Road
- Site specific geotechnical investigation for the northern access road and Dudley Street shoulder widening;

D R A F T

- Review typical cross section for the access road, its geometry including roundabout intersection arrangement, proximity to Cotter Road intersection, intersection sight distances, minimum acceptable radii of curves to provide a flexible access location into the CBP, superelevation, and confirm vehicular turning paths (including steer tag ACTION buses);
- Confirm proposed bus stop location on Dudley Street and connectivity to shared path network;
- Incorporation of the existing Uriarra Track and appropriate crossing arrangement over the new access road;
- PSP design, services location and any required services relocations and/or protection, including identification of any proposed amendments required for Dudley Street;
- Investigate and include appropriate shared trench arrangements to rationalise existing services and utility infrastructure;
- Review and advise on Development Application (DA) requirements and specific requirements from Environment and Planning Directorate for environmental impact on fauna habitat and flora (note: DA submission is not required at this stage);
- Design to include a 180 metre single carriageway access road and relevant road related assets as per TCCS Design Standard for Urban Infrastructure;
- Heritage considerations (Archaeological and Post European);
- Contamination constraints including contaminated soils;
- P50 and P90 cost estimates for the works using the Monte Carlo method;
- Consideration and incorporation of stormwater from adjacent blocks such as the Uniting Church, and WSUD requirements;
- Undertake safety in design report;
- Documentation necessary to facilitate the cadastral boundary realignment or creation of new blocks to establish the proposed road reserves. This documentation is to also consider the zoning covering the proposed road reserves to ensure that any areas outside the existing TSZ1 – Transport Zone are to be identified;

A project variation has been approved to compile an EIS for Impact Track DA, Lighting and Landscape Design, DA Report and Submission, NCA Works Approval Application, Document Readiness and Tender Documentation These components will be included in further detail design reports.

The landscaping and street lighting design will be undertaken during the Draft PSP circulation and included in the detailed design. The proposed landscaping and street lighting for the Brickworks Estate has not been provided yet and there will be some coordination for the access road works to transition from the TCCS requirements to the estate requirements.

D R A F T

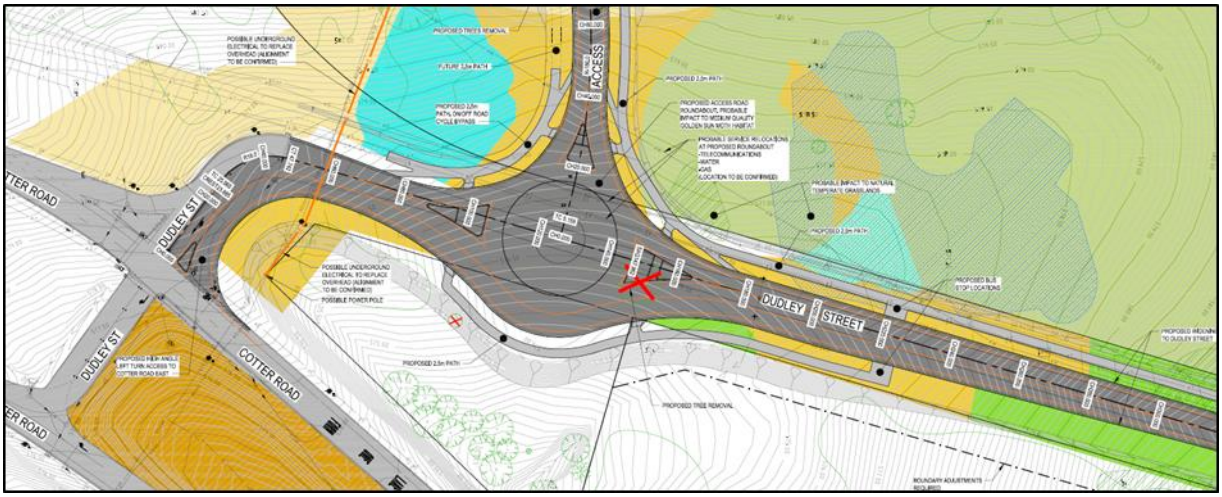
2.0 Previous Studies and Concurrent Projects

2.1 Concept Design Report

A feasibility and concept design was undertaken in 2016 by Cardno and identified improvements for Dudley Street and alignment of the new access road and intersection to provide access for the future development requirements.

A feasibility design review was undertaken and is tabulated in Appendix A.

Figure 2 Concept Design



2.2 Environmental Studies

The following environmental investigations have been undertaken to date and have been reviewed for consideration in the planning approval requirements for the Proposal:

- Briefing note Golden Sun Moth and Native Temperate Grassland Survey and Ecological Assessment of Dudley Street Road Reserve, January 2017 by Umwelt.
- Site Investigation Report (Stage 1), March 2016 by AECOM
- Detailed Engineering Survey, October 2014 by Leach Steger
- Site Investigation – Traffic, Transport and Carparking, February 2016 by AECOM
- Yarralumla Brickworks Precinct Tree Assessment, Nov 2015 by DSD Landscape Architects
- Yarralumla Brickworks Precinct - Dudley Street Tree Assessment, Nov 2016 by DSD Landscape Architects
- GSM Survey and Ecological Assessment of Dudley Street Road Reserve, Feb 2016 by Umwelt
- Canberra Brickworks and Environs Ecological Assessment, December 2014 by Umwelt
- Bushfire Risk Assessment Report, Canberra Brickworks Precinct, Jan 2016 by ABPP
- Preliminary Geotechnical Site Investigation for the Canberra Brickworks, Nov 2013 by SMEC
- Preliminary Environmental Site Investigation-Canberra Brickworks, Feb 2014 by SMEC
- Yarralumla Brickworks Railway Remnants registration, 2013 by the ACT Government
- Stage 1 Aboriginal Cultural Heritage Assessment, Aug 2014 by Navin Officer

D R A F T

2.3 Canberra Brickworks Estate Development

AECOM were provided access to review the proposed road cross section for the access road, location of the access road and the servicing connections and utility requirements of the submitted Tenders for the Brickworks development.

The proposed access road alignment shown by both Tenderers was located to the west of the concept design alignment. However no exact dimensions or CAD information was provided for the location,

The alignment of the access road was changed from the Concept Design to approximately the same location as proposed by the Tenderers. The cross section of the access road into the Estate was not in accordance with EPSD/TCCS requirements in terms of lane widths and the provision of on-road cycling. The same general arrangement of the cross section with a depressed median has been adopted for the PSP design with lanes widths to reflect TCCS standards and the inclusion of on-road cycling.

The Doma Group have been selected as the preferred tenderer. A recent meeting between the Doma Group and AECOM has enabled coordination of the design. The alignment of the access road has shifted slightly further to the west and the vertical grading has been updated to match the Doma Group requirements for their development of the Brickworks.

2.4 Geotechnical Investigations

A geotechnical investigation is planned and is pending approval of the Construction Environmental Management Plan due to the high value environmental areas within the project site area.

The results of the investigation will be used to validate the pavement design and assumed subgrade CBR. The results will be included in the detailed design report.

2.5 Detailed Survey

The survey for the area was provided by the client. Additional survey was required by Steger of an area further north and west of Dudley Street, towards the Canberra Brickworks which included:

- Base topographic and detail survey;
- Sewer and stormwater pit lifting;
- Underground service tracing;
- Tree survey;
- Cadastre from ACTMAP digital database; and
- Overhead powerline catenary in two locations.

This survey has been included in our PSP design base.

2.6 Tree Assessment

Previous tree assessment reports have been provided by the client as inputs for this PSP design.

Some findings from the tree assessment reports show that:

- Majority of the trees within the vicinity of Dudley Street are poor quality rating regulated trees based on the Arboricultural assessment. There are also a few individual/groups of trees which are medium quality rating regulated trees.
- Groups of trees situated to the north of Dudley Street and east of Dunrossil Drive (situated within Block 2, Section 103; Block 1, Section 127 and Block 3, Section 94 Yarralumla) are a small cluster of groups of Pines (P. radiata). These add to the landscape screen.
- Individual English Elm trees are situated to the north of Dudley Street.

D R A F T

3.0 Planning and Environmental Considerations

3.1 Land use zoning

As shown in Figure 3, the Proposal extends from Dudley Street at the intersection with Novar Street (in the east) along Dudley Street turning north to meet with Block 7, Section 94 Yarralumla.

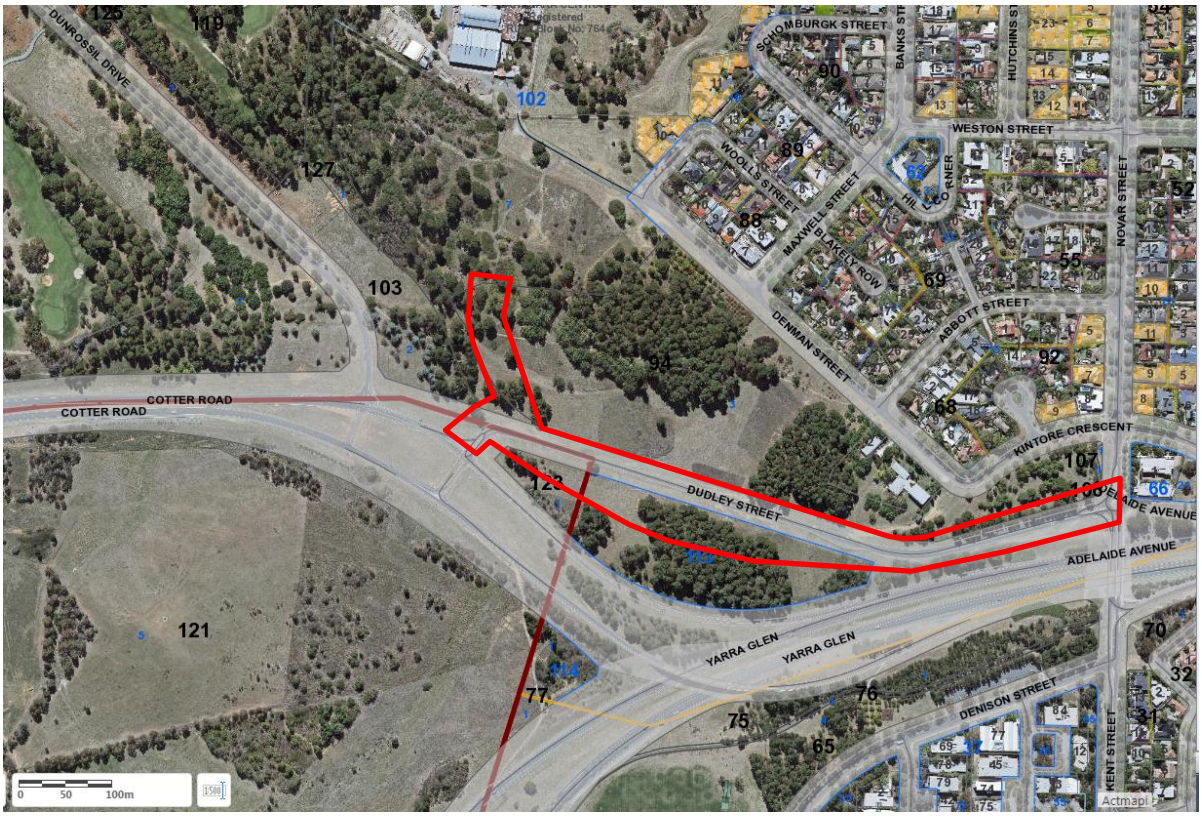


Figure 3 Site Location

3.1.1 Land Custodianship

The entire Proposal site is located within Territory land with the exception of Dudley Street, which is National land under the management of the National Capital Authority (NCA) (a Commonwealth Government Agency).

3.1.2 Blocks

The Proposal traverses a number of blocks with differing zoning as listed in Table 1 (note this table does not include road reserves). Figure 4 shows these areas in relation to the Proposal boundary.

Table 1 Blocks and Sections within which the Proposal is proposed

Block	Section	Division	Zoning	Applicable statutory planning framework	Land Custodianship
3	94	Yarralumla	PRZ2; PRZ1	Territory Plan	Public land
1	127	Yarralumla	PRZ2	Territory Plan	Public land
1	113	Yarralumla	Designated Land	National Capital Plan	Public land
1	123	Curtin	Designated Land	National Capital Plan	Public Land

D R A F T

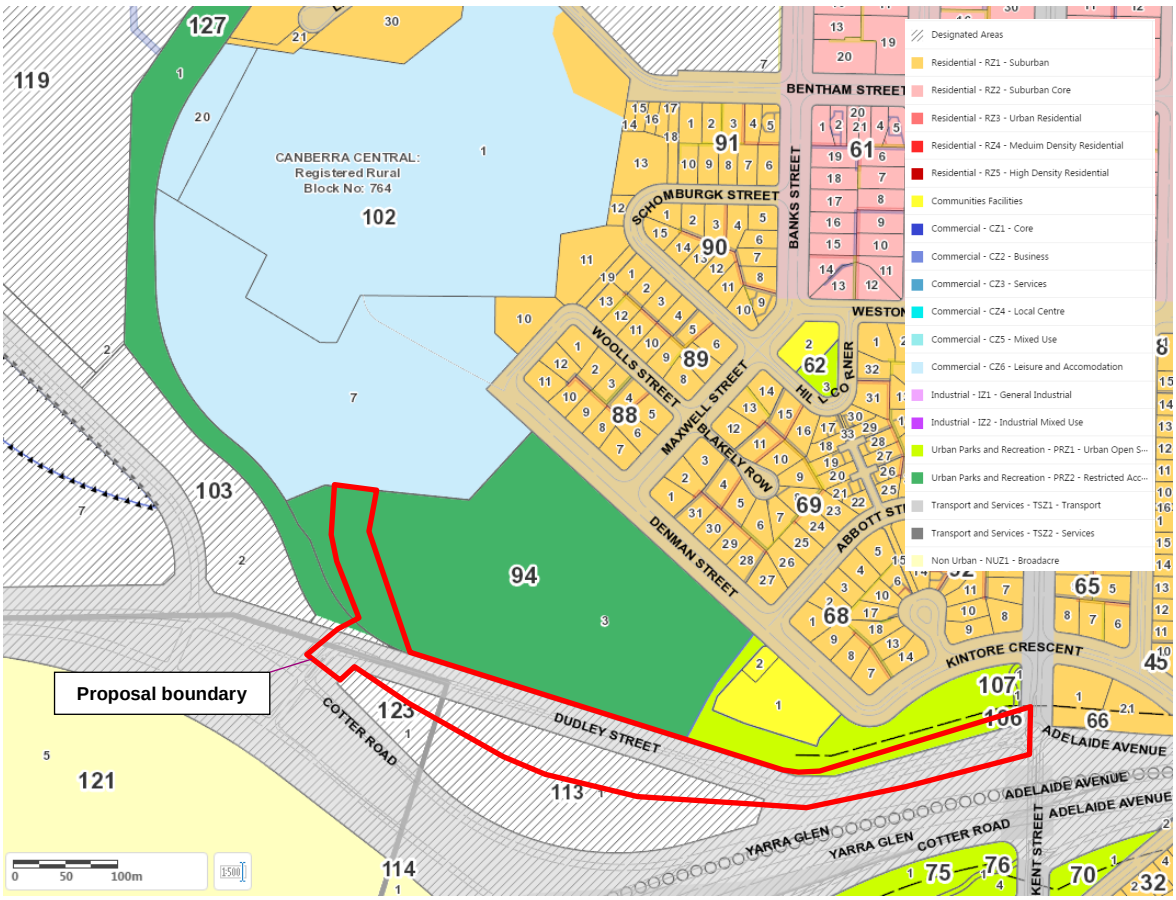


Figure 4 Zoning in the Proposal area

3.2 Planning Approval

Multiple jurisdictions and planning frameworks apply to the Proposal, and, the pathway to project approval is complex. Further adding to the complexity is, there are a number of potential approval pathways within each regulatory framework which depend on the outcome of further environmental investigations. The Planning Approvals Advice report (Appendix B) describes the various potential pathways and further investigation requirements to arrive at project approval from all the relevant authorities.

The Proposal, with the exception of the Dudley Street road reserve, is located within land subject to the Territory Plan, administered by ACT Environment, Planning and Sustainable Development Directorate (ACT EPSD) in accordance with the *Planning and Development Act 2007* (PD Act)). Territory Development approvals are by the ACT Planning and Land Authority (ACT PLA) under the PD Act and are required for works proposed in areas subject to the Territory Plan, unless an exemption is in place. The Proposal is unlikely to meet the criteria for such an exemption. . All permissible works and assessment processes associated to the Proposal are subject to a pre-application meeting and confirmation from ACT PLA.

Dudley Street road reserve is located within a Designated Area, which is subject to the requirements of the National Capital Plan (NCP) administered by the National Capital Authority (NCA). The NCA has responsibility for determining detailed conditions of planning, design and development for proposals in Designated Areas. For the Dudley Street works, development approval is required from the NCA through a Works Approval process. AECOM has begun consultation with the NCA, with an initial meeting with Sarah Treble to discuss the proposed scope of works (refer to Section 5.2for details). Works proposed in Designated Areas do not require development approval from the ACT's planning authority (ACT PLA) under the ACT's legislative planning framework (PD Act). Notwithstanding, works proposed in Designated Areas still require project endorsement from the ACT agencies which administer ACT environmental regulations.

D R A F T

In addition to the above, the requirements under the Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act) need to be considered for the Proposal.

A summary of the approvals and investigations required is provided below:

Development approval from ACT PLA under the PD Act – will be required for the Proposal. The proposed access road from Dudley Street to Block 7 Section 102 Yarralumla (the CBP site) is within Block 3 Section 94 Yarralumla which is currently zoned as PRZ2 – Urban Parks and Recreation Zone in the Territory Plan. The proposed access road can be considered as a 'minor road' and therefore a permissible development as noted in PRZ2 Development Table. Block 3 also has Pe: Urban Open Space overlay.

The proposed works would be assessed in the Impact Track under the PD Act, as there are triggers due to potentially significant impacts to Golden Sun Moth and Natural Temperate Grassland; and part of the proposal area is within a site listed on the ACT contaminated land register. Proposals assessed in the Impact Track require an EIS to be prepared and approved by ACT PLA (and the Commonwealth Minister for the Environment and Energy if the Proposal is deemed a controlled action) before a development application can be lodged with ACT PLA.

Works Approval from the NCA - will be required for works proposed in Designated Areas (the majority of the Proposal) which are subject to the requirements of the NCP. The Works Approval Application must:

- Include the standard items listed on the Works Approval Application Information Checklist (Appendix B) as required by NCA.
- Demonstrate compliance with the relevant planning policies of the NCP.
- Include a Draft Construction Environmental Management Plan
- Include evidence of Proposal endorsement from the ACT agencies which administer ACT environmental regulations (ACT Heritage, the Conservator of Flora and Fauna, ACT Environment Protection Authority and TCCS).
- Include evidence of approval under the EPBC Act (if approval is required, see below)

Assessment and approval under the EPBC Act – will be required. In December 2015, Umwelt carried out a vegetation assessment and Golden Sun Moth Survey generally in accordance with the EPBC Act survey guidelines for this species. Based on the wide distribution of golden sun moths throughout the proposed development area, the majority of the site has been determined to constitute habitat, albeit of varying quality.

Natural temperate grassland has also been confirmed to be present within the Proposal area, which meets the definition of the endangered ecological community under the EPBC Act. 'Natural Temperate Grassland of the South Eastern Highlands' is a listed ecological community under the EPBC Act, and since April 2016, it has been listed as critically endangered. There are no currently published thresholds for what constitutes a significant impact to natural temperate grassland, so impacts would need to be considered in the context of the proposed alignment within the overall site.

Ecological Assessment is required to be undertaken as a priority during the Final Sketch Plan stage, to determine whether significant impacts to ecological matters protected under the EPBC Act are likely. If significant impacts are likely, a referral is required to be submitted to the Commonwealth Department of the Environment and Energy (DoEE) for a decision from the Minister for the Environment and Energy on whether the Proposal will need formal assessment and approval under the EPBC Act.

Endorsement from ACT Government agencies which administer ACT environmental regulations – will be required for all works. Endorsement from the ACT agencies (ACT Heritage, the Conservator of Flora and Fauna, ACT Environment Protection Authority (EPA) and TCCS) satisfies the NCA's requirement for endorsement by the ACT agencies for works proposed in Designated Areas, as well as the endorsements required for development approval under the PD Act for areas subject to the Territory Plan.

Ecological Assessment – is required to confirm whether the Proposal (works proposed in areas subject to the Territory Plan, as well as works in Designated Areas) would trigger the need for an EIS

D R A F T

under the ACT planning framework due to potential impacts on ecological aspects. Consultation with the Conservator of Flora and Fauna indicated that threatened ecological communities and species are likely to occur within the Proposal site. However, an ecological impact assessment should be undertaken to confirm this. The ecological assessment would also confirm if any ecological matters protected under the EPBC Act are present within the Proposal site. This would inform whether a referral under the EPBC Act is required.

Heritage – The purpose of the Heritage Act 2004 is to provide for the recognition, registration and conservation of places and objects of natural and cultural significance in the ACT.

The ACT Heritage Council is an independent body established under the *Heritage Act 2004*, which has the role of providing advice on appropriate conservation of cultural, natural and Aboriginal Heritage places and objects in the ACT.

In accordance with section 148 of the PD Act, Development Applications are to be accompanied by advice from the ACT Heritage Council stating that the development meets the requirements of the *Heritage Act 2004*. The ACT Heritage Council is able to comment on development proposals in the merit or impact track, including advice on the heritage significance of a place or object, which must be considered by ACT PLA when approving or refusing an application.

Although the PD Act does not apply to the areas of the Proposal which is located within Designated Areas subject to the NCP, the NCP requires a development proposal to give due protection to any natural or cultural heritage place in the ACT included on register of the ACT Government. Further, the NCA require that endorsement for the Proposal is obtained from the ACT Heritage Council and provided with the Works Approval documentation.

Following a review of the ACT Heritage Register and the initial assessments undertaken for the site no known heritage items are located within the Project footprint. The access road would connect to the CBP which contains the heritage listed Yarralumla Brickworks (ID: 440). No significant impacts are anticipated on this item. A Stage 1 Aboriginal Cultural Heritage Assessment (Navin Officer, 2014) did not identify any non-Indigenous heritage sites within the Project area.

Environmental Authorisation or Environmental Protection Agreement – will be required by the EPA under the *Environmental Protection Act 1997* as the Proposal at minimum meets the criteria for two class B activities listed in Schedule 1 of the Act which require either an environmental protection agreement or environmental authorisation. Whether the Proposal meets the criteria for a class A activity, which requires an environmental authorisation, will be confirmed during more detailed design phases.

Draft Construction Environmental Management Plan – is required to demonstrate to the NCA and the Conservator of Flora and Fauna that appropriate safeguards and mitigation measures will be implemented to manage the key environmental risks during construction. This is likely also to be required in an application for a WWL. The CEMP should include unanticipated discovery protocols for contamination and heritage items as required by the EPA and ACT Heritage, respectively

Tree Assessment - A Tree Assessment is required to document all the individual trees in the Proposal site, their attributes and whether they will be removed for the construction of the Proposal. The tree attributes to be documented include species, size, health and overall tree quality. The assessment will also identify any trees which meet the criteria for a Regulated Tree and therefore are classed as a Protected Tree under the *Tree Protection Act 2005*. The Tree Assessment will need to be provided to the TCCS for advice regarding the protection measures, and endorsement. The Tree Assessment will also need to be provided to the Conservator of Flora and Fauna, along with the Landscaping Plans and Ecological Assessment, to enable the Conservator's evaluation of the Proposal and whether endorsement will be provided.

A number of Tree Assessments have been undertaken to identify and map the existing trees within the Proposal area. There are a number of regulated and non-regulated trees of varying quality within the Proposal area. Some regulated medium and low quality trees will likely be impacted by the Proposal. Impacts to trees are required to reduce the ecological impacts to EPBC Act listed habitats which dominate the grassed areas within the Proposal area. Determining the preferred alignment of the access road is a balance between minimising impacts to trees, minimising impacts to EBPC Act listed species while also meeting the objectives of the Proposal.

D R A F T

Contamination - Under Section 21A of the *Environmental Protection Act 1997* the EPA is required to keep a register of contaminated sites. A section of the Proposal is located within land included on the register of contaminated sites. Phase 1 and Phase 2 contamination assessments have been completed for the Proposal site. Analysis of these assessments is required during the preparation of the environmental impact assessment to ensure adequate investigations have been undertaken to apply for the portion of the Proposal site to be removed from the register. The EPA will advertise in the ACT Legislation Register and The Canberra Times (within 10 working days) when a record is removed from the register.

D R A F T

4.0 Traffic Assessment

4.1 Roads and Traffic

4.1.1 Data Sources

Intersection traffic counts were undertaken by Austraffic surveys in July 2014 for each of the three key intersections considered in the Dudley Street network distribution model. These intersections were as follows:

- Cotter Road and Dudley Street
- Novar Street, Dudley Street and Adelaide Avenue Eastbound On-Ramp
- Novar Street and Kintore Crescent

These intersection counts were undertaken in both the AM and PM peak periods.

For the modelling undertaken, a growth rate of 2% per year has been applied.

Updated counts are currently being undertaken and will be available for future designs.

There is no additional traffic report included as part of the Preliminary Sketch Plan (PSP) report.

4.1.2 Existing Road Network

The key roads in the local road network are outlined below and detailed in terms of their road hierarchy, purpose and design. A road hierarchy summary is provided in Table 2.

Table 2 Road Hierarchy

Name	Road Hierarchy
Dudley Street	Major Collector Road
Cotter Road	Arterial Road
Kent Street	Major Collector Road
Adelaide Avenue	Arterial Road
Kintore Crescent	Access Road
Yarra Glen	Arterial Road
Novar Street	Major Collector Road
Denman Street	Access Road

Dudley Street is a major collector road located between Cotter Road and Novar Street. It is a key eastbound road link between Cotter Road and the suburbs of Yarralumla and Deakin. Dudley Street is currently a two-way single-carriageway road with a single lane in each direction. The lane widths on Dudley Street are typically around 3m in width at the mid-block. The current daily traffic for this road is ~8,000vpd. There are currently two bus stops on Dudley Street and an informal access to the Yarralumla Uniting Church.

Cotter Road is an arterial road located between the new development area of the Molonglo Valley in the west and Yarra Glen. In the vicinity of the site it is a two-way dual-carriageway road with two lanes in each direction to the west of Dudley Street and a single lane in each direction to the east of Dudley Street. The carriageway widths of Cotter Road vary from ~9m to ~5.5m within the vicinity of the site. The current daily traffic volumes for this road are ~16,000vpd east of Dudley Street. On-road cycle lanes are located on Cotter Road in the vicinity of the site.

Kent Street is a major collector road running south from the Dudley Street and Novar Roundabout until Kitchener Street. It provides connectivity between Yarralumla, Deakin and Hughes. In the vicinity

D R A F T

of the site it is a two-way single-carriageway road with one lane in each direction. The lane widths are ~3.3m wide immediately south of the site. The current daily traffic volumes on Kent Street directly south of the site are ~13,000vpd.

Adelaide Avenue is an arterial road located between Kent Street and the State Circle. It provides connectivity between Yarralumla/Deakin and Canberra City. Adelaide Avenue is a two-way dual-carriageway road with two vehicle lanes and a single bus lane in each direction. The lane widths on Adelaide Avenue are ~3.5m. On-road cycling is located on Adelaide Avenue in both directions.

Kintore Crescent is a local access road located between Denman Street and Guilfoyle Street. It provides access for local vehicles onto Novar Street. Kintore Crescent is a two-way single-carriageway road with single vehicle lanes in each direction. The lane widths on Kintore Crescent are ~3.5m. The current daily traffic volumes on Kintore Crescent are ~1,000vpd.

Yarra Glen: is an arterial road between Kent Street and the edge of Phillip. It directly connects to Adelaide Avenue and therefore provides connectivity between Woden and Canberra City. Yarra Glen is a two-way dual-carriageway road with two vehicle lanes and a single bus lane in the northern direction continuing onto Adelaide Avenue. The southern bus lane that continues from Adelaide Avenue merges after approximately 700m. The lane widths on Yarra Glen are approximately 3.5 metres wide and there is on road cycling provided on both sides of Yarra Glen

Novar Street is a major collector road that continues from Kent Street until it reaches the intersection with Brown Street and Alexandrina Drive. It is a key road as it meets Kent Street on the overpass allowing vehicles leaving Adelaide Avenue and Yarra Glen to access key generators such as the hospital. Novar Street is currently configured with a two-way single carriageway road with a single lane in each direction. These lanes are configured with approximate lane widths of 4m. There are currently 4 bus stops on Novar Street.

Denman Street is a local access road located between Kintore Crescent and the Old Canberra Brickworks Precinct. It currently provides access to the Old Canberra Brickworks and the Yarralumla Uniting Church. Denman Street is currently configured with a two-way single carriageway road with a single lane in each direction. The lane widths on Denman Street are approximately 4m.

4.2 Proposed Arrangement

4.2.1 General

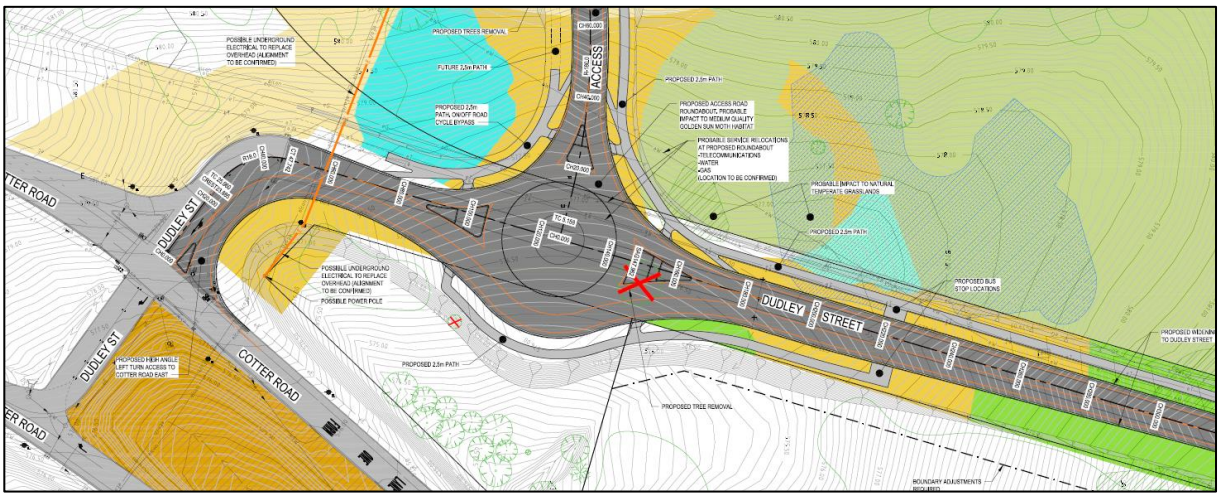
Due to the proposed development of the Canberra Brickworks Precinct (CPB), road network connectivity to Dudley Street is required in order to reduce the traffic impact of the development on the local lower order streets within Yarralumla. Upgrades to Dudley Street are required in order to facilitate the new road connection and to cater for traffic volumes from the new access road.

4.2.2 Options Discussion

The CBP Estate Development access point arrangements from Dudley Street for the new development of the Canberra Brickworks Precinct were investigated as part of the CBP Access Road and Dudley Street Upgrade Concept Design Report developed by Cardno in October 2016. This report recommended that the CBP access road connect to Dudley Street via a roundabout arrangement aligned with Dudley Street in an east-west direction with the access leg meeting the intersection at a right angle and proceeding north. The proposed arrangement is shown in Figure **5** below.

D R A F T

Figure 5 **Cardno Access Road Concept Design**



The CBP access point was revised to be located further west than originally proposed. As a result, AECOM further investigated options for intersection arrangements for the future CBP access road. Two main options were considered which are as follows:

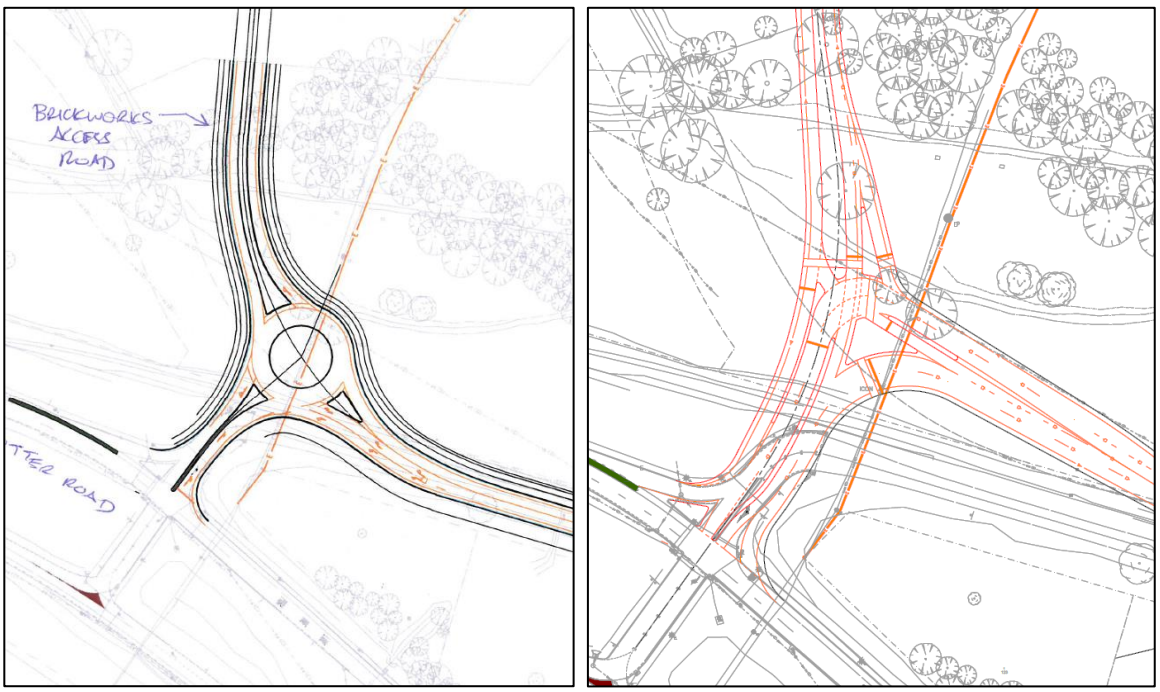
- A realigned roundabout located north of the intersection of Dudley Street and Cotter Road
- A signalised T-intersection located north of the intersection of Dudley Street and Cotter Road

The two options were considered from both a geometric design perspective and an operational/safety perspective.

The overall footprint and constructability of the two design options were considered comparable.

The concept plans for the two options are shown below in Figure 6 .

Figure 6 AECOM Design Options



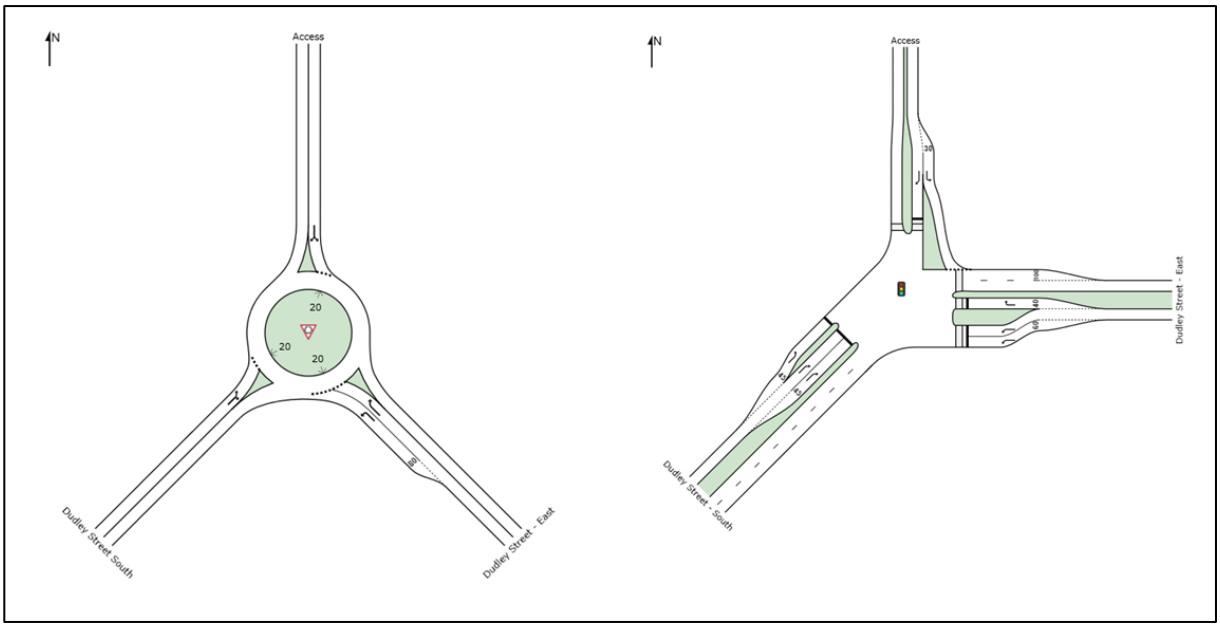
D R A F T

Both designs were circulated with Roads ACT and during this discussion the signalised option was not supported as:

- As the intersection needed a second lane to cater to the expected traffic volumes both lanes became trap lanes where vehicles would either have to turn left or right. These lanes would likely lead to drivers swapping lanes at the last minute as most drivers would want to turn right onto Cotter's Road rather than left.
- Worries regarding appropriate signal phasing in relation to the Cotter Road signals which were already phased with the Lady Denman Drive signals.
- Concern over the queue length approaching from the south due to the large volume of vehicles that travel from Cotter Road onto Dudley Street.

The options considered by AECOM were modelled using the intersection modelling program SIDRA INTERSECTION 7.0. The intersections were modelled in a network to determine their operation as a function of the adjacent intersections. The traffic volumes used in the modelling were determined using the future yields of the development and the likely distribution of the additional traffic accessing Dudley Street. The intersection layouts modelled in SIDRA are shown in Figure 7 below.

Figure 7 SIDRA Layouts



The linked network SIDRA modelling considered the following intersections:

- Dudley Street / Cotter Road
- Dudley Street / New Access Road (Roundabout and Signalisation)
- Dudley Street / Novar Street / Adelaide Avenue On-Ramp

The results of the linked SIDRA models incorporating these three intersections in the future scenario is summarised in Table **4** and Table **6** below.

4.2.3 Roundabout Option

4.2.3.1 Advantages and Disadvantages for the Roundabout Option

A summary of the key advantages/disadvantages relating to the roundabout option can be found in Table 3.

D R A F T

Table 3 Advantages and Disadvantages associated with the Roundabout Option

Advantages	Disadvantages
The design would allow for an overall greater throughput of traffic minimising the impacts and delays on the existing Dudley Street	The layout does not provide any priority crossing locations for pedestrians.
The intersection approaches include functional deflections to reduce speed through the intersection and minimise the likelihood of incidences.	Less preferred arrangement for safe cyclist movements.
The heavy right turn AM movement from Cotter Road onto Dudley Street will not be heavily impacted by the proposed intersection layout.	

4.2.3.2 SIDRA 7 Roundabout Analysis Results

Table 4 SIDRA Results – Roundabout Option

Intersection	Peak	Degree of Saturation	Average Delay (s)	95th Percentile Queue (m)	Level of Service
Dudley Street / Cotter Road	AM	0.90	14	89	B
	PM	0.66	20	82	B
Dudley Street / New Access Road (Roundabout)	AM	0.63	9	54	A
	PM	0.88	5	29	A

4.2.4 Intersection Option

4.2.4.1 Advantages and Disadvantages for the Intersection Option

The functional operation of a signalised intersection in this location has a number of shortcomings primarily relating to insufficient storage area between Cotter Road and Dudley Street and with regards to increased overall delays to motorists as a result of the introduction of traffic signals. A summary of the key advantages/disadvantages relating to the signalised intersection option can be found in .

Table 5 Advantages and Disadvantages associated with the Intersection Option

Advantages	Disadvantages
Safer passage for pedestrians through the intersection.	Two approach lanes are required from each leg of the intersection to facilitate the required traffic throughput.
Safer movement for right turning cyclists at the intersection.	The requirement of two lanes on approach to Cotter Road encourages weaving conflict between the intersections in an unacceptably short distance between the intersections.
Ability to coordinate signal function with the existing signalised intersection at Dudley Street / Cotter Road.	Delays on the major movements on Dudley Street. Greater impact and delays on the existing heavy movement between Dudley Street and Cotter Road.

D R A F T

4.2.4.2 SIDRA 7 Intersection Analysis Results

Table 6 SIDRA Results – Signalised Intersection Option

Intersection	Peak	Degree of Saturation	Average Delay (s)	95th Percentile Queue (m)	Level of Service
Dudley Street / Cotter Road	AM	0.80	9	82	A
	PM	0.61	17	97	B
Dudley Street / New Access Road (Signals)	AM	0.72	13	80	B
	PM	0.36	14	42	B

4.2.5 Summary of Both Options

The results of the analysis exposed the operational benefits and issues of the implementation of both the options considered. The key points of discussion of the modelling results are as follows:

- The SIDRA results indicated that typically the roundabout option functioned better in terms of delays and queuing compared to the signalised intersection arrangement.
- The signalised intersection arrangement operated in conjunction with the intersection of Dudley Street / Cotter Road better than the roundabout arrangement (as a result of signal coordination). The signal cycle times applied match the existing cycle times (80s in the AM, 90s in the PM)
- The average delay of the roundabout arrangement was found to be less than that of the signalised arrangement.
- The degree of saturation of both options was 0.9 or less indicating acceptable operation.
- During the heavy volume AM period, the roundabout arrangement operated with an overall level of service of A, the signalised intersection arrangement operated with an overall level of service B.
- Queuing from the signalised intersection of Dudley Street / Site Access in the AM peak on the southern leg was up to 80m. This queue would impact on the operation of Cotter Road in the AM peak.
- The worst movement in the signalised intersection arrangement is the right turn movement from the new access road in the AM peak period with an average delay of 69s and queuing up to 35m.
- The worst movement in the roundabout arrangement is the right turn movement from the new access road in the AM peak with an average delay of 24s and queuing up to 26m.

There was no notable difference in impact of either option on the operation of the intersection of Dudley Street / Novar Street / Adelaide Avenue On-Ramp. This intersection is currently operating at close to capacity as per previous modelling undertaken.

4.2.6 Wire Rope Barrier

Austroads Guide to Road Design – Part 6: Roadside Design, Safety and Barriers is used as the basis for determining clear zone requirements and possible hazards associated with the road side. Dudley Street has an AADT of around 10,000 which against a 70km/h design speed outlines a clear zone of

D R A F T

8.5m. Due to the curve of the road at that location (approx. 300m radius) a curve correction factor increases the clear zone to 11.05m.

A treatment option was then included in the PSP as inside this clear zone you have a potentially unrecoverable slope that leads onto Yarra Glen which is a major arterial road and has a large volume of traffic moving in the opposing direction. A crash caused by an errant vehicle leaving Dudley Street down onto Yarra Glen would likely have a high severity.

To mitigate the chance of a severe crash occurring wire rope barriers were proposed. They were selected as one option as they provide the sufficient structural integrity to contain and redirect the design vehicle, there is room for the barrier to deflect and the design is simple (easy to construct and cost effective).

In summary, a wire rope barrier was implemented as while a barrier will lead to a higher likelihood of crashes the reduced severity justified the implementation. Further design of the batter for the clear zone, review of barrier treatment and risk analysis will be undertaken in the subsequent steps of the design process.

4.2.7 Discussion and Recommendation

The primary objective of the Dudley Street / Site Access intersection is to provide safe ingress and egress to the future development of CBP with minimal impacts to the existing Dudley Street and surrounding road network. The roundabout arrangement assessed provides optimum intersection operational efficiency as indicated in the modelling undertaken. Further, the roundabout arrangement offers reduced weaving conflicts compared to the signalised intersection arrangement option.

Pedestrian volumes crossing Dudley Street are very low and are not expected to increase in the future scenarios, as such catering for pedestrian facilities as part of this upgrade is not the primary focus of this assessment. Implementation of a retrofitted mid-block pedestrian crossing facility could be considered in the future if the pedestrian demand in this area was to increase.

Cycling facilities can be catered for in both intersection arrangements.

The traffic assessment undertaken for this PSP report has determined that preferred arrangement for the intersection of Dudley Street / Site Access is the roundabout arrangement due to a more effective intersection operation and safer overall intersection function.

The intersection options were provided to Roads ACT for their review and comment and the preferred arrangement has been endorsed by Roads ACT.

D R A F T

5.0 Stakeholder Consultation

Stakeholders were consulted throughout the preliminary design process. The minutes for the meetings are found in Appendix C.

5.1 Uniting Church

A meeting was held on the 6th of February 2017 with various representatives from the Uniting Church of Yarralumla to discuss the stormwater drainage from the Church. It was agreed with CMTEDD that the stormwater flow from the Church would be incorporated into the Dudley Street upgrade works.

The key points of discussion and outcomes from the meeting are listed below.

- Uniting Church representatives noted that the stormwater drainage outlets flow in the direction towards Dudley Street
- There is visible erosion close to these outlets as seen in Figure 7. AECOM visually inspected the outlets within the vicinity of the church.

Figure 8 Stormwater outlet with visible erosion at the Yarralumla Uniting Church

- The stormwater from the main church drains towards Deakin.
- Uniting Church representatives raised their concern regarding the stormwater drainage from the church affecting any downstream future developments.
- The property had been surveyed approximately 12 months ago.

The stormwater flow from the uniting church is to be further explored in the detailed design stage of this project.

5.2 National Capital Authority

AECOM met with a Sarah Treble from the National Capital Authority (NCA) on the 1st of February 2017 to discuss the proposed scope of works. The key points of discussion and outcomes of the meetings are listed below:

- NCA queried the traffic numbers and impacts on Cotter Road and Dunrossil Drive that could affect dignitaries on route to or from Government House.

D R A F T

- NCA requested that the draft alignment to be shared with them to understand the required boundary changes prior to a Works Approval submission
- The current cross sections for the access road and Dudley Street were presented and NCA will internally discuss if further additional landscaping treatments along Dudley Street will be required.
- NCA highlighted that both ACT Heritage and ACT Conservator should be consulted.
- NCA highlighted that public consultation will be required prior to the Works approval application
- NCA highlighted that the approval application will be only for Dudley Street.

Further consultation with the NCA is to be undertaken in the during the Draft PSP design review.

5.3 Land Development Agency

The Land Development Agency is a key stakeholder in the design and representatives have been attending the fortnightly project meetings over the PSP design development.

The key issues for the LDA and assumptions for the PSP design are:

- Alignment of the Access Road – to suit the Brickworks Development considering the topographical and environmental constraints
- A shared path is required to provide a connection to the estate from Cotter Road. The proposed gradient on the access road will need to meet the maximum gradient design requirements for the access road.
- Stormwater design for the Dudley Street upgrade and the access road assumes the existing run off conditions. Increased run off due to the development will be managed and attenuated by the development.
- The LDA have a Community Panel set up for the Brickworks project which include groups such as the Yarralumla Residents Association (YRA), Inner South Community Council, Pedal Power etc.
- Presentation of the draft PSP design to be planned for the Community Panel.

5.4 TCCS/ACTION

A meeting was held with TCCS and ACTION on the 23rd January 2017.

The key points of discussion and outcomes of the meeting are listed below:

- Local buses are to use Dudley Street to service the future development
- Current bus route on Novar Street will be retained
- Bus stop is to be indented
- Bus stop bay (gradient) is to comply with the TAMS standard
- There is to be one bus stop (in each direction) on Dudley Street and located as close as possible to the Canberra Brickworks development. Local stop location to be clearly communicated to the LDA and the Developer.
- A few areas of concern for ACTION include:
    - Dudley Street/Cotter Road westbound intersection – safety concern for buses turning right into Cotter road as currently the intersections is unsignalised.
    - Dudley Street/Novar Street is a tight intersection
    - Adelaide Avenue southbound off ramp/Kent Street is a tight intersection.

D R A F T

5.6 Utility Authorities

During the PSP design process AECOM has liaised with utility authorities regarding the proposed works and location of existing utilities. The existing utilities impacted by the works and the outcomes of discussions with utility authorities are outlined in Section 7.0

The impacted and proposed utility authorities include:

- Jemena/Zinfra
- ActewAGL
- Icon Water
- Telstra
- Transact/iiNet

5.7 Inter-Directorate

There have been inter-directorate discussions and a meeting with the Conservator Liaison from the Environment, Planning and Sustainable Development Directorate of ACT Government on the 23rd of March 2017. This meeting involved discussions regarding the environmental issues and impacts. It was confirmed that an EPBC and EIS would be required to support the Development Approval Processes.

5.8 Walter Burley Griffin Society

Civil Infrastructure and Capital Works of the Economic Development Directorate have advised the Walt Burley Griffin Society of the works occurring at Dudley Street. The Walt Burley Griffin Society has been advised of the works due to Dudley Street being part of the original road layout by Walt Burley Griffin. The Walt Burley Griffin Society mentioned that their main interests with respect to Griffin's plan and street layouts are in relation to the terminus of the Adelaide Avenue axial and Griffin's principles of designing with landforms and vistas. The Griffin Society has requested to be notified of public briefings regarding the draft design plans.

D R A F T

6.0 Road Alignment

6.1 Introduction

The design standards selected for the project and adopted in subsequent road design comply with the provisions detailed within the standards and guidelines listed below and their referenced documents.

The speed limits in the vicinity of the project area are:

- Posted speed limit on Dudley Street is 60 km/h with a design speed of 70 km/h.
- Posted speed limit on the Access Road is 50 km/h with a design speed of 60 km/h.

The adopted reaction time is 2 seconds.

6.2 Design Standards and Criteria

Below is a list of the guidelines and standards that have been used during the design process.

- ACT Territory and Municipal Services (TaMS) – Design Standards for Urban Infrastructure (DSUI)
- ACT Department of Urban Services – Crime Prevention and Urban Design Resource Manual
- ACTEW Water Supply and Sewerage Standards
- AUSTROADS – Part 2: Pavement Structural Design
- AUSTROADS – Part 3: Geometric Design
- AUSTROADS – Part 4A Unsignalised and Signalised Intersections
- AUSTROADS – Part 4B Roundabouts
- AUSTROADS – Part 5B Drainage – Open Channels, Culverts and Floodways
- AUSTROADS – Part 6 Roadside Design, Safety and Barriers
- AUSTROADS – Part 6A Pedestrian and Cycle Paths
- AS 1428 – Design for access and mobility

The design criteria based on relevant Guidelines and Standards is tabulated in Appendix D.

6.3 Project Inputs and Assumptions

The PSP design is based upon available information, which includes:

- Information gathered from WAE drawings and during site visits;
- Location of utilities (supplied in CAD/DWG format by utilities authorities);
- Detailed engineering survey and survey of critical utilities to confirm their locations – refer to Section 2.5;
- Tree assessment – refer to Section 2.6;
- Environmental investigations and mapping of environmental constraints provided by the client
- Liaison with utilities providers; and
- Proposed geotechnical investigation – refer to Section 2.4.

6.4 Cross Sections

6.4.1 Existing

Dudley Street is a single carriageway road with one way in each direction with a traffic lane width of about 3 m with no shoulder.

D R A F T

6.4.2 Proposed

Dudley Street

The proposed cross section on Dudley Street is as follow:

- 4.0 m wide traffic lane to cater for buses.
- 1.5 m wide on-road cycle lane.
- 6.7 m wide verge on both sides generally to cater for:
    - 2.5 m wide path;
    - 2.0 m wide streetlight/tree planting corridor; and
    - Utilities.

The proposed cross section has been discussed and accepted by CICW and TCCS.

Access Road

The proposed cross section on the Access Road is as follow:

- 3.5 m wide traffic lanes.
- 1.5 m wide on-road cycle lanes.
- 4.0 m wide depressed median.
- 6.25 m wide verge on both sides generally to cater for:
    - 2.5 m wide path;
    - 2.0 m wide tree planting corridor adjacent to the road boundary; and
    - 1.75 m wide utility corridor.

It is a total width of 26.5 m. The proposed cross section has been discussed and agreed with CICW and TCCS to use the dimensions required in the current planning and road design standards to support the Development Application process.

The Doma Group's proposed cross section for the access road into the Estate is shown below. The total width is 22.5m. The cross section is as follows:

- 3.3 m wide traffic lanes.
- No on-road cycle lanes.
- 3.4 m wide depressed median.
- 5.5 m wide verge on western side and 7m wide verge on eastern side to cater for:
    - 2m and 2.5 m wide paths;
    - tree planting corridor adjacent to the road boundary; and
    - utilities corridor.

The lane widths are less than the 3.5 m required for a minor collector road. The 3.4 m wide median is less than required for tree planting under current TCCS requirements. The transition between the access road in the ACT Government land and the Estate will need to be coordinated with the Doma Group during the detailed design process.

D R A F T

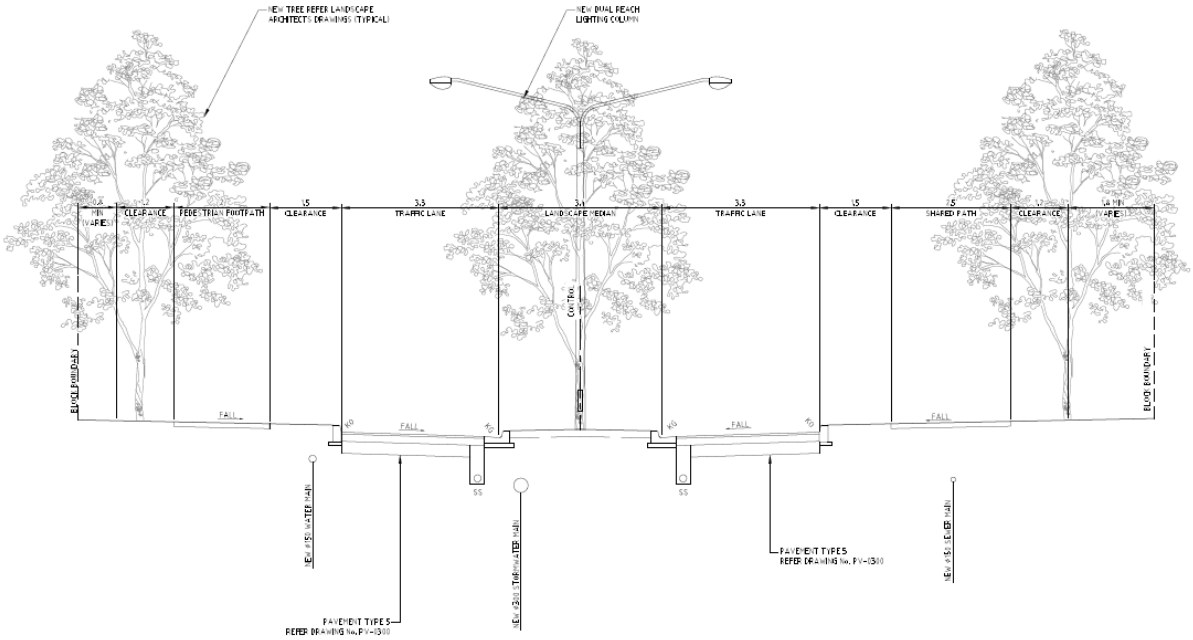


Figure 9 Doma Group Estate Access

6.5 Horizontal Alignment

6.5.1 Dudley Street

The horizontal curve of existing Dudley Street approaching to Novar Street has a radius of 130 m. This is less than the required minimum value of 149 m for trucks for a design speed of 70 km/h with 3% superelevation. The minimum value of 149 m has been adopted in the design.

Three options were considered in the developing the preferred horizontal alignment for Dudley Street taking into account constructability and environmental impact. These options are:

- Option 1 – widening on both sides of the existing Dudley Street as documented in the Concept Design drawings.
- Option 2 – widening on the southern side of the existing Dudley Street, utilising existing pavement on Dudley Street as much as possible.
- Option 3 – realigned Dudley Street further south clear of encroachment into a higher quality of Natural Temperate Grassland and Golden Sun Moth area.

6.5.1.1 Option 1 – Widening on both sides of Dudley Street

In this option, consideration was given to widening on both sides of existing Dudley Street as documented in the Concept Design drawings. The impacts of this option are:

- Encroaching into a higher quality Natural Temperate Grassland and Golden Sun Moth present along the north verge of existing Dudley Street.
- Constructability issue in areas where the proposed vertical alignment of the road is substantially higher than the existing.

6.5.1.2 Option 2 – Widening on the southern side of Dudley Street

In this option, consideration was given to widening on the southern side of existing Dudley Street, in an attempt to reduce encroachment to a higher quality environmental area and improve constructability. The impacts of this option are:

D R A F T

- Some or limited encroachment into a higher quality Natural Temperate Grassland and Golden Sun Moth present along the north verge of existing Dudley Street.
- Temporary works such as retaining walls may be required to contain earthworks and allow existing Dudley Street to be opened to traffic in areas were the proposed vertical alignment of the road is substantially higher than the existing.

6.5.1.3 Option 3 – Alignment shifted further south of Dudley Street

In this option, consideration was given to shift the alignment further south of the existing Dudley Street in an attempt to avoid encroachment to a higher quality environmental area and improve constructability. The impacts of this option are:

- No encroachment into a higher quality Natural Temperate Grassland and Golden Sun Moth present along the north verge of existing Dudley Street.
- Temporary tie-in works will be required to allow construction on existing Dudley Street and keeping Dudley Street be opened to traffic at all times.

6.5.1.4 Discussions

These three options were discussed with CICW and PCW. It was agreed that Option 3 is the preferred option as it has minimal impacts to a higher quality environmental areas along the northern verge of the existing Dudley Street whilst providing a better constructability solution for the project.

6.5.2 Access Road

The location of the entry into the CBP Estate was provided by Doma Group in May 2017 and it has been used in the documentation of the PSP design for the Access Road.

6.6 Vertical Alignment

6.6.1 General

The following parameters have been adopted in the development of vertical alignment on Dudley Street and the Access Road:

- Maximum longitudinal grade of 2% at the approaches to the roundabout; and
- Maximum longitudinal grade of 5%;

6.6.2 Dudley Street

The K value for the vertical curve on the existing Dudley Street approaching Novar Street is 10. This is less than the absolute minimum K value of 11.3 for a design speed of 70 km/h and an existing situation condition with a reaction time of 1.5 second. The proposed K value for the PSP design in this vicinity is 13.5 which is higher than the absolute minimum K value of 11.3 noted above. It is however lower than absolute minimum K value using a reaction time of 2 second in the existing situation condition. Adopting the proposed K value of 11.3 is considered acceptable as the vertical curve is located close to Novar Street intersection where vehicles are likely to travel in a lower speed than the posted speed limit.

The following are the location of cut and fill for the proposed vertical alignment on Dudley Street:

- A filling depth of approximately 1.1 m at the approach to Dudley Street/Access Road roundabout from Cotter Road;
- A filling depth of approximately 3 .0 m at the approach to Dudley Street/Access Road roundabout from Novar Street; and
- A cutting depth of 3.0 m at approximate Chainage 280.

6.6.3 Access Road and Uriarra Track Crossing

The maximum grade of 6% has been adopted in the assessment of vertical alignment of the Access Road.

D R A F T

The Access Road is generally located in cut. At the location where the existing Uriarra Track crosses the access road, the cut is approximately 2.2 m deep. In discussions with CICW, it was agreed that the alignment of the track and the crossing should be directed closer to the roundabout connecting with the off road path network due to pedestrian safety concerns for reduced sight lines for vehicles due to the cut batters.

The LDA has advised that the alignment of the Uriarra Track and the crossing of the access road is a sensitive issue for the YRA and the proposed alignment in the Draft PSP design will not be accepted by the community.

Four options for the location and approach to the Uriarra Track crossing the Access Road have been considered. Refer to Section 10.2.2 for outline of the options considered.

6.7 Intersection Geometry

The roundabout geometry at the intersection of Dudley Street and the Access Road has been designed to accommodate the vehicle turning movements for the following vehicles:

- 19 m Semi-Trailer
- 14.5 m Rigid Bus
- 15.7 m Tag-Steer Bus

The existing Kent Street / Dudley Street intersection has been checked for both the 14.5 m bus and 15.7 m tag-steer bus. The kerb line on the Kent Street approach left turn into Dudley Street has been realigned to accommodate the future bus movements on Dudley Street.

D R A F T

7.0 Utilities

A number of the existing utilities in the road corridor are identified as being impacted by the proposed works. Initial discussions with utilities authorities had been undertaken and the record of discussion with utility authorities is provided in Appendix E. AECOM also undertook a site visit to confirm the locations and conditions of the utilities as seen on the survey and DBYD data. A summary of the findings from the site visit is seen in Appendix F.

7.1 Water

Dial Before You Dig (DBYD) information shows an existing 150mm diameter water main on the northern verge of Dudley Street that continues in the North West direction towards Dunrossil Drive. There are four hydrants and a valve situated in the northern verge of Dudley Street, closer to the Dudley Street and Novar Street intersection.

Based on the pre-tender submission of the Canberra Brickworks development, the existing 150mm diameter water main along Dudley Street is to be upgraded to a 225mm water main to provide supply to the Canberra Brickworks Development. ICON Water indicated that the upgrading of the existing 150mm diameter main will start from the junction of 225mm/150mm diameter main on Dunrossil Dr and connect to the existing tee junction of the 225 mm diameter main at Dudley Street/Novar Street intersection. The existing tee is currently 150mm x 225mm and is proposed to be a 225mm x 225mm tee.

7.2 Sewer

Based on DBYD information, there is no sewer infrastructure within the proposed works area. There is sewerage infrastructure servicing the Uniting Church and the existing blocks north of Dudley Street, however these will not be impacted by the proposed works.

No provision for sewer is required along Dudley Street based on the pre-tender submission of the Canberra Brickworks development.

7.3 Electrical

There is a 11 kV overhead powerline runs over Cotter Road and Dudley Street. The cables crossing over Dudley Street have been surveyed and it is indicating that there is only 6 m clearance vertically between the cables and the proposed finish design levels which is less than ActewAGL's minimum clearance requirement of 6.7 m. Therefore, it is proposed for these cables between two poles to be relocated underground. The proposed undergrounding of the 11kV overhead powerlines may be undertaken as early works under the Utilities Act. Further discussions are required in the next stage of the design.

ActewAGL indicated the impacted cables from Pole 67767 to 62980 can be relocated underground. ActewAGL requested for 4 x 125 mm conduit crossings are to be specified to both accommodate relocated cables and provision for future demands. ActewAGL indicated an allowance of $60,000 for ActewAGL to relocate the cable and the civil contractor to provide the trenching and backfilling is required.

There is also a HV overhead powerline which crosses over Dudley Street at Dudley Street/Novar Street intersection. These cables crossing over Dudley Street have been surveyed and it is indicating that these cables are higher than 6.7 m above Dudley Street.

There are multiple underground street lighting cables running around the vicinity of Dudley Street:

- Along the northern verge of Dudley Street close to the Dudley Street and Cotter Road intersection (running up until SL212537)
- Near the Cotter Road and Dudley Street intersection (2 x 140) which runs down towards the northern verge of Cotter Road.

D R A F T

- 1 x 140 underground street lighting cable which crosses Dudley Street close to the western bend to a break in the cable and then to a cable positioned diagonally close to the intersection of Dudley Street and Cotter Road.
- An underground street lighting cable road crossing close to the Dudley Street/Novar Street intersection (1 x 140 and 1 x 100) which connects to the northern verge and then runs up along the Western Verge of Novar Street.
- Street lighting cables from the western verge of Novar Street (close to the Dudley Street and Novar Street intersection) continues to the southern verge of Dudley Street until SL212272.

The pre-tender submission of the Canberra Brickworks development indicated 2x125 mm electrical conduits, 1 x 50mm street lighting conduits and 1x63 mm communication conduit are required along Dudley Street. These conduits have been incorporated in a shared trench arrangement along Dudley Street.

7.4 Gas

There is a 63mm PE gas distribution main running along the northern verge of Dudley Street. There is also a 110mm PE gas distribution main crossing under Dudley Street in the vicinity of Dudley Street/ Novar Street intersection.

The impacts to the 63 mm PE gas main are found in two areas:

- Area 1 – western end – closer to Cotter Road
    - In this area, the gas main will be located in the fill section of the realigned Dudley St
    - An increased cover to the existing main (varying depth) up to 2 m high. Approximate length of gas main located in fill is around 100 m.
- Area 2 – eastern end – closer to Dudley Street/Novar Street
    - In this area, the gas main will be located in cut section of the realigned Dudley Street
    - It is proposed for the gas main to be relocated. Approximate relocation length is about 260 m.

Zinfra indicated no concern with the additional cover over the existing gas main in Area 1 and agreed with the gas main requires relocation in Area 2. Zinfra indicated an allowance of $10,000 for ActewAGL to relocate the cable and the civil contractor to provide the trenching and backfilling is required.

No provision for gas main is required along Dudley Street based on the pre-tender submission of the Canberra Brickworks development.

7.5 Communications

The pre-tender submission of the Canberra Brickworks development indicated 5x100 mm communication conduits are required along Dudley Street. These conduits have been incorporated in a shared trench arrangement along Dudley Street.

7.5.1 Optus

There is no Optus infrastructure within the vicinity of the proposed work area.

7.5.2 Telstra

There are multiple Telstra conduits running across the northern verge of Dudley Street and one Telstra conduit running under the Cotter Road / Dudley Street intersection. These conduits will be impacted by the works (especially close to the new proposed roundabout) and consultation with Telstra regarding protection and /or relocation for the impacted conduits will be required in the detailed design stage of the project.

D R A F T

7.5.3 iiNet (TransACT)

There is an iiNet communications conduit which crosses in the vicinity of Dudley Street/Novar Street intersection. There will be new kerb realignment within this area; however there will be no earthworks. This conduit will not be impacted by the works.

7.5.4 Government (SSICT or Icon) Fibre

There is an existing Icon Fibre running north from Cotter Road under the new roundabout intersection.

There is an existing Icon Fibre which runs from the northern verge of Dunrossil Drive towards the new roundabout.

Icon were contacted early in the design to confirm the location of the fibre and the draft PSP drawings will be provided for their review and comment with regard to any impacts during construction.

D R A F T

8.0 Stormwater Management

8.1 Design Criteria

The drainage design of Dudley Street and the Access Road has been carried out in accordance with TaMS Design Standards for Urban Infrastructure (DSUI), adopting the 20 year ARI for the assessment of minor storm event and the 100 year ARI for major storm event.

The runoff coefficients adopted for the respective catchments are shown in Table 7.

Table 7 Runoff Coefficients

Catchment	Runoff Coefficient	
	20 Year ARI	100 Year ARI
A	0.395	0.49
B	0.35	0.44
C	0.34	0.42
D	0.9	0.9
E	0.9	0.9
F	0.9	0.9

8.2 Cross Drainage

The existing Dudley Street has minimal existing stormwater infrastructure within the road reserve, with two drainage culvert crossings. The locations of these crossings are:

- A 750 mm diameter pipe located close to Chainage 140
- A 375 mm diameter pipe located close to Chainage 420

Preliminary peak flows have been calculated using the Rational Method and design parameters from the TaMS DSUI. Catchment areas have been delineated using ACTMAPi 1 m interval contours and the available detailed survey.

Table **8** presents catchment areas, existing cross drainage stormwater infrastructure, and the 100 year ARI peak design flows within the project area.

Table 8 Catchments and Stormwater flows

Catchment	Area (ha)	Existing culvert size	$Q_{20}\ (m^3/s)$	$Q_{100}\ (m^3/s)$	Comments
A	6.60	750 mm diameter pipe	0.65	1.15	Upgrade existing culvert to a 1350 mm diameter pipe
B	1.8	375 mm diameter pipe	0.20	0.35	Upgrade existing culvert to a 750 mm diameter pipe
C	1.05	-	0.10	0.15	New catchment are due to the Access Road

D R A F T

D	2.0	-	0.70	1.0	New pavement area
E	0.15	-	0.05	0.08	New pavement area
F	0.5	-	0.20	0.25	New pavement area

The hydraulic capacity of cross drainage culverts was calculated in accordance with Austroads Part 5B.

8.3 Stormwater pipe network

General approach adopted in the stormwater pipe drainage network design is:

- Modification to the existing stormwater network is undertaken with minimal alteration to the existing catchment boundaries.
- The capacity of the pipe network is determined using Colebrook White Chart.

CICW requested for the stormwater from the Uniting Church to be considered in this project scope of work. The following has been included incorporating the outcome of discussion with the Uniting Church representative:

- Grated sumps to be placed at the invert of the outlets surrounding the Yarralumla Uniting Church.
- A 225mm diameter pipe is proposed to connect the grated sump which discharges to Dudley Street stormwater system.

The locations of the outlets from the Uniting Church will need to be surveyed in the next stage of the design.

D R A F T

9.0 Pavements

9.1 Subgrade Conditions

Douglas Partners is currently in the process in obtaining environmental approval to undertake geotechnical investigation. Thus, for the purpose of this report, an assumption subgrade CBR 3% has been adopted in the assessment of pavement design. This assumption will be updated when the geotechnical investigation is complete.

9.2 Design Traffic Loading

The design equivalent standard axles (ESA) have been calculated for both 20 year and 40 year design life for each section:

- Dudley Street (between Cotter Road and Dudley Street/Access Road roundabout);
- Dudley Street (between Novar Street and Dudley Street/Access Road roundabout); and
- Access Road

The following criteria have been adopted in the calculation of design equivalent standard axles (ESA):

- The existing AADT survey data for Dudley Street between Cotter Road and Novar Street provided by the ACT Government undertaken in October 2015;
- The AADT for 2021 is based on conservative projections;
- Assumption that construction of the access road and new developments will commence in 2018;
- The adopted ESA per heavy vehicle is 1.8;
- The adopted percentage for Heavy Commercial Vehicles (HCV) is 5% between the year 2015 to 2021 and remains constant at 3% from the year 2022 (assuming the developments are completed);
- The assumed growth for the AADT from the year 2021 to 2031 is 2% which is indicative and conservative, the growth rate from the year 2031 onwards is adopted as 0.50% due to the limited available information.
- For the access road:
    - Adopted percentage for Heavy Commercial Vehicles (HCV) is assumed to be 5% from 2018 to 2022 due to construction traffic and 3% from 2022 onwards;
    - Development is assumed to be progressed linearly until 2021, from 2022 it is assumed that the Canberra Brickworks Precinct is fully developed (i.e. no more growth in terms of traffic from the estate).

Based on the above criteria, the design traffic loads for the access road and the upgraded Dudley Street are shown in Table 9 (for a start date of 2018). Calculations are included in Appendix G.

Table 9 Projected design traffic loading

Street	20 Year ESA	40 Year ESA
Access to Cotter Road	3.1×10^6	6.4×10^6
Dudley Street between the roundabout and Novar Street	2.9×10^6	6.0×10^6
Access road to Canberra Brickworks Precinct	6.7×10^5	N/A

The design traffic for the roundabout has been assumed equal to the largest of the approach roads, namely 3.1×10^6 ESA. Because the design traffic loads for Dudley Street (to Novar Street) and the

D R A F T

roundabout and access to Cotter Road are similar, the designs for all these pavements are based on the traffic loads for the access road to Cotter Road.

9.3 Pavement Design Options

The following options have been considered for the thickness design of the pavements.

a. A granular pavement with “thin” asphalt surfacing for the access road to the Canberra Brickworks Precinct, since the 20 year design traffic is less than one million ESA.

b. Either a granular pavement with “thin” asphalt surfacing or a full depth asphalt pavement for Dudley Street between the roundabout and Novar Street because the 20 year design traffic is between one and ten million ESA.

c. A full depth asphalt pavement for the roundabout because (i) a granular pavement is liable to premature rutting and shoving under the shear stresses imposed by turning vehicles, and (ii) a robust pavement requiring low maintenance is desirable in this location.

d. A full depth asphalt pavement is also proposed for the access road to Cotter Road, since it is also likely to be subject to shear stresses arising from the intersection with Cotter Road.

Pavement thickness designs have been prepared in accordance with Austroads AGPT02-12 “Guide to Pavement Technology Part 2: Pavement Structural Design”. Granular pavement designs are shown in Table 10 and full depth asphalt pavement designs for both 20 year and 40 year traffic loads are shown in Table 11 for whole of life cost comparison purposes. Calculations for the full depth asphalt pavement are included in Appendix H.

Table 10 Thickness designs for granular pavements, 20 year traffic load (all thicknesses in mm)

Pavement Layer	Access Rd to CBP	Dudley St to Novar St
Asphalt surface AC14	45	45
Prime	Yes	Yes
Based DGB20	200	200
Subbase DGS20	180	200
Select Fill CBR 6	150	150
Subgrade design CBR	3%	3%

Table 11 Thickness designs for full depth asphalt pavements (all thicknesses in mm)

Pavement Layer	20 Year Traffic	40 Year Traffic
Asphalt surface AC14	45	45
Asphalt base AC20	160	175
Prime	Yes	Yes
Subbase DGB20	100	100
Working platform Select Fill CBR 6	150	150
Subgrade design CBR	3%	3%

It is noted that a “Circly” assessment of the Dudley Street to Novar Street granular pavement indicates a nominal asphalt fatigue life of 9 years. However, the performance of “thin” asphalt pavements in the ACT is far better than this calculation would indicate and the flexible granular design is recommended provided appropriate maintenance is maintained.

D R A F T

9.4 Whole of Life Costing

Assessment of likely whole of life costs for the above pavements over a 40 year period has been based on the adopted maintenance requirements and unit costs presented in Table 12.

Table 12 Adopted Maintenance Strategy for Whole of Life Costing (40 years)

Pavement Type	Adopted Periodic Maintenance	Maintenance Cost ($/m^2)
Granular pavement	1.5% heavy patch every 4 years	2.91
	Mill 35 mm, tack coat and 45 mm resheet years 8 and 16	49.00
	In-situ stabilisation (Foamed Bitumen Stabilised 320mm thick of granular layer) including milling 80 mm, seal coat and resheet 50 mm at 20 years	141.00
	0.5% heavy patch every 8 years after stabilisation	0.97
	Mill 50 mm and resheet 50 mm every 10 years after stabilisation	61.00
Full depth asphalt pavement (20 year design life)	0.5% heavy patch every 5 years to year 20	0.97
	1% heavy patch every 5 years after 20 years	1.94
	Mill and resheet every 10 years	61.97
Full depth asphalt pavement (40 year design life)	0.5% heavy patch every 5 years	0.97
	Mill and resheet every 10 years	61.97

NOTE: Routine maintenance cost of $0.60/m^2/year also applies to all pavements

Note that the adopted maintenance strategies listed above are for comparison purposes only and do not purport to indicate actual maintenance costs. Decisions on when to undertake maintenance and the type of maintenance selected will be made by the ACT road maintenance group.

Relative pavement costs for a 40-year period based on the data in Table 12 are summarised in Table 13. No residual value has been assigned to any pavement.

Table 13 Summary of Relative Costs – 40 Year Period

SUMMARY		Whole of Life Cost @ Discount Rate ($/m2)		
Pavement Type	**Initial costs (based on Rates)**	**4%**	**7%**	**10%**
Granular pavement for 20 year life + rehab to 40 years	$102.94	$270.87	$208.54	$172.93
Full Depth Asphalt for 20 year life + rehab to 40 years	$174.51	$284.14	$242.84	$219.78
Full Depth Asphalt for 40 year life	$185.29	$288.24	$250.22	$228.76

D R A F T

The data in Table 13 indicates that the whole of life costs for granular pavement are always lower compared to the full depth asphalt pavement types. The initial cost is also lower for the granular pavement in comparison to both the 20 year and 40 year life full depth asphalt types. The 20 year life full depth asphalt with rehabilitation to 40 years has a lower initial cost but very similar whole of life costs (within about 2.5%) at all discount rates in comparison to the full depth asphalt for a 40 year life.

Based on the whole of life costing analysis, it is recommended that a granular pavement is adopted for the Dudley Street segment with the extension to Novar Street. The whole of life costing shows that the maintenance work for the 20 year life granular pavement is cost effective and it is assessed that maintenance work could be programmed without significant impact on road users.

As previously discussed, a full depth asphalt pavement is recommended for the roundabout and the extension to Cotter Road. The 40 year design life pavement is preferred as the whole of life costs are similar and the 20 year life pavement involves greater maintenance and therefore more disruption to road users in a location difficult to bypass.

9.5 Summary of Adopted Pavement Designs

Pavement Type 1 – Granular (20 year) - Access Road to CBP

- 45 mm AC14-MD (AR 450 binder)
- Prime
- 200 mm DGB20
- 180 mm DGS20
- 150 mm Select Fill (CBR 6)
- Subgrade (Assumed CBR 3%)

Pavement Type 2 – Granular (20 year) – Dudley Street to Novar Street

- 45 mm AC14-HD (AR 450 binder)
- Prime
- 200 mm DGB20
- 200 mm DGS20
- 150 mm Select Fill (CBR 6)
- Subgrade (Assumed CBR 3%)

Pavement Type 3 – Full Depth Asphalt – Roundabout and extension to Cotter Road

- 45 mm AC14-HD (A15E binder)
- 175 mm AC20-HD (AR450 Binder)
- Prime
- 100 mm DGS20
- 150 mm Select Material (CBR 6)
- Subgrade (Assumed CBR 3%)

Note that these pavement profiles are required to be updated once the geotechnical investigation results become available.

D R A F T

10.0 Other Design Issues

10.1 Public Transport

There was a discussion with Transport Canberra undertaken in January 2017 (refer to Section 5.4) with the outcomes of the meeting have been incorporated in the PSP design drawings.

ACTION has been consulted during the development of the PSP design. Dudley Street will be a bus route that serves the Brickworks Development.

The location of the bus stops has been agreed by ACTION to be located as close as possible to the access road for commuters to walk from the development.

10.2 Shared paths and On-road cycle paths

10.2.1 Shared Paths

A 2.5 m wide shared path is proposed on both sides of the Access Road to the roundabout. The shared path on the eastern verge continues along the northern verge of Dudley Street and connects to the shared path on Novar Street.

The shared path on the western verge of the Access Road continues along the southern verge of Dudley Street to the bus stop location.

The gradient of the shared path follows the road gradient of up to 6%. This path has been designed in accordance with Austroads Part 6A Pedestrian and Cyclist Paths and does not comply with AS1428 Accessibility Standard.

10.2.2 Uriarra Track

The Uriarra Track is an existing informal track that traverses the site in an east west direction. The track will be impacted by the earthworks and the cut batter for the Access Road. The LDA had advised that a pedestrian refuge crossing arrangement should be provided on the Access Road.

Due to safety concerns regarding visibility of pedestrians the crossing location has been realigned closer to the roundabout in the draft PSP design. However the LDA has advised that this is not an acceptable outcome and further options for the crossing need to be considered to retain the crossing location on its current alignment.

Four options for the location and approach to the Uriarra Track crossing the Access Road have been considered. A memo outlining each option with attached long sections is attached in Appendix K.

The four options are:

1(a) Retain the existing track alignment and crossing location and flatten and extend the approach cut batters
1(b) Retain the existing track alignment and crossing location and provide stairs
2 Realignment of the track toward the Brickworks with crossing located where cut depth is reduced closer to the Brickworks entrance
3 Pedestrian overpass for the track using single super tee girder

Given that the existing track is not a formal path and does not comply with DDA requirements we have assumed that the crossing does not have to meet DDA requirements.

There is minimal difference with regard to increase in environmental impacts for all four options. There is moderately disturbed Golden Sun Moth Habitat on the southern side of the Uriarra Track which is impacted more by the Access Road than the crossing options.

There are trees both sides of the Access Road. Options 2 and 3 have the greatest impact on the existing trees. Option 2 moves the crossing location 10 m north of the existing through the existing trees and Option 3's large footprint impacts more trees than Options 1a and 1b. Option 2 will have an

D R A F T

impact on the high quality and medium quality rating regulated trees whilst Option 1a, 1b and 3 will mostly impact the poor quality and medium quality rating regulated trees.

For the Access Road and Dudley Street Upgrade there is a deficit of material and an additional 6,720 m^3 of imported fill is required. The cut material gained from the Uriarra Track regrading can be used to reduce the deficit of fill. The cost of importing fill is greater than the cost of general earthworks.

We have assumed the path surface treatment on the regraded approaches would be decomposed granite gravel to maintain the informal track appearance.

A high level cost assessment of the options is shown below for comparison purposes. The costs are based on earthwork quantities, decomposed granite gravel path length, landscape of batters, stairs, concrete path for the draft PSP design and the bridge superstructure and include a 40% contingency.

Table 14 High Level costs for Uriarra Track Options

Draft PSP	Option 1a	Option 1b	Option 2	Option 3
$53,000	$44,000	$25,000	$34,000	$793,000

Although Option 1b has the lowest cost and environmental impact it is the least functional of the four options investigated. Option 2 has a satisfactory balance between costs especially for cyclists and functionality while minimising environmental impact. The LDA will present the options to the community for feedback and to incorporate in the detailed design.

10.3 Landscape

Landscape design was not required in the scope of works for the PSP design due to the pending Canberra Brickworks Estate development and the proposed landscaping to be undertaking as part of the Estate.

The proposed cross sections for both the Access Road and Dudley Street has allowed for the provision of street trees.

The proposed median planting for the Estate may be carried through into the access road if required by the Estate Development.

10.4 Street Lighting

Street Lighting design was not required in the scope of works for the PSP design due to the Canberra Estate.

The proposed cross sections for both the Access Road and Dudley Street has allowed for the provision of street lights.

The proposed lighting for the Estate may be carried through into the access road if required by the Estate Development.

10.5 Earthworks

Due to the existing topography there are significant earthworks required for the construction of the Access Road and the upgrade to Dudley Street.

Generally the batter slopes adopted are 4H:1V in both cut and fill areas. The batter slopes in the vicinity of the Uriarra Track crossing will be reviewed.

Based on the design surface and existing surface, the approximate earthworks quantities are 14,300m^3 cut and 21,008 m^3 fill. The excess fill required is 6,720 m^3.

The above estimates are based on the following criteria:

- Exclude topsoil removal;

D R A F T

- Exclude pavement boxing; and
- Exclude removal of any unsuitable material.

The geotechnical investigation will provide inputs with regard to stability of excavations and suitability of excavated materials to be used in fill.

D R A F T

11.0 Construction Staging

11.1 General

The proposed construction staging discussed in this section of the report considers the existing Dudley Street to be opened to traffic throughout the construction period. This construction staging will require temporary tie-in works to enable works on existing Dudley Street.

An alternative arrangement such as a full road closure of the existing Dudley Street over the whole construction period was discussed with CICW and PCW in an attempt to avoid the construction of any temporary tie-in works to minimise environmental disturbance in the project area. CICW indicated that based on initial their discussion with TCCS a full road closure can be considered as an option however it is subject to further discussions and consultations with key stakeholders.

Another possible staging arrangement is a full road closure of existing Dudley Street over a short period of time to enable works on existing Dudley Street and to avoid the need of any temporary tie-in works. This arrangement could be discussed further with TCCS and key stakeholders in the next stage of design.

11.2 Stage 1

The following works are proposed in the construction of Stage 1 (refer to drawing no. CS-0801):

- Construction of majority of the roundabout and the Access Road;
- Construction of new pavement and earthworks north of the existing Dudley Street at the approach to Novar Street intersection and temporary (eastern) tie-in to existing Dudley Street;
- Construction of new pavement and earthworks south of the existing Dudley Street and temporary (western) tie-in to Cotter Road intersection;
- Traffic is utilising existing Dudley Street as per current arrangement.

11.3 Stage 2

The following works are proposed in the construction of Stage 2 (refer to drawing no. CS-0802):

- Works are mainly in the vicinity of the approach to Novar Street;
- Construction on existing Dudley Street between new Stage 1 works (south of existing Dudley Street) and Novar Street; and
- Traffic is utilising new pavement from Novar Street and eastern temporary tie-in constructed in Stage 1 works and back onto existing Dudley Street further west of Novar Street.

11.4 Stage 3

The following works are proposed in the construction of Stage 3 (refer to drawing no. CS-0804):

- Construction on existing Dudley Street between new Stage 2 works and Cotter Road;
- Traffic is utilising new pavement from Novar Street and western temporary tie-in to Cotter Road constructed in Stage 1 works;
- Traffic lane on Cotter Road eastbound is reduced to one lane approaching Dunrossil Drive;
- A left turn lane is provide into the western temporary tie-in from Dunrossil Drive;
- Cycle lane on Cotter Road eastbound is maintained;
- Temporary traffic signal is proposed at the western temporary tie-in/Cotter Road eastbound intersection;
- All traffic movements, except the left turn movement from Dudley Street to Cotter Road eastbound, are maintained at the western temporary tie-in/Cotter Road eastbound intersection; and

D R A F T

- Traffic on Cotter Road westbound is unaffected.

Discussion and confirmation with TCCS relating to temporary traffic signal at the western temporary tie-in/Cotter Road intersection will be required to be undertaken in the next stage of design.

12.0 Safety in Design Considerations

Refer to Appendix I for the Safety in Design Report.

D R A F T

13.0 Opinion of Probable Costs

13.1 Assessment of Opinion of Probable Costs

The assessment of probable costs has been prepared based on the Draft PSP design drawings. Assumptions have been made for the Landscaping and Street Lighting based on similar road projects.

The construction cost assessment below includes a 30% contingency and 10% GST.

Table 15 Bill of Quantities Summary for Draft PSP Design

Item No	Description	Total
00	PRELIMINARIES	$ 350,000
100	PROVISION FOR TRAFFIC	$ 162,500
200	EARTHWORKS	$ 992,733
303	UNDERGROUND SERVICES	$ 126,543
305	STORMWATER DRAINAGE	$ 561,745
306	SUBSOIL DRAINAGE	$ 98,695
307	CONDUITS	$ 168,708
308	WATER SUPPLY	$ 227,825
400	FLEXIBLE PAVEMENT CONSTRUCTION	$ 1,369,615
600	CONCRETE KERBS, FOOTPATHS AND MINOR WORKS	$ 650,318
700	ROAD FURNITURE	$ 65,825
800	INCIDENTAL WORKS	$ 70,000
900	LANDSCAPE	$ 219,800
1000	ROAD SIGNS	$ 6,375
1100	PAVEMENT MARKING	$ 28,425
1400	STREET LIGHTING	$ 469,750
	SUB-TOTAL	$ 5,568,855
	CONTINGENCY	$ 1,670,657
	GST (10%)	$ 723,951
	TOTAL (INCL. GST)	$ 7,963,463

D R A F T

A P50 and P90 Cost Estimate has been undertaken to review and identify the level of inherent and contingent risk for the works and the level of contingency that should be applied at this stage of design.

The combined model (cost estimate and risk register) has been simulated with the output results summarised below. The @RISK Output Reports are included in Appendix J.

It should be noted that the estimate includes for construction costs only and excludes GST.

Table 16 P50 and P90 Output Results

	BOQ	P50	P90
Base cost estimate	$ 5,568,855	$ 5,568,855	$ 5,568,855
Inherent risk		$ 55,604	$ 159,122
Contingent risk		$ 984,384	$ 1,818,541
Contingency (30%)	$ 1,671,450		
Total	**$ 7,240,305**	**$ 6,608,844**	**$ 7,546,518**
Contingency ($)	$ 1,671,450	$ 1,039,988	$ 1,977,663
Contingency (%)	30.0%	18.7%	35.5%

The assessment of probable costs BOQ has been separated into two packages for the scenario where the Access Road needs to be constructed prior to the Dudley Street Upgrade.

Package 1 is the opinion of probable cost for the roundabout and access road with the limit of works extending to the bus stop on Dudley Street.

Package 2 is the Dudley Street upgrade works to Novar Street.

No design has been undertaken to consider the transition between the construction of Package 1 and Package 2 or staging of either of the packages. The assessment of probable costs is based on a split of quantities based on the current PSP design.

Table 17 Bill of Quantities Summary Package 1 – Access Road and Roundabout

	PACKAGE 1 - ACCESS ROAD AND ROUNDABOUT	
PAY ITEM	**DESCRIPTION**	**AMOUNT**
	SUMMARY TABLE	
00	**PRELIMINARIES**	$ 350,000.00
100	**PROVISION FOR TRAFFIC**	$ 113,500.00
200	**EARTHWORKS**	$ 265,430.00
303	**UNDERGROUND SERVICES**	$ 66,045.00
304	**SEWERAGE**	
305	**STORMWATER DRAINAGE**	$ 325,050.00
306	**SUBSOIL DRAINAGE**	$ 34,000.00
307	**CONDUITS**	$ 100,015.00
308	**WATER SUPPLY**	$ 148,155.00
309	**WATER SERVICES**	
400	**FLEXIBLE PAVEMENT CONSTRUCTION**	$ 859,714.60
500	**RIGID PAVEMENT CONSTRUCTION**	
600	**CONCRETE KERBS FOOTPATHS AND MINOR WORKS**	$ 323,835.50
700	**ROAD FURNITURE**	$ 1,625.00
800	**INCIDENTAL WORKS**	$ -
900	**LANDSCAPE**	$ 100,600.00

D R A F T

1000	**ROAD SIGNS**	$ 3,225.00
1100	**PAVEMENT MARKINGS**	$ 10,915.00
1200	**SEGMENTAL PAVING**	
1300	**TRAFFIC SIGNALS**	$ -
1400	**STREET LIGHTING**	$ 198,580.00
	SUB-TOTAL	**$ 2,900,690.10**
	CONTINGENCY (30%)	**$ 3,770,897.13**
	GST (10%)	$ 377,089.71
	TOTAL (Inc GST)	**$ 4,147,986.85**

The Preliminaries items for both packages based on provision of Contractor and Superintendent facilities so a similar amount is provided for both packages. The construction period and landscape maintenance period have been maintained at 26 weeks for both packages.

Table 18 Bill of Quantities Summary Package 2 – Dudley Street Upgrade

	PACKAGE 2 - DUDLEY STREET UPGRADE	
PAY ITEM	**DESCRIPTION**	**AMOUNT**
	SUMMARY TABLE	
00	**PRELIMINARIES**	$ 335,000.00
100	**PROVISION FOR TRAFFIC**	$ 113,500.00
200	**EARTHWORKS**	$ 730,255.00
303	**UNDERGROUND SERVICES**	$ 52,947.50
304	**SEWERAGE**	
305	**STORMWATER DRAINAGE**	$ 222,070.00
306	**SUBSOIL DRAINAGE**	$ 60,545.00
307	**CONDUITS**	$ 68,692.50
308	**WATER SUPPLY**	$ 94,670.00
309	**WATER SERVICES**	
400	**FLEXIBLE PAVEMENT CONSTRUCTION**	$ 509,939.50
500	**RIGID PAVEMENT CONSTRUCTION**	
600	**CONCRETE KERBS FOOTPATHS AND MINOR WORKS**	$ 326,460.00
700	**ROAD FURNITURE**	$ 64,200.00
800	**INCIDENTAL WORKS**	$ 70,000.00
900	**LANDSCAPE**	$ 139,800.00
1000	**ROAD SIGNS**	$ 3,150.00
1100	**PAVEMENT MARKINGS**	$ 21,010.00
1200	**SEGMENTAL PAVING**	
1300	**TRAFFIC SIGNALS**	
1400	**STREET LIGHTING**	$ 274,320.00
	SUB-TOTAL	**$ 3,086,559.50**
	CONTINGENCY (30%)	**$ 4,012,527.35**
	GST (10%)	$ 401,252.74
	TOTAL (Inc GST)	**$ 4,413,780.09**

D R A F T

14.0 Items to be Addressed in Detailed Design

14.1 Further Investigation

In the next phase of design the following tasks will need to be undertaken:

- Stormwater modelling for the proposed pipe culverts.
- Further investigation of the stormwater from the Yarralumla Uniting Church – including survey of the outlet locations
- Pavement design will be updated for the Geotechnical Investigation report.
- Liaison and coordination with utility authorities to determine requirements for relocation and/or protection
- Uriarra Track crossing Access Road
- Further review of constructability with regard to utility requirements and timing
- Environmental studies for the EIS submission

14.2 Risk Management

The risks and issues that need to be considered in the next stage of planning and design include:

- Coordination with Canberra Brickworks Estate Development.
- Environmental and planning approvals.

DRAFT

Appendix A

D R A F T

Appendix A – Feasibility Design Review

Item	Description	Dudley Street	Canberra Brickworks Access Road	Comments	Amendment	Amendment date
1	**General**					
1.1	Traffic volume			AECOM is currently undertaking additional traffic study		
1.2	Safety (General)					
1.2.1	Safety barrier	Ch 500 to Ch 660 Require safety barrier to delineate and protect errant vehicle going down steep embankment and onto Adelaide Avenue		Noted in the discussion with TCCS on 23/01/17		
2	**Cross Section**					
2.1	Traffic Lane widths					
2.1.1	Bus route lane	4 m wide (excluding on-road cycle lane) is required	3.5 m wide is acceptable	Discussed with TCCS on 23/01/17		
2.1.2	Bus stop	Bus stop is to be indented		Discussed with TCCS on 23/01/17		
2.2	Verge Width					
2.2.1	Utilities	Stormwater system is required on both sides of the carriageway where the road has a crown crossfall.	Stormwater system is required on both sides of the carriageway where the road has a crown crossfall.	May increase the verge width. Noted in the discussion with TCCS on 23/01/17		
3	**Sight Distance**					
4	**Horizontal Alignment**					
4.1	Horizontal Curve	Ch 475 to 550 Radius of 130 m is below the absolute minimum radius (superelevation for trucks) of 149 m specified in AGRD Part 3. Noted in the Feasibility report	Ch 5 to 93 Radius of 180 m is below the minimum desirable radius (adverse crossfall for trucks) of 203 m specified in AGRD Part 3, however, above the absolute minimum value	Discussed with TCCS on 23/01/17 Dudley St - amend design to meet the absolute minimum radius for trucks. Access Rd - depend on the road connection to the development.		
4.2	Intersection					
4.2.1	Roundabout with access road	Proposed to be moved further south to minimise environment and drainage impacts To include on-road cycling at the roundabout		Discussed with TCCS on 23/01/17		
4.2.2	Cotter Road	Check tight radius bend for steer tag bus, tourist bus		Discussed with TCCS on 23/01/17		
4.2.3	Novar St/Kent St	Adelaide Ave off ramp, right turn to Novar St - tight bend for steer tag bus		Discussed with TCCS on 23/01/17		
5	**Vertical Alignment**					
5.1	On-road cycle lane	Ch 200 to 330 The length of 130 m (5.3% grade) exceed the acceptable length of gradient without landing for cyclist noted in AGRD Part 6A.	Ch 60 to 130 The length of 70 m (10% grade) exceed the acceptable length of gradient without landing for cyclist noted in AGRD Part 6A.	This matches with the road on Dudley St - proposed design is accepted. Access Road - to be discussed further when location and alignment of the access road is confirmed. Discussed with TCCS on 23/01/17		
5.2	Bus stop	Ch 220 Proposed bus stops located on 5% longitudinal grade. Works around the bus stops are required to comply with the maximum allowable grade on bus stops or relocate bus stops location		Relocate the proposed bus location to a flatter vertical grade. Discussed with TCCS on 23/01/17		
5.3	Shared path	Ch 200 to 330 5.3% grade is steeper than the limiting maximum gradient noted in AGRD Path 6A. Noted in the Feasibility report - it is expected not to form part of Accessible Pedestrian Route (located well away from a town centre)	Ch 60 to 130 10% grade is steeper than the limiting maximum gradient noted in AGRD Path 6A.	This matches with the road on Dudley St - proposed design is accepted. Access Road - to be discussed further when location and alignment of the access road is confirmed. Discussed with TCCS on 23/01/17		
		Ch 200 to 330 The length of 130 m (5.3% grade) exceed the acceptable length of steep gradient for cyclist noted in AGRD Part 6A.	Ch 60 to 130 The length of 70 m (10% grade) exceed the acceptable length of steep gradient for cyclist noted in AGRD Part 6A.	This matches with the road on Dudley St - proposed design is accepted. Access Road - to be discussed further when location and alignment of the access road is confirmed. Discussed with TCCS on 23/01/17		

D R A F T

Appendix B

D R A F T

Appendix B – Planning Approvals Advice Memo

CBP Access Road and Dudley Street Upgrade

Procurement and Capital Works

23-May-2017

Doc No. 0001

AECOM

Planning Approvals Advice

CBP Access Road and Dudley Street Upgrade

Planning Approvals Advice

CBP Access Road and Dudley Street Upgrade

Client: Procurement and Capital Works

ABN: N/A

Prepared by

AECOM Australia Pty Ltd
Level 2, 60 Marcus Clarke Street, Canberra ACT 2600, Australia
T +61 2 6201 3000 F +61 2 6201 3099 www.aecom.com
ABN 20 093 846 925

23-May-2017

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 AS/NZS4801 and OHSAS18001.

© AECOM Australia Pty Ltd (AECOM). All rights reserved.

AECOM has prepared this document for the sole use of the Client and for a specific purpose, each as expressly stated in the document. No other party should rely on this document without the prior written consent of AECOM. AECOM undertakes no duty, nor accepts any responsibility, to any third party who may rely upon or use this document. This document has been prepared based on the Client's description of its requirements and AECOM's experience, having regard to assumptions that AECOM can reasonably be expected to make in accordance with sound professional principles. AECOM may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified. Subject to the above conditions, this document may be transmitted, reproduced or disseminated only in its entirety.

Quality Information

Document	Planning Approvals Advice
Ref	60533438 \\aucbr1fp001\projects\cbr\60533438\4. tech work area\4.3\3.0 draft\planning approvals advice\cbp and dudley street-planningapprovalsadvice_2.docx
Date	23-May-2017
Prepared by	Richard Farmer
Reviewed by	Jane Peters

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
1	23-May-2017	Draft for review	Jane Peters Project Manager	

Table of Contents

Acronyms i
Executive Summary i
1.0 Introduction 4
1.1 Proposal Description 4
1.2 Land use zoning 5
1.2.1 Land Custodianship 5
1.2.2 Blocks 5
1.3 Initial environmental constraints 6
2.0 Planning Context Overview 8
3.0 Commonwealth Planning Policies 8
3.1 Environment Protection and Biodiversity Conservation Act 1999 8
3.1.1 Potential for a Significant Impact under the EPBC Act 9
3.1.2 Referral Process 11
3.2 National Capital Authority Policies 11
3.2.1 National Capital Plan 11
3.2.2 Works Approval process 12
4.0 ACT Planning Policies 14
4.1 Planning and Development Act 2007 14
4.1.1 Development Approval Process Overview 14
4.1.2 Development Approval Process 14
4.1.3 Works in Designated Areas (subject to the National Capital Plan) 20
4.2 Heritage Act 2014 21
4.3 Nature Conservation Act 2014 21
4.3.1 Ecological Impact Assessment 22
4.4 Tree Protection Act 2005 22
4.4.1 Tree Assessment 23
4.5 Environment Protection Act 1997 24
4.5.1 Environmental Authorisation or Environmental Protection Agreement 24
4.5.2 Contaminated Sites Register 25
4.6 Water Resources Act 2007 25
4.6.1 Waterway Work Licence 25
5.0 References 26

Appendix A
Works Approval Application Form A

Appendix B
Works Approval Information Checklist B

Appendix C
Protected Matters Search Tool Report C

Acronyms

CEMP	Construction Environmental Management Plan
DA	Development Application
DoEE	Department of Environment and Energy
EIS	Environmental Impact Statement
EPA	ACT Government Environment Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPSD	ACT Government Environment, Planning and Sustainable Development Directorate
ESO	Environmental Significance Opinion
FSP	Final Sketch Plan
LDA	ACT Government Land Development Agency
NC Act	Nature Conservation Act 2014
NCA	National Capital Authority
NCP	National Capital Plan
NES	National Environmental Significance
PD Act	Planning and Development Act 2007
PLA	ACT Government Planning and Land Authority
PMST	EPBC Act Protected Matters Search Tool
PSP	Preliminary Sketch Plan
TCCS	Transport Canberra and City Services

Executive Summary

The Canberra Brickworks Precinct (CBP) is located in the central Canberra suburb of Yarralumla. The CBP site is proposed to be developed into around 380 residential dwellings and will repurpose a highly valued historical amenity. A new access road is required to service the precinct from Dudley Street, which is functioning at capacity under existing traffic use conditions (AECOM 2016). A Preliminary Sketch Plan (PSP) design has recently been developed for the CBP Access Road and Dudley Street Upgrade (the Proposal) to meet the needs of the future development while taking into consideration the earlier feasibility and concept design studies. This report assesses the PSP design against potential approval requirements and considers the appropriate approvals pathways for the Proposal.

Multiple jurisdictions and planning frameworks apply to the Proposal, and as such, the pathway to project approval is complex. Further adding to the complexity is that, there are a number of potential approval pathways within each regulatory framework which depend on the outcome of further environmental investigations. This report describes the various potential pathways and further investigation requirements to arrive at project approval from all the relevant authorities.

The Proposal, with the exception of the Dudley Street road reserve, is located within land subject to the Territory Plan, administered by ACT Environment, Planning and Sustainable Development Directorate (ACT EPSD) in accordance with the *Planning and Development Act 2007* (PD Act)). Territory Development approvals are by the ACT Planning and Land Authority (ACT PLA) under the PD Act and are required for works proposed in areas subject to the Territory Plan, unless an exemption is in place. The Proposal is unlikely to meet the criteria for such an exemption. All permissible works and assessment processes associated to the Proposal are subject to a pre-application meeting and confirmation from ACT PLA.

Dudley Street road reserve is located within a Designated Area, which is subject to the requirements of the National Capital Plan (NCP) administered by the National Capital Authority (NCA). The NCA has responsibility for determining detailed conditions of planning, design and development for Proposals in Designated Areas. For the Dudley Street works, development approval is required from the NCA through a Works Approval process. Works proposed in Designated Areas do not require development approval from the ACT's planning authority (ACT PLA) under the ACT's legislative planning framework (PD Act). Notwithstanding, works proposed in Designated Areas still require project endorsement from the ACT agencies which administer ACT environmental regulations.

In addition to the above, the requirements under the Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act) need to be considered for the Proposal.

A summary of the approvals and investigations required is provided below:

Development approval from ACT PLA under the PD Act – will be required for the Proposal. The proposed access road from Dudley Street to Block 7 Section 102 Yarralumla (the CBP site) is within Block 3 Section 94 Yarralumla which is currently zoned as PRZ2 – Urban Parks and Recreation Zone in the Territory Plan. The proposed access road can be considered as a 'minor road' and therefore a permissible development as noted in PRZ2 Development Table. Block 3 also has Pe: Urban Open Space overlay.

The proposed works would be assessed in the Impact Track under the PD Act, as there are triggers due to potentially significant impacts to Golden Sun Moth and Natural Temperate Grassland; and part of the Proposal area is within a site listed on the ACT contaminated land register. Proposals assessed in the Impact Track require an EIS to be prepared and approved by ACT PLA (and the Commonwealth Minister for the Environment and Energy if the Proposal is deemed a controlled action) before a development application can be lodged with ACT PLA.

Works Approval from the NCA - will be required for works proposed in Designated Areas (the majority of the Proposal) which are subject to the requirements of the NCP. The Works Approval Application must:

- Include the standard items listed on the Works Approval Application Information Checklist (Appendix B) as required by NCA.
- Demonstrate compliance with the relevant planning policies of the NCP.

- Include a Draft Construction Environmental Management Plan
- Include evidence of Proposal endorsement from the ACT agencies which administer ACT environmental regulations (ACT Heritage, the Conservator of Flora and Fauna, ACT Environment Protection Authority and TCCS).
- Include evidence of approval under the EPBC Act (if approval is required, see below)

Assessment and approval under the EPBC Act – will be required. In December 2015, Umwelt carried out a vegetation assessment and Golden Sun Moth Survey generally in accordance with the EPBC Act survey guidelines for this species. Based on the wide distribution of golden sun moths throughout the proposed development area, the majority of the site has been determined to constitute habitat, albeit of varying quality.

Natural Temperate Grassland has also been confirmed to be present within the Proposal area, which meets the definition of the endangered ecological community under the EPBC Act. 'Natural Temperate Grassland of the South Eastern Highlands' is a listed Threatened Ecological Community (TEC) under the EPBC Act, and since April 2016, it has been listed as critically endangered. There are no currently published thresholds for what constitutes a significant impact to Natural Temperate Grassland, so impacts would need to be considered in the context of the proposed alignment within the overall site.

Ecological Assessment is required to be undertaken as a priority during the Final Sketch Plan stage, to determine whether significant impacts to ecological matters protected under the EPBC Act are likely. If significant impacts are likely, a referral is required to be submitted to the Commonwealth Department of the Environment and Energy (DoEE) for a decision from the Minister for the Environment and Energy on whether the Proposal will need formal assessment and approval under the EPBC Act.

Endorsement from ACT Government agencies which administer ACT environmental regulations – will be required for all works. Endorsement from the ACT agencies (ACT Heritage, the Conservator of Flora and Fauna, ACT Environment Protection Authority (EPA) and TCCS) satisfies the NCA's requirement for endorsement by the ACT agencies for works proposed in Designated Areas, as well as the endorsements required for development approval under the PD Act for areas subject to the Territory Plan.

Ecological Assessment – is required to confirm whether the Proposal (works proposed in areas subject to the Territory Plan, as well as works in Designated Areas) would trigger the need for an EIS under the ACT planning framework due to potential impacts on ecological aspects. Consultation with the Conservator of Flora and Fauna indicated that TEC's and species are likely to occur within the Proposal site. However, an ecological impact assessment should be undertaken to confirm this. The ecological assessment would also confirm if any ecological matters protected under the EPBC Act are present within the Proposal site. This would inform whether a referral under the EPBC Act is required.

Environmental Authorisation or Environmental Protection Agreement – will be required by the EPA under the *Environmental Protection Act 1997* as the Proposal at minimum meets the criteria for two class B activities listed in Schedule 1 of the Act which require either an environmental protection agreement or environmental authorisation. Whether the Proposal meets the criteria for a class A activity, which requires an environmental authorisation, will be confirmed during more detailed design phases.

Tree Assessment - A Tree Assessment is required to document all the individual trees in the Proposal site, their attributes and whether they will be removed for the construction of the Proposal. The assessment will also identify any trees which meet the criteria for a Regulated Tree and therefore are classed as a Protected Tree under the *Tree Protection Act 2005*. The Tree Assessment will need to be provided to the TCCS for advice regarding the protection measures, and endorsement. The Tree Assessment will also need to be provided to the Conservator of Flora and Fauna, along with the Landscaping Plans and Ecological Assessment, to enable the Conservator's evaluation of the Proposal and whether endorsement will be provided.

A number of Tree Assessments have been undertaken to identify and map the existing trees within the Proposal area. There are a number of regulated and non-regulated trees of varying quality within the Proposal area. Some regulated medium and low quality trees will likely be impacted by the Proposal. Impacts to trees are required to reduce the ecological impacts to EPBC Act listed habitats which dominate the grassed areas within the Proposal area. Determining the preferred alignment of the

access road is a balance between minimising impacts to trees, minimising impacts to EBPC Act listed species while also meeting the objectives of the Proposal.

Contamination - Under Section 21A of the *Environmental Protection Act 1997* the EPA is required to keep a register of contaminated sites. A section of the Proposal is located within land included on the register of contaminated sites. Phase 1 and Phase 2 contamination assessments have been completed for the Proposal site. Analysis of these assessments is required during the preparation of the environmental impact assessment to ensure adequate investigations have been undertaken to apply for the portion of the Proposal site to be removed from the register. The EPA will advertise in the ACT Legislation Register and The Canberra Times (within 10 working days) when a record is removed from the register.

Draft Construction Environmental Management Plan – is required to demonstrate to the NCA and the Conservator of Flora and Fauna that appropriate safeguards and mitigation measures will be implemented to manage the key environmental risks during construction. This is likely also to be required in an application for a WWL. The CEMP should include unanticipated discovery protocols for contamination and heritage items as required by the EPA and ACT Heritage, respectively.

1.0 Introduction

Procurement and Capital Works (PCW) commissioned AECOM to prepare a Preliminary Sketch Plan (PSP) for the first stage of the Canberra Brickworks Precinct (CBP) Access Road and Dudley Street Upgrade (the Proposal). This follows an earlier feasibility study and concept design developed by AECOM and Calibre respectively.

This Approvals Advice report accompanies the PSP and provides advice on the planning approvals and further investigations required to obtain project approval for the CBP Access Road and Dudley Street Upgrade Project (the 'Proposal'). It is intended that this report is read in conjunction with the PSP which provides further details on the Proposal design.

1.1 Proposal Description

The Canberra Brickworks Precinct (CBP) is located in the central Canberra suburb of Yarralumla. The CBP site is proposed to be developed into around 380 residential dwellings and will repurpose a highly valued historical amenity. A new access road is required to service the precinct from Dudley Street, which is functioning at capacity under existing traffic use conditions (AECOM 2016).

The Proposal would generally include:

- Upgrading Dudley Street;
- A roundabout intersection with Dudley Street and the new access road; and
- An access road travelling north to connect the intersection to the CBP.

As shown in Figure 1, the Proposal extends from Dudley Street at the intersection with Novar Street (in the east) along Dudley Street turning north to meet with Block 7, Section 94 Yarralumla.

Dudley Street

The proposed cross section on Dudley Street is as follows:

- 4.0 m wide traffic lane to cater for buses;
- 1.5 m wide on-road cycle lane; and
- 6.7 m wide verge on both sides generally to cater for:
  - 2.5 m wide path;
  - 2.0 m wide streetlight/tree planting corridor; and
  - Utilities.

The proposed cross section has been discussed and accepted by Capital Works and Transport Canberra at Transport Canberra and City Services (TCCS).

Access Road

The proposed cross section on the Access Road is as follow:

- 3.5 m wide traffic lane;
- 1.5 m wide on-road cycle lane;
- 4.0 m wide depressed median; and
- 6.25 m wide verge on both sides generally to cater for:
  - 2.5 m wide path;
  - 2.0 m wide tree planting corridor adjacent to the road boundary; and
  - 1.75 m wide utility corridor.

The PSP design has incorporated recommendations made during the review of the feasibility design and reference design to minimise environmental, ecological and community impacts; including relocation of the intersection to the west and relocation of the Dudley Street alignment to the south to minimise impacts on the identified

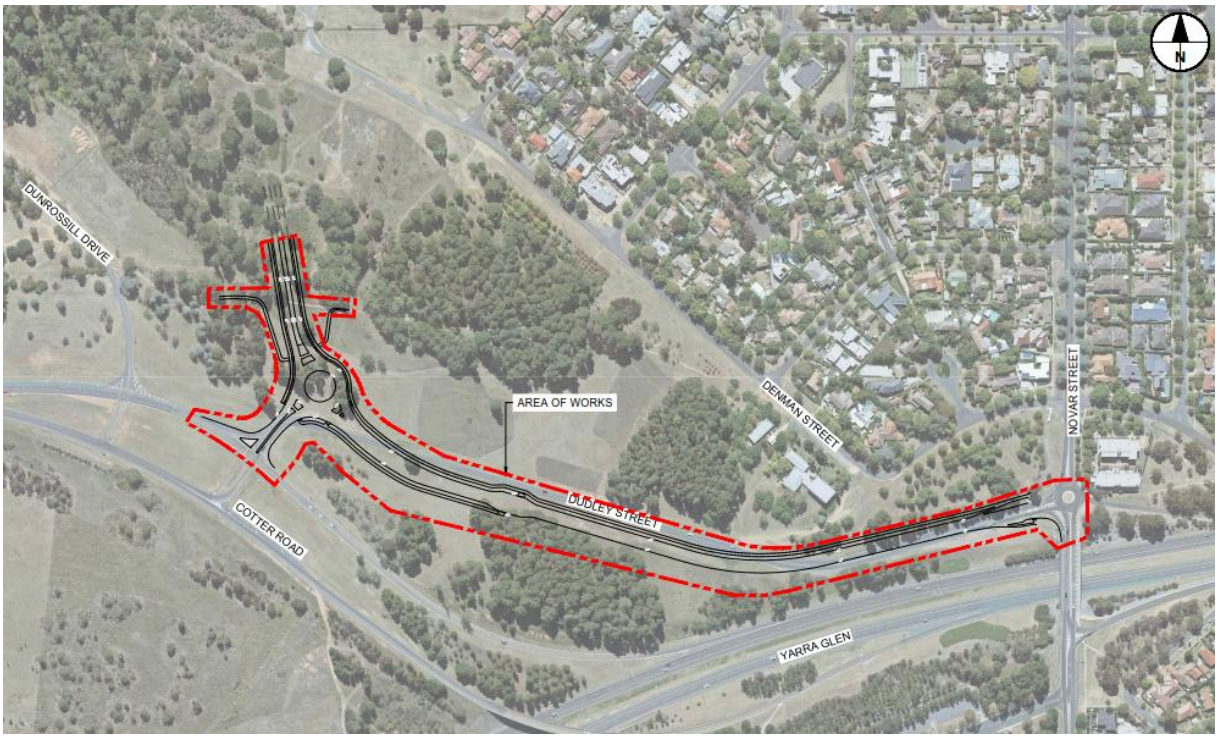


Figure 1 Site Location and Proposal layout

1.2 Land use zoning

1.2.1 Land Custodianship

The entire Proposal site is located within Territory land with the exception of Dudley Street, which is National land under the management of the National Capital Authority (NCA) (a Commonwealth Government Agency).

1.2.2 Blocks

The Proposal traverses a number of blocks with differing zoning as listed in Table 1 (note this table does not include road reserves). Figure 2 shows these areas in relation to the Proposal boundary.

Table 1 Blocks and Sections within which the Proposal is proposed

Block	Section	Division	Zoning	Applicable statutory planning framework	Land Custodianship
3	94	Yarralumla	PRZ2; PRZ1	Territory Plan	Public land
1	127	Yarralumla	PRZ2	Territory Plan	Public land
1	113	Yarralumla	Designated Land	National Capital Plan	Public land
1	123	Curtin	Designated Land	National Capital Plan	Public land

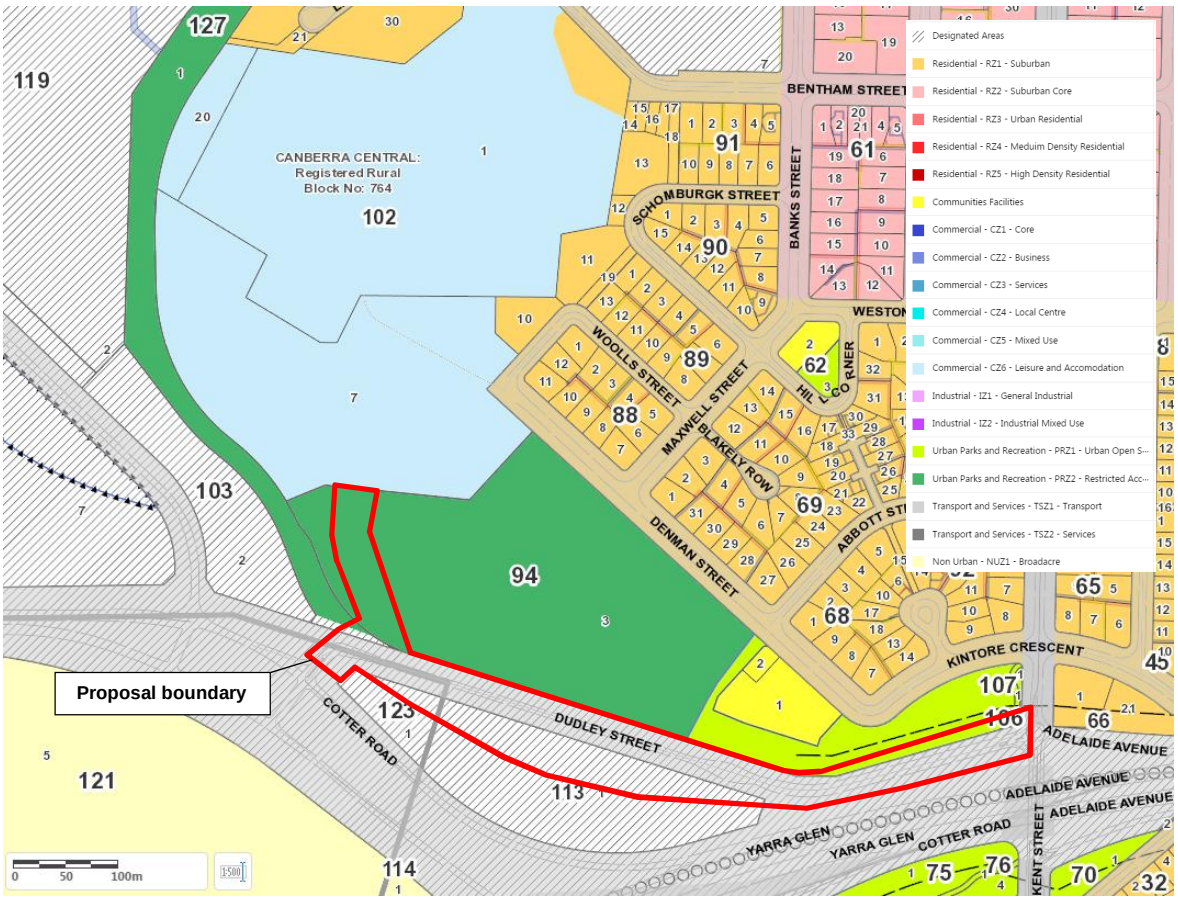


Figure 2 Zoning in the Proposal area

1.3 Initial environmental constraints

The following environmental investigations have been undertaken to date and have been reviewed for consideration in the planning approval requirements for the Proposal:

- Site Investigation Report (Stage 1), March 2016 by AECOM
- Detailed Engineering Survey, October 2014 by Leach Steger
- Site Investigation – Traffic, Transport and Carparking, February 2016 by AECOM
- Yarralumla Brickworks Precinct Tree Assessment, Nov 2015 by DSD Landscape Architects
- Yarralumla Brickworks Precinct - Dudley Street Tree Assessment, Nov 2016 by DSD Landscape Architects
- GSM Survey and Ecological Assessment of Dudley Street Road Reserve, Feb 2016 Umwelt
- Canberra Brickworks and Environs Ecological Assessment, December 2014 by Umwelt
- Bushfire Risk Assessment Report, Canberra Brickworks Precinct, Jan 2016 by ABPP
- Preliminary Geotechnical Site Investigation for the Canberra Brickworks, Nov 2013 by SMEC
- Preliminary Environmental Site Investigation-Canberra Brickworks, Feb 2014 by SMEC
- Yarralumla Brickworks Railway Remnants registration, 2013 by the ACT Government
- Stage 1 Aboriginal Cultural Heritage Assessment, Aug 2014 by Navin Officer
- Briefing note Golden Sun Moth and Native Temperate Grassland Survey and Ecological Assessment of Dudley Street Road Reserve, January 2017 by Umwelt.

Key environmental constraints which have been identified during the document review are presented in Figure 3.

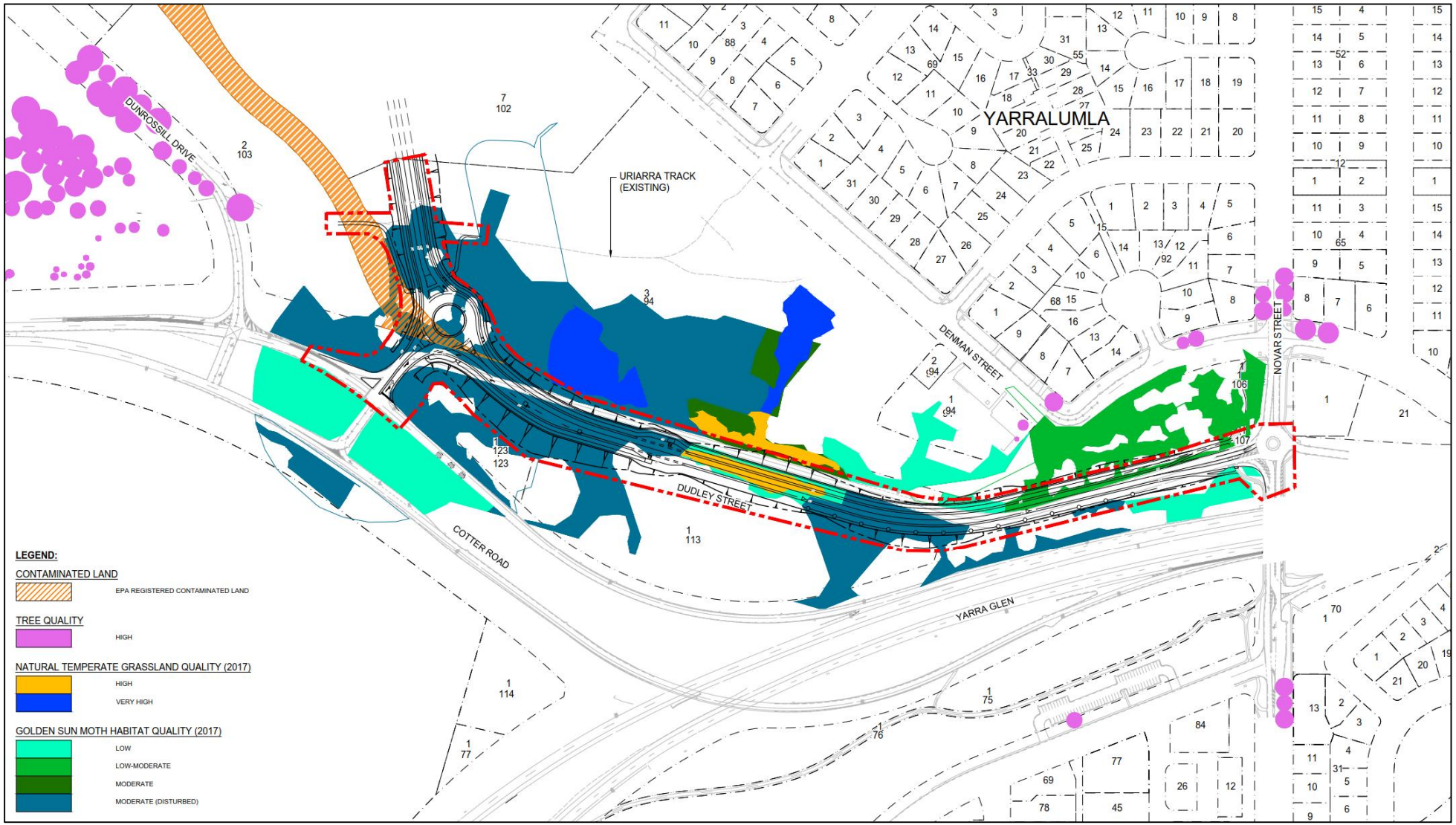


Figure 3 Initial environmental constraints identified in the Proposal area

2.0 Planning Context Overview

The Proposal, with the exception of the Dudley Street road reserve, is located within land subject to the Territory Plan, administered by ACT Environment, Planning and Sustainable Development Directorate (ACT EPSD) in accordance with the *Planning and Development Act 2007* (PD Act)). Territory Development approvals are by the ACT Planning and Land Authority (ACT PLA) under the PD Act and are required for works proposed in areas subject to the Territory Plan, unless an exemption is in place. The Proposal is unlikely to meet the criteria for such an exemption. All permissible works and assessment processes associated to the Proposal are subject to a pre-application meeting and confirmation from ACT PLA.

Dudley Street road reserve is located within a Designated Area, which is subject to the requirements of the National Capital Plan (NCP) administered by the NCA. The NCA has responsibility for determining detailed conditions of planning, design and development for Proposals in Designated Areas. For the Dudley Street works, development approval is required from the NCA through a Works Approval process. Works proposed in Designated Areas do not require development approval from the ACT's planning authority (ACT PLA) under the ACT's legislative planning framework (PD Act). Notwithstanding, works proposed in Designated Areas still require project endorsement from the ACT agencies which administer ACT environmental regulations.

In addition to the above, the requirements under the Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act) need to be considered for the Proposal.

As a result of the multiple planning jurisdictions applicable to the Proposal, the pathway to project approval is complex. Further adding to the complexity is that at this early stage of the Proposal, there are a number of potential approval pathways within each regulatory framework which depend on the outcome of further investigations (such as contamination and ecological assessments).

Sections 3.0 and 4.0 describes the Commonwealth and ACT Government planning policies respectively, and how they apply the Proposal to arrive at planning approval from relevant authorities.

3.0 Commonwealth Planning Policies

3.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is the Australian Government's central piece of environmental legislation, providing a legal framework to protect and manage nationally and internationally important flora, fauna, Threatened Ecological Communities (TECs) and Heritage places (Matters of National Environmental Significance (NES)).

Under the EPBC Act, approval from the Commonwealth Minister for Environment and Energy is required for an action that is:

- Likely to have a significant impact on a Matter of NES
- Carried out on Commonwealth Land and is likely to have a significant impact on the environment
- Undertaken outside of Commonwealth Land but is likely to have a significant impact on the environment on Commonwealth Land.

Matters of NES include:

- World Heritage Properties
- National heritage places
- Listed migratory species
- Wetlands of International Importance
- Commonwealth Marine Areas
- TECs and threatened species
- Nuclear actions.

If the Proposal is likely, or potentially likely, to have a significant impact on any of the above triggers for approval, the Proposal must be referred. Referral of an action involves providing relevant information on a referral form and submitting it to the Commonwealth Department of the Environment and Energy. This process is discussed further in Section 3.1.2.

Based on a review of the referral, the Departmental delegate (on the Minister's behalf) will decide whether the proposed action is likely to have a significant impact on one or more matters protected by the EPBC Act and would therefore become a 'controlled action'. If the proposed action is a controlled action, the Proposal will need to undergo a formal assessment and approval process under the EPBC Act before it can proceed.

If the Departmental delegate determines the Proposal to be a controlled action, this is likely to trigger the requirement for an Environmental Impact Statement (EIS) under ACT legislation (see Section 4.1.2).

3.1.1 Potential for a Significant Impact under the EPBC Act

This Section reviews the potential for a significant impact on matters protected by the EPBC Act, based on desktop investigations undertaken for the Proposal and initial ecological surveys for Golden Sun Moth and Natural Temperate Grassland.

Matters of National Environmental Significance

Matters of NES with the potential to be affected by the Proposal were identified using the EPBC Act Protected Matters Search Tool (PMST), administered by the Commonwealth Department of Environment and Energy and accessed from <http://www.environment.gov.au/epbc/pmst/index.html>. A one kilometre buffer was applied to the search. A copy of the PMST report is provided in Appendix C.

Table 2 lists the Matters of NES and their potential applicability to the development as identified using the PMST.

Table 2 Matters of NES

Matter of NES	Comment	Potential for Significant Impact
World Heritage Properties	Not applicable - none identified within 1 km of the Proposal site.	No.
National heritage places	Not applicable - none identified within 1 km of the Proposal site.	No.
Wetlands of International Importance	Not applicable – none identified within 1 km of the Proposal site, and all located upstream from the Proposal.	No.
Listed TECs	One TEC identified as likely to occur within 1 km of the Proposal site: · Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT (Natural Temperate Grassland), listed as Endangered under the EPBC Act and *Nature Conservation Act* (NC Act) *2014*. One TEC with may occur within 1 km of the Proposal site: · White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box-Gum Woodland), listed as Critically Endangered under the EPBC Act and Endangered under NC Act.	Ecological surveys and initial consultation with the ACT Conservator of Flora and Fauna indicates that Natural Temperate Grassland is located within the Proposal area and may potentially be significantly impacted by the Proposal. An ecological impact assessment is required to confirm this (see Section 4.3.1).

Matter of NES	Comment	Potential for Significant Impact
Listed threatened species	25 threatened species identified as potentially occurring within 1 km of the site (see Appendix C a full list). This includes: · 7 bird species · 2 frogs · One invertebrate · 4 mammals · 3 reptiles · 9 flora species	Ecological surveys and initial consultation with the ACT Conservator of Flora and Fauna indicates that Golden Sun Moth (*Synemon plana*) is located within a large portion of the Proposal area and may potentially be significantly impacted by the Proposal. An ecological impact assessment is required to confirm this (see Section 4.3.1).
Migratory species	10 migratory bird species identified as potentially occurring within 1 km of the Proposal site (see Appendix C for a full list).	It is unlikely that the Proposal site would contain critical habitat for migratory bird species and therefore it is unlikely that there is potential for a significant impact. However, an ecological assessment is required to confirm this (see Section 4.3.1).
Commonwealth Marine Areas	Not applicable.	No.
The Great Barrier Reef Marine Park	Not applicable.	No.
Nuclear actions	Not applicable.	No.

Other Matters Protected by the EPBC Act

Table 3 lists the Other Matters protected by the EPBC Act for which the Proposal may present a potential significant impact.

Table 3 Other Matters Protected by the EPBC Act

Other Matter	Comment	Potential for Significant Impact
Commonwealth Land	Not applicable.	No.
Commonwealth Heritage Places	Three Commonwealth heritage places identified within 1 km of the Proposal site: · Australian Forestry School (former) · CSIRO Forestry Precinct · Royal Australian Mint.	Not likely. These heritage places are not located within or adjacent to the Proposal footprint.
Listed Marine Species	Not applicable.	No.
Whales and Other Cetaceans	Not applicable.	No.

Other Matter	Comment	Potential for Significant Impact
Critical Habitats	Not applicable – none identified within 1 km of the Proposal site.	No.
Commonwealth Reserves Terrestrial	Not applicable.	No.
Commonwealth Reserves Marine	Not applicable.	No.

As noted within the above tables, an Ecological Impact Assessment will be required to assess whether the Proposal is likely to have a significant impact on the TECs and listed threatened species located within proximity to the Proposal site.

In December 2015 and December 2016, Umwelt carried out vegetation assessments and Golden Sun Moth surveys generally in accordance with the EPBC Act survey guidelines for this species. Based on the wide distribution of Golden Sun Moth throughout the Proposal Area, the majority of the site has been determined to constitute habitat, albeit of varying quality. As a critically endangered species under the EPBC Act, any impacts on this species as a result of the Proposal would trigger an EPBC referral. In the current PSP design this is considered likely.

Natural Temperate Grassland was also confirmed to be present with the Proposal area, during the Umwelt surveys, which meets the definition of the TEC under the EPBC Act. 'Natural Temperate Grassland of the South Eastern Highlands' is a listed TEC under the EPBC Act, and since April 2016, it has been listed as critically endangered. There are no currently published thresholds for what constitutes a significant impact to Natural Temperate Grassland, so impacts would need to be considered in the context of the proposed alignment within the overall site. Any loss of the community would trigger an EPBC referral. In the current design this is considered likely.

The requirements of an ecological assessment are discussed further in Section 4.3.1. The outcomes of the Ecological Impact Assessment will confirm whether a referral to the Department of Environment and Energy is required (though it is considered likely at this stage). A referral is required if significant impacts on matters protected under the EPBC Act are likely.

3.1.2 Referral Process

The purpose of a referral is to obtain a decision from the Commonwealth Minister of the Environment and Energy on whether the Proposal will need formal assessment and approval under the EPBC Act (a controlled action). A referral is made by submission of a referral form obtained from the Department of the Environment and Energy. Since October 2014, the Department commenced cost recovery arrangements for environmental assessments, and as such, there are fees associated with the assessment of projects, including referrals.

On receipt of the referral, a decision is made within 20 business days, provided sufficient information is provided in the referral. Within this period, there is a 10 day period for public comment.

If the Proposal is deemed a controlled action, it will be subject to a formal assessment and approval process. The type of assessment would depend on the complexity of the Proposal and potential impacts. The assessment may be in the form of an EIS prepared under a bilateral agreement with the ACT government. The bilateral agreement essentially allows the Commonwealth to delegate to the ACT the responsibility for conducting the environmental assessment for the Proposal, under the EPBC Act. An EIS prepared under the bilateral agreement must be approved by both the Minister for the Environment and Energy and ACT PLA before the Proposal can proceed.

3.2 National Capital Authority Policies

3.2.1 National Capital Plan

The Commonwealth's *Australian Capital Territory (Planning and Land Management) Act 1988* establishes the NCA which requires the establishment of the NCP. The NCP aims to ensure that

development within Canberra and the ACT occurs in an appropriate manner. It provides a framework for development in regards to planning and design, while advancing those aspects of Canberra and the Territory which are important to the national role of Canberra. The NCP provides a framework for the Territory Plan (see Section 4.1) which provides more specific guidance on the development of the region.

The NCP also provides detailed planning policies and guidelines for areas designated as having the special characteristics of the National Capital (referred to as Designated Areas). Any works in these Designated Areas require the prior written approval of the NCA in the form of a Works Approval (see Section 3.2.2).

Dudley Street road reserve and the land to the south of Dudley Street (Block 1, Section 113 Yarralumla) are located within Designated Areas. As such, a number of policies, standards and special requirements of the NCP are applicable to the Proposal. These are summarised below.

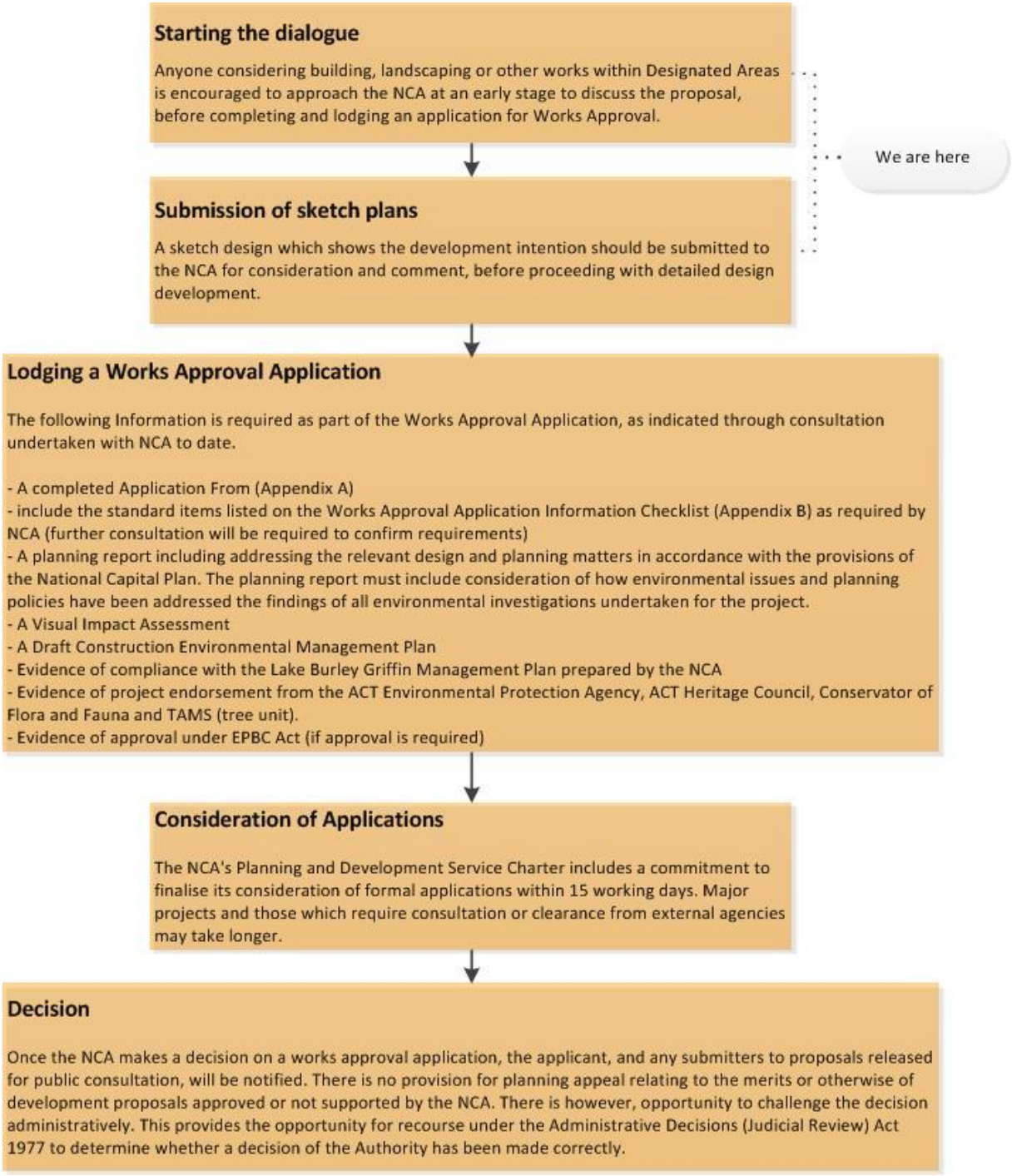
The Central National Area

Proposal areas which are located within Designated Areas partly fall within the Central National Area of the NCP. Development in the Central National Area is subject to certain detailed conditions of planning, design and development as outlined in the NCP.

3.2.2 Works Approval process

A Works Approval from the NCA will be required for the development proposed in Designated Areas of the NCP to demonstrate that the Proposal is complies with the applicable policies of the NCP. The Works Approval is required for the Dudley Street upgrade. The process for obtaining Works Approval is summarised in Figure 4.

As part of the Works Approval Application, the NCA requires certain standard information, such as design concept drawings, detailed sites plans, architectural drawings etc. A list of these typical information requirements is provided in Appendix B. Further consultation with the NCA is required to confirm which of these items are required for this Proposal. NCA also require a draft Construction Environmental Management Plan (CEMP) be submitted with the Works Approval Application.



Source: NCA Website

Figure 4 NCA Works Approval Process

4.0 ACT Planning Policies

4.1 Planning and Development Act 2007

The PD Act provides the statutory planning framework for development within ACT. The PD Act establishes the ACT Planning and Land Authority (ACT PLA) as the ACT planning authority. ACT PLA is responsible for approving development in all areas of the ACT other than Designated Areas.

The Environment, Planning and Sustainable Development Directorate (ACT EPSD) administers the Territory Plan, which is the key statutory planning document in the ACT, providing the policy framework for the administration of planning for all areas of the ACT other than Designated Areas. The Territory Plan is consistent with the principals and policies of the NCP.

The Territory Plan includes a statement of strategic directions, a map (the Territory Plan Map) which sets out zones and precincts in the ACT, objectives and development tables applying to each zone, and a series of general, development and precinct codes. It also includes structure plans and concept plans for the development of future urban areas. The statutory requirements for the Territory Plan are set out in the PD Act.

The majority of the Proposal is in an area subject to the Territory Plan and therefore subject to the PD Act. The land use zoning is PRZ1 and PRZ2 (see Figure 2). A Territory Plan Variation is requirement if the proposed development is prohibited within the applicable development table. The Proposal falls into the 'Minor road' land use under the Community Facilities development table of the Territory Plan. A Minor use development is a permitted land use within the Community Facilities zone. As such, a Territory Plan Variation is not required.

4.1.1 Development Approval Process Overview

The PD Act established a system of development approvals involving a three tier system of environmental assessment tracks: code, merit and impact.

- A Code Track development involves assessment against the rules in the applicable Assessment Code of the Territory Plan. The Code track is used for minor developments, for example, a single dwelling not on new residential land, a dual occupancy proposal, or a house extension. This track is not relevant to the Proposal.
- A Merit Track assessment aims to provide flexibility and a performance-based assessment that enables applicants to propose an innovative design outcome, even if the development deviates from prescriptive code requirements. Examples of merit track developments include an indoor recreation facility in a commercial zone, an apartment in a commercial zone or a multi-unit development in a residential zone.
- The Impact Track requires proposed developments to undergo the broadest level of assessment. They are considered against the Territory Plan and, unless exempt by the minister, are to be addressed by an EIS. Impact track assessment applies to infrastructure proposals and developments in sensitive areas, developments that have been declared impact assessable by the minister, and all other proposals not covered by the exempt, prohibited, code or merit tracks (S123 and S132). Developments which may be subject to impact track assessment include larger projects such as: constructing solar or wind farms, major dams or roads; light rail line; or clearing a significant area of native vegetation.

Schedule 4 of the PD Act provides the triggers for assessment under the Impact Track.

4.1.2 Development Approval Process

If not exempt from development approval, obtaining development approval for the Proposal within the Territory Plan boundaries would involve the submission of a Development Application to ACT PLA which is assessed against the rules or criteria of the Community Facilities Development Code under the Territory Plan.

In the PD Act, Section 123 states that the Impact Track applies to a development Proposal if the following conditions are met:

(a) the relevant development table (in the Territory Plan) states that the impact track applies; or

(b) the Proposal is of a kind mentioned in schedule 4; or

(c) the Minister makes a declaration under section 124 in relation to the Proposal; or

(d) section 125 (Declaration by Public Health Act Minister affects assessment track) or section 132 (Impact track applicable to development Proposals not otherwise provided for) provides that the impact track applies to the Proposal; or

(e) the Commonwealth Minister responsible for administering the Environment Protection and Biodiversity Conservation Act 1999 (Cwlth) advises the Minister in writing that the development proposed—

(i) is a controlled action under that Act, section 76; and

(ii) does not require assessment under that Act, part 8 (Assessing impacts of controlled actions) because a bilateral agreement between the Commonwealth and the Territory under that Act allows the Proposal to be assessed under this Act.

Subsection (a) does not apply to the Proposal and it is unlikely that subsection (c) or (d) would apply to the Proposal. Subsection (e) may apply to the Proposal if a referral is submitted to the Department of the Environment and Energy and the Minister determines that it is a controlled action (see Section 3.1).

If an EIS is required under the PD Act, and also required under the EPBC Act because it is a controlled action, the EIS would be prepared under a bilateral agreement with the ACT government. The bilateral agreement essentially allows the Commonwealth to delegate to the ACT the responsibility for conducting the environmental assessment for the Proposal, under the EPBC Act. The EIS must be approved by both authorities (Minister for the Environment and Energy; and ACT PLA) before a development application can be lodged with ACT PLA. If an EIS is not required under the EPBC Act, it would not be prepared under bilateral agreement and only ACT PLA need to approve the EIS before a development application can be lodged.

The following section reviews the potential applicability of subsection (b) which stipulates that if the Proposal is of a kind mentioned in schedule 4 of the PD Act, an assessment in the Impact Track and EIS is required.

Schedule 4 Triggers for an Impact Track Assessment and EIS

The types of Schedule 4 triggers for an assessment in the Impact Track are divided into:

- Activities (Part 4.2 of Schedule 4) – lists certain types of activities which trigger the need for impact track assessment, e.g. construction of a water storage dam above a certain size; and
- Areas and processes (Part 4.3 of Schedule 4) – lists certain areas or biophysical characteristics which trigger the need for impact track assessment, e.g. an area which contains listed threatened species or communities.

These activities and areas and processes are listed in Table 4 and Table 5, along with their potential applicability to the proposed works subject to the Territory Plan and potentially development approval under the PD Act.

An Environmental Significance Opinion (ESO) stating that the Proposal will not have a significant adverse environmental impact can be sought from the relevant agency if the Proposal triggers an Impact Track assessment under items 1, 2, 3, or 6(a) of Schedule 4, Part 4.3 (Table 5). If an ESO is provided, the Proposal can be assessed in the Merit Track, and an EIS is not required, provided the Proposal does not have other triggers for an assessment in the Impact Track.

For the proposed works within Designated Areas subject to the NCP, although development approval under the PD Act is not applicable, the triggers for an assessment in the Impact Track and EIS have been reviewed in this Section in order to understand the scale of potential environmental impacts through the perspective of ACT environmental planning legislation. This would highlight potential

constraints for endorsement by the relevant ACT government agencies from which NCA require endorsement.

The potential triggers for an Impact Track assessment and EIS have been considered separately in Table 4 and Table 5 for the section of the Proposal subject to the Territory Plan, and Designated Areas.

Table 4 Schedule 4, Part 4.2 - Development Proposals requiring an assessment in the Impact Track— activities

Item	Proposal	Territory Plan[1]	Designated Areas[2]
1	Proposal for construction of a transport corridor including a major road, a dedicated bus way, a railway, or a light rail corridor, on any land, other than on land designated under the Territory Plan as a future urban area or in a transport and services zone, if the Proposal is likely to have a significant adverse environmental impact on— a. air quality so as to be detrimental to the health of persons in an adjoining residential, commercial or community facility zone; or b. ambient noise or vibration so as to be detrimental to the health of persons in an adjoining residential, commercial or community facility zone	Not applicable	Not applicable
2	Proposal that involves— a. electricity transmission line construction, including additions or realignment works, outside an existing easement or exceeding 500m in length, that are intended to carry underground or above-ground transmission lines with a voltage of 132kV or more; or b. a coal electricity generating station; or c. an electricity generating station (other than a coal electricity generating station) including gas, wind, hydroelectric, geothermal, bio-material, solar power or co-generation— a. that is capable of supplying— i. the amount of electrical power prescribed by regulation; or ii. if no amount is prescribed—4MW or more of electrical power; or b. in a location or of a kind or nature prescribed by regulation; or d. an electricity generating station if the temperature of water released from the station into a body of water (other than an artificial body of water) is likely to vary by more than 2oC from the ambient temperature of the body of water	Not applicable	Not applicable

Item	Proposal	Territory Plan[1]	Designated Areas[2]
3	Proposal for construction of a water storage dam— a. that will be at least 15m high when measured from the lowest point of the general foundations to the crest of the dam; or b. that will be at least 10m high when measured from the lowest point of the general foundations to the crest of the dam if— i. the crest is not less than 500m in length; or ii. the water storage capacity of the reservoir formed by the dam at normal operating level is at least 1 000 000m3; or iii. the recommended design flood discharge dealt with by the dam is at least 2 000m3 per second; or c. in the river corridor zone under the Territory Plan unless the conservator of flora and fauna produces an environmental significance opinion that the Proposal is not likely to have a significant adverse environmental impact; or d. on a continuously flowing river in a non-urban zone under the Territory Plan unless the conservator of flora and fauna produces an environmental significance opinion that the Proposal is not likely to have a significant adverse environmental impact	Not applicable	Not applicable
4	Proposal for construction of an airport or airfield (other than a helicopter landing facility used exclusively for emergency services purposes, including medical evacuation, fire fighting, retrieval or rescue)	Not applicable	Not applicable
5	Proposal for construction of a wastewater treatment plant (including a plant for the treatment of sewage or other effluent) that— a. will be less than 1km from the boundary of a residential block or unit in a residential or commercial zone; or b. will be able to treat each day more than— i. 2 500 people equivalent capacity; or ii. 750 kL; or c. will have capacity to store more than 1kt of sewage, sludge or effluent; or d. will incinerate sewage or sewage products; or e. will have a capacity to treat more than 100ML of wastewater (excluding stormwater) each year; but f. is not— i. a plant for the treatment of stormwater; or ii. a small-scale wastewater treatment plant (including a plant for the treatment of sewage or other effluent but not including a small-scale plant prescribed by regulation); or iii. a residential on-site wastewater treatment system (including a septic tank)	Not applicable	Not applicable
6	Proposal for construction of a petroleum storage facility with a storage capacity greater than 500 kL of petroleum products at 1 time	Not applicable	Not applicable
7	Proposal for construction of a permanent venue for the conduct of motor racing events	Not applicable	Not applicable

Item	Proposal	Territory Plan[1]	Designated Areas[2]
8	Proposal for use of land for a commercial landfill facility, other than for the disposal of virgin excavated natural material (or other earth and rock fill that is inert waste) if— a. the intended capacity of the facility is more than 5 kt each year, or 20 kt in total; or b. the facility will be— i. in an area with a high watertable, highly permeable soils, sodic soils or saline soils; or ii. less than 2 km from the boundary of a residential block or unit in a residential or commercial zone	Not applicable	Not applicable
9	Proposal for the construction of a waste management facility that is— a. an incineration facility for the destruction by thermal oxidation of waste including biological, veterinary, medical, clinical, dental, quarantine and municipal waste; or b. for the sterilisation of clinical waste; or c. for the storage, treatment, disposal, processing, recycling, recovery, use or reuse of regulated waste	Not applicable	Not applicable
10	Proposal for a waste transfer station or recycling facility that sorts, consolidates or temporarily stores solid waste (including municipal waste) for transfer to another site for disposal, storage, reprocessing, recycling, use or reuse, if the transfer station— a. is intended to handle more than 30 kt of waste each year; or b. will be less than 1 km from the boundary of a residential block or unit in a residential or commercial zone; but c. is not a small-scale waste management facility, on or near a residential block or near a residential unit, consisting of wheelie bins, small hoppers, or other small waste management bins or enclosures for the use of people living on the residential block or in the residential unit	Not applicable	Not applicable

Notes:
1 Applicability: Works proposed subject to the Territory Plan
2 Applicability: Works proposed in designated areas

Table 5 Schedule 4, Part 4.3 - Development Proposals requiring an assessment in the Impact Track

Item	Development Proposals requiring EIS (Schedule 4 of PD ACT (Part 4.3))	Triggered by the Proposal?
1	Proposal that is likely to have a significant adverse environmental impact on 1 or more of the following, unless the conservator of flora and fauna provides an environmental significance opinion indicating that the Proposal is not likely to have a significant adverse environmental impact: (a) a critically endangered species; (b) an endangered species; (c) a vulnerable species; (d) a conservation dependent species; (e) a provisionally listed threatened species; (f) a listed migratory species; (g) a threatened ecological community; (h) a protected native species; (i) a Ramsar wetland; (j) any other protected matter	**Likely – to be confirmed through further ecological assessment**
2	Proposal involving— (a) the clearing of more than 0.5ha of native vegetation in a native vegetation area, other than on land that is designated as a future urban area under the territory plan, unless the conservator of flora and fauna produces an environmental significance opinion that the clearing is not likely to have a significant adverse environmental impact; or (b) the clearing of more than 5.0ha of native vegetation in a native vegetation area, on land that is designated as a future urban area under the territory plan, unless the conservator of flora and fauna produces an environmental significance opinion that the clearing is not likely to have a significant adverse environmental impact	**Likely – to be confirmed through further ecological assessment**
3	Proposal for development on land reserved under s 315 for the purpose of a wilderness area, national park, nature reserve or special purpose reserve, unless the conservator of flora and fauna produces an environmental significance opinion that the Proposal is not likely to have a significant adverse environmental impact	**No**
4	Proposal that is likely to have a significant adverse environmental impact on— (a) a domestic water supply catchment; or (b) a water use purpose mentioned in the territory plan (water use and catchment general code); or (c) a prescribed environmental value mentioned in the territory plan (water use catchment general code) of a natural waterway or aquifer	**No**

Item	Development Proposals requiring EIS (Schedule 4 of PD ACT (Part 4.3))	Triggered by the Proposal?
5	Proposal that is likely to result in environmentally significant water extraction or consumption, other than a Proposal for an urban lake, pond or retardation basin or a wastewater reuse scheme— (a) in an existing urban area or on land that has been designated as a future urban area; and (b) that is designed in accordance with the water sensitive urban design general code under the territory plan	**No**
6	Proposal that is likely to have a significant adverse impact on the heritage significance of a place or object registered under the Heritage Act 2004, unless— (a) the heritage council produces an environmental significance opinion that the Proposal is not likely to have a significant adverse impact; or (b) the Proposal is the demolition of a building that is affected residential premises, and the heritage council has approved a statement of heritage effect in relation to the Proposal	**Potential – the works would be undertaken adjacent to Site H68 'Yarralumla Brickworks' listed on the ACT Heritage Register**
7	Proposal involving land included on the register of contaminated sites under the *Environment Protection Act 1997*.	**Yes – though the section impacted by the Proposal is not anticipated to be contaminated. To be confirmed through further due diligence assessment**
8	Proposal, other than on land in an existing urban area or land that is designated under the territory plan as a future urban area, with the potential to adversely affect the integrity of a site where significant environmental or ecological scientific research is being conducted by a government entity, a university or another entity prescribed by regulation	**No**

As indicated in the above tables the proposed works trigger the need for an assessment in the Impact Track and EIS under Schedule 4 of the PD Act due to likely significant impacts on critically endangered species and likely clearing of more than 0.5ha of vegetation; and also due to the Proposal partly being located on land included on the register for contaminated sites under the *Environment Protection Act 1997.*

4.1.3 Works in Designated Areas (subject to the National Capital Plan)

A portion of the Proposal is located within Designated Areas, which are subject to the requirements of the NCP, and requires development approval from the NCA. The Territory Plan does not apply to Designated Areas, and development approval from ACT PLA under the PD Act is not required for works proposed in these areas.

Although a Commonwealth agency is the planning authority for part of the Proposal, and approval under the PD Act is not applicable to these areas, the NCA still require that endorsement for the Proposal is obtained from the ACT government agencies that administer, or provide advice under, the relevant environmental planning laws for the Territory. These agencies include:

- ACT Heritage (a department of the ACT Environment and Planning Directorate) and ACT Heritage Council (established under the *Heritage Act 2004*)

- Conservator of Flora and Fauna (established under the NC Act and also has duties to provide advice under the *Tree Protection Act 2007*)
- ACT Environment Protection Authority (established by the *Environment Protection Act 1997*)
- Urban Treescapes (a department of TCCS) (administers the *Tree Protection Act 2007*).

Each of these environmental planning regulations and other relevant policies are discussed further in the following sections.

4.2 Heritage Act 2014

The purpose of the *Heritage Act 2004* is to provide for the recognition, registration and conservation of places and objects of natural and cultural significance in the ACT.

The ACT Heritage Council is an independent body established under the *Heritage Act 2004*, which has the role of providing advice on appropriate conservation of cultural, natural and Aboriginal Heritage places and objects in the ACT.

In accordance with section 148 of the PD Act, Development Applications are to be accompanied by advice from the ACT Heritage Council stating that the development meets the requirements of the *Heritage Act 2004*. The ACT Heritage Council is able to comment on development proposals in the merit or impact track, including advice on the Heritage significance of a place or object, which must be considered by ACT PLA when approving or refusing an application.

Although the PD Act does not apply to the areas of the Proposal which is located within Designated Areas subject to the NCP, the NCP requires a development proposal to give due protection to any natural or cultural heritage place in the ACT included on register of the ACT Government. Further, the NCA require that endorsement for the Proposal is obtained from the ACT Heritage Council and provided with the Works Approval documentation.

Following a review of the ACT Heritage Register and the initial assessments undertaken for the site (see Section 1.3) no known heritage items are located within the Proposal footprint. The access road would connect to the CBP which contains the heritage listed Yarralumla Brickworks (ID: 440). No significant impacts are anticipated on this item. A Stage 1 Aboriginal Cultural Heritage Assessment (Navin Officer, 2014) did not identify any non-Indigenous heritage sites within the Proposal area.

4.3 Nature Conservation Act 2014

The NC Act is the chief legislation for the protection of native plants and animals in the ACT and for the management of the conservation reserve network. The Act protects native plants and animals, and provides management authority for conservation lands. It provides the legal underpinning of nature conservation policy, management and action across the Territory.

The Conservator of Flora and Fauna is established by the NC Act. The Conservator acts on issues that affect the conservation matters embodied in the NC Act. This relates, in particular, to protecting native plants and animals including the administration of a licensing system for the taking, keeping, selling, importing, exporting, disturbing, displaying and killing of native plants and animals; managing the nature reserve system; and protecting and conserving threatened species and ecological communities.

The Conservator of Flora and Fauna has additional responsibilities to give advice under the PD Act, the *Fisheries Act 2000* and the *Tree Protection Act 2005*.

Under the PD Act, ACT PLA must refer development applications for the development to the Conservator of Flora and Fauna. The conservator's advice must contain an assessment of whether the proposed development is likely to have a significant adverse environmental impact on a protected matter. If a significant adverse environmental impact is likely, the Conservator must advise about suitable offsets for the proposed development. A significant impact would also have implications for the type of approval pathway if the Proposal requires approval under the PD Act (refer to Section 4.1.2).

For the works subject to the Territory Plan endorsement from the Conservator of Flora and Fauna will be required.

Although approval under the PD Act does not apply to the areas of the Proposal which are located within Designated Areas subject to the NCP, the NCA require that endorsement for the Proposal is obtained from the Conservator of Flora and fauna and provided with the Works Approval documentation. To enable evaluation of the Proposal the Conservator requires information on tree removal and the proposed landscaping to mitigate vegetation removal. The Conservator also requires proposed mitigation measures to demonstrate the management of environmental impacts during construction. This could be provided in the form of a draft CEMP which is also required by the NCA and EPA (refer to Section 3.2.2 and 0).

Through the process of submitting the above information and gaining endorsement from the Conservator of Flora and Fauna, the Conservator would also fulfil their requirements under the *Tree Protection Act 2007*, which requires that the Conservator gives advice in on a proposed development in relation to tree protection. Further information on the *Tree Protection Act 2007* is provided in the following section.

As discussed in Section 4.1.2 and 3.1.1, an ecological impact assessment is also recommended to confirm the presence and significance of impacts in the Proposal site. This is discussed further below in Section 4.3.1. The ecological impact assessment should also be provided to the Conservator of Flora and Fauna to enable the Conservator to provide a comprehensive review of the potential impacts of the Proposal and inform subsequent endorsement.

4.3.1 Ecological Impact Assessment

As discussed in Section 4.1.2, an ecological assessment is required to confirm whether the Proposal would trigger the need for an EIS (under the ACT planning framework) due to potential impacts on ecological aspects. Consultation with the Conservator of Flora and Fauna indicated that TEC and species are unlikely to occur within the Proposal site. However, an ecological assessment should be undertaken to confirm this.

The ecological impact assessment would also confirm the ecological values of the Proposal site with regard to important habitat. The ecological assessment would also confirm if any ecological matters protected under the EPBC Act are present within the Proposal site. This would inform whether a referral under the EPBC Act is required (refer to Section 3.1.1).

4.4 Tree Protection Act 2005

The *Tree Protection Act 2005,* administered by TCCS, came into force to protect individual trees of exceptional value and to ensure that the urban forest cover of the city is protected. The *Tree Protection Act 2005* provides protection in two ways:

- Protects individual trees of importance by establishing a Tree Register
- Protects the urban forest by preventing unnecessary removal of trees in areas declared as Tree Management Precincts. The purpose of Tree Management Precincts is to minimise the unnecessary loss of canopy cover in areas of high development activity, heritage precincts and during the construction of new estates. In a Tree Management Precinct, approval will be required to remove, damage or undertake groundwork within the tree protection zone of Regulated Trees.

The legislation has two types of Protected Tree. These are Regulated Trees and Registered Trees. A Registered Tree is a tree that has been identified as being exceptional for its:

- natural or cultural heritage value
- landscape and aesthetic value
- scientific value
- is listed on the ACT Tree Register or Provisional tree Register

A Regulated Tree is a tree that is located on leased Territory land in an area declared as a Tree Management Precinct and is either:

- 12 m or more in height; or
- 1.5 m or more in circumference at 1 metre above ground level; or
- with two or more trunks and the total circumference of all the trunks, 1 metre above ground level, is 1.5 m or more, or
- 12 m or more in crown width.

Any activity that is likely to cause damage to a Protected Tree is prohibited. This includes killing or removing a tree, or activities that are likely to cause the death or decline of a tree. Undertaking groundwork within the Tree Protection Zone of a protected tree also requires approval.

4.4.1 Tree Assessment

A Tree Assessment is required to document all the individual trees in the Proposal site, their attributes and whether they will be removed for the construction of the Proposal. The tree attributes to be documented include species, size, health and overall tree quality. The assessment will also identify any trees which meet the criteria for a Regulated Tree and therefore are classed as a Protected Tree under the Act.

The Tree Assessment will need to be provided to the TCCS for advice regarding the protection measures, and endorsement. The Tree Assessment will also need to be provided to the Conservator of Flora and Fauna, along with the Landscaping Plans and Ecological Assessment, to enable the Conservator's evaluation of the Proposal and whether endorsement will be provided (see section 4.2).

A number of Tree Assessments have been undertaken to identify and map the existing trees within the Proposal area. Figure 5 provides an aboricultural Tree Assessment within the Proposal area undertaken by DSD Landscape Architects in 2016.

There are a number of regulated and non-regulated trees of varying quality within the Proposal area. Some regulated medium and low quality trees will likely be impacted by the Proposal. Impacts to trees are required to reduce the ecological impacts to EPBC Act listed habitats which dominate the grassed areas within the Proposal area. Determining the preferred alignment of the access road is a balance between minimising impacts to trees, minimising impacts to EBPC Act listed species while also meeting the objectives of the Proposal.

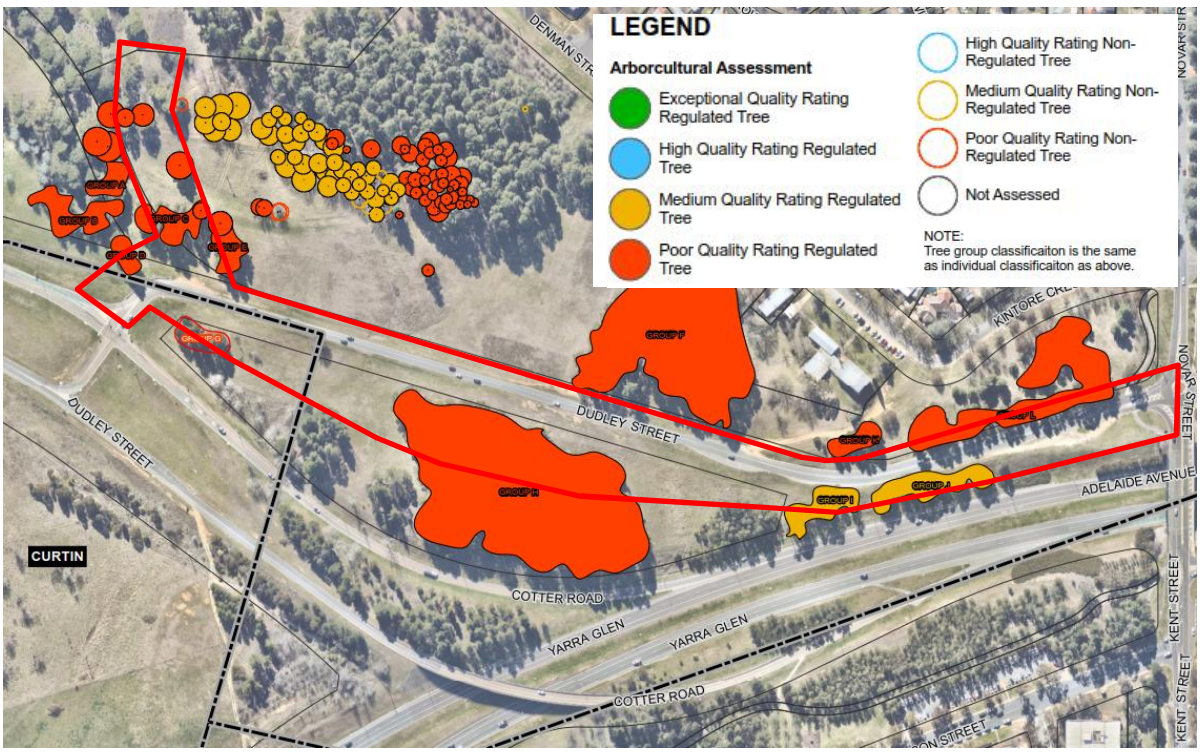


Figure 5 Tree assessment (*Source: DSD Landscape Architects 2016*)

4.5 Environment Protection Act 1997

The ACT's *Environmental Protection Act 1997* was established to protect the environment from pollution and its effects and provides a regulatory framework to help reduce and eliminate the discharge of pollutants into the air, land and water. The *Environmental Protection Act 1997* establishes the EPA. As a statutory position, the EPA is responsible for administering the Act.

Under the PD Act, ACT PLA must refer development applications for the development to the EPA. For the works proposed which are subject to the Territory Plan, regardless of whether a development approval under the PD Act is exempt, endorsement from the EPA will be required. The NCA also require that endorsement for the Proposal is obtained from the EPA for Designated Areas with evidence required as part of the Works Approval documentation.

The requirement for a Waterway Work License (WWL) is discussed in Section 4.6.1. The requirement for an environmental protection agreement or environmental is discussed in Section 4.5.1.

4.5.1 Environmental Authorisation or Environmental Protection Agreement

Under the *Environmental Protection Act 1997*, a person must not conduct an activity listed in schedule 1 as a class A activity unless the person holds an environmental authorisation in relation to that activity. Further, a person must not conduct an activity listed in schedule 1 as a class B activity unless the person –

a. Is a party an environmental protection agreement that is in effect in relation to that activity; or
b. Holds an environmental authorisation in relation to that activity.

Environmental protection agreements are formal agreements between the EPA and the people conducting certain activities that pose environmental risks. Environmental Authorisations set out conditions for activities carrying with them the greatest environmental risk. Each authorisation can be individually tailored for the activity it authorises, and can impose specific conditions on the conduct of the activity

Table 6 lists the class A and B activities which have the potential to be, or are, applicable to the Proposal.

Table 6 Activities under Schedule 1 of the *Environmental Protection Act 1997*

Activity Class	Item	Item description	Applicability
B	4	major land development or construction activities, being— (a) land development, or the construction of a commercial building, on a site of 0.3ha or more and including the construction of associated public infrastructure; or (b) the construction of public infrastructure on a site of 0.3ha or more; but not including the installation of pipes or lines for linear utilities such as gas, water, electricity and telephone	Applicable. The Proposal site is larger than 0.3 ha.
B	5	management of municipal services maintenance on unleased land, being the maintenance of— (a) urban parkland or other municipal landscapes; or (b) public places, public roads or public footpaths; or (c) the stormwater system	Applicable.

As shown in Table 6 the Proposal at minimum meets the criteria for two class B activities and will require either an environmental protection agreement or environmental authorisation. Whether the Proposal meets the criteria for a class A activity, which requires an environmental authorisation, will be confirmed during more detailed design phases though is not considered likely at this stage.

4.5.2 Contaminated Sites Register

Under Section 21A of the *Environmental Protection Act 1997* the EPA is required to keep a register of contaminated sites. The following are included on the register:

- an order under Subsection 91C(1) of the Act to assess whether land is contaminated;
- an order under Subsection 91D(1) of the Act to remediate contaminated land; or
- an environment protection order under Subsection 125(2) or Subsection 125(3) of the Act to manage contaminated land.

The EPA will remove the site from the register (as permitted under Subsection 21A(5) of the Act) where the actions required under the order to assess if the land is contaminated have been:

- completed; and
- audited by an accredited auditor; and
- as a result of an assessment, the land is found not to be contaminated.

A section of the Proposal is located within land included on the register of contaminated sites under the *Environment Protection Act 1997*.

Phase 1 and Phase 2 contamination assessments have been completed for the Proposal site. Analysis of these assessments will be required during the preparation of the environmental impact assessment to ensure adequate investigations have been undertaken to apply for the portion of the Proposal site to be removed from the register.

The EPA will advertise in the ACT Legislation Register and The Canberra Times (within 10 working days) when a record is removed from the register

4.6 Water Resources Act 2007

4.6.1 Waterway Work Licence

Under section 42 of the *Water Resources Act 2007,* administered by the ACT EPA, construction or altering a water structure, or doing any other work in or on a waterway, is not permitted before obtaining a WWL. When considering an application for a WWL, the EPA must be satisfied that the work will not adversely affect the flow or quality of the water, the aquatic habitat in the waterway or the interests of other water users.

The *Water Resources Act 2007* defines a waterway as:

c. a river, creek, stream or other natural channel in which water flows (whether continuously or intermittently); or

d. the stormwater system or any other channel formed (whether completely or partly) by altering or relocating a waterway mentioned in paragraph (a); or

e. a lake, pond, lagoon or marsh (whether formed by geomorphic processes or by works) in which water collects (whether continuously or intermittently).

There are no anticipated water resources within 40 metres of the Proposal.

5.0 References

ACT Government (2011) Environment Protection Guidelines for Construction and Land Development in the ACT,

ACT Government (2013) Yarralumla Brickworks Railway Remnants registration

ACT Heritage Council (2015) Cultural Heritage Reporting Policy

AECOM (2016) Site Investigation Report (Stage 1)

AECOM (2016) Site Investigation – Traffic, Transport and Carparking

Department of Environment (DoE) (2013a) Significant impact guidelines 1.1 - Matters of National Environmental Significance

Department of Environment (DoE) (2013b) Significant impact guidelines 1.2 – Actions on, or impacting upon, Commonwealth land and Actions by Commonwealth Agencies

National Capital Authority (NCA) (1995) Lake Burley Griffin Management Plan

Navin Officer (2014) Stage 1 Aboriginal Cultural Heritage Assessment, Aug 2014

Leach Steger (2014) Detailed Engineering Survey, October 2014

DSD Landscape Architects (2015) Yarralumla Brickworks Precinct Tree Assessment

DSD Landscape Architects (2016) Yarralumla Brickworks Precinct - Dudley Street Tree Assessment

ABPP (2016) Bushfire Risk Assessment Report, Canberra Brickworks Precinct

SMEC (2013) Preliminary Geotechnical Site Investigation for the Canberra Brickworks

SMEC (2014) Preliminary Environmental Site Investigation-Canberra Brickworks

Umwelt (2014) Canberra Brickworks and Environs Ecological Assessment

Umwelt (2016) GSM Survey and Ecological Assessment of Dudley Street Road Reserve

Umwelt (2017) Briefing note Golden Sun Moth and Native Temperate Grassland Survey and Ecological Assessment of Dudley Street Road Reserve, January 2017

Appendix A

Works Approval Application Form

Australian Government
National Capital Authority

APPLICATION FOR WORKS APPROVAL

(Works Approval under the Australian Capital Territory (Planning and Land Management) Act 1988)

Treasury Building, Parkes ACT 2600 | Telephone 6271 2888 | Fax 6273 4427 | Web www.nationalcapital.gov.au

Do you understand the Development Approval process? ☐ Yes ☐ No If not, please ring 6271 2888 for further information or visit our website

Note:3 sets of all drawings to be lodged with application.

APPLICANT'S DETAILS

Applicant: .....Contact Person: .....

Postal Address:.....

Phone: ..... Email: .....

Invoicing details (If different)

Name:.....

Postal Address:.....

Please note:

• that the NCA will provide an invoice in accordance with the details provided above. This invoice is for the cost of making an application not for approval. Applications are not valid until fees are paid in full.

☐ I understand the there is a cost associated with making an application for works approval

• that details of this application, location and the name of the applicant will be placed on the NCA's web site.

If you do not wish to have these details published on the NCA's website, please tick the box below.

☐ I do not wish to have details of this application published.

LOCATION ON OF PROPOSED WORKS

Block ☐ Section ☐ Suburb/District ☐

DESCRIPTION OF PROPOSED WORKS

Project Name.....

Type of Works ☐ Buildings ☐ Landscape ☐ Signs ☐ Demolition

☐ Temporary Works ☐ Other (please specify) ☐

Estimated Cost of Works ☐

DETAILS OF PROPOSED WORKS (WHERE APPLICABLE)

Site Area	☐	SETBACKS	Front	☐
Gross Floor Area	☐		Side(s)	☐
Site Coverage	☐		Rear	☐
Car Park Spaces	☐	HEIGHT	Storeys	☐

Lease Compliance ☐ Yes ☐ No

NATURE OF SUBMISSION

☐ Sketch Plans ☐ Working Drawings ☐ Amendments ☐ Sample Board

Please list drawing numbers .....

.....

DECLARATION: This application is being lodged by: the lessee or a representative of the lessee with his/her approval

Signature of Submitter:..... Date: ☐

NCA STAFF TO COMPLETE

Development Approval Application No.: ☐

Fee Calculated: ☐ Fee Received/to be invoiced ☐

Signature: ..... Date: ☐

Appendix B

Works Approval Information Checklist

Australian Government
National Capital Authority

Development Application
INFORMATION CHECKLIST

THE FOLLOWING INFORMATION IS REQUIRED FOR MAJOR DEVELOPMENT APPLICATIONS PLEASE DISCUSS WITH THE DEVELOPMENT ASSESSMENT TEAM THE INFORMATION REQUIRED FOR YOUR PROPOSED WORKS.

TWO SETS OF ALL PLANS /DRAWINGS ARE REQUIRED TO BE PROVIDED.

- ☐ **A Locality Plan** which identifies the site and its context.
- ☐ **A Site Analysis Plan**
- ☐ **Design Concept Drawings/Statements** explaining the concept behind the design and siting of buildings and landscaping as proposed.
- ☐ **A Detailed Site Plan** (1:200 or 1:500) which identifies site boundaries and the key characteristics of the site including:
  - ☐ site contours;
  - ☐ underground services (water, sewer, gas & electricity);
  - ☐ surface drainage pattern;
  - ☐ existing vegetation (particularly the established trees) - their size, species, condition and exact location;
  - ☐ vehicular and pedestrian access;
  - ☐ existing development and other features which may contribute to a full understanding of the site and its context.
- ☐ **Schedule of Proposed Works** which give details of the works proposed including extent of earthworks, off-site work requirements and works associated with service connections. It should also describe the quantitative characteristics of the proposed development such as:
  - ☐ gross floor area;
  - ☐ site coverage;
  - ☐ building height;
  - ☐ building setbacks from property line;
  - ☐ external materials and colours (a sample board may be required);
  - ☐ on-site and off-site carparking provisions.
- ☐ **Architectural Drawings** (1:100 or 1:200) sufficient to fully explain the scheme and should include:
  - ☐ floor plans;
  - ☐ elevations;

- ☐ sections (indicating finished floor levels and roof heights);
- ☐ perspective drawings;
- ☐ coloured elevation showing external finishes;
- ☐ external lighting plan;
- ☐ external signage plan.

☐ **Landscape Plans** (1:200 or 1:500) which include:

- ☐ existing trees proposed to be retained and the ones to be removed or pruned with a tree survey report/arborist report;
- ☐ proposed planting design;
- ☐ location, size and species details of proposed planting;
- ☐ final site levels (including verge levels) and drainage;
- ☐ location and finishes of pedestrian & vehicular access paths and carpark areas;
- ☐ location and details of signage and external lighting.

☐ **Civil & Excavation Plans** – civil drawings showing changes to site services including the method of undertaking works, extent of excavation including RL levels.

☐ **A Planning Report** addressing the relevant design and planning matters in accordance with the provisions of the National Capital Plan. Advice in relation to how obligations have been met under other legislation including the Environment Protection and Biodiversity Conservation Act 1999 and the Copyright Amendment (Moral Rights) Act 2000.

☐ **A Design Model** is required for any major development and/or proposed in a prominent location.

☐ **A Public Consultation Report** (in accordance with the NCA's Consultation Protocol)outlining the consultation process carried out by the proponent and how the matters raised during consultation have been addressed in accordance with the requirements of the National Capital Plan.

☐ **Traffic Assessment Report** which considers the potential impact on the area, vehicle access and egress, parking arrangements, road capacity.

☐ **A Site Establishment and Construction (or Demolition) Management Plan** which identifies:

- ☐ the location of temporary work sheds & material storage areas;
- ☐ temporary site fencing & signs;
- ☐ construction/demolition vehicle access & circulation areas;
- ☐ methods to be used for protecting street trees and trees to be retained on site;
- ☐ methods of protection of verge landscaping from possible damage during construction/demolition);
- ☐ measures to contain run-offs from the site with due consideration given to erosion management during construction/demolition;
- ☐ steps to be taken to restore the site and site access after construction/demolition;
- ☐ temporary traffic management.

☐ **External Agency Clearances**

- ☐ Territory and Municipal Services;
- ☐ ACT Planning and Land Authority -leasing;
- ☐ ACT Department of the Environment, Climate Change, Energy and Water.

Appendix C

Protected Matters Search Tool Report

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

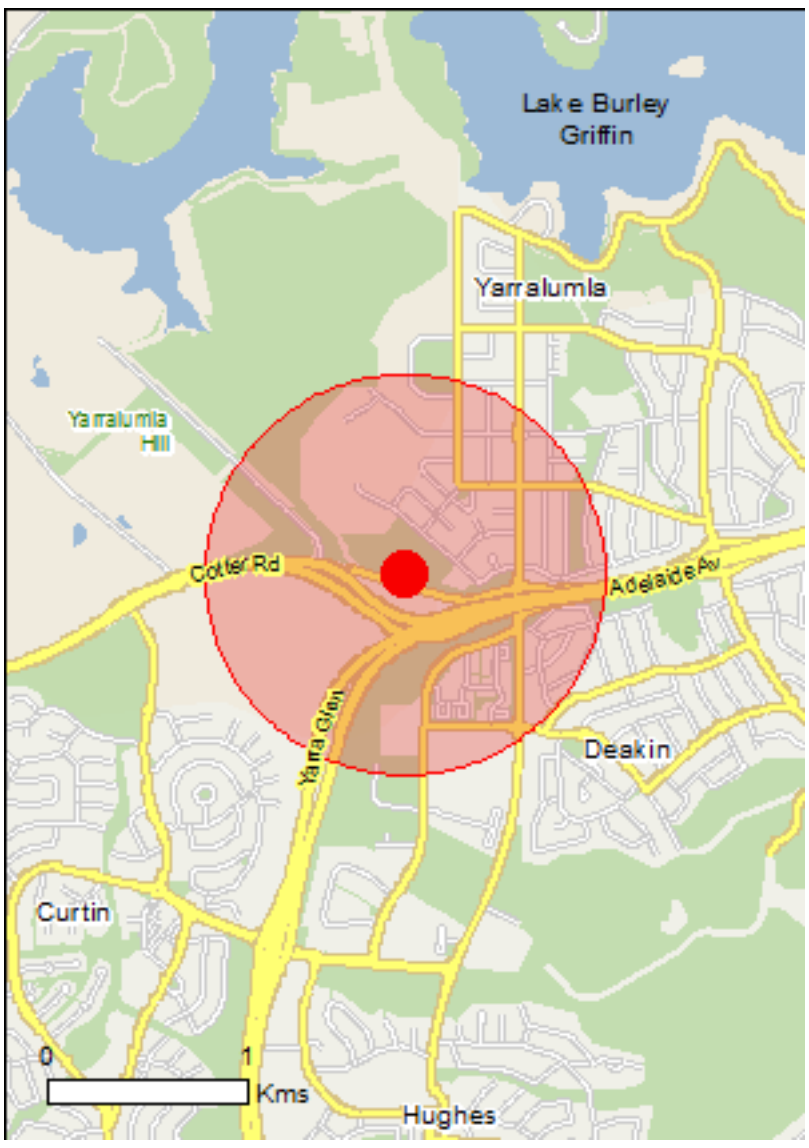
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

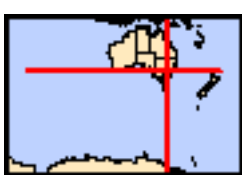
Report created: 10/01/17 22:14:43

Summary
Details
Matters of NES
Other Matters Protected by the EPBC Act
Extra Information
Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	4
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	28
Listed Migratory Species:	10

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	3
Listed Marine Species:	16
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	34
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Banrock station wetland complex	800 - 900km upstream
Hattah-kulkyne lakes	600 - 700km upstream
Riverland	700 - 800km upstream
The coorong, and lakes alexandrina and albert wetland	800 - 900km upstream

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Natural Temperate Grassland of the South Eastern Highlands	Critically Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Polytelis swainsonii Superb Parrot [738]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Fish		
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat may occur within area
Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species

Name	Status	Type of Presence
		habitat may occur within area
Frogs		
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat may occur within area
Litoria castanea Yellow-spotted Tree Frog, Yellow-spotted Bell Frog [1848]	Endangered	Species or species habitat likely to occur within area
Insects		
Synemon plana Golden Sun Moth [25234]	Critically Endangered	Species or species habitat known to occur within area
Mammals		
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat may occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Plants		
Eucalyptus aggregata Black Gum [20890]	Vulnerable	Species or species habitat likely to occur within area
Lepidium hyssopifolium Basalt Pepper-cress, Peppercress, Rubble Pepper-cress, Pepperweed [16542]	Endangered	Species or species habitat may occur within area
Leucochrysum albicans var. tricolor Hoary Sunray, Grassland Paper-daisy [56204]	Endangered	Species or species habitat likely to occur within area
Pelargonium sp. Striatellum (G.W.Carr 10345) Omeo Stork's-bill [84065]	Endangered	Species or species habitat may occur within area
Prasophyllum petilum Tarengo Leek Orchid [55144]	Endangered	Species or species habitat may occur within area
Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid [81964]	Critically Endangered	Species or species habitat may occur within area
Rutidosis leptorrhynchoides Button Wrinklewort [7384]	Endangered	Species or species habitat likely to occur within area
Swainsona recta Small Purple-pea, Mountain Swainson-pea, Small Purple Pea [7580]	Endangered	Species or species habitat likely to occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area
Reptiles		

Name	Status	Type of Presence
Aprasia parapulchella		
Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat likely to occur within area
Delma impar		
Striped Legless Lizard [1649]	Vulnerable	Species or species habitat likely to occur within area
Tympanocryptis pinguicolla		
Grassland Earless Dragon [66727]	Endangered	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat known to occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus		
Osprey [952]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Historic		
Australian Forestry School (former)	ACT	Listed place
The CSIRO Forestry Precinct	ACT	Listed place
The Royal Australian Mint	ACT	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis		
Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis		
Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos		
Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis		
European Goldfinch [403]		Species or species habitat likely to occur within area
Carduelis chloris		
European Greenfinch [404]		Species or species habitat likely to occur within area
Columba livia		
Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus		
House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis		
Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris		
Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula		
Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-35.3128 149.09315

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

© Commonwealth of Australia
Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

DRAFT

Appendix C

D R A F T

Appendix C – Stakeholder Consultation Minutes

AECOM Australia Pty Ltd
Level 2
60 Marcus Clarke Street
Canberra ACT 2600
Australia
www.aecom.com

+61 2 6201 3000 tel
+61 2 6201 3099 fax
ABN 20 093 846 925

Minutes of Meeting

Canberra Brickworks Access and Dudley Street Upgrade Design Services

Subject	TCCS Meeting	Page	1
Venue	Level 4, Conference Room, Macarthur House	Time	14.00 - 15.00
Participants	Joanne Makela (PCW) Gerard Coffey (CICW) Carl Pillig (TCCS) John Hillman (TCCS) Jane Peters (AECOM) Rod Weeks (AECOM) Linda Mulyadi (AECOM)		
Apologies	-		
File/Ref No.	60533438	Date	23-Jan-2017
Distribution	As above		

No	Item	Action	Date
1.	Public Transport		
a)	Local buses to use Dudley St. Current bus route on Novar St will be retained.	Noted	
b)	Traffic lane on Dudley St is to be 4 m wide. Traffic lane on Access Road is 3.5 m wide.	Noted	
c)	Bus stop is to be indented.	Noted	
d)	Bus stop bay (gradient) is to comply with the TAMS standard.	Noted	
e)	Only 1 bus stop (one in each direction) is required on Dudley Street and to be located as closed as possible to Canberra Brickworks development. Local stop location to be clearly communicated to LDA and the Developer.	Noted	
f)	Areas of concern for ACTIION: · Dudley St/ Cotter Rd westbound intersection (safety concern for buses turning right into Cotter road as currently the intersection is unsignalised) · Dudley St/ Novar St – tight intersection · Adelaide Ave southbound off ramp/ Kent Street – tight intersection	Noted	
2.	Road Geometry		
a)	Discussed inputs to the design parameters such as traffic volume, road classification, design speed, design vehicles.	Noted	
b)	Discussed the outcome of review of the Feasibility Design – refer to attached spreadsheets Rev B.	Noted	
c)	Cross Section – verge to allow for future trees. A barrier will be required. To be discussed with the NCA.	AECOM	
d)	New roundabout should have on-road cycling in accordance with Std Drg 13-09 and agreed with Roads ACT. On-road cycling and off-road	Noted	

No	Item	Action	Date
	shared path grades to follow the road gradients.		
e)	Vertical and horizontal alignment of the access road subject to review of Tenderers' alignments.	Noted	

AECOM Australia Pty Ltd
Level 2
60 Marcus Clarke Street
Canberra ACT 2600
Australia
www.aecom.com

+61 2 6201 3000 tel
+61 2 6201 3099 fax
ABN 20 093 846 925

Minutes of Meeting

Canberra Brickworks Access and Dudley Street Upgrade Design Services

Subject	LDA Meeting	Page	1
Venue	Shared Services Procurement, Level 2 Annex, Sulman Room	Time	11.00 - 12.00
Participants	Gerard Coffey Irena Sharp Richard Marshall Jane Peters Rod Weeks Joanne Makela		
Apologies	Brendan Hogan		
File/Ref No.		Date	15-Dec-2016
Distribution	As above		

No	Item	Action	Date
1.	NCA Involvement (a) The LDA has had briefings with the NCA regarding the land sale. Rebecca Sorenson is the NCA contact and knows the scope of works for the access road. (b) LDA agreed for AECOM to contact the NCA early in the process. (c) The landscape works for the access road will be consistent with the estate. (d) Assumed no additional landscaping treatments along Dudley Street and not included in AECOM scope.	AECOM to arrange meeting with NCA following review of tenderer submissions.	26/1/17
2.	Alignment of Access Road. (a) LDA would like to see the alignment move closer to the west however understand geometrical and environmental constraints to alignment. (b) The tender submissions for the estate are due on 19 January 2017. There is a 5 -6 week evaluation period. (c) The tenderers were provided with a copy of Cardno concept design and constraint mapping.	LDA – provide copy of relevant sections of the submissions.	19/1/17

No	Item	Action	Date
	(d) LDA to provide AECOM with a copy of the relevant sections of submissions to review proposed connection to the estate.		
3.	Cycle Paths A shared path is required to provide a connection to the estate from the Cotter Road. The proposed gradient on the access road will need to meet the maximum gradient design requirements. Moving the alignment to the west may improve the gradient.		
4.	Proposed Roundabout Location and Boundaries (a) The LDA do not have a position on moving the roundabout further south to improve the design. (b) No information on the future planning for the Cotter Road. It was noted that if the intersection with Cotter Road moved further south it would remove the sharp bends and improve the geometry. (c) The existing Dudley Street road reserve boundary will need to be adjusted. A wider road reserve boundary will benefit the constructability of the design. The construction staging will be challenging for Dudley Street to remain open during construction. (d) Dudley Street is on the Griffin Plan. GC will advise the Walter Burley Griffin Society of the concept design and works proceeding for PSP. IS to provide contact.	GC to advise the Griffin Legacy Group. IS to provide contact details. *Post meeting note: Contact made with WBGS.*	13/1/17
5.	Old Uriarra Track (a) The local walking track referred to as a remnant of the Old Uriarra Road is not heritage listed. (b) The Yarralumla Residents Association (YRA) would like to see the informal track remain and where is crosses the access road a pedestrian crossing in form of a refuge or pavement treatments to be provided.		
6.	Stormwater Design The stormwater design for the Dudley Street Upgrade and the access road assumes the existing run off conditions. Increased run off due to the development will be managed and attenuated by the		

No	Item	Action	Date
	development.		
7.	Traffic Projections (a) Design acceptance by Roads ACT will require updated traffic projections. The optional additional traffic task of reviewing the updated traffic volume projections for $2500 is accepted by the client. *Post meeting note: Accepted* (b) There is an ACTION bus service on Dudley Street but not proposed to enter the estate via the access road. GC to talk to Carl Pillig from ACTION to confirm. (c) However tourist buses may use the access road to the Brickworks so the roundabout and access road needs to accommodate this vehicle.	GC to contact Carl Pillig of ACTION regarding future planning for bus network. *Post meeting note: ACTION advised that the rapid route would not be redirected*.	
8.	Community Panel – Consultation (a) The LDA have a Community Panel set up for the Brickworks project comprised of the following groups: - Yarralumla Residents Association (YRA) - Inner South Community Council - Pedal Power - See Change (sustainability focus) - National Trust - Geological Society - Canberra Business Chamber (b) A presentation of the draft PSP design should be planned for this panel. Two week notice required for the LDA to organise. (c) The Uniting Church will need to be consulted regarding connection of stormwater. IS will provide further details and contacts. (d) The Equestrian Association is a separate group and could be invited to the presentation.	IS to provide Uniting Church details.	
9.	Cost Estimate (a) GC has requested a review and update of the cost estimate based on AECOM review of the concept design by the end of January as input for the Business Case. (b) The BOQ and Cost Estimate need to be separated into three components:		

No	Item	Action	Date
	- Access Road - Roundabout and connection to Cotter Road - Dudley Street Upgrade		

AECOM Australia Pty Ltd
Level 2
60 Marcus Clarke Street
Canberra ACT 2600
Australia
www.aecom.com

+61 2 6201 3000 tel
+61 2 6201 3099 fax
ABN 20 093 846 925

Minutes of Meeting

60533438 – CBE Brickworks Access and Dudley Street Upgrade

Subject	Stormwater from the Uniting Church	Page	1
Venue	Uniting Church – Yarralumla	Time	2:30pm
Participants	Allan Hall (Uniting Church) Norman (Uniting Church) Aubrey (Uniting Church) Jane Peters (AECOM) Shane Wickramasinghe (AECOM)		
Apologies	Gerard Coffey – CICW		
File/Ref No.	Project: 60533438	Date	06-Feb-2017
Distribution	As above		

No	Item	Action	Date
1	**Purpose of Meeting**		
1.1	Discussion with Uniting Church Representatives regarding the stormwater flow from the Church to be incorporated in Dudley St upgrade works.	Noted	
2	**Stormwater Drainage**		
2.1	The Uniting Church representatives advised that the Crown did not supply any drainage to the Church.	Noted	
2.2	The Uniting Church representatives noted that the stormwater drainage outlets flow in the direction towards Dudley Street. They advised that this was visible based on the erosion close to the outlet. AECOM had a walk around on site to see the outlets within the vicinity of the church.	Noted	
2.3	The Uniting Church representatives noted that the stormwater from the main church drains towards Deakin.	Noted	
2.4	The Uniting Church representatives noted their concern of the stormwater drainage from the church affecting any downstream future developments.	Noted	
2.5	The Uniting Church representatives mentioned that the property had been surveyed 12 months ago.	Noted	
3	**Other**		
3.1	The Uniting Church representatives noted that there are a variety of groups who use the church for different purposes and that parking was a big issue in and around the church. The informal arrangement on Denman Street with no kerbing provides flexibility in catering for parking.	Noted	
3.2	The Uniting Church representatives raised concern regarding access to the Brickworks Precinct and Denman Street being used as the	Noted	

No	Item	Action	Date
	second access. AECOM mentioned that they would raise these concerns with the client.		
3.3	AECOM mentioned that they would provide the Uniting Church with updates in the progress of their design.	Noted	
4	**Meeting closed at 3:30 PM**		

AECOM Australia Pty Ltd
Level 2
60 Marcus Clarke Street
Canberra ACT 2600
Australia
www.aecom.com

+61 2 6201 3000 tel
+61 2 6201 3099 fax
ABN 20 093 846 925

Minutes of Meeting

Canberra Brickworks Access and Dudley Street Upgrade Design Services

Subject	TCCS Meeting	Page	1
Venue	Level 3 Annex, Overall Room, Macarthur House	Time	11.00 - 12.00
Participants	Joanne Makela (PCW) - Part Nicole Moulston (PCW) Gerard Coffey (CICW) Mike Day (TCCS) - Part Tim Heffernan (AECOM) Linda Mulyadi (AECOM)		
Apologies	Brendan Hogan (AECOM)		
File/Ref No.	60533438	Date	28-Feb-2017
Distribution	As above and Jane Peters (AECOM)		

No	Item	Action	Date
1.	General		
a)	CICW provided an introduction (including background) of the project to TCCS.	Noted	
2.	Intersection Layout		
a)	Discussed the two intersection layouts with TCCS.	Noted	
b)	Discussed weaving issue on both intersection layouts on Dudley St approaching to Cotter Road eastbound.	Noted	
c)	Signalised intersection arrangement: · Needs 2 right turn lanes (for storage) on Dudley St eastbound · Needs 2 left turn lanes (for storage) on Dudley St westbound · May not have much different in footprint (compared to roundabout arrangement) due to the required 2 turn lanes.	Noted	
d)	Roundabout intersection arrangement: · Only 1 left turn lane is required on Dudley St westbound – thus, weaving is no longer an issue. · Thus, agreed that this is the preferred intersection arrangement.	Noted	
3.	Informal progress meeting		
a)	AECOM to progress with the agreed layout and the environmental aspect of the project.	AECOM	
b)	Typical section of the Access Rd - to adopt the outcome of discussion with John Hillman (TCCS) in January 17: · 3.5 m traffic lane · 1.5 m on-road cycle lane · 2.5 m off road path · 4 m wide median (from CBW tenderer's submission)	Noted	

DRAFT

Appendix D

D R A F T

Appendix D – Design Criteria Table

Item	Design parameters	Dudley Street		Canberra Brickworks Access Road		Relevant Standards,Guidelines or supporting documents	Comments	Amendment	Amendment date
1	**General**								
1.1	Traffic volume	>8,000 vpd		2,221 vpd		Feasibility Report	Discussed with TCCS on 23/01/17		
1.2	Road Classification	Major Collector Road		Minor Collector Road		Project Brief, Feasibility Report, Estate Development Code Table 1A and Table 2A	Discussed with TCCS on 23/01/17		
1.3	Design Speed	70 km/h (60 km/h posted)		60 km/h (50 km/h posted)		Feasibility Report, Estate Development Code Table 1A and Table 2A	Discussed with TCCS on 23/01/17		
1.4	Bus Route	Yes		Yes - tourist buses		Feasibility Report (on Dudley St)	Discussed with LDA dated 15 Dec 16 (on Access Road). Discussed with TCCS on 23/01/17		
1.5	Design Vehicle	Semi-trailer (19 m long), Steer tag bus, Tourist bus		Semi-trailer (19 m long), Tourist bus			Discussed with TCCS on 23/01/17		
2	**Cross Section**								
2.1	Traffic Lane widths								
2.1.1	Traffic lane, right-turn and left-turn lane width	3.5 m		3.5 m		AGRD Part 3, 4.2.4, Table 4.3, and Table 4.6			
2.1.2	Bus route lane	4 m		4 m		Estate Development Code Table 2A and Table 3			
2.2	On-road cycle lane	1.5 m	Desirable Minimum	1.5 m	Desirable Minimum	AGRD Part 3, 4.8.7, Table 4.18			
2.3	Shared path	2.0 m (on both sides), aligned at least 1.5 m away from the kerb		2.0 m (on both sides), aligned at least 1.5 m away from the kerb		Estate Development Code Table 2A			
2.4	Road Clear Zone	Design ADT >6000		Design ADT 1501 - 6000		AGRD Part 6, table 4.1			
		6.5 m (6:1 to flat fill batter)		4.5 m (6:1 to flat fill batter)					
		8.5 m (4:1 to 5:1 fill batter)		5.0 m (4:1 to 5:1 fill batter)					
		6.0 m (4:1 to 5:1 cut batter)		4.5 m (4:1 to 5:1 cut batter)					
		5.0 m (3:1 and steeper cut batter)		4.5 m (3:1 and steeper cut batter)					
2.5	Verge Width	6.25 m	Minimum	6.25 m	Minimum	Estate Development Code Table 2A			
3	**Sight Distance**								
3.1	Desirable Minimum Stopping Sight Distance (SSD) - Cars	92 m	Reaction time - 2.0 sec d - 0.36	73 m	Reaction time - 2.0 sec d - 0.36	AGRD Part 3, 5.3.1, table 5.5	Grade correction needs to be considered in the design		
3.2	Desirable Minimum Stopping Sight Distance (SSD) - Trucks	105 m	Reaction time - 2.0 sec d - 0.29	82 m	Reaction time - 2.0 sec d - 0.29	AGRD Part 3, 5.3.2, table 5.6	Grade correction needs to be considered in the design		
3.3	Approach Sight Distance (ASD)	92 m	Reaction time - 2.0 sec d - 0.362 K (vert) - 38.9 m	73 m	Reaction time - 2.0 sec d - 0.362 K (vert) - 24.0 m	AGRD Part 4A, 3.2.1, table 3.1	Grade correction needs to be considered in the design		
3.4	Safe Intersection Sight Distance (SSID)	151 m	Reaction time - 3.0 sec d - 0.362 K (vert) - 25 m	123 m	Reaction time - 3.0 sec d - 0.362 K (vert) - 16 m	AGRD Part 4A, 3.2.1, table 3.2	Grade correction needs to be considered in the design		

Item	Design parameters	Dudley Street		Canberra Brickworks Access Road		Relevant Standards,Guidelines or supporting documents	Comments	Amendment	Amendment date
4	**Horizontal Alignment**								
4.1	Superelevation								
4.1.1	e	3%	Desirable	3%	Desirable	AGRD Part 3, 7.6.1, table 7.6			
		5%	Maximum	5%	Maximum				
4.1.2	Side Friction Factor - cars	0.19	Desirable Maximum	0.24	Desirable Maximum	AGRD Part 3, 7.6.1, table 7.5			
		0.31	Absolute Maximum	0.33	Absolute Maximum				
4.1.3	Side Friction Factor - trucks	0.14	Desirable Maximum	0.17	Desirable Maximum	AGRD Part 3, 7.6.1, table 7.5			
		0.23	Absolute Maximum	0.24	Absolute Maximum				
4.1.4	Minimum Radius (Cars) - based on 3% superelevation	176 m	Desirable	105 m	Desirable	AGRD Part 3, 7.4.1, Eq 5			
		114 m	Absolute minimum	79 m	Absolute minimum				
4.1.5	Minimum Radius (Trucks) - based on 3% superelevation	227 m	Desirable	142 m	Desirable	AGRD Part 3, 7.4.1, Eq 5			
		149 m	Absolute minimum	105 m	Absolute minimum				
4.2	Adverse Crossfall	-3%		-3%					
4.2.1	Minimum Radius (Cars) - based on -3% adverse crossfall	242 m	Desirable	135 m	Desirable	AGRD Part 3, 7.4.1, Eq 5			
		138 m	Absolute minimum	95 m	Absolute minimum				
4.2.2	Minimum Radius (Trucks) - based on -3% adverse crossfall	351 m	Desirable	203 m	Desirable	AGRD Part 3, 7.4.1, Eq 5			
		193 m	Absolute minimum	135 m	Absolute minimum				
4.3	Minimum Horizontal Curve lengths	140 m		100 m		AGRD Part 3, 7.6.2, table 7.7			
4.4	Minimum Short Tangent Length (0.6V)	42 m		36 m		AGRD Part 3, 7.5.3			
4.5	Minimum width of path connection at pedestrian crossing	1.5 m		1.5 m					

Item	Design parameters	Dudley Street		Canberra Brickworks Access Road		Relevant Standards,Guidelines or supporting documents	Comments	Amendment	Amendment date
5	**Vertical Alignment**								
5.1	Minimum Vertical Clearances								
5.1.1	Overhead Powerline	11.50 m		11.50 m			To be confirmed with ActewAGL		
5.2	Maximum Grades								
5.2.1	Traffic Lane	12%		12%		Estate Development Code Table 2A			
5.2.2	Cycle Lane	Depending on the length of the gradient		Depending on the length of the gradient		AGRD Part 6A, 7.4.1, figure 7.1			
5.2.3	Bus Route	Considerations to be given in the vicinity of a bus stop - max longitudinal grade < 2.5%		Considerations to be given in the vicinity of a bus stop - max longitudinal grade < 2.5%		ACT Standard drawing DS13-03-1 and 2			
5.2.4	At Intersection	3%		3%		AGRD Part 4A, 2.2.2			
5.2.5	At Roundabout (<6%)	3 to 4%		3 to 4%		AGRD Part 4B, 4.10.2			
5.2.6	With Kerb and Gutter	1%	Desirable	1%	Desirable	AGRD Part 3, 8.5.6			
		0.50%	Minimum	0.50%	Minimum				
5.2.7	In Cut	0.50%				AGRD Part 3, 8.5.6			
5.2.8	Shared Path	Max gradient - 5% Landing for gradient between 3% - 5%		Max gradient - 5% Landing for gradient between 3% - 5%		AGRD Part 6A, 7.4.1			
		Refer to Figure 7.1 for acceptable length of steep gradient		Refer to Figure 7.1 for acceptable length of steep gradient		AGRD Part 6A, 7.4.1, figure 7.1			
5.3	Vertical Curves								
5.3.1	Minimum length of Crest Vertical Curve	50 to 60 m		40 to 50 m		AGRD Part 3, 8.6.3, table 8.6			
5.3.2	Minimum K (based on SSD)	19.10 m	Crest	11.80 m	Crest	AGRD Part 3, 8.6.3, table 8.7			
		8 to 21 m	Sag	6 to 16 m	Sag	AGRD Part 3, 8.6.5, figure 8.9			
5.3.3	Minimum Crest K (based on ASD and SSID)	Refer to comments		Refer to comments			Refer to ASD and SSID parameters above		

DRAFT

Appendix E

D R A F T

Appendix E – Utilities Correspondance

From: Mulyadi, Linda
Sent: Monday, 1 May 2017 4:41 PM
To: Wickramasinghe, Shane
Subject: FW: Overhead HV line clearance requirements

Hi Shane,

FYI

Regards,

Linda Mulyadi
Project Engineer
D +61 2 6275 1808
Linda.Mulyadi@aecom.com

AECOM
Level 2, St George Centre, 60 Marcus Clarke Street, Canberra, ACT 2601
PO Box 1942 Canberra City 2601
T +61 2 6201 3000 F +61 2 6201 3099
aecom.com

Built to deliver a better world

LinkedIn Twitter Facebook Instagram

Read insights, share ideas on AECOM's Connected Cities blog.

From: enworks [mailto:enworks@actewagl.com.au]
Sent: Monday, 1 May 2017 4:35 PM
To: Mulyadi, Linda
Subject: RE: Overhead HV line clearance requirements

Hi Linda,

The OH HV between Pole 67767 & Pole 62980 can be relocated to underground HV cable. Please specify 4x125mm ID UPVC HD Electrical Conduits for road crossings.

Regards
Kedar Vedanti
Industry Interface and Coordination Lead
Network Connection Services
Customer Connections Branch
Energy Networks - ActewAGL Distribution
t 02 6248 3582 **| f** 02 6293 5762

www.actewagl.com.au

Find us on Facebook and Twitter
Please consider our environment before printing this email.

From: Mulyadi, Linda [mailto:Linda.Mulyadi@aecom.com]
Sent: Monday, 1 May 2017 4:31 PM
To: enworks <enworks@actewagl.com.au>
Subject: RE: Overhead HV line clearance requirements

Hi Kedar,

Thanks for your call and glad we get clarification on the impacted cables which are from Pole 67 767 and 62 980.

Just to confirm that these cables can be relocated underground. As suggested, if possible, to try to consider future utilities for the Canberra Brickworks development (if there is a tower in the middle of the roundabout, etc) and perhaps alternative route for the relocation would provide a better outcome.

I will allow about $60,000 at this stage for ActewAGL to relocate the cables with the civil contractor to provide the trench and backfilling.

Thanks again.

Regards,

Linda Mulyadi
Project Engineer
D +61 2 6275 1808

Linda.Mulyadi@aecom.com

AECOM
Level 2, St George Centre, 60 Marcus Clarke Street, Canberra, ACT 2601
PO Box 1942 Canberra City 2601
T +61 2 6201 3000 F +61 2 6201 3099
aecom.com

Built to deliver a better world

LinkedIn Twitter Facebook Instagram

Read insights, share ideas on AECOM's Connected Cities blog.

From: Mulyadi, Linda
Sent: Monday, 1 May 2017 12:29 PM
To: 'enworks'
Subject: RE: Overhead HV line clearance requirements

Hi Kedar,

Great to speak with you earlier.

Please find attached, the location in which the vertical clearance over the proposed road is about 6 m to the 11kV OH HV. Note that I have included our plan rather than the dial before you dig plan as I think our plan shows clearer on the proposed road.

Please call if you wish to have further discussion regarding this.

Thanks.

Regards,

Linda Mulyadi
Project Engineer
D +61 2 6275 1808
Linda.Mulyadi@aecom.com

AECOM
Level 2, St George Centre, 60 Marcus Clarke Street, Canberra, ACT 2601
PO Box 1942 Canberra City 2601
T +61 2 6201 3000 F +61 2 6201 3099
aecom.com

Built to deliver a better world

LinkedIn Twitter Facebook Instagram

Read insights, share ideas on AECOM's Connected Cities blog.

From: enworks [mailto:enworks@actewagl.com.au]
Sent: Monday, 1 May 2017 11:54 AM
To: Mulyadi, Linda
Subject: RE: Overhead HV line clearance requirements

Hi Linda,

Could you please give me a call to discuss below. Thank you

I tried your landline but call is not going through.

Regards
Kedar Vedanti
Industry Interface and Coordination Lead
Network Connection Services
Customer Connections Branch
Energy Networks - ActewAGL Distribution
t 02 6248 3582 **| f** 02 6293 5762

www.actewagl.com.au

Find us on Facebook and Twitter
Please consider our environment before printing this email.

From: Mulyadi, Linda [mailto:Linda.Mulyadi@aecom.com]
Sent: Monday, 1 May 2017 11:39 AM

To: enworks <enworks@actewagl.com.au>
Cc: Wickramasinghe, Shane <Shane.Wickramasinghe@aecom.com>
Subject: FW: Overhead HV line clearance requirements

Hi Kedar,

I tried to call and left a message and thought of sending you an email as well.

I would like to discuss with you regarding relocating overhead HV network to underground from pole 67768 to 62964 (further to your earlier discussions with Justine Nam).

We have undertaken survey of the overhead HV cables and we only have around 6 m vertical clearance to the proposed road level. I understand the minimum vertical clearance for 11kV is 6.7 m, thus the overhead cable will need to be relocated underground.

From your latest email, you indicated there is pole substation in one of the pole and thus cannot be relocated. Thus, we would like to explore the following:

1. Any possibility of increasing the height of the pole?
2. Relocating to underground, what would the works required and approximate associated costs?

Thanks in advance for your time and assistance. Please let me know if there is anything else we need to consider in regards to the powerline.
Please note that I am only in the office on Monday and Tuesday. Please contact Shane if additional information/ clarification is required when I am away.
Thanks again.
Regards,

Linda Mulyadi
Project Engineer
D +61 2 6275 1808
Linda.Mulyadi@aecom.com

AECOM
Level 2, St George Centre, 60 Marcus Clarke Street, Canberra, ACT 2601
PO Box 1942 Canberra City 2601
T +61 2 6201 3000 F +61 2 6201 3099
aecom.com

Built to deliver a better world

LinkedIn Twitter Facebook Instagram

Read insights, share ideas on AECOM's Connected Cities blog.

From: enworks [mailto:enworks@actewagl.com.au]
Sent: Wednesday, 25 January 2017 3:25 PM
To: Nam, Justin
Subject: RE: Overhead HV line clearance requirements

Hi Justin,

Could you please confirm – you would like to have the OH HV network relocated to underground from pole 67768 to 62964, unfortunately we may not able to underground HV network from 67768 as there is pole substation located at this pole.

I did try to call you to discuss, please give me a call to discuss further, thank you

Regards
Kedar Vedanti
Industry Interface and Coordination Lead
Network Connection Services
Customer Connections Branch
Energy Networks - ActewAGL Distribution
t 02 6248 3582 **| f** 02 6293 5762

www.actewagl.com.au

Find us on Facebook and Twitter
Please consider our environment before printing this email.

From: Nam, Justin [mailto:Justin.Nam@aecom.com]
Sent: Wednesday, 25 January 2017 11:15 AM
To: enworks <enworks@actewagl.com.au>
Subject: RE: Overhead HV line clearance requirements

Hey Kedar,

Thank you for the overhead HV line clearance requirement document.

Regarding this HV line, as part of this Dudley Street road upgrade boring of this overhead HV line from Pole #67768 to Pole #62964 may be required. I am aware that an application for electricity network connection or alteration is needed to be filled out as part of this process. Are there any requirements necessary that you would like to make comments on regarding the relocation of the overhead HV line?

Regards,

Justin Nam
Graduate Civil Engineer
D +61 2 6201 3036
Justin.Nam@aecom.com

AECOM
Level 2, St George Centre, 60 Marcus Clarke Street, Canberra, ACT 2601
PO Box 1942 Canberra City 2601
T +61 2 6201 3000 F +61 2 6201 3099
aecom.com

Built to deliver a better world

LinkedIn Twitter Facebook Instagram

Read insights, share ideas on AECOM's Connected Cities blog.

From: enworks [mailto:enworks@actewagl.com.au]
Sent: Thursday, 12 January 2017 10:37 AM
To: Nam, Justin
Subject: RE: Overhead HV line clearance requirements

Hi Justin,

Attached as requested.

Regards
Kedar Vedanti
Industry Interface and Coordination Lead
Network Connection Services
Customer Connections Branch
Energy Networks - ActewAGL Distribution
t 02 6248 3582 **| f** 02 6293 5762

www.actewagl.com.au

Find us on Facebook and Twitter
Please consider our environment before printing this email.

From: Nam, Justin [mailto:Justin.Nam@aecom.com]
Sent: Thursday, 12 January 2017 10:36 AM
To: enworks <enworks@actewagl.com.au>
Subject: RE: Overhead HV line clearance requirements

Thanks Kedar,

Could you also refer me to the ActewAGL standard drawings for me to check the clearances for the OH HV 11kV line please?

I think it would be useful if we had access to the Actew standard drawings for future projects! If not, could you just please advise me on what the clearance requirements are for a OH HV 11kV line.

Thank you,

Justin Nam
Graduate Civil Engineer
D +61 2 6201 3036
Justin.Nam@aecom.com

AECOM
Level 2, St George Centre, 60 Marcus Clarke Street, Canberra, ACT 2601
PO Box 1942 Canberra City 2601
T +61 2 6201 3000 F +61 2 6201 3099
aecom.com

Built to deliver a better world

LinkedIn Twitter Facebook Instagram

Read insights, share ideas on AECOM's Connected Cities blog.

From: enworks [mailto:enworks@actewagl.com.au]
Sent: Thursday, 12 January 2017 10:13 AM
To: Nam, Justin
Subject: RE: Overhead HV line clearance requirements

Hi Justin,

The OH HV line is 11kV and there is a pole sub at pole 67768.

Regards
Kedar Vedanti
Industry Interface and Coordination Lead
Network Connection Services
Customer Connections Branch
Energy Networks - ActewAGL Distribution
t 02 6248 3582 **| f** 02 6293 5762

www.actewagl.com.au

Find us on Facebook and Twitter
Please consider our environment before printing this email.

From: Nam, Justin [mailto:Justin.Nam@aecom.com]
Sent: Wednesday, 11 January 2017 3:13 PM
To: enworks <enworks@actewagl.com.au>
Subject: Overhead HV line clearance requirements

Hey Kedar,

Hope you had a great Christmas and New Year!

I am currently looking at clearance requirements for an overhead HV line running across Dudley Street from Pole #67768 to Pole #62964 (please see attached).

Could you please advise me of what voltage this overhead HV line is and what the clearance requirements are for this line?

Thank you for your help in advance.

Kind Regards,

Justin Nam
Graduate Civil Engineer
D +61 2 6201 3036
Justin.Nam@aecom.com

AECOM
Level 2, St George Centre, 60 Marcus Clarke Street, Canberra, ACT 2601
PO Box 1942 Canberra City 2601
T +61 2 6201 3000 F +61 2 6201 3099
aecom.com

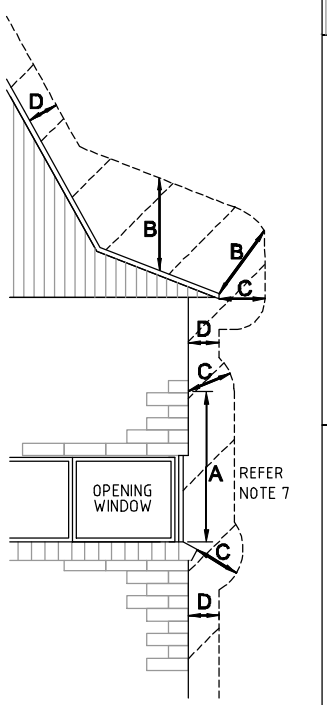
Built to deliver a better world

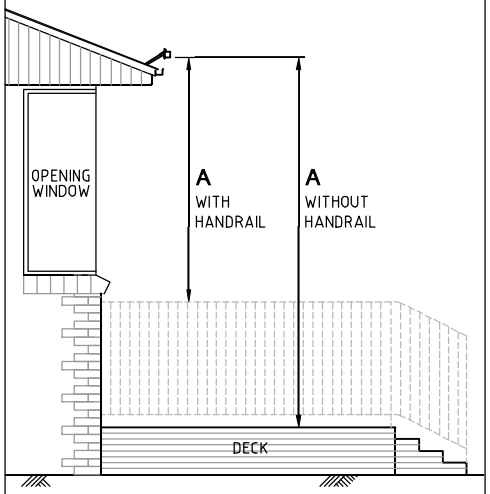
LinkedIn Twitter Facebook Instagram

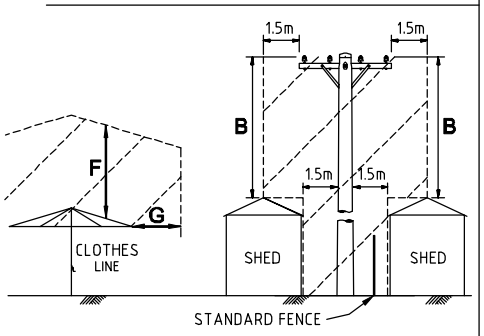
Read insights, share ideas on AECOM's Connected Cities blog.

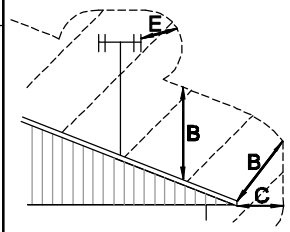
********** *PLEASE NOTE* This email and any attachments may be confidential. If received in error, please delete all copies and advise the sender. The reproduction or dissemination of this email or its attachments is prohibited without the consent of the sender. WARNING RE VIRUSES: Our computer systems sweep outgoing email to guard against viruses, but no warranty is given that this email or its attachments are virus free. Before opening or using attachments, please check for viruses. Our liability is limited to the re-supply of any affected attachments. Any views expressed in this message are those of the individual sender, except where the sender expressly, and with authority, states them to be the views of the organisation. **********
****
********** *PLEASE NOTE* This email and any attachments may be confidential. If received in error, please delete all copies and advise the sender. The reproduction or dissemination of this email or its attachments is prohibited without the consent of the sender. WARNING RE VIRUSES: Our computer systems sweep outgoing email to guard against viruses, but no warranty is given that this email or its attachments are virus free. Before

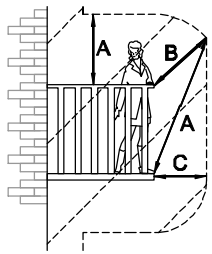
opening or using attachments, please check for viruses. Our liability is limited to the re-supply of any affected attachments. Any views expressed in this message are those of the individual sender, except where the sender expressly, and with authority, states them to be the views of the organisation. ********** ********** *PLEASE NOTE* This email and any attachments may be confidential. If received in error, please delete all copies and advise the sender. The reproduction or dissemination of this email or its attachments is prohibited without the consent of the sender. WARNING RE VIRUSES: Our computer systems sweep outgoing email to guard against viruses, but no warranty is given that this email or its attachments are virus free. Before opening or using attachments, please check for viruses. Our liability is limited to the re-supply of any affected attachments. Any views expressed in this message are those of the individual sender, except where the sender expressly, and with authority, states them to be the views of the organisation. ********** ********** *PLEASE NOTE* This email and any attachments may be confidential. If received in error, please delete all copies and advise the sender. The reproduction or dissemination of this email or its attachments is prohibited without the consent of the sender. WARNING RE VIRUSES: Our computer systems sweep outgoing email to guard against viruses, but no warranty is given that this email or its attachments are virus free. Before opening or using attachments, please check for viruses. Our liability is limited to the re-supply of any affected attachments. Any views expressed in this message are those of the individual sender, except where the sender expressly, and with authority, states them to be the views of the organisation. ********** ********** *PLEASE NOTE* This email and any attachments may be confidential. If received in error, please delete all copies and advise the sender. The reproduction or dissemination of this email or its attachments is prohibited without the consent of the sender. WARNING RE VIRUSES: Our computer systems sweep outgoing email to guard against viruses, but no warranty is given that this email or its attachments are virus free. Before opening or using attachments, please check for viruses. Our liability is limited to the re-supply of any affected attachments. Any views expressed in this message are those of the individual sender, except where the sender expressly, and with authority, states them to be the views of the organisation. ********** ********** *PLEASE NOTE* This email and any attachments may be confidential. If received in error, please delete all copies and advise the sender. The reproduction or dissemination of this email or its attachments is prohibited without the consent of the sender. WARNING RE VIRUSES: Our computer systems sweep outgoing email to guard against viruses, but no warranty is given that this email or its attachments are virus free. Before opening or using attachments, please check for viruses. Our liability is limited to the re-supply of any affected attachments. Any views expressed in this message are those of the individual sender, except where the sender expressly, and with authority, states them to be the views of the organisation. **********











OVERHEAD CONDUCTORS MUST NOT COME WITHIN THE SHADED AREA

TABLE 1 – GROUND CLEARANCE (OTHER THAN INSULATED SERVICE CONDUCTORS)

LOCATION	DISTANCE TO GROUND IN ANY DIRECTION		
	U<1kV	1kV<U<33kV	33kV<U<132kV
OVER LAND WHICH DUE TO ITS STEEPNESS OR SWAMPINESS IS NOT ABLE TO BE TRAVERSED BY VEHICLES.	4.5m	4.5m	5.5m
OVER LAND OTHER THAN THE CARRIAGEWAY OF ROADS.	5.5m (note 4)	5.5m	6.7m
OVER THE CARRIAGEWAY OF MINOR ROADS	6m	6.7m	8m
OVER THE CARRIAGEWAY OF MAJOR ROADS	6.7m (note 5)	6.7m	9m

TABLE 2 – GROUND CLEARANCE (INSULATED SERVICE CONDUCTORS)

LOCATION	DISTANCE TO GROUND IN ANY DIRECTION
OVER THE CENTRE OF A ROAD.	5.5m
OVER ANY OTHER PART OF A ROAD.	4.6m
OVER A FOOTWAY OR LAND THAT IS LIKELY TO BE USED BY HEAVY VEHICLES	4.6m
OVER A FOOTWAY OR LAND THAT IS NORMALLY USED ONLY BY MOTOR CARS OR VEHICLES OF SIMILAR HEIGHT	3.0m
ELSEWHERE.	2.7m

TABLE 3 – CLEARANCE FROM STRUCTURES

	LOCATION	CONDUCTOR					
		U<1kV		U>1kV		1kV<U<33kV	33kV<U<132kV
		INSULATED	BARE	INSULATED WITH EARTHED SCREEN	INSULATED WITHOUT EARTHED SCREEN	BARE or COVERED	BARE
A	VERTICALLY (AND NEAR VERTICALLY), FROM ANY PART OF THE STRUCTURE NORMALLY ACCESSIBLE TO PEOPLE	2.7m	3.7m	2.7m	3.7m	4.6m	5.0m
B	VERTICALLY (AND NEAR VERTICALLY), FROM ANY PART OF THE STRUCTURE NOT NORMALLY ACCESSIBLE TO PEOPLE BUT ON WHICH A PERSON CAN STAND	1.2m	2.7m	2.7m	2.7m	3.7m	4.5m
C	ANY DIRECTION (OTHER THAN VERTICALLY), FROM THOSE PARTS OF THE STRUCTURE NORMALLY ACCESSIBLE TO PERSONS, OR FROM ANY PART NOT NORMALLY ACCESSIBLE TO PERSONS BUT ON WHICH A PERSON COULD STAND.	1.5m (note 3)	2.0m	1.5m	1.5m	2.7m	3.0m
D	ANY DIRECTION (OTHER THAN VERTICALLY), FROM ANY PART OF THE STRUCTURE NOT NORMALLY ACCESSIBLE TO PERSONS.	0.3m (note 3)	1.5m	0.3m	1.5m	2.7m	2.7m
E	ANY DIRECTION, FROM AN OUTDOOR WIRELES OR TELEVISION AERIAL OR PART OF A STAY WIRE FOR THE AERIAL	1.5m	1.5m	1.5m	1.5m	1.5m	2.7m
F	VERTICALLY FROM ANY PART OF A FULLY EXTENDED CLOTHES LINE	1.8m	3.7m	4.6m	4.6m	4.6m	5.5m
G	ANY DIRECTION (OTHER THAN VERTICALLY), FROM ANY PART OF A FULLY EXTENDED CLOTHES LINE	1.8m	3.0m	3.0m	3.0m	3.0m	3.0m

GENERAL NOTES:

1. **THE MINIMUM DISTANCE FROM ANY PART OF AN AERIAL LINE IS TO BE MEASURED FROM THE NEAREST POINT TO WHICH THE LINE SAGS OR SWINGS. FOR SAG THIS IS AT THE MAXIMUM DESIGN OPERATING TEMPERATURE (NORMALLY 65°C FOR DISTRIBUTION LINES and 120°C FOR TRANSMISSION LINES). FOR SWING THIS IS AT THE MAXIMUM DESIGN WIND LOADING (500Pa WIND)**
2. COVERED CONDUCTORS TO BE TREATED AS BARE CONDUCTORS
3. THIS CLEARANCE CAN BE FURTHER REDUCED TO ALLOW FOR TERMINATION AT THE POINT OF ATTACHMENT
4. LOW VOLTAGE CONDUCTORS CONSTRUCTED PRIOR TO 1998 REQUIRE ONLY 4.6m GROUND CLEARANCE OVER LAND OTHER THAN ROADS
5. MAJOR ROADS ARE DEFINED AS ROADS WITH DUAL CARRIAGEWAYS OR 100kph (or GREATER) SPEED LIMIT. ALL OTHER ROADS SHALL BE CONSIDERED AS MINOR ROADS
6. REFER TO DRAWING 3832-020, CLEARANCE REQUIREMENT FOR SWIMMING POOL FROM ELECTRICAL INFRASTRUCTURE.
7. WHERE THERE IS A RISER BRACKET INSTALLED OVER AN EVES OVERHANG ABOVE WINDOW DIMENSION "A" IS NOT APPLICABLE
8. ELECTRICAL POINT OF ATTACHMENT MUST BE ACCESSIBLE AND FREE OF OBSTRUCTION AT ALL TIMES.

No	REVISION	DATE	CKD	AUTH
L	REMOVED POOL REFE, ADDED DECK DETAIL	8/4/15	CD	WC
K	HV CLEARANCE ABOVE MAJOR RD'S REVISED TABLE 1	26/7/07	GA	GA
J	NOTE 1 AMENDED INCLUDE TRANS, LINE DESIGN TEMP.	13/8/03	GA	SF
H	GENERAL NOTE 3 AND POOL NOTE 5 REVISED	1/4/03	GA	GA
M	DRG APPROVED AS CURRENT	24/04/15	CD	WC

ActewAGL
The information contained within this drawing and associated electronic file shall remain the property of ActewAGL and shall not be copied or used for any other purpose without express written permission from ActewAGL. © Copyright ActewAGL 2005.

Drawn:
Designed: A-NNR
Design Approved:
Branch Engineer: G ASTBURY
Branch Manager: F ARGUE

MINIMUM CLEARANCES INSULATED & BARE OVERHEAD CONDUCTORS

Project No:
Work Pack No:
CWA Doc No:

Scale: NTS
Date:
Sheet No:
File:
Tender No:
Status: Current

A3 | 3811-004 | Rev M

CADD File Name: \\SEAPPSPRD38\am\VAULT,D-DRWELECDBP,P-AMCONTEXT_1\Mains\Design_Data\OH\3811_004.dwg
Date Plotted: 15/05/2015 Plot Style: ActewAGL_STD.ctb Plotted by: Pelle, Joseph

From: Paa, Jaime <Jaime.Paa@iconwater.com.au>
Sent: Monday, 1 May 2017 4:12 PM
To: Mulyadi, Linda
Cc: Wickramasinghe, Shane
Subject: RE: Dudley St upgrade - upgrade existing 150 mm water main

Hi Linda,

As discussed, the existing WM from point B to A is DN150 CICL, and B-C is DN150 UNK.
At point C, the DN150 is connected to DN225 UNK WM at Novar St.

Regards,

Jaime Paa
Technical Officer- Hydraulic Asset Acceptance
Asset Assurance and Information

Icon Water
GPO Box 366 Canberra ACT 2601
T 02 6180 6014 **M** 04XX XXX XXX
iconwater.com.au | Twitter | YouTube | LinkedIn

SAFETY ◆ EXCELLENCE ◆ OPENNESS

From: Mulyadi, Linda [mailto:Linda.Mulyadi@aecom.com]
Sent: Monday, 1 May 2017 12:51 PM
To: Paa, Jaime
Cc: Wickramasinghe, Shane
Subject: Dudley St upgrade - upgrade existing 150 mm water main

Hi Jamie,

I tried to call and left a message and thought of sending you an email.

We have been engaged by Procurement and Capital Works (ACT Government) to undertake PSP design of the Access Road to Canberra Brickworks Development and Dudley Street Upgrade. Note that we have been advised the existing 150 mm diameter water main is to be upgraded to a 225 mm on Dudley St is required for the Canberra Brickworks Development.

Thus, we would like to assess in terms of the extent of upgrading required for the water main – please see attached sketch.

We have highlighted in Blue (from point B to point C) being the extent of 150 mm water main require upgrading. We are not sure the size of the water main between point A and point B. Thus, will you be able to clarify this please so that we can either include or exclude the section from point A to B.
Thanks in advance for your time and assistance. Please let me know if there is anything else we need to consider in regards to upgrading 150 mm diameter main.
Please note that I am only in the office on Monday and Tuesday. Please contact Shane if additional information/ clarification is required when I am away.
Thanks again.
Regards,

Linda Mulyadi
Project Engineer
D +61 2 6275 1808
Linda.Mulyadi@aecom.com

AECOM
Level 2, St George Centre, 60 Marcus Clarke Street, Canberra, ACT 2601
PO Box 1942 Canberra City 2601
T +61 2 6201 3000 F +61 2 6201 3099
aecom.com

Built to deliver a better world

LinkedIn Twitter Facebook Instagram

Read insights, share ideas on AECOM's Connected Cities blog.

********** *PLEASE NOTE* This email and any attachments may be confidential. If received in error, please delete all copies and advise the sender. The reproduction or dissemination of this email or its attachments is prohibited without the consent of the sender. WARNING RE VIRUSES: Our computer systems sweep outgoing email to guard against viruses, but no warranty is given that this email or its attachments are virus free. Before opening or using attachments, please check for viruses. Our liability is limited to the re-supply of any affected attachments. Any

views expressed in this message are those of the individual sender, except where the sender expressly, and with authority, states them to be the views of the organisation. **********

From: Paa, Jaime <Jaime.Paa@iconwater.com.au>
Sent: Monday, 1 May 2017 4:13 PM
To: Mulyadi, Linda
Cc: Wickramasinghe, Shane
Subject: RE: Dudley St upgrade - upgrade existing 150 mm water main

Thanks Linda,

Regards,

Jaime Paa
Technical Officer- Hydraulic Asset Acceptance
Asset Assurance and Information

Icon Water
GPO Box 366 Canberra ACT 2601
T 02 6180 6014 **M** 04XX XXX XXX
iconwater.com.au | Twitter | YouTube | LinkedIn

SAFETY ◆ EXCELLENCE ◆ OPENNESS

From: Mulyadi, Linda [mailto:Linda.Mulyadi@aecom.com]
Sent: Monday, 1 May 2017 4:09 PM
To: Paa, Jaime
Cc: Wickramasinghe, Shane
Subject: RE: Dudley St upgrade - upgrade existing 150 mm water main

Hi Jamie,

Thanks for the discussion over the phone.

Just to confirm that the upgrading of the existing 150 mm diameter main will start from point A (at the crossing of existing 225 mm diameter main on Dunrossil Dr) and connect to point C (existing tee junction of 225 mm diameter main).

Thanks again.

Regards,

Linda Mulyadi
Project Engineer
D +61 2 6275 1808
Linda.Mulyadi@aecom.com

AECOM
Level 2, St George Centre, 60 Marcus Clarke Street, Canberra, ACT 2601
PO Box 1942 Canberra City 2601
T +61 2 6201 3000 F +61 2 6201 3099
aecom.com

Built to deliver a better world

LinkedIn Twitter Facebook Instagram

Read insights, share ideas on AECOM's Connected Cities blog.

From: Mulyadi, Linda
Sent: Monday, 1 May 2017 12:51 PM
To: 'Jaime.Paa@iconwater.com.au'
Cc: Wickramasinghe, Shane
Subject: Dudley St upgrade - upgrade existing 150 mm water main

Hi Jamie,

I tried to call and left a message and thought of sending you an email.

We have been engaged by Procurement and Capital Works (ACT Government) to undertake PSP design of the Access Road to Canberra Brickworks Development and Dudley Street Upgrade. Note that we have been advised the existing 150 mm diameter water main is to be upgraded to a 225 mm on Dudley St is required for the Canberra Brickworks Development.

Thus, we would like to assess in terms of the extent of upgrading required for the water main – please see attached sketch.

We have highlighted in Blue (from point B to point C) being the extent of 150 mm water main require upgrading. We are not sure the size of the water main between point A and point B. Thus, will you be able to clarify this please so that we can either include or exclude the

section from point A to B.
Thanks in advance for your time and assistance. Please let me know if there is anything else we need to consider in regards to upgrading 150 mm diameter main.
Please note that I am only in the office on Monday and Tuesday. Please contact Shane if additional information/ clarification is required when I am away.
Thanks again.
Regards,

Linda Mulyadi
Project Engineer
D +61 2 6275 1808
Linda.Mulyadi@aecom.com

AECOM
Level 2, St George Centre, 60 Marcus Clarke Street, Canberra, ACT 2601
PO Box 1942 Canberra City 2601
T +61 2 6201 3000 F +61 2 6201 3099
aecom.com

Built to deliver a better world

LinkedIn Twitter Facebook Instagram

Read insights, share ideas on AECOM's Connected Cities blog.

********** *PLEASE NOTE* This email and any attachments may be confidential. If received in error, please delete all copies and advise the sender. The reproduction or dissemination of this email or its attachments is prohibited without the consent of the sender. WARNING RE VIRUSES: Our computer systems sweep outgoing email to guard against viruses, but no warranty is given that this email or its attachments are virus free. Before opening or using attachments, please check for viruses. Our liability is limited to the re-supply of any affected attachments. Any views expressed in this message are those of the individual sender, except where the sender expressly, and with authority, states them to be the views of the organisation. **********

From: Mulyadi, Linda
Sent: Tuesday, 16 May 2017 9:37 AM
To: Jim Dawson
Cc: Wickramasinghe, Shane
Subject: RE: Dudley Street Upgrade - impacted gas main

Hi Jim,

Hope you are well.

Just wondering whether you manage to have a look at the estimate for the relocation works for the project.

Thanks.

Regards,

Linda Mulyadi
Project Engineer
D +61 2 6275 1808
Linda.Mulyadi@aecom.com

AECOM
Level 2, St George Centre, 60 Marcus Clarke Street, Canberra, ACT 2601
PO Box 1942 Canberra City 2601
T +61 2 6201 3000 F +61 2 6201 3099
aecom.com

Built to deliver a better world

LinkedIn Twitter Facebook Instagram

Read insights, share ideas on AECOM's Connected Cities blog.

From: Mulyadi, Linda
Sent: Monday, 1 May 2017 3:31 PM
To: 'Jim Dawson'
Cc: Wickramasinghe, Shane
Subject: RE: Dudley Street Upgrade - impacted gas main

Hi Jim,

Thanks for this and nice chatting with you as well.

I marked up the plan you sent to show the extent of relocation, which is around 260 m – see attached.

The typical section is looking east (toward Kent St/Novar St)

Thanks again Jim.

Regards,

Linda Mulyadi
Project Engineer
D +61 2 6275 1808
Linda.Mulyadi@aecom.com

AECOM
Level 2, St George Centre, 60 Marcus Clarke Street, Canberra, ACT 2601
PO Box 1942 Canberra City 2601
T +61 2 6201 3000 F +61 2 6201 3099
aecom.com

Built to deliver a better world

LinkedIn Twitter Facebook Instagram

Read insights, share ideas on AECOM's Connected Cities blog.

From: Jim Dawson [mailto:James.Dawson@zinfra.com.au]
Sent: Monday, 1 May 2017 3:24 PM
To: Mulyadi, Linda
Cc: Wickramasinghe, Shane
Subject: RE: Dudley Street Upgrade - impacted gas main

G'day Linda,

Nice catching up..

Now, can you red-pen the attached to show the extent of relocation.

I'll give you an estimate for this work as soon as I can.
The main at the other end can remain in situ without protection.

Doh!, I've forgotten.
was your cross-section looking west, or east?

Regards

Jim Dawson
Construction Project Planner

Ph: 61926227
E: james.dawson@zinfra.com.au

Zinfra

5-7 Johns Place
HUME ACT 2620

From: Mulyadi, Linda [mailto:Linda.Mulyadi@aecom.com]
Sent: Monday, 1 May 2017 10:57 AM
To: Jim Dawson
Cc: Wickramasinghe, Shane
Subject: Dudley Street Upgrade - impacted gas main

Hi Jim,

I would like to discuss with you regarding impacted 63 mm diameter PE gas main located on the existing northern verge of Dudley Street (see attached sketch).

To provide you with a background, AECOM has been engaged by Procurement and Capital Works (ACT Government) to undertake PSP design of the Access Road to Canberra Brickworks Development and Dudley Street Upgrade. Note that we have been advised no gas connection to Dudley St is required for the Canberra Brickworks Development.

There are two areas where the 63 mm PE gas main is impacted:

1. Area 1 – western end – closer to Cotter Road
    - In this area, the gas main will be located in fill section of the realigned Dudley St.
    - An increased cover to the existing main (varying depth) up to 2 m high. Approximate length of gas main located in fill is around 100 m.
    - Please advise whether there is any protection required for the additional fill.
    - If yes to protection:
        - what is the maximum fill it can be added over to the existing main with no protection.
        - Any typical section for the protection measure
2. Area 2 – eastern end – closer to Novar St/Kent St
    - In this area, the gas main will be located in cut section of the realigned Dudley St.
    - It is proposed for the gas main to be relocated. Approximate relocation length is about 260 m.
    - Typical section of Dudley St showing the realigned gas main is included in the attached sketch. Please confirm/ comment on the acceptability of this cross section.
    - Please advise on the approximate relocation costs by Zinfra, assuming that the civil contractor will provide the trench and backfilling.

Thanks in advance for your time and assistance. Please let me know if there is anything else we need to consider in regards to the gas main.
Please note that I am only in the office on Monday and Tuesday. Please contact Shane if additional information/ clarification is required when I am away.
Thanks again.
Regards,

Linda Mulyadi
Project Engineer
D +61 2 6275 1808
Linda.Mulyadi@aecom.com

AECOM
Level 2, St George Centre, 60 Marcus Clarke Street, Canberra, ACT 2601

PO Box 1942 Canberra City 2601
T +61 2 6201 3000 F +61 2 6201 3099
aecom.com

Built to deliver a better world

LinkedIn Twitter Facebook Instagram

Read insights, share ideas on AECOM's Connected Cities blog.

********** This is a confidential message intended for the named recipient(s) only. The contents herein are privileged to the sender and the use thereof is restricted to the intended purpose. If you have received this e-mail in error, please do not use, disclose, distribute, copy, print or relay on this email. If receipt is in error, please advise the sender by reply email. Thank you.
****

From: Wayne Read <w.read@staff.iinet.net.au>
Sent: Tuesday, 24 January 2017 11:46 AM
To: Nam, Justin
Cc: Mulyadi, Linda; Christiaan Theron
Subject: RE: Request for iinet infrastructure advice - Canberra Brickworks Precinct

Hi Nam,
On previous projects:
In the first year after installation, where the developers have provided trenching underneath the footpath, the developer has experienced a 25% failure rate of the footpath and had to remediate the iiNet pits at their cost.

iiNet preference is not to place pits into footpaths unless it is the absolute last resort.

Regards
Wayne

Wayne Read
Design Manager

iinet
connect better
www.iinet.net.au

470 Northbourne Avenue Dickson ACT 2602
Phone: 02 62298072
email: w.read@staff.iinet.net.au
Follow us on

From: Nam, Justin [mailto:Justin.Nam@aecom.com]
Sent: Monday, 23 January 2017 2:05 PM
To: Wayne Read
Cc: Mulyadi, Linda; Christiaan Theron
Subject: RE: Request for iinet infrastructure advice - Canberra Brickworks Precinct

Hey Wayne,

Thank you for your comments regarding the shared trench for CBP and Dudley Street Road Upgrade. We are currently looking at the alignment of the shared trench and exploring options, one of the options is to have the shared trench underneath a footpath due to the restrictions experienced in the verge. Could you please provide your comments regarding this shared trench alignment? Are there any requirements that we need to know about regarding this matter?

Thank you,

Justin Nam
Graduate Civil Engineer
D +61 2 6201 3036
Justin.Nam@aecom.com

AECOM
Level 2, St George Centre, 60 Marcus Clarke Street, Canberra, ACT 2601
PO Box 1942 Canberra City 2601
T +61 2 6201 3000 F +61 2 6201 3099
aecom.com

Built to deliver a better world

LinkedIn Twitter Facebook Instagram

Read insights, share ideas on AECOM's Connected Cities blog.

From: Wayne Read [mailto:w.read@staff.iinet.net.au]
Sent: Monday, 23 January 2017 7:23 AM
To: Nam, Justin
Cc: Mulyadi, Linda; Christiaan Theron
Subject: RE: Request for iinet infrastructure advice - Canberra Brickworks Precinct

Hi Nam,
iiNet appreciates the opportunity to provide comment for this precinct.

- whether iiNet connection into the CBP is required?

Yes. An iiNet connection into CBP is required

- Requirement for iiNet conduits in this shared trench to facilitate future iiNet connection into the proposed CBP development

Yes. Please include iiNet in the proposed shared trench for this development

- general comments regarding connections and design/construction requirements

Pit and pit would be required in the proposed shared trenches
The developer is to contact iiNet at the detailed design stage for the access road, upgrade to Dudley Street and the CBP development.

Please don't hesitate to contact iiNet should further information be required

Kind Regards

Wayne

Wayne Read
Design Manager

iinet
connect better
www.iinet.net.au

470 Northbourne Avenue Dickson ACT 2602
Phone: 02 62298072
email: w.read@staff.iinet.net.au

Follow us on

From: Nam, Justin [mailto:Justin.Nam@aecom.com]
Sent: Thursday, 19 January 2017 1:50 PM
To: Wayne Read
Cc: Mulyadi, Linda
Subject: Request for iinet infrastructure advice - Canberra Brickworks Precinct

Hey Wayne,

We have recently been engaged by the Economic Development Directorate (EDD) to review the current utilities for the development of a new Access Road and road upgrade of Dudley Street for the proposed Canberra Brickworks Precinct (CBP) development .

The proposed development is as per the attached plan. At the moment, there have not been any development yields and plans for the CBP but the available information that we have so far are:

- The CBP could be developed with up to 380 residential dwellings
- CBP will be accessible via two access roads (one including the proposed access road connecting into Dudley Street).

Based on the information provided, could you please comment on the following:

- From the information provided regarding the CBP and the road upgrade of Dudley Street and Access Road into CBP, could you please provide comments on whether iiNet connection into the CBP is required?
- If so, there are planned shared trenching proposed on the verge of the Access Road and upgraded Dudley Street. Is there a requirement for iiNet conduits in this shared trench to facilitate future iiNet connection into the proposed CBP development?
- Provide general comments regarding connections and design/construction requirements for iiNet infrastructure.

It would be much appreciated if you could provide a response to this as soon as possible due to the timeframe of this project. Thank you in advance for your advice.

Regards,

Justin Nam
Graduate Civil Engineer
D +61 2 6201 3036
Justin.Nam@aecom.com

AECOM
Level 2, St George Centre, 60 Marcus Clarke Street, Canberra, ACT 2601
PO Box 1942 Canberra City 2601
T +61 2 6201 3000 F +61 2 6201 3099
aecom.com

Built to deliver a better world

LinkedIn Twitter Facebook Instagram

Read insights, share ideas on AECOM's Connected Cities blog.

From: DBYD Government Fibre <dbydgovfibre@commencecomms.com.au>
Sent: Wednesday, 18 January 2017 11:09 AM
To: craig.richardson@finance.gov.au; 'Brenner, Karl'
Cc: Nam, Justin; Mulyadi, Linda
Subject: Request for ICON infrastructure - Canberra Brickworks Precinct Access Road and Dudley Street Road Upgrade
Attachments: DBYD Seq 58023661 and 58023662 Gov Fibre Optic - onsite booking required - please call.pdf; Affected Icon Infrastructure.pdf

Hi Craig and Karl,

Can you please take a look at the below request from Justin Nam at AECOM and respond with any requirements in regards to the ICON infrastructure?

Justin, it's best to liase direct with the Department of Finance on these types of requests as they can advise on any special requirements. If you need to speak to Craig or Karl, you can call them on 02 6215 1894.

Kind regards

Donna Wullaert

P: 02 6226 3869
M: 0410 469 989
E: admin@commencecomms.com.au
W: www.commencecomms.com.au
The experts in underground service locating

.

From: Nam, Justin [mailto:Justin.Nam@aecom.com]
Sent: Wednesday, 18 January 2017 10:37 AM
To: dbydgovfibre@commencecomms.com.au
Cc: Mulyadi, Linda <Linda.Mulyadi@aecom.com>
Subject: Request for ICON infrastructure - Canberra Brickworks Precinct Access Road and Dudley Street Road Upgrade

Hi Commence Communications,

We have recently been engaged by the Economic Development Directorate (EDD) to review the current utilities for the development of a new access road and road upgrade for the proposed Canberra Brickworks Precinct development .

The proposed development is as per the attached plan. The DBYD is also attached for your reference. The affected Icon infrastructure are highlighted for your information.

Based on the attached information, could you please comment on the following:

- The proposed road upgrade will require a widening and possible reseal of the existing road (Dudley Street). As seen in the attached plan, Icon infrastructure is currently extending across Dudley Street which is affected by the proposed road upgrade. Could you please advise us if there are any requirements that we may need to consider when undertaking the road upgrade on top of existing Icon infrastructure (design and construction)?

It would be much appreciated if you could provide a response to this as soon as possible due to the timeframe of this project. Thank you in advance for your advice.

Kind Regards,

Justin Nam
Graduate Civil Engineer
D +61 2 6201 3036
Justin.Nam@aecom.com

AECOM
Level 2, St George Centre, 60 Marcus Clarke Street, Canberra, ACT 2601
PO Box 1942 Canberra City 2601
T +61 2 6201 3000 F +61 2 6201 3099
aecom.com

Built to deliver a better world

LinkedIn Twitter Facebook Instagram

Read insights, share ideas on AECOM's Connected Cities blog.

DRAFT

Appendix F

D R A F T

Appendix F – Site Visit Notes (Utilities)

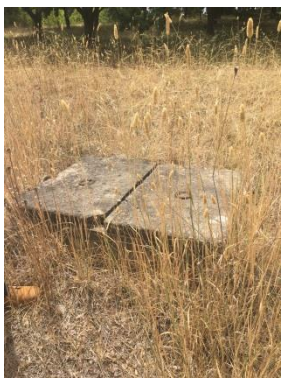
Site Visit - Dudley Street

Sheet	Asset	Location	Condition	Comment
Sheet 1 (# 10-0000-CA-0001)	1. Communications Pit	Northern Verge of Dudley Street	Good/Reasonable	No indication of any damage
	2. Overhead HV line	Southern Verge of Dudley Street (Looking towards Cotter Road) – Pole #67767	Good	Boring between Pole #67767 and #62980 may be required if clearances are not met.
	3. Stormwater Sump (North)	Northern Kerb Line of Dudley Street	Condition and operation of stormwater sump and line is unknown.	Further investigation needed to check whether it is decommissioned or damaged.
	Stormwater Sump (South)	Southern Kerb Line of Dudley Street	Condition and operation of stormwater sump and line is unknown.	Further investigation needed to check whether it is decommissioned or damaged.
Sheet 2 (# 10-0000-CA-0002)	1. Communications Pit	Northern Verge of Dudley	Good/Reasonable	Second communications

Sheet	Asset	Location	Condition	Comment
		Street.		Pit shown on plan (north of this respective pit) could not be located. Long patches of grass found in this area – protected species of Golden Sun Moths.
	2. 750mm diameter culvert 	Southern Verge side of Dudley Street culvert	Reasonable – long grass/vegetation covering the exit of the culvert.	
	3. Gas Line			White pegs found in this area could potentially indicate where the gas main/easement lies. Location unknown.
Sheet 3 (# 10-0000-CA-0003)	1. Communications Pit	Northern verge of Dudley Street.	Telecommunication pit lid slightly damaged upon visual inspection.	Large communications pit indicated on plan could not be located on site. Questions raised over this pits existence.

Sheet	Asset	Location	Condition	Comment
	 2. High Pressure Gas Message Sign	Northern Verge of Dudley Street.	Reasonable	
	 3. Survey Mark 	Northern Verge of Dudley Street.	Good/Reasonable	
Sheet 4 (# 10-0000-CA-0004)	1. Hydrant	Northern Verge of Dudley Street	Good	

Sheet	Asset	Location	Condition	Comment
	2. Overhead Electricity Poles/Powerlines	Northern Verge of Dudley Street.	Good	
	3. Hydrant	Northern Verge of Dudley Street.	Condition is unknown – hydrant cover is not attached	

Sheet	Asset	Location	Condition	Comment
Sheet 5 (# 10-0000-CA-0005)	1. Hydrant	Northern Verge of Dudley Street	Good/Reasonable	
Sheet 6 (# 10-0000-CA-0006)	1. Communications Pits x 2 	Northern Verge of Dudley Street.	Condition unknown – unsure whether decommissioned. Further investigation is required.	Significant rocks are found within this area around Dudley Street.
	2. Overhead HV line	Northern Verge of Dudley Street towards the CBP.	Good	This pole may need to relocated or upgraded into an underground electricity service line.

DRAFT

Appendix G

D R A F T

Appendix G – Design Traffic Calculations

Dudley Street (Access Road)

Road Classification: Minor Collector Road

Year	AADT (based on AM peak)	AADT- Adopted	Assumed Growth (%)	Projected AADT	Yearly Total Traffic	Assumed HCV (%)	Assumed ESA/HV	Directional Factor	ESAs per year	Assumptions
2011					-	5%	1.8	0.5		
2012					-	5%	1.8	0.5		
2013					-	5%	1.8	0.5		
2014					-	5%	1.8	0.5		
2015				-	-	5%	1.8	0.5		
2016				-	-	5%	1.8	0.5		
2017				-	-	5%	1.8	0.5		
2018	0	0	-	-	-	5%	1.8	0.5	-	Commence construction of access road and new developments.
2019	1200	1200		1,200	438,000	5%	1.8	0.5	19,710	Development is assumed to be progressed linearly until 2021. 5% HVC is assumed due to construction traffic.
2020	2400	2400		2,400	876,000	5%	1.8	0.5	39,420	
2021	3490	3,490	0.00%	3,490	1,273,850	5%	1.8	0.5	57,323	
2022			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	Assume CBP is fully Developed i.e. no more growth in traffic . %HCV is assumed to be 3%
2023			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2024			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2025			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2026			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2027			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2028			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	Reduction to 3% due to developments being finished approximately after 10 years
2029			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2030			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2031		3,490	0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2032			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2033			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2034			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2035			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2036			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2037			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
						Design Traffic			**6.67.E+05**	Between 2018 to 2037
						Minimum Design ESA for Minor Collector Road (DS6)			**1.00E+05**	Design Standards 6 - Minor Collector Roads (no buses) = 1 x 10^5
						Adopted Design ESA			**6.67E+05**	
						Rounded Design ESA				6.67E+05

Dudley Street - Near Cotter

Road Classification: Major Collector Road

Year	AADT (based on AM peak)	AADT- Adopted	Assumed Growth (%)	Projected AADT	Yearly Total Traffic	Assumed HCV (%)	Assumed ESA/HV	Directional Factor	ESAs per year	Assumptions
2011				-	-	5%	1.8	0.5		
2012				-	-	5%	1.8	0.5		
2013				-	-	5%	1.8	0.5		
2014				-	-	5%	1.8	0.5		
2015	9650	9650	4.71%	9,650	3,522,250	5%	1.8	0.5		AADT data from Ed (Brendan's email) for 2015 - Weekday Average (VPD): 4741 (Cotter) + 4885 (Novar) = 9626 (round to nearest 50 - thus, adopt 9650)
2016				10,105	3,688,192	5%	1.8	0.5		
2017				10,581	3,861,951	5%	1.8	0.5		
2018				11,079	4,043,897	5%	1.8	0.5	181,975	Assume construction commences within 6 - 12 months from April 2017 (thus, construction commences in 2018) Adopted 5% due to new developments occuring.
2019				11,601	4,234,415	5%	1.8	0.5	190,549	
2020				12,148	4,433,908	5%	1.8	0.5	199,526	
2021	12720	12,720	2.00%	12,720	4,642,800	5%	1.8	0.5	208,926	Predictions from Brendan for 2017 - treated as 2021 - 2% growth rate as indicative and conservative.
2022				12,974	4,735,656	3%	1.8	0.5	127,863	Reduction to 3% due to developments being finished
2023				13,234	4,830,369	3%	1.8	0.5	130,420	
2024				13,499	4,926,977	3%	1.8	0.5	133,028	
2025				13,769	5,025,516	3%	1.8	0.5	135,689	
2026				14,044	5,126,026	3%	1.8	0.5	138,403	
2027				14,325	5,228,547	3%	1.8	0.5	141,171	
2028				14,611	5,333,118	3%	1.8	0.5	143,994	
2029				14,904	5,439,780	3%	1.8	0.5	146,874	
2030				15,202	5,548,576	3%	1.8	0.5	149,812	
2031		15,202	0.50%	15,506	5,659,547	3%	1.8	0.5	152,808	0.50% growth rate adopted due to limited available information.
2032				15,583	5,687,845	3%	1.8	0.5	153,572	
2033				15,661	5,716,284	3%	1.8	0.5	154,340	
2034				15,739	5,744,866	3%	1.8	0.5	155,111	
2035				15,818	5,773,590	3%	1.8	0.5	155,887	
2036				15,897	5,802,458	3%	1.8	0.5	156,666	
2037				15,977	5,831,470	3%	1.8	0.5	157,450	
						Design Traffic			**3.11.E+06**	Between 2018 to 2037
						Minimum Design ESA for Major Collector Roads [with buses] (DS6)			**1.00E+06**	From Design Standards 6 - Pavements: Design Traffic for Major Collector Roads (with buses) - 1 x 10^6
						Adopted Design ESA			**3.11E+06**	
						Rounded Design ESA				3.11E+06

Dudley Street (Novar Street)

Road Classification: Major Collector Road

Year	AADT (based on AM peak)	AADT- Adopted	Assumed Growth (%)	Projected AADT	Yearly Total Traffic	Assumed HCV (%)	Assumed ESA/HV	Directional Factor	ESAs per year	Assumptions
2011				-	-	5%	1.8	0.5		
2012				-	-	5%	1.8	0.5		
2013				-	-	5%	1.8	0.5		
2014				-	-	5%	1.8	0.5		
2015	9650	9650	3.57%	9,650	3,522,250	5%	1.8	0.5		AADT data from Ed (Brendan's email) for 2015 - Weekday Average (VPD): 4741 (Cotter) + 4885 (Novar) = 9626 (round to nearest 50 - thus, adopt 9650)
2016				9,994	3,647,967	5%	1.8	0.5		
2017				10,351	3,778,171	5%	1.8	0.5		
2018				10,721	3,913,023	5%	1.8	0.5	176,086	Assume construction commences within 6 - 12 months from April 2017 (thus, construction commences in 2018) Adopted 5% due to new developments occuring.
2019				11,103	4,052,688	5%	1.8	0.5	182,371	
2020				11,500	4,197,337	5%	1.8	0.5	188,880	
2021	11910	11,910	2.00%	11,910	4,347,150	5%	1.8	0.5	195,622	Predictions from Brendan for 2017 - treated as 2021 - 2% growth rate as indicative and conservative.
2022				12,148	4,434,093	3%	1.8	0.5	119,721	Reduction to 3% due to developments being finished
2023				12,391	4,522,775	3%	1.8	0.5	122,115	
2024				12,639	4,613,230	3%	1.8	0.5	124,557	
2025				12,892	4,705,495	3%	1.8	0.5	127,048	
2026				13,150	4,799,605	3%	1.8	0.5	129,589	
2027				13,413	4,895,597	3%	1.8	0.5	132,181	
2028				13,681	4,993,509	3%	1.8	0.5	134,825	
2029				13,954	5,093,379	3%	1.8	0.5	137,521	
2030				14,234	5,195,247	3%	1.8	0.5	140,272	
2031		14,234	0.50%	14,518	5,299,152	3%	1.8	0.5	143,077	0.50% growth rate adopted due to limited available information.
2032				14,591	5,325,647	3%	1.8	0.5	143,792	
2033				14,664	5,352,276	3%	1.8	0.5	144,511	
2034				14,737	5,379,037	3%	1.8	0.5	145,234	
2035				14,811	5,405,932	3%	1.8	0.5	145,960	
2036				14,885	5,432,962	3%	1.8	0.5	146,690	
2037				14,959	5,460,127	3%	1.8	0.5	147,423	
						Design Traffic			**2.93.E+06**	Between 2018 to 2037
						Minimum Design ESA for Major Collector Roads [with buses] (DS6)			**1.00E+06**	From Design Standards 6 - Pavements: Design Traffic for Major Collector Roads (with buses) - 1 x 10^6
						Adopted Design ESA			**2.93E+06**	
						Rounded Design ESA				2.93E+06

Dudley Street (Access Road)

Year	AADT (based on AM peak)	AADT- Adopted	Assumed Growth (%)	Projected AADT	Yearly Total Traffic	Assumed HCV (%)	Assumed ESA/HV	Directional Factor	ESAs per year	Assumptions
2011					-	5%	1.8	0.5		
2012					-	5%	1.8	0.5		
2013					-	5%	1.8	0.5		
2014					-	5%	1.8	0.5		
2015				-	-	5%	1.8	0.5		
2016				-	-	5%	1.8	0.5		
2017				-	-	5%	1.8	0.5		
2018	0	0	-	-	-	5%	1.8	0.5	-	Commence construction of access road and new developments.
2019	1163.333333	1163.333333		1,163	424,617	5%	1.8	0.5	19,108	Development is assumed to be progressed linearly until 2021. 5% HVC is assumed due to construction traffic.
2020	2326.666667	2326.666667		2,327	849,233	5%	1.8	0.5	38,216	
2021	3490	3,490	0.00%	3,490	1,273,850	5%	1.8	0.5	57,323	
2022			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	Assume CBP is fully Developed i.e. no more growth in traffic . %HCV is assumed to be 3%
2023			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2024			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2025			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2026			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2027			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2028			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	Reduction to 3% due to developments being finished approximately after 10 years
2029			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2030			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2031		3,490	0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2032			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2033			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2034			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2035			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2036			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2037			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2038			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2039			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2040			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2041			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2042			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2043			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2044			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2045			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2046			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2047			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2048			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2049			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2050			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2051			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2052			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2053			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2054			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2055			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2056			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
2057			0.00%	3,490	1,273,850	3%	1.8	0.5	34,394	
						Design Traffic			**1.35.E+06**	Between 2018 to 2057
						Minimum Design ESA for Minor Collector Road (DS6)			**1.00E+05**	Design Standards 6 - Minor Collector Roads (no buses) = 1 x 10^5
						Adopted Design ESA			**1.35E+06**	
						Rounded Design ESA				1.35E+06

Dudley Street - Near Cotter

Year	AADT (based on AM peak)	AADT- Adopted	Assumed Growth (%)	Projected AADT	Yearly Total Traffic	Assumed HCV (%)	Assumed ESA/HV	Directional Factor	ESAs per year	Assumptions
2011				-	-	5%	1.8	0.5		
2012				-	-	5%	1.8	0.5		
2013				-	-	5%	1.8	0.5		
2014				-	-	5%	1.8	0.5		
2015	9650	9650	4.71%	9,650	3,522,250	5%	1.8	0.5		AADT data from Ed (Brendan's email) for 2015 - Weekday Average (VPD): 4741 (Cotter) + 4885 (Novar) = 9626 (round to nearest 50 - thus, adopt 9650)
2016				10,105	3,688,192	5%	1.8	0.5		
2017				10,581	3,861,951	5%	1.8	0.5		
2018				11,079	4,043,897	5%	1.8	0.5	181,975	Assume construction commences within 6 - 12 months from April 2017 (thus, construction commences in 2018) Adopted 5% due to new developments occuring.
2019				11,601	4,234,415	5%	1.8	0.5	190,549	
2020				12,148	4,433,908	5%	1.8	0.5	199,526	
2021	12720	12,720	2.00%	12,720	4,642,800	5%	1.8	0.5	208,926	Predictions from Brendan for 2017 - treated as 2021 - 2% growth rate as indicative and conservative.
2022				12,974	4,735,656	3%	1.8	0.5	127,863	Reduction to 3% due to developments being finished
2023				13,234	4,830,369	3%	1.8	0.5	130,420	
2024				13,499	4,926,977	3%	1.8	0.5	133,028	
2025				13,769	5,025,516	3%	1.8	0.5	135,689	
2026				14,044	5,126,026	3%	1.8	0.5	138,403	
2027				14,325	5,228,547	3%	1.8	0.5	141,171	
2028				14,611	5,333,118	3%	1.8	0.5	143,994	
2029				14,904	5,439,780	3%	1.8	0.5	146,874	
2030				15,202	5,548,576	3%	1.8	0.5	149,812	
2031		15,202	0.50%	15,506	5,659,547	3%	1.8	0.5	152,808	0.50% growth rate adopted due to limited available information.
2032				15,583	5,687,845	3%	1.8	0.5	153,572	
2033				15,661	5,716,284	3%	1.8	0.5	154,340	
2034				15,739	5,744,866	3%	1.8	0.5	155,111	
2035				15,818	5,773,590	3%	1.8	0.5	155,887	
2036				15,897	5,802,458	3%	1.8	0.5	156,666	
2037				15,977	5,831,470	3%	1.8	0.5	157,450	
2038				16,057	5,860,628	3%	1.8	0.5	158,237	
2039				16,137	5,889,931	3%	1.8	0.5	159,028	
2040				16,217	5,919,380	3%	1.8	0.5	159,823	
2041				16,299	5,948,977	3%	1.8	0.5	160,622	
2042				16,380	5,978,722	3%	1.8	0.5	161,425	
2043				16,462	6,008,616	3%	1.8	0.5	162,233	
2044				16,544	6,038,659	3%	1.8	0.5	163,044	
2045				16,627	6,068,852	3%	1.8	0.5	163,859	
2046				16,710	6,099,196	3%	1.8	0.5	164,678	
2047				16,794	6,129,692	3%	1.8	0.5	165,502	
2048				16,878	6,160,341	3%	1.8	0.5	166,329	
2049				16,962	6,191,143	3%	1.8	0.5	167,161	
2050				17,047	6,222,098	3%	1.8	0.5	167,997	
2051				17,132	6,253,209	3%	1.8	0.5	168,837	
2052				17,218	6,284,475	3%	1.8	0.5	169,681	
2053				17,304	6,315,897	3%	1.8	0.5	170,529	
2054				17,390	6,347,477	3%	1.8	0.5	171,382	
2055				17,477	6,379,214	3%	1.8	0.5	172,239	
2056				17,565	6,411,110	3%	1.8	0.5	173,100	
2057				17,653	6,443,166	3%	1.8	0.5	173,965	
						Design Traffic			**6.43.E+06**	Between 2018 to 2057
						Minimum Design ESA for Major Collector Roads [with buses] (DS6)			**1.00E+06**	From Design Standards 6 - Pavements: Design Traffic for Major Collector Roads (with buses) - 1 x 10^6
						Adopted Design ESA			**6.43E+06**	
						Rounded Design ESA				6.43E+06

Dudley Street (Novar Street)

Year	AADT (based on AM peak)	AADT- Adopted	Assumed Growth (%)	Projected AADT	Yearly Total Traffic	Assumed HCV (%)	Assumed ESA/HV	Directional Factor	ESAs per year	Assumptions
2011				-	-	5%	1.8	0.5		
2012				-	-	5%	1.8	0.5		
2013				-	-	5%	1.8	0.5		
2014				-	-	5%	1.8	0.5		
2015	9650	9650	3.57%	9,650	3,522,250	5%	1.8	0.5		AADT data from Ed (Brendan's email) for 2015 - Weekday Average (VPD): 4741 (Cotter) + 4885 (Novar) = 9626 (round to nearest 50 - thus, adopt 9650)
2016				9,994	3,647,967	5%	1.8	0.5		
2017				10,351	3,778,171	5%	1.8	0.5		
2018				10,721	3,913,023	5%	1.8	0.5	176,086	Assume construction commences within 6 - 12 months from April 2017 (thus, construction commences in 2018) Adopted 5% due to new developments occuring.
2019				11,103	4,052,688	5%	1.8	0.5	182,371	
2020				11,500	4,197,337	5%	1.8	0.5	188,880	
2021	11910	11,910	2.00%	11,910	4,347,150	5%	1.8	0.5	195,622	Predictions from Brendan for 2017 - treated as 2021 - 2% growth rate as indicative and conservative.
2022				12,148	4,434,093	3%	1.8	0.5	119,721	Reduction to 3% due to developments being finished
2023				12,391	4,522,775	3%	1.8	0.5	122,115	
2024				12,639	4,613,230	3%	1.8	0.5	124,557	
2025				12,892	4,705,495	3%	1.8	0.5	127,048	
2026				13,150	4,799,605	3%	1.8	0.5	129,589	
2027				13,413	4,895,597	3%	1.8	0.5	132,181	
2028				13,681	4,993,509	3%	1.8	0.5	134,825	
2029				13,954	5,093,379	3%	1.8	0.5	137,521	
2030				14,234	5,195,247	3%	1.8	0.5	140,272	
2031		14,234	0.50%	14,518	5,299,152	3%	1.8	0.5	143,077	0.50% growth rate adopted due to limited available information.
2032				14,591	5,325,647	3%	1.8	0.5	143,792	
2033				14,664	5,352,276	3%	1.8	0.5	144,511	
2034				14,737	5,379,037	3%	1.8	0.5	145,234	
2035				14,811	5,405,932	3%	1.8	0.5	145,960	
2036				14,885	5,432,962	3%	1.8	0.5	146,690	
2037				14,959	5,460,127	3%	1.8	0.5	147,423	
2038				15,034	5,487,427	3%	1.8	0.5	148,161	
2039				15,109	5,514,864	3%	1.8	0.5	148,901	
2040				15,185	5,542,439	3%	1.8	0.5	149,646	
2041				15,261	5,570,151	3%	1.8	0.5	150,394	
2042				15,337	5,598,002	3%	1.8	0.5	151,146	
2043				15,414	5,625,992	3%	1.8	0.5	151,902	
2044				15,491	5,654,122	3%	1.8	0.5	152,661	
2045				15,568	5,682,392	3%	1.8	0.5	153,425	
2046				15,646	5,710,804	3%	1.8	0.5	154,192	
2047				15,724	5,739,358	3%	1.8	0.5	154,963	
2048				15,803	5,768,055	3%	1.8	0.5	155,737	
2049				15,882	5,796,895	3%	1.8	0.5	156,516	
2050				15,961	5,825,880	3%	1.8	0.5	157,299	
2051				16,041	5,855,009	3%	1.8	0.5	158,085	
2052				16,121	5,884,284	3%	1.8	0.5	158,876	
2053				16,202	5,913,706	3%	1.8	0.5	159,670	
2054				16,283	5,943,274	3%	1.8	0.5	160,468	
2055				16,364	5,972,991	3%	1.8	0.5	161,271	
2056				16,446	6,002,855	3%	1.8	0.5	162,077	
2057				16,528	6,032,870	3%	1.8	0.5	162,887	
						Design Traffic			**6.04.E+06**	Between 2018 to 2057
						Minimum Design ESA for Arterial Road (DS6)			**1.00E+06**	From Design Standards 6 - Pavements: Design Traffic for Major Collector Roads (with buses) - 1 x 10^6
						Adopted Design ESA			**6.04E+06**	
						Rounded Design ESA				6.04E+06

DRAFT

Appendix H

D R A F T

Appendix H – Full Depth Asphalt Calculations (CIRCLY)

CIRCLY Version 5.1c (15 January 2015)

Layer no. 1 is INCLUDED in max. CDF calculation
Layer no. 2 is INCLUDED in max. CDF calculation
Layer no. 4 is INCLUDED in max. CDF calculation
Layer no. 5 is INCLUDED in max. CDF calculation
Job Title: Dudley St FDA

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: 3_1e6 Title: 3.1e6 ESA

Load No.	Load ID	Movements
1	ESA75-Full	3.10E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius Ref. stress	Pressure/	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: DudleyFD Title: Dudlley FDA

Layer No.	Lower i/face	Material ID	Isotropy (or Ev)	Modulus (or vvh)	P.Ratio F	Eh	vh
1	rough	CBR_AC14	Iso.	4.00E+03	0.40		
2	rough	CBR_AC20	Iso.	4.00E+03	0.40		
3	rough	Gran_150	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
4	rough	subsltCB6	Aniso.	6.00E+01	0.45	4.14E+01	3.00E+01	0.45
5	rough	Sub_CBR3	Aniso.	3.00E+01	0.45	2.07E+01	1.50E+01	0.45

Performance Relationships:

Layer	Location	Performance	Component	Perform.	Perform.	Traffic

No.	ID		Constant	Exponent	Multiplier
1	bottom	CBR14 ETH	0.003667	5.000	1.200
2	bottom	CBR20 ETH	0.003547	5.000	1.200
4	top	selAus2004 EZZ	0.009300	7.000	1.600
5	top	Sub_2004 EZZ	0.009300	7.000	1.600

Reliability Factors: Not Used.

Details of Layers to be sublayered:
Layer no. 3: Austroads (2004) sublayering
Layer no. 4: Austroads (2004) sublayering

Automatic layer thickness design:
Layer number to be designed: 2
Minimum thickness: 0
Maximum thickness: 5000

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	45.00	CBR_AC14	ESA75-Full	1.93E-05	3.72E-31
2	158.22	CBR_AC20	ESA75-Full	-1.72E-04	1.00E+00
3	100.00	Gran_150	n/a	n/a	
4	150.00	subsltCB6	ESA75-Full	3.54E-04	5.73E-04
5	0.00	Sub_CBR3	ESA75-Full	4.77E-04	4.66E-03

CIRCLY Version 5.1c (15 January 2015)

Layer no. 1 is INCLUDED in max. CDF calculation
Layer no. 2 is INCLUDED in max. CDF calculation
Layer no. 4 is INCLUDED in max. CDF calculation
Layer no. 5 is INCLUDED in max. CDF calculation
Job Title: Dudley St FDA

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: 6.4e6 Title: 6.4e6 ESA

Load No.	Load ID	Movements
1	ESA75-Full	6.40E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius Ref. stress	Pressure/	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: DudleyFD Title: Dudlley FDA

Layer No.	Lower i/face	Material ID	Isotropy (or Ev)	Modulus (or vvh)	P.Ratio F	Eh	vh
1	rough	CBR_AC14	Iso.	4.00E+03	0.40		
2	rough	CBR_AC20	Iso.	4.00E+03	0.40		
3	rough	Gran_150	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
4	rough	subsltCB6	Aniso.	6.00E+01	0.45	4.14E+01	3.00E+01	0.45
5	rough	Sub_CBR3	Aniso.	3.00E+01	0.45	2.07E+01	1.50E+01	0.45

Performance Relationships:

Layer	Location	Performance	Component	Perform.	Perform.	Traffic

No.	ID		Constant	Exponent	Multiplier
1	bottom	CBR14	ETH	0.003667	5.000	1.000
2	bottom	CBR20	ETH	0.003547	5.000	1.000
4	top	selAus2004	EZZ	0.009300	7.000	1.000
5	top	Sub_2004	EZZ	0.009300	7.000	1.000

Reliability Factors: Not Used.

Details of Layers to be sublayered:
Layer no. 3: Austroads (2004) sublayering
Layer no. 4: Austroads (2004) sublayering

Automatic layer thickness design:
Layer number to be designed: 2
Minimum thickness: 0
Maximum thickness: 5000

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	45.00	CBR_AC14	ESA75-Full	1.98E-05	6.40E-31
2	175.28	CBR_AC20	ESA75-Full	-1.55E-04	1.01E+00
3	100.00	Gran_150	n/a	n/a	
4	150.00	subsltCB6	ESA75-Full	3.14E-04	3.23E-04
5	0.00	Sub_CBR3	ESA75-Full	4.27E-04	2.75E-03

DRAFT

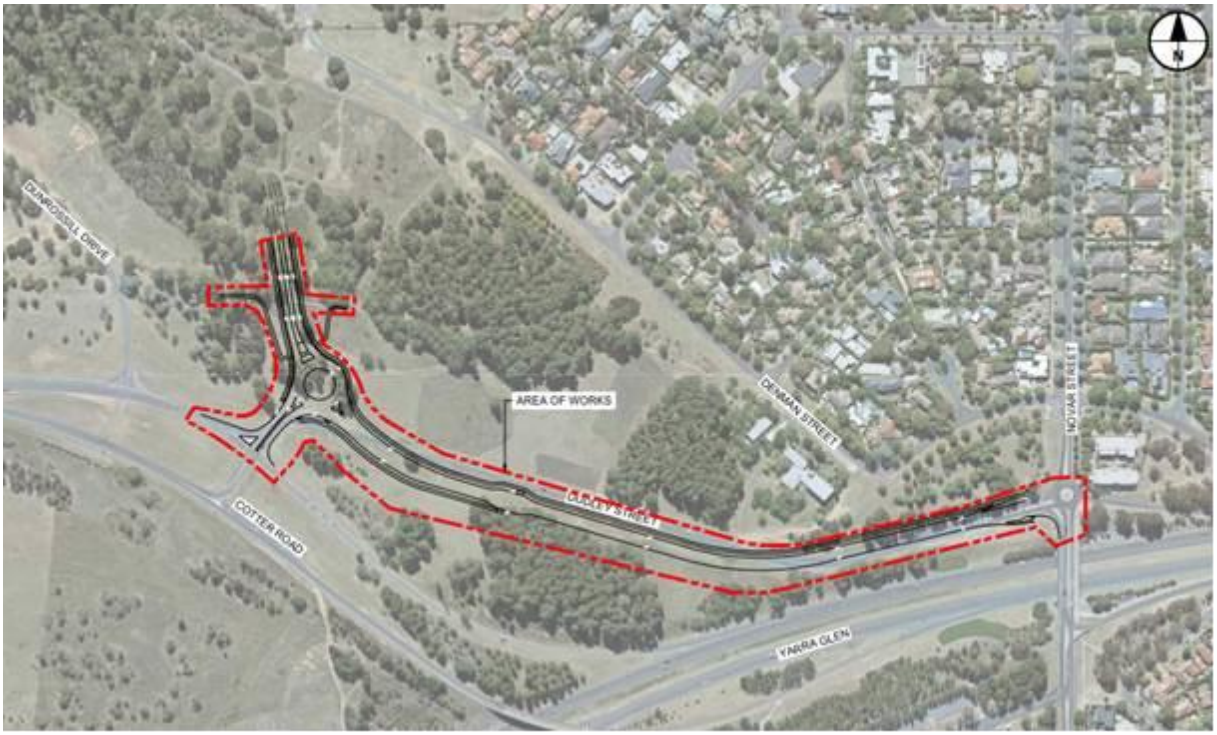
Appendix I

D R A F T

Appendix I – Safety in Design

Safety In Design Report

Preliminary Sketch Plan (PSP)



D R A F T

Safety In Design Report

Draft PSP Design

Client: ACT Procurement

ABN: N/A

Prepared by

AECOM Australia Pty Ltd
Level 2, 60 Marcus Clarke Street, Canberra ACT 2600, Australia
T +61 2 6201 3000 F +61 2 6201 3099 www.aecom.com
ABN 20 093 846 925

17-May-2017

Job No.: 60533438

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 AS/NZS4801 and OHSAS18001.

© AECOM Australia Pty Ltd (AECOM). All rights reserved.

AECOM has prepared this document for the sole use of the Client and for a specific purpose, each as expressly stated in the document. No other party should rely on this document without the prior written consent of AECOM. AECOM undertakes no duty, nor accepts any responsibility, to any third party who may rely upon or use this document. This document has been prepared based on the Client's description of its requirements and AECOM's experience, having regard to assumptions that AECOM can reasonably be expected to make in accordance with sound professional principles. AECOM may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified. Subject to the above conditions, this document may be transmitted, reproduced or disseminated only in its entirety.

D R A F T

Quality Information

Document Safety In Design Report

Ref 60533438

Date 17-May-2017

Prepared by

Reviewed by

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	06-Dec-2012	PSP Design	Jane Peters Associate Director	

D R A F T

Table of Contents

1.0 Introduction 1
1.1 General 1
1.2 Project Description 1
2.0 Safety in Design Process 2
2.1 General 2
2.2 Approach 2
3.0 Recommendations 5
3.1 Key Findings 5
3.2 Further Work 8
4.0 References 8

Appendix A
Safety In Design Matrix A

D R A F T

1.0 Introduction

1.1 General

The Work Health and Safety Act (2011) (WHS Act) require the Work Health and Safety Design Process to be documented as a standard part of the design documentation process.

In accordance with the WHS Act 2011, Section 295 that the objective of this report is to state “the hazards relating to the design of the structures that, so far as the designer is reasonably aware –

a. create a risk to the health or safety of persons who are to carry out any construction work on the structure or part; and

b. are associated only with the particular design and not with other designs of the same type of structure.”

This Safety in Design report has been prepared as part of the Preliminary Sketch Plan (PSP) review of the project. This includes a risk register and risk mitigation plan analysis and will consider risks to the project during the design, construction, operation, maintenance and demolition phases of the project and will build on the risk register previously developed for the project.

1.2 Project Description

The Canberra Brickworks Precinct (CBP) Estate is currently being facilitated by the Land Development Agency. The delivery of the new CBP estate in Yarralumla has instigated the need for an additional access road to the precinct as well as an upgrade to Dudley Street to cater for the increase in traffic and demand from the development.

Procurement and Capital Works engaged AECOM in December 2016 to undertake the Preliminary Sketch Plan design for the CBP Access Road and Dudley Street upgrade. The CBP development is envisaged to have approximately 380 residential dwellings whilst retaining its heritage value. A previous concept design and feasibility study has informed the current PSP design.

The scope of works included for the design of the CBP access road and Dudley Street upgrade include:

- Design of new access road off Dudley Street and the upgrade of Dudley Street to a Major Collector Road

The scope of this project includes undertaking and reporting on the following:

- Review of the existing documentation including studies and design documentation for the adjacent estate development;
- Site specific geotechnical investigation for the northern access road and Dudley Street shoulder widening;
- Review typical cross section for the access road, its geometry including roundabout intersection arrangement, proximity to Cotter Road intersection, intersection sight distances, minimum acceptable radii of curves to provide a flexible access location into the CBP, superelevation, and confirm vehicular turning paths (including steer tag ACTION buses);
- Confirm proposed bus stop location on Dudley Street and connectivity to shared path network;
- Incorporation of existing historical track and appropriate crossing arrangement over the new access road;

D R A F T

- PSP design, services location and any required services relocations and/or protection, including identification of any proposed amendments required for Dudley Street;
- Investigate and include appropriate shared trench arrangements to rationalise existing services and utility infrastructure;
- Review and advise on Development Application (DA) requirements and specific requirements from Environment and Planning Directorate for environmental impact on fauna habitat and flora (note: DA submission is not required at this stage);
- Design to include a 180 metre single carriageway access road and relevant road related assets as per TCCS Design Standard for Urban Infrastructure;
- Heritage considerations (Archaeological and Post European);
- Contamination constraints including contaminated soils;
- P50 and P90 cost estimates for the works using the Monte Carlo method;
- Consideration and incorporation of stormwater from adjacent blocks such as the Uniting Church, and WSUD requirements;
- Undertake safety in design report; and
- Documentation necessary to facilitate the cadastral boundary realignment or creation of new blocks to establish the proposed road reserves. This documentation is to also consider the zoning covering the proposed road reserves to ensure that any areas outside the existing TSZ1 – Transport Zone are to be identified.

2.0 Safety in Design Process

2.1 General

According to Worksafe ACT:

"*Safe design is a design process that eliminates, or minimises, potential and actual work health and safety hazards by involving decisions makers and considering the life cycle of the designed plant, substance or structure*."

For designers, this means applying systematic risk management techniques when making choices about design, materials and method of manufacture or construction to enhance safety of those who will use, handle, store, construct, assemble, dismantle, dispose or be affected by the operation of the plant, substance or structure."

Also, it is fundamentally critical for the safety in design information to be transferred between all people involved the life cycle of the project.

2.2 Approach

The Work Health and Safety Act (2011) require the Work Health and Safety Design Process to be documented as a standard part of the design documentation process. A flow chart of this process is provided on the next page. The main steps in this process include:

D R A F T

1. Risk Identification.

Both standard industry risks and project specific risks were identified by the project team. The risks have been assessed using the Consequence and Likelihood Scales and the Risk Analysis Matrix developed in accordance with Australian Standard AS/NZS 4360-2004.

2. Risk Mitigation.

The above identified risks must be mitigated through one of the following approaches:

- Elimination
- Substitution
- Engineering controls
- Administration
- Personal protection.

These mitigation measures are arranged in a hierarchical order with elimination is the best approach to mitigating a risk.

3. Lifecycle Consideration.

The Work Health and Safety Act (2011) requires the design to consider the full lifecycle of the project including:

- Construction
- Usage/Operation
- Maintenance
- Decommissioning

4. Capability and Performance Details plus Design Assumptions.

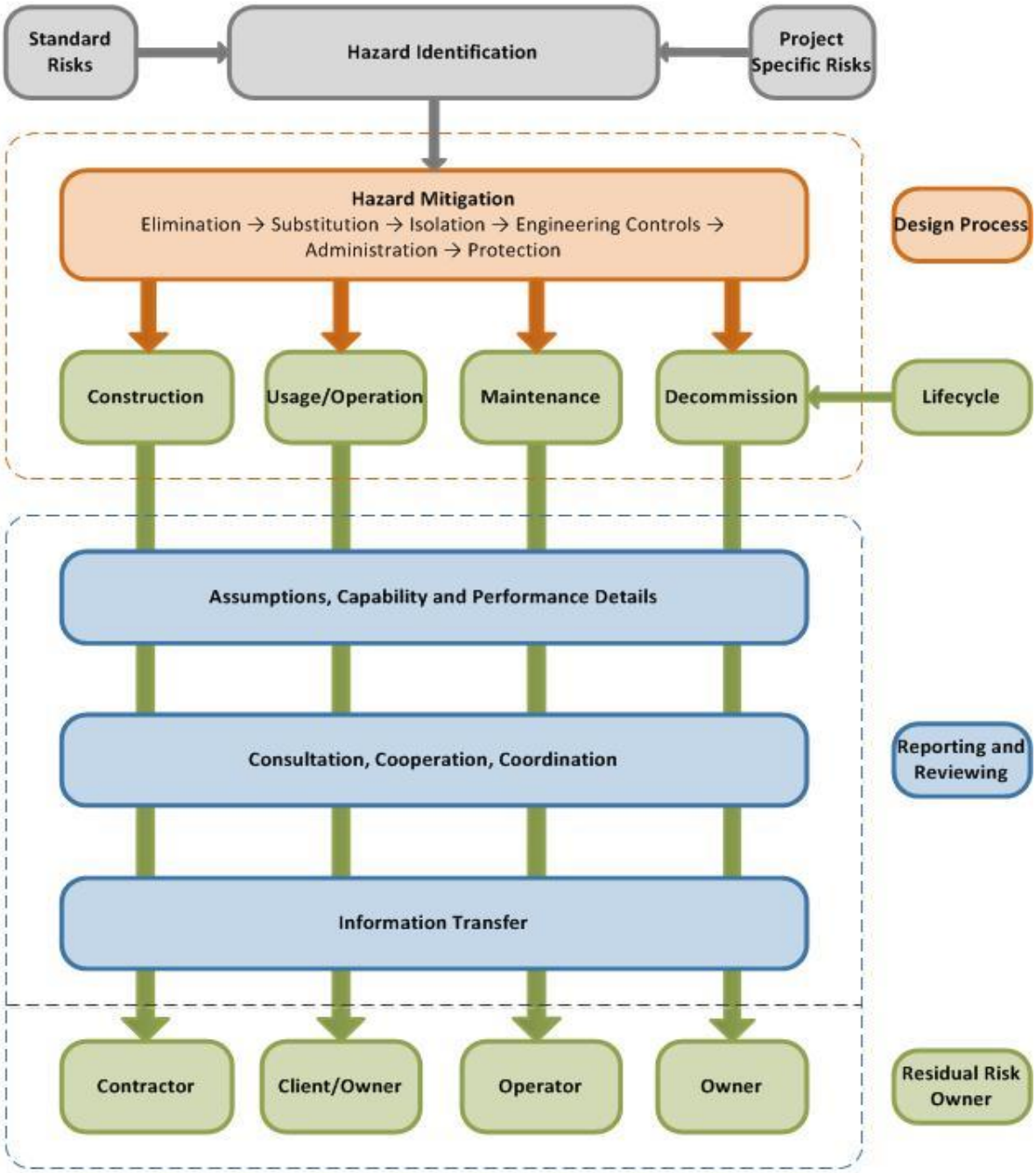
The design parameters and design assumptions for this project have been documented in other sections of the design report and therefore available to the project owner. Critical capability and performance details such as design loads are also stated on the drawings so they are readily available to other parties through the lifecycle of the project via the works as executed drawing system.

5. Consultation and Coordination.

To date there has been consultation with the road authority (TAMS) and the bus operator (ACTION) plus the various underground infrastructure providers (Actew Water, Telstra and ZNX gas. There have also been internal workshops to develop the Safety in Design risk registers. Further consultation is required with maintenance personnel and Peddle Power who represent cyclists

D R A F T

Safety in Design Process



Notes:

1. The Safety in Design Process has been undertaken in accordance with the current (2011) harmonised Work Health and Safety legislation established by the Commonwealth and State/Territory Governments.
2. This process identifies risks to the personal safety of workers and users of the facility. It is only one part of the overall project risk management plan.
3. This process identifies safety risks specific to a particular project and contractors, workers, owners, users and operators must also refer to the other supporting Regulations and Codes of Practice that cover general safe behaviour.
4. This process does not relieve contractors, workers, owners, users and operators from identifying and mitigating other safety risks within their particular areas of experience.
5. Contractors, owners and operators must continue to manage the residual risks identified by this process.

D R A F T

6. Information Transfer.

The identification of safety risks and how they are mitigated in the design is documented in the Safety in Design Register provided in the Appendices. This Register is spilt into the four lifecycle phases. These registers are split into the following three stages

- Firstly, the hazard is identified along with the cause. The scale of the consequence and the likelihood is assessed to set the level of risk
- Secondly, ways to control the risk are determined and the scale of the consequence and the likelihood is assessed to set the level of the mitigated risk. A position is nominated to be responsible for managing the risk.
- Thirdly, there is the monitoring and close out of the risk. There is also direction on the management of any residual risk.

7. Residual Risk Owner

Unless the risk can be eliminated by the designer there is likely to be a residual risk which must be managed by another party, ie the Residual Risk Owner. The Residual Risk Owner is nominated along with a brief direction on how the ongoing risk is to be managed. Depending on the stage in the lifecycle of the project, the residual risk owner maybe the contractor, the owner, or the maintenance operator. It is also important that this safety in design process does not relieve contractors, owners, workers, users and operators from identifying and mitigating other safety risks within their particular areas of experience.

3.0 Recommendations

3.1 Key Findings

The key design considerations and findings resulting from the Safety in Design are summarised in the following table. The more regular safety in design issues will be documented in the Safety in Design Register which is provided in the Appendix. The table also assesses the risk level which because the consequence is the possibility of death or life threating injuries and the likelihood is at least possible (Could happen and happen on other projects), then the risk level is usually high. Possible mitigation measures are being proposed and assessed as the design continues to be developed.

No.	Hazard Description	Hazard Cause	Risk Level	Possible Mitigation	Residual Risk
DESIGN PHASE					
C1	Horizontal and Vertical Geometry	Sight distance	Extreme	Clearly document the standard of vehicle and pedestrian protection measures as a part of the concept TTM plans	High

D R A F T

No.	Hazard Description	Hazard Cause	Risk Level	Possible Mitigation	Residual Risk
C2	Intersection Layouts	Route used by buses, coaches and semi-trailers	Extreme	Specify minimum lane widths and check heavy vehicle turning paths and provide Clearly document the standard of vehicle and pedestrian protection measures as a part of the concept TTM plans	High
C3	Cross Sections	Water main relocation and shared services trench	High	Accurately locate services with hydraulic drilling	High
C4	Intersection/Access Estate Entry Roundabout	Materials falling on pedestrians or pedestrians/ vehicle collisions if directed to cross Gundaroo Drive.	High	Specify the use of appropriate protection systems	Medium

No.	Hazard Description	Hazard Cause	Risk Level	Possible Mitigation	Residual Risk
CONSTRUCTION PHASE					
C1	Brownfields site with collisions between cars and construction plant / workers (construction under traffic)	High volumes of traffic passing through a confined site	Extreme	Clearly document the standard of vehicle and pedestrian protection measures as a part of the concept TTM plans	High
C2	Heavy vehicles not staying within the lanes causing accidents	Route used for construction of Canberra Brickworks	Extreme	Specify minimum lane widths and check heavy vehicle turning paths and provide Clearly document the standard of vehicle and pedestrian protection measures as a part of the concept TTM plans	High

D R A F T

No.	Hazard Description	Hazard Cause	Risk Level	Possible Mitigation	Residual Risk
C3	Cyclists colliding with construction plant and facilities	Confined Space / Poor sight lines	High	Off road shared paths to be used during construction works.	High
C4	Noise and pollution to nearby properties	Machinery use	High	Limit high noise level machinery use during morning and night time	Medium
C5	Impact to Golden Sun Moths their habitat and Natural Temperature Grasslands (areas of environmental significance)	Machinery use and access tracks	High	Identify areas of high environmental significant importance from awareness from the environmental significance map.	Medium
C6	Contamination found during excavation works	Contamination	High	Requirement in specification for EMP and management of uncontrolled find	Low
C7	Electrical Shock	Overhead HV cable	Extreme	Survey of catenary and construction management flags.	High

No.	Hazard Description	Hazard Cause	Risk Level	Possible Mitigation	Residual Risk
USER / OPERATION PHASE					
U1	Vehicle collisions with bus passengers and other pedestrians run over	Lack of safe crossings near bus stops	Extreme	Check sight lines for vehicles and pedestrians. Speed limit 60 km/hr.	High
U2	Bus collisions with other vehicles	Cars not giving way to buses as they exit a bus stop	High	Sight distance for both cars and buses. Driver training.	High
U3	Collisions with cyclists in roundabout	On road cycling provided through roundabout	Extreme	Provide option for cyclists to use off road path at the roundabout	Extreme

D R A F T

No.	Hazard Description	Hazard Cause	Risk Level	Possible Mitigation	Residual Risk
MAINTENANCE PHASE					
M1	Litter collection particularly in the median	Workers on foot exposed to high speed traffic	Extreme	Avoid the use of ground cover type planting and mulches which collect litter. Use grasses which are mown by workers in more protective machinery.	Medium
M2	Collisions between public traffic/cyclists and maintenance workers / plant	Highly trafficked road	High	Maintenance crews to provide TTM's to manage activities with potential traffic conflicts.	Medium
M3	Stormwater manholes in pavement	Access	Extreme	Provide cleaning from adjacent structures located clear of pavement	High

3.2 Further Work

The development of the Safety in Design Registers is ongoing, particularly in the case of mitigation measures which must be incorporated into the final design. A detail Safety in Design Register is currently being developed for the next design phase.

4.0 References

- Work Health and Safety Regulation 2011, ACT, 1 July 2012.
- Work Health and Safety (Safe Design of Structures codes of practice) Approval 2012, ACT, July 2012.
- Work Health and Safety (How to Manage Work Health and Safety Risks) Code of Practice 2011, ACT, December 2011.
- Work Health and Safety (Construction Work Code of Practice) Approval 2012, ACT, July 2012.
- Work Health and Safety (Demolition Work Code of Practice) Approval 2012, ACT, July 2012.

DRAFT

Appendix A

Safety In Design Matrix

D R A F T

Appendix A Safety In Design Matrix

Risk and Environmental Impacts Register Template

Project Name	Canberra Brickworks Precinct Access Road and Dudley Street Design Service
Project Number	60533438

Cat	Risk	Impact	Legislative Regulation & Authority (if applicable)	Cause(s)	Assessor's Name	Date Created	Before Mitigation				Main Action to be Taken	Mitigation/Control (include potential for emergency response)
							Likelihood	Consequence		Risk/Impact Level		
1.00	**Program**											
1.01	Geotechnical - Delay in getting approvals in a timely manner	Delay in receipt of Geotechnical information due to possible delay in getting approvals from authorities as well as environmental approvals	EPA/ TCCS and NCA	Delays in getting approvals		10-Jan-17	Possible	Minor	2	**M**	Prevention	Review of available reports and maps including topographical maps, regional geology maps and previous geotechnical investigations. Review and consideration of environmental constraints map for impact on environmentally significant areas. Obtain preliminary geotechnical report
1.02	Ecological Constraints - Uncertainty of approvals	Uncertainty of whether the Proposal requires referral, assessment and approval under the EPBC Act (due to potential golden sun moth habitat and/or natural temperature grassland)	EPBC Act	Uncertainty of the presence of golden sun moth habitat and/or natural temperature grassland		10-Jan-17	Possible	Moderate	3	**H**	Prevention	Consultation with EPD, Conservator of Flora and Fauna, and the ACT Hertiage Council should be done to identify potential programme issues early in the design process
1.03	Stakeholder Liaison	Delay in program		Unavailability of key stakeholders due to unexpected holiday/leave		10-Jan-17	Unlikely	Minor	2	L	Prevention	Commence liaison with key stakeholders at Project Inception and gather their input
2.00	**Design**											
2.01	Horizontal and Vertical Geometry - Poor horizontal and vertical alignment coordination	Poor horizontal and vertical alignment coordination resulting in safety issues. Substandard horizontal curve radii giving safety issues for the design speed		Poor horizontal and vertical alignment coordination		10-Jan-17	Possible	Minor	2	**M**	Prevention	Using survey data to identify level constraints at existing critical points along the alignment. Determine the alignment which can best fit the constraints identified whilst considering the impacts of the proposed design speed on curve radii, sight distance requirements and earthwork minimisation
2.02	Horizontal and Vertical Geometry - Substandard vertical curve lengths causing unsafe operational conditions	Substandard vertical curve lengths don't give required sight distances for 70 km/h design speed for Dudley Street and presumably 60 km/h on the Access Road creating unsafe operational conditions		Substandard vertical curve lengths		10-Jan-17	Unlikely	Moderate	3	**M**	Prevention	k-values on all vertical curves will be checked to the appropriate reaction time to ensure required stopping sight distances are achieved Design speed at Access Road of 60 km/h can be altered to the required design speed.
2.03	Intersection Layouts - ASD not achieved at intersection	ASD not achieved at intersection creating unsafe operational conditions		Poor horizontal and vertical alignment coordination		10-Jan-17	Unlikely	Moderate	3	**M**	Prevention	Check sight distances on western approach to proposed roundabout to ensure ASD requirements are met
2.04	Intersection Layouts - Future traffic projections show no growth	Future traffic projections show no growth across the network and the distributions do not appear to have been based on any empirical evidence		Projections aren't updated to account for increases in traffic (if any)		10-Jan-17	Unlikely	Moderate	3	**M**	Prevention	Updated projections taking account of any increases in traffic from the duplicaiton of Cotter Road and the increased development from Molonglo may change the volumes and capacities on the network. Projection should be checked with EPD to determine expected future volumes
2.05	Cross Sections - Proposed cross section does not meet requirements for various traffic modes	Proposed cross sections don't meet requirements for the various traffic modes creating unsafe operational conditions		Relevant Guidelines and Standards were not properly checked resulting in non-comforming cross section		10-Jan-17	Unlikely	Moderate	3	**M**	Prevention	Verify cross sections against the requirements of Austroads, Estate Development Code and TCCS
2.06	Cross Sections - Utility agency requirements not met for new and relocated utilities	Utility agency requirements not met for new and relocated utilities creating delays in the designs		Poor coordination with utility authorities regarding clearance/relocation requirements for new/relocated utilities		10-Jan-17	Unlikely	Moderate	3	**M**	Prevention	Liaise with utility agencies to ensure shared trench arrangements meet their requirements with respect to servicing the estate
2.07	Cross Sections - Clear zones not considered	Clear zones not considered creating safety issues		Clear zone values are incorrect/not considered		10-Jan-17	Unlikely	Moderate	3	**M**	Prevention	Check lengths of need for safety barriers especially on curves adjacent to Adelaide Avenue batter. Add barriers as necessary

Risk and Environmental Impacts Register Template

Project Name	Canberra Brickworks Precinct Access Road and Dudley Street Design Service
Project Number	60533438

Cat	Risk	Impact	Legislative Regulation & Authority (if applicable)	Cause(s)	Assessor's Name	Date Created	Before Mitigation				Main Action to be Taken	Mitigation/Control (include potential for emergency response)
							Likelihood	Consequence		Risk/Impact Level		
2.08	Intersection/Access Estate Entry Roundabout - Proposed roundabout at the Estate entry may not cater for buses or larger vehicles. On-road and off-road cycling facilities not included	Roundabout not designed for larger vehicles and/or buses resulting in failure of road surface and unsafe turning movements Poor integration of on-road cycling facilities creating unsafe operational conditions		Heavy vehicles and buses were not considered during the design process Design constraints		10-Jan-17	Unlikely	Moderate	3	M	Prevention	Check vehicle path turning templates and kerb line clearances to determine actual footprint of roundabout On-road cycle lanes usually remain on the road for roundabouts in 60 km/h speed environments and therefore intersection needs to verify for this travel mode and consideration to impacts on the environmental sites to the north of the intersection. Consider moving intersection further south to enable this on-road facility to be included. Refer sketch following, this intersection location is subject to review by LDA.
2.09	Cotter Road Intersection - Potential for collisions between opposing traffic on tight corner	Collision of vehicles on tight corner of intersection				10-Jan-17	Possible	Moderate	3	H	Prevention	Introduce a median separator
2.10	Informal shortcut to Denman Street	Informal shortcut to Denman Street from Dudley Street is a safety and environmental concern				10-Jan-17	Unlikely	Minor	2	L	Prevention	Ensure access is cut off and track is removed. Restore disturbed and eroded areas
2.11	Stormwater Management/WSUD - Lowpoint created at proposed roundabout	Lowpoint created against road upgrade works at the proposed roundabout (north west sector) is undersized for proposed upstream estate development creating flooding risks				10-Jan-17	Unlikely	Moderate	3	M	Prevention	Consider proposed culvert design (20 year ARI) to accommodate estate drainage and road is at sufficient elevation to allow culvert to be provided
2.12	Stormwater Management/WSUD - Headwall to proposed culvert at lowpoint created impacts environmental sensitive areas	Headwall to proposed culvert at lowpoint created against road upgrade works at proposed roundabout (north east sector) impacts on environmental sensitive areas				10-Jan-17	Possible	Minor	2	M	Reduction	Minimise headwall extent by using a drop structure. Also limit any ponding which may have an impact of the Golden Sun Moth environment through changed moisture conditions
2.13	Stormwater Management/WSUD - Existing culvert under Cotter Road not of sufficient size to cater for increased runoff from proposed estate	Existing culvert under Cotter Road not of sufficient size to cater for increased runoff from proposed estate causing flooding and erosion with higher velocities				10-Jan-17	Unlikely	Moderate	3	M	Prevention	Liaise with LDA to determine what measures are to introduced in the estate design to limit upstream flows to existing downstream infrastructure capacities and whether any retarding structures are required upstream as part of this project
2.14	Stormwater Management/WSUD - Potential for flooding at CH 440 low point	Flooding occurs on the road creating unsafe operational conditions				10-Jan-17	Unlikely	Moderate	3	M	Prevention	Ensure proposed culvert upgrade meets current design (20 year ARI) requirements given age of present culvert and check for impacts of increased flows downstream. Locate sumps at designed sag lowpoint. Consider raising the road at the lowpoint and provide positive protection to the pavements
2.15	Earthworks - Significant imbalance in excavated and fill material	Cost implications to disposal of excavated material off-site Cost implications to obtaining required fill material				10-Jan-17	Possible	Minor	2	M	Prevention	Determine where the vertical alignment can be adjusted to balance/minimise earthworks
2.16	Pavement - Pavement profile does not meet required standards	The pavement profile does not meet required standards and economical construction leading to costly maintenance regimes		Pavement design done poorly and not to standard		10-Jan-17	Unlikely	Moderate	3	M	Prevention	As required in a PSP design the pavement will be selected based on Whole-of-Life costing analysis considering, amongst other parameters, the volumes of heavy vehicles and subgrade conditions extracted from the geotechnical investigation

Safety in Design Register
Construction Phase

Project Name	CB Access Road and Dudley Street Upgrade	**Construction Phase**	
Project Number	60533438		

Analysis								Controls						Monitoring and Close Out			
ID	Risk Area	Hazard Description	Causes	Consequences	Before Mitigation (Inherent Risk)			SID Risk Owner	Design Approach	Mitigation planned or in place	Residual Risk			Evidence of Design Close Out	Date Completed	Residual Risk Owner	Residual Comments
					Likelihood	Consequence	Risk				Likelihood	Consequence	Risk/Impact Level				
1.00	**Traffic Management**																
1.01	Public Traffic	Collisions between public traffic	High Traffic volumes in confined area	injury or death	Possible	Major	Extreme	Civil Lead Designer	Engineering	On TTM plans, reduce speed to 40 kph and provide adequate lane widths	Unlikely	Moderate	Medium	Shown on drawings		Contractor	Use approved TTM plans
1.02	Public Traffic	Collisions between public traffic and construction traffic in and around work area	Frequently turning traffic - high traffic volumes	injury or death	Possible	Major	Extreme	Civil Lead Designer	Engineering	Locate the site compound where the normal Austroads intersection sight distance requirements can be achieved for 40kph construction speed zone	Unlikely	Major	High	Shown on drawings		Contractor	Use approved TTM plans
1.03	Public Traffic	Collisions between public traffic and workers / plant	Brown fields site / confined space	injury or death	Possible	Major	Extreme	Civil Lead Designer	Engineering	TTM plans to specify suitable traffic protection barriers to separate contruction and public traffic	Unlikely	Moderate	Medium	Shown on drawings	27/09/2013	Contractor	Use approved TTM plans
1.03	Public Traffic	Route used by cosntruction vehicles during Brickworks development	Confined space for public traffic	injury or death	Likely	Major	Extreme	Civil Lead Designer	Engineering	Check truck turn paths against vehicle barriers as shown on concept TTM plans. Specify minimum lane widths	Unlikely	Major	High	Shown on drawings		Contractor	Check minimum lane widths
1.04	Public Traffic	Collisions between public traffic	legibility of the temporary arrangement through the works due to changing traffic arrangements /conditions	injury or death	Possible	Major	Extreme	Civil Lead Designer	Engineering	Regular inspection and monitoring of TTM's on site during the works.	Unlikely	Major	High	Shown on drawings		Contractor	Inspection and monitoring of construction TTM.
1.05	Cyclists	On-road cyclist hit in roundabout	Confined space	injury or death	Possible	Major	Extreme	Civil Lead Designer	Engineering	Clear signage to take cyclists off the roundabout.	Unlikely	Major	High	Shown on drawings		Contractor	Inspection and monitoring of construction TTM.
1.06	Cyclists	Cyclists colliding with construction plant and facilities	Confined Space / Poor sight lines	injury or death	Possible	Major	Extreme	Civil Lead Designer	Engineering	Off road shared paths to be used during construction works.	Unlikely	Major	High	Shown on drawings		Contractor	
1.07	Public Transport	Buses colliding with construction plant	Confined space for buses	injury or death	Possible	Major	Extreme	Civil Lead Designer	Engineering	No existing bus route during construction	Unlikely	Major	High	Shown on drawings		Contractor	Use approved TTM plans
2.00	**Environmental Management**																
2.01	Contamination	Contamination of stormwater system due to fuel / oil spills / pavement construction	Oil / silt pollutes downstream creek with risk to public health	Sickness	Possible	Minor	Medium	Civil Lead Designer	Engineering	Specify protection to downstream stormwater sumps during construction eg filter rolls, silt fences and sed ponds	Unlikely	Minor	Low	Concept Erosion and Sediment control drg		Contractor	Maintain construction plant in good condition and have a contamination spills action plan and all necessary equipment on site - Obtain stormwater licence from EnvironmentACT
2.02	Contamination	Presence of Contaminated matrials on site	Use of asbestos conduits/ pipe material	Sickness	Possible	Moderate	High	Civil Lead Designer	Engineering	Requirement in Specification for EMP.	Unlikely	Minor	Low	Specification		Contractor	Contractor to prepare EMP with unexpected finds protocol for the management of potentially contaminated materials
2.03	Air	Dust and Noise Pollution	Poor construction practices	Personal health impacts	likely	minor	High	Civil Lead Designer	Administration	Add EMP notes requiring Contractor to comply with Environment ACT guidelines	Possible	Minor	Medium	Note on drawings		Contractor	Obtain approved EMP.
2.30	Water	Contamination of stormwater system due to pavement construction	Silt enters downstream water course and lakes	Personal health impacts	Likely	Insignificant	Medium	Civil Lead Designer	Engineering	Specify protection to downstream stormwater sumps during construction eg filter rolls	Unlikely	Insignificant	Low	Note on drawings		contractor	Obtain stormwater licence from EnvironmentACT
		Damage to high value environmental areas	Construction vehicle movements	Time and cost implications	Likely	Moderate	High	Civil Lead Designer	Administration	Add EMP notes requiring Contractor to fence areas of high environmental values to avoid access	Unlikely	Moderate	Medium	Specification and Hold Point		Contractor	
3.00	**Demolition**																
3.01	Services	Damage to existing communications / elecricity services during removal of existing pavements	Electrocution, High financial cost to repair.	injury or death	Possible	Catastrophic	Extreme	Civil Lead Designer	Engineering	Specify that services be located using hydraulic pot-holing by contractor and no heavy vibrating equipment or rock-breakers to be used within vicinity of existing utilities	Rare	Catastrophic	High	Specification - Contractor required by contract to locate existing services		Contractor	Contractor to locate existing services using hydraulic drilling and notify superintendent of potential implicaitons
3.02	Services	Damage to existing water services during relocation works	Time and cost delays. Injury risk for workers within trenches.	injury	Possible	Major	Extreme	Civil Lead Designer	Engineering	Specify that services be located using hydraulic pot-holing by contractor and no heavy vibrating equipment or rock-breakers to be used within vicinity of existing utilities	Rare	Major	High	Specification - Contractor required by contract to locate existing services		Contractor	Contractor to locate existing services using hydraulic drilling and notify superintendent of potential implicaitons
3.03	Services	Damage to existing gas main ervices during excavation	Explosion	injury or death	Possible	Catastrophic	Extreme	Civil Lead Designer	Engineering	Specify that services be located using hydraulic pot-holing by contractor and no heavy vibrating equipment or rock-breakers to be used within vicinity of existing utilities. Incorporation of Jemena clearance and safety requirements in tender documentation.	Rare	Catastrophic	High	Specification - Contractor required by contract to locate existing services		Contractor	Contractor to locate existing services using hydraulic drilling and notify superintendent of potential implicaitons
4.00	**Earthworks**																
4.01	Debris	Vehicles collide with rock or debris on road	Construction vehicles leaving debris on road	Injury	Possible	Major	Extreme	Civil Lead Designer	Administration	Add EMP notes requiring Contractor to ensure loose excavated material to be transported with covers in place	Rare	Major	High	Specification - Contractor to ensure vehicle passages are clear of excavated material		Contractor	Superintendent to ensure necessary exclusion zones are maintained between roadways and excavation
4.02	Existing Services	Disturbing/hitting unknown or incorrectly shown utilities	Electrical shock / explosion	injury or death	Possible	Catastrophic	Extreme	Civil Lead Designer	Administration	Undertake Dial-Before-You-Dig seaches and instruct Contractor to confirm location of all known services through hydraulic pot-holing and to locate unknown services with a hydraulic drilled transect section extending beyond the scope of the works	Rare	Catastrophic	High	Note on drawings		Contractor	Undertake Dial-Before-You-Dig seaches and confirm location of all known services through hydraulic pot-holing and to locate unknown services with a hydraulic drilled transect section extending beyond the scope of the works
4.03	Existing Services	High vibration loads from pneumatic hammers and compaction equipment could damage sensitive services	Explosion causing serious injury/death.	injury or death	Possible	Catastrophic	Extreme	Civil Lead Designer	Administration	Specify that no heavy vibrating equipment or rock-breakers to be operated in vicinity of utilities	Rare	Catastrophic	High	Note on drawings		Contractor	No heavy vibrating equipment or rock-breakers in vicinity of services
4.3	Site congestion	Collision between machinery on site	Machine operators could be seriously injured. Vehicles and pedestrians near the site could be injured as a result.		Unlikely	Major	High	Civil Lead Designer	Administration	Limit number of machines operating on site at any one time where at all possible. Provide a spotter for each machine	Unlikely	Moderate	Medium	Note on drawings		Contractor	Limit number of machines operating on site at any one time where at all possible. Provide a spotter for each machine
4.31	Site congestion	Workers run over by plant	Site congestion		Possible	Major	Extreme	Civil Lead Designer	Administration	Specify that Contractor to provide a spotter for each machine	Unlikely	Major	High	Note on drawings		Contractor	Contractor to provide a spotter for each machine
4.32	Site congestion	Workers run over by plant	Workers distracted by mobile phone usage		Possible	Major	Extreme	Civil Lead Designer	Administration	Specify that Contractor to ban mobile phone use in moving plant. Workers on foot to only use mobile phones in designated fenced off safe areas	Unlikely	Major	High	Note on drawings		Contractor	Contractor to provide a spotter for each machine
4.04		High vibration loads from pneumatic hammers and compaction equipment could impact nearby residences			Possible	Moderate											
5.00	**Services Installation**																
5.01	Existing Services	Electrical shock / Explosion	Disturbing/hitting unknown or incorrectly shown services		Possible	Catastrophic	Extreme	Civil Lead Designer	Administration	Undertake Dial-Before-You-Dig seaches and instruct Contractor to confirm location of all known services through hydraulic pot-holing and to locate unknown services with a hydraulic drilled transect sectionextending beyond the scope of the works	Rare	Catastrophic	High	Note on drawings		contractor	Undertake Dial-Before-You-Dig seaches and confirm location of all known services through hydraulic pot-holing and to locate unknown services with a hydraulic drilled transect sectionextending beyond the scope of the works
5.01	Existing Services	Collapse of existing structures	Over-loading existing services	Financial risk	Unlikely	Moderate	Medium	Civil Lead Designer	Engineering	Minimise work required in vicinity of existing structures	Rare	Moderate	Medium	Where possible, detail construction away from existing structures		Contractor	Contractor to assess integrity of existing structures before working in vicinity of or modifying

Canberra

Safety in Design Register
Construction Phase

Project Name	CB Access Road and Dudley Street Upgrade	**Construction Phase**
Project Number	60533438	

Analysis								Controls						Monitoring and Close Out			
ID	Risk Area	Hazard Description	Causes	Consequences	Before Mitigation (Inherent Risk)			SID Risk Owner	Design Approach	Mitigation planned or in place	Residual Risk			Evidence of Design Close Out	Date Completed	Residual Risk Owner	Residual Comments
					Likelihood	Consequence	Risk				Likelihood	Consequence	Risk/Impact Level				
5.02	Trenching	Workers buried	Trench excavation collapses		Possible	Major	Extreme	Civil Lead Designer	Engineering	Minimise the need to lay serves deeper than 1.5 metres (which would then require the Contractor to protect the trench through benching or some other Workcover approved technique	Unlikely	Major	High	No deep sevices		Contractor	Operate as per Workcover regulations
5.03	Trenching	Rough surface increases risk of collisions	Poor trench backfill practices	Injury or death	Possible	Major	Extreme	Civil Lead Designer	Subsitution	Specify correctly installed granular backfill and develop a robust pavement design	Rare	Minor	Low	Shown on drawings		Contractor	Backfill as per Specifications and Actew standards
6.00	**Pavements**																
6.01	Pavement	Failure of pavement	Due to poor construction methods	Financial risk	Possible	Major	Extreme	Civil Lead Designer	Engineering	Develop a robust pavement design (ie full depth asphalt)	Rare	Major	High	Shown on drawings		Contractor	Superintendent to check pavement placing is to specification by Contractor
		Heavy plant in confined area	Workers run over by plant causing serious injury or death		Possible	Major	Extreme	Civil Lead Designer	Elimination	Develop a pavement design (ie concrete) that minimises the need for compaction plant and other heavy moving equipment	Rare	Minor	Low	Shown on drawings		Contractor	Contractor to provide a spotter for each machine
		High vibration loads from pneumatic hammers and compaction equipment could damage existing services	Explosion causing serious injury/death.		Possible	Catastrophic	Extreme	Civil Lead Designer	Administration	Specify that no heavy vibrating equipment or rock-breakers allowed on site	Rare	Catastrophic	High	Note on drawings		Contractor	No heavy vibrating equipment or rock-breakers allowed on site.
		Labour extensive process where workers are exposed to other vehicles / plant	Workers run over by plant / vehicles causing serious injury or death		Possible	Major	Extreme	Civil Lead Designer	Administration	Specify that work to be undertaken beind the vehicle protection barriers with the Contractor supply a spotter for any plant also operating near workers	Unlikely	Moderate	Medium	Note on drawings		Contractor	Use approved TTM plans
6.10	Tied Kerbs					Major	#N/A	Civil Lead Designer	Elimination	Use U-bars	Possible	Minor	Medium	Shown on drawings		Contractor	Do not close northbound lane. Use suitable construction techniques
6.02	Pavement	Failure of pavement surface finish causing rough ride	Rough surface increases risk of collisions	Injury or death	Possible	moderate	High	Civil Lead Designer	Subsitution	Develop a robust pavement design (ie concrete)	Rare	Minor	Low	Shown on drawings		contractor	Comply with Specifications
6.03	Pavement	Heavy plant in confined area	Workers run over by plant causing serious injury or death	Injury or death	Possible	Catastrophic	Extreme	Civil Lead Designer	Elimination	Develop a pavement design (ie concrete) that minimises the need for compaction plant and other heavy moving equipment	Rare	Minor	Low	Shown on drawings		contractor	Contractor to provide spotters for machines
6.04	Pavement	High vibration loads from pneumatic hammers and compaction equipment could damage existing services	Explosion causing serious injury/death.	Injury or death	Possible	Catastrophic	Extreme	Civil Lead Designer	Administration	Specify that no heavy vibrating equipment or rock-breakers to work within vicinity of services. Utility authorities to confirm clearances for heavy or vibrating machinery from utilities.	Rare	Catastrophic	High	Note on drawings		contractor	Specify that no heavy vibrating equipment or rock-breakers to work within vicinity of services. Utility authorities to confirm clearances for heavy or vibrating machinery from utilities.
6.05	Pavement	Labour extensive process where workers are exposed to other vehicles / plant	Workers run over by plant / vehicles causing serious injury or death	Injury or death	Possible	Catastrophic	Extreme	Civil Lead Designer	Administration	Specify that work to be undertaken beind the vehicle protection barriers with the Contractor supply a spotter for any plant also operating near workers	Unlikely	Moderate	Medium	Note on drawings		contractor	Use approved TTM plans
6.06	Tied Kerbs	Unprotected started bars	Falling onto starter bars	Injury or death	Possible	Major	Extreme	Civil Lead Designer	Elimination	Use U-bars	Possible	Minor	Medium	Shown on drawings	27/09/2013	contractor	
11.00	**Line Marking**																
11.01	Vehicles	Workers run over by plant or other vehicles	Workers suffer serious injury or death		Possible	Major	Extreme	Civil Lead Designer	Administration	Specify that work to be undertaken behind the vehicle protection barriers with the Contractor supply a spotter for any plant also operating near workers	Unlikely	Moderate	Medium	Note on drawings		contractor	Contractor to provide a spotter for each machine Use approved TTM Plan

Safety in Design Register
Maintenance Phase

Project Name	CBP Access Road and Dudley Street Upgrade
Project Number	60533438

Analysis										Controls						Monitoring and Close Out			
ID	Risk Area	Hazard Description	Causes	Consequences	Before Mitigation (Inherent Risk)				SID Risk Owner	Design Approach	Mitigation planned or in place	Residual Risk			Evidence of Design Close Out	Date Completed	Residual Risk Owner	Residual Comments
					Likelihood	Consequence		Risk				Likelihood	Consequence	Risk/Impact Level				
1.00	**Traffic Management**																	
1.01	Public Traffic	Litter cleanup adjacent to road carriageways	Workers on foot exposed to high speed traffic	injury or death	Possible	Catastrophic	5	Extreme	Civil Lead Designer	Engineering	Avoid the use of ground cover type planting and mulches which collect litter. Use grasses which are mown by workers in more protective machinery	Unlikely	Catastrophic	Extreme	Final Design Drawings	27/09/2013	TaMS	Temporary traffic management plans are required for clean up works adjacent to the road carriageway.
1.02	Public Traffic	Collisions between public traffic/cyclists and maintenance workers / plant	Brown fields site / confined space	injury or death	Possible	Catastrophic	5	Extreme	Civil Lead Designer	Engineering	Maintenance crews to provide TTM's to manage activities with potential traffic conflicts	Unlikely	Catastrophic	Extreme	Final Design Drawings	27/09/2013	TaMS	Temporary traffic management plans are required for maintenance works adjacent to the road carriageway.
1.03	Public Traffic	Stormwater pits adjacent to roads	Access to deep pits adjacent to high speed roads requires large exclusion zone	injury or death	Possible	Catastrophic	5	Extreme	Civil Lead Designer	Engineering	Proposed stormwater pits to achieve minimum grade so they do not need to be constructed so deep	Rare	Catastrophic	High	Final Design Drawings	27-Sep-13	TaMS	Temporary traffic management plans are required for maintenance works adjacent to the road carriageway.
5.00	**Services Repairs**																	
5.01	Existing Services	Electrical shock / Explosion	Disturbing/hitting unknown or incorrectly shown services	Injury of death	Possible	Catastrophic	5	Extreme	Civil Lead Designer	Administration	Undertake Dial-Before-You-Dig seaches and instruct Contractor to confirm location of all known services through hydraulic pot-holing and to locate unknown services with a hydraulic drilled transect sectionextending beyond the scope of the works. WAE drawings to locate existing utilities.	Rare	Catastrophic	High	Note on drawings		contractor	Undertake Dial-Before-You-Dig seaches and confirm location of all known services through hydraulic pot-holing and to locate unknown services with a hydraulic drilled transect sectionextending beyond the scope of the works
5.02	Trenching	Workers buried	Trench excavation collapses		Possible	Major	4	Extreme	Civil Lead Designer	Engineering	Minimise the need to lay servces deeper than 1.5 metres (which would then require the Contractor to protect the trench through benching or some other Workcover approved technique	Unlikely	Major	High	No deep sevices		contractor	Operate as per Workcover regulations
5.03	Trenching	Rough surface increases risk of collisions	Poor trench backfill practices		Possible	moderate	3	High	Civil Lead Designer	Subsitution	Specify correctly installed granular backfill and develop a robust pavement design (ie concrete)	Rare	Minor	Low	Shown on drawings	30/08/2012	contractor	Backfill as per Specifications and Actew standards
6.00	**Pavement Repairs**																	
6.01	Pavement	Failure of pavement surface finish causing rough ride	Rough surface increases risk of collisions	Injury	Possible	Major	4	Extreme	Civil Lead Designer	Engineering	TTM plans in place.							
11.00	**Line Marking**																	
11.01	Vehicles	Workers run over by plant or other vehicles	Workers suffer serious injury or death		Possible	Major	4	Extreme	Civil Lead Designer	Administration	Specify that work to be undertaken behind the vehicle protection barriers with the Contractor supply a spotter for any plant also operating near workers	Unlikely	Moderate	Medium	Note on drawings	30/08/2012	contractor	Contractor to provide a spotter for each machine Use approved TTM Plan

Safety in Design Register
Usage Phase

Project Name	CB Access Road and Dudley Street Upgrade
Project Number	60533438

Analysis								Controls			Residual Risk				Monitoring and Close Out				
ID	Risk Area	Hazard Description	Causes / Consequences	Before Mitigation (Inherent Risk)				SID Risk Owner	Design Approach	Mitigation planned or in place					Evidence of Design Close Out	Date Completed	Residual Risk Owner	Residual Comments	
				Likelihood	Consequence		Risk				Likelihood	Consequence		Risk/Impact Level					
1.00	**Traffic Management**																		
1.01	Public Traffic	Heavy Traffic volumes	Collisions at roundabouts due to high traffic volumes - injury	Likely	Major	4	Extreme	Civil Lead Designer	Engineering	Design of roundabout and Dudley Street upgrade for traffic volumes should reduce number of traffic accidents	Unlikely	Major	4	High	Work as Executed Drawings		TCCS		
1.02	Bus Movements	Buses pulling out of laybys to enter traffic flow	Collisions with cars, cyclists.	Possible	Catastrophic	5	Extreme	Civil Lead Designer	Engineering	Speed limit of 60 km/hr. Linemarked on road cycling. Bus Driver training. Check sight distance for design.	Unlikely	Catastrophic	5	Extreme	Work as Executed Drawings		Action		
1.03	Pedestrians	Crossing Dudley Street from bus stop	Vehicle hitting a pedestrian crossing 60 km /hr road	Possible	Major	4	Extreme	Civil Lead Designer	Engineering	Sight distance checks for pedestrians and vehicles	Possible	Major	4	Extreme	Work as Executed Drawings		TCCS		
1.04	Cyclists	On road cyclist hit at roundabout	On road cyclist through roundabout	Possible	Catastrophic	5	Extreme	Civil Lead Designer	Engineering	Option for cyclist to use off-road paths. Slow speed through the roundabout.	Unlikely	Catastrophic	5	Extreme	Work as Executed Drawings		TCCS		
2.00	**Environmental Management**																		
2.10	Contamination	Contamination of stormwater system due to fuel / oil spills	Oil pollutes downstream lake with risk to public health	Unlikely	Minor	2	Low	Civil Lead Designer	Engineering		Unlikely	Minor	2				TCCS		
2.20	Air	Noise Pollution	Personal health impacts	likely	minor	2	High	Civil Lead Designer	Engineering	Noise monitoring and assessment undertaken for Environmental Impact Statement for Development Approval	Possible	Minor	2	Medium	Work as Executed Drawings		TCCS		
4.00	**Pedestrians and Cyclist**																		
4.01	Off road paths	Steep grades for connections to existing paths	Lost control of motorised scooters / wheel chairs	Possible	Major	4	Extreme	Civil Lead Designer	Engineering	Provide warning signage at new path connections where disability requirements are not able to be met.	Rare	Major	4	High	Final Design Drawings		TaMS		
6.00	**Pavements**																		
6.01	Pavement	Failure of pavement surface finish causing rough ride	Rough surface increases risk of collisions	Possible	moderate	3	High	Civil Lead Designer	Subsitution	Develop a robust pavement design and monitor during construction against the specification.	Rare	Minor	2	Low	Shown on drawings	27/09/2013	contractor	Comply with Specifications	

DRAFT

Appendix J

P50 and P90 Cost Estimate Risk Assessments

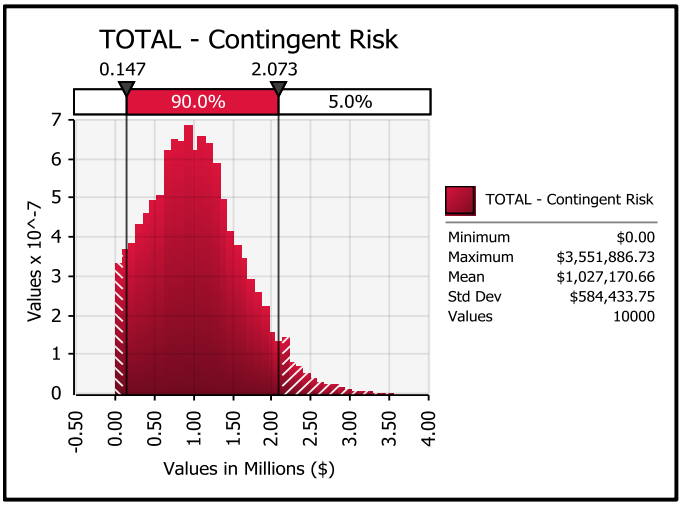
D R A F T

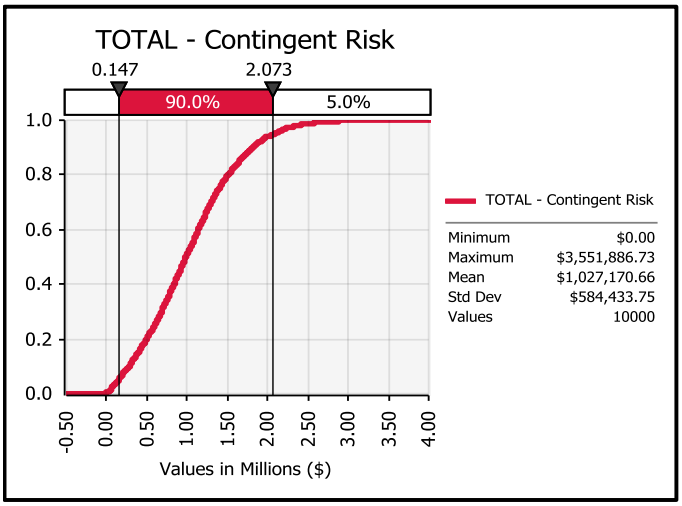
Appendix J P50 and P90 Cost Estimate Risk Assessments

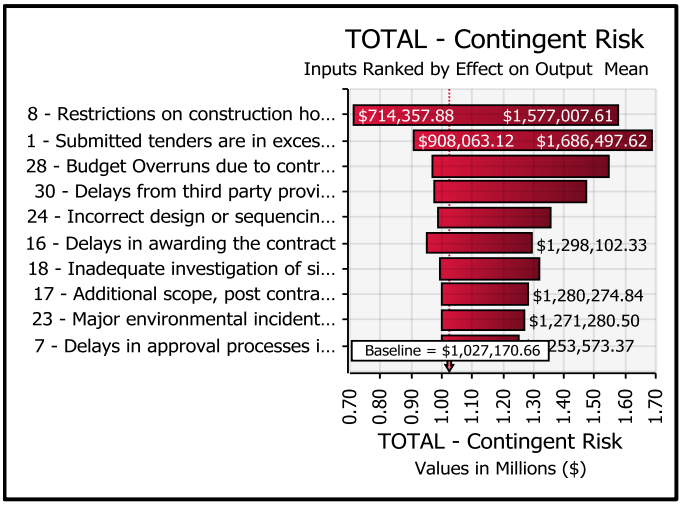
@RISK Output Report for: TOTAL - Contingent Risk

Performed By: Fry, Jamie

Date: Wednesday, 24 May 2017 9:13:38 AM







Simulation Summary Information

Workbook Name	60533438_Brickworks-Access-Roa
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	181
Number of Outputs	2
Sampling Type	Latin Hypercube
Simulation Start Time	24/05/2017 10:12
Simulation Duration	00:00:33
Random # Generator	Mersenne Twister
Random Seed	52059311

Summary Statistics for TOTAL - Contingent Risk

Statistics		Percentile	
Minimum	$ -	**5%**	$ 146,664
Maximum	$ 3,551,887	**10%**	$ 275,570
Mean	$ 1,027,171	**15%**	$ 389,887
Std Dev	$ 584,434	**20%**	$ 494,593
Variance	3.41563E+11	**25%**	$ 591,911
Skewness	0.489895285	**30%**	$ 680,331
Kurtosis	3.01643717	**35%**	$ 759,994
Median	$ 984,384	**40%**	$ 834,585
Mode	$ -	**45%**	$ 911,161
Left X	$ 146,664	**50%**	$ 984,384
Left P	5%	**55%**	$ 1,063,611
Right X	$ 2,073,348	**60%**	$ 1,139,661
Right P	95%	**65%**	$ 1,217,372
Diff X	$ 1,926,684	**70%**	$ 1,300,117
Diff P	90%	**75%**	$ 1,395,280
#Errors	0	**80%**	$ 1,511,490
Filter Min	Off	**85%**	$ 1,649,101
Filter Max	Off	**90%**	$ 1,818,541
#Filtered	0	**95%**	$ 2,073,348

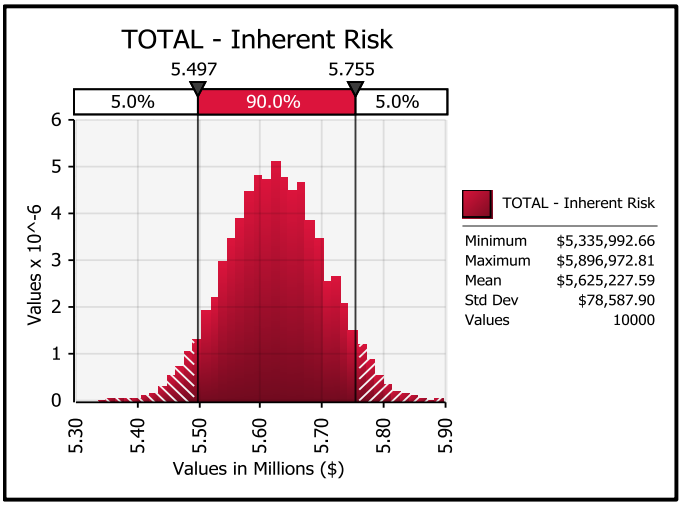
Change in Output Statistic for TOTAL - Contingent Ri

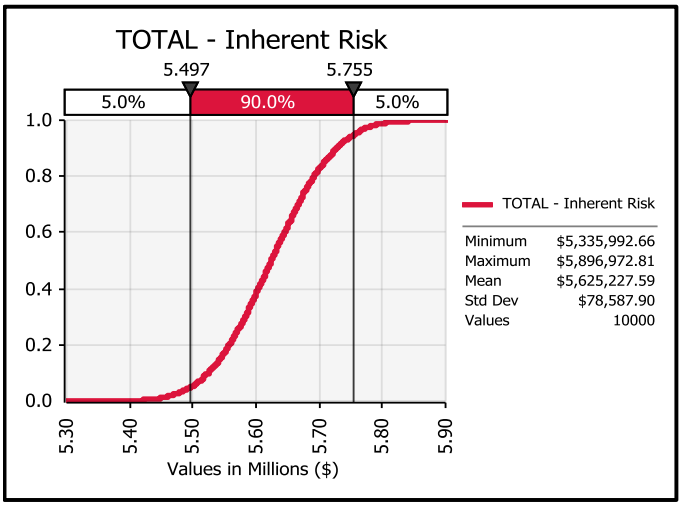
Rank	Name	Lower	Upper
1	8 - Restrictions or	$ 714,358	$ 1,577,008
2	1 - Submitted ten	$ 908,063	$ 1,686,498
3	28 - Budget Over	$ 969,611	$ 1,545,210
4	30 - Delays from t	$ 977,913	$ 1,470,492
5	24 - Incorrect des	$ 990,873	$ 1,353,847
6	16 - Delays in awa	$ 953,460	$ 1,298,102
7	18 - Inadequate ir	$ 994,632	$ 1,320,022
8	17 - Additional sc	$ 999,048	$ 1,280,275
9	23 - Major enviror	$ 1,000,047	$ 1,271,280
10	7 - Delays in appr	$ 1,002,015	$ 1,253,573

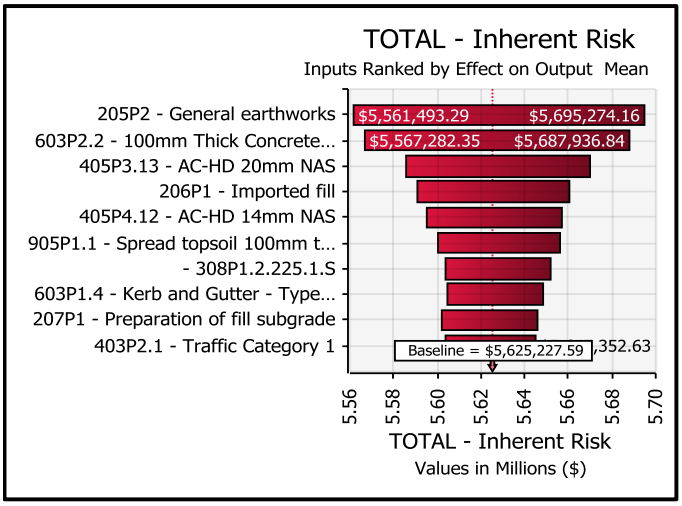
@RISK Output Report for: TOTAL - Inherent Risk

Performed By: Fry, Jamie

Date: Wednesday, 24 May 2017 9:13:33 AM







Simulation Summary Information

Workbook Name	60533438_Brickworks-Access-Roa
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	181
Number of Outputs	2
Sampling Type	Latin Hypercube
Simulation Start Time	24/05/2017 10:12
Simulation Duration	00:00:33
Random # Generator	Mersenne Twister
Random Seed	52059311

Summary Statistics for TOTAL - Inherent Risk

Statistics		Percentile	
Minimum	$ 5,335,993	**5%**	$ 5,496,709
Maximum	$ 5,896,973	**10%**	$ 5,524,385
Mean	$ 5,625,228	**15%**	$ 5,543,131
Std Dev	$ 78,588	**20%**	$ 5,558,159
Variance	6176057435	**25%**	$ 5,570,658
Skewness	0.037201515	**30%**	$ 5,582,488
Kurtosis	2.873718886	**35%**	$ 5,593,816
Median	$ 5,624,459	**40%**	$ 5,603,770
Mode	$ 5,627,221	**45%**	$ 5,614,481
Left X	$ 5,496,709	**50%**	$ 5,624,459
Left P	5%	**55%**	$ 5,634,040
Right X	$ 5,754,996	**60%**	$ 5,644,833
Right P	95%	**65%**	$ 5,656,279
Diff X	$ 258,288	**70%**	$ 5,666,782
Diff P	90%	**75%**	$ 5,678,132
#Errors	0	**80%**	$ 5,691,999
Filter Min	Off	**85%**	$ 5,708,607
Filter Max	Off	**90%**	$ 5,727,978
#Filtered	0	**95%**	$ 5,754,996

Change in Output Statistic for TOTAL - Inherent Risk

Rank	Name	Lower	Upper
1	205P2 - General	$ 5,561,493	$ 5,695,274
2	603P2.2 - 100mm	$ 5,567,282	$ 5,687,937
3	405P3.13 - AC-HI	$ 5,585,470	$ 5,669,517
4	206P1 - Imported	$ 5,591,148	$ 5,660,064
5	405P4.12 - AC-HI	$ 5,595,468	$ 5,657,350
6	905P1.1 - Spread	$ 5,600,649	$ 5,656,554
7	- 308P1.2.225.1.	$ 5,603,997	$ 5,651,813
8	603P1.4 - Kerb ar	$ 5,604,289	$ 5,648,658
9	207P1 - Preparati	$ 5,601,914	$ 5,646,065
10	403P2.1 - Traffic	$ 5,603,956	$ 5,645,353

DRAFT

Appendix K

Uriarra Track Crossing Options

D R A F T

Appendix K Uriarra Track Crossing Options

AECOM Australia Pty Ltd
Level 2
60 Marcus Clarke Street
Canberra ACT 2600
Australia
www.aecom.com

+61 2 6201 3000 tel
+61 2 6201 3099 fax
ABN 20 093 846 925

Memorandum

To	Gerard Coffey, Julie Pearson, Nicole Moulston	Page	1
CC	Irena Sharp		
Subject	Uriarra Track Crossing Options - Canberra Brickworks Access and Dudley Street Upgrade		
From	Jane Peters		
File/Ref No.	60533438	Date	23-Jun-2017

As part of the Canberra Brickworks Precinct (CBP) community consultation process, the former LDA established a Community Panel who prepared a set of Precinct Objectives for the LDA's land scale process including the request to retain the Uriarra Track. Uriarra Track is outside the CBP development site and crosses the Access Road into the Canberra Brickworks development. The works associated with the Access Road design and construction up to the CBP development site boundary are being delivered by the Territory and options for the Uriarra Track crossing of the Access Road are therefore being considered as part of this design.

Due to the grade and earthworks for the Access Road the Uriarra Track alignment is located in up to 2m of cut. The track was realigned in the Draft PSP design to take the crossing closer to the roundabout where the cut is much lower and sight distance and pedestrian safety is improved. The feedback onthe Draft PSP design is that the Uriarra Track crossing may need to be located on the existing track alignment.

Four options have therefore been investigated for the Uriarra Track alignment and crossing of the new Canberra Brickworks Access Road. The proposed crossing locations meet sight distance criteria when treated either as an intersection or as a crossing point on the road.

The four options are:

1(a) Retain the existing track alignment and crossing location and flatten and extend the approach cut batters
1(b) Retain the existing track alignment and crossing location and provide stairs
2 Realignment of the track toward the Brickworks with crossing located where cut depth is reduced closer to the Brickworks entrance
3 Pedestrian overpass for the track using single super tee girder

A plan and long section of each option are attached to this memo.

Given that the existing track is not a formal path and does not comply with DDA requirements we have assumed that the crossing does not have to meet DDA requirements.

The modelled path width is 3 m wide for a 2m wide path with 0.5 m shoulder each side.

Option 1a

Option 1a follows the existing Uriarra Track alignment and provides an at-grade crossing perpendicular to the Access Road. The approaches to the crossing are at 6% grade in accordance with maximum requirements under Austroads Guide to Road Design Part 6A Section 7.4.1. The maximum depth of cut at the crossing location is 2.4m. The length of regrading of the track on the approaches is approximately 27 m on each side. The batters each side of the approach are 4 H : 1V (which are mowable).

The sight distance has been assessed for pedestrians crossing the road taking into account the grade of the Access Road and the earthworks.

The total cut volume for this option is 236 m^3. The total fill volume is 3 m^3. The excess cut is 233 m^3 for removal.

Option 1b

Option 1b is similar to Option1a but with six steps on both sides within the batter to reduce the extent of earthworks and improve sight distance due to the stair height enabling a higher viewpoint. The approaches to the crossing are at 6% grade in accordance with maximum requirements under Austroads Guide to Road Design Part 6A Section 7.4.1.

This option also provides an effective speed constraint for cyclists and runners on the track intending to cross the road.

The length of regrading of the track on the approaches is reduced by half from Option 1a to approximately 17 m.

The total cut is 83 m^3. The total fill is 3 m^3. The excess of cut over fill is 80 m^3. This option therefore has a smaller footprint and less environmental impact.

Option 2

For Option 2 the alignment of the crossing has been moved approximately 10 m north of the existing Uriarra Track alignment to tie in to the existing topography and reduce the earthworks. This will also improve sight distance and improve pedestrian safety.

The approaches to the crossing are at 6% grade in accordance with maximum requirements under Austroads Guide to Road Design Part 6A Section 7.4.1. The length of regrading of the track on the approaches is approximately 20 m.

The total cut is 178 m3. The total fill is 4 m3 and the excess of cut over fill is 174 m^3. As this alignment ties into the existing topography the footprint is less than Option 1a and has less environmental impact.

Option 3

Option 3 is an overpass that follows the existing track alignment, approximately 7m above design road level to meet clearance criteria.

The bridge is proposed to be a single span structure, approximately 25m long, over the proposed new Access Road corridor. The superstructure is a single 1m deep super T precast girder with cast in situ concrete deck. The structure is supported on elastomeric bearings sitting on reinforced concrete abutment headstocks, each with twin cast in situ concrete piles. The earthworks of the abutments are supported by a reinforced soil walls to minimise span length.

The design criteria for the bridge is listed below.

Table 1 Proposed bridge design criteria

Design Element	Proposed Criteria
Design standard	AS5100-2017 Bridge Design
Design life	100 years
Path type	Shared path
Deck width	3.0m clear measured between cycle rails
Deck profile	Two way crossfall with kerbs
Drainage	Stormwater contained on deck and directed to bridge ends
Vertical clearance	5.4m minimum over roadway and 2.7m over shared paths

Design Element	Proposed Criteria
Horizontal clearance	Sufficient opening for proposed new Access Road alignment with 3.5m on the western verge for shared path and shared services trench, and 3.0m on the eastern verge for shared path.
Protection screens	Steel mesh arch safety screens enclose bridge deck as it is located above a roadway. At the apex, the safety screen arch is approximately 3.4m above the bridge deck.
Barrier and railings	Protection screens will fulfil barrier requirements. Pedestrian and cycle railings attached to the protection screen frame

The approaches extend approximately 50 m either side of the access road at a general grade of 10%

The structural elements of the bridge utilise high quality concrete elements to minimise future maintenance requirements. The steel screens and railings are galvanised to provide long term protection and are detailed to be replaceable. The bearings are detailed as elastomeric for long life.

Inspection of the bridge can be undertaken on foot from the shared path of the bridge for topside elements and from the shared paths adjacent to the proposed Dudley St for underside of the elements. Inspection of the bearings will require an elevated work platform positioned on the shared path.

Below is a high level cost estimation for the bridge only based on the details provided in the strategic arrangement sketches. This cost estimate does not include elements such as civil works, site establishment and contract management.

Deck length	25.5m
Deck width	3.7m
Deck area	94.4m^2
Bridge unit cost	\$4,500 per m^2 (this is an estimated rate
Estimated bridge cost	\$425k
Contingency	40%
Estimated bridge cost	\$600k

There is minimal additional cut for this option. There is an excess of fill of 1905 m3 required for the approaches and behind the abutments.

This Option has the largest footprint and greatest visual impact. The option also has the highest cost. However, the primary benefit of this option is pedestrian safety.

Conclusion

There is minimal difference with regard to increase in environmental impacts for all four options. There is moderately disturbed Golden Sun Moth Habitat on the southern side of the Uriarra Track which is impacted more by the Access Road than the crossing options.

There are trees both sides of the Access Road. Options 2 and 3 have the greatest impact on the existing trees. Option 2 moves the crossing location 10 m north of the existing through the existing trees and Option 3's large footprint impacts more trees than Options 1a and 1b. Option 2 will have an impact on the high quality and medium quality rating regulated trees whilst Option 1a, 1b and 3 will mostly impact the poor quality and medium quality rating regulated trees.

For the Access Road and Dudley Street Upgrade there is a deficit of material and an additional 6,720 m^3 of imported fill is required. The cut material gained from the Uriarra Track regrading can be used to reduce the deficit of fill. The cost of importing fill is greater than the cost of general earthworks.

We have assumed the path surface treatment on the regraded approaches would be decomposed granite gravel to maintain the informal track appearance.

A high level cost assessment of the options is shown below for comparison purposes. The costs are based on earthwork quantities, decomposed granite gravel path length, landscape of batters, stairs, concrete path for the draft PSP design and the bridge superstructure and include a 40% contingency.

Draft PSP	**Option 1a**	**Option 1b**	**Option 2**	**Option 3**
$53,000	$44,000	$25,000	$34,000	$793,000

Although Option 1b has the lowest cost and environmental impact it is the least functional of the four options investigated. Option 2 has a satisfactory balance between costs especially for cyclists and functionality while minimising environmental impact.

Jane Peters
Associate Director - Civil
jane.peters@aecom.com

Direct Dial: +61 2 6201 3004
Direct Fax: +61 2 6201 3099

PLAN - OPTION 1A

A1 SCALE 1:250

DATUM 583.000

DESIGN LEVELS	584.550	584.211	584.201	584.181	584.161	584.151	584.498
EXISTING LEVELS	584.550	584.548	584.540	584.520	584.499	584.498	584.498
DESIGN OFFSETS	-2.858	-1.500	-1.000	0.000	1.000	1.500	2.889

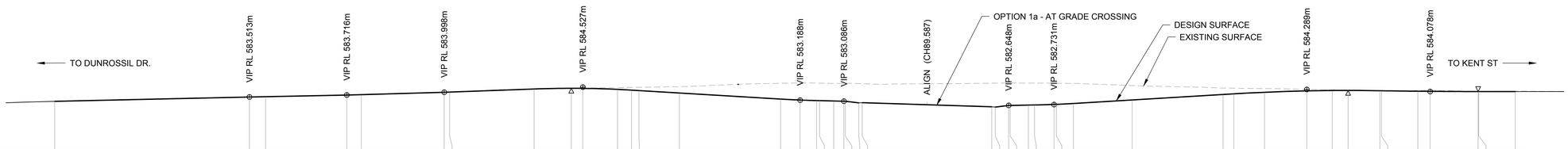
TYPICAL SECTION - S1

DATUM 582.000

DESIGN LEVELS	584.652	583.803	583.793	583.773	583.753	583.743	584.393
EXISTING LEVELS	584.652	584.435	584.437	584.439	584.465	584.465	584.393
DESIGN OFFSETS	-4.896	-1.500	-1.000	0.000	1.000	1.500	4.099

TYPICAL SECTION - S1

TYPICAL CROSS SECTIONS - OPTION 1A

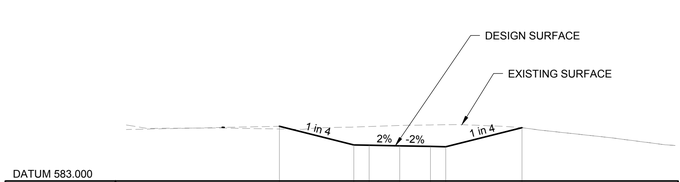


DATUM 578

| | | | | | | |

PLAN - OPTION 1B

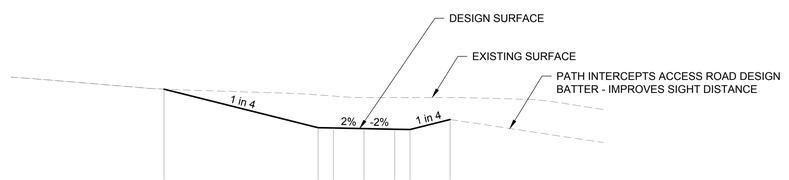
A1 SCALE 1:250



DATUM 583.000

DESIGN LEVELS	584.788	584.181	584.171	584.151	584.131	584.121	584.743
EXISTING LEVELS	584.699	584.763	584.781	584.816	584.832	584.839	584.743
DESIGN OFFSETS	-3.929	-1.500	-1.000	0.000	1.000	1.500	3.989

TYPICAL SECTION - S1

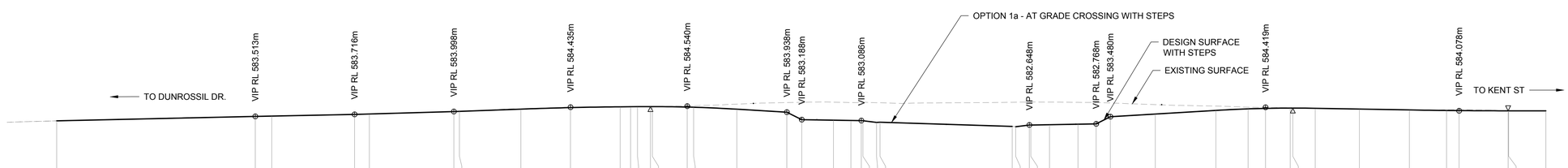


DATUM 582.000

DESIGN LEVELS	585.000	583.743	583.733	583.713	583.693	583.683	584.010
EXISTING LEVELS	585.000	584.811	584.774	584.723	584.724	584.724	584.725
DESIGN OFFSETS	-6.530	-1.500	-1.000	0.000	1.000	1.500	2.808

TYPICAL SECTION - S2

TYPICAL CROSS SECTIONS - OPTION 1B

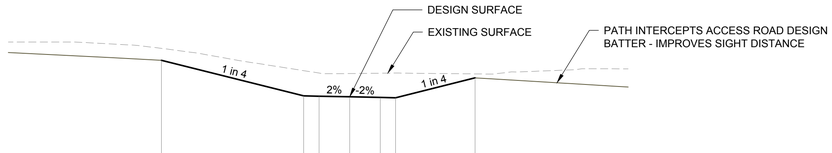


DATUM 578

| | | | | | | |

PLAN - OPTION 2

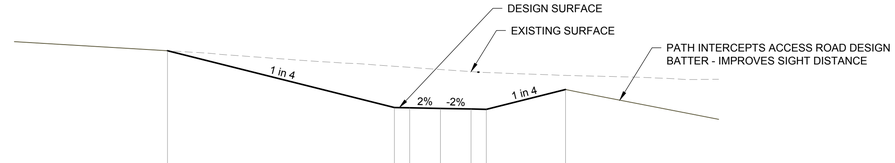
A1 SCALE 1:250



DATUM 582.000

DESIGN LEVELS	585.150	583.989	583.979	583.959	583.939	583.929	584.577
EXISTING LEVELS	585.540	584.813	584.735	584.718	584.729	584.734	584.706
DESIGN OFFSETS	-6.145	-1.500	-1.000	0.000	1.000	1.500	4.094

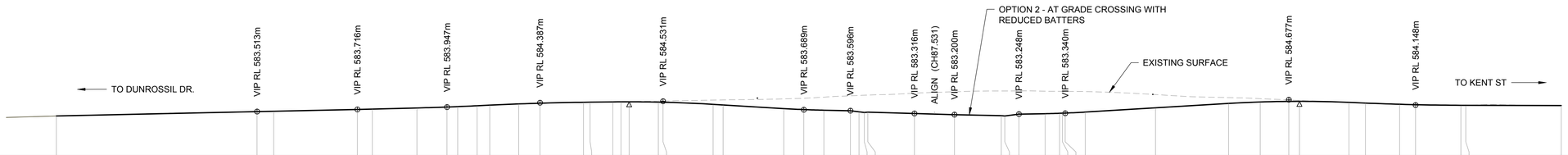
TYPICAL SECTION - S1



DATUM 582.000

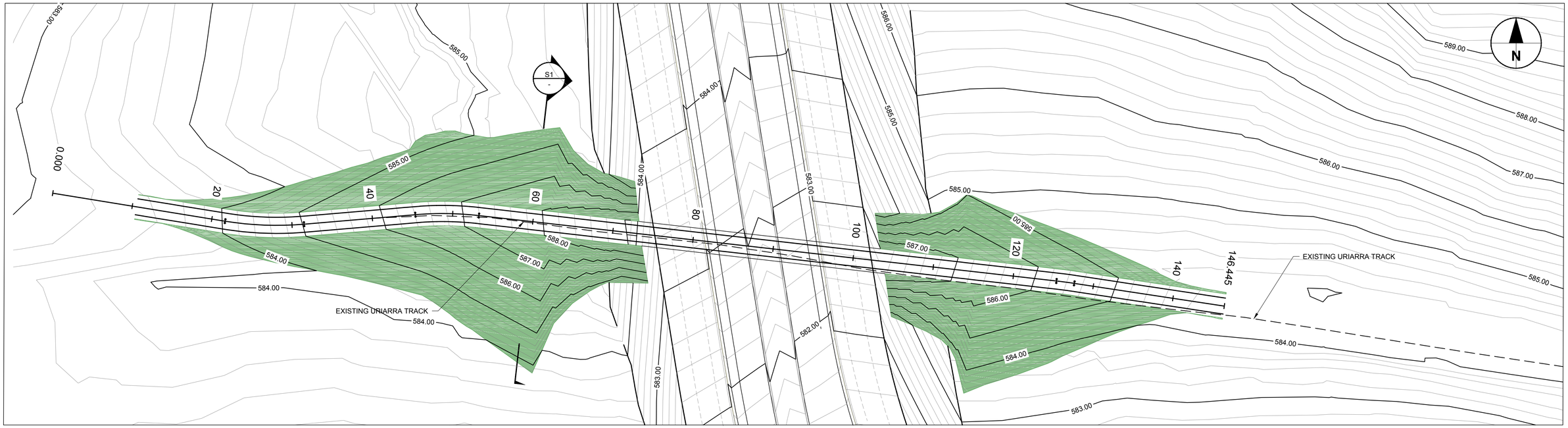
DESIGN LEVELS	585.789	583.937	583.927	583.907	583.887	583.877	584.523
EXISTING LEVELS	585.789	585.283	585.247	585.176	585.107	585.078	584.984
DESIGN OFFSETS	-8.909	-1.500	-1.000	0.000	1.000	1.500	4.085

TYPICAL SECTION - S1



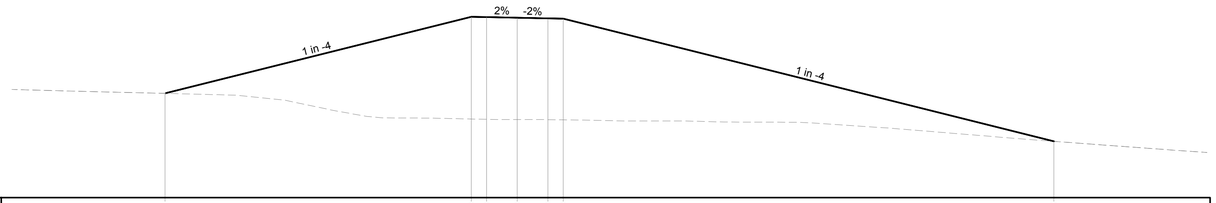
DATUM 579

| | | | | | | |



PLAN - OPTION 3

A1 SCALE 1:250



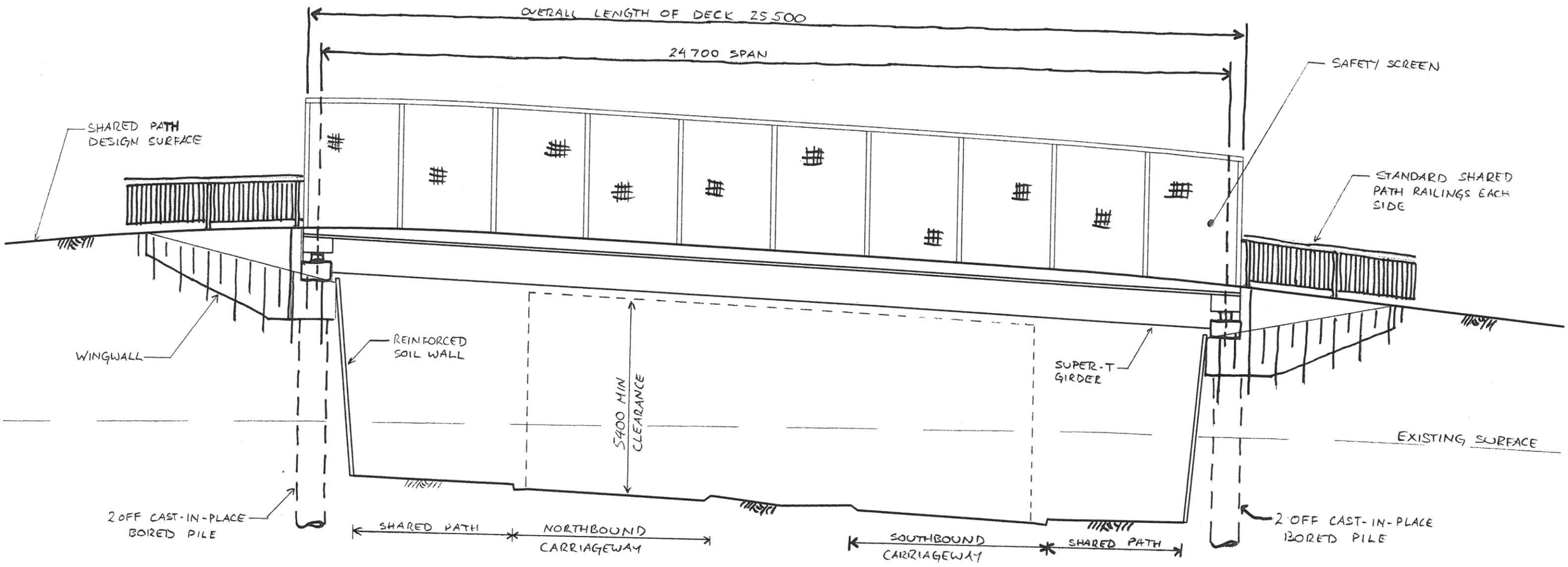
DATUM 582.000

| | | |

OPTION 3 OVERPASS BRIDGE SKETCH

TO DUNROSSIL DR

TO KENT ST

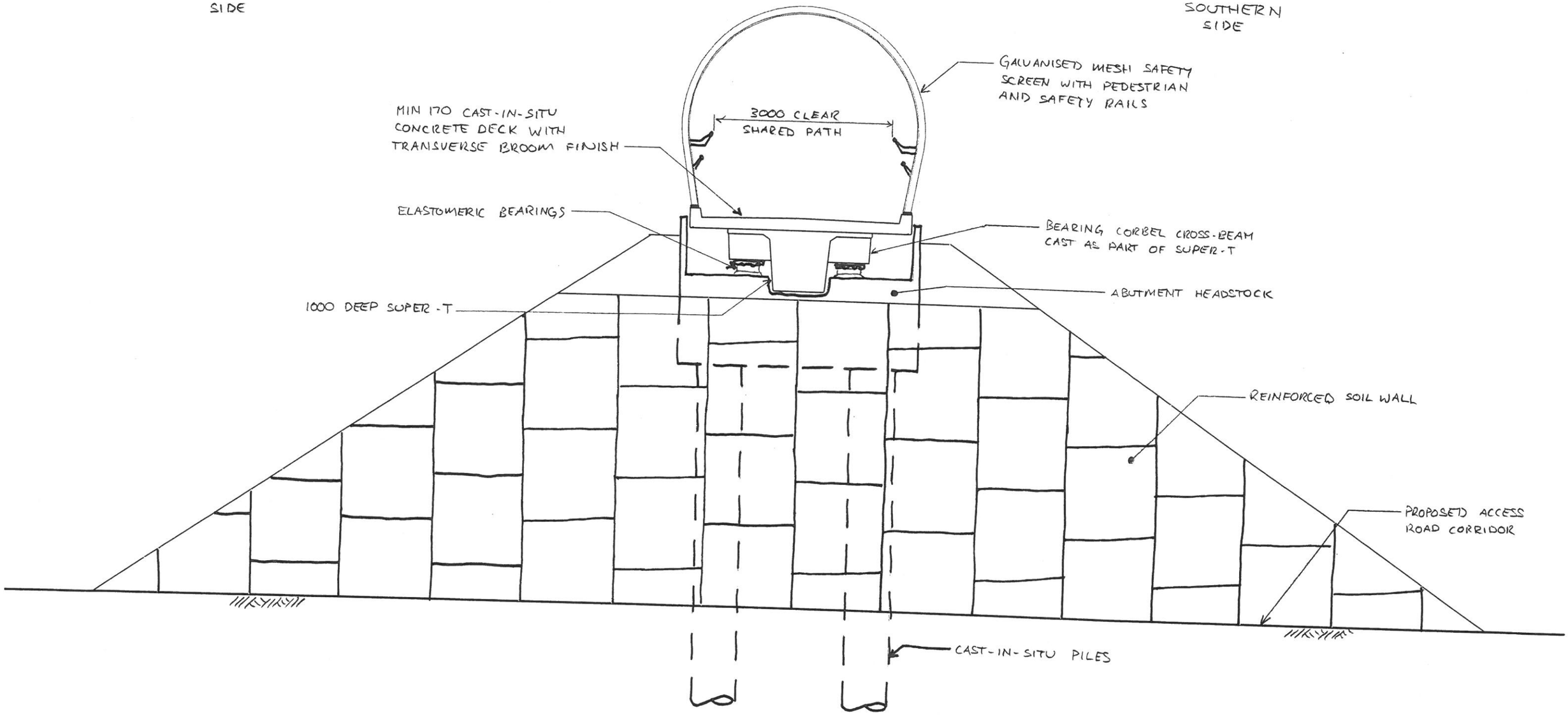


ELEVATION
NOT TO SCALE

NOTES
- DESIGN CODE AS 5100:2017
- DESIGN LOADING 5kPa
- FOR PLAN LAYOUT REFER CIVIL DRAWINGS

NORTHERN SIDE

SOUTHERN SIDE



SECTION

NOT TO SCALE

Kent Street/Novar Street Intersection Upgrade

Traffic options and Analysis Report

P:\CBR\60613743\500_DELIV\580_Other\Traffic\Kent Street Traffic report_V4.docx
Revision A – 05-Mar-2020
Prepared for – Land Release Infrastructure Transport Canberra and City Services – ABN: N/A

Kent Street/Novar Street Intersection Upgrade

Traffic options and Analysis Report

Client: Land Release Infrastructure Transport Canberra and City Services

ABN: N/A

Prepared by

AECOM Australia Pty Ltd
Civic Quarter, Level 4, 68 Northbourne Avenue, GPO Box 1942 ACT 2601, Canberra ACT 2601, Australia
T +61 2 6100 0551 www.aecom.com
ABN 20 093 846 925

05-Mar-2020

Job No.: 60613743

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 AS/NZS4801 and OHSAS18001.

© AECOM Australia Pty Ltd (AECOM). All rights reserved.

AECOM has prepared this document for the sole use of the Client and for a specific purpose, each as expressly stated in the document. No other party should rely on this document without the prior written consent of AECOM. AECOM undertakes no duty, nor accepts any responsibility, to any third party who may rely upon or use this document. This document has been prepared based on the Client's description of its requirements and AECOM's experience, having regard to assumptions that AECOM can reasonably be expected to make in accordance with sound professional principles. AECOM may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified. Subject to the above conditions, this document may be transmitted, reproduced or disseminated only in its entirety.

Quality Information

Document	Kent Street/Novar Street Intersection Upgrade
Ref	60613743
Date	05-Mar-2020
Prepared by	Alex Miles and Tim Nell
Reviewed by	Tim Heffernan

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	05-Mar-2020	Draft Traffic Assessment for Review	Brendan Hogan Traffic Lead	

Table of Contents

Project Summary i
1.0 Introduction 1
1.1 Approach 1
1.2 Purpose of this Report 1
1.3 The Study Area 1
2.0 Previous Studies and Concurrent Projects 2
2.1 Dudley Street Design 2
2.2 Kent Street Feasibility Assessment Concept Design Analysis 2
3.0 Data collection and projections 3
3.1 Traffic Model Development 3
3.2 Traffic data summary 3
3.3 Peak Hour Periods 4
3.4 Traffic movement Summary 4
4.0 Options Testing and Design Optimisation 6
4.1 Options Discussion 6
4.2 Active Travel 6
4.3 Dudley St / Kent St / Novar St / Adelaide Ave on ramp Options 8
4.3.1 Dual right turn from Dudley 8
4.3.2 Signalised left from Kent to Dudley 9
4.3.3 Dual right turn from Kent 10
4.4 Kent Street Bridge 10
1.1 Merge Length 10
4.5 Kent Street / Adelaide Avenue off ramp 11
4.5.1 Priority versus signalised control 11
4.6 Kent Street / Denison Street 12
4.6.1 Banning the Right Turn 12
4.6.2 Square up the intersection of Denison Street and Kent Street 12
4.7 Agreed Layout 13
5.0 Model results 14
5.1 Comparison of preferred scheme against future base (do nothing) 14
6.0 Conclusion 15

Appendix A
Traffic Survey Results A
Dudley Street and Kent Street A
Kent Street / Adelaide Avenue off-ramp / Denison Street C

Appendix B
Approaches to forecast growth rate A
Growth based on SCATs data B-1
Growth based on CSTM Population forecasts B-3
Canberra Strategic Transport Model B-6

Project Summary

AECOM have previously undertaken the detailed design and corresponding Transport Assessment for the Dudley Street upgrade works associated with the development of the proposed Canberra Brickworks Precinct in Yarralumla.

The project identified that while the improvements on Dudley Street would help alleviate the impacts of increased traffic that this pressure would be constrained by nearby intersections, most notably the roundabout at the intersection of Kent Street and Dudley Street. A feasibility study was undertaken to determine the possibly of signalising this intersection to improve capacity and safety in that area.

These works found that in order to signalise this intersection, the two adjacent intersections would also need to be signalised to manage traffic flows over the Kent Street Bridge.

These intersections are:

- Kent Street / Dudley Street / Novar Street / Adelaide Avenue on-ramp
- Kent Street / Adelaide Avenue off-ramp
- Kent Street/ Denison Street

A concept was developed as a basis for further investigations which looked to minimise impacts on existing verges and kerbs. This led to the development of the concept design as shown in Figure 1.

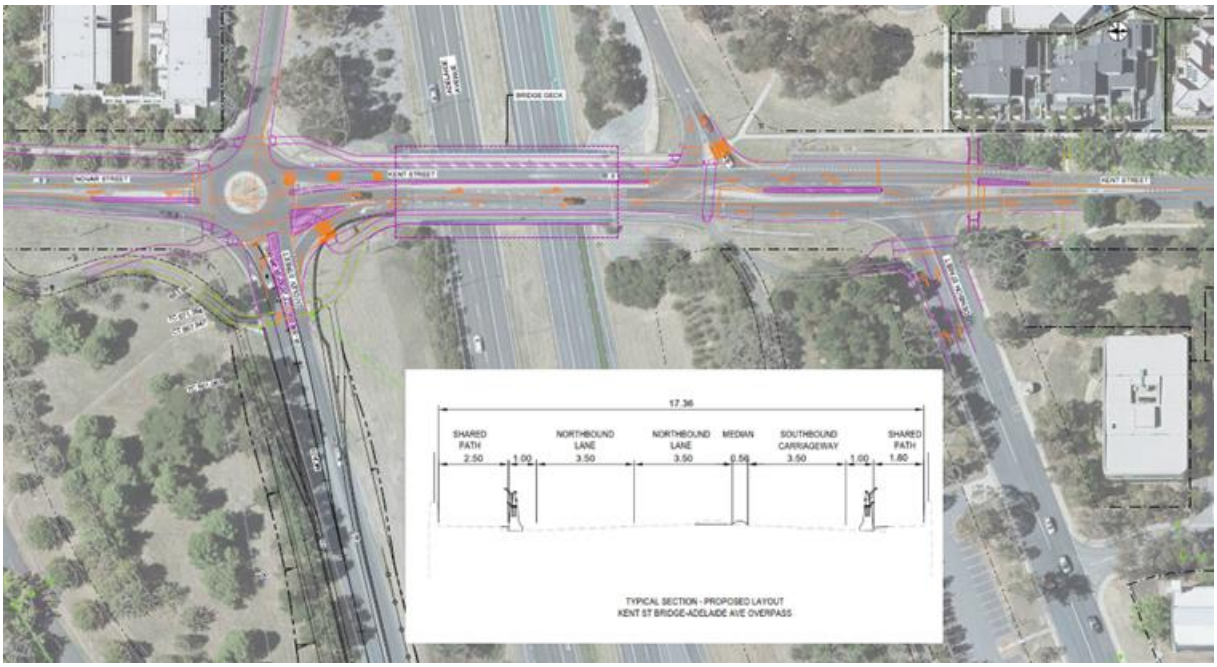


Figure 1: Preliminary concept plan for upgrade of Kent Street Intersections

Key elements of this design included:

- Dedicated right turn lane from Dudley Street and a separate short shared through and left turn lane
- Retention of and minor augmentation of the left slip lane form Kent Street to Dudley Street
- Two southbound lanes on Novar Street – merging to one lane before the bridge due to geometric constraints over the bridge
- A separate right and left lane on the Adelaide Avenue off ramp
- Two northbound lanes on approach to the Denison Street intersection.
- Conversion of three intersections to signalised intersections allowing coordination which is effective due to their proximity.

This feasibility stage concept did not investigate in detail elements of the bridge structures or impacts to all services.

Infrastructure Delivery Partnership Group (IDPG) on behalf of Land Release Infrastructure (LRI) within Transport Canberra and City Services (TCCS) engaged AECOM to undertake a review of concept design and option analysis of Kent Street/Novar Street intersection design developed by AECOM in January 2018.

The key project objective is to improve the safety and efficiency of the three intersections within the project area, namely Novar Street/Dudley Street/Adelaide Avenue on-ramp intersection, Kent Street/Adelaide Avenue off-ramp intersection and Kent Street/Denison Street intersection for all road users (vehicles, pedestrians and cyclists).This report focuses on the traffic and transport aspects of the design testing and documents the methodology, options and recommendation associated with refining the design to inform PSP.

This study built upon this past work and analysed various alternatives to ensure that the network operated efficiently and safely.

It was found that the following design options provided significant benefits over the earlier concept design proposed as part of the Dudley Street Upgrade Works:

- Dual right turning lanes from Dudley Street to Kent Street.
- A longer merge after turning right from Dudley Street to Kent Street - assists both with storage capacity (and hence performance) but also creates a greet offset from manoeuvring points and thus improves safety.
- Banning the right turn from Denison Street onto Kent Street has also been recommended as the movement volume is very low and likely to be delayed if offered. There are several alternative routes for vehicles to utilise should this turn be banned.
- While all intersections are proposed to be signalised the following proposed priority controlled left turns are proposed:
    - Priority controlled left turn from Kent Street to Dudley Street
    - Priority controlled left turn from the Adelaide off-ramp onto Kent Street.

The analysis in the Aimsun model showed the existing layout was not expected to cope with the increased traffic demands in the future and a large number of vehicles were unable to enter the network during the simulation period due to the large level of queuing on some legs particularly Dudley Street and Novar Street. The proposed PSP layout showed an improvement with all vehicles being able to navigate the study area and no vehicles waiting to enter the network.

The agreed PSP layout is shown in Figure 2.

Figure 2 PSP Layout

1.0 Introduction

1.1 Approach

AECOM has utilised an Aimsun microsimulation model to better understand, investigate and predict the operation of the following intersections in the future:

- Dudley Street / Novar Street/Kent Street /Adelaide on-ramp
- Kent Street/Adelaide Avenue off-ramp
- Kent Street/Denison Street

The base modelling and existing count information including calibration and validation was carried out as part of the feasibility works previously undertaken. Since that time changes to the Canberra Strategic Model (CSTM) forecasts and known developed in the area can provide a better reflection of expected future conditions and have been assessed in the development of the network testing and layout optimisation considering safety capacity and constructability.

Further information is provided in Section 2.0.

1.2 Purpose of this Report

This report provides a summary of the key assumptions, outputs and recommendations from the traffic analysis undertaken to inform the PSP design for the Kent Street upgrades.

1.3 The Study Area

Location of the study area is shown in Figure 3. It considers the approach routes to the three intersections and extends back along Dudley Street to enable visualisations of the queuing extents and network behaviour.

Figure 3: Study Area Extents

2.0 Previous Studies and Concurrent Projects

2.1 Dudley Street Design

AECOM have previously undertaken the detailed design and corresponding Transport Assessment for the Dudley Street upgrade works associated with the development of the proposed Canberra Brickworks Precinct in Yarralumla.

The project identified that while the improvements on Dudley Street would help alleviate the impacts of increased traffic that this pressure would be constrained by nearby intersections most notably the roundabout at the intersection of Kent Street and Dudley Street.

2.2 Kent Street Feasibility Assessment Concept Design Analysis

A feasibility study was undertaken to determine the possibly of signalising this intersection to improve capacity and safety in that area.

These works found that in order to signalise this intersection, the two adjacent intersections would also need to be signalised to manage traffic flows over the Kent Street Bridge.

These intersections are:

- Kent Street / Dudley Street / Novar Street / Adelaide Avenue on-ramp
- Kent Street / Adelaide Avenue off-ramp
- Kent Street/ Denison Street

A concept was developed as a basis for further investigations which looked to minimise impacts on existing verges and kerbs.

A concept design was established as part of a previous Traffic and Transport Assessment undertaken for the Dudley Street upgrade works associated with the development of the proposed Canberra Brickworks Precinct in Yarralumla. The project identified that while the improvements on Dudley would help alleviate the impacts of increased traffic that this pressure would be constrained by nearby intersections most notably the roundabout at the intersection of Kent Street and Dudley Street. The transport analysis found that the existing intersections were already approaching capacity and therefore a concept design was produced to help improve this.

Key elements of the previous feasibility design included:

- Dedicated right turn lane from Dudley Street and a separate short shared through and left turn lane
- Retention of and minor augmentation of the left slip lane form Kent Street to Dudley Street
- Two southbound lanes on Novar Street – merging to one lane before the bridge due to geometric constraints over the bridge
- A separate right and left lane on the Adelaide Avenue off ramp
- Two northbound lanes on approach to the Denison Street intersection.
- Conversion of three intersections to signalised intersections allowing coordination which is effective due to their proximity.

3.0 Data collection and projections

3.1 Traffic Model Development

As part of the review of the Kent Street Design the traffic previous traffic forecasts for the network are being reviewed. This review allows consideration post construction of the Cotter Road duplication and the updated Canberra Strategic Model (CSTM) forecasts. It provides better certainty on the future traffic volumes to the community and other stakeholders. The future model outputs have also been revised to align with current TCCS requirements which were not developed at the time of the previous works.

The focus of these traffic works are the optimisation of the future layout. There was agreement that with the new intersection layouts and control mechanisms (sign control to signals), the project team was not required to revisit the base case calibration or validation of the model nor get updated base count information. The base calibration previously approved by TCCS and the process and count information remain valid for these works.

These refined forecast values were used to assess the concept suitability in line with civil constraints and safety considerations. This will help ensure a safe efficient design. The review indicated that most approaches had a slightly higher volume that the previous projections.

This report outlines the selected growth rate assumptions and data used for forecasting the growth rate in the vicinity of the Kent Street and Novar Street intersection.

The traffic modelling package used to assess this job is Aimsun. An origin destination matrix was developed based on count data. The model achieved 100% GEH less than 5.

3.2 Traffic data summary

Intersection traffic counts were undertaken by Trans Traffic Survey in 2017 for each of the key intersections considered in the Kent Street network distribution model. These intersections were as follows:

1. Dudley Street / Novar Street/Kent Street /Adelaide on-ramp
2. Kent Street/Adelaide Avenue off-ramp including Denison Street

The turning movements for intersection 2 were rationalised as one data set to determine number of through traffic movements directly from off-ramp to Denison Street.

These intersection counts were undertaken in both the AM and PM peak periods and the raw data can be found in Appendix A.

For the modelling undertaken, a growth rate of 1.3% has been used. This growth rate has been based on three alternative approaches which are shown in Appendix B. A summary of the approaches is shown in Table 1.

Table 1:Summary of approaches to forecast growth rate

Approach	Growth Rate (per annum)
SCATS data and comparative assessment	1%
Canberra Strategic Transport Model (CSTM) volume projections	1.3%
CSTM land use forecast values	1.5%

Based on the review of the various approaches and datasets a rate of 1.3% was chosen per annum between 2016 to 2031.

3.3 Peak Hour Periods

The count data identified the same peak hour period for the network at each of the sites. This was:

- AM Peak Hour - 8:15 am to 9:15 am
- PM Peak Hour - 4:45 pm to 5:45 pm

These peak hour periods have been adopted for the modelling and reporting.

3.4 Traffic movement Summary

The hourly model flow values for each peak are shown in Figure 4 and Figure 5.

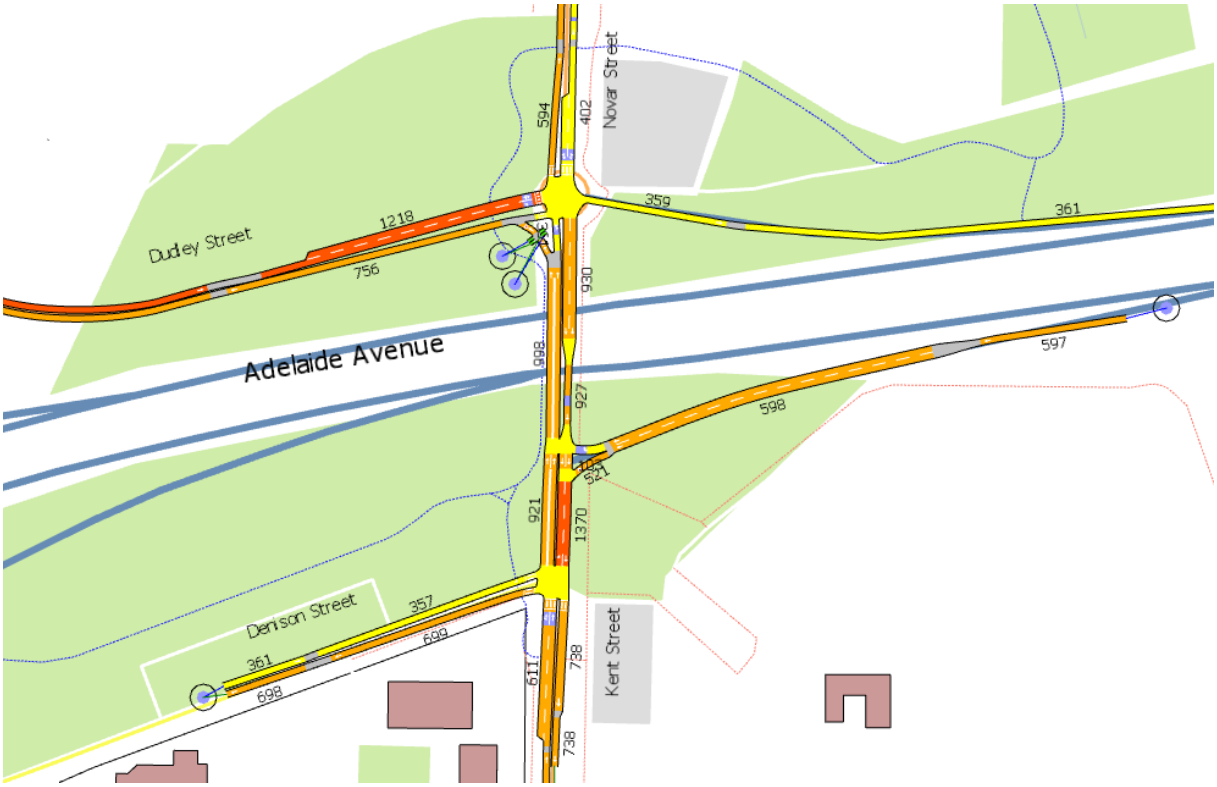


Figure 4: AM Peak Hour Traffic Volumes

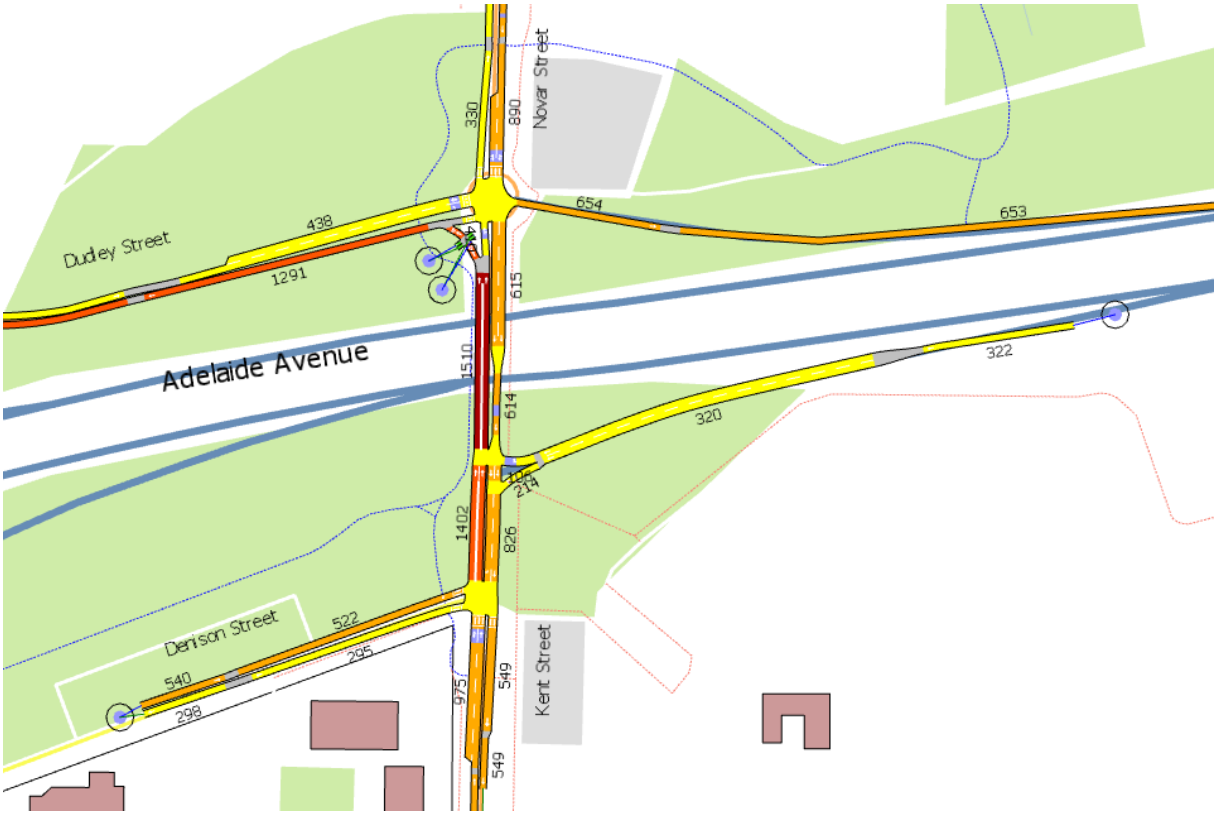


Figure 5: PM Peak Hour Traffic Volumes

4.0 Options Testing and Design Optimisation

4.1 Options Discussion

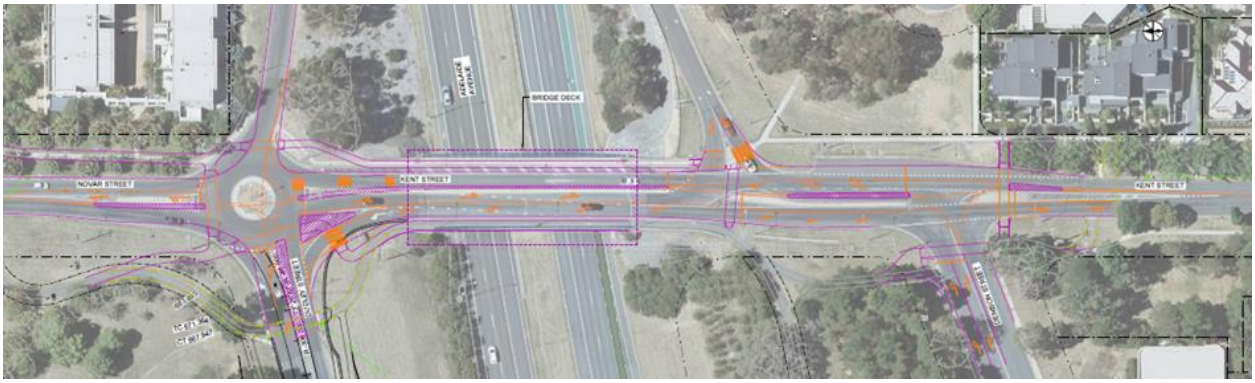
In undertaking the review, a number of options were considered based on safety, capacity and constructability. Locations where changes in geometry and layout we assessed were:

- Dudley Street / Kent Street / Novar Street / Adelaide Avenue on ramp
- Kent Street bridge (lane configurators and widths)
- Kent Street / Adelaide Avenue off ramp
- Kent Street / Denison Street

The changes were based on testing more detailed survey and utility conflict information, active travel consolidation, wayfinding improvements and further refinement on expected traffic volumes and distributions when comparing the previous forecasts.

The previous arrangement is shown in Figure 6 below.

Figure 6 Previous Concept Design



Each intersection and associated options are discussed in the sections below.

4.2 Active Travel

The proposed facilities are to prioritise the key links and provide safe and efficient crossings-interaction of the safety and capacity of all users and vehicles given the tight geometric constraints across the bridge were reviewed. The facilities are provided as a high standard in terms of width, connectivity, lighting and crossing facilities with intuitive way finding and connectivity.

Based on this review, the active travel network has been rationalised. Figure 8 showcases the proposed improvements to the path network. The paths proposed to be removed are shown in red on Figure 7 whilst additional new paths are shown in green on Figure 8.

The pedestrian links proposed to be removed are indicated by circled letters on Figure 7. This is primarily about removing the path connection to the east side of the bridge where there are issues with safety, visibility, lighting and high levels of probable conflict with limited pedestrian demand. All active travel road crossings adjacent the bridge will now be signalised to provide safe, controlled crossing points.

The below points summarise the locations and comments:

- Pram ramps at the Adelaide Avenue off-ramp/Kent Street intersection (location A) – safety and connectivity issues.
- Pedestrian refuge on Kent Street at the Kent Street/Denison Street intersection (location B) – being substituted with a signalised crossing 10 m to the west.
- Pedestrian refuge on Dudley Street (location C) – being substituted with a signalised crossing 10 m to the north.
- Pram ramps at the Adelaide Avenue on-ramp/Kent Street intersection (location D) – safety and connectivity issues.

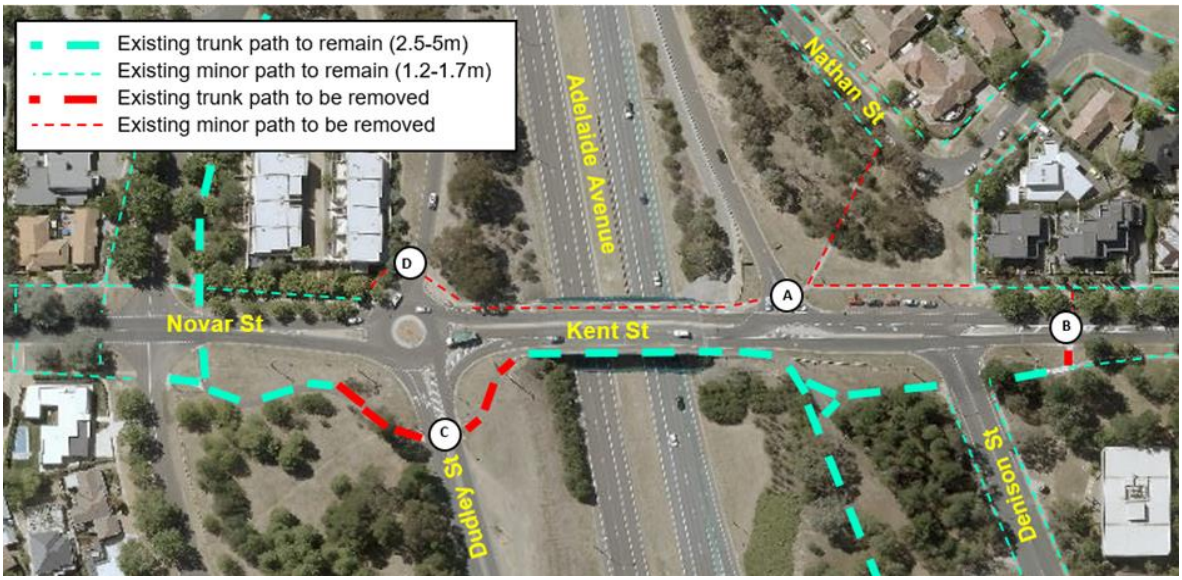


Figure 7 Existing paths and crossings to be removed

The pedestrian facilities proposed to be added are indicated by circled letters on Figure 8 below:

- Crossing at the northern leg of the Novar Street/Kent Street intersection (location E);
- Crossing at the western leg of the Novar Street/Kent Street intersection (location F);
- Crossing at the left-turn slip lane at Novar Street/Kent Street intersection (location G);
- Crossing on Kent Street at the Kent Street/Denison Street intersection (location H).

In addition, it is proposed to merge the on-road cycling lane at the Adelaide Avenue off-ramp to the existing off-road cycle path along Nathan Street.

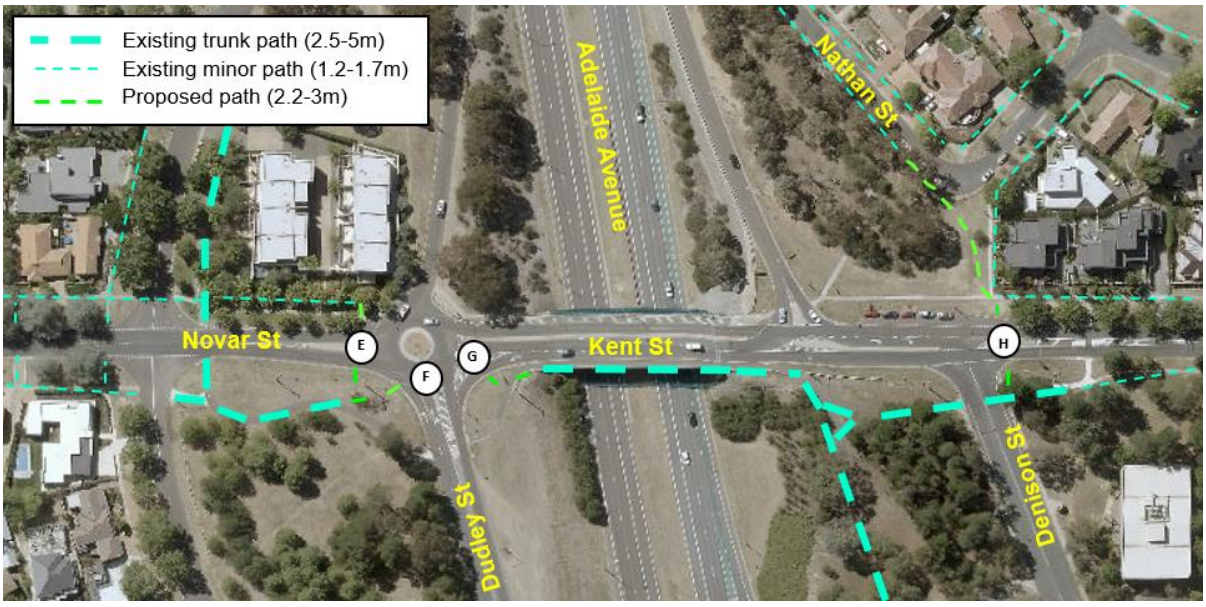


Figure 8 Proposed paths

The current principal cycling route is shown in dark blue in Figure 9. Cyclists currently travel along the Adelaide Avenue off-ramp, merge with cars and cross the Kent Street intersection to end up on the western verge of the bridge. Cyclists travel along the Kent Street bridge, cross at Dudley Street and then cross further up again just before the Kintore Crescent/Guilfoyle Street intersection to connect to the path along the southern side of Guilfoyle Street.

If the changes described in the above section are implemented, the principal cycling route would be affected. The future principal cycling route is shown in green in Figure 9. Cyclists would exit the Adelaide Avenue on-road cycling lane using a new ramp, travel along the off-road path on Nathan Street and arrive at the Kent Street/Denison Street intersection crossing (location H).

Figure 9 Current and future principal cycling route

The changes will enable:

- Improved safety for cyclists existing Adelaide Avenue on-road cycling lane.
- Easier route of travel from Adelaide Avenue to Kent Street (the gradient along Nathan Street is flatter than along the Adelaide Avenue off-ramp).
- Maximised traffic efficiency at the Adelaide Avenue off-ramp/Kent Street intersection.
- The removal of the Kent Street roundabout will enable prioritised signalised crossings at the road junction.

4.3 Dudley St / Kent St / Novar St / Adelaide Ave on ramp Options

4.3.1 Dual right turn from Dudley

A key constraint of the network was the right-turn from Dudley Street across the bridge. Accordingly, one option that was considered was the potential of allowing a dual turning lane from Dudley Street turning right onto Kent Street. This was tested to provide more capacity for the heavy volume movement and enable more effective green time to be given to other approaches when compared to one right turn lane. The dual right is recommended as it provides additional network capacity and reduced queuing as shown by the Aimsun results in Table 2.

Table 2: Aimsun results for the effect of dual turning lanes compared against a single turning lane

Average Network Delay (s)	Dudley Approach configuration	
	Single right turn	Dual right turn
AM	136.1	68.5
PM	67.1	44.8

4.3.2 Signalised left from Kent to Dudley

Another option that was considered was to provide a signalised left turn from Kent Street to Dudley Street, rather than providing a left slip lane. This was considered as it was seen to reduce conflict with active travel movements and could enable two through northbound lanes. Layouts are shown in Figure 10.

Figure 10: Change in layout to test the effectiveness of providing a signalised left turn lane from Kent Street to Dudley Street

Average Network Delay (s)	Dudley Approach configuration	
	Signalised Left	Left Slip Lane
AM	150.9	84.5
PM	441.22	80.8

The model showed that the signalisation of the free left resulted in significant queuing and delays for that approach and had considerable downstream impacts. Having the heavy PM left turn movement outside of the signals assisted with minimising queuing across the bridge and was seen to provide a better outcome when balanced across all users.

Based on the changes to pashing, the signalisation of the left turn did not necessarily reduce delays to active travel movements and in some instances increased it.

4.3.3 Dual right turn from Kent

An option that was considered was the provision of a dual right turn from Kent Street to the Adelaide Avenue on-ramp. It was found that there was insufficient width to allow for the provision of an additional lane (which would also be short) while still allowing for the dual right turn movement from Dudley Street to Kent Street. The dual right turn lane from Dudley Street t Kent Street was considered a higher priority due to the heavy traffic demand utilising this movement.

4.4 Kent Street Bridge

1.1 Merge Length

Two options have been modelled to reflect options assessed relating to the bridge layout and lane configurations. There were several sub sets of the bridge options but they can be largely classified as a wider southbound section for most of the bridge (the merge function can happen on the bridge) or one southbound lane over the bridge (where the merge has to happen before the bridge). These have been approximated as a 65m merge length or a 20m merge length.

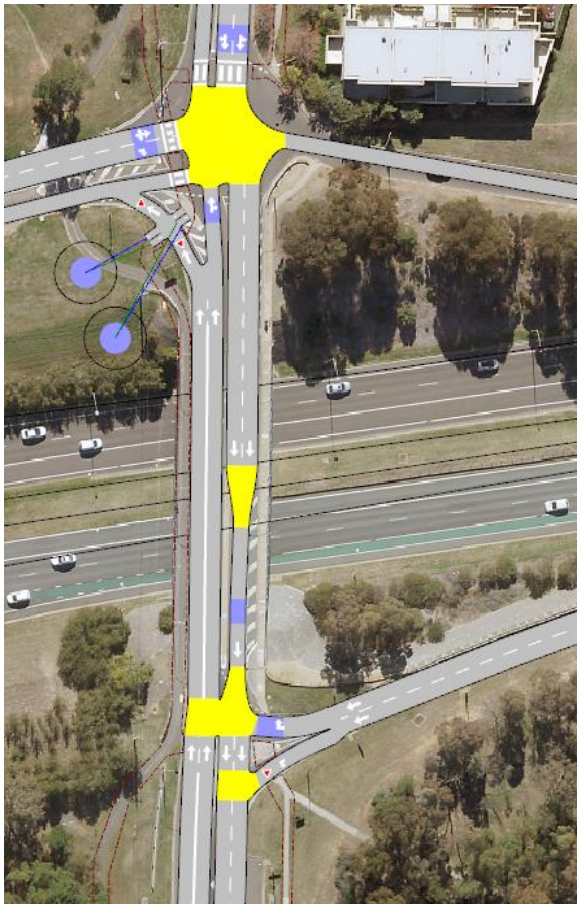


Figure 11: 65m merge movement length

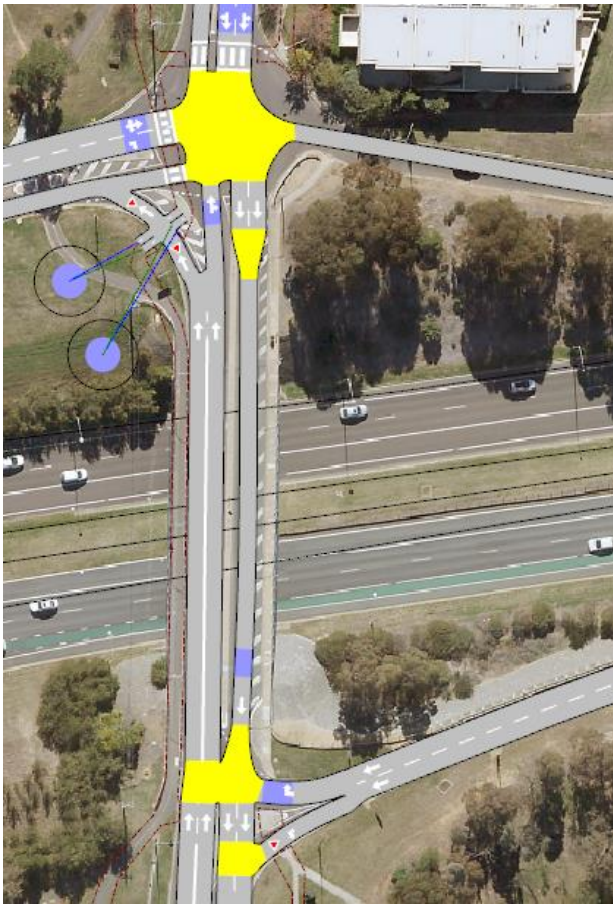


Figure 12: 20 m merge movement length

From a safety perspective the long merge is a far better outcome as it separates the right turn movement and merge function so drivers only have to concentrate on one manoeuvre at a time. The longer merge also enables greater queue spaces, capacity and a longer length over which vehicles can merge further reducing the potential for conflict.

Table 3 presents results for the effect of merge lengths. The longer merge lead to a lower level of delay in both the AM and the PM peak. It is more noticeable in the AM peak.

Table 3: Aimsun Modelling Network Results for merge lengths

Average Network Delay (s)	Merge length comparisons	
	Short Merge	Long Merge
AM	109.9	84.4
PM	83.97	80.8

4.5 Kent Street / Adelaide Avenue off ramp

As outlined in the active travel section, it is proposed that the pedestrian footpath on the eastern side of the bridge is consolidated, shifting demand to the upgraded path on the western side of the bridge. This also has the following benefits to the network:

- It is possible to improve the performance greatly at the intersection of Kent Street and the Adelaide off-ramp by removing a signal phase.
- Crossing the Adelaide On-Ramp on the northern side of the bridge can be avoided also leading to a reduced complexity in the phasing.
- Improved pedestrian safety reducing exposure and converting all crossings to pedestrian priority or signals.

4.5.1 Priority versus signalised control

The control placed on this intersection is important to the intersections operation as it has a strong interplay with other movements crossing the bridge. By signalising it is possible to coordinate the signals better and ensure that there is space for the larger movements in the model but utilizing priority control allows the vehicles to pick gaps.

A comparison of either a signalised or priority controlled left lane at the top of the Adelaide off-ramp is provided below in Table 4 for both merge lengths.

Table 4: Aimsun Modelling Network Results for Adelaide off-ramp intersection control effects

Average Network Delay (s)	Left turn control	
	Signalised	Priority Controlled
AM	227.8	126.7
PM	109.5	87.2

Priority control leads to much lower average network delays for the network and therefore it is the preferred option. A priority controlled left turn in this location is believed to be a safe movement as vehicles only need to pick gaps in a single lane of traffic. The priority control maximises the ability for vehicles to pick gaps where appropriate and with larger gaps provided by the signals at the intersection of Dudley street and Novar Street. The right turn was signalised in both scenarios for safety and capacity reasons.

4.6 Kent Street / Denison Street

4.6.1 Banning the Right Turn

Consideration was given to banning the right turn out of Denison Street. By removing the right turn it is expected that vehicle operation in this area can be improved dramatically as this reduces the number of phases that are present at the intersection of Kent Street and Denison Street.

The ban is believed to be possible as there are only 17 vehicles in the AM and 20 in the PM expected to be making this movement over a three-hour period. These numbers are low and there are other network links south that can be taken by these vehicles including Denison Street (South) and Geils Court.

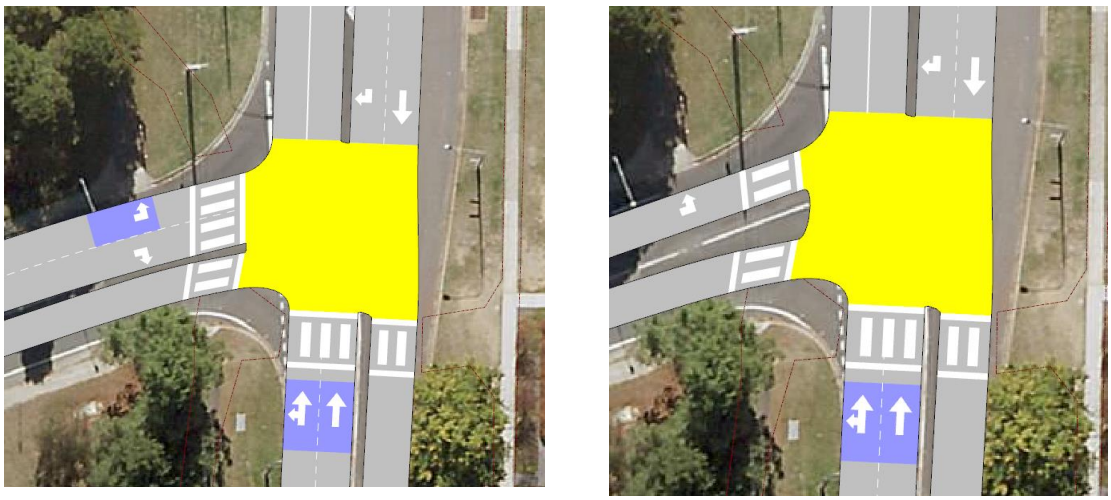


Figure 13: Comparison of geometry with right turn versus right turn ban

Figure 13 presents results for both the effect of merge lengths as well as the effect of banning the right turn. The longer merge and banning the right turn both lead to a lower level of delay in both the AM and the PM peak.

Table 5: Aimsun Modelling Network Results for merge lengths and right turn ban effects

Average Network Delay (s)	Right turn provision	
	Right Allowed	No Right Turn
AM	227.8	84.4
PM	109.5	80.8

By removing the right out and simplifying the phasing it saved almost 100 seconds in average network delays as it impacts on three critical movements being the east bound, west bound and right-turn in movements.

4.6.2 Square up the intersection of Denison Street and Kent Street

One option which was considered, but not recommended, was to square up the intersection at Denison Street and Kent Street. The primary goal of this is to increase the distance between the Kent Street and Adelaide Avenue off-ramp intersection to provide additional storage and time to merge.

This option is not recommended as the safety improvement and capacity improvement are relatively minor and the realignment of the intersection would be a relatively costly option and impact services and vegetation.

4.7 Agreed Layout

The agreed layout is shown in Figure 14 and is characterised by three signalised intersections with the following noteworthy inclusions:

- Dual right turn lanes from Dudley Street to Kent Street over the bridge
- Long merge length southbound on bridge.
- Pedestrian crossing provided on southbound side of the bridge.
- Right turn ban for vehicles exiting Denison Street.
- Left slip lane from Kent Street to Dudley Street.

The extent of two lane approaches in the traffic model reflects observed operation where traffic used wider single lane carriageways (around 6+m) as two lanes.

Figure 14: PSP Layout

5.0 Model results

5.1 Comparison of preferred scheme against future base (do nothing)

The results of the modelling of the proposed layout compared to the future base (do nothing) results are shown below in Table 6.

The models outputs presented below include:

- Average delay
- Vehicles waiting to enter the network

Table 6 Aimsun model results

Scenario	Peak	Average Delay (s)	Vehicles Waiting to Enter
Base	AM	241	898
	PM	83	217
PSP Layout	AM	86	0
	PM	82	0

*Colours based on scale indicating the smallest and largest results found during modelling.

It can be seen that the average delays improve between the base scenario and the proposed PSP layout. The base model suffers from congestion on Dudley Street attempting to turn right onto Kent Street which causes both Novar Street and the Adelaide Off-ramp to backup. This eventually leads to high numbers of vehicles that are unable to enter the network during the simulation which lasts from 7am to 10am during the AM model.

Analysing the vehicles that are unable to enter the network provides an important measure to understand the congestion present in the various models. As delay times are only recorded after vehicles have travelled over the road a model that represents heavy congestion may report unstable and erroneous values for delay times. For these reasons, a low number of unreleased vehicles represents a stable model that accurately reflects the vehicle movements in the model.

The proposed PSP layout allows all vehicles through the network in both the AM and PM cases indicating a substantial improvement over the base. This is possible largely due to the coordinated signals between the three intersections which are tightly related and also due to the dual right turn from Dudley onto Kent Street.

The base conditions utilise a roundabout and priority-controlled intersections and therefore there is no phasing associated with the base case.

In the proposed PSP design all three of these intersections have been signalised largely due to the heavy interaction between them. By signalising these movements, it is possible to coordinate these signal phases to get the most out of the existing bridge asset which is necessary to ensure a good outcome. Signalising the intersection of the Adelaide off-ramp and Kent Street was also seen as desirable from a safety point of view due to the crest and the closeness to the intersection of Denison Street and Kent Street.

6.0 Conclusion

This assessment has outlined the development of the PSP layout for the intersections of:

- Kent Street /Dudley Street
- Kent Street / Adelaide Off-ramp
- Kent Street / Denison Street

Due to the proximity of these intersections coordinated signals allow for better performance then the existing roundabout and priority-controlled intersections.

A concept design was established as part of a previous Traffic and Transport Assessment undertaken for the Dudley Street upgrade works associated with the development of the proposed Canberra Brickworks Precinct in Yarralumla. It was found that through a more detailed assessment of geometry, and confirmation about bridge options, that a layout could be developed that provided benefits over the earlier concept design proposed as part of the Dudley Street Upgrade Works. The improvements include:

- Dual right turning lanes from Dudley Street to Kent Street.
- A longer merge after turning right from Dudley Street to Kent Street.
- Banning the right turn from Denison Street onto Kent Street.
- While all intersections are proposed to be signalised the following proposed priority controlled left turns are proposed:
    - Priority controlled left turn from Kent Street to Dudley Street
    - Priority controlled left turn from the Adelaide off-ramp onto Kent Street.

An Aimsun model showed the existing layout was not expected to cope with the increased traffic demands in the future and a large number of vehicles were unable to enter the network during the simulation period due to the large level of queuing on some legs particularly Dudley Street and Novar Street. The proposed PSP layout showed an improvement with all vehicles being able to navigate the study area and no vehicles waiting to enter the network.

Appendix A

Traffic Survey Results

Appendix A Traffic Survey Results

All counts were undertaken by Trans Traffic Survey on Wednesday the 21st of the June 2017.

Dudley Street and Kent Street

Light Vehicles

Time		North Approach Novar St				East Approach Adelaide Ave				South Approach Novar St				West Approach Dudley St			
Period Start	Period End	U	R	SB	L	U	R	WB	L	U	R	NB	L	U	R	EB	L
7:00	7:15	0	6	11	5	0	0	0	0	1	23	23	20	0	51	0	18
7:15	7:30	0	12	10	4	0	0	0	0	0	39	26	18	0	85	3	34
7:30	7:45	0	16	11	4	0	0	0	0	0	35	27	23	0	105	2	36
7:45	8:00	0	23	27	4	0	0	0	0	0	92	19	32	0	146	0	43
8:00	8:15	0	15	25	13	0	0	0	0	0	102	28	32	0	133	2	55
8:15	8:30	0	25	35	15	0	0	0	0	0	99	26	29	1	145	5	79
8:30	8:45	0	16	26	7	0	0	0	0	0	98	37	29	0	131	2	75
8:45	9:00	0	25	28	6	0	0	0	0	0	139	44	36	0	124	5	75
9:00	9:15	0	11	41	12	0	0	0	0	0	126	48	42	0	135	1	66
9:15	9:30	0	22	38	9	0	0	0	0	0	74	43	31	0	143	0	41
9:30	9:45	0	16	27	7	0	0	0	0	0	77	42	27	0	74	0	46
9:45	10:00	0	17	27	12	0	0	0	0	0	59	46	30	0	65	0	35
15:30	15:45	1	36	50	46	0	0	0	0	0	92	34	91	0	42	1	29
15:45	16:00	0	22	31	29	0	0	0	0	0	73	29	74	0	37	2	25
16:00	16:15	0	41	24	32	0	0	0	0	0	73	35	111	0	50	0	25
16:15	16:30	0	37	52	30	0	0	0	0	0	82	32	103	0	49	0	20
16:30	16:45	0	28	44	32	0	0	0	0	0	109	33	136	0	41	1	24
16:45	17:00	0	36	30	30	0	0	0	0	0	100	31	132	0	44	1	21
17:00	17:15	0	57	50	39	0	0	0	0	0	123	32	166	0	44	2	22
17:15	17:30	0	52	53	75	0	0	0	0	0	120	50	139	0	50	2	30
17:30	17:45	0	44	77	72	0	0	0	0	0	95	49	129	0	47	1	22
17:45	18:00	0	23	58	39	0	0	0	0	0	73	64	71	0	49	3	31
18:00	18:15	0	28	38	41	0	0	0	0	0	72	34	90	0	41	5	32
18:15	18:30	0	21	21	18	0	0	0	0	0	55	33	49	0	34	1	16

Heavy Vehicles

Time		North Approach Novar St				East Approach Adelaide Ave				South Approach Novar St				West Approach Dudley St			
Period Start	Period End	U	R	SB	L	U	R	WB	L	U	R	NB	L	U	R	EB	L
7:00	7:15	0	1	1	0	0	0	0	0	0	0	2	2	0	1	0	0
7:15	7:30	0	1	2	0	0	0	0	0	0	2	1	0	0	1	0	0
7:30	7:45	0	0	1	0	0	0	0	0	0	1	0	0	0	2	0	0
7:45	8:00	0	0	1	0	0	0	0	0	0	0	1	1	0	1	0	2
8:00	8:15	0	0	3	0	0	0	0	0	0	1	4	1	0	0	0	0
8:15	8:30	0	2	1	0	0	0	0	0	0	2	2	0	0	0	0	3
8:30	8:45	0	1	2	2	0	0	0	0	0	2	2	2	0	0	0	1
8:45	9:00	0	1	1	0	0	0	0	0	0	2	2	0	0	1	0	0
9:00	9:15	0	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0
9:15	9:30	0	0	3	0	0	0	0	0	0	1	2	0	0	2	0	1
9:30	9:45	0	1	3	0	0	0	0	0	0	2	1	0	0	1	0	2
9:45	10:00	0	0	1	1	0	0	0	0	0	0	3	3	0	3	0	0
15:30	15:45	0	0	1	1	0	0	0	0	0	1	2	2	0	1	0	3
15:45	16:00	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
16:00	16:15	0	1	2	1	0	0	0	0	0	2	1	0	0	0	0	0
16:15	16:30	0	0	1	1	0	0	0	0	0	1	1	0	0	1	0	0
16:30	16:45	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
16:45	17:00	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
17:00	17:15	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1
17:15	17:30	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
17:30	17:45	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45	18:00	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0
18:00	18:15	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
18:15	18:30	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0

Kent Street / Adelaide Avenue off-ramp / Denison Street

Light Vehicles

Time		North Approach Kent St				East Approach Adelaide Ave				South Approach Kent St				West Approach Denison St			
Period Start	Period End	U	R	SB	L	U	R	WB	L	U	R	NB	L	U	R	EB	L
7:00	7:15	0	20	43	0	0	12	15	25	0	0	50	2	0	1	0	5
7:15	7:30	0	51	44	0	0	6	20	35	0	0	69	1	0	2	0	8
7:30	7:45	0	58	58	0	0	6	25	34	0	0	61	1	0	1	0	18
7:45	8:00	0	87	86	0	0	6	30	38	0	0	116	0	0	0	0	21
8:00	8:15	0	74	84	0	0	14	38	58	0	0	120	2	0	0	0	28
8:15	8:30	0	92	88	0	0	14	50	53	0	0	115	6	0	0	0	25
8:30	8:45	0	77	80	0	0	19	52	52	0	0	106	5	0	0	0	39
8:45	9:00	0	80	72	0	0	18	49	60	0	0	133	4	0	0	0	68
9:00	9:15	0	92	84	0	0	22	43	52	0	0	133	8	0	2	0	61
9:15	9:30	0	79	102	0	0	16	45	41	0	0	96	3	0	0	0	36
9:30	9:45	0	44	57	0	0	15	20	55	0	0	102	6	0	2	0	29
9:45	10:00	0	48	44	0	0	18	25	54	0	0	88	2	0	4	0	29
15:30	15:45	0	25	67	0	0	10	20	58	0	0	137	3	0	4	0	70
15:45	16:00	0	28	40	0	0	14	25	49	0	0	107	1	0	2	0	55
16:00	16:15	0	23	51	0	0	12	15	52	0	0	117	2	0	0	0	90
16:15	16:30	0	22	79	0	0	11	23	42	0	0	123	2	0	1	0	83
16:30	16:45	0	18	67	0	0	19	20	68	0	0	148	1	0	3	0	111
16:45	17:00	0	27	47	0	0	14	18	57	0	0	152	2	0	1	0	97
17:00	17:15	0	25	69	0	0	7	15	54	0	0	216	3	0	1	0	98
17:15	17:30	0	23	80	0	0	19	21	92	0	0	187	5	0	2	0	103
17:30	17:45	0	32	92	0	0	19	24	63	0	0	160	3	0	0	0	94
17:45	18:00	0	27	80	0	0	20	25	46	0	0	118	2	0	1	0	70
18:00	18:15	0	18	61	0	0	14	19	42	0	0	115	2	0	0	0	67
18:15	18:30	0	24	31	0	0	17	15	47	0	0	73	1	0	3	0	47

Heavy Vehicles

Time		North Approach Kent St				East Approach Adelaide Ave				South Approach Kent St				West Approach Denison St			
Period Start	Period End	U	R	SB	L	U	R	WB	L	U	R	NB	L	U	R	EB	L
7:00	7:15	0	0	2	0	0	0	0	1	0	0	3	0	0	0	0	1
7:15	7:30	0	0	3	0	0	1	0	1	0	0	1	0	0	0	0	1
7:30	7:45	0	1	2	0	0	0	0	1	0	0	1	0	0	0	0	0
7:45	8:00	0	2	0	0	0	1	1	1	0	0	0	0	0	0	0	1
8:00	8:15	0	0	3	0	0	1	2	2	0	0	4	1	0	0	0	1
8:15	8:30	0	1	0	0	0	1	0	1	0	0	2	0	0	0	0	1
8:30	8:45	0	1	1	0	0	1	1	2	0	0	2	0	0	0	0	3
8:45	9:00	0	0	2	0	0	0	0	1	0	0	2	0	0	0	0	2
9:00	9:15	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1
9:15	9:30	0	2	3	0	0	0	1	1	0	0	2	0	0	0	0	1
9:30	9:45	0	1	3	0	0	1	1	2	0	0	1	0	0	0	0	1
9:45	10:00	0	1	3	0	0	2	0	2	0	0	3	0	0	0	0	1
15:30	15:45	0	1	1	0	0	1	0	0	0	0	2	0	0	0	0	2
15:45	16:00	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00	16:15	0	0	2	0	0	0	0	1	0	0	2	0	0	0	0	1
16:15	16:30	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0
16:30	16:45	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
16:45	17:00	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00	17:15	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0
17:15	17:30	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
17:30	17:45	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45	18:00	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0
18:00	18:15	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
18:15	18:30	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

Appendix B

Approaches to forecast growth rate

Appendix B Approaches to forecast growth rate

Three approaches were utilised to forecast the future growth rate that could be expected between 2016 and 2031. These approaches were:

1. Use of SCATs volumes collected in 2016,2017and 2019.
2. Use of the CSTM population assumptions for 2016 and 2031 to provide an estimate of growth in this area.
3. Lastly, the CSTM was used focusing on its predictions for traffic volumes and the expected growth calculated between the 2016 and 2031 models.

Growth based on SCATs data

SCATS data is a useful comparison across various time periods and can be used to help rationalise and substitute other traffic count information. The signalised intersection in proximity to the site is the intersection of Dudley Street and Cotter Road. Data was collected in 2016 – pre cotter road duplication construction, 2017 - during construction and 2019 - post construction.

As expected, the number of vehicles utilising Cotter Road during the peak periods has increased as indicated in Figure 15 and Figure 16. Note that the detector definitions are given in Figure 17.

It appears that construction traffic had an effect indicated by the drop-in volumes between the 2016 counts and the 2017 counts. Traffic counts have then increased between 2017 and 2019. This study is especially interested in Dudley Street which has grown linearly between 2016 and 2019 by an average of 1.0% per annum in the peaks.

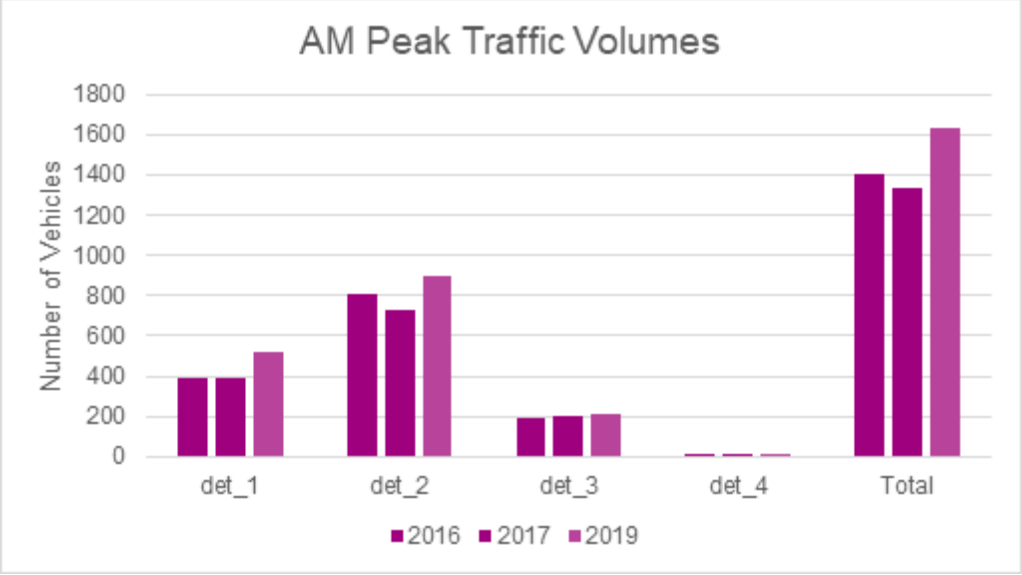


Figure 15: AM Peak Traffic Volumes

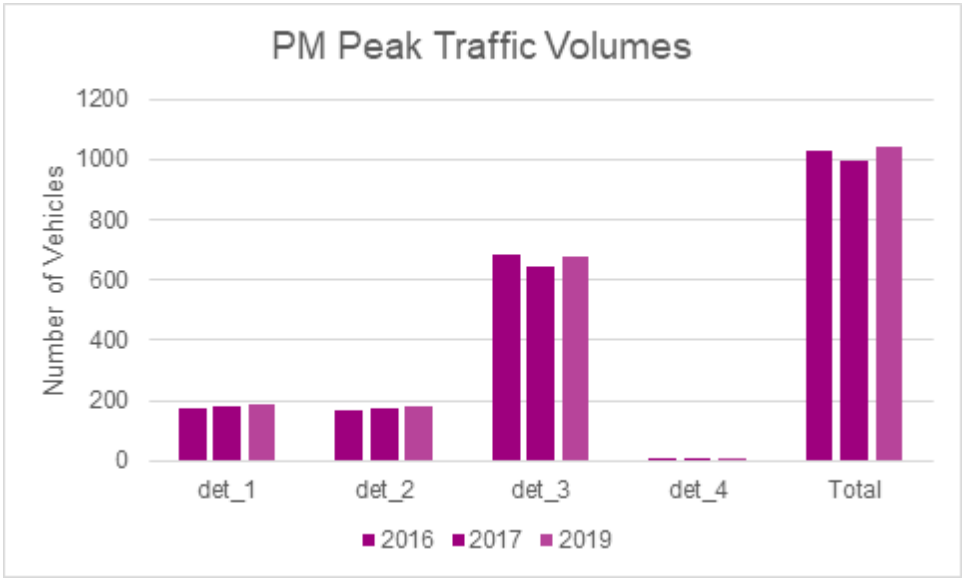


Figure 16: PM Peak Traffic Volumes

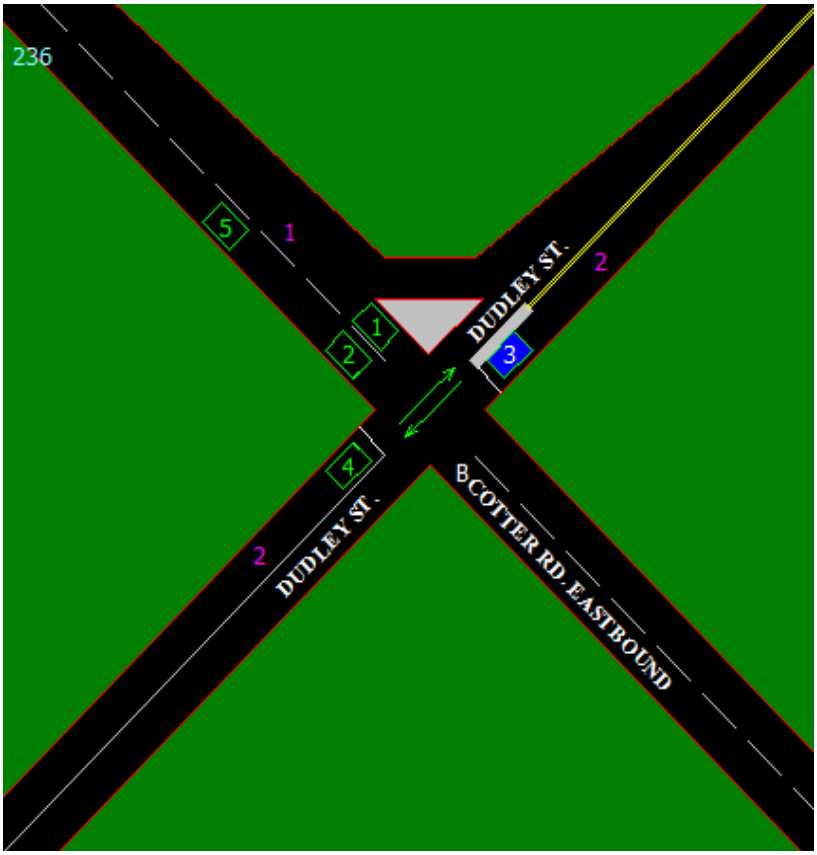


Figure 17: Detector identifications and locations

Growth based on CSTM Population forecasts

Another method to forecast the level of traffic growth in the region would be to determine the rates of growth in the surrounding area and use this rate to forecast existing volumes. This has been undertaken by utilizing the Canberra Strategic Transport Model assumptions which specifies land use characteristics for zones across Canberra. The zones used in this analysis are shown in Figure 18 and are:

- 051107
- 051106
- 051104
- 050302
- 050303

Note that these zones have been classified as either North or South of the Kent Street and Novar Street intersection.

Figure 18: Zones in the vicinity of the Kent Street and Novar Street Intersection

Table 7 utilises the CSTM population forecasts to arrive at a background level of growth. Importantly it can be seen that the total growth rate is very similar to the growth rate in the original approach. If this approach is used the following will be considered:

- The forecasted traffic volumes would be used as a base level of traffic volumes. The new residential development will be included in addition to this base level. While the development may already be included in the CSTM population forecasts this would be expected to be a conservative approach.
- Construction traffic will no longer need to be accounted for as growth will utilise SCATs data from 2019 after the Cotter Road duplication has been finished.

Table 7: Growth forecasts

Growth Statistics	North	South	Total
2016 Population	2208	2263	4471
2031 Population	3122	2378	5500
2016 – 2031 Population Difference	914	115	1029
Population Growth %	41.39%	5.08%	23.01%
Linear Growth Rate per annum	2.76%	0.34%	1.53%
Exponential Growth Rate per annum	2.34%	0.33%	1.39%

The land uses represented in the CSTM have been provided below for reference.

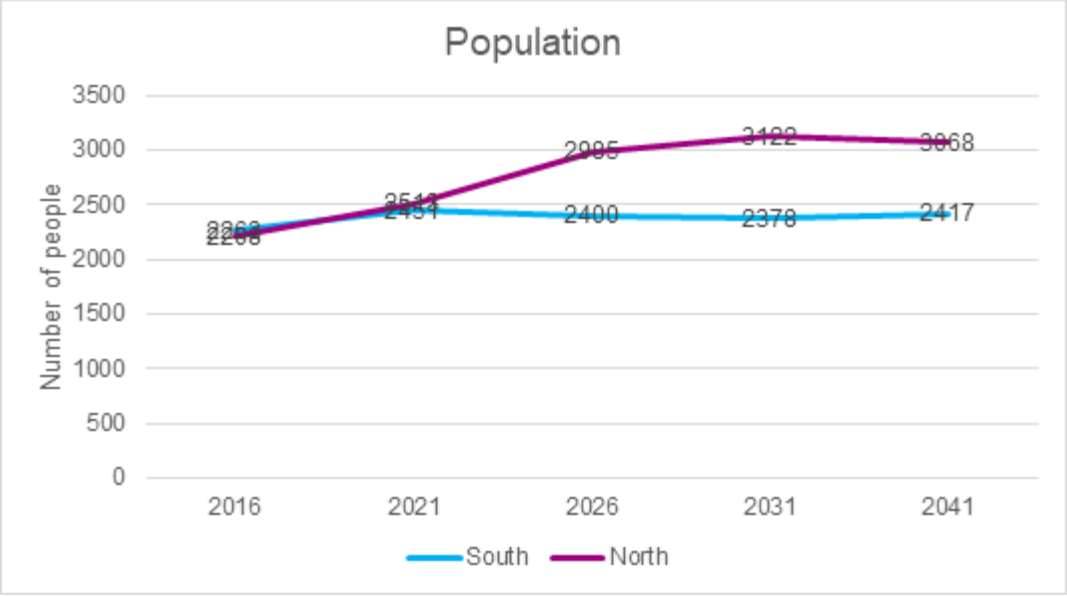


Figure 19: Population present in the five zones identified across the CSTM model years

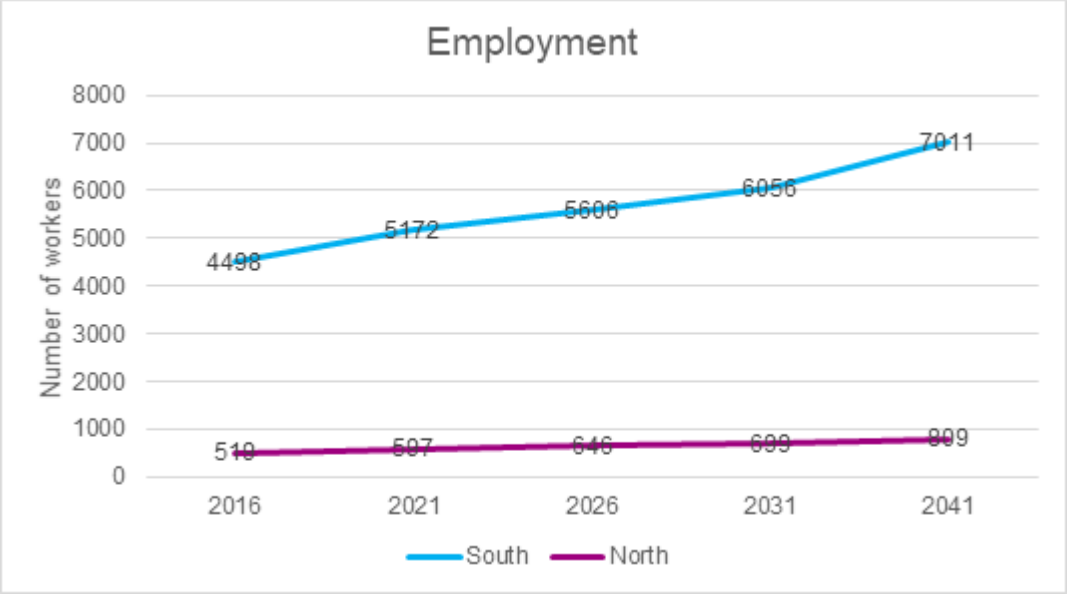


Figure 20: Number of people employed in the five zones identified across the CSTM model years

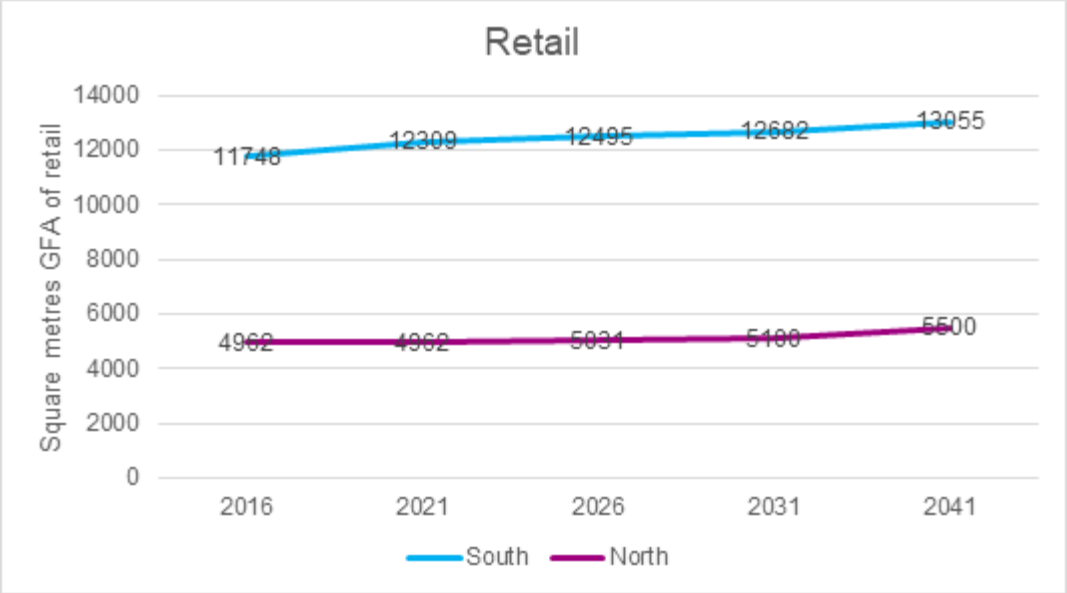


Figure 21: Floor area of retail present in the five zones identified across the model years

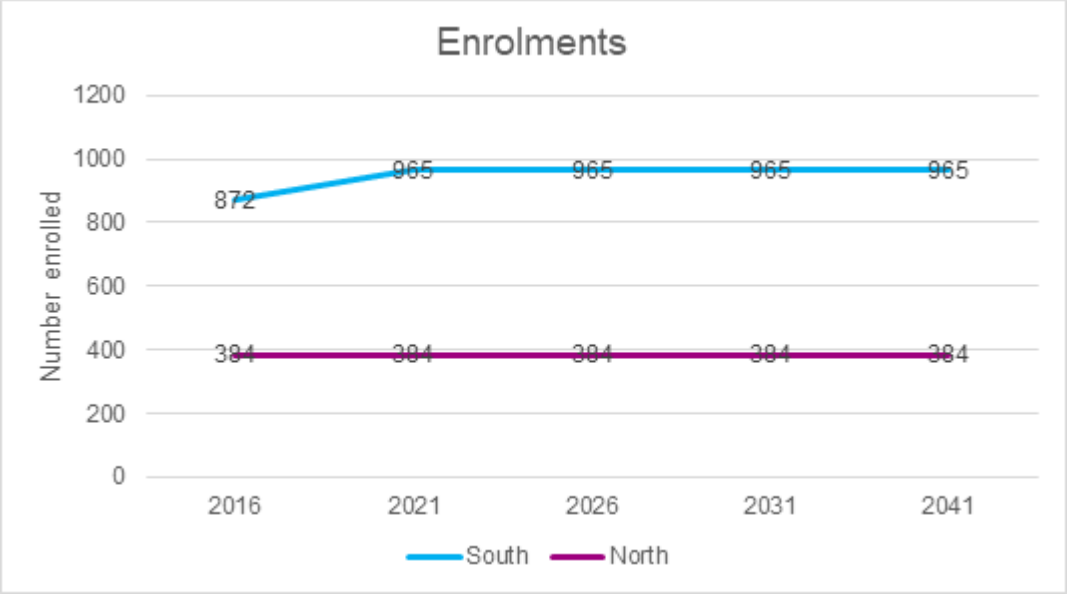


Figure 22: Number of students in the five zones identified across the model years

Canberra Strategic Transport Model

While the CSTM provides demand forecasts in the medium and long-term planning horizons, the preferred method of estimating future demand when conducting detailed traffic modelling and analysis is to grow current traffic volumes using growth rates extracted from the CSTM.

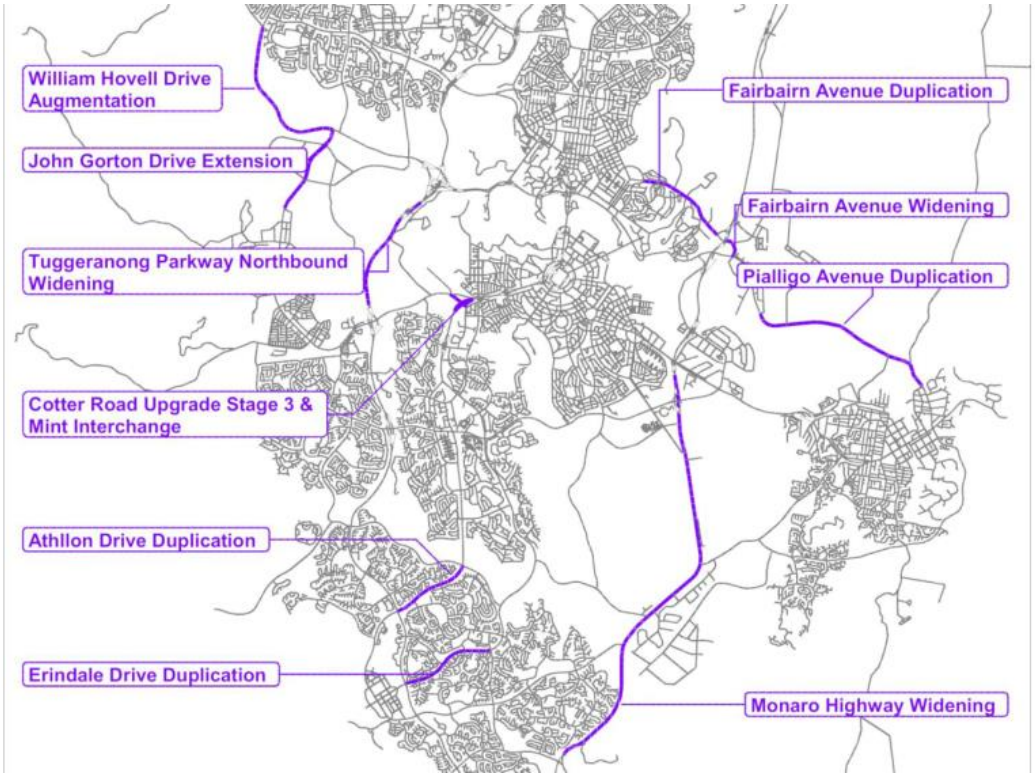


Figure 23: 2026 CSTM assumed road upgrades

The introduction of the Cotter Road and Mint Interchange which is assumed in the 2031 AM Canberra Strategic Model changes demand drastically in this area (Figure 23). This causes large fluctuations in the distribution of vehicles and therefore unusual growth rates compared to the current conditions without the Mint Interchange.

Two scenarios were analysed in the CSTM, one with the Mint Interchange and one without the Mint Interchange. The average growth rate between the two scenarios was approximately 1.25%.

Yarralumla Brickworks

Traffic and Parking Report

Yarralumla Brickworks

Traffic and Parking Report

Client: Canberra Brickworks Developments Pty Ltd

ABN: 616 498 670

Prepared by

AECOM Australia Pty Ltd
Civic Quarter, Level 4, 68 Northbourne Avenue, GPO Box 1942 ACT 2601, Canberra ACT 2601, Australia
T +61 2 6100 0551 www.aecom.com
ABN 20 093 846 925

29-Apr-2021

Job No.: 60636275

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 AS/NZS4801 and OHSAS18001.

© AECOM Australia Pty Ltd (AECOM). All rights reserved.

AECOM has prepared this document for the sole use of the Client and for a specific purpose, each as expressly stated in the document. No other party should rely on this document without the prior written consent of AECOM. AECOM undertakes no duty, nor accepts any responsibility, to any third party who may rely upon or use this document. This document has been prepared based on the Client's description of its requirements and AECOM's experience, having regard to assumptions that AECOM can reasonably be expected to make in accordance with sound professional principles. AECOM may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified. Subject to the above conditions, this document may be transmitted, reproduced or disseminated only in its entirety.

Quality Information

Document Yarralumla Brickworks

Ref 60636275

Date 29-Apr-2021

Prepared by Nethmei Senarath and Danny Ma

Reviewed by Tim Heffernan

Revision History

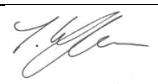
Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
0	28-Oct-2020	Draft	Tim Heffernan	
A	04-Nov-2020	Minor update	Tim Heffernan	
B1	15-Mar-2021	For Submission	Tim Heffernan Senior Transport Engineer	
C	29-Apr-2021	For Submission, after updates to the land use mix	Ronnie Paulus Transport Advisory Team Lead	

Table of Contents

Executive Summary i
1.0 Introduction 1
1.1 Background 1
1.2 Purpose of this Report 1
1.3 References 1
2.0 Existing Conditions 2
2.1 The Site 2
2.1.1 Current Land Use 2
2.2 Road Network 3
2.2.1 Hierarchy 3
2.2.2 Yarralumla Road network 4
2.3 Traffic Volumes 5
2.4 Car Parking 9
2.4.1 Parking Supply and Restrictions 9
2.4.2 Parking Utilisation 13
2.5 Public Transport 14
2.6 Active Travel 16
2.7 Crash Analysis 17
3.0 Proposed Land Use 18
3.1 Land Use 18
3.2 Vehicle Access 19
3.3 Service Access 19
3.4 Car Parking 19
4.0 Car Parking 20
4.1 Car Parking Requirement 20
4.2 Adequacy of Parking Supply 21
4.2.1 Accessible Parking Provision 22
4.2.2 Motorcycle Parking Provision 22
5.0 Sustainable Transport Infrastructure 23
5.1 Bicycle End Trip Facilities 23
5.2 Walkability Score 24
6.0 Impact of the Development 25
6.1 Traffic Generation 25
6.2 Traffic Distribution 25
7.0 Queuing Analysis 28
7.1 Public Car Park Queuing Analysis 28
8.0 Network Analysis 29
8.1 Study Area Definition 29
8.2 Base Year Model – Calibration and Validation 31
8.2.1 GEH 32
8.2.2 R^2 Value 33
8.2.3 Base Model Stability 35
8.3 Future Year Base Model 35
8.3.1 Future Year Base Model Geometry 35
8.3.2 Background Traffic Growth 37
8.4 Future Year Scenario Model 37
8.5 Network Performance 37
8.5.1 Network Demand 37
8.5.2 Network Results 38
8.6 Intersection Performance 40
8.6.1 Key Intersection Performance 40
8.6.2 Overall Intersection Performance 41
8.7 Network Issues and Mitigation Measures 48
8.8 Network Analysis Summary 49
9.0 Conclusions and Recommendations 50

Appendix A
GEH Results A

Appendix B
Background Traffic Growth Approach B

Appendix C
Aimsun Outputs C

Executive Summary

The proposed Yarralumla Brickworks Development on Blocks 1,7, and 20 of Section 100, Yarralumla include the following land uses:

- 18 single residential lots (houses)
- 303 apartments
- 59 townhouses
- 1500 m^2 of commercial/office space
- 1320 m^2 of food and beverage space
- 2310 m^2 of fitness and wellness space
- 795 m^2 of medical facility space
- Parklands and open spaces

A summary of the key findings of this report are detailed below:

Adequacy of Car Parking

- The parking for the proposed development will meet the demand for both the private and public land uses.
- For the residential apartments, 150 parking spaces in excess of the requirements in the *Parking and Vehicular Access General Code* (PVAGC) are proposed for the development.
- For the public uses, there is a deficit of 47 parking spaces when compared against the direct application of PVAGC requirements. However, it must be highlighted that in a mixed-use facility such as this development, generally the parking spaces would be shared by different facilities during different peaks of the day. Given such temporal nature of the parking demand, the temporal profile analysis indicated that the peak demand will be 288 parking spaces, while there is a total of 327 public parking spaces proposed for the development. There is a low risk of insufficient public parking being provided on site based on the analysis undertaken.

Impact on Traffic Operations

- AIMSUN modelling showed that the increase in background traffic demand to 2031 has notable impact on the overall performance of the network in the study area. There is notable increase in delays particularly at the intersections along Kent Street. This could also be attributed to the proposed signalisation of the intersections along the road where there are added delays to traffic along Kent Street, whereas in the existing base case, traffic along Kent Street has priority. It should be emphasised that AECOM has not undertaken sensitivity analysis on the proposed future augmentation of the road as part of the traffic modelling for the Yarralumla Brickworks development. This was undertaken as part of the optioneering analysis for the Kent Street upgrade project and the future layout from the Kent Street upgrade analysis has been used as the layout for the future Brickworks analysis in this report.
- AECOM undertook sensitivity analysis to optimise signal timing at the intersections along Kent Street. The signals were modelled as actuated signals with more favourable green time for traffic along Kent Street.
- As a result of this study, it has been determined that the proportional impact to the traffic network that can be attributed to the future Brickworks development will not have a material impact in terms of increases in delay or level of service operation at key intersections or throughout the study area in 2031.

Accessible, Motorcycle and Bicycle Parking

- The ACT Parking and Vehicular Access General Code requires that 3% of public spaces to be provided be compliant for disabled parking. This amounts to 10 disabled parking spaces required for the site.
- There is a requirement to provide motorcycle parking at a rate of 3 spaces per 100 public car parking spaces in addition to the car parks. This results in 10 motorcycle spaces for the development
- The Bicycle Parking General Code for the ACT was used to determine the required supply of bicycle parking spaces. According to the code a supply of 347 bicycle parking spaces must be provided in total, with 312 spaces allocated for residents, and 35 for visitors and guests. In addition to this, an extra 10 bicycle parking spaces was allocated for fitness & wellness centre visitors, totalling to 357 spaces.

Site Access and Service Vehicles

- The main access to the site is proposed via the new Brickworks Access Road which connects to Dudley Street and Cotter Road. Service vehicles will also use this access.
- Other access to the site is through Denman Street which serves 5 townhouses and 7 residential lots and via Bentham Street which serves for 11 residential lots.

1.0 Introduction

1.1 Background

Canberra Brickworks Developments Pty Ltd (ACN 616 498 670) has briefed AECOM Australia Pty Ltd (ABN 20 093 846 925) to prepare a Transport Impact Assessment to support the Yarralumla Brickworks development in Yarralumla, ACT.

1.2 Purpose of this Report

i. Existing traffic and parking conditions surrounding the site;

ii. Suitability of the proposed parking in terms of supply (quantum) and layout;

iii. Service vehicle requirements;

iv. Pedestrian and bicycle requirements;

v. The traffic generating characteristics of the proposed development;

vi. Suitability of the proposed access arrangements for the site;

vii. The transport impact of the development proposal on the surrounding road network

1.3 References

In preparing this report, reference has been made to the following:

- An inspection of the site and its surrounds;
- Australian Standard/ New Zealand Standard, Parking Facilities, Part 1: Off-Street Car Parking AS/NZS 2890.1:2004
- Australian Standard, Parking Facilities, Part 2: Off-Street Commercial Vehicle Facilities AS 2890.2:2002
- Australian Standard / New Zealand Standard, Parking Facilities, Part 6: Off-Street Parking for People with Disabilities AS/NZS 2890.6:2009
- Environment, Planning and Sustainable Development Directorate (EPSDD) Parking and Vehicular Access Code (formerly ACTPLA)
- Environment, Planning and Sustainable Development Directorate (EPSDD) Bicycle Parking General Code (formerly ACTPLA)
- EPD (formerly ACTPLA) Residential Subdivision Development Code
- RMS NSW Guide to Traffic Generating Developments (October 2002 Version 2.2)
- Traffic and car parking observations undertaken and as referenced in the context of this report
- Other documents and data as referenced in this report
- Transport Canberra And City Services Standard Drawings.
- Transport Canberra And City Services Microsimulation Modelling Guidelines.

2.0 Existing Conditions

2.1 The Site

The subject site is located on Blocks 1,7, and 20 of Section 100, Yarralumla (Figure 1). Current access to the site area is available via Denman Street.

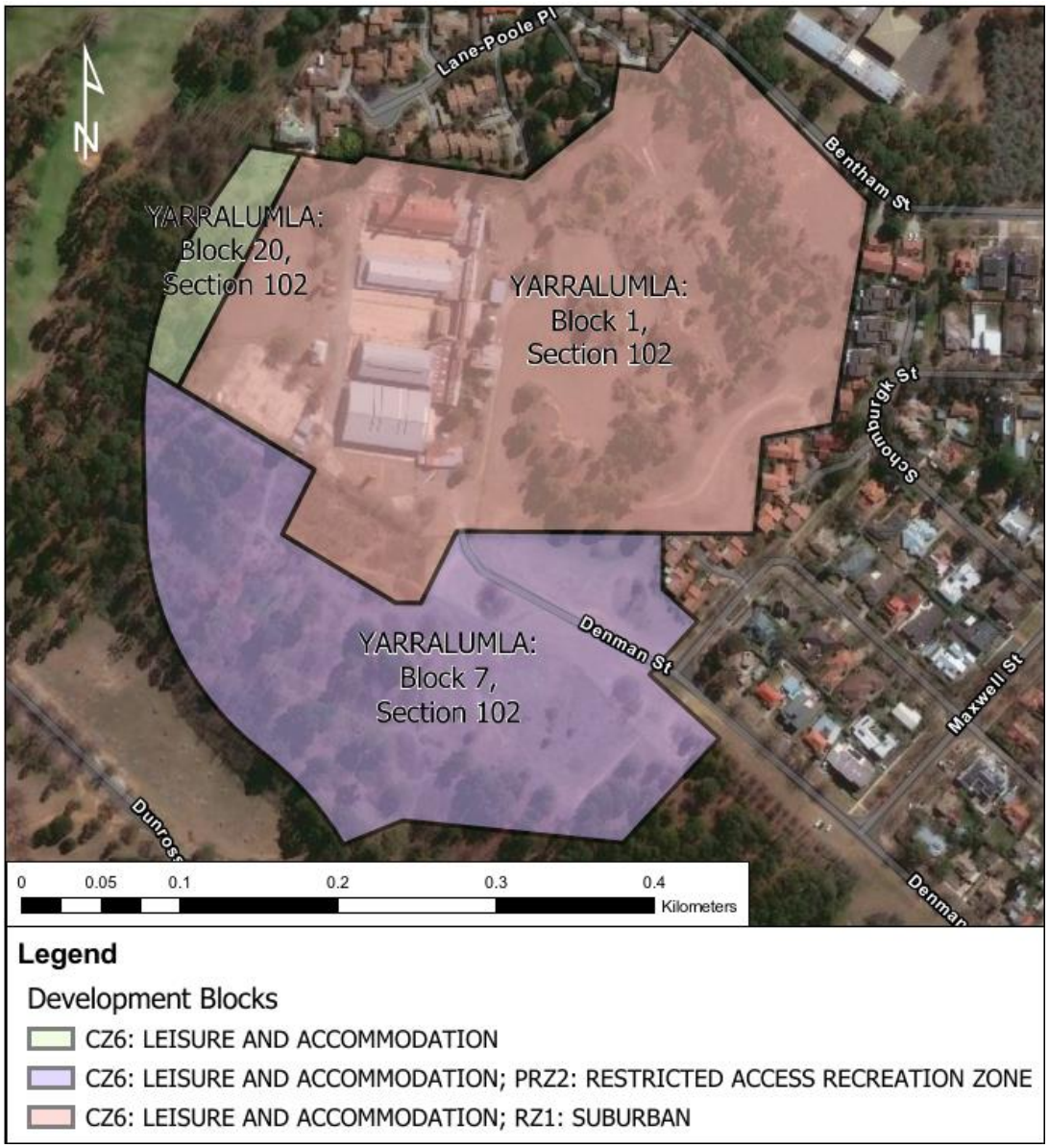


Figure 1 Study Area

2.1.1 Current Land Use

Currently, Block 1, Section 102, Yarralumla accommodates the Old Canberra Brickworks site. Blocks 7 and 20, Section 102 Yarralumla are currently unoccupied. Under the Territory Plan, all three blocks are classified as a CZ6: Leisure and Accommodation zone. Additionally, Block 1 is also classified as a RZ1: Suburban Zone and Block 7 is classified as a PRZ2: Restricted Access Recreation Zone.

2.2 Road Network

2.2.1 Hierarchy

The classification of roads in the ACT is based on a formal road hierarchy. The classification fundamentally relates to the predominant function of a road and to the extent it serves the two basic purposes of the road network – the movement of traffic and access to property. The road classifications used are outline below.

2.2.1.1 Arterial Roads

Arterial roads predominantly serve longer distance travel within a district and through traffic from one district to another. They include limited access roads and parkways (or freeways) having full access control and grade separated inter-sections. A small number have higher levels of property access for urban design reasons, for example Northbourne Avenue, or reflect the planning and design parameters of the time of their construction, for example, Limestone Avenue. Traffic capacity is a function of the design of the road rather than being constrained by environmental objectives.

2.2.1.2 Major Collector Roads

Major collector roads collect and distribute traffic within residential, industrial and commercial areas. They form the link between the primary network and the roads within local areas and should carry only traffic originating or terminating in the area. The volume of traffic carried is constrained by environmental objectives - safety and traffic noise - rather than road geometry and reflects the limited area that they serve. Direct property access is still permissible, but the level of traffic may dictate that access and egress arrangements should be such that vehicles can exit properties in a forward direction.

2.2.1.3 Minor Collector Roads

Minor collector roads collect and distribute traffic from access streets, linking to the major collector roads within the neighbourhood. They can also provide secondary connections direct to the external arterial road network. Traffic volumes are compatible with direct property access.

2.2.1.4 Access Streets

Access streets are used where the residential environment is dominant, traffic is subservient, speed and traffic volumes are low, and pedestrian and cycle movements are facilitated. The primary role of Access Streets is to provide direct property access. Access streets can link traffic from the local network (including rear lanes) to collector roads. In most cases they will not have direct connections to Arterial roads.

2.2.2 Yarralumla Road network

Adelaide Avenue and Cotter Road are the arterial roads which feed traffic into Yarralumla. Novar Street and Hopetoun Circuit are the main north/south connections in the form of major collector roads. These then feed into the minor collectors which include Bentham Street, Weston Street and Schlich Street. A summary of the road classifications in the study area can be seen in Figure 2 below.

Figure 2 Road Classification Summary

2.3 Traffic Volumes

AECOM were previously engaged by the ACT Government to carry out Preliminary Sketch Plan (PSP) design for the Canberra Brickworks Precinct (CBP) Access Road upgrade of Dudley Street. As a part of this project Aimsun traffic modelling was undertaken for the network extents shown in Figure 3.

Note that at the time of writing this design and report, it was determined that using data collected in 2017 was still the best source to use in the following analyses due to the significant impact and limitations of collecting traffic data due to COVID-19 in 2020.This model utilised AM (7:00AM-10AM) and PM (3:30PM-6:30PM) count data undertaken on Wednesday, 21 June 2017 for the following intersections:

- Novar Street / Dudley Street / Adelaide Ave off-ramp
- Kent Street / Denison Street
- Kent Street / Adelaide Ave on-ramp

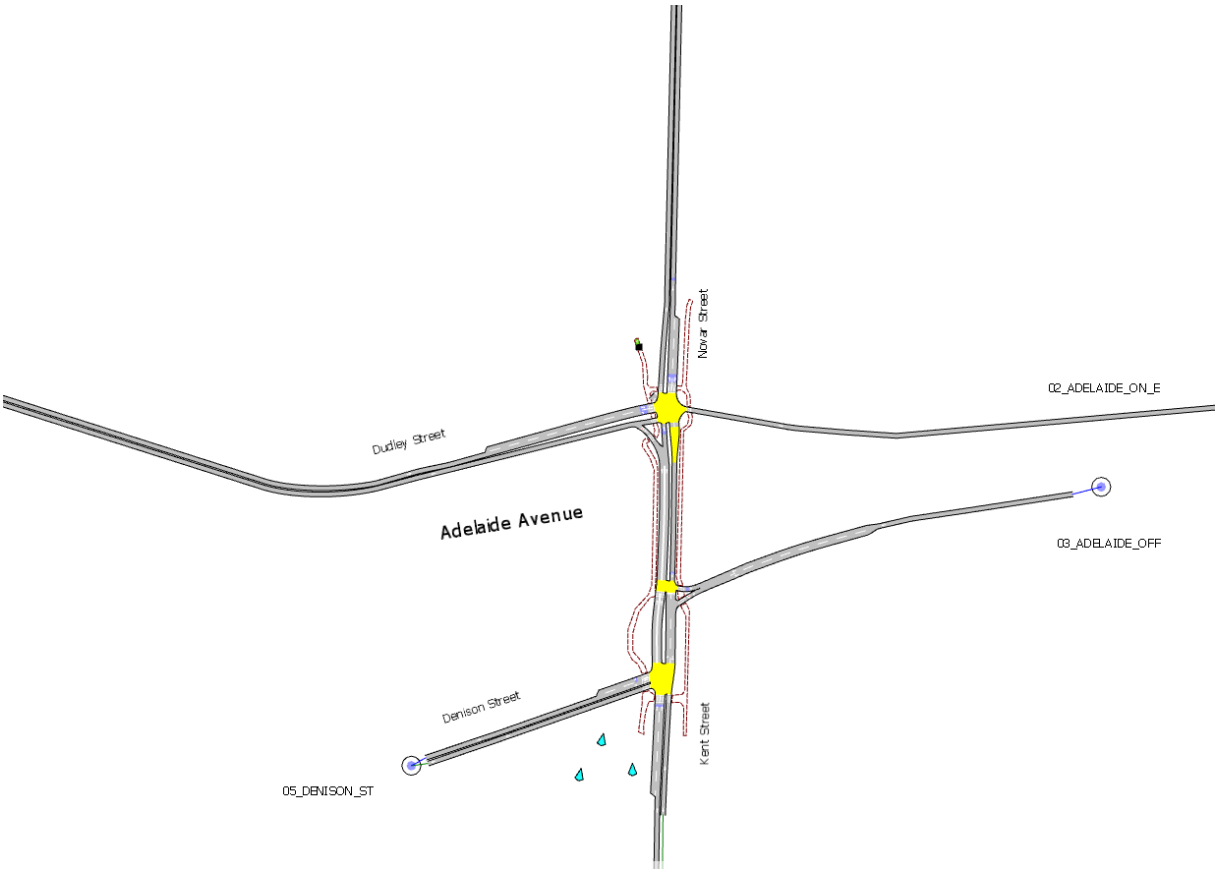


Figure 3 Original Dudley Street Model Extents

In addition to the 2017 traffic counts, AM (7:00AM-10AM) and PM (3:30PM-6:30PM) traffic surveys were undertaken on Tuesday, 25 August 2020 for the following intersections:

- Dudley Street / Cotter Road
- Maxwell Street / Denman Street
- Abbot Street / Denman Street
- Novar Street / Kintore Crescent
- Novar Street / Abbott Street

- Banks St / Weston St / Maxwell St
- Banks St / Bentham St
- Novar St / Bentham St
- Novar St / Weston St
- Hutchins St / Bentham St

A summary of the 2017 and 2020 AM and PM traffic volumes for the intersections outlined above are shown in Figure 4 and Figure 5 below.

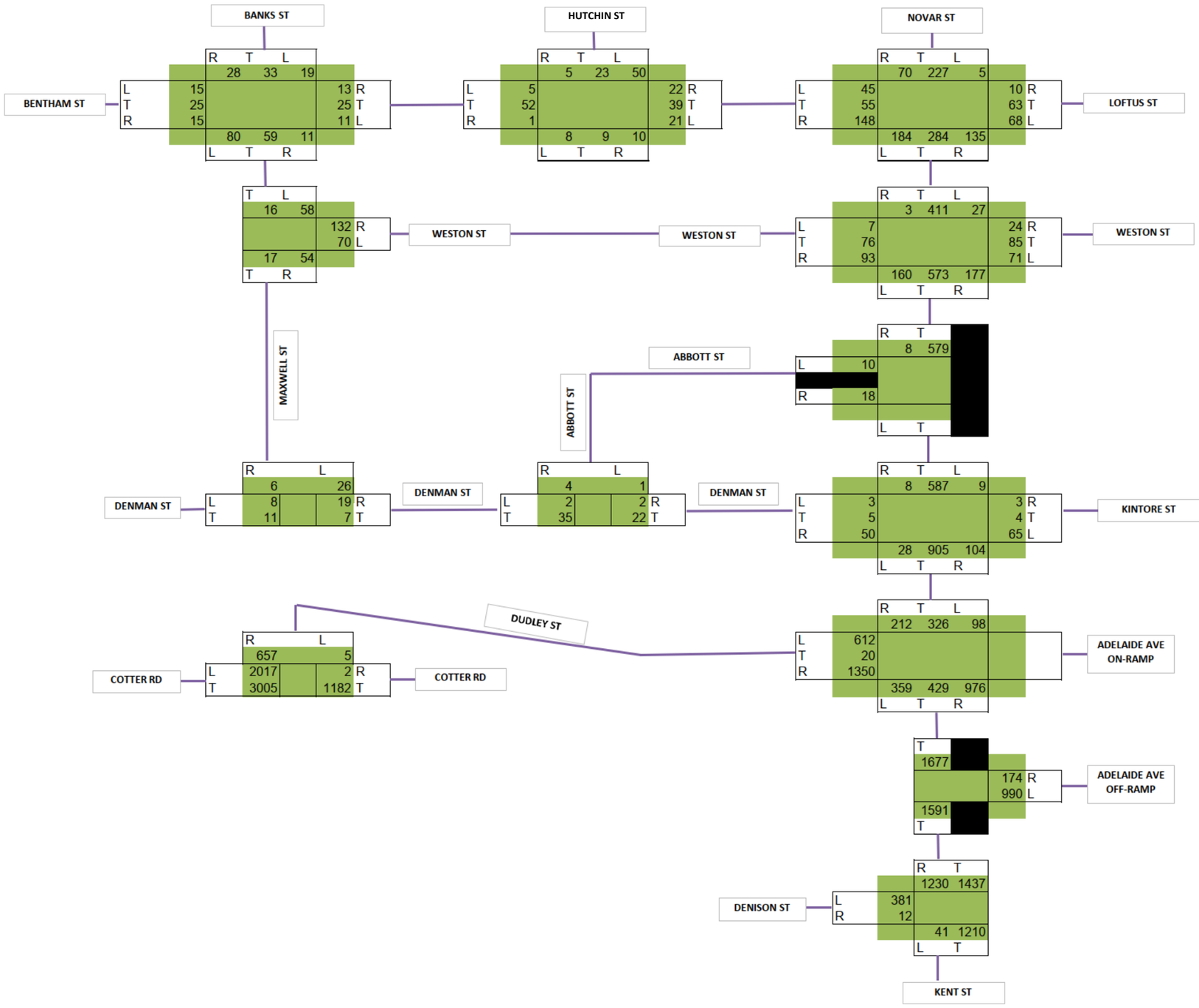


Figure 4 7AM-10AM Yarralumla Traffic Survey Volumes

Notes:

- Traffic counts at Dudley St / Novar St, Kent St / Denison St and Kent St / Adelaide Ave are 2017 counts as part of the originally modelled “core” traffic area
- All other intersection counts are 2020 counts at the request of TCCS

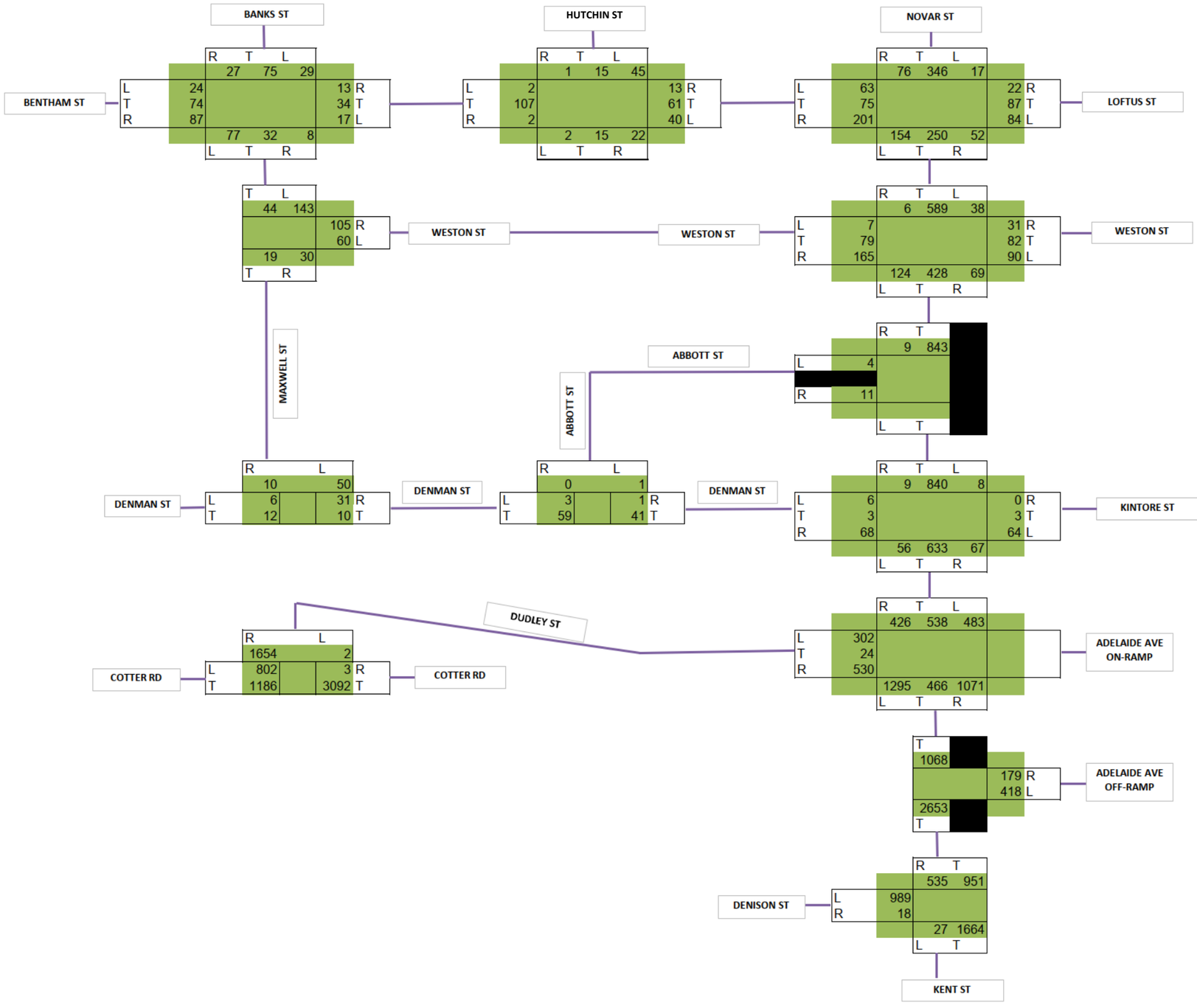


Figure 5 3.30PM-6.30PM Yarralumla Traffic Survey Volumes

Notes:

- Traffic counts at Dudley St / Novar St, Kent St / Denison St and Kent St / Adelaide Ave are 2017 counts as part of the originally modelled “core” traffic area
- All other intersection counts are 2020 counts at the request of TCCS

2.4 Car Parking

A number of weekday and weekend spot counts were undertaken in 2015 in AECOM's previous site investigation for the Yarralumla Brickworks development. This was to determine the key parking attractors, on-street parking utilisation and dedicated parking utilisation in Yarralumla. Note that the 2015 data was used due to the limitations in collecting reliable parking data in 2020 given the impact of COVID-19.

The main parking generators in the study area impacting on the proposed development are the shopping centre and the Uniting church on Denman Street. The Yarralumla Primary school has its own short-term parking demand, and this has not been studied in detail.

The St Nicholas Greek-Australian Pre School & Child Care Centre has on-site parking provisions. Parking was observed to be contained within the site throughout the day with Hill Corner used for peak pickup and drop off times. Few vehicles were observed to park along Maxwell Street associated with the centre.

Overflow parking at lunch times associated with the restaurant and café trade at the Yarralumla shops occurs on the adjacent streets and parking restrictions generally restrict short term parking to one side of these roads. This seems to work for normal demand.

The normal church parking demand is mostly catered within the unmarked gravel area located at the church entrance. There will be occasional heavy demand for infrequent weekday funerals and the large annual fete.

2.4.1 Parking Supply and Restrictions

Parking supply and restrictions have been focused around the two key generators within close proximity of the site. These are the Shops and Church.

Shops On-street

The locational requirements for various types of parking are outlined within the Parking and Vehicular Access General Code within the Territory Plan. For local centres, within Yarralumla parking should be accommodated onsite or within 200m. As such, a 200m radius from the central shop building has been included within the image. The actual 200m walking distances based on the path network are also shown and is the basis of the parking supply numbers.

A summary of the on-street parking restrictions observed on site can be seen in Figure 6.

Figure 6 On-Street Parking Restrictions (2021)

Onsite parking is available at the rear of buildings on 16 and 18 Bentham Street (south side between Novar and Hutchins St). This parking was observed to have some capacity. Visitors to these tenancies may be utilising parking on Bentham Street rather than parking at the rear. Mueller Street has a wider cross section (approx. 9.3m) which can accommodate parking on both sides of the road.

Within the 200m walkable distance area, there are approximately 70 spaces. These include un-restricted and time restricted parking. There are also approximately 25 time restricted no parking

spaces along Novar Street and Bentham Street. These supply numbers do not include full time no parking zones or illegal parking.

Shops onsite supply and demand

A summary of the parking restrictions and onsite supply associated with the Yarralumla shops can be seen in Figure 7

Figure 7 Yarralumla shops parking restrictions and Supply (2021)

The wide variety of parking time restrictions seems overly complicated but has probably been developed over time in consultation with users and may well be very workable.

Church

The available parking supply and restrictions associated with the Church can be seen in Figure 8.The peak period of parking associated with the church located on Denman Street was observed to be during mass on Sunday mornings. The peak demand results from a spot count during this peak utilisation period (9:30-10:30 AM on a Sunday, 2015) can be seen in Figure 11. Occasionally, during one-off services or community events the parking demand further increases.

Figure 8 Spot count of parking utilisation associated with church (2021)

It should be noted that this parking is currently informal and does not comply with local territory standards. As part of the off-site works associated with the Yarralumla Brickworks project, a footpath is proposed to be installed along Denman St such that it allows the Church or ACT government to install 15 parallel parking spaces whilst maintaining 1.5m clearance to light poles. It should be highlighted that the provision of these kerbs and new parking spaces are not part of the Yarralumla Brickworks project scope and needs to be implemented and financed by the respective landowners. A concept layout of the proposed parking arrangement is shown in Figure 9

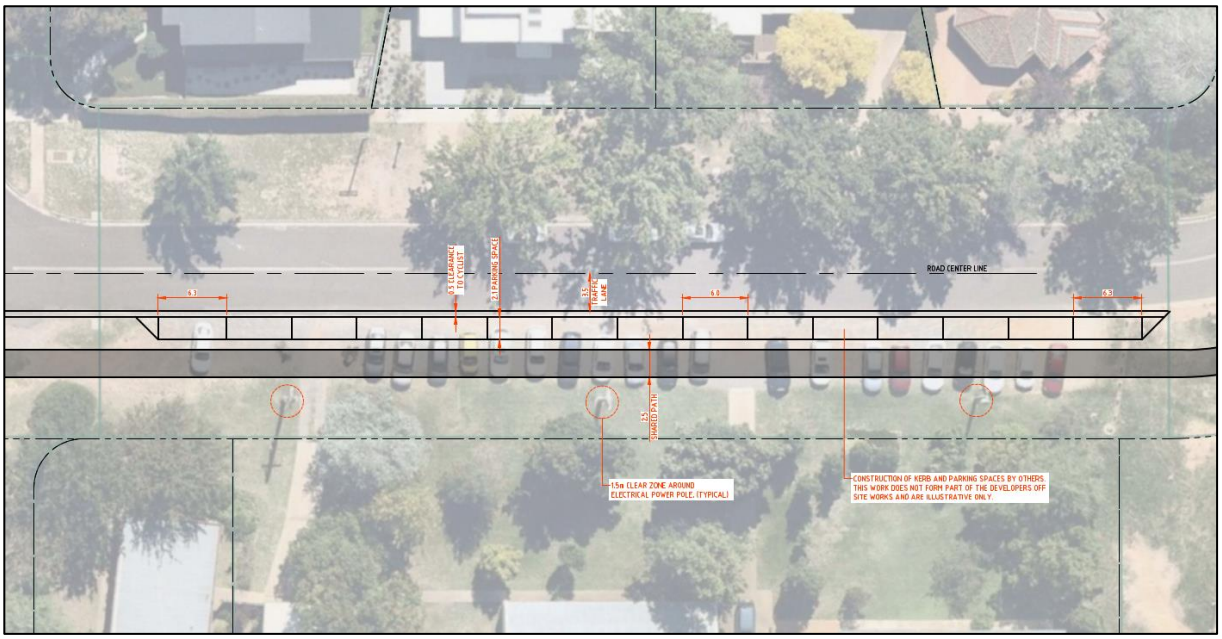


Figure 9 Church Car Parking Option

2.4.2 Parking Utilisation

The on-street parking utilisation throughout Yarralumla was, on average, very low. The preference of residents to park their vehicles in garages resulted in the observed parking levels on-street to be generally between 0 and 2 vehicles for any local access road. The three observed exceptions to this were the on-street parking in the vicinity of the shops, the on-street parking in the vicinity of the church during peak use periods and on-street parking adjacent to construction zones.

The parking utilisation of the shops onsite supply was at 95% or greater for all spot counts conducted, for both weekdays and weekends. The overflow parking associated with the shops is located primarily along Hutchins Street and Bentham Street west of the shop complex. The utilisation of the overflow parking was low on weekend days and high on weekdays, particularly during the lunch peak period. A summary of utilisation of parking associated with the shops which includes all available on-street parking within 200m walkable distance can be seen in Figure 10 and Figure 11.

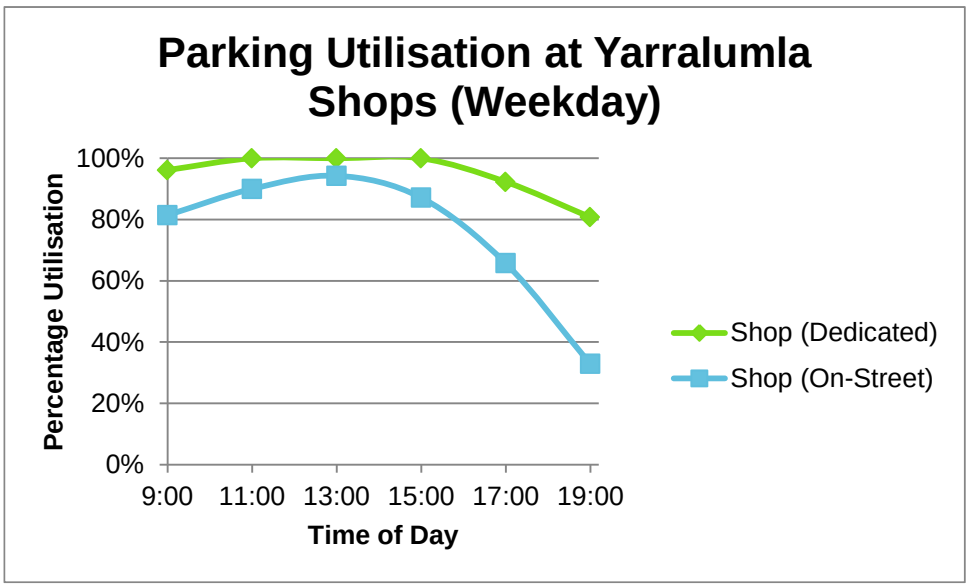


Figure 10 Parking Utilisation on a Weekday (2015).

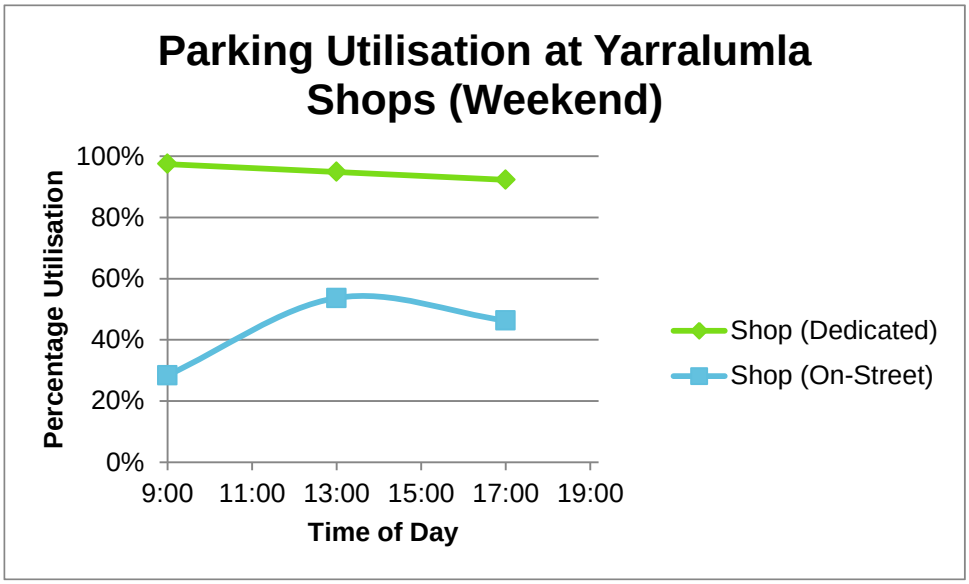


Figure 11 Parking Utilisation on a Weekend (2015).

The above graphs indicate that there is an adequate parking supply for weekend use, however the parking associated with the shops is over capacity during the working week. Based on site observations, there is limited available on-street supply during the weekday peak.

2.5 Public Transport

While there are a large number of bus routes which travel along Adelaide Avenue, there are currently no stops which give residents of Yarralumla access to these services. There is currently a single route (route number 57) which services Yarralumla. Service 57 travels between Woden Town Centre and the City Interchange. Within Yarralumla, the route travels along Novar Street, Schlich Street and Hopetoun Circuit.

A summary of the bus route through Yarralumla can be seen in Figure 12.

Figure 12 Public Transport Routes

A review of the public transport available in the vicinity of the site is summarised in Table 1.

Table 1 Public Transport Provision

Route #	Route Description	Frequency (Peak/Off-Peak)
57	City Interchange, Parkes, Deakin, Yarralumla, Hughes, Garran, Phillip, Woden Interchange	20 mins / 60 mins

2.6 Active Travel

The existing path network was reviewed for the study area. The paths included shared paths, footpaths and recreational trails (Figure 13).

The suburb has an excellent provision of footpaths with almost all verges containing paths. The quality of the paths is generally reasonable although there are isolated areas of cracking or level differences.

Major trip attractors of shops, schools and churches were reviewed for their travel patterns. The Yarralumla Primary school had a fairly dispersed pedestrian movement and the churches had relatively low pedestrian activity. Informal connections through the suburb along access trails were well worn especially closer to the lake.

On-road cycle lanes are provided along Cotter Road and Adelaide Avenue. There is limited connectivity between the local path network and on-road cycle lanes with only one direct connection near the eastern end of the on-ramp from Novar Street south of the intersection of Guilfoyle Street and Newman Street.

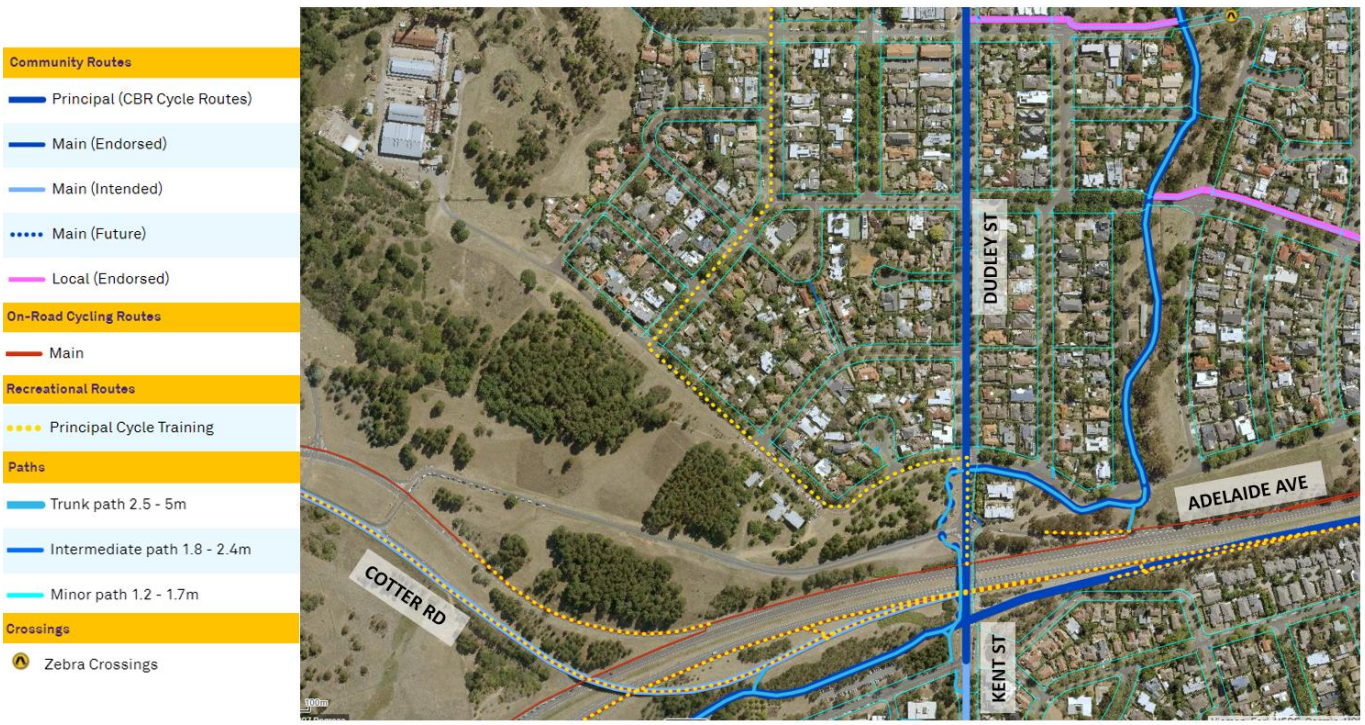


Figure 13 Active Travel Links

(Source: ACTMapi, 2020)

2.7 Crash Analysis

Figure 14 shows recorded road crash data from 1st January 2015 to 31st December 2019. Analysis of the crash diagram shows that many of the crashes are clustered around intersections where there are more conflict points. In the study area, these are mostly on approach to Novar Street and Kent Street intersection. There are also a cluster of crashes near the Yarralumla shops area, which is likely due to conflict of vehicles manoeuvring from the car parks. The highest severity of crashes observed in the area was a fatal crash near the intersection of Strickland Crescent and Ken Street. There were also 36 injury crashes observed, which mostly occurred along Cotter Road, Novar Street and Kent Street.

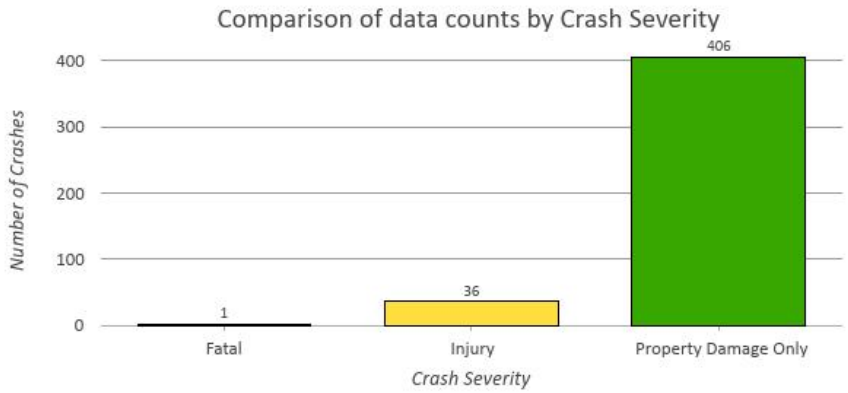


Figure 14 Yarralumla Road Crashes (2015-2019)

3.0 Proposed Land Use

3.1 Land Use

The proposed land use for the Yarralumla Brickworks precinct include the following:

- 18 single residential lots (houses)
- 303 apartments
- 59 townhouses
- 1500 m^2 of commercial/office space
- 1320 m^2 of food and beverage space
- 2310 m^2 of fitness and wellness space
- 795 m^2 of medical health facility space
- Parklands and open spaces

It is understood that the final mix of residential uses may change slightly as the project progresses. However, this is not expected to be significant. The block details plan for the precinct is shown in Figure 15.

Figure 15 Yarralumla Brickworks Block Details Plan

3.2 Vehicle Access

The main vehicle access to the development will be via the new Brickworks Access Road which connects to Dudley Street. There is also other accesses to the site via Denman Street and Bentham Street which serves the townhouses and single residential lots on the east side of the site.

3.3 Service Access

Service access is proposed via the new Brickworks Access Road. A central waste collection facility is proposed for both residential and commercial waste within the heritage precinct as shown in Figure 16.

Figure 16 Waste Collection Location

3.4 Car Parking

The following parking supply is proposed for the Yarralumla Brickworks site:

- 327 public parking spaces
- 771 private parking spaces

The final site parking provision will be subject to consistent with the final mix of residential property types constructed.

4.0 Car Parking

4.1 Car Parking Requirement

The car parking provision requirements for various types of developments are detailed in the Environmental, Planning and Sustainable Development Directorate (EPSDD) (formerly ACTPLA), Parking and Vehicular Access General Code (PVAGC). Although residential development is permitted in a CZ6 zone, no specific rates for parking are provided in the code. The proposed development was designed using the standard residential parking rates from the PVAGC (3.1.5 schedule 1), which are accepted as the general parking rates for residential in the ACT. There are no issues identified in the minor differences in the objectives between sections 3.1.1 and 3.2.1 of the PVAGC. The rates used are outlined below.

The code indicates the following parking rates for the CZ6 zone (unless stated otherwise) in the Yarralumla area:

Townhouses and Apartments (section 3.1.5 schedule 1 of the PVAGC):

- 1 space per single bedroom dwelling
- 1.5 spaces per two-bedroom dwelling
- 2 spaces per three or more-bedroom dwelling
- 1 visitor space per four dwellings

Commercial (Office) and Commercial (Agency)

- 2.5 spaces per 100 m^2 GFA

Food and Beverage

- 10 spaces per 100 m^2 GFA

Fitness and Wellness (Gym)

- 3.5 spaces per 100 m^2 GFA

Medical (Health Facility)

- 4 spaces per practitioner

Note: The parking provisions for the single residential lots are to be provided within each lot and thus these parking spaces (resident and visitor parking including bike storage) are not considered in this assessment.

Table 2 outlines the expected peak demand from the development as per the rates above.

Table 2 Yarralumla Brickworks Car Parking Requirements

Use	Yield	Units	Provision Rate	Units	Parking Requirement
Apartments	303	Apartments	*See Table 3		503
Townhouses	59	Townhouses	*See Table 4		118
Private Subtotal					**621**
Commercial (office)	1500	m^2 GFA	0.025	spaces/m^2	38

Use	Yield	Units	Provision Rate	Units	Parking Requirement
Food and Beverage	1320	m^2 GFA	0.1	spaces/m^2	132
Fitness and Wellness	2310	m^2 GFA	0.035	spaces/m^2	81
Medical	795	m^2 GFA	4	spaces/practitioner	32 (assuming 8)
Apartment Visitors	303	Apartments	0.25	spaces/m^2	76
Townhouses Visitors	59	Townhouses	0.25	spaces/m^2	15
Public Subtotal					**374**
DEVELOPMENT TOTAL					**995**

Table 3 Apartment Breakdown

Apartment Type	Number of Unites	Rate (per unit)	Parking Requirement
1 BR	5	1	5
2 BR	196	1.5	294
3+ BR	102	2	204
TOTAL	**303**		**503**

Note: Visitor parking shown in Table 2.

Table 4 Townhouse Breakdown

Townhouse Type	Number of Units	Rate (per unit)	Parking Requirement
3+ BR	59	2	118
TOTAL	**54**		**118**

Note: Visitor parking shown in Table 2.

4.2 Adequacy of Parking Supply

Table 5 Land Use Parking Supply and Demand

Land Use	Car Park Requirement	Car Park Supply	Difference
Private Parking	621	771	+150[Comment 1]
Public Parking	374	327	-47[Comment 2]
TOTAL			**+103**

As seen in Table 5 above, there is an excess of 103 car parks supplied for the proposed development.

There are 150 excess parking spaces for residential apartments and townhouses, which is a commercial decision to supply more storage space for cars, bicycles and other uses.

There are 47 less public parking spaces than the requirement in the PVAGC. Given the temporal nature of parking demand for the non-residential land uses, a temporal profile analysis based on observations from past projects for similar land uses has been undertaken as shown in Figure 17 below. The analysis shows that the peak demand of 288 parking spaces will occur around 8:00pm for the site. The 327 carparks provided for the public is 39 spaces more than the estimated peak demand. Therefore, the shortfall in public parking of 47 spaces is not a significant risk in terms of ensuring the sufficient parking supply for the site considering the peak demand analysis.

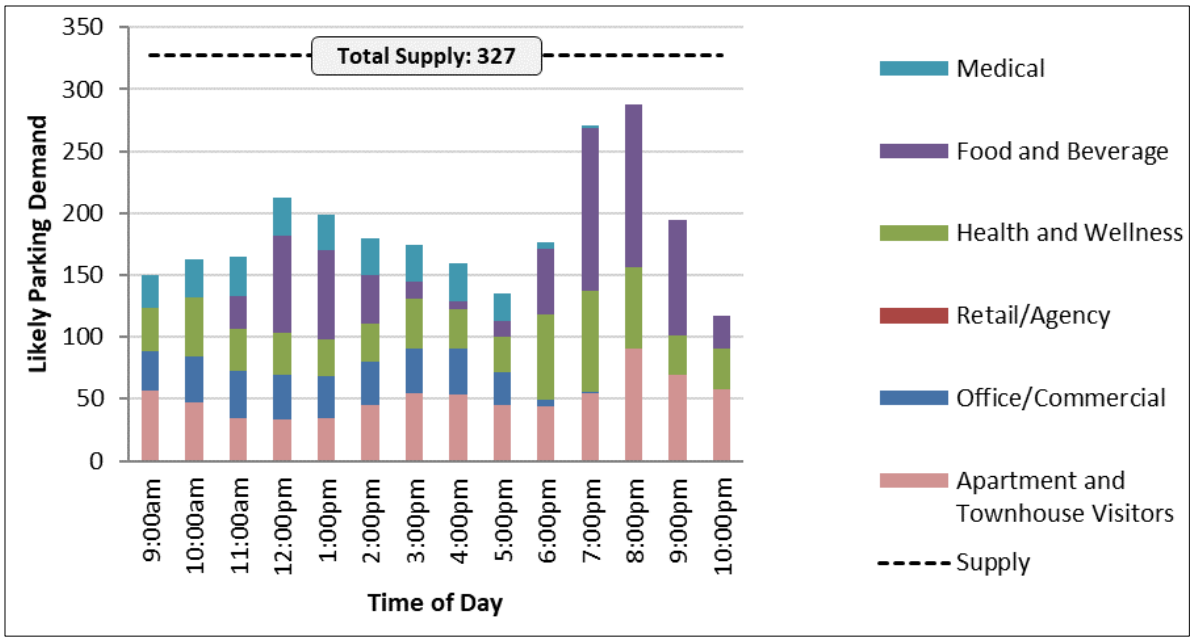


Figure 17 Temporal Parking Supply and Demand for Public Land Uses

4.2.1 Accessible Parking Provision

Accessible parking needs to be provided in accordance with the ACT Parking and Vehicular Access General Code. The code requires that a minimum of 3% of spaces be provided for people with disabilities. In this proposal, this amounts to 10 spaces for the public land uses.

4.2.2 Motorcycle Parking Provision

There is a requirement to provide motorcycle parking at a rate of 3 spaces per 100 public car parking spaces in addition to the car parks. This results in 10 motorcycle spaces for the development

5.0 Sustainable Transport Infrastructure

5.1 Bicycle End Trip Facilities

The Bicycle Parking General Code (BPGC) for the ACT was used to determine the required supply of bicycle parking spaces. The bicycle parking space requirements are summarised in Table 6.These are based on the following rates of supply of bicycle parking spaces.

Apartments

- 1 per apartment for residents
- 1 per 12 apartments after the first 12 apartments for visitors and guest

Townhouses

- Nil for residents
- Nil for visitors and guests

Commercial (Office) and Commercial (Agency)

- 1 space per 250 m^2 GFA after the first 250 m^2 GFA for employees; and
- 1 space per 950 m^2 GFA after the first 400 m^2 GFA for visitors and guests.

Food and Beverage

- 1 space per 400 m^2 GFA after the first 400 m^2 GFA for employees; and
- 1 space per 200 m^2 GFA after the first 200 m^2 GFA for visitors and guests. (Minimum 2)

Medical (Health Facility)

- 1 space per 8 practitioners after the first 8 practitioners for employees; and
- 1 space per 4 practitioners for visitors and guests

The Fitness and Wellness centre has been classified as an “Indoor Recreation Facility”. The BPGC does not provide bicycle parking requirements for this use. Rather, it is subject to individual assessment. In order to promote active travel and wellbeing within the site, the Wellness Centre has been allocated a provision of bicycle parking spaces equivalent to 10% of the total car parking spaces. This equates to 10 ‘Class 3’ bicycle racks to be provided in close proximity to the Fitness and Wellness centre.

The single residential lots have no minimum bicycle parking requirement.

A summary of how the bicycle parking requirements apply to the proposed development is presented in Table 6.

Table 6 Bicycle Parking Space Requirement - Residents and Employees

Land Use	Yield	Spaces per unit	Class	Total
Apartments	303 apartments	1 per apartment	1,2	*303*
Commercial (Office)	1500 m^2 GFA	1 per 250m^2 GFA after the first 250m^2 GFA	1,2	*5*
Food and Beverage	1320 m^2 GFA	1 per 400m^2 GFA after the first 400 m^2 GFA	1,2	*3*
Medical	795 m^2 GFA	1 per 8 practitioners after the first 8 practitioners	1, 2	*1*
TOTAL				***312***

Table 7 Bicycle Parking Space Requirement - Visitors and Guests

Land Use	Yield	Visitors and Guests		
		Spaces per unit	Class	Total
Apartments	303 apartments	1 per 12 apartments after the first 12 apartments	3	*25*
Commercial (Office)	1500 m^2 GFA	1 per 950 m^2 GFA after the first 400m^2 GFA	3	*2*
Food and Beverage	1320 m^2 GFA	1 per 200 m^2 GFA after the first 200m^2 GFA (minimum 2)	3	*6*
Medical	795 m^2 GFA	1 per 4 practitioners	3	*2*
Fitness and Wellness	2310 m^2 GFA	10% of total car parking spaces	3	*10*
TOTAL				***45***

Residential visitor parking spaces will be interspersed across site at an appropriate distribution.

Note: Bicycle parking for residential purposes can also be accommodated through storage areas, given these are provided for the apartments. It is proposed that bike cages will be provided for the employees within the facilities and bike racks will be provided for residents.

5.2 Walkability Score

Yarralumla has a walk score of 51 out of 100, making it a “somewhat walkable”.[1] Scores between 50-69 outline that some errands can be accomplished on foot. Points are awarded based on the distance to amenities in the following categories: dining and drinking, groceries, shopping, errands, parks, schools and culture and entertainment. Amenities within a 5-minute walk are given maximum points. A decay function is used to give points to more distant amenities, with no points given after a 30-minute walk. Walk Score also measures pedestrian friendliness by analysing population density and road metrics such as block length and intersection density.

[1] www.walkscore.com

6.0 Impact of the Development

6.1 Traffic Generation

The traffic generation for the development was determined based upon rates RTA Guide to Traffic Generating Developments version 2.2.

- A trip rate of 0.85 vehicles per dwelling in a peak hour was applied to houses and townhouses as per dwelling houses rate in the RTA Guide.
- A trip rate of 0.6 vehicles per dwelling in a peak hour was applied to apartments as per the medium density residential flat building rate in the RTA Guide.
- A trip rate of 2 vehicles per 100 m^2 GFA in a peak hour was applied to the commercial/office and commercial/agency GFA as per the RTA Guide.
- A trip rate of 5 vehicles per 100 m^2 GFA in a peak hour was applied to the food and beverage GFA as per the restaurant rate in the RTA Guide.
- A trip rate of 3 vehicles per 100 m^2 GFA in a peak hour was applied to the health and wellness GFA as per the gymnasium rate in the RTA Guide.

A summary of the peak hour trip generation for the development is as follows:

Table 8 Peak Hour Site Traffic Generation

Land Use	Yield	Units	Vehicle Trips per Peak Hour	Peak Hour Generation
Houses	18	houses	0.85	15
Townhouses	59	townhouses	0.85	50
Apartments	303	units	0.6	182
Commercial/Office	1500	m^2 GFA	0.02	30
Food and Beverage	1320	m^2 GFA	0.05	66
Fitness and Wellness	2310	m^2 GFA	0.03	69
Medical	795	m^2 GFA	0.104	83
TOTAL				**495 veh/hr**

6.2 Traffic Distribution

The trip distribution assigned to the site generated traffic was determined using existing turning movement patterns and the 2016 Australian Bureau of Statistics (ABS) journey to work data. For a driver of a vehicle from the Yarralumla area to their destination of full-time work is split between the key areas within the ACT as follows:

- Belconnen 8%
- City North and South Canberra 46%
- Gungahlin 1%
- Woden/Tuggeranong 45%

Given the journey to work data the following percentage splits shown in Table 9 to each key destination points in the Aimsun model have been estimated.

Table 9 Traffic Distribution Percentage Splits

Destination	Percentage Split
Novar Street	5%
Adelaide Avenue	27%
Cotter Road East	17%
Cotter Road West	19%
Kent Street	32%

The inbound/outbound splits for the site land uses are summarised in Table 10.

Table 10 Inbound and Outbound Splits

Land Use	Peak	INBOUND	OUTBOUND
Residential	AM	20%	80%
	PM	80%	20%
Commercial (Office)	AM	80%	20%
	PM	20%	80%
Commercial (Agency)	AM	80%	20%
	PM	20%	80%
Fitness and Wellness	AM	50%	50%
	PM	50%	50%
Food and Beverage	AM	50%	50%
	PM	70%	30%

Applying the distributions results in the inbound and outbound movement for the AM and PM peaks as outlined in Table 11 and Table 12 respectively.

Table 11 Site AM Peak Hour Traffic Generation

AM Peak Hour Traffic Generation						
Land Use	**Traffic Rate**	**In %**	**Out %**	**In**	**Out**	**Total**
Houses	15	20%	80%	3	12	15
Apartments	50	20%	80%	10	40	50
Townhouses	182	20%	80%	36	145	182
Commercial (Office)	30	80%	20%	24	6	30
Food and Beverage	66	50%	50%	33	33	66
Fitness and Wellness	69	50%	50%	35	35	70
Medical	83	50%	50%	41	41	82
TOTAL				**182**	**312**	**495**

Table 12 Site PM Peak Hour Traffic Generation

PM Peak Hour Traffic Generation						
Land Use	**Traffic Rate**	**In %**	**Out %**	**In**	**Out**	**Total**
Houses	15	80%	20%	12	3	15
Apartments	50	80%	20%	40	10	50
Townhouses	182	80%	20%	145	36	182
Commercial (Office)	30	20%	80%	6	24	30
Food and Beverage	66	70%	30%	46	20	66
Fitness and Wellness	69	50%	50%	35	35	70
Medical	83	50%	50%	41	41	82
TOTAL				**325**	**169**	**495**

7.0 Queuing Analysis

7.1 Public Car Park Queuing Analysis

Queueing theory from 'Austroads Guide to Traffic Management Part 2: Traffic Theory' was used to determine the 95th percentile queue along the access to the public carpark. A processing time of 12 seconds per vehicle has been applied. This is the average number of seconds to service a vehicle under a ticketed machine boom gate scenario. This processing time accounts for the approximate time to open a boom gate. Introduction of automatic number plate recognition gates would significantly improve operation and peak queue durations. Table 13 summarises the results of the analysis.

Table 13 Public car park access queuing

Location		AM		PM	
		Ingress	**Egress**	**Ingress**	**Egress**
Basement Ramp Access / Egress	Peak Arrival Rate (vph)	113	81	93	101
	Peak Queue (vehicles)	3	2	2	2
	Probability of more than 1 vehicle in queue*	14.2%	7.3%	9.6%	11.3%

*includes vehicle using the facility.

Across all time periods the expected maximum queue is three vehicles. AS/NZS 2890.1 *Parking Facilities, Part 1: Off-Street Car Parking,* requires that the maximum grade is 10% for not less than 0.8 of the queue length.

8.0 Network Analysis

8.1 Study Area Definition

The Aimsun modelling extents were determined based on TCCS requirements to include the internal Yarralumla road network. The extents if the modelling is shown in Figure 18 and Figure 19 below. The original network area in 2017 did not include the residential streets of Yarralumla (north of Denman/Kintore/Novar intersection). Upon request from TCCS, AECOM extended the model in 2020 to include the Yarralumla residential streets shown below. As the 2017 survey count data and the COVID impacted 2020 survey count data were unlikely to correlate at the interface between the two data sets, TCCS agreed to reduce the calibration requirements. The agreement involved ensuring that the core 2017 site area (2017 Aimsun Base Model) met the calibration criteria for these intersections as per the ACT Microsimulation Modelling Guidelines, and factoring the COVID impacted 2020 demands up to meet the 2017 demands, acknowledging that calibration in the Yarralumla residential streets may not meet requirements of the guidelines, however ensuring the conservative 2017 demands would be modelled as the base demand volumes.

Figure 18 Yarralumla Brickworks Aimsun Modelling Area

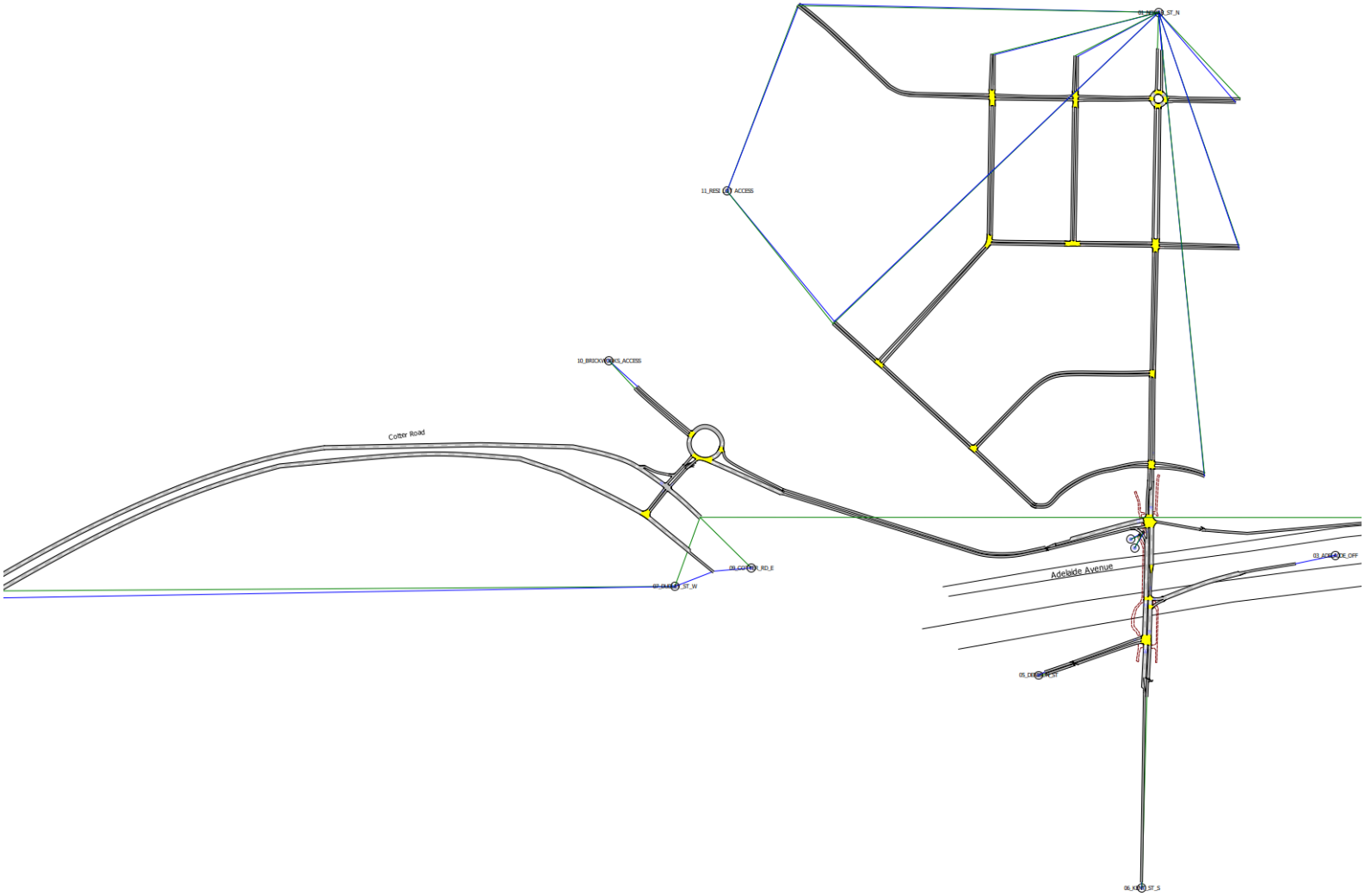


Figure 19 Yarralumla Brickworks Aimsun Network

8.2 Base Year Model – Calibration and Validation

In comparing the 3-hour 2017 base counts for the AM and PM peaks to the August 2020 counts, the 2017 base counts were higher than the 2020 counts for all Origins/Destinations, apart from the AM destination volumes to centroid *07_Dudley Street* and AM origin volumes from centroid *01_Novar St_N*.

For centroid *07_Dudley Street*, the difference between the original 2017 counts and the 2020 counts was 90 vehicles across the 3-hour period. For centroid *01_Novar St_N*, the 3-hour difference between the 2017 counts and 2020 counts were 57 vehicles. The 57 and 90 vehicles were proportioned based on the 2017 origin/destination proportions and was added to the demand matrix.

The 2020 counts were also used to determine the proportion of vehicles attracted and generated to the centroid *01_Novar St_N* from the side street. These side streets include Bentham St, Denman St. Loftus St, Weston St and Kintore Cres (Figure 20).

The 2020 counts were also used as inputs into the base model for the through movements on Cotter Road.

The model calibration has been undertaken as outlined in Section 8.2.1. Validation of the model was not undertaken due to the unavailability of 2017 travel time and queue length data.

The base model was extended to include the local area network of Yarralumla at the request of TCCS to understand the traffic impacts on the lower order local street network

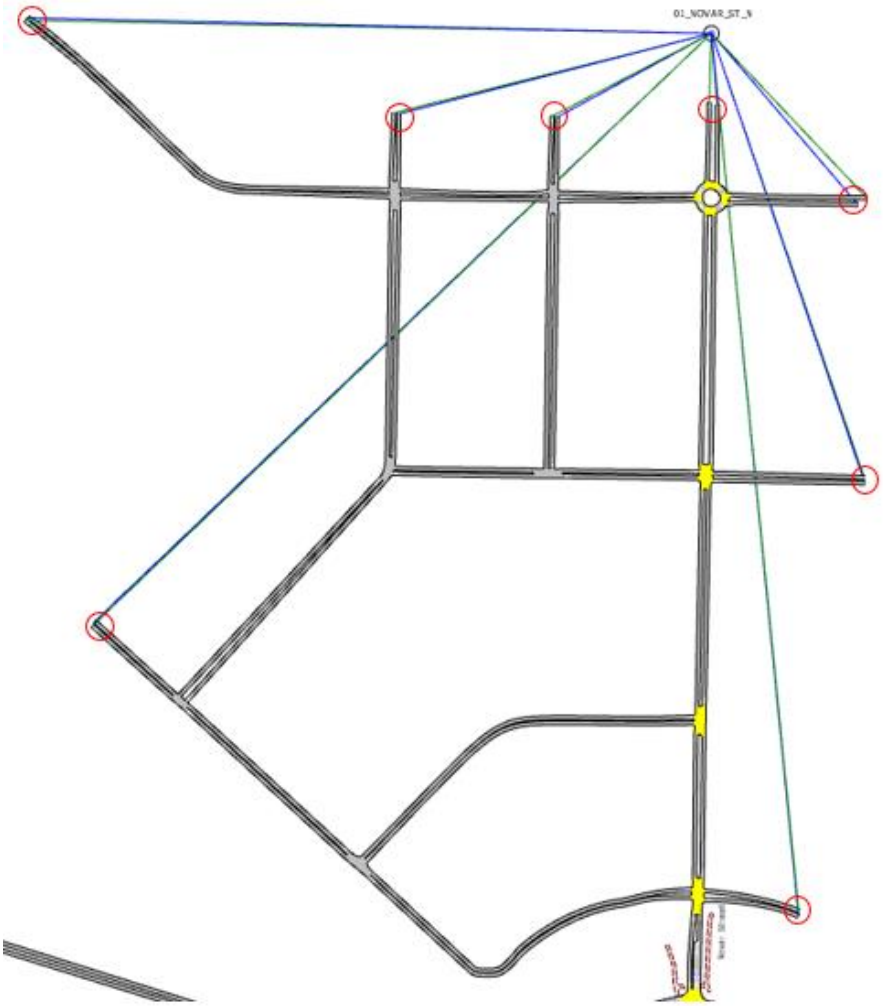


Figure 20 Centroid 01_Novar St_N Attractions and Generators

8.2.1 GEH

Given the 2017 base counts were utilised for the core of the model, a simple validation exercise has been undertaken to check flow volumes along Kent Street, Novar Street, Dudley Street and Cotter Road. The core calibration area and secondary calibration area are shown in Figure 21. Turn volumes along the suburban side streets were not analysed as the volumes generated from the side streets are a proportion of the 2017 volumes and hence won't match the 2020 counts.

Figure 21 Aimsun Model Calibration Area

Table 14 and Table 15 show the GEH results (the comparison between the modelled and survey traffic data) for the base model turn volumes in the core calibration area. As per the targets outlined in the *ACT Traffic Microsimulation Modelling Guidelines*, more than 85% of turn volumes have a GEH of less than 6 and a 100% of turn volumes have a GEH of less than 10.

Note that the GEH values are based on the average of the seed runs. In the AM peak, seed number 86524 showed an unusual lock-up at the Dudley Street / Novar Street roundabout and hence was omitted from the model.

Table 16 and Table 17 show the AM and PM peak GEH values for the northbound and southbound link volumes along Novar Street in the secondary calibration area. For the AM peak, the GEH targets in the *ACT Traffic Microsimulation Modelling Guidelines* are met. However, in the PM peak there is a significant deviation from the GEH targets outlined in the guidelines. The reason for this is that on Novar Street approach at the Novar Street / Dudley Street intersection, there is a 475 vehicle difference for the 3.30PM-6.30PM period between the 2017 counts and the 2020 counts. Since the

2017 counts are the higher counts and were maintained in the model, the GEH values will not match the 2020 count volumes in the secondary calibration area along Novar Street. Approaching the traffic modelling in this manner for the Yarralumla area is conservative, given the higher counts are utilised and results in a more robust traffic model.

Detailed GEH results for the core calibration area and the secondary calibration area are available in Appendix A.

Table 14 AM Core Calibration Area GEH results

Time Period	Number of Turns (Core Calibration Area)	Number of Turns with GEH<5	Number of Turns with GEH<10
7am-8am	23	23 (100%)	23 (100%)
8am-9am	23	20 (87%)	23 (100%)
9am-10am	23	22 (96%)	23 (100%)

Table 15 PM Core Calibration Area GEH results

Time Period	Number of Turns (Core Calibration Area)	Number of Turns with GEH<5	Number of Turns with GEH<10
3.30pm-4.30pm	23	22 (96%)	23 (100%)
4.30pm-5.30pm	23	23 (100%)	23 (100%)
5.30pm-6.30pm	23	23 (100%)	23 (100%)

Table 16 AM Secondary Calibration Area GEH results

Time Period	Number of Links (Core Calibration Area)	Number of Links with GEH<5	Number of Links with GEH<10
7am-8am	16	16 (100%)	16 (100%)
8am-9am	16	15 (94%)	16 (100%)
9am-10am	16	16 (100%)	16 (100%)

Table 17 PM Peak Secondary Calibration Area GEH results

Time Period	Number of Links (Core Calibration Area)	Number of Links with GEH<5	Number of Links with GEH<10
3.30pm-4.30pm	16	15 (94%)	16 (100%)
4.30pm-5.30pm	16	11 (69%)	15 (94%)
5.30pm-6.30pm	16	4 (25%)	16 (100%)

8.2.2 R^2 Value

Figure 22 to Figure 24 shows that the AM peak R^2 values are between 0.97 and 0.98 for the core calibration area. Similarly, for the PM peak, the R^2 values for the core calibration area are between 0.98 and 0.99. This also meets the R^2 target outlined in the *ACT Traffic Microsimulation Modelling Guidelines* where the required value is greater than 0.95.

AM Peak

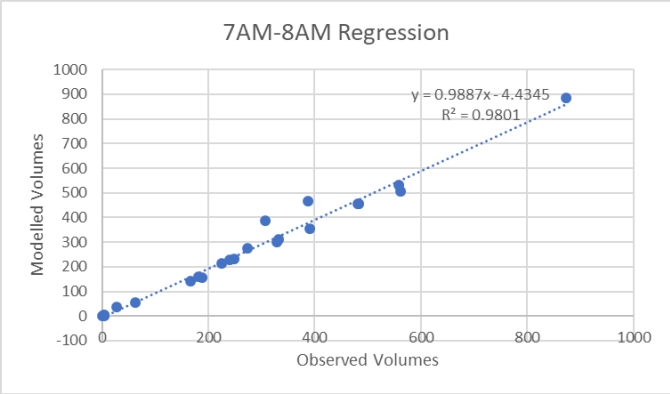


Figure 22 7AM-8AM Base R^2 Plot

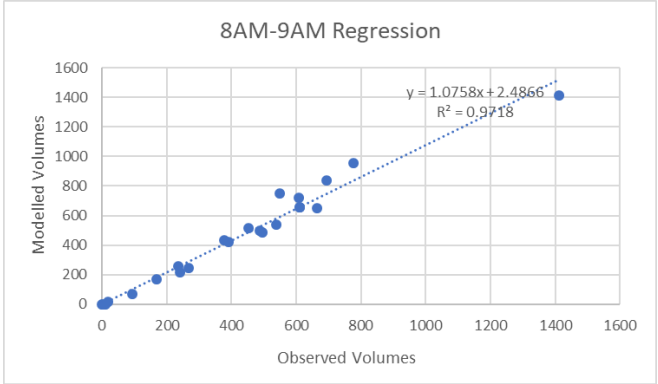


Figure 23 8AM-9AM Base R^2 Plot

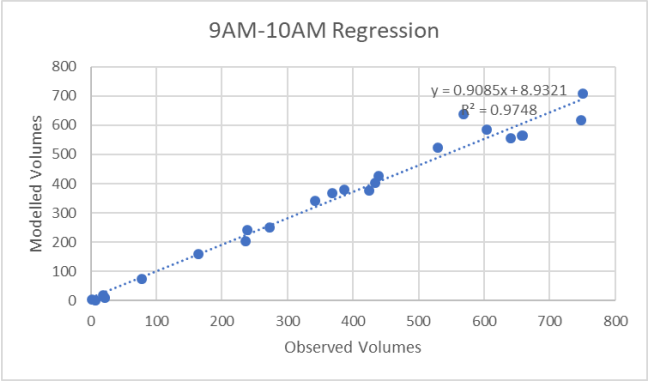


Figure 24 9AM-10AM Base R^2 Plot

PM Peak

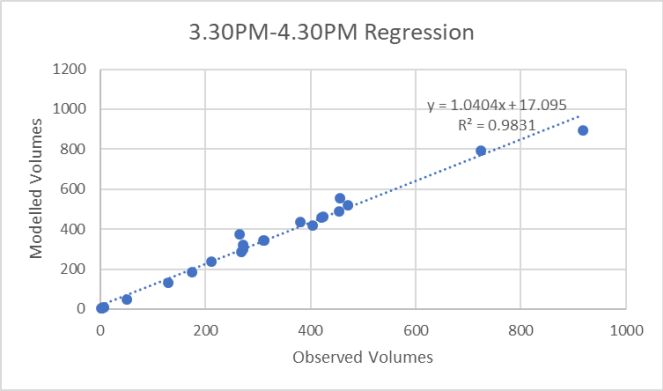


Figure 25 3.30PM-4.30PM Base R^2 Plot

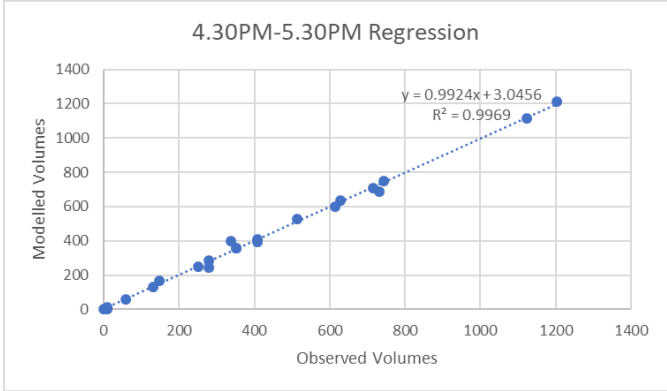


Figure 26 4.30PM-5.30PM Base R^2 Plot

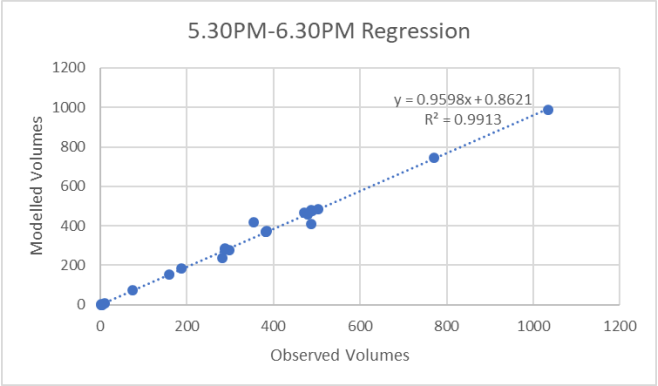


Figure 27 5.30PM-6.30PM Base R^2 Plot

8.2.3 Base Model Stability

A summary of the model stability analysis, comparing the stability of the base model between seed value runs is shown in Table 18.

The model stability is analysed by comparing differences in travel times between seed runs based on the “coefficient of variation” metric, where a variation of less than 5% is considered to indicate a good level of stability. The stability analysis shoes that the coefficient of variation is 4% and 3% for the AM and PM peak periods respectively.

Therefore, it is considered that both the AM and PM peak periods are stable and can reliably be used to forecast future scenarios.

As outlined previously, seed number 86524 showed an unusual lock-up at the Dudley Street / Novar Street roundabout and hence was omitted from the model in the AM peak.

Table 18 Model Stability Analysis

VHT	Seed 28	Seed 560	Seed 2849	Seed 7771	Seed 86524	Avg	Standard Deviation	Coefficient of Variation
AM Peak	495.11	474.74	456.05	454.23	N/A	470.03	19.12	4%
PM Peak	285.32	271.52	284.59	285.59	293.07	284.02	7.79	3%

8.3 Future Year Base Model

8.3.1 Future Year Base Model Geometry

The 2031 future year base model was updated to include the following changes:

- Canberra Brickworks Access Road and Dudley Street upgrade (Figure 28)
- Ken Street upgrades (Figure 29) which include
  - Signalisation of the Dudley Street/Kent Street, Kent Street / Adelaide Avenue off-ramp and Kent Street/ Denison Street intersection
  - Upgrades to the road alignment along Kent Street

Base Case

Future Case

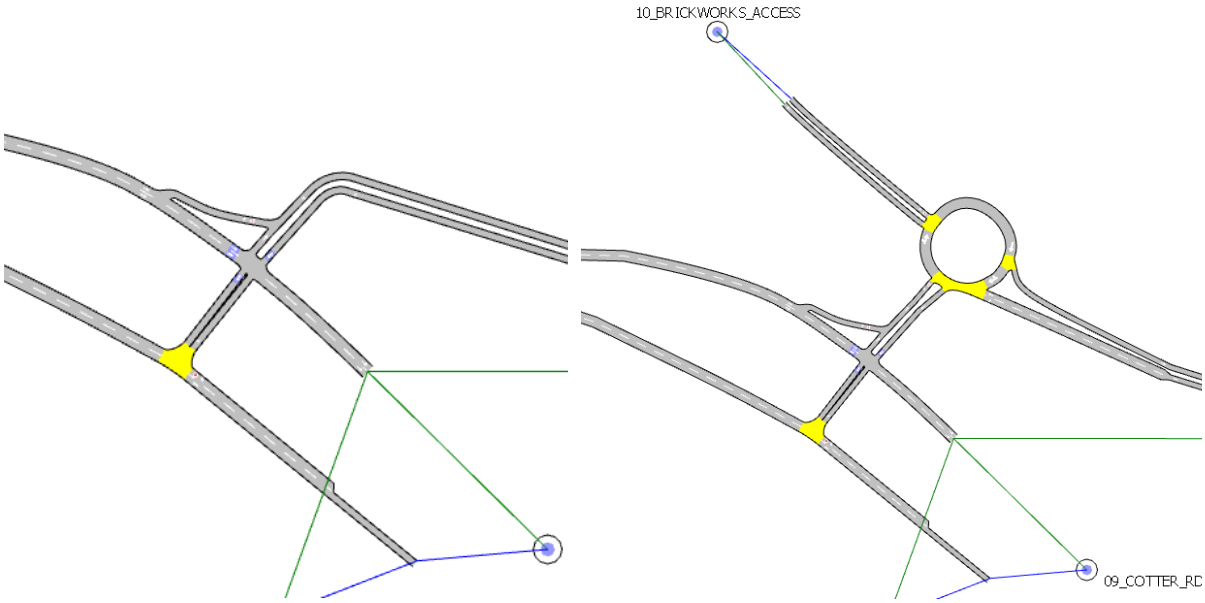


Figure 28 Brickworks Access Dudley Street Upgrades

Base Case

Future Case

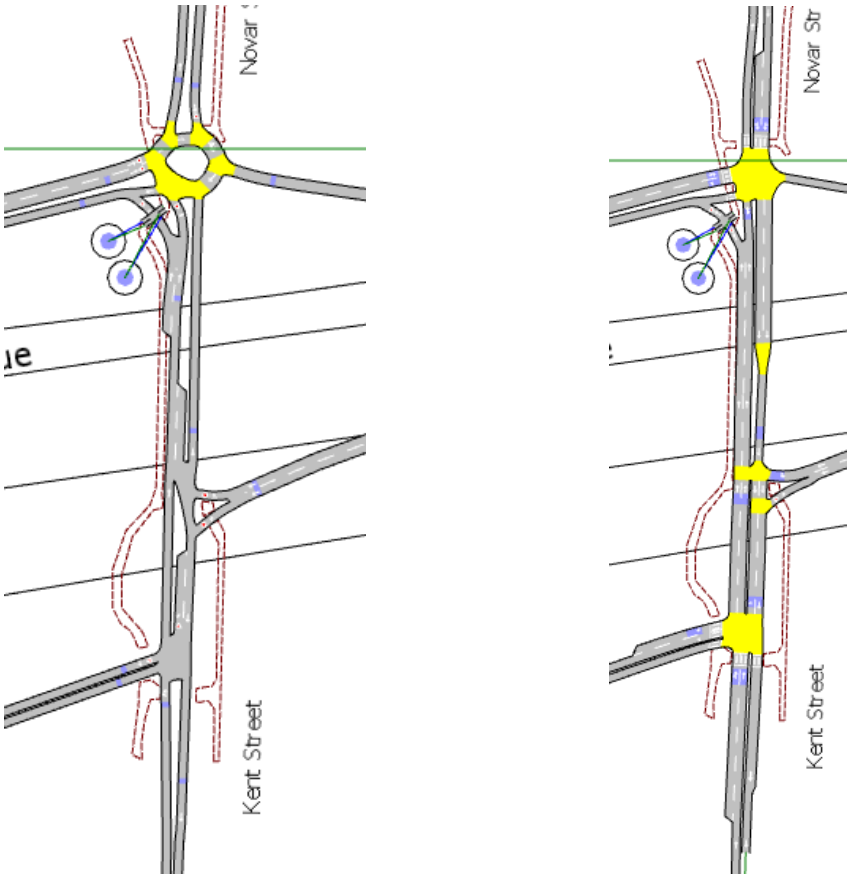


Figure 29 Kent Street Upgrades

8.3.2 Background Traffic Growth

A background traffic growth rate of 1.3% per annum has been utilised for the future year 2031 scenario. Details of how the growth rate was determined is available in Appendix B. A summary of the approaches to forecast growth rate is shown in Table 19.

Table 19 Summary of Approaches to Forecast Growth Rate

Approach	Annual Growth Rate
SCATS data and comparative assessment	1%
Canberra Strategic Transport Model (CSTM) volume projections	1.3%
CSTM land use forecast values	1.5%

Based on the review of the various approaches and datasets a rate of 1.3% was chosen per annum between 2017 to 2031.

CSTM is the most accurate model available for determination of the traffic growth in the ACT and is the preferred traffic growth method for TCCS.

8.4 Future Year Scenario Model

The peak hour trip generation for the site as outlined in Section 6.1 was added to the 2031 future year base model to determine 2031 future year scenario model. Since the model is a 3-hour model for both the AM and PM peaks, a trip generation of 100% was utilised for the peak 1 hour and a trip generation of 50% was utilised for each hour either side of the peak 1-hour period.

Please note that there were minor revisions to the Yarralumla masterplan and the land use mix after the future year modelling exercise was concluded. It must be stressed that the trip generation and parking estimates presented in the previous sections reflect the latest estimates, yet the same is not applicable to the Aimsun modelling. AECOM has reviewed the changes to the masterplan layout and considers that internal circulation has not altered significantly. Whereas, the overall peak hour trips of the revised masterplan have increased by 54 vehicles, given the maximum traffic distribution split in Table 9 of the Kent St (32%), these changes will result in an additional 17 vehicles during the peak hour which is considered insignificant to the overall traffic demand of this street and its intersections. Hence AECOM has not undertaken model re-runs and assumes that there will not significant deviations to the results and discussions presented in the following sections.

8.5 Network Performance

To assess network performance, the base model and two traffic demand scenarios were tested for AM and PM weekday peaks:

1. Existing Base
2. 2031 without development
3. 2031 with development

8.5.1 Network Demand

The total network demand for each of the scenarios listed above is shown below in Figure 30. The number of vehicles waiting to enter the network is shown in Figure 31. The maximum number of vehicles waiting to enter the network is 14 vehicles for all scenarios. This indicates the scenarios are operating reasonably and that there are no unusual lock-ups or operational issues in the models during their operation.

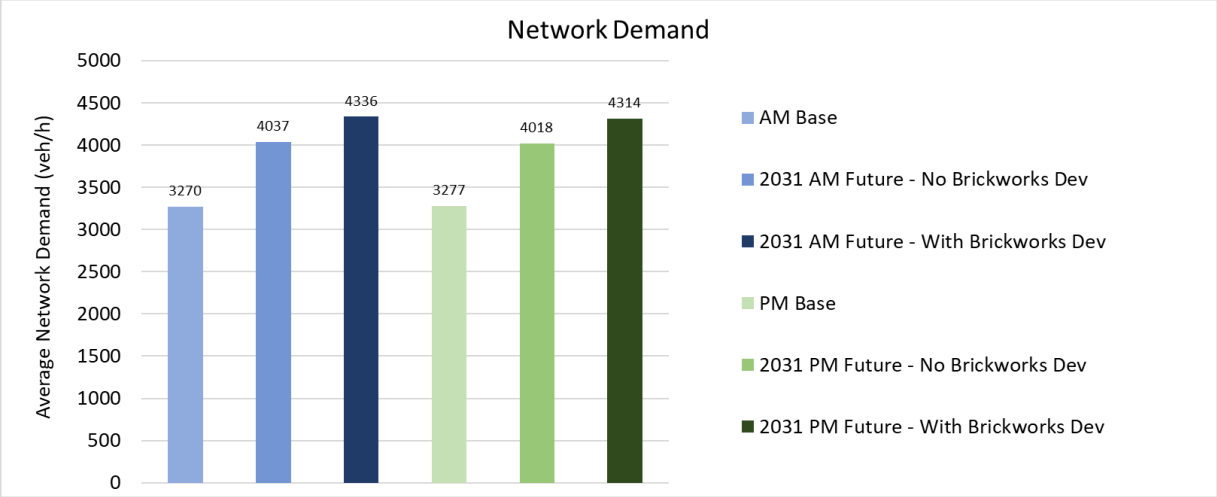


Figure 30 Average Network Demand

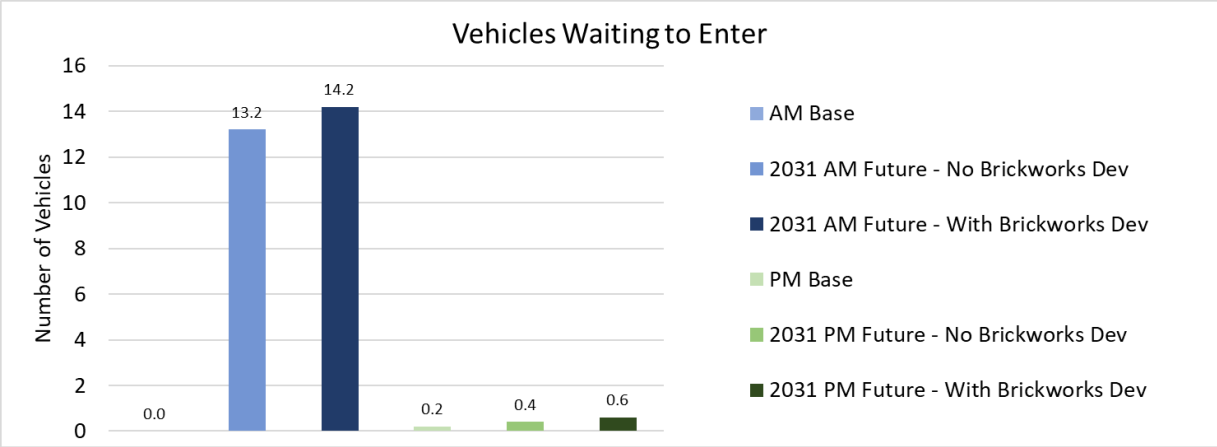


Figure 31 Vehicles Waiting to Enter the Network

8.5.2 Network Results

For each of the demand scenarios, overall network performance in the study area network was summarised in Figure 32 to Figure 35, expressed in terms of a range of performance criteria:

- Average network delay times in the study area (Figure 32)
- Number of missed turns in the study area network (Figure 33)
- Total vehicle hours travelled in the study area network (Figure 34)
- Total vehicle kilometres travelled in the study area network (Figure 35)

These show that the increase in travel times and delays from the existing base to 2031 is mostly due to the increase in background traffic growth in 2031.Compared to the base 2031 data, the additional demand from the Yarralumla Brickworks site has minor impact to the road network. The most noticeable delays are delays along Kent Street which consequently increase delays along Dudley Street. To alleviate these delays, additional green time was allowed for vehicles along the Kent Street approach at the Dudley Street / Kent Street intersection which resulted in better performance of the intersection.

The number of missed turns represent the number of vehicles that deviated from their original assigned path. This is mostly attributed to congestion in the model and vehicles undertaking an alternate route. The AM base model has more missed turns than 2031 base and 2031 scenario model.

This higher number of missed turns in the existing scenario can be attributed to the different intersection layouts between the existing and 2031 scenarios.

The vehicle hours travelled (VHT), and vehicle kilometres travelled (VKT) give an overall indication of additional congestion in the network because of the proposed development. As a result of the Yarralumla Brickworks development, there is only a minor increase in the VHT and VKT over the total 3-hour model period for the AM and PM peaks.

Other network results plots, including vehicle density and average delay can be found in Appendix C. These plots show the most critical 1-hour period for the AM and PM peaks which are 8.30AM-9.30AM and 4.45PM-5.45PM respectively.

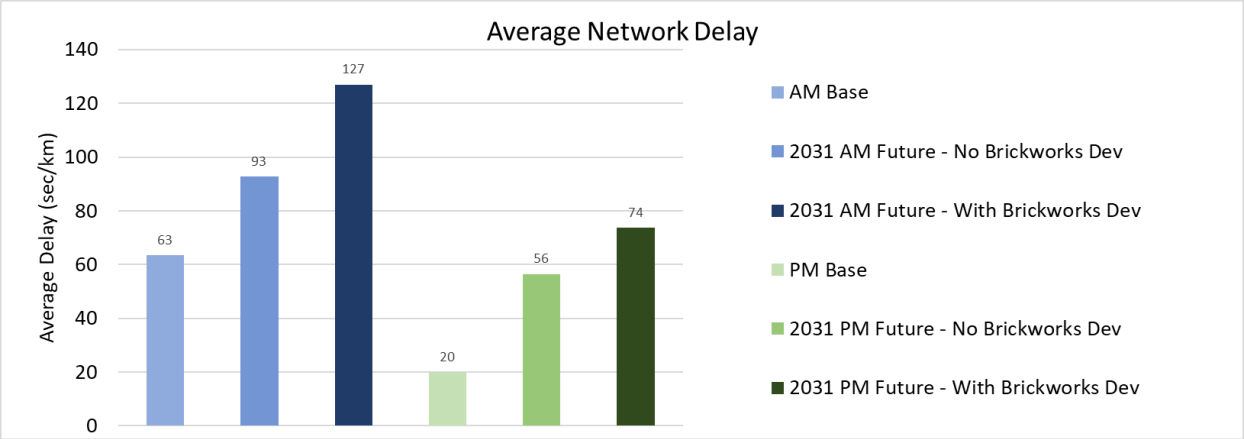


Figure 32 Average Network Delay

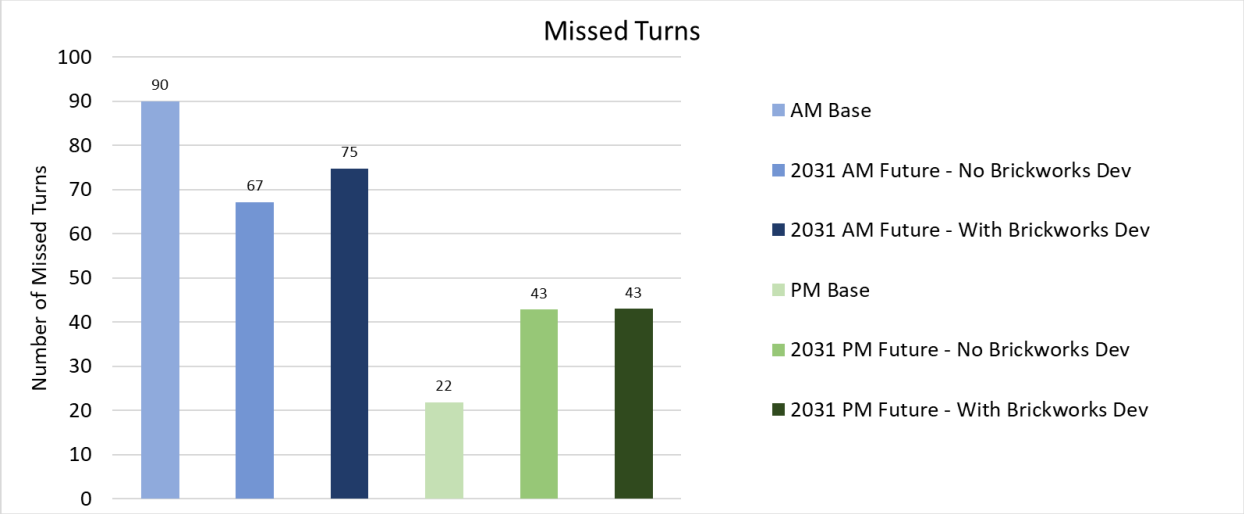


Figure 33 Number of Missed Turns

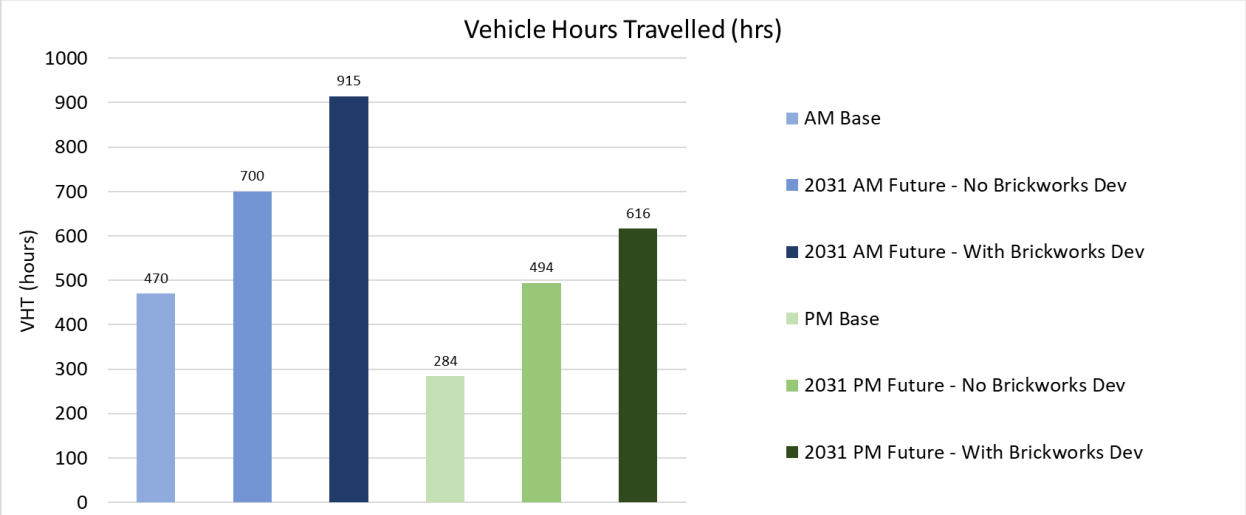


Figure 34 Vehicle Hours Travelled (hrs)

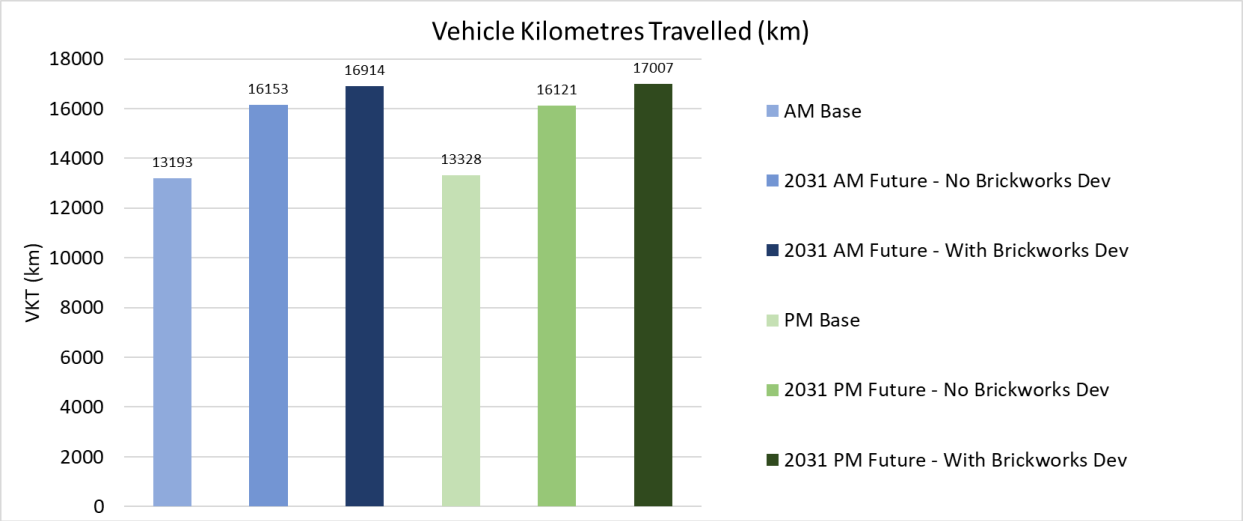


Figure 35 Vehicle Kilometres Travelled (km)

8.6 Intersection Performance

8.6.1 Key Intersection Performance

Intersection performance was analysed at each of the major intersections possibly impacted by the proposed development in the model in both the AM and PM peaks. The results of this analysis are shown in Figure 36. The average intersection delay as a result of the proposed development typically had less than a 5 second increase in delay at any of the key intersections in model. The maximum increase in delays is 13 seconds at the Dudley Street / Kent Street intersection in the PM peak between the base 2031 and 2031 development year scenarios, this is a result of the demand generated from the Brickworks site increasing the traffic movements from Dudley Street turning right into Kent Street southbound. As can be seen in Figure 36, the increase in intersection delay between the existing base model and the 2031 models are mostly attributed to background traffic growth.

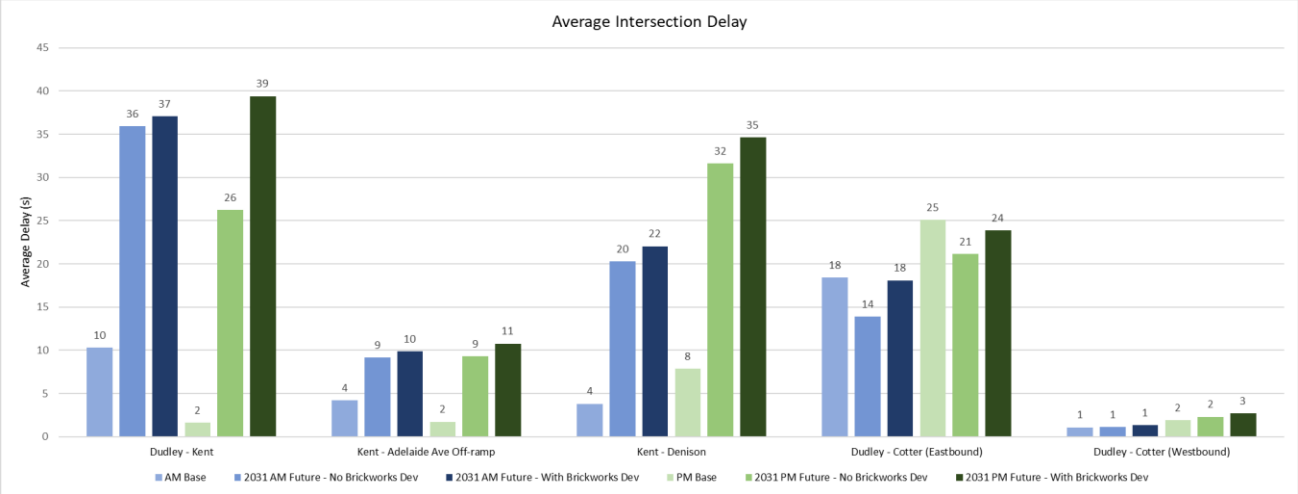


Figure 36 Average Intersection Delay

8.6.2 Overall Intersection Performance

Intersection performance is commonly presented in terms of level of service (LOS), ranging from A to F as shown in Table 20.

Table 20 Level of Service Criteria - Intersections

Level of Service	Description
A	Good Operation
B	Good with acceptable delays & spare capacity
C	Satisfactory
D	Operating near capacity
E	At capacity; incidents will cause excessive delays
F	Flow break down occurs

The results of the level of service analyses for the existing and future AM and PM peak scenarios are shown in Figure 37 to Figure 42. The AM and PM peaks shown represent the most critical 1-hour period which are 8.30AM-9.30AM and 4.45PM-5.45PM. In the existing base case, the worst level of service recorded is LOS F in the AM peak. This is along the Dudley Street leg on approach to the Dudley Street / Kent Street roundabout. The low level of service on this leg is largely due to the high volumes from the Kent Street approach.

When comparing the LOS with the added traffic from Brickworks development with the 2031 forecast volumes, there is decrease in serviceability at the Dudley Street / Kent Street and Denison Street / Kent Street intersections. This is mostly due to the increase in demand along the Kent Street and the delays at the traffic lights. AECOM have undertaken sensitivity analysis and have optimised signal timing along Kent Street to minimise delays.

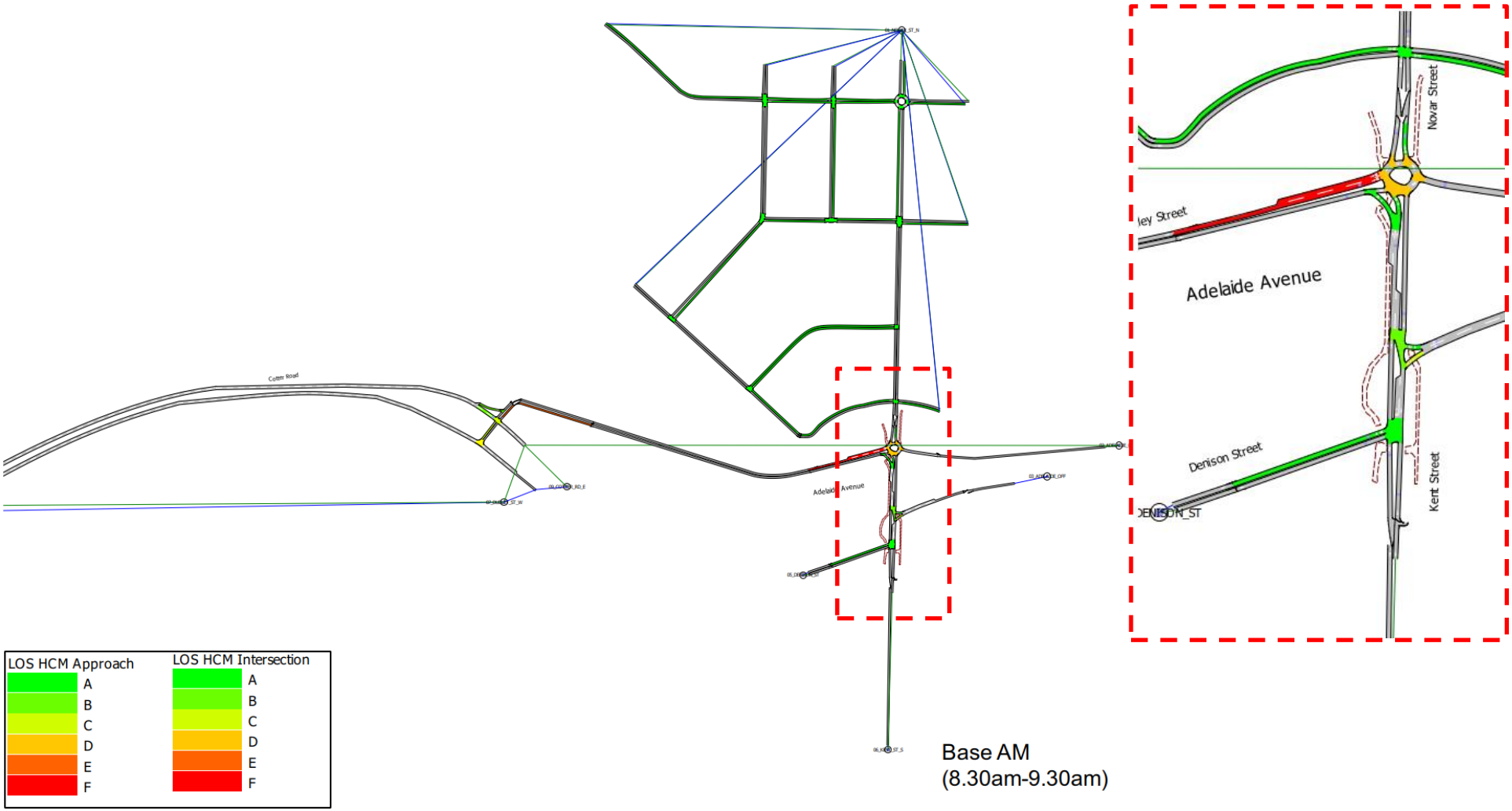


Figure 37 Base AM LOS – 8.30AM-9.30AM

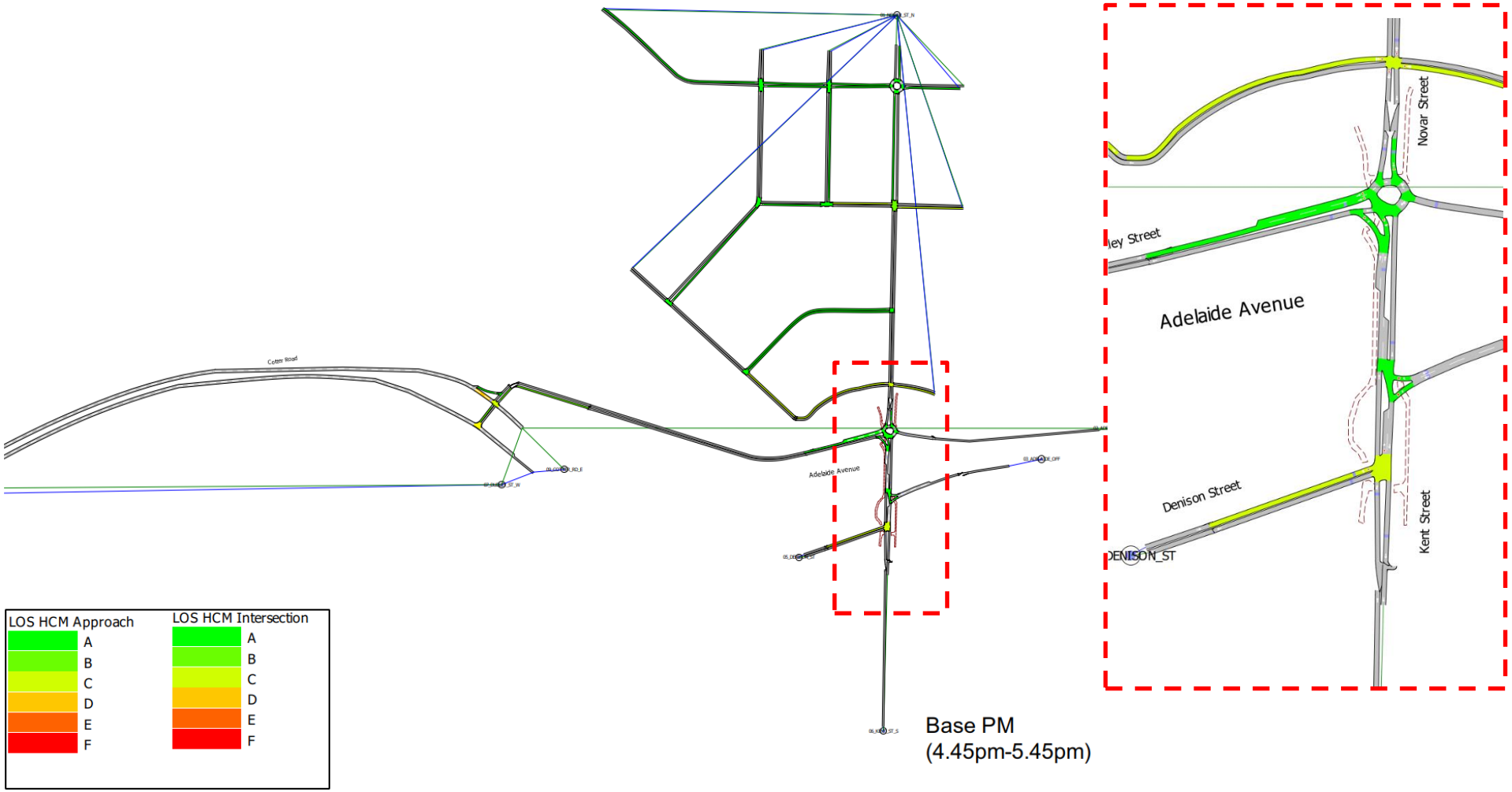


Figure 38 Base PM LOS – 4.45PM-5.45PM

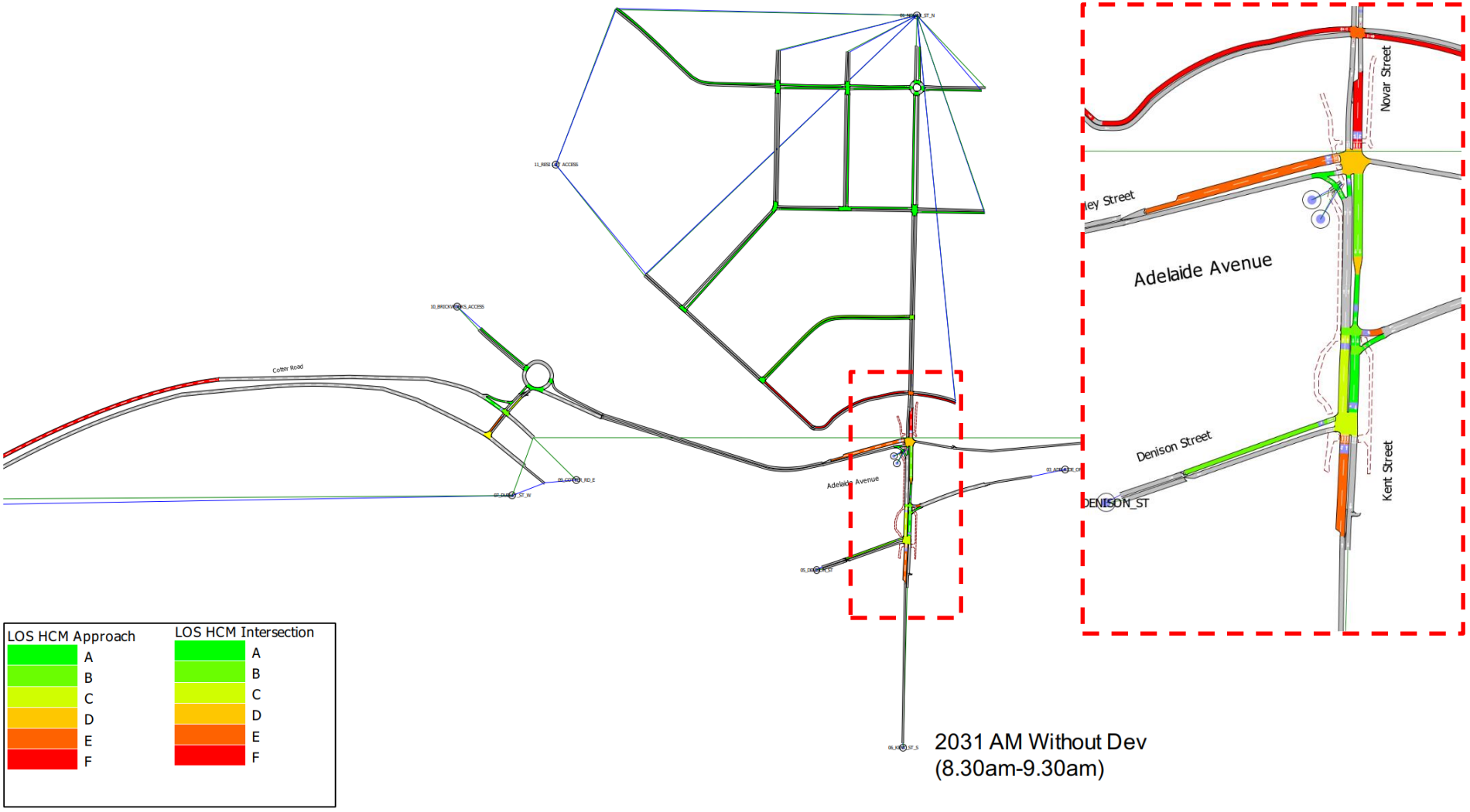


Figure 39 2031 AM Without Dev LOS – 8.30AM-9.30AM

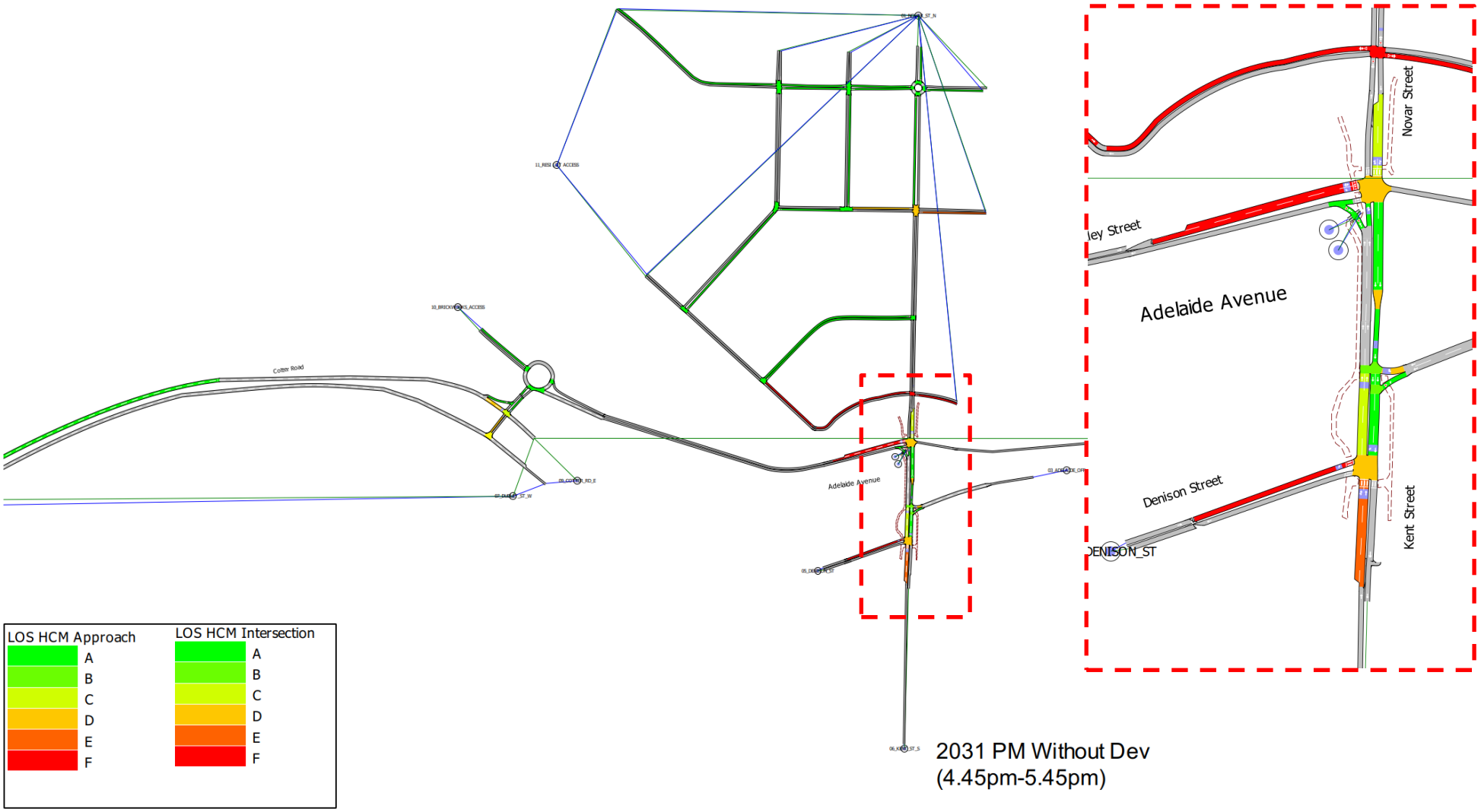


Figure 40 2031 PM Without Dev LOS – 4.45PM-5.45PM

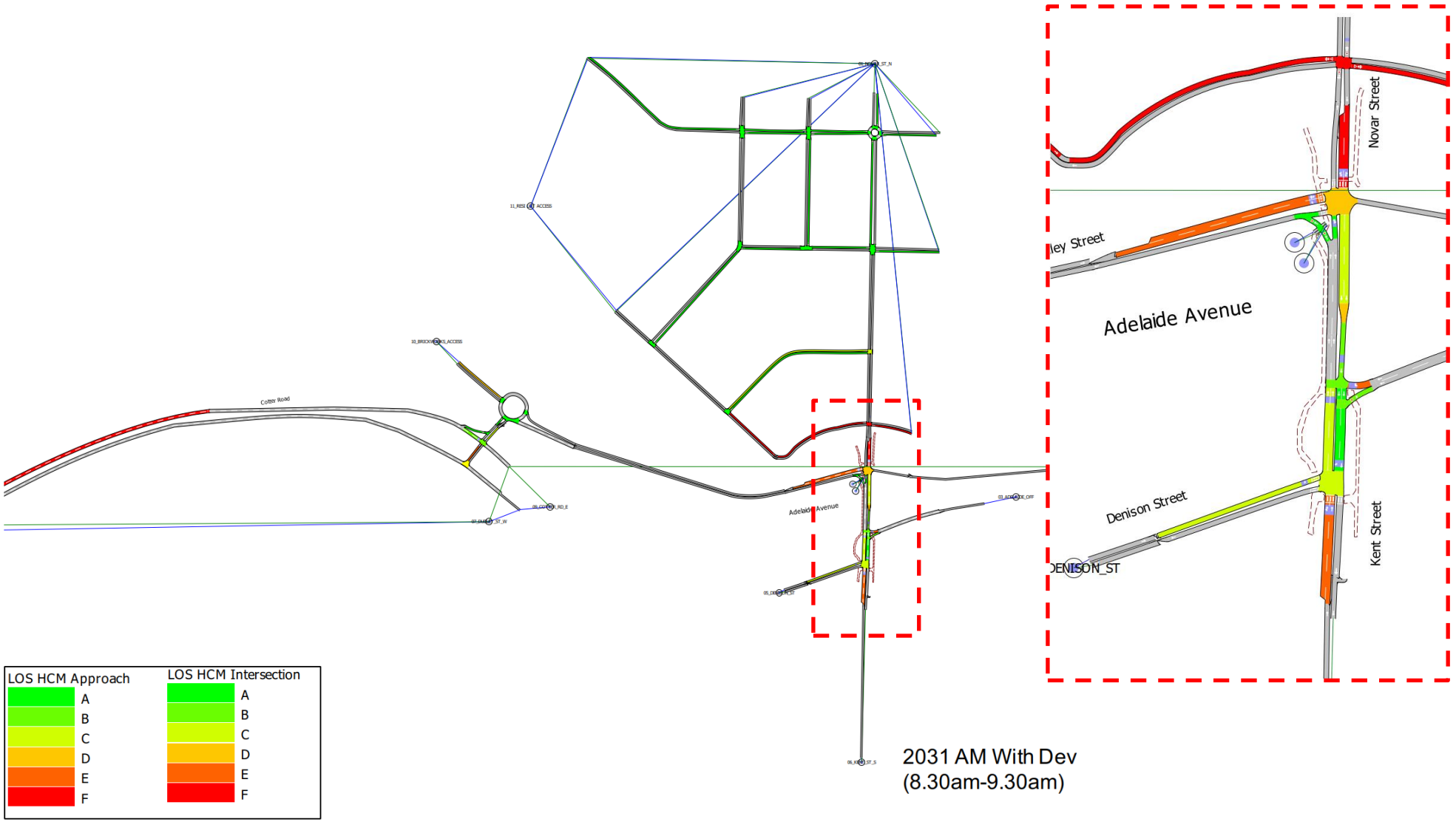


Figure 41 2031 AM With Dev LOS – 8.30AM-9.30AM

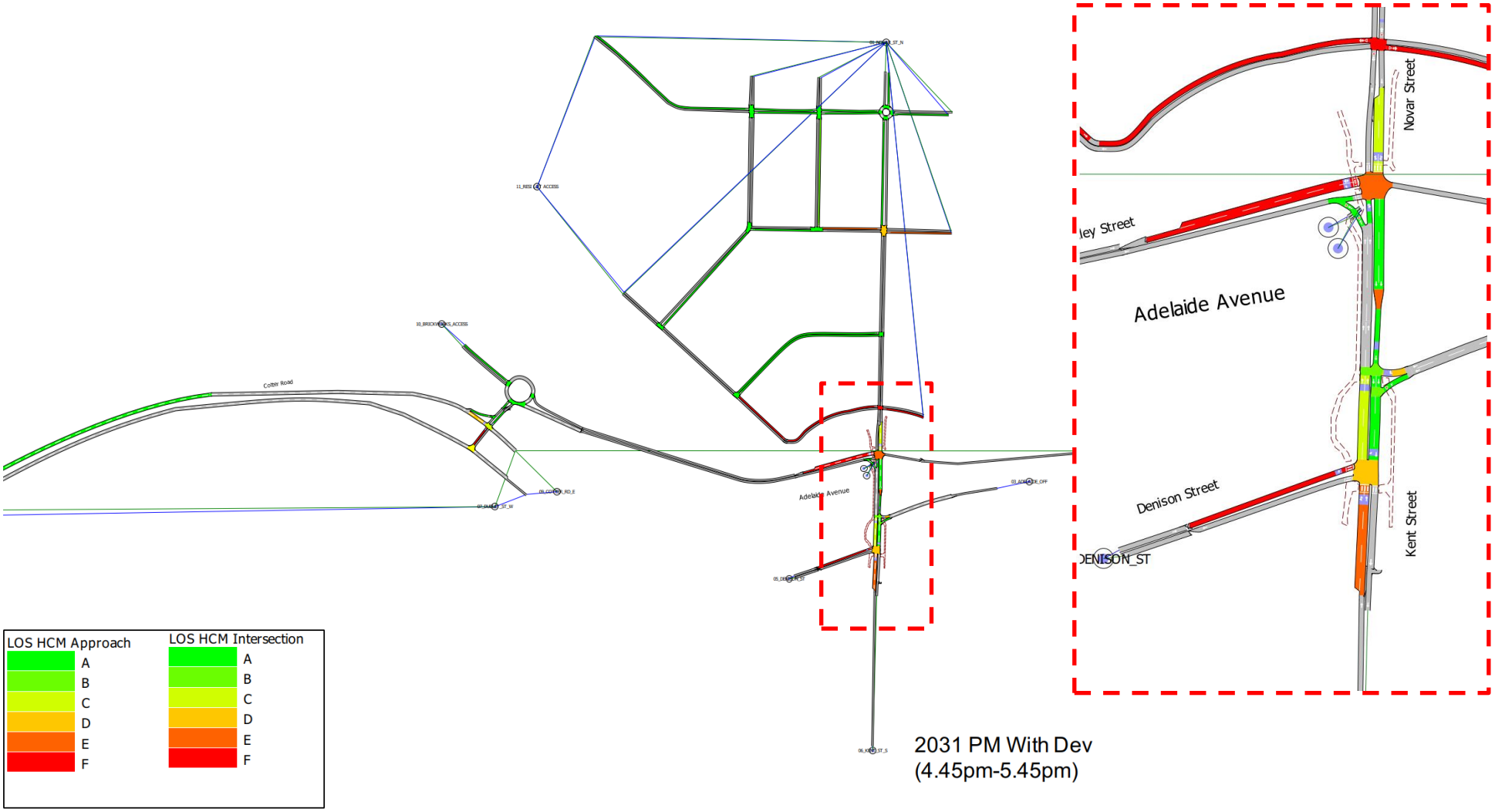


Figure 42 2031 PM With Dev LOS – 4.45PM-5.45PM

8.7 Network Issues and Mitigation Measures

Following on from the results analysis in Sections 8.5 and 8.6, there is a notable increase in network delays and decrease in level of service as a result of the background growth in Yarralumla through to 2031 in both the AM and PM peak periods.

AECOM has not undertaken a thorough review of the suitability on the future road network augmentations as a part of the traffic modelling for the Yarralumla Brickworks development. The future road augmentations and network extents are as per TCCS's requirements for the Aimsun model network coding and the proposed Kent Street and Dudley Street designs previously undertaken by AECOM.

The critical factor relating to this project is identifying the individual impact on the future traffic network of the Yarralumla Brickworks development. The traffic distributions outlined in Section 6.2 indicate that most of the traffic to the site is generated from Kent Street and the Adelaide Avenue off-ramp, whilst traffic exiting the site travel mostly via Cotter Road. The site traffic distribution is also shown in Figure 43.

As noted above and in Section 8.6.1, the increase in delays in 2031 are mostly due to the increase in background traffic growth. There is notable increase in delays particularly at the intersections along Kent Street. This could also be attributed to the proposed signalisation of the intersections along the road where there are added delays to traffic along Kent Street. Whereas in the existing base case, traffic along Kent Street has priority. When comparing the 2031 development with the base 2031 scenario, the is a slight decrease in LOS at the Denison Street and Dudley Street intersections along Kent Street. However, overall increase in delays at the intersections are only minor with the maximum increase being 13 seconds.

AECOM also undertook sensitivity analysis to optimise signal timing at the intersections along Kent Street. The signals were modelled as actuated signals with more favourable green time for traffic along Kent Street.

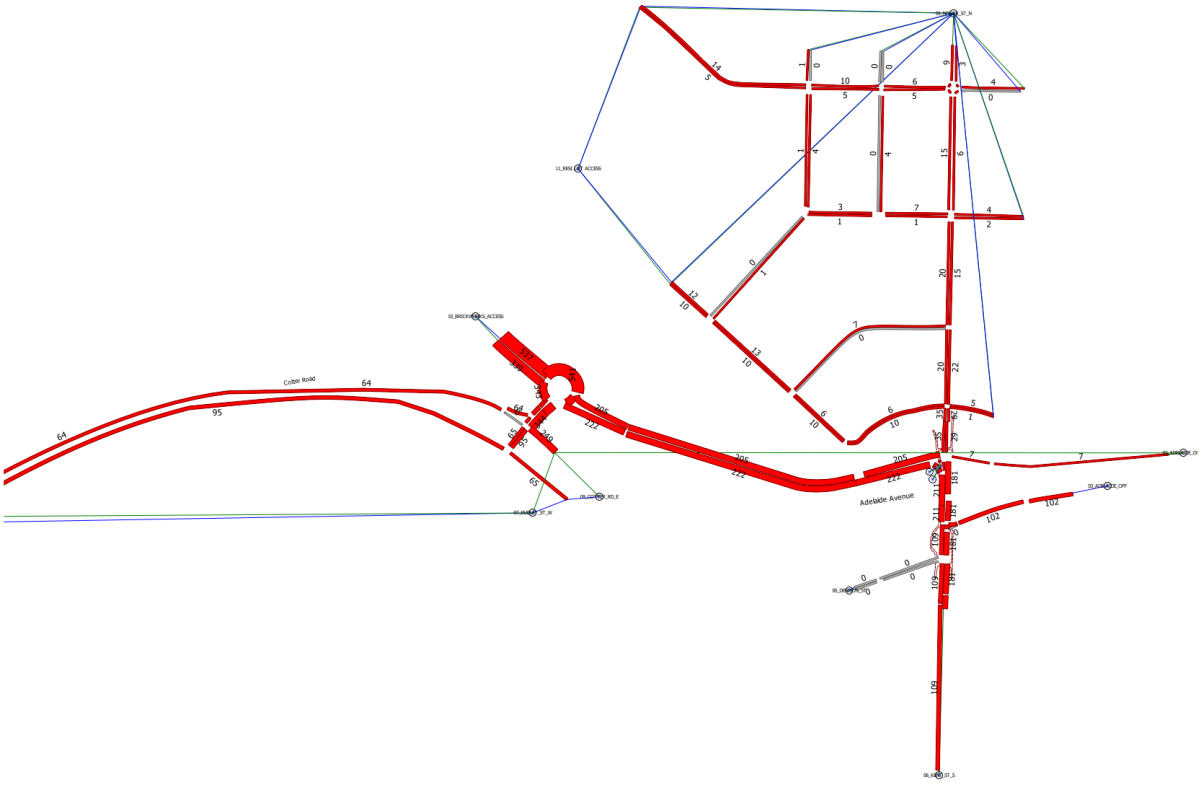


Figure 43 2031 7AM-10AM – Yarralumla Brickworks Traffic Distribution

8.8 Network Analysis Summary

In summary, the analysis undertaken as part of this study has determined the operational impacts which will occur throughout the study area in 2031 in the peak AM and PM periods as a result of background growth and the proposed Yarralumla Brickworks Development. As a result of this study, it has been determined that the proportional impact to the traffic network that can be attributed to the future Brickworks development is not significant in terms of increases in delay or level of service operation at key intersections or throughout the study area in 2031.

9.0 Conclusions and Recommendations

A summary of the key findings of the report are detailed below:

Adequacy of Car Parking

- The parking for the proposed development will meet the demand for both the private and public land uses.
- For the residential apartments, 150 parking spaces in excess of the requirements in the *Parking and Vehicular Access General Code* (PVAGC) are proposed for the development.
- For the public uses, there are 47 less parking spaces than the direct application of requirements in the PVAGC. However, given the temporal nature of the parking demand, the temporal profile analysis indicated that the peak demand will be 288 parking spaces, while there is a total of 327 public parking spaces proposed for the development. There is a low risk of insufficient public parking being provided on site based on the analysis undertaken.

Impact on Traffic Operations

- AIMSUN modelling showed that the increase in background traffic demand 2031 has notable impact on the overall performance of the network in the study area. There is notable increase in delays particularly at the intersections along Kent Street. This could also be attributed to the proposed signalisation of the intersections along the road where there are added delays to traffic along Kent Street, whereas in the existing base case traffic along Kent Street has priority. It should be emphasised that AECOM has not undertaken sensitivity analysis on the proposed future augmentation of the road as part of the traffic modelling for the Yarralumla Brickworks development. This was undertaken as part of the optioneering analysis for the Kent Street upgrade project and the currently proposed future layout from the Kent Street upgrade analysis has been used as the layout for the future Brickworks analysis in this report.
- AECOM undertook sensitivity analysis to optimise signal timing at the intersections along Kent Street. The signals were modelled as actuated signals with more favourable green time for traffic along Kent Street optimising the overall operation of the road network.
- As a result of this study, it has been determined that the proportional impact to the traffic network that can be attributed to the future Brickworks development is not significant in terms of increases in delay or level of service operation at key intersections or throughout the study area in 2031.

Accessible, Motorcycle and Bicycle Parking

- The ACT Parking and Vehicular Access General Code requires that 3% of public spaces to be provided be compliant for disabled parking. This amounts to 10 disabled parking spaces required for the site.
- The Bicycle Parking General Code for the ACT was used to determine the required supply of bicycle parking spaces. According to the code a supply of 347 bicycle parking spaces must be provided in total, with 312 spaces allocated for residents, and 35 for visitors and guests. The design for the Yarralumla brickworks accommodates this need and additionally an extra 10 bicycle parking spaces has been provided for the Fitness and Wellness Centre totalling to 357 spces.

Site Access and Service Vehicles

- The main access to the site is proposed via the new Brickworks Access Road which connects to Dudley Street and Cotter Road. Service vehicles will also use this access.
- There are other accesses to the site via Denman Street and Bentham Street which provides access to the townhouses and the residential lots on the east side of the development.

Appendix A

GEH Results

Appendix A GEH Results

AM Base Existing - 7am-8am - Core Calibration Area		
Intersection	**Turn**	**GEH**
Kent St/Denison St	North_R	1.269040131
Kent St/Denison St	North_T	3.753785968
Kent St/Denison St	West_L	0.949414688
Kent St/Denison St	West_R	0.358568583
Kent St/Denison St	South_L	0.393919299
Kent St/Denison St	South_T	1.536278286
Kent St/Adelaide Avenue	North_T	1.142392192
Kent St/Adelaide Avenue	East_L	0.818463256
Kent St/Adelaide Avenue	East_R	1.461264561
Kent St/Adelaide Avenue	South_T	1.785743948
Dudley St/ Kent St	North_Entry	2.140649838
Dudley St/ Kent St	North_Exit	1.032795559
Dudley St/ Kent St	South_Entry	4.237890068
Dudley St/ Kent St	South_Exit	1.211950882
Dudley St/ Kent St	West_Entry	1.18990815
Dudley St/ Kent St	West_Exit	2.48352234
Dudley St/ Kent St	East_Exit	0.709119614
Dudley St/Cotter Rd	North_R	1.785163617
Dudley St/Cotter Rd	North_L	0.447213595
Dudley St/Cotter Rd	West_L	2.336808541
Dudley St/Cotter Rd	West_T	0.396289487
Dudley St/Cotter Rd	East_R	2.915475947
Dudley St/Cotter Rd	East_T	0.030219894
AM Base Existing - 7am-8am - Secondary Calibration Area		
Intersection	**Turn**	**GEH**
Novar St/Denman St/Kintore St	North_Entry	1.36438208
Novar St/Denman St/Kintore St	North_Exit	2.787849459
Novar St/Denman St/Kintore St	South_Entry	3.490011487
Novar St/Denman St/Kintore St	South_Exit	1.226341047
Novar St/Abbot St	North_Entry	1.793223961
Novar St/Abbot St	North_Exit	2.895520661
Novar St/Abbot St	South_Entry	2.821382463
Novar St/Abbot St	South_Exit	1.36438208
Novar St/Weston St	North_Entry	2.311494736
Novar St/Weston St	North_Exit	3.328074235
Novar St/Weston St	South_Entry	2.828427125
Novar St/Weston St	South_Exit	3.681758696
Novar St/Loftus St/Bentham St	North_Entry	2.246987105
Novar St/Loftus St/Bentham St	North_Exit	1.678744119
Novar St/Loftus St/Bentham St	South_Entry	3.34688303
Novar St/Loftus St/Bentham St	South_Exit	2.612833391

AM Base Existing - 8am-9am – Core Calibration Area		
Intersection	**Turn**	**GEH**
Kent St/Denison St	North_R	2.929549265
Kent St/Denison St	North_T	7.944231357
Kent St/Denison St	West_L	0.211930708
Kent St/Denison St	West_R	0
Kent St/Denison St	South_L	0.058722022
Kent St/Denison St	South_T	0.497183076
Kent St/Adelaide Avenue	North_T	1.728628455
Kent St/Adelaide Avenue	East_L	1.514155837
Kent St/Adelaide Avenue	East_R	2.760671363
Kent St/Adelaide Avenue	South_T	0.497282977
Dudley St/ Kent St	North_Entry	1.354424
Dudley St/ Kent St	North_Exit	2.756966388
Dudley St/ Kent St	South_Entry	4.25872517
Dudley St/ Kent St	South_Exit	1.728628455
Dudley St/ Kent St	West_Entry	5.12456341
Dudley St/ Kent St	West_Exit	1.790082569
Dudley St/ Kent St	East_Exit	0.596523158
Dudley St/Cotter Rd	North_R	1.305044379
Dudley St/Cotter Rd	North_L	1.58113883
Dudley St/Cotter Rd	West_L	6.019920661
Dudley St/Cotter Rd	West_T	0
Dudley St/Cotter Rd	East_R	3.900142448
Dudley St/Cotter Rd	East_T	0.075369097
AM Base Existing - 8am-9am – Secondary Calibration Area		
Intersection	**Turn**	**GEH**
Novar St/Denman St/Kintore St	North_Entry	1.328120274
Novar St/Denman St/Kintore St	North_Exit	4.093156081
Novar St/Denman St/Kintore St	South_Entry	5.638394056
Novar St/Denman St/Kintore St	South_Exit	0.137665542
Novar St/Abbot St	North_Entry	1.524079423
Novar St/Abbot St	North_Exit	4.238336246
Novar St/Abbot St	South_Entry	4.093156081
Novar St/Abbot St	South_Exit	1.391447324
Novar St/Weston St	North_Entry	3.363329729
Novar St/Weston St	North_Exit	0.805451674
Novar St/Weston St	South_Entry	4.334816858
Novar St/Weston St	South_Exit	1.571481405
Novar St/Loftus St/Bentham St	North_Entry	2.546818464
Novar St/Loftus St/Bentham St	North_Exit	0.453609212
Novar St/Loftus St/Bentham St	South_Entry	2.662559326
Novar St/Loftus St/Bentham St	South_Exit	3.352716832

AM Base Existing - 9am-10am – Core Calibration Area		
Intersection	**Turn**	**GEH**
Kent St/Denison St	North_R	1.503357461
Kent St/Denison St	North_T	2.879670749
Kent St/Denison St	West_L	0.412957192
Kent St/Denison St	West_R	3.464718387
Kent St/Denison St	South_L	0
Kent St/Denison St	South_T	0.649707074
Kent St/Adelaide Avenue	North_T	3.799724792
Kent St/Adelaide Avenue	East_L	0.013520923
Kent St/Adelaide Avenue	East_R	0.458831468
Kent St/Adelaide Avenue	South_T	0.830780155
Dudley St/ Kent St	North_Entry	1.470440253
Dudley St/ Kent St	North_Exit	2.460578423
Dudley St/ Kent St	South_Entry	0.250503645
Dudley St/ Kent St	South_Exit	3.751112423
Dudley St/ Kent St	West_Entry	5.036318409
Dudley St/ Kent St	West_Exit	2.297507087
Dudley St/ Kent St	East_Exit	0.34474016
Dudley St/Cotter Rd	North_R	0.193447764
Dudley St/Cotter Rd	North_L	1.326977605
Dudley St/Cotter Rd	West_L	3.432146955
Dudley St/Cotter Rd	West_T	1.555555556
Dudley St/Cotter Rd	East_R	3
Dudley St/Cotter Rd	East_T	0.013034365
AM Base Existing - 9am-10am – Secondary Calibration Area		
Intersection	**Turn**	**GEH**
Novar St/Denman St/Kintore St	North_Entry	1.429914923
Novar St/Denman St/Kintore St	North_Exit	4.111180494
Novar St/Denman St/Kintore St	South_Entry	4.011518446
Novar St/Denman St/Kintore St	South_Exit	0.644018619
Novar St/Abbot St	North_Entry	1.56492329
Novar St/Abbot St	North_Exit	4.237455139
Novar St/Abbot St	South_Entry	4.12387141
Novar St/Abbot St	South_Exit	1.367061337
Novar St/Weston St	North_Entry	2.237103826
Novar St/Weston St	North_Exit	4.701293556
Novar St/Weston St	South_Entry	4.395783103
Novar St/Weston St	South_Exit	2.186462366
Novar St/Loftus St/Bentham St	North_Entry	1.93792558
Novar St/Loftus St/Bentham St	North_Exit	0.87038828
Novar St/Loftus St/Bentham St	South_Entry	4.619536525
Novar St/Loftus St/Bentham St	South_Exit	2.07291272

PM Base Existing - 3.30pm-4.30pm – Core Calibration Area		
Intersection	**Turn**	**GEH**
Kent St/Denison St	North_R	0.67363307
Kent St/Denison St	North_T	6.083293825
Kent St/Denison St	West_L	1.773937188
Kent St/Denison St	West_R	0.905725667
Kent St/Denison St	South_L	0.518163247
Kent St/Denison St	South_T	1.610152972
Kent St/Adelaide Avenue	North_T	1.726949027
Kent St/Adelaide Avenue	East_L	0.140221462
Kent St/Adelaide Avenue	East_R	0.342159569
Kent St/Adelaide Avenue	South_T	2.441780509
Dudley St/ Kent St	North_Entry	2.77241312
Dudley St/ Kent St	North_Exit	1.68224449
Dudley St/ Kent St	South_Entry	1.75516915
Dudley St/ Kent St	South_Exit	1.681638182
Dudley St/ Kent St	West_Entry	1.032702477
Dudley St/ Kent St	West_Exit	2.141191853
Dudley St/ Kent St	East_Exit	1.908022451
Dudley St/Cotter Rd	North_R	4.454873556
Dudley St/Cotter Rd	North_L	1.056996395
Dudley St/Cotter Rd	West_L	2.906190969
Dudley St/Cotter Rd	West_T	0.621739119
Dudley St/Cotter Rd	East_R	0.14509525
Dudley St/Cotter Rd	East_T	0.837398799
PM Base Existing - 3.30pm-4.30pm – Secondary Calibration Area		
Intersection	**Turn**	**GEH**
Novar St/Denman St/Kintore St	North_Entry	3.706929312
Novar St/Denman St/Kintore St	North_Exit	3.022155991
Novar St/Denman St/Kintore St	South_Entry	4.211550416
Novar St/Denman St/Kintore St	South_Exit	2.540429395
Novar St/Abbot St	North_Entry	4.007850345
Novar St/Abbot St	North_Exit	2.833640327
Novar St/Abbot St	South_Entry	3.094149027
Novar St/Abbot St	South_Exit	2.66505862
Novar St/Weston St	North_Entry	1.402865919
Novar St/Weston St	North_Exit	2.466042212
Novar St/Weston St	South_Entry	2.386358407
Novar St/Weston St	South_Exit	4.292702287
Novar St/Loftus St/Bentham St	North_Entry	2.666666667
Novar St/Loftus St/Bentham St	North_Exit	6.630119074
Novar St/Loftus St/Bentham St	South_Entry	2.49878019
Novar St/Loftus St/Bentham St	South_Exit	1.142857143

PM Base Existing - 4.30pm-5.30pm – Core Calibration Area		
Intersection	**Turn**	**GEH**
Kent St/Denison St	North_R	1.673320053
Kent St/Denison St	North_T	3.121109401
Kent St/Denison St	West_L	0.088993393
Kent St/Denison St	West_R	0.311399578
Kent St/Denison St	South_L	0.372104204
Kent St/Denison St	South_T	0.330165124
Kent St/Adelaide Avenue	North_T	0.361110026
Kent St/Adelaide Avenue	East_L	0.069473347
Kent St/Adelaide Avenue	East_R	0.077915507
Kent St/Adelaide Avenue	South_T	0.233079984
Dudley St/ Kent St	North_Entry	0.630996578
Dudley St/ Kent St	North_Exit	0.228232408
Dudley St/ Kent St	South_Entry	0.55164357
Dudley St/ Kent St	South_Exit	0.32910819
Dudley St/ Kent St	West_Entry	0.309985441
Dudley St/ Kent St	West_Exit	0.124541289
Dudley St/ Kent St	East_Exit	0.230693362
Dudley St/Cotter Rd	North_R	1.652454686
Dudley St/Cotter Rd	North_L	4.38178046
Dudley St/Cotter Rd	West_L	2.076607682
Dudley St/Cotter Rd	West_T	0.548971641
Dudley St/Cotter Rd	East_R	1.549193338
Dudley St/Cotter Rd	East_T	0.172702099
PM Base Existing - 4.30pm-5.30pm – Secondary Calibration Area		
Intersection	**Turn**	**GEH**
Novar St/Denman St/Kintore St	North_Entry	9.679671342
Novar St/Denman St/Kintore St	North_Exit	0.539637207
Novar St/Denman St/Kintore St	South_Entry	0.88659463
Novar St/Denman St/Kintore St	South_Exit	9.398150073
Novar St/Abbot St	North_Entry	9.914890658
Novar St/Abbot St	North_Exit	0.343325955
Novar St/Abbot St	South_Entry	0.539637207
Novar St/Abbot St	South_Exit	9.857741018
Novar St/Weston St	North_Entry	1.377725865
Novar St/Weston St	North_Exit	0.738898886
Novar St/Weston St	South_Entry	0.684566176
Novar St/Weston St	South_Exit	10.17086979
Novar St/Loftus St/Bentham St	North_Entry	1.647616878
Novar St/Loftus St/Bentham St	North_Exit	4.647890234
Novar St/Loftus St/Bentham St	South_Entry	0.977067169
Novar St/Loftus St/Bentham St	South_Exit	3.61359675

PM Base Existing - 5.30pm-6.30pm		
Intersection	**Turn**	**GEH**
Kent St/Denison St	North_R	0.264106838
Kent St/Denison St	North_T	3.29141862
Kent St/Denison St	West_L	1.224801493
Kent St/Denison St	West_R	0.894427191
Kent St/Denison St	South_L	0.603361371
Kent St/Denison St	South_T	0.16609096
Kent St/Adelaide Avenue	North_T	0.763861429
Kent St/Adelaide Avenue	East_L	0.543739068
Kent St/Adelaide Avenue	East_R	0.442039804
Kent St/Adelaide Avenue	South_T	0.914943174
Dudley St/ Kent St	North_Entry	0.900754698
Dudley St/ Kent St	North_Exit	0.307160418
Dudley St/ Kent St	South_Entry	0.400662801
Dudley St/ Kent St	South_Exit	0.733187095
Dudley St/ Kent St	West_Entry	0.331831824
Dudley St/ Kent St	West_Exit	1.118525901
Dudley St/ Kent St	East_Exit	0.691910513
Dudley St/Cotter Rd	North_R	3.559535357
Dudley St/Cotter Rd	North_L	2.898275349
Dudley St/Cotter Rd	West_L	2.870174285
Dudley St/Cotter Rd	West_T	0.626589248
Dudley St/Cotter Rd	East_R	2.607680962
Dudley St/Cotter Rd	East_T	1.445997611
Novar St/Denman St/Kintore St	North_Entry	9.397840981
Novar St/Denman St/Kintore St	North_Exit	6.398595123
Novar St/Denman St/Kintore St	South_Entry	5.126672383
Novar St/Denman St/Kintore St	South_Exit	9.143033508
Novar St/Abbot St	North_Entry	9.002931119
Novar St/Abbot St	North_Exit	6.892250015
Novar St/Abbot St	South_Entry	6.435034221
Novar St/Abbot St	South_Exit	9.177935787
Novar St/Weston St	North_Entry	2.884058845
Novar St/Weston St	North_Exit	6.326678736
Novar St/Weston St	South_Entry	7.082425891
Novar St/Weston St	South_Exit	8.996755649
Novar St/Loftus St/Bentham St	North_Entry	3.109118942
Novar St/Loftus St/Bentham St	North_Exit	0.764919329
Novar St/Loftus St/Bentham St	South_Entry	6.469962847
Novar St/Loftus St/Bentham St	South_Exit	2.792948679

Appendix B

Background Traffic Growth Approach

Appendix B Background Traffic Growth Approach

Three approaches were utilised to forecast the future growth rate that could be expected between 2016 and 2031. These approaches were:

1. Use of SCATs volumes collected in 2016, 2017and 2019.
2. Use of the CSTM population assumptions for 2016 and 2031 to provide an estimate of growth in this area.
3. Lastly, the CSTM was used focusing on its predictions for traffic volumes and the expected growth calculated between the 2016 and 2031 models.

Growth based on SCATs data

SCATS data is a useful comparison across various time periods and can be used to help rationalise and substitute other traffic count information. The signalised intersection in proximity to the site is the intersection of Dudley Street and Cotter Road. Data was collected in 2016 – pre cotter road duplication construction, 2017 - during construction and 2019 - post construction.

As expected, the number of vehicles utilising Cotter Road during the peak periods has increased as indicated in Figure 44 and Figure 45. Note that the detector definitions are given in Figure 46.

It appears that construction traffic had an effect indicated by the drop-in volumes between the 2016 counts and the 2017 counts. Traffic counts have then increased between 2017 and 2019. This study is especially interested in Dudley Street which has grown linearly between 2016 and 2019 by an average of 1.0% per annum in the peaks.

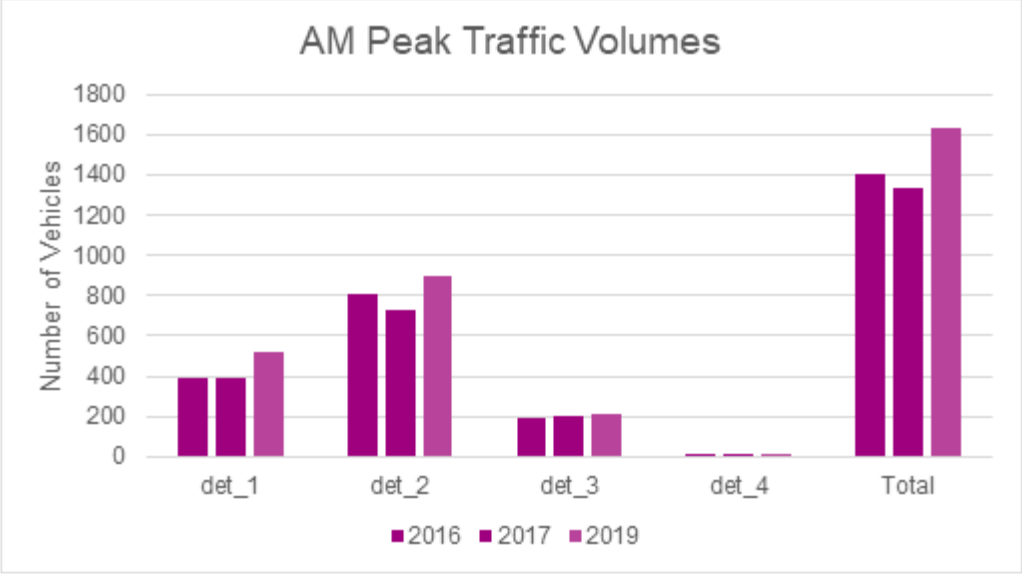


Figure 44: AM Peak Traffic Volumes

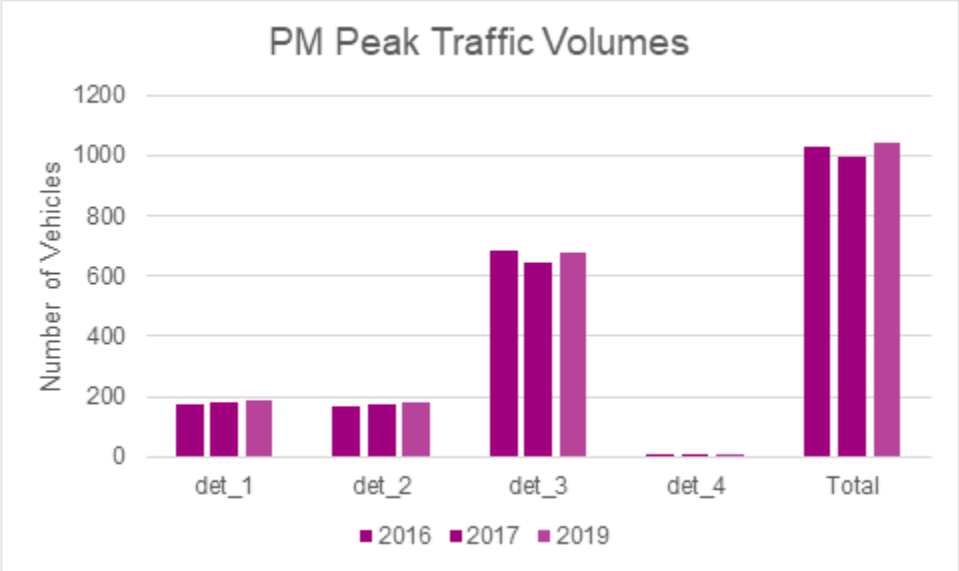


Figure 45: PM Peak Traffic Volumes

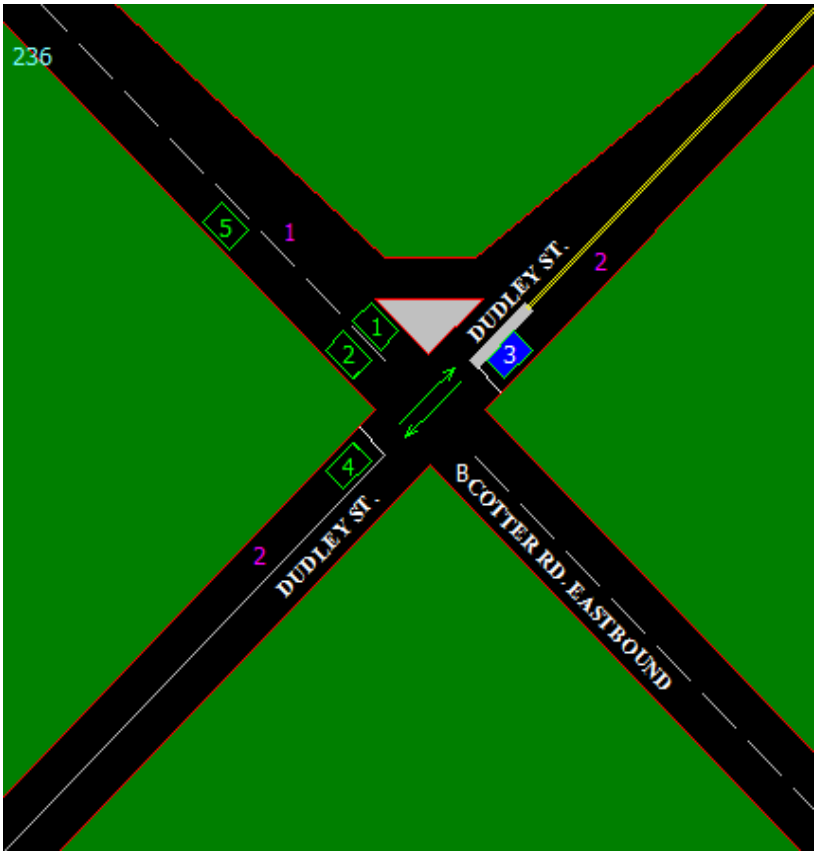


Figure 46: Detector identifications and locations

Growth based on CSTM Population forecasts

Another method to forecast the level of traffic growth in the region would be to determine the rates of growth in the surrounding area and use this rate to forecast existing volumes. This has been undertaken by utilizing the Canberra Strategic Transport Model assumptions which specifies land use characteristics for zones across Canberra. The zones used in this analysis are shown in Figure 47 and are:

- 051107
- 051106
- 051104
- 050302
- 050303

Note that these zones have been classified as either North or South of the Kent Street and Novar Street intersection.

Figure 47: Zones in the vicinity of the Kent Street and Novar Street Intersection

Table 21 utilises the CSTM population forecasts to arrive at a background level of growth. Importantly it can be seen that the total growth rate is very similar to the growth rate in the original approach. If this approach is used the following will be considered:

- The forecasted traffic volumes would be used as a base level of traffic volumes. The new residential development will be included in addition to this base level. While the development may already be included in the CSTM population forecasts this would be expected to be a conservative approach.
- Construction traffic will no longer need to be accounted for as growth will utilise SCATs data from 2019 after the Cotter Road duplication has been finished.

Table 21: Growth forecasts

Growth Statistics	North	South	Total
2016 Population	2208	2263	4471
2031 Population	3122	2378	5500
2016 – 2031 Population Difference	914	115	1029
Population Growth %	41.39%	5.08%	23.01%
Linear Growth Rate per annum	2.76%	0.34%	1.53%
Exponential Growth Rate per annum	2.34%	0.33%	1.39%

The land uses represented in the CSTM have been provided below for reference.

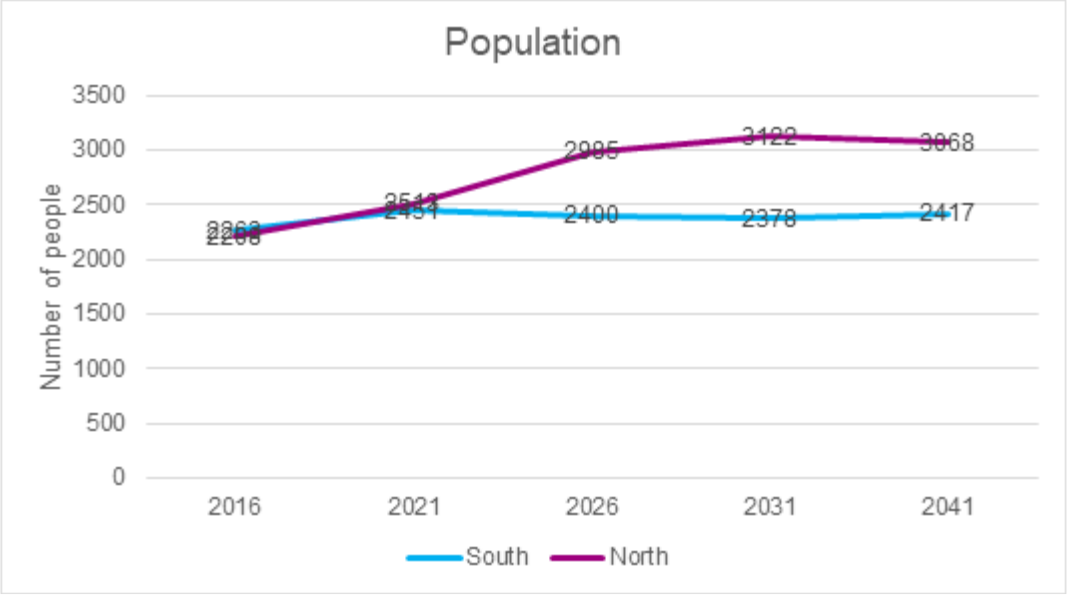


Figure 48: Population present in the five zones identified across the CSTM model years

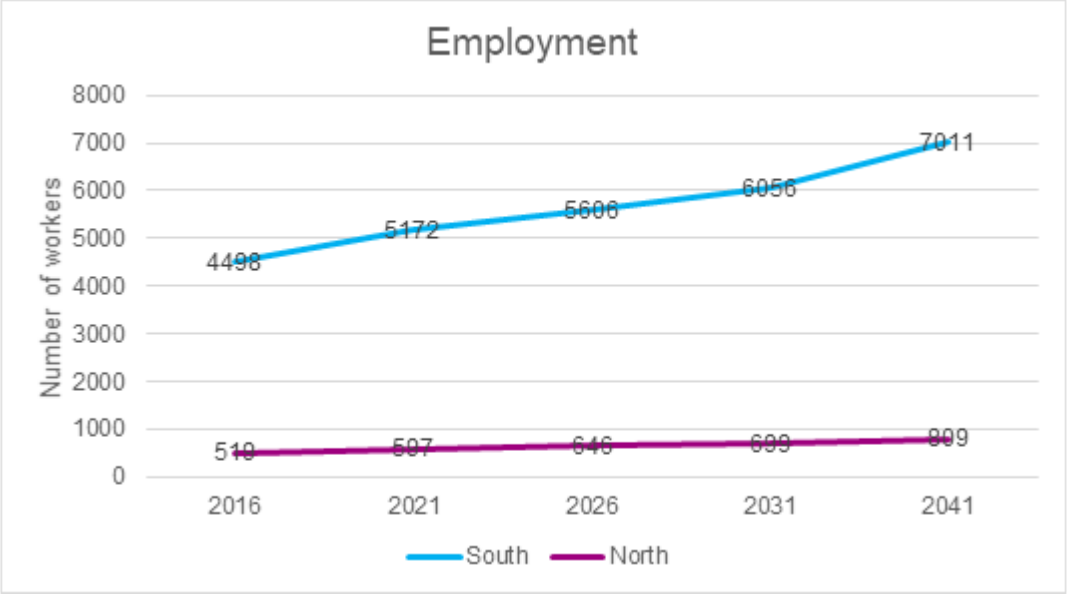


Figure 49: Number of people employed in the five zones identified across the CSTM model years

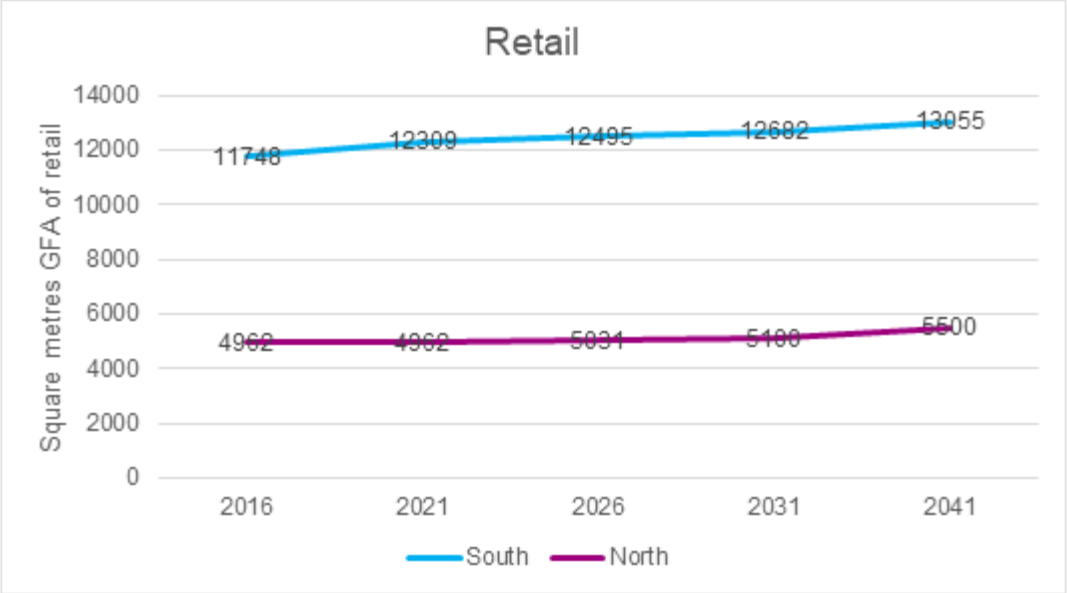


Figure 50: Floor area of retail present in the five zones identified across the model years

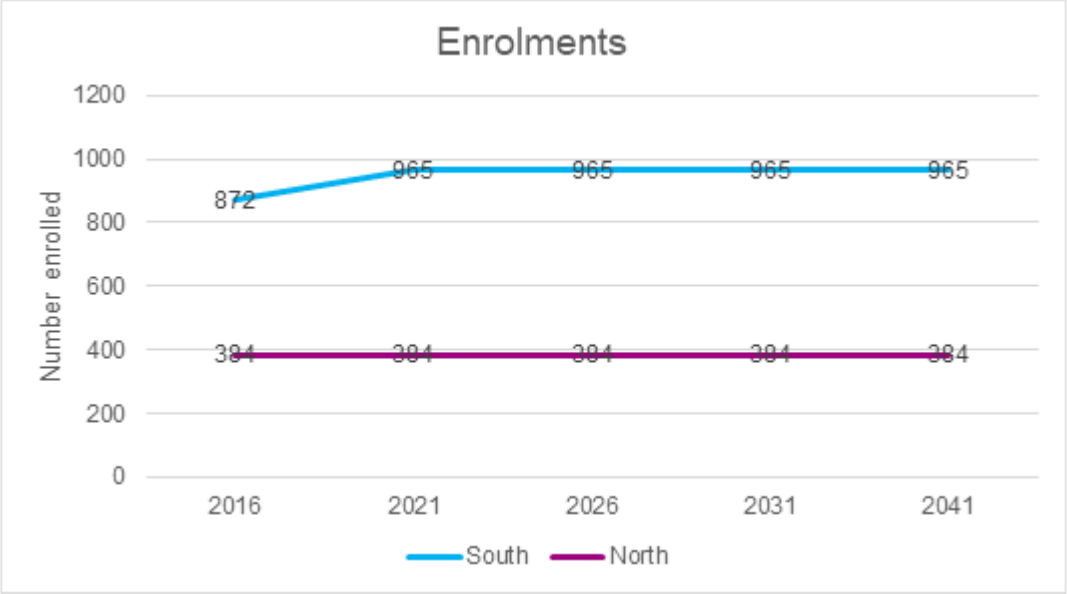


Figure 51: Number of students in the five zones identified across the model years

Canberra Strategic Transport Model

While the CSTM provides demand forecasts in the medium and long-term planning horizons, the preferred method of estimating future demand when conducting detailed traffic modelling and analysis is to grow current traffic volumes using growth rates extracted from the CSTM.

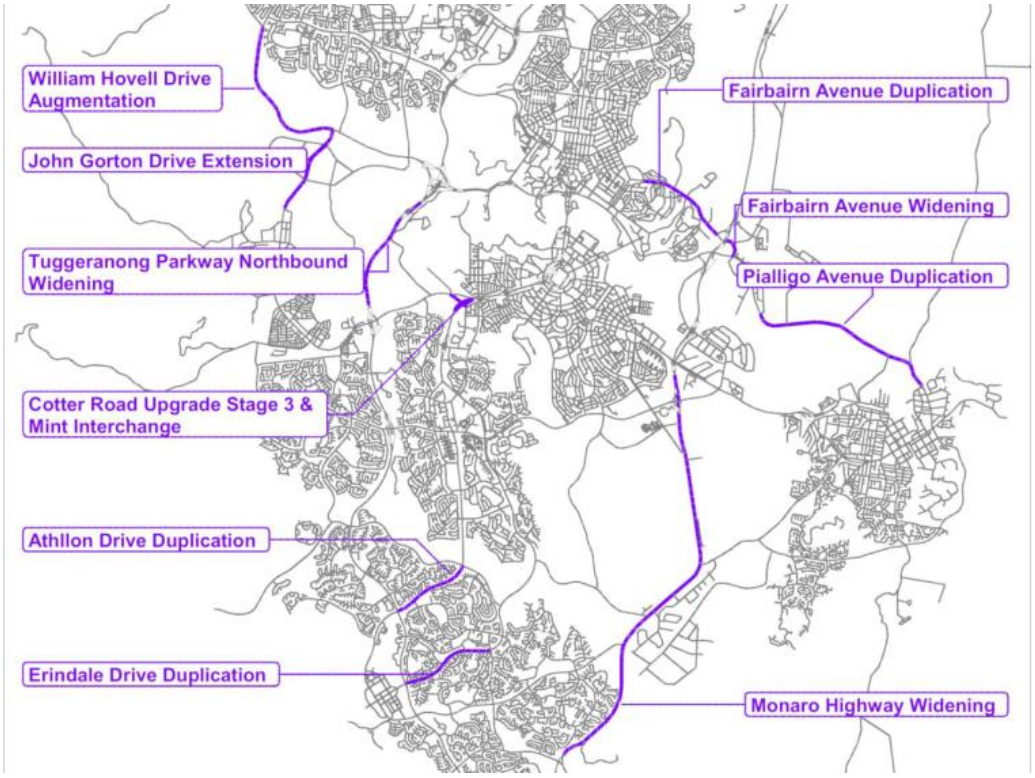


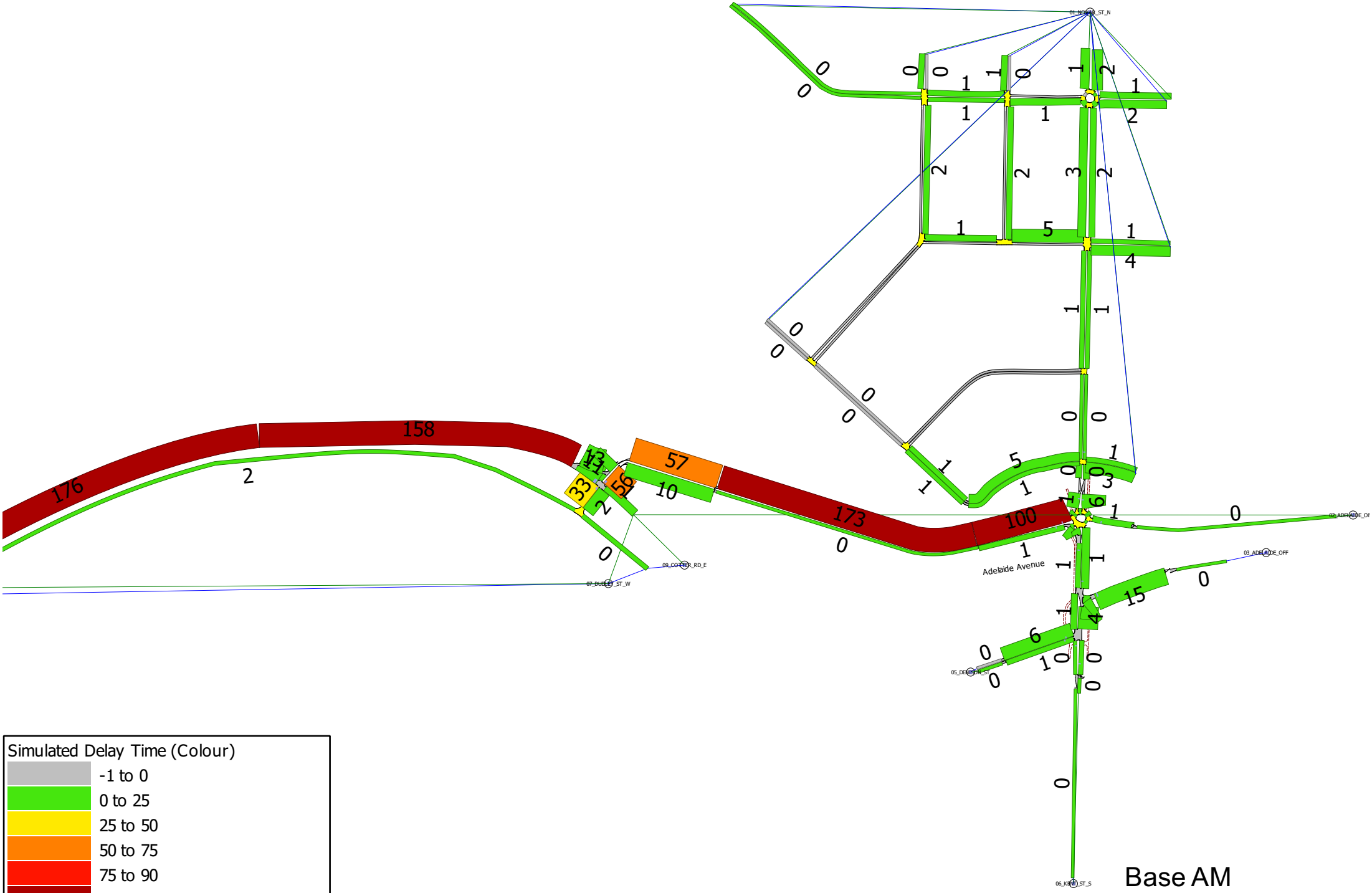
Figure 52: 2026 CSTM assumed road upgrades

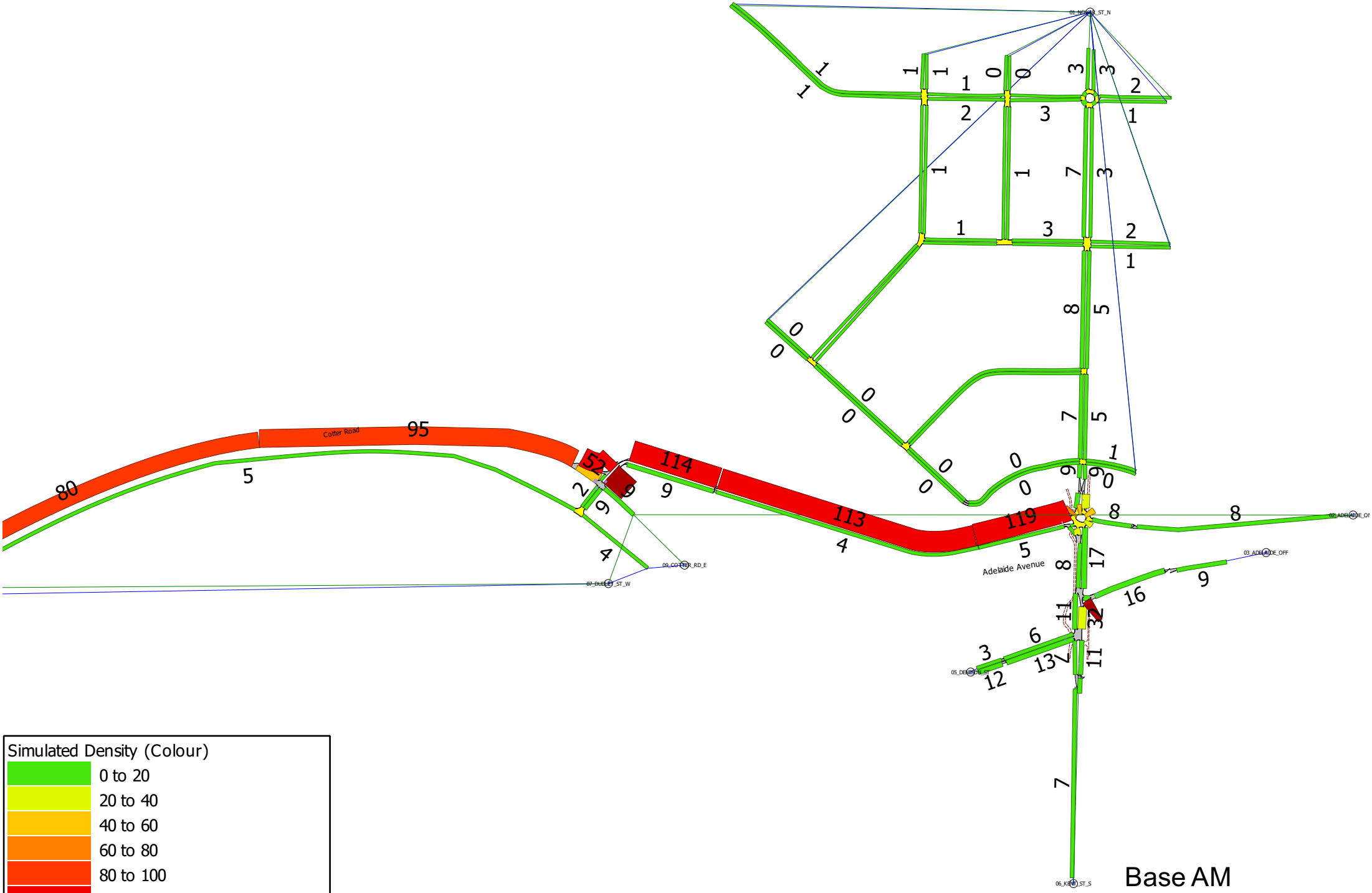
The introduction of the Cotter Road and Mint Interchange which is assumed in the 2031 AM Canberra Strategic Model changes demand drastically in this area (Figure 52). This causes large fluctuations in the distribution of vehicles and therefore unusual growth rates compared to the current conditions without the Mint Interchange.

Two scenarios were analysed in the CSTM, one with the Mint Interchange and one without the Mint Interchange. The average growth rate between the two scenarios was approximately 1.25%.

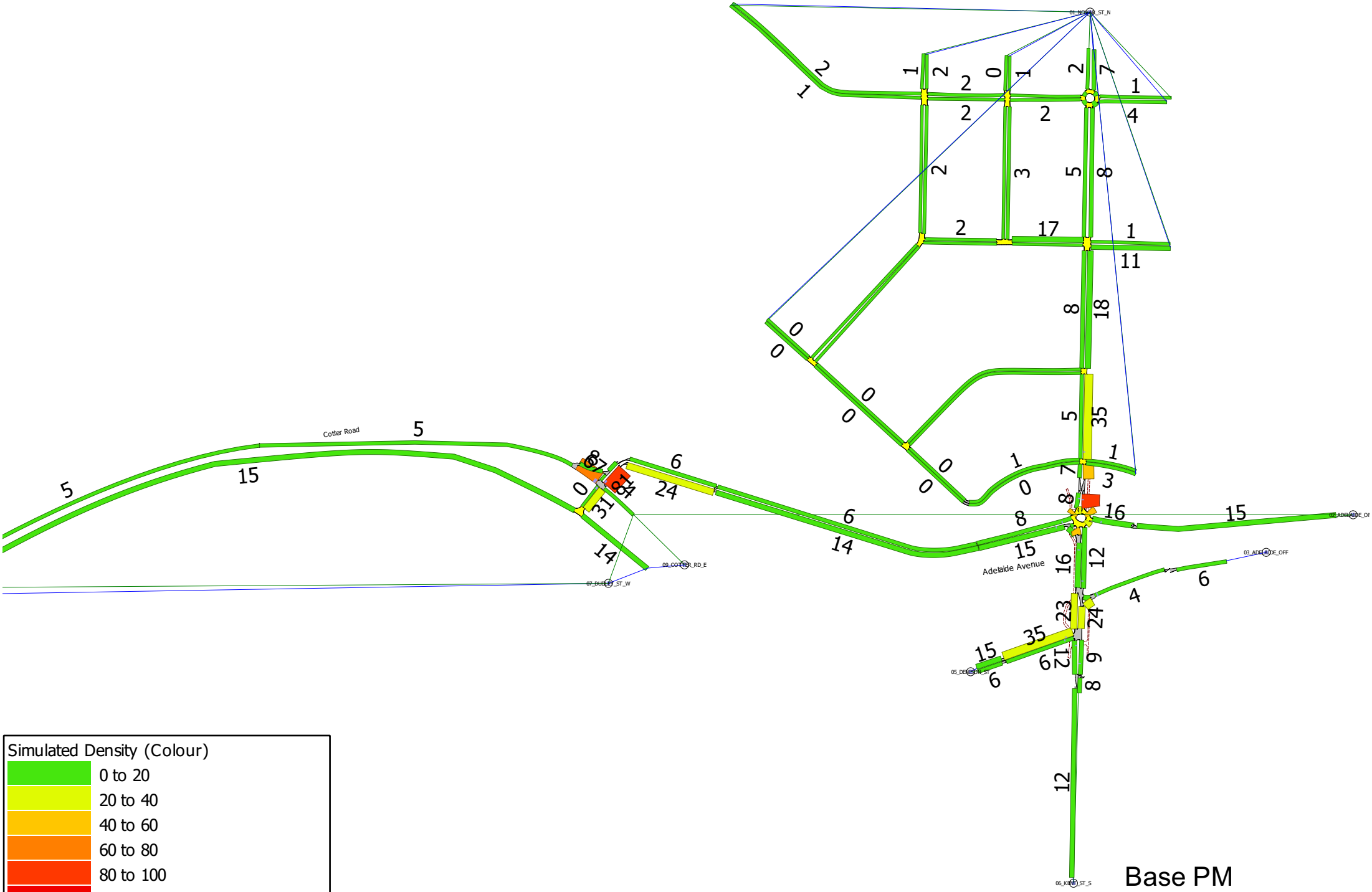
Appendix C

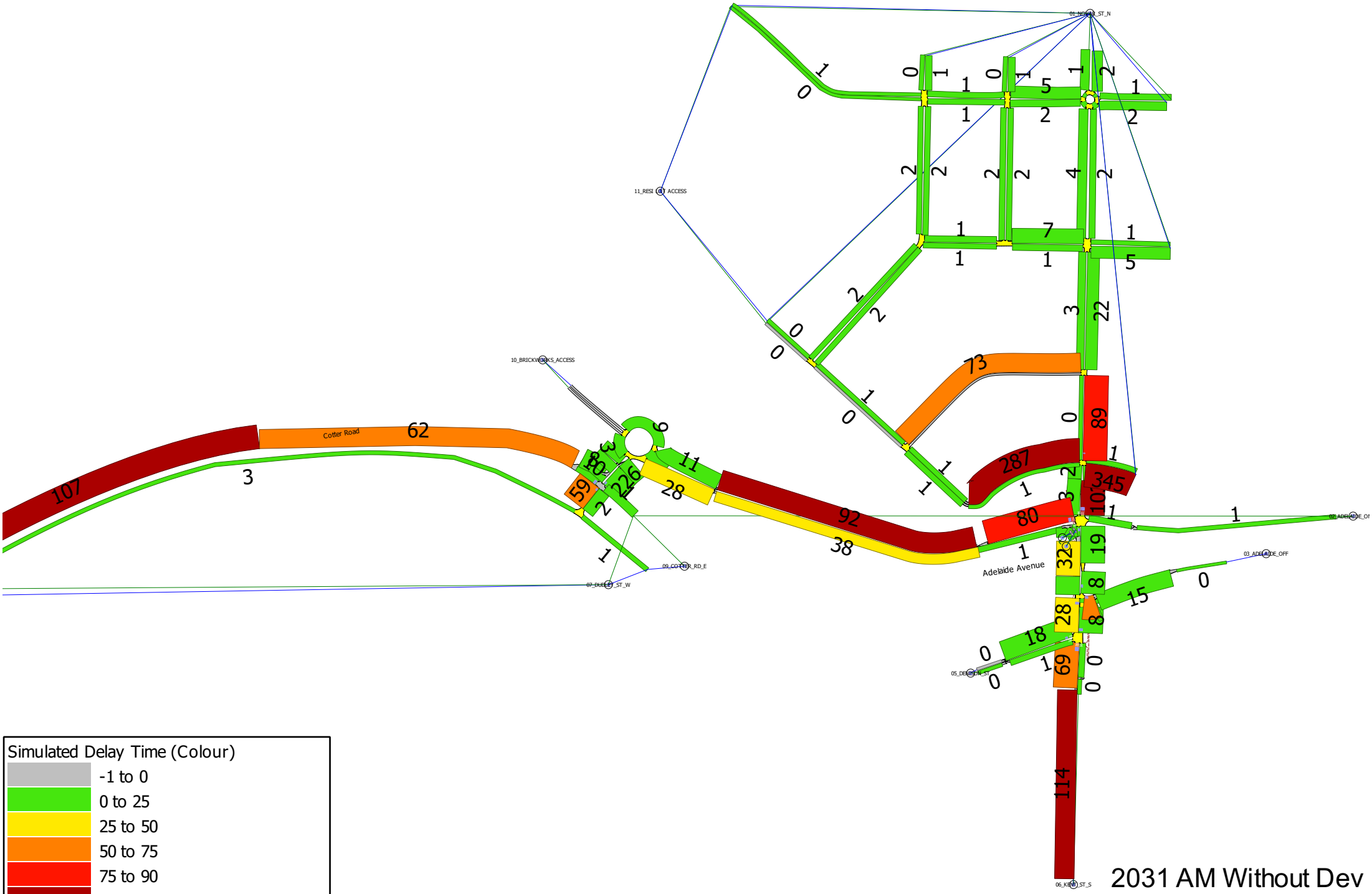
Aimsun Outputs

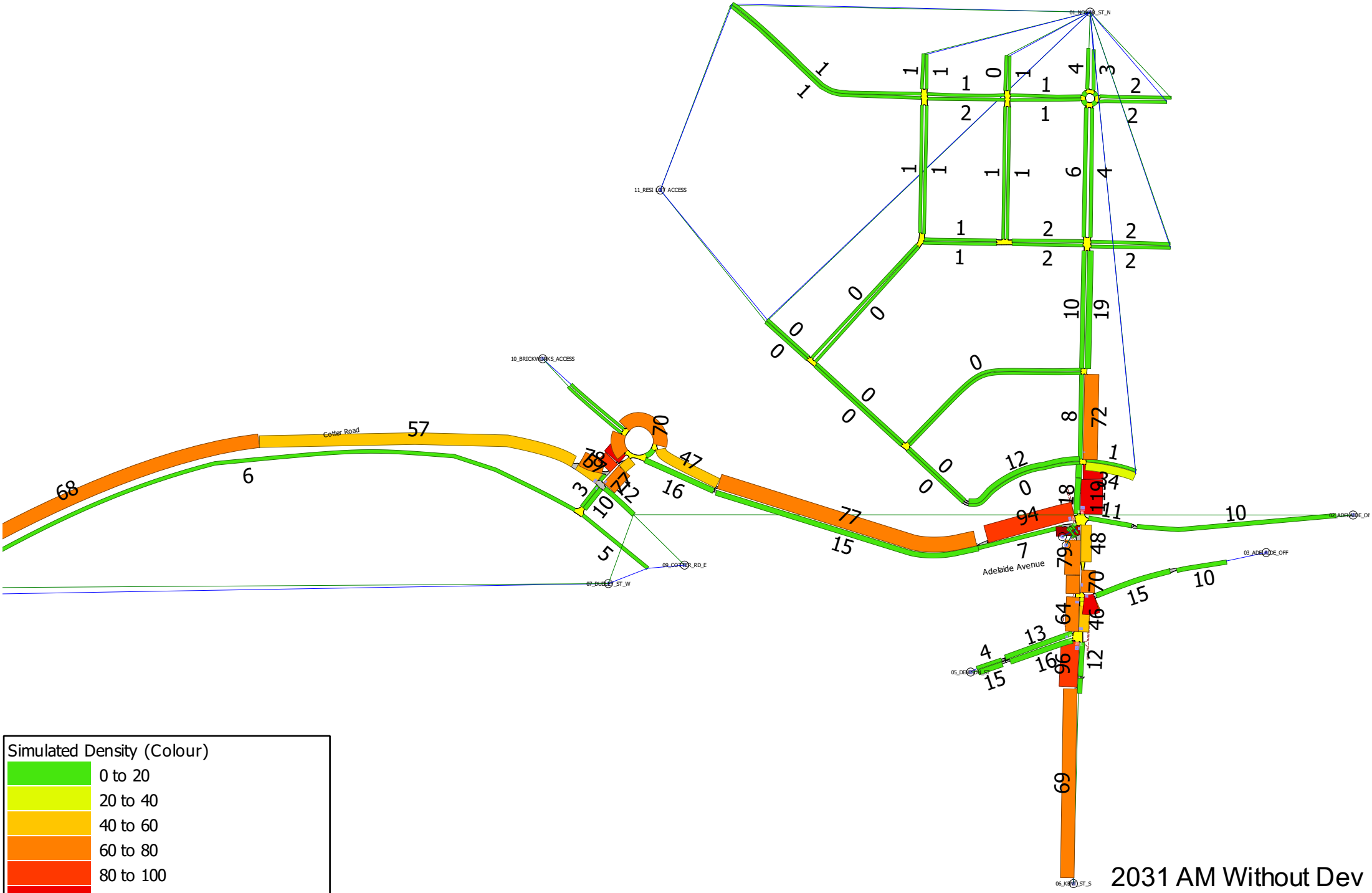

Simulated Delay Time (Colour)
-1 to 0
0 to 25
25 to 50
50 to 75
75 to 90
90 to 1.79769e+308
Adelaide Avenue
Base AM
(8.30am-9.30am)


Cotter Road
Adelaide Avenue
Simulated Density (Colour)
0 to 20
20 to 40
40 to 60
60 to 80
80 to 100
100 to 120
120 to 1.79769e+308
Base AM
(8.30am-9.30am)

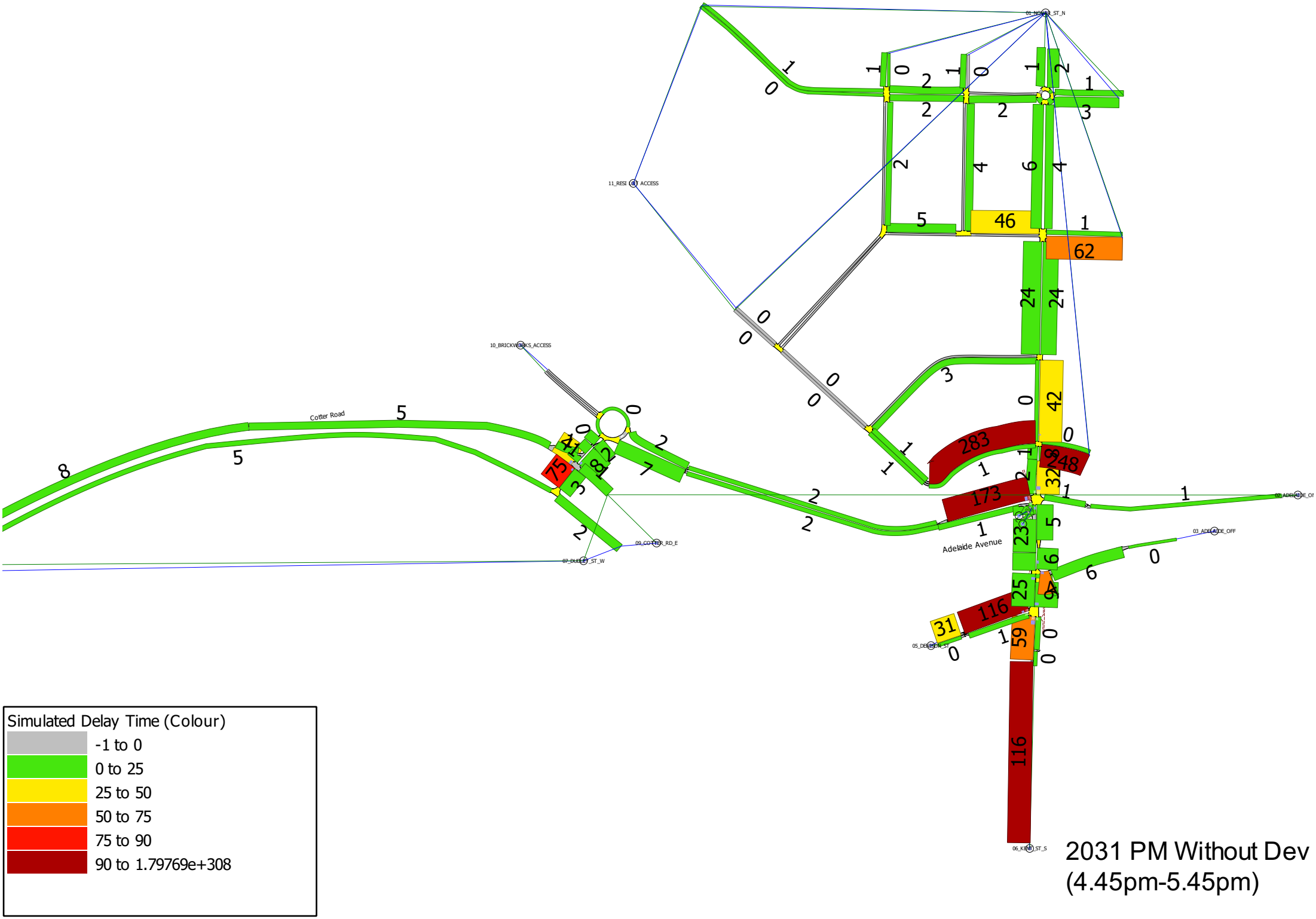
Cotter Road
Adelaide Avenue
01_NORTH_ST_N
02_ADELAIDE_OI
03_ADELAIDE_OFF
05_DENISON_ST
06_KENT_ST_S
07_DUESBURY_ST_W
09_COTTER_RD_E
Simulated Delay Time (Colour)
-1 to 0
0 to 25
25 to 50
50 to 75
75 to 90
90 to 1.79769e+308
Base PM
(4.45pm-5.45pm)

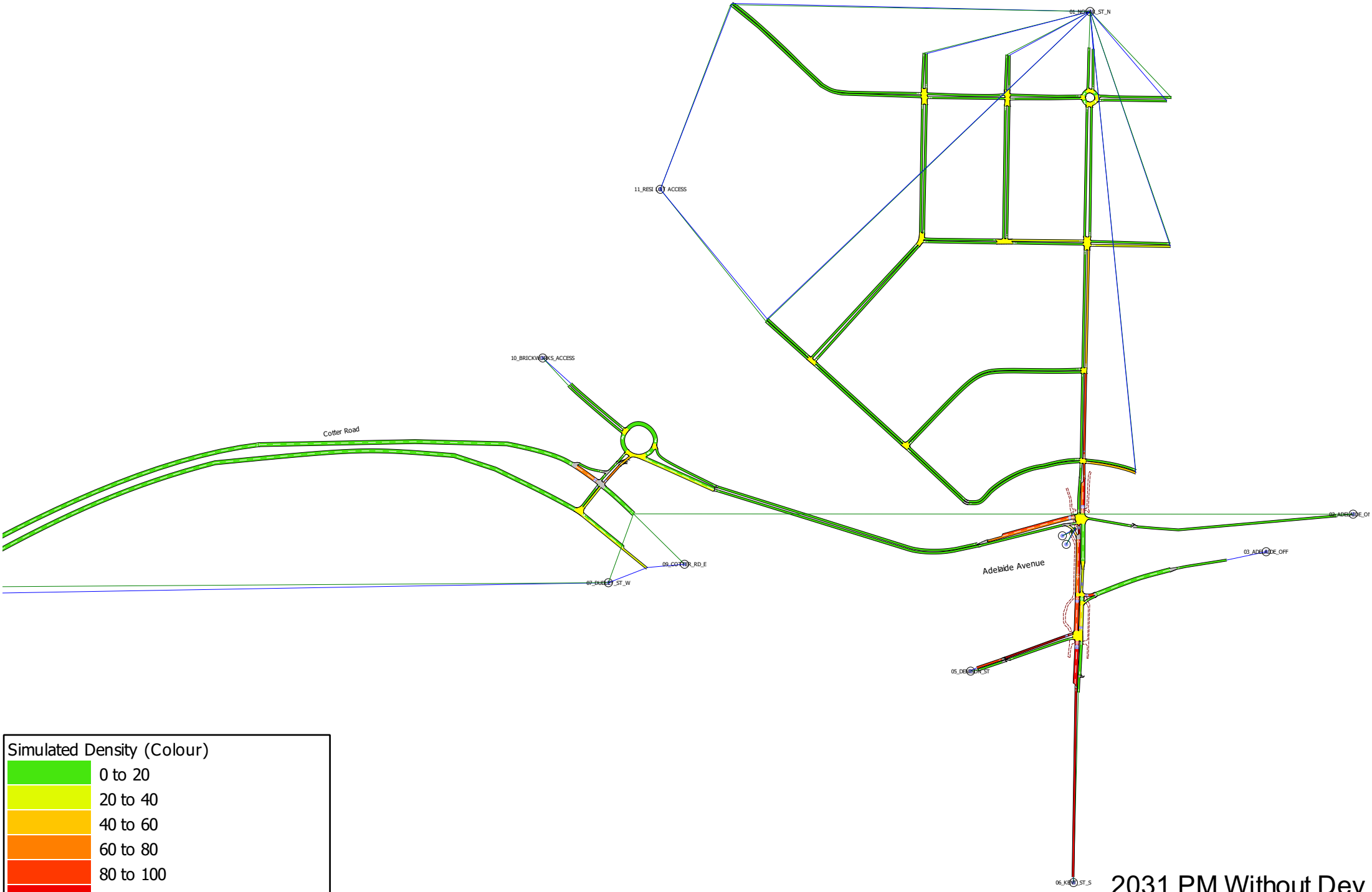

Cotter Road
Adelaide Avenue
01_NORTH_ST_N
02_ADELAIDE_OFF
03_ADELAIDE_OFF
05_DENISON_ST
06_KENT_ST_S
07_QUEEN_ST_W
09_COTTER_RD_E
Simulated Density (Colour)
0 to 20
20 to 40
40 to 60
60 to 80
80 to 100
100 to 120
120 to 1.79769e+308
Base PM
(4.45pm-5.45pm)


Cotter Road
Adelaide Avenue
11_RESI ACCESS
10_BRICKWORKS_ACCESS
09_COTTER_RD_E
07_DUFFY_ST_W
05_DENISON_ST
06_KENT_ST_S
03_ADELAIDE_OFF
Simulated Delay Time (Colour)
-1 to 0
0 to 25
25 to 50
50 to 75
75 to 90
90 to 1.79769e+308
2031 AM Without Dev
(8.30am-9.30am)

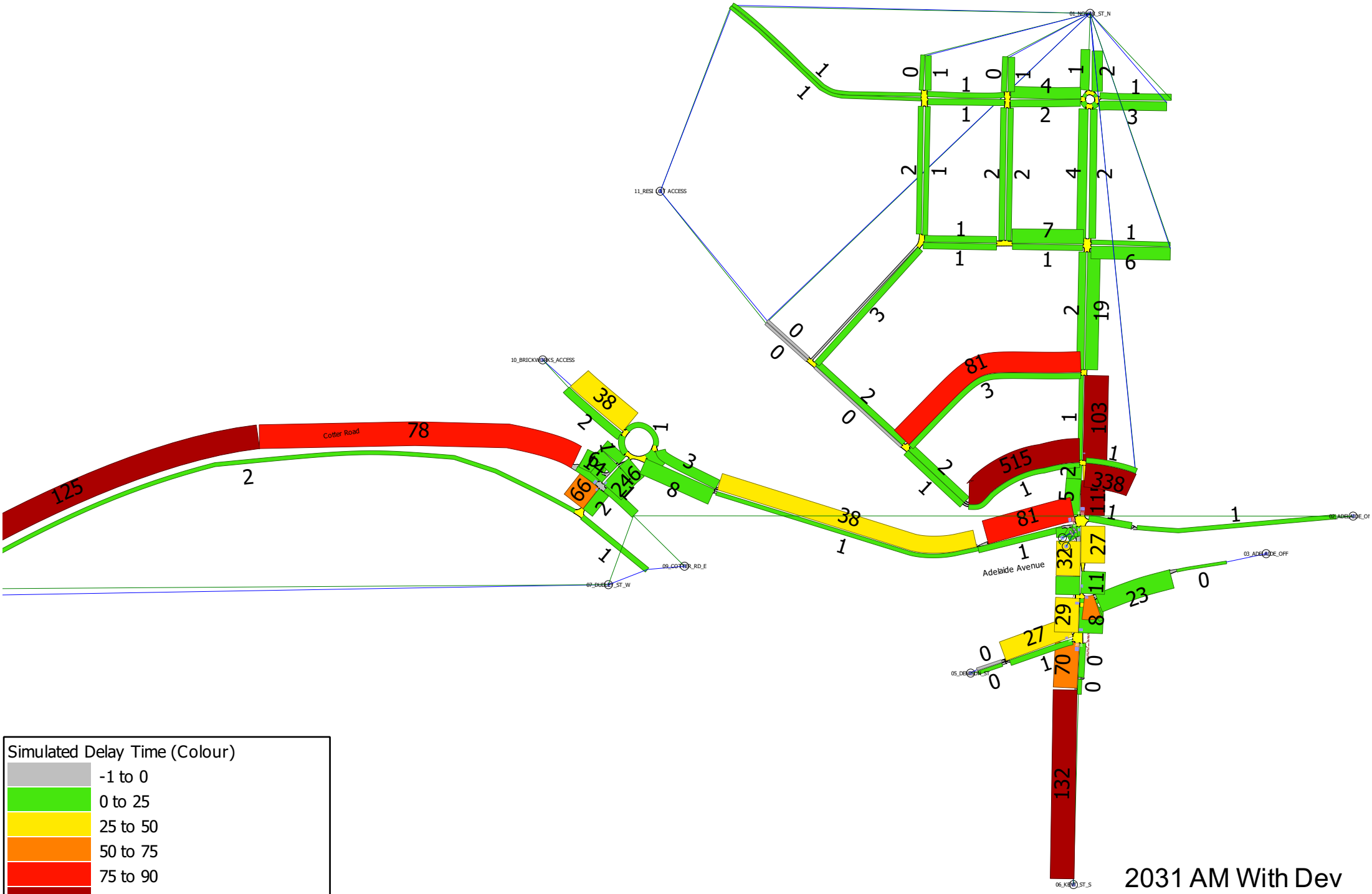


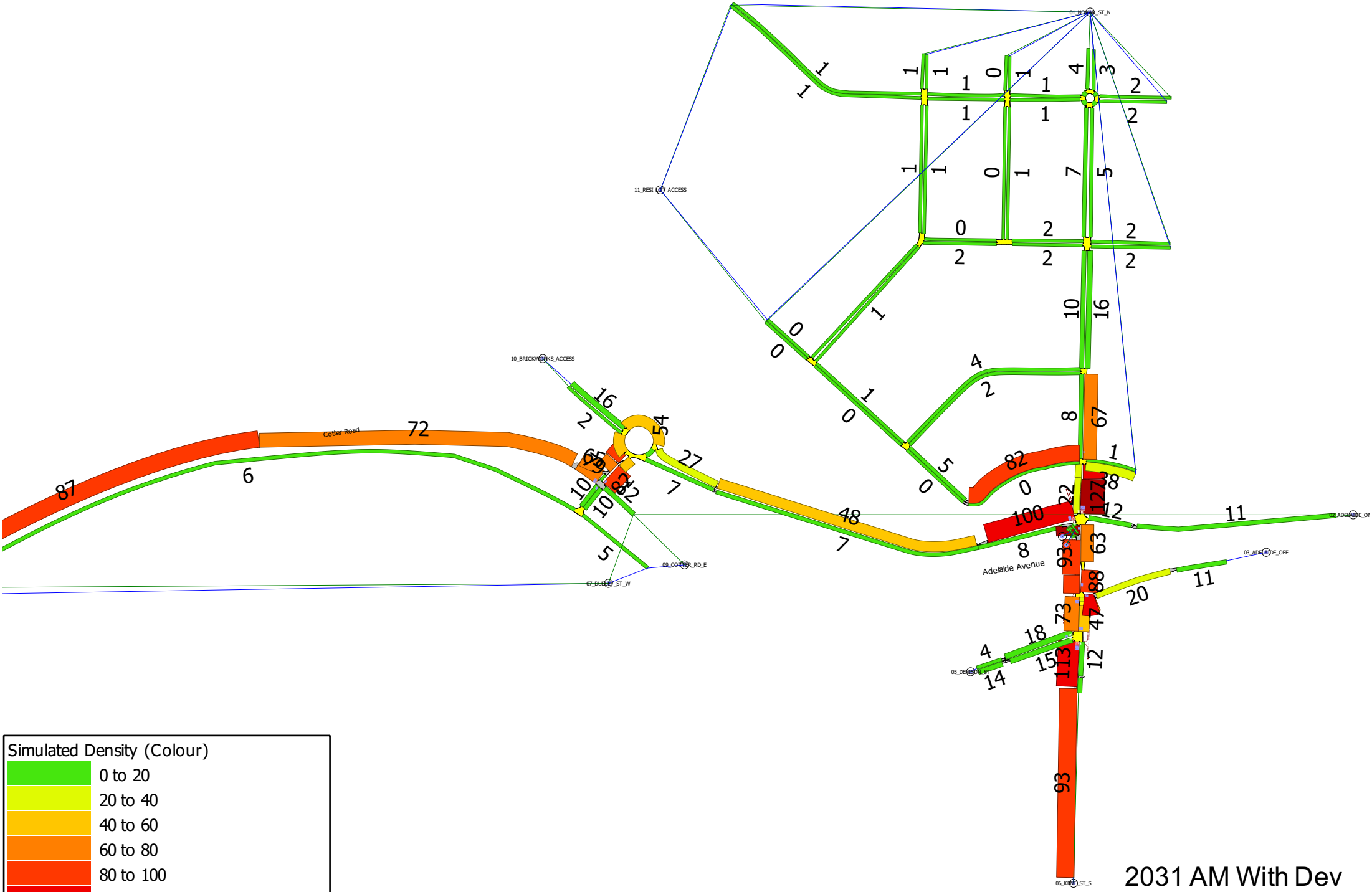
2031 AM Without Dev
(8.30am-9.30am)

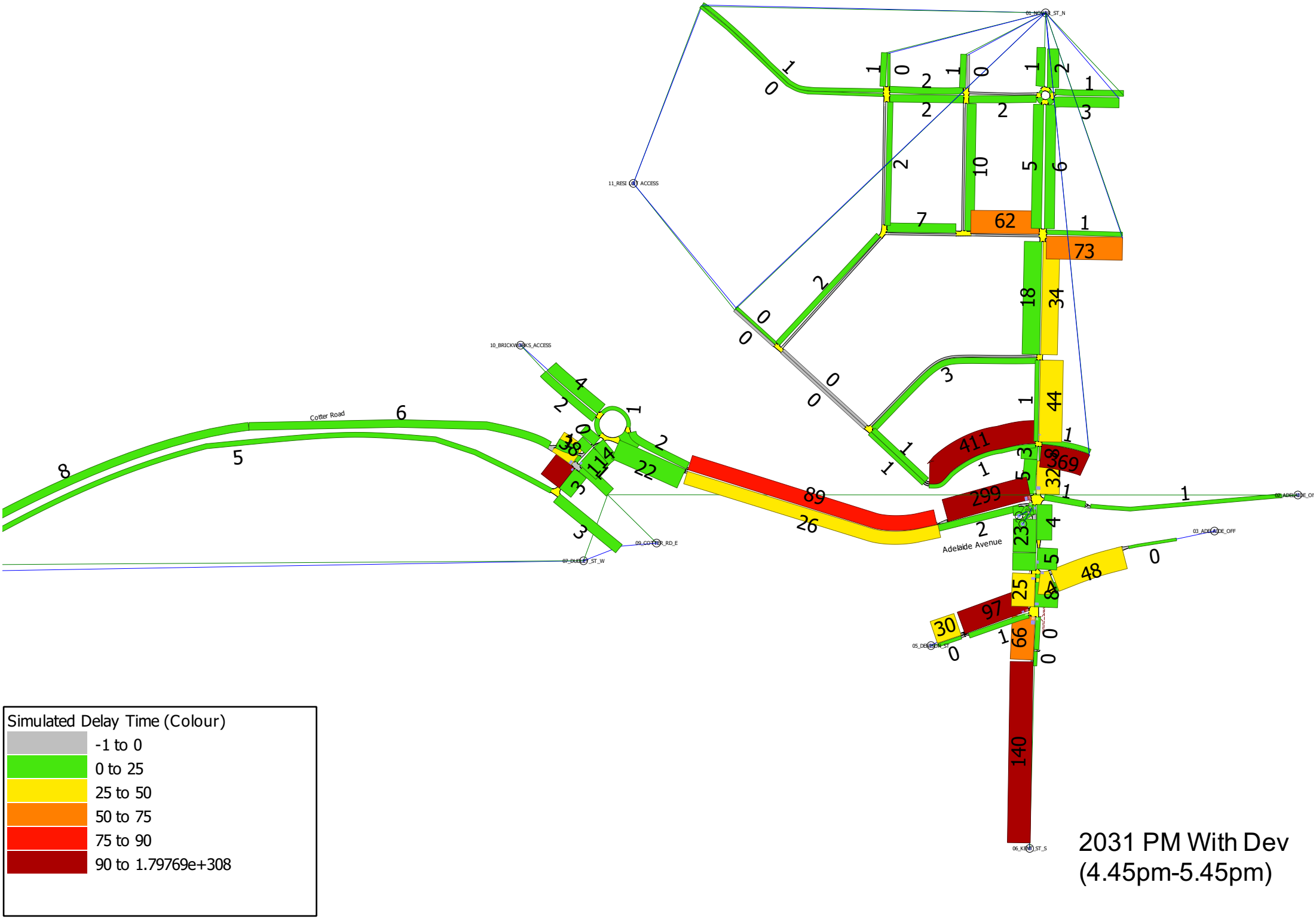

Cotter Road
Adelaide Avenue
10_BRICKWORKS_ACCESS
11_RESI ACCESS
09_COTTER_RD_E
07_DUESBURY_ST_W
05_DENISON_ST
06_KENT_ST_S
03_ADELAIDE_OFF
Simulated Delay Time (Colour)
-1 to 0
0 to 25
25 to 50
50 to 75
75 to 90
90 to 1.79769e+308
2031 PM Without Dev
(4.45pm-5.45pm)

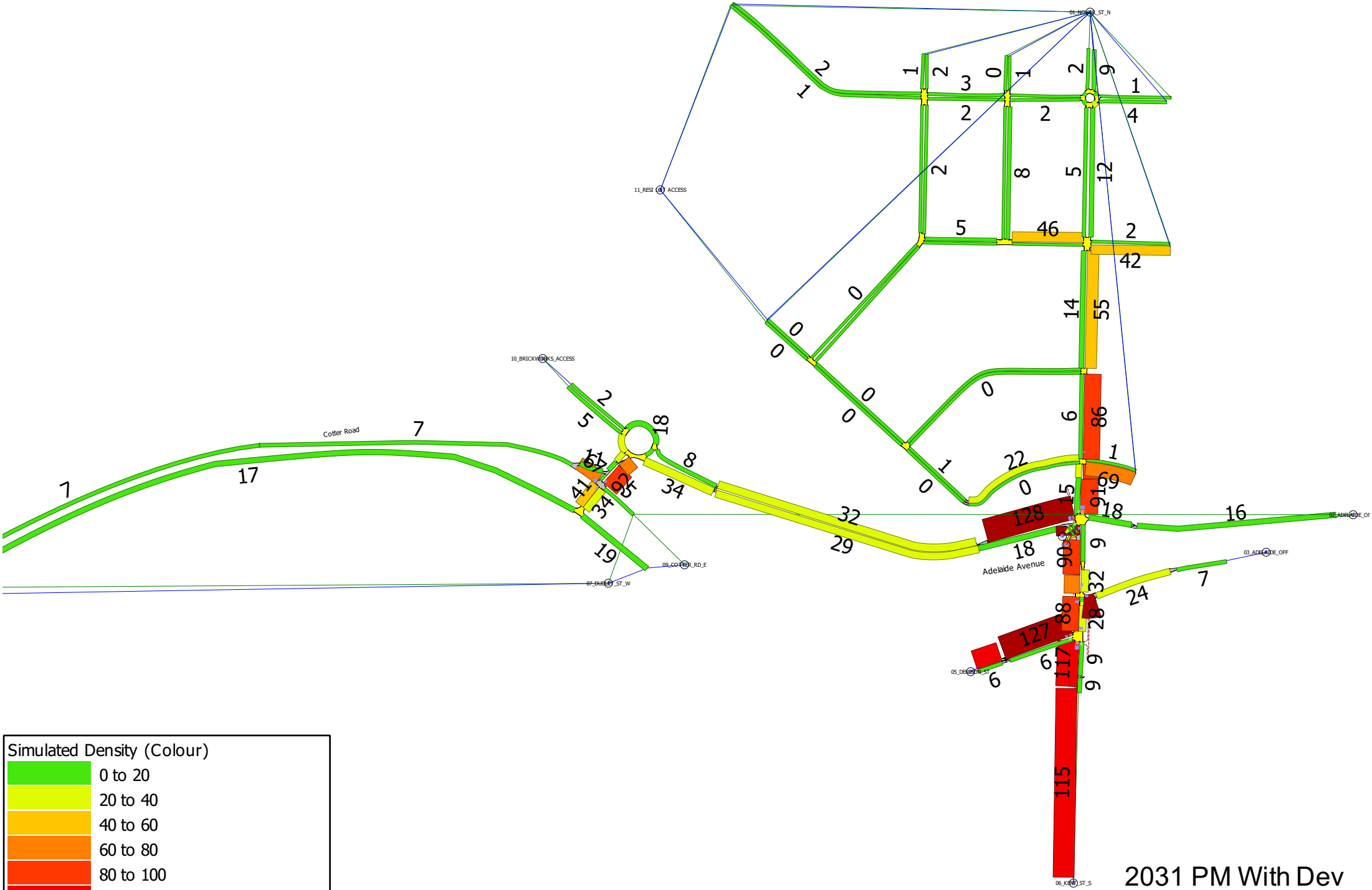


2031 PM Without Dev (4.45pm-5.45pm)


Cotter Road
Adelaide Avenue
10_BRICKWORKS_ACCESS
11_RESI ACCESS
09_COTTER_RD_E
07_DUES_ST_W
05_DENISON_ST
06_KENT_ST_S
03_ADELAIDE_OFF
Simulated Delay Time (Colour)
-1 to 0
0 to 25
25 to 50
50 to 75
75 to 90
90 to 1.79769e+308
2031 AM With Dev
(8.30am-9.30am)


Cotter Road
Adelaide Avenue
10_BRICKWORKS_ACCESS
09_COTTER_RD_E
07_DUES_ST_W
06_KENT_ST_S
03_ADELAIDE_OFF
11_RESI ACCESS
Simulated Density (Colour)
0 to 20
20 to 40
40 to 60
60 to 80
80 to 100
100 to 120
120 to 1.79769e+308
2031 AM With Dev
(8.30am-9.30am)


Cotter Road
Adelaide Avenue
10_BRICKWORKS_ACCESS
09_COTTER_RD_E
07_DUESBURY_ST_W
11_RESI ACCESS
01_NORTH_ST_N
02_ADELAIDE_OFF
03_ADELAIDE_OFF
05_DENISON_ST
06_KENT_ST_S
Simulated Delay Time (Colour)
-1 to 0
0 to 25
25 to 50
50 to 75
75 to 90
90 to 1.79769e+308
2031 PM With Dev
(4.45pm-5.45pm)



2031 PM With Dev
(4.45pm-5.45pm)

Status

NOT FOR CONSTRUCTION

DO NOT SCALE OFF DRAWINGS. VERIFY ALL DIMENSIONS ON SITE PRIOR TO WORK.
COPYRIGHT: The contents and information contained in this document are copyright of Sellick Consultants, Use or copy of this document in whole or part without written permission constitutes an infringement of copyright.

Rev	Description	Date	Drawn By
A	ICON WATER COMMENTS ADDRESSED	13.05.2020	DCA

LEGEND

- LEASE BOUNDARY
- PROPOSED BLOCK BOUNDARY
- EXISTING TREE TO BE REMOVED
- EXISTING TREE TO RETAINED
- 580.0 PROPOSED CONTOUR
- 580.0 EXISTING CONTOUR
- GAZETTED ROAD
- PRIVATE ROAD
- COMMUNITY TITLE

Scales

0 20 30 40 50m

1:1000 @ A1

sellick consultants Est 1965

www.sellickconsultants.com.au

Client Logo

DOMAGROUP

Original Size	A1	Drawn By: DA	Drafting Check: DCA
Date Plotted	13-May-20	Designed By: AE	Design Check: BC
Coordinate System	STROMLO GRID	Approved: BC	Approved Date: 30/04/2020
Height Datum	AHD	Approved Signature	

Project Name and Location

THE CANBERRA BRICKWORKS

BLOCKS 1,7 & 20 SECTION 102

Drawing Title

CONCEPT EDP - GAZETTED ROAD PLAN

Project Number	Type	Discipline	Drg No.	Sub-No.	Rev
191148	DRG	CIV	17	01	A

File Name: P:\2019\191148_Yarralumla-Brickworks\04_CAD\4.2_Drawings\CIV\EDP\191148-drg-civ-17-01.dwg

dsb Landscape Architects
14 Hannah Place, Deakin, ACT, 2600
02 6285 1955 dsb@dsbla.com.au www.dsbla.com.au

YARRALUMLA BRICKWORKS PRECINCT

TREE ASSESSMENT

Tree Management Report

3272 - 25 November 2015

Company	Land Development Agency	**Date**	24 November 2015
Attention	Irena Sharp	**This Page +**	6
From	Michael Reeves	**Project No.**	3272
Project	Yarralumla Brickworks Precinct Tree Assessment		
Subject	Tree Management Report		

dsb Landscape Architects
14 Hannah Place, Deakin, ACT, 2600
02 6285 1955 dsb@dsbla.com.au www.dsbla.com.au

Yarralumla Brickworks Precinct Tree Assessment

Tree Management Report

The following Tree Management Report provides general commentary on the quality of the trees assessed within the scope of the project and any management issues that arose from the assessment.

The project extent includes Blocks 1, 20 and 7 Section 102 Yarralumla and an additional 30m buffer area adjacent. No buffer is provided to the Yarralumla residential area between Denman Street and Bentham Street and adjacent to Lane Poole Place. Groups A to AF refer to Tree Assessment groups from this Tree Assessment.

This Tree Management Report identifies and reports on areas of similar landscape characteristics.

1. General Commentary
2. Brickworks Quarry
3. Plantations adjacent to Denman Street
4. Pine Plantation – South-eastern edge of Block 7
5. Southern extent of Block 7
6. Western extent of Block 7
7. Central area of Block 7
8. Northern area of Block 7
9. Brickworks surrounds in Block 1
10. Block 20

1. General Commentary

dsb landscape Architects has provided tree assessment services to Land Development Agency across this site since 2013.

- The predominant species within the site is Pinus radiata (weed species), Pinus ponderosa and Pinus sylvestris and Ulmus procera and various tree and shrub weed species.
- Generally the condition of the trees has deteriorated since the last vegetation assessment across the project site.
- Within the Quarry, the trees are Pines of low quality. Pinus ponderosa (a dominant species) is subject to a fungal attack to the needles and these trees have a limited life span due to this. Pinus sylvestris is an unreliable species in the Canberra area.

- The majority of trees in the quarry are located on steep slopes and risk and performance assessment concludes that removal is recommended. Most of the pines within the quarry are at, or approaching, the end of their useful life. Many trees have died since the last assessment.
- A number of resident planted trees are located along the eastern boundary. The social value of these trees may warrant consideration for retention.
- Within Block 7, the Pines generally are of low quality. The isolated elm trees and extensive surrounding elm suckers are subject to elm leaf beetle that uncontrolled will result in a limited life span for these elms. The pines within Block 7 are at, or approaching, the end of their useful life. Areas of elms, elm suckers, blackberry and urban weed tree species are common and extensive. A group of better quality pine trees are located adjacent to the railway remnants.
- On the south east corner of Block 7 is located a copse of Oak trees that have good landscape and amenity potential. The Pines located on the ridge above these oaks contribute to the landscape setting for the project.
- Adjacent to Dunrossil Drive, on the south western edge of Block 7 is an 8m high unmanaged dense thicket of urban weed tree species and other weed species. Individual senescent pines are located through this area.
- Along the western edge of the brickworks, the pines are at, or approaching, the end of their useful life and the understory is an unmanaged dense thicket of urban weed tree species and other weed species.
- Generally the landscape is unmanaged and weed species (both trees and shrubs (blackberry) and grasses) are prevalent.
- The project site and surrounds would benefit from a landscape renewal plan to,
    - identify the limited number of trees to be retained,
    - manage removal of the poor quality and senescent trees,
    - determine the replacement landscape and
    - develop an implementation and staging strategy to direct the replacement landscape installation.

2. Brickworks Quarry

Tree species located within the quarry include,

- Pinus radiata (a weed species),
- Pinus ponderosa – generally affected by a fungal disease in the canopy needles. This leads to the decline of the trees. Examples of this fungal attack can be found adjacent to the Forestry School in Banks Street Yarralumla,
- Pinus sylvestris – generally poorly performing and an unreliable species in the Canberra area, and
- Ulmus procera – affected by Elm Leaf Beetle.

Generally the trees are poorly performed with poor form and structure. Trees are self sown. Most have inherent faults in the tree structure. The majority are located on the steep side slopes of the quarry excavation.

There are isolated better performing individuals located on undisturbed ground outside of the quarry disturbance. Some of the better performing individual trees warrant a 'retain and manage' assessment.

The tree management recommendation for the quarry area as a landscape unit is implementation of a removal strategy. This recommendation is based on the limited opportunity to reduce risk or enhance amenity by horticultural practices and the limited opportunity to enhance the quality of individual trees. This recommendation is based on the limited landscape benefit of retaining the better performing individuals where the resultant landscape is wide spaced individual trees.

3. Plantations adjacent to Denman Street

A Quercus palustris plantation is located adjacent to Denman Street. This plantation is poorly performing and has been degraded by neglect and being progressively overgrown by weed understorey and weed tree species. Additional Groups A, B & C of unmaintained and unmanaged weed tree species are located adjacent to Denman Street. Group A is wind blown self seeded pines within the extent of the Quercus palustris plantation. Group B is Quercus sp. regrowth from a pile of dumped acorns with pine wildings within. Group C is Quercus sp. regrowth from a pile of dumped acorns with elm trees and suckers established from bird droppings.

Group H is an isolated collection of large elms and oaks of poor quality requiring work to warrant retention.

The tree management recommendation is the removal of the weed species and establishment of tree management practices to enhance the Quercus palustris plantation.

4. Pine Plantation – South-eastern edge of Block 7

Group D refers to the Pinus radiata plantation located on the south eastern edge of Block 7. A component of this plantation is located within Block 7 and a component is located within the 30m buffer adjacent to Block 7.

The component within Block 7 consists of wide spaced mature specimens of P. radiata with form typical of the species. The risk is of large limb fall.

The component within the 30m buffer consists of close plantation spacing with high canopy on straight poles with typical plantation form and of lesser risk.

This pine plantation is located on the high point of the precinct landform and provides a significant contribution to existing and potential landscape character. This plantation is a significant visual / scenic landscape element.

The tree management recommendation is retention and management of sufficient parts of this plantation so as to provide visual screening of development within the precinct boundaries. Removal of wide spaced mature trees should be subject to a 'visual screening of development' test.

5. Southern extent of Block 7

Trees in this locality include,

- Individual trees of a remnant pine plantation, located on high ground adjacent to overhead power lines, and
- Quercus cerris plantation located on lower ground to the south.

This combination of pines on the high ground and oaks on the lower ground presents and forms a visual screen of the precinct from views to the south.

The individual pine trees are of better than lowest quality but include inherent risk from dual leaders and other inherent faults.

The oak plantation is in need of management and selective thinning to alleviate overcrowding issues and to promote the longevity of the plantation.

The tree management recommendation is retention and management of sufficient parts of this plantation so as to provide visual screening of the development within the precinct boundaries. Removal of individual trees of a remnant pine plantation should be subject to a 'visual screening of development' test.

6. Western extent of Block 7

The western extent of Block 7 includes Groups AF, V, O and E.

This locality includes dense vegetation 8-10m high with isolated 20m+ high senescent pine trees, occasional pine wildings and urban weed tree species and shrub species. This area is a visually prominent component of the brickworks/Westbourne Woods landscape character. This area provides a visual screen and vegetative separation of the Yarralumla Brickworks Precinct from Dunrossil Drive and Cotter Road.

Species immediately identifiable include,

- Ulmus procera,
- Sorbus sp.,
- Fraxinus sp.,
- Crataegus sp.,
- Wild Roses,
- Celtis australis,
- Blackberry,
- Robinia pseudoacaia,
- Boxthorn,
- Photinia sp.,
- Broom,
- St Johns Wort and
- Prunus cerasifera nigra

The is evidence of senescent pine trees falling. Fallen timber and broken trunks are found across these Groups. Current ACT Government open space policy is to provide dense planting adjacent to high risk tree plantations to discourage recreational activity and reduce the possibility of accident. This dense understorey of urban tree and shrub weed species provides this exclusion service. Yarralumla residents that continue to use pedestrian paths through this area for recreational activity are at risk of accident from falling trees and branches from the senescent pine trees.

This vegetated area on the western edge of the Yarralumla Brickworks Precinct has conflicting issues.

This vegetated area would be a bushfire asset protection zone (APZ) for development within the precinct. Management of this APZ would include reduction of the fuel load (removal of dense vegetation) consistent with the bushfire risk. Removal of vegetation promotes high risk recreational activity beneath the senescent pine trees.

Retention of the existing weeds and pines is inconsistent with prudent bushfire planning.

Removal of the existing weeds and pines is inconsistent with maintenance of the landscape character of the area.

The western extent of Block 7 and surrounds would benefit from a landscape renewal plan to;

- identify the limited number of trees to be retained,
- manage the removal of the poor quality and senescent trees,
- manage the removal of weed species,
- determine the replacement landscape and
- develop an implementation and staging strategy to direct the replacement landscape installation.

This landscape renewal plan is recommended.

7. Central area of Block 7

This central area of Block 7 contains individual trees of a remnant pine plantation. Most are isolated, poorly performing and exhibiting poor form with clear poles and high canopy tops. There are isolated better performing groups and individuals on the edges and scattered trough this area. Within this area are significant Ulmus procera sucker regrowth thickets with Robinia pseudoacacia weed trees and suckers and understorey weeds of blackberry, privet and boxthorn.

Retention of the small number of better performing trees and removal of the poorly performing trees will result in wide spaced retained trees and the loss of landscape character.

The tree management recommendation is removal of trees and weeds.

8. Northern area of Block 7

This area of Block 7 contains dense Ulmus procera sucker fields extending from the Denman Street edge through to the pines located over the heritage railway formations. Adjacent to the heritage railway formations is a cluster of mature, but younger than adjacent Group AF, pine trees. The quality of these trees is variable with a mixture of 'remove' and 'retain and manage'.

Retention of this group of pines adjacent to the railway formations may enhance the precinct.

This group of pines has good landscape and amenity potential and management of the trees is not a significant cost.

Selective thinning to favour the better quality individual trees will result in an enhanced arboricultural and urban amenity assessment for this area overlapping with the heritage railway formations.

The tree management recommendation is to undertake selective thinning and management of the remaining trees to achieve a landscape character coinciding with the railway formations. Remove the dense Ulmus procera sucker fields.

9. Brickworks surrounds in Block 1

The Brickworks complex includes isolated trees in random locations across the area. In addition, there is an extensive and significant vegetative edge along the southern and western fence line. This is an unmaintained and unmanaged dense group of weed tree and urban weed species. This forms a significant landscape edge to

the brickworks complex.

Tree 405 is an isolated individual pine tree with better qualities than most trees within the brickworks.

Tree management recommendation is retention and management of trees within this heritage precinct in accordance with the Heritage Plan.

Tree 443 is located on top of a high wall in close proximity to the brickworks buildings. Should this tree fall, it is likely to cause substantial damage to the adjacent brickworks buildings. Removal should be considered in favour of the heritage structures.

Trees 408 and 409 are in close proximity to heritage buildings. These are aggressive weed trees and left to grow in these locations are likely to result in damage to the adjacent structures. Removal should be considered in favour of the heritage structures.

Other trees within the brickworks complex should be considered for potential damage to heritage structures and appropriate action considered.

10. Block 20

Block 20 consists of,

- Group AD located on the northern edge of the asbestos remediation area,
- Group AF located on the southern edge of the asbestos remediation area, and
- resident installed plantings associated with the Lane Poole Place residential area to the north of the fencing to the brickworks and the asbestos remediation area.

Within Group AD are a number of large, better quality Ulmus procera trees that have the potential to contribute positively to the landscape character of the area. Retention and management is recommended.

Group AF consists of senescent pines and weed species. Commentary at 7. A landscape renewal plan is recommended.

Resident installed plantings include Groups Y, Z, AA, AB and AC. Group Y is a young planting of Casuarina along the fence line. Group Z is a collection of Fraxinus and Liquidamber trees within mown lawn. Group AA is an ordered planting of plum and apple tree species within mown lawn. Group AB is two rows of Lombardy Poplars adjacent to mown lawn. Group AC is a tight grouping of mature Ulmus procera located along the edge of the golf course fence at the northern extent of Group AF.

Retention and management is recommended.

QUALITY ASSURANCE

Contact information

dsb Partners Pty Ltd
Trading as **dsb Landscape Architects**
ABN 94 052 528 293 ACN 052 528 293

Directors: Michael Reeves, Adam Barker & David Pearce

Deakin Chambers
14 Hannah Place
Deakin ACT 2600

Phone 02 6285 1955
Email dsb@dsbla.com.au
Web www.dsbla.com.au

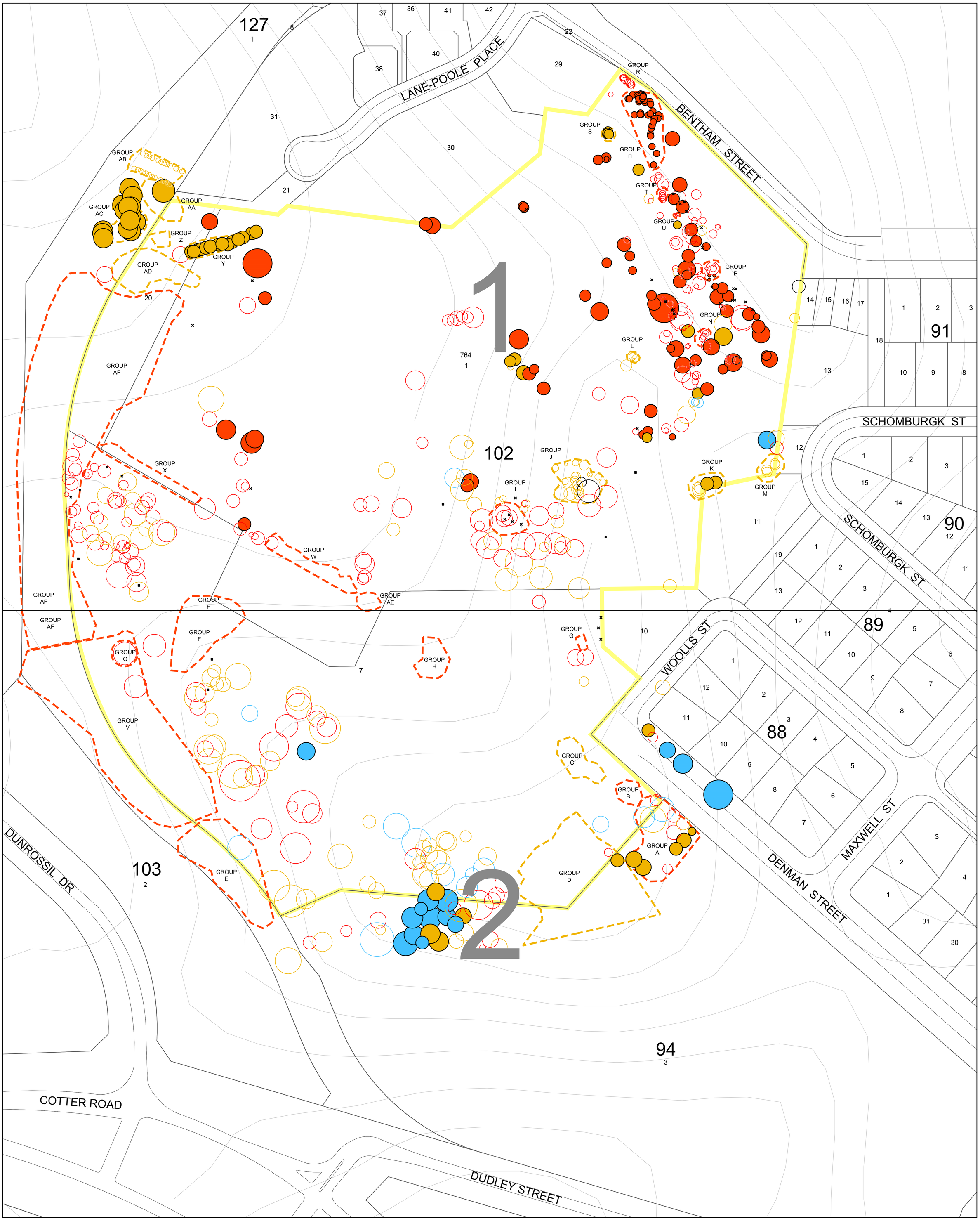
Quality Assurance Information

Project: Yarralumla Brickworks Precinct Tree Assesment – Tree Management Report

Job number: 3272
Date: 24 November 2015
Prepared by: Michael Reeves
Reviewed by: Paul Scholtens

Issue History

Issue Number	Issue Date	Details	Authorised by
1	24 /11/2015	Tree Management Report	Ps



AMENDMENT				
No.	DESCRIPTION	A□□ro□ed □y	Drawn □y	Date

SCALE/NORTHPOINT

N

0 10 20 30 40 50 60 70 80

1:2200□ A3 1:1100□ A1

DIRECTORATE/DEPARTMENT

ACT Government | Land Development Agency CANBERRA FIRST

PRO□ECT

CANBERRA BRICKWORKS

PRECINCT

TREE ASSESSMENT

DRAWING TITLE

ARBORCULTURAL AMENITY ASSESSEMENT

Site Plan

PRO□ECT NUMBER	DRAWING NUMBER	AMENDMENT
P01192	00 12/21/2015 11:21	
AutoCAD Sa□ed: 12/21/2015	Plotted: AM	By: ERM

G:\LDA\5. LRP a-f\Can□erra Bri□□wor□s and En□irons\CB□E Strategy_from 2008 to □une 2015\Ma□s and Figures\P01192 CB Pre□in□t Tree Assessment\DWG\P01192 CB Pre□in□t ARBORCULTURAL Amenity Tree Assessment.dwg

LANE-POOLE PLACE

BENTHAM STREET

SCHOMBURGK ST

SCHOMBURGK ST

SEE SHEET 3
FOR TREE GROUP DETAIL 1

SEE SHEET 3
FOR TREE GROUP DETAIL 2

SEE SHEET 3
FOR TREE GROUP DETAIL 3

GROUP AA
GROUP AB
GROUP AC
GROUP AD
GROUP AE
GROUP AF
GROUP F
GROUP I
GROUP J
GROUP K
GROUP L
GROUP M
GROUP N
GROUP P
GROUP R
GROUP S
GROUP T
GROUP U
GROUP W
GROUP X
GROUP Y
GROUP Z

LEGEND

TREE QUALITY TRAINING:

- EXCEPTIONAL QUALITY RATING REGULATED TREE
- HIGH QUALITY RATING REGULATED TREE
- MEDIUM QUALITY RATING REGULATED TREE
- POOR QUALITY RATING REGULATED TREE
- EXCEPTIONAL QUALITY RATING NON-REGULATED TREE
- HIGH QUALITY RATING NON-REGULATED TREE
- MEDIUM QUALITY RATING NON-REGULATED TREE
- POOR QUALITY RATING NON-REGULATED TREE
- NOT ASSESSED
- DEAD TREE
- NO TREE AT THIS LOCATION

TREE GROUP QUALITY RATING:

- COLOUR RATINGS AS ABOVE

QOINS SHEET P01192-02

NO.	AMENDMENT	APPROVED BY	DATE	REVISED BY

NOTES:

SCALE/NORTHPOINT

0 7.5 15 22.5 30 37.5 45 52.5 60 67.5 75

1:1500 A3 1:750 A1

DIRECTORATE/DEPARTMENT

PROJECT

CANBERRA BRICKWORKS PRECINCT

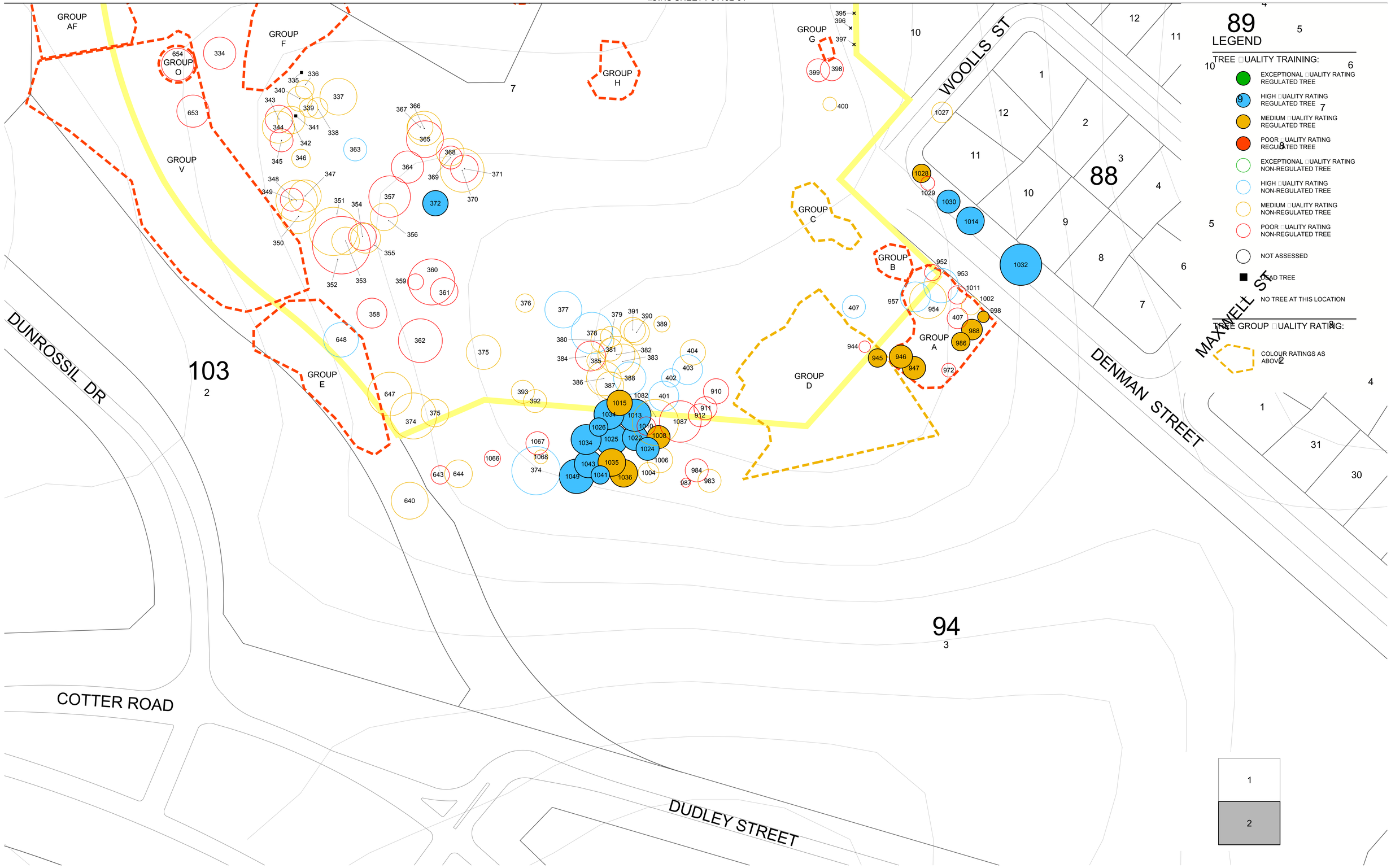
TREE ASSESSMENT STUDY

DRAWING TITLE

ARBORCULTURAL AMENITY ASSESSMENT
Site Plan

PROJECT NUMBER	DRAWING NUMBER	AMENDMENT
P01192	01	
AutoCAD Saved: 21/12/2015	Plotted: 21/12/2015 11:22:22 AM	By:ERM

Drawing FilePath: G:\LDA\5. LRP A-fCan erra Bri wor s And En irons\CB E Strategy_from 2008 To une 2015\Ma s And Figures\P01192 CB Pre in t Tree Assessment\DWG\P01192 CB Pre in t ARBORCULTURAL Amenity Tree Assessment.dwg
Layout Name: 01 PDF Creation Date: 21/12/2015 11:22:22 AM



NO.	AMENDMENT	APPROVED BY	DATE	REVISED BY

NOTES:

SCALE/NORTHPOINT

0 7.5 15 22.5 30 37.5 45 52.5 60 67.5 75

1:1500□ A3 1:750□ A1

DIRECTORATE/DEPARTMENT

PRO□ECT

CANBERRA BRICKWORKS PRECINCT

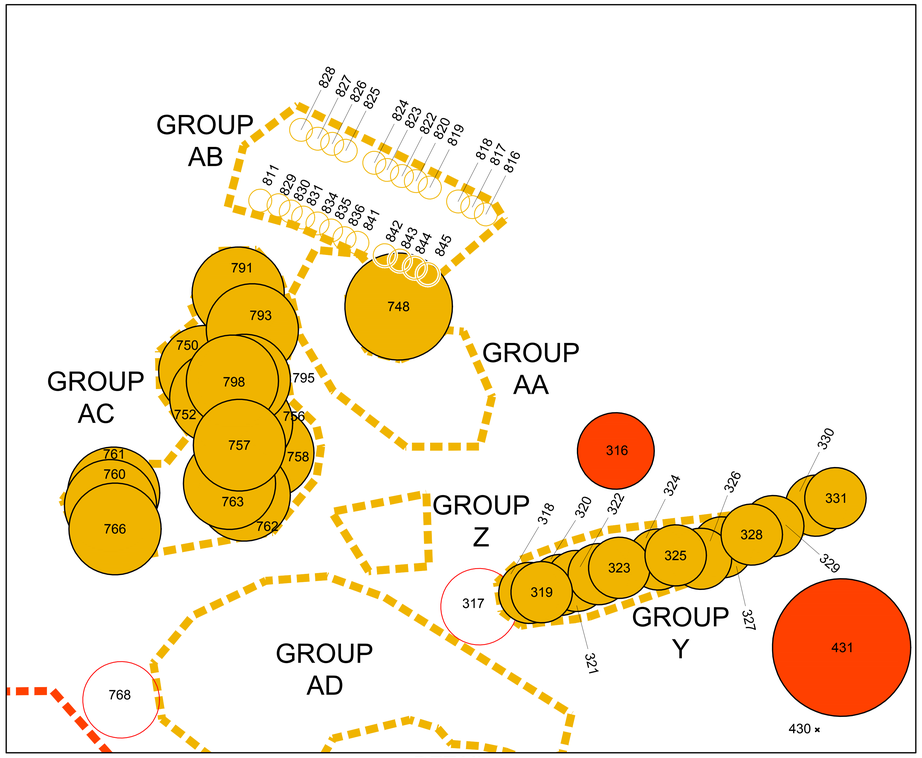
TREE ASSESSMENT STUDY

DRAWING TITLE

ARBORCULTURAL AMENITY ASSESSMENT
Site Plan

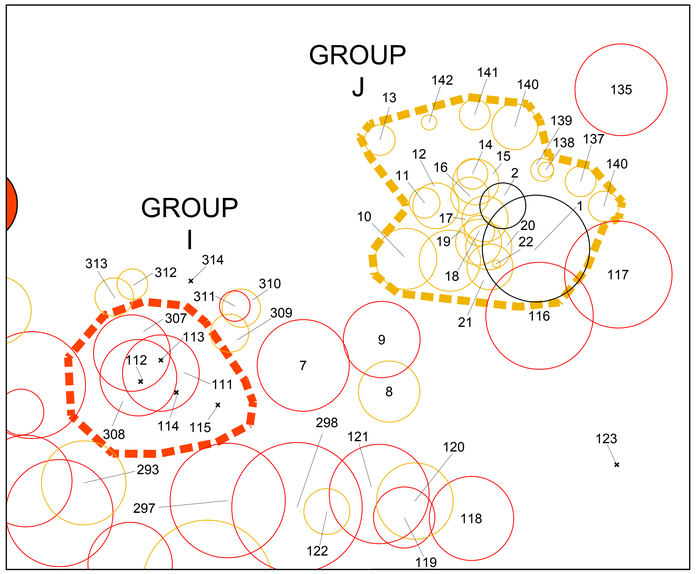
PRO□ECT NUMBER	DRAWING NUMBER	AMENDMENT
P01192	02	
AutoCAD Sa□ed: 21/12/2015	Plotted: 21/12/2015 11:24:21 AM	By:ERM

Drawing FilePath: G:\LDA\5. LRP A-ñCan□erra Bri□□wor□s And En□lrons\CB□E Strategy_from 2008 To□une 2015\Ma□s And Figures\P01192 CB Pre□in□t Tree Assessment\DWG\P01192 CB Pre□in□t ARBORCULTURAL Amenity Tree Assessment.dwg
Layout Name: 02 PDF Creation Date: 21/12/2015 11:24:21 AM



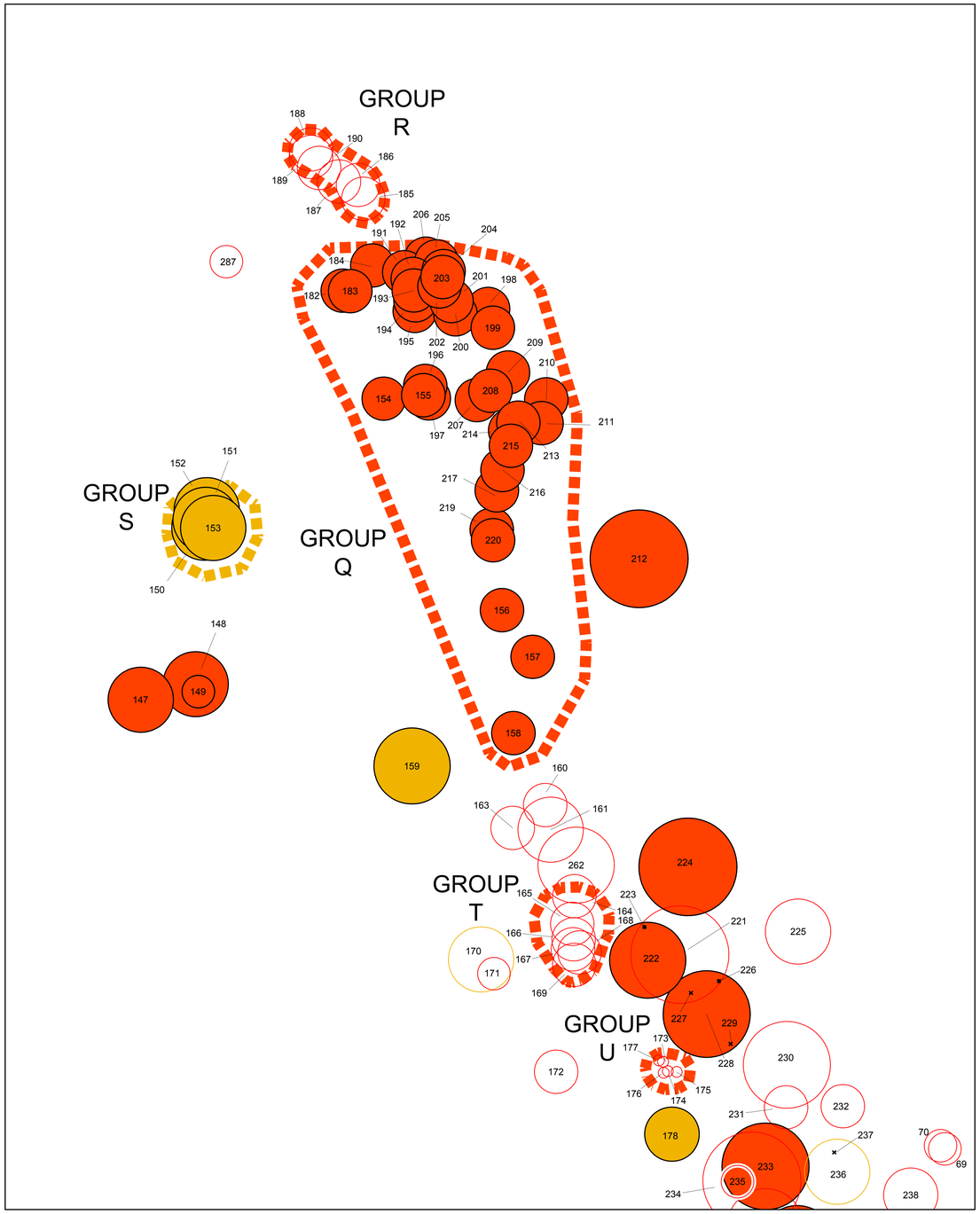
DETAIL 1

0 5 10 15 20 25 30 35 40m



DETAIL 3

0 5 10 15 20 25 30 35 40m



DETAIL 2

0 5 10 15 20m

LEGEND

TREE □UALITY TRAINING:

- EXCEPTIONAL □UALITY RATING REGULATED TREE
- HIGH □UALITY RATING REGULATED TREE
- MEDIUM □UALITY RATING REGULATED TREE
- POOR □UALITY RATING REGULATED TREE
- EXCEPTIONAL □UALITY RATING NON-REGULATED TREE
- HIGH □UALITY RATING NON-REGULATED TREE
- MEDIUM □UALITY RATING NON-REGULATED TREE
- POOR □UALITY RATING NON-REGULATED TREE
- NOT ASSESSED
- DEAD TREE
- NO TREE AT THIS LOCATION

TREE GROUP □UALITY RATING:

- COLOUR RATINGS AS ABOVE

NO.	AMENDMENT	APPROVED BY	DATE	REVISED BY

NOTES:

SCALE/NORTHPOINT

N

SCALE AS SHOWN

DIRECTORATE/DEPARTMENT

PRO□ECT

CANBERRA BRICKWORKS PRECINCT

TREE ASSESSMENT STUDY

DRAWING TITLE

ARBORCULTURAL AMENITY ASSESSMENT Details

PRO□ECT NUMBER	DRAWING NUMBER	AMENDMENT
P01192	03	

AutoCAD Sa□ed: 21/12/2015 Plotted: 21/12/2015 11:26:52 AM By:ERM

Drawing FilePath: G:\LDA\5. LRP A-f\Can□erra Bri□□wor□s And En□irons\CB□ E Strategy_from 2008 To □une 2015\Ma□s And Figures\P01192 CB Pre□in□t Tree Assessment\DWG\P01192 CB Pre□in□t ARBORCULTURAL Amenity Tree Assessment.dwg
Layout Name: 03 PDF Creation Date: 21/12/2015 11:26:52 AM

Company	DOMA GROUP and BLOC	**Date**	17 January 2020
Attention	David Murphy	**This Page +**	3
From	Michael Reeves	**Project No.**	3862
Project	Yarralumla Brickworks Precinct		
Subject	Tree Assessment Update		

dsb Landscape Architects
14 Hannah Place, Deakin, ACT, 2600
02 6285 1955 dsb@dsbla.com.au www.dsbla.com.au

David Murphy,

dsb Landscape Architects was previously engaged by the ACT Land Development Agency to undertake a tree assessment and report on Blocks 1, 20 and 7 Section 102 Yarralumla (The Yarralumla Brickworks Precinct).

A Tree Assessment Report and Tree Management Report was prepared Project Number 3272 and dated 25 November 2015.

dsb Landscape Architects has been providing at Yarralumla Brickworks, tree assessment services to the Land Development Agency since 2013.

DOMA GROUP and BLOC are preparing an Estate Development Plan submission to ACT Government. dsb Landscape Architects have been engaged to provide arborist services to support this EDP.

dsb Landscape Architects has been engaged in discussions with ACT Tree Protection Unit regarding arborist services to support this EDP. Mr Mark Diehm indicated that a completely new Tree Assessment Report would not be required and that a Tree Assessment Update of the Tree Assessment and Report prepared in 2015, based upon recent inspection of the site, would be sufficient.

dsb Landscape Architects' arborist Paul Scholtens and Registered Landscape Architect Michael Reeves attended to Blocks 1, 20 and 7 Section 102 Yarralumla (The Yarralumla Brickworks Precinct) on Wednesday 15 January 2020. Arborist Paul Scholtens and Registered Landscape Architect Michael Reeves have conducted the tree assessments in 2013 and later 2015 and are familiar with the location, the asbestos remediation works by CAPCORP, the trees and the weather over this extended period.

The full extent of Blocks 1, 20 and 7 Section 102 Yarralumla (The Yarralumla Brickworks Precinct) was investigated and the current condition of the trees recorded.

In 2015, the predominant species within the site is Pinus radiata (weed species), Pinus ponderosa and Pinus sylvestris and Ulmus procera and various tree and shrub weed species. This remains the case and apart from isolated tree deaths in the period 2015 to 2020 the trees within the precinct remain.

In 2015 it was noted that generally the condition of the trees had deteriorated since the 2013 vegetation assessment. In 2020 a similar deteriorating condition assessment prevails. In 2015, the predominant condition was POOR with a cohort of MEDIUM quality trees. In 2020, the majority of the trees are POOR and the greater proportion of trees previously assessed as MEDIUM are now POOR.

In 2015, it was reported that within the Quarry, the trees are Pines of low quality. Pinus ponderosa (a dominant species) is subject to a fungal attack to the needles and these trees have a limited life span due to this. Pinus sylvestris is an unreliable species in the Canberra area. The majority of trees were assessed POOR with Group J MEDIUM. In 2020, the POOR trees have deteriorated further and the Group J MEDIUM trees have maintained this assessment. Some of the MEDIUM assessment isolated trees adjacent to the Denman Street fence have deteriorated with Tree 296 now POOR.

The majority of trees within the quarry are located on steep slopes and in 2015 an opinion was expressed that there may be a risk of falling trees. Evidence from the 2020 inspection revealed that very few pines have fallen in the intervening period despite the deterioration in their condition. Most of the pines within the quarry are at or approaching the end of their safe useful life. Retention for landscape and amenity purposes may be considered in the short term whilst other landscape plantings are establishing.

A number of resident-planted trees are located along the eastern boundary. In 2015 their assessment was HIGH and MEDIUM. In 2020 these assessments remain unchanged.

In 2015, it was reported that within Block 7, the Pines generally are of low quality. The isolated elm trees and extensive surrounding elm suckers are subject to elm leaf beetle that uncontrolled will result in a limited life span for these elms. The pines within Block 7 are at, or approaching, the end of their useful life. Areas of elms, elm suckers, blackberry and urban weed tree species are common and extensive. A group of better-quality pine trees are located adjacent to the railway remnants.

In 2020, within Block 7 the pines have deteriorated further and POOR assessment prevails. The blackberry are less predominant. The Elms and suckers are extensive and the condition is POOR. The better-quality pine trees adjacent to the railway embankments have deteriorated further and are now commonly POOR. A number of pines within this area are of less-worse condition and, should weather conditions improve, they may be worthy of retention with extensive remedial attention (Trees 733, 727, 724, 737, 738, 723, 713, 708, 714 and 718).

Along the western and southwestern perimeter of the precinct, the pines reported in 2015 as senescent and at the end of their safe useful life have deteriorated further and continue their POOR assessment.

Along the northern boundary, on the access from Lane Poole Place the planted mound remains under maintenance by the adjacent lessees. The row of Casuarina adjacent to the security fence has deteriorated in condition but retains the MEDIUM assessment.

In 2015, it was reported of a Quercus palustris plantation located adjacent to Denman Street. This plantation is poorly performing and has been degraded by neglect and being progressively overgrown by weed understorey and weed tree species. Additional Groups A, B & C of unmaintained and unmanaged weed tree species are located adjacent to Denman Street. Group A is wind blown self seeded pines within the extent of the Quercus palustris plantation. Group B is Quercus sp. regrowth from a pile of dumped acorns with pine wildings within. Group C is Quercus sp. regrowth from a pile of dumped acorns with elm trees and suckers established from bird droppings.

Group H is an isolated collection of large elms and oaks of poor quality requiring work to warrant retention.

In 2020, these trees adjacent to Denman Street have deteriorated further with current POOR assessment common.

If we can be of any further assistance to you in regard to the project please do not hesitate to contact me.

Regards,

Michael Reeves

Director

Registered Landscape Architect AILA #486

1. QUALITY ASSURANCE

Contact information:

DSB Partners Pty Ltd
Trading as dsb Landscape Architects
ABN 94 052 528 293

Directors: Adam Barker, David Pearce and Michael Reeves

Canberra
Deakin Chambers
14 Hannah Place
Deakin ACT 2600

Melbourne
331/173 City Road
Southbank, VIC 3006

Phone: (02) 6285 1955

Email: dsb@dsbla.com.au

Web: www.dsbla.com.au

Quality assurance information

Report title: Yarralumla Brickworks Tree Assessment Update_____

Job number: 3862_____

Date: 17 January 2020_____

Prepared by: Michael Reeves_____

Reviewed by: Paul Scholtens_____

Issue history

Issue Number	Issue Date	Details	Authorised by
1	17/1/20	Yarralumla Brickworks Tree Assessment Update	Ps

LEGEND

Existing tree to retain

Existing tree to remove

© Copyright McGregor Coxall
AUS ACN 082 334 290
UK 10199853
PRC ID NO. 06000002201607080008
Sydney Melbourne Shenzhen Bristol
www.mcgregorcoxall.com

MCGREGOR COXALL

Client
DOMA GROUP

Project Team
SJB Architects
Sixdegrees
CUMULUS
Sellick Consultants

Project Name
YARRALUMLA BRICKWORKS

Project No.
0619SYD

Address
Yarralumla ACT 2600

Key Plan

Issue Log

Rev	Revision Description	By / Checked	Date
C	Draft Issue for EDP	MF/MK	13/05/2021
D	Final Draft EDP	MK/JM	2/06/2021
E	Final Draft EDP	MK/JM	15/06/2021
F	Final EDP	YC/MK	5/11/2021

Scale
1 : 1000 @ A1

North

All dimensions are in millimetres unless otherwise noted.
Do not scale from this drawing.

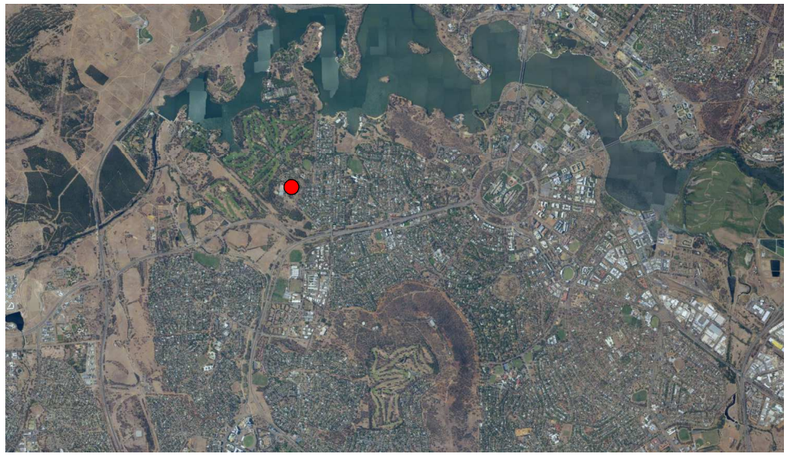
Phase
Schematic Design

Sheet Title
Tree Protection Plan

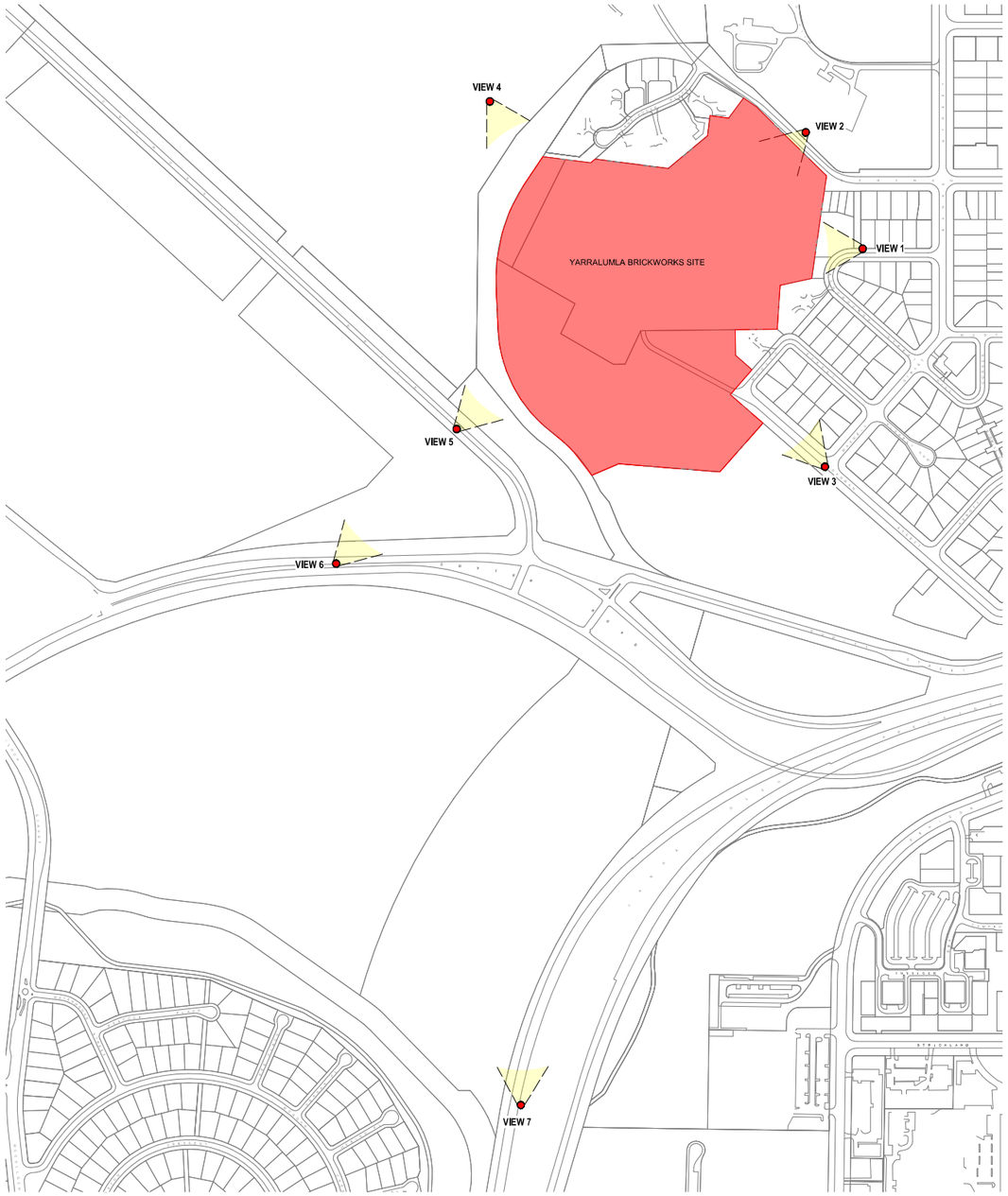
Sheet No.
LD-EDP-200

Rev
F

YARRALUMLA BRICKWORKS
VIEW IMPACT STUDIES



LOCATION PLAN



VIEW LOCATIONS KEY MAP

UNCONTROLLED ISSUE

REV	DESCRIPTION	DATE
1	VIEW STUDIES	20/10/2020

STEWART ARCHITECTURE
36 MILDURA STREET FYSHWICK 2609
PO BOX 3469 MANUKA ACT 2603
OFFICE@STEWARTARCHITECTURE.COM.AU

PROJECT **YARRALUMLA BRICKWORKS**

PROJECT No. **1644**

This drawing is copyright and remains the property of Stewart Architecture.
This drawing is for development application purposes and not for construction.

DRAWING No. **SK250**
DRAWING TITLE **VIEWS - KEY DIAGRAM**
SCALE
DATE **Issue Date**

VIEW 1
SCHOMBURGK STREET - EXISTING VIEW

VIEW 1
SCHOMBURGK STREET - PROPOSED VIEW

UNCONTROLLED ISSUE

REV	DESCRIPTION	DATE
1	VIEW STUDIES	20/10/2020

STEWART ARCHITECTURE
36 MILDURA STREET FYSHWICK 2609
PO BOX 3469 MANUKA ACT 2603
OFFICE@STEWARTARCHITECTURE.COM.AU

PROJECT **YARRALUMLA BRICKWORKS**

PROJECT No. **1644**

This drawing is copyright and remains the property of Stewart Architecture.
This drawing is for development application purposes and not for construction.

DRAWING No. **SK251**
DRAWING TITLE **VIEW STUDIES - SCHOMBURGK STREET**

SCALE **@ A1**
DATE **Issue Date**

VIEW 2
BENTHAM STREET - EXISTING VIEW

VIEW 2
BENTHAM STREET - PROPOSED VIEW

UNCONTROLLED ISSUE

REV	DESCRIPTION	DATE
1	VIEW STUDIES	20/10/2020

STEWART ARCHITECTURE
36 MILDURA STREET FYSHWICK 2609
PO BOX 3469 MANUKA ACT 2603
OFFICE@STEWARTARCHITECTURE.COM.AU

PROJECT **YARRALUMLA BRICKWORKS**

PROJECT No. **1644**

This drawing is copyright and remains the property of Stewart Architecture.
This drawing is for development application purposes and not for construction.

DRAWING No. **SK252**
DRAWING TITLE **VIEW STUDIES - BENTHAM STREET**
SCALE
DATE **Issue Date**

VIEW 3
CORNER OF DENMAN AND MAXWELL STREET - EXISTING VIEW

VIEW 3
CORNER OF DENMAN AND MAXWELL STREET - PROPOSED VIEW

UNCONTROLLED ISSUE

REV	DESCRIPTION	DATE
1	VIEW STUDIES	20/10/2020

STEWART ARCHITECTURE
36 MILDURA STREET FYSHWICK 2609
PO BOX 3459 MANUKA ACT 2603
OFFICE@STEWARTARCHITECTURE.COM.AU

PROJECT **YARRALUMLA BRICKWORKS**

PROJECT No. **1644**

This drawing is copyright and remains the property of Stewart Architecture.
This drawing is for development application purposes and not for construction.

DRAWING No. **SK253**
DRAWING TITLE **VIEW STUDIES - CORNER DENMAN AND MAXWELL STREET**
SCALE
DATE **Issue Date**

VIEW 4
FAIRWAY VIEW AT ROYAL CANBERRA GOLF COURSE - EXISTING VIEW

VIEW 4
FAIRWAY VIEW AT ROYAL CANBERRA GOLF COURSE - PROPOSED VIEW

UNCONTROLLED ISSUE

REV	DESCRIPTION	DATE
1	VIEW STUDIES	20/10/2020

STEWART ARCHITECTURE
36 MILDURA STREET FYSHWICK 2609
PO BOX 3469 MANUKA ACT 2603
OFFICE@STEWARTARCHITECTURE.COM.AU

PROJECT **YARRALUMLA BRICKWORKS**

PROJECT No. **1644**

This drawing is copyright and remains the property of Stewart Architecture.
This drawing is for development application purposes and not for construction.

DRAWING No. **SK254**
DRAWING TITLE **VIEW STUDIES - ROYAL CANBERRA GOLFCOURSE FAIRWAY**
SCALE
DATE **Issue Date**

VIEW 5
DUNROSSIL DRIVE - EXISTING VIEW

VIEW 5
DUNROSSIL DRIVE - PROPOSED VIEW

UNCONTROLLED ISSUE

REV	DESCRIPTION	DATE
1	VIEW STUDIES	20/10/2020

STEWART ARCHITECTURE
36 MILDURA STREET FYSHWICK 2609
PO BOX 3469 MANUKA ACT 2603
OFFICE@STEWARTARCHITECTURE.COM.AU

PROJECT **YARRALUMLA BRICKWORKS**

PROJECT No. **1644**

This drawing is copyright and remains the property of Stewart Architecture.
This drawing is for development application purposes and not for construction.

DRAWING No. **SK255**
DRAWING TITLE **VIEW STUDIES - DUNROSSIL DRIVE**
SCALE
DATE **Issue Date**

VIEW 6
COTTER ROAD - EXISTING VIEW

VIEW 6
COTTER ROAD - PROPOSED VIEW

UNCONTROLLED ISSUE

REV	DESCRIPTION	DATE
1	VIEW STUDIES	20/10/2020

STEWART ARCHITECTURE
36 MILDURA STREET FYSHWICK 2609
PO BOX 3469 MANUKA ACT 2603
OFFICE@STEWARTARCHITECTURE.COM.AU

PROJECT **YARRALUMLA BRICKWORKS**

PROJECT No. **1644**

This drawing is copyright and remains the property of Stewart Architecture.
This drawing is for development application purposes and not for construction.

DRAWING No. **SK256**
DRAWING TITLE **VIEW STUDIES - COTTER ROAD**
SCALE
DATE **Issue Date**

VIEW 7
YARRA GLEN DRIVE/ADELAIDE AVENUE - EXISTING VIEW

VIEW 7
YARRA GLEN DRIVE/ADELAIDE AVENUE - PROPOSED VIEW

UNCONTROLLED ISSUE

REV	DESCRIPTION	DATE
1	VIEW STUDIES	20/10/2020

STEWART ARCHITECTURE
36 MILDURA STREET FYSHWICK 2609
PO BOX 3469 MANUKA ACT 2603
OFFICE@STEWARTARCHITECTURE.COM.AU

PROJECT **YARRALUMLA BRICKWORKS**

PROJECT No. **1644**

This drawing is copyright and remains the property of Stewart Architecture.
This drawing is for development application purposes and not for construction.

DRAWING No. **SK257**
DRAWING TITLE **VIEW STUDIES - YARRA GLEN/ADELAIDE AVENUE**
SCALE
DATE **Issue Date**

alluvium

FINAL CONCEPT POND DESIGN

Yarralumla Brickworks, Canberra, BLOC

December 2016

Document history

Revision:

Revision no.	03
Author/s	Jenny Butcher Stuart Cleven
Checked	Stuart Cleven David Barratt
Approved	Stuart Cleven

Distribution:

Revision no.	03
Issue date	13/12/2016
Issued to	BLOC
Description:	Final concept design

Revision no.	02
Issue date	07/12/2016
Issued to	BLOC
Description:	Draft concept design

Contact:

Name	Alluvium Consulting Pty Ltd
ABN	76 151 119 792
Contact person	David Barratt
Ph.	0407 488 933
Email	David.barratt@alluvium.com.au
Address	Unit 1/11 Murray Crescent Manuka ACT 2603

Ref: R:\Projects\2016\xxx_Yarralumla_Brickworks (P316014)\1_Deliverables\P316014_R01V03 Yarralumla_Brickworks_concept_design.docx

Contents

1 Introduction 3

Reference material 3

2 Site overview 4

2.1 Catchments 5

2.2 Options 5

3 Site analysis 7

3.1 Hydrologic and hydraulic analysis 7

3.2 Criteria for SWMS 7

4 Wetland and pond concept design 8

4.1 Capture efficiency and velocity calculations 10

5 Stormwater quality treatment system design and residence time analysis 11

5.1 MUSIC model setup 11

5.2 Residence time analysis 12

5.3 MUSIC treatment results 12

6 Recommendations 13

7 Costing (Option 2) 16

Appendix A Development plan layouts 18

Appendix B Rational calculations 20

Appendix C Treatment asset calculations 22

Figures

Figure 1. *Site location* 4

Figure 2. *Overall Catchment Plan* 6

Figure 3. *Typical pond cross section (Melbourne Water Constructed Wetlands design manual) adapted to the site* 9

Figure 4. *MUSIC schematic of the Yarralumla Brickworks (Option 2)* 11

Figure 5. *Concept layout overview* 14

Figure 6. *Concept layout detail* 15

Figure 7. *Irrigation Area Diagram* 19

Tables

Table 1. Study site subcatchments 5

Table 2. Design flows (rational method) 7

Table 3. Pond batter requirements 8

Table 4. Pond design parameters 9

Table 5. Treatment asset parameters 9

Table 6. Fraction Impervious 11

Table 7. Residence time results for Options 1 to 3 12

Table 8. MUSIC results for each treatment asset scenario (including harvesting) 12

Table 9. MUSIC results for each treatment asset scenario 13

Table 10. Cost estimates for the proposed works 16

Table 11. Rational calculations 21
Table 12. Sediment basin calculations 23
Table 13. Velocity calculation – sediment basin 24
Table 14. Velocity calculations - wetland 24

Abbreviations

Alluvium	Alluvium Consulting Australia Pty Ltd
AHD	Australian Height Datum
ARI	Average Recurrence Interval
EDD	Extended Detention Depth
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
NWL	Normal Water Level
SWMS	Surface/Storm Water Management Strategy
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids

1 Introduction

Alluvium Consulting Australia Pty Ltd (Alluvium) has been engaged by BLOC to prepare a proof of concept for a proposed amenity and stormwater treatment pond and wetland in support of a development tender for the Yarralumla Brickworks site in Yarralumla, Canberra. This proof of concept is phase 1 of what will ultimately form a Surface/Stormwater Management Strategy (SWMS).

The objective of a SWMS is to propose management strategies for stormwater quality and quantity. Through meeting this objective, the SWMS acts as a critical component of the development planning and urban design process and ensures stormwater is managed in accordance with requirements in the ACT. Information with respect to the pond is provided at a concept design level.

Reference material
A variety of reference material was drawn upon to determine both the existing and developed site conditions and to use the correct parameters for designing the pond and wetland. These materials included:

- The Development Masterplan
- The Canberra Brickworks Precinct Proposed Services Connection Plan (Sellicks Consultants, June 2016)
- Irrigation Area Diagram (McGregor & Coxall, December 2016)
- The Waterways Water Sensitive Urban Design General Code (ACT Planning and Land Authority)
- The ACT Practice Guidelines for WSUD (ACT Planning and Land Authority 2016)

2 Site overview

The Yarralumla Brickworks site covers an area of approximately 16 hectares and is generally bounded by Bentham Street to the north, the Royal Canberra Golf Course to the west, and connects to Dudley Street to the south. There are remnants of the former Yarralumla Brickworks Railway, and a depression currently exists at the site of the former quarry. This is where the pond has been proposed to be built.

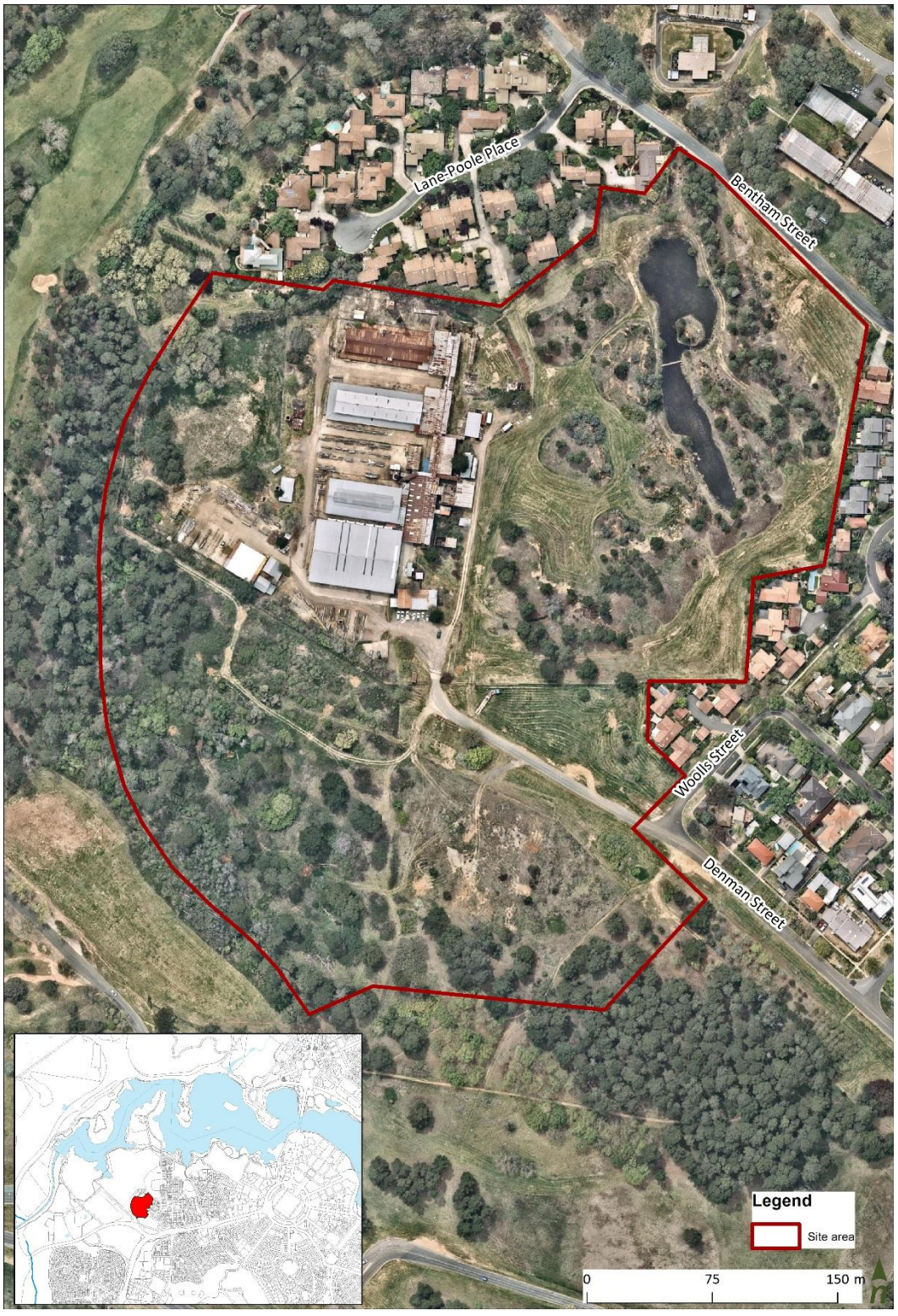


Figure 1. *Site location*

There are a number of constraints and opportunities, including:

1. There is an existing depression where the sediment pond, wetland and pond will be located (the old quarry)
2. There is an existing residential area to the west (around Lane-Poole Place) which contains a stormwater system that could be tapped into for additional water for the Water Sensitive Urban Design (WSUD) assets

The proposed site development layout can be seen at Appendix A.

2.1 Catchments

There are six subcatchments on the site according to the proposed stormwater services network (Figure 2), all connecting to a point in the north-west of the site. The existing residential catchment has also been analysed in case additional stormwater is necessary for the correct water turnover in the pond. The size and direction of these catchments are provided in Table 1.

Table 1. Study site subcatchments

Catchment	Internal/ External	Area (ha)	Flow Direction
A	Internal	1.2	South-west
B	Internal	1.5	North-west
C	Internal	2.3	North
D	Internal	1.9	North-west
E	Internal	1.5	North-west
F	Internal	1.4	West
Total	*Internal*	*9.8*	-
Existing residential catchment	External	2.6	South-west

2.2 Options

Three options for inflow to the WSUD assets have been analysed:

- **Option 1**: Inflow from catchment A only
- **Option 2**: Inflow from a pipe diversion from all catchments within the site area (pumped)
- **Option 3**: Additional inflow from the existing residential catchment into the system if necessary (for meeting reuse demand and meeting residence time)

Figure 2. *Overall Catchment Plan*

3 Site analysis

3.1 Hydrologic and hydraulic analysis

The design flows that have been used for fully developed conditions to assess pipe capacity requirements (Phase 2 of this project if required) and diversion flow for the pond have been undertaken using the rational method and are provided in Table 2 and Appendix B.

Table 2. Design flows (rational method)

Catchment	Area (ha)	Q 3 month ARI	Minor flow (5 year ARI)
A	1.2	0.024 m^3/s	0.12 m^3/s
B	1.5	0.035 m^3/s	0.08 m^3/s
C	2.3	0.047 m^3/s	0.23 m^3/s
D	1.9	0.065 m^3/s	0.32 m^3/s
E	1.5	0.037 m^3/s	0.19 m^3/s
F	1.4	0.031 m^3/s	0.16 m^3/s
Total	*9.8*	*0.205 m^3/s*	*1.02 m^3/s*
Existing residential	2.6	0.080 m^3/s	0.40 m^3/s
Total + Existing residential	2.6	0.277 m^3/s	1.38 m^3/s

3.2 Criteria for SWMS

The criteria for the proposed strategy, based on the analysis of existing conditions are as follows:

- Pollutant removal
- Proof of concept (sediment basin, wetland and pond)
- Convey major flows through the site via overland flows along road reserves (Phase 2 of project if required)
- Convey minor flows through local catchments in a piped network (Phase 2 of project if required)

4 Wetland and pond concept design

The proposed wetland and pond will be located in the old quarry within the site, where there is an existing depression. This can be seen in the landscape plan (see Appendix A). The wetland will receive inflow from the combined subcatchments within the site, with the 3 month ARI being diverted into the sediment basin, then flowing into the macrophyte zone, and finally the pond.

Key design considerations as per the ACT Practice Guidelines for WSUD (2016) include the following:

- Consideration of depth and inundation frequency to ensure the health of fringing vegetation
- Pre-treatment of the diverted stormwater to ensure minimal nutrients and sediments are entering the pond, thus reducing the risk of algal blooms
- Sufficient inflow into the pond to ensure there is a minimum residence time (turn-over of water) of less than 50 days so to avoid stagnant water and algal blooms
- 20%ile residence time between 20 and 30 days for water in the pond
- Appropriate batters to ensure public safety (minimum of 1 in 6)
- Sediment removal frequency (at least once every 5 years)
- Velocities through the pond are 0.5 m/s in the 1 year ARI
- A maximum depth of 3-4m and a minimum depth of 0.6-2m for the pond
- A maximum Extended Detention Depth (EDD) of 0.5m
- An access ramp into the sediment pond for maintenance
- A sediment dewatering area located next to the sediment pond

The pond batters have been adopted from Melbourne Water's *WSUD Engineering Procedures: Stormwater* (2004). The batter requirements, including safety benches and freeboard requirements, result in a minimum width of 24.1m needed for the pond given a 2m wide base. The pond batters are shown in Table 3 and a typical cross section of the pond is represented in Figure 3. These batters apply to the sediment basin and wetland as well.

Table 3. Pond batter requirements

Description	***Slope***	***Distance***
NWL to -350 mm	1 in 8	2.8
-350 mm to 1500mm	1 in 3	1.15
Above NWL	Minimum 1 in 6	Varies

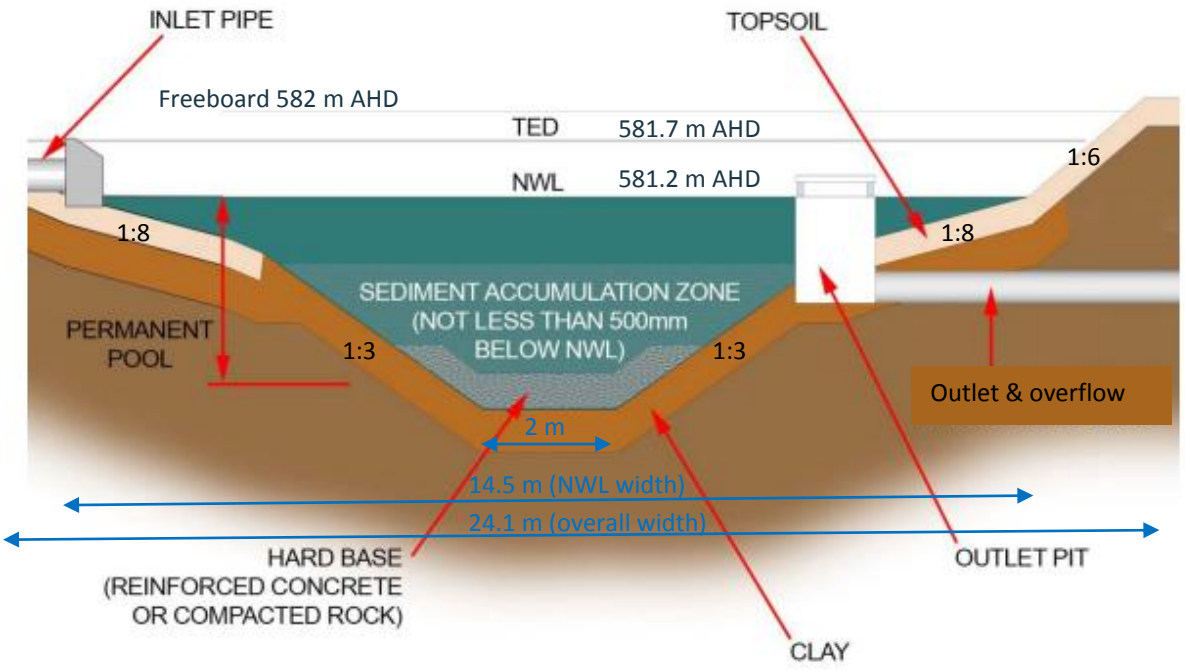


Figure 3. *Typical pond cross section (Melbourne Water Constructed Wetlands design manual) adapted to the site*

The treatment area for the wetland, sediment basin and pond have been determined by the available space and minimum batters requirements. The areas were then analysed to check they met requirements such as the residence time for the pond, and velocity and sediment capture efficiency requirements.

Table 4. Pond design parameters

Parameter	Design value
Pond area (at NWL)	1500 m^2
Pond depth	1.5 m
Normal Water Level (NWL)	581.2 m AHD
Elevation at base	579.7 m AHD
EDD	0.5 m
Freeboard	0.3 m
Volume (approximate)	1500 m^3

Table 5. Treatment asset parameters

	Wetland	***Sediment Basin***
Treatment area (NWL), m^2	880	180
Average depth, m	0.4	1.0
Volume, m^3	352	180
Extended detention, m	0.5	0.5
Freeboard, m	0.3	0.3
Extended detention time (hours)	72	12

4.1 Capture efficiency and velocity calculations

Provision for sediment dewatering has been made. These areas assume a depth of 500 mm and allow for the 5 year cleanout sediment volume to be accommodated. These calculations are based on the typical sediment loading rate of 1.6 m^3/ha/yr for a developed catchment. The possible locations of this dewatering area are provided in the concept design maps (Figure 5 and Figure 6). Full calculations for sediment pond capture efficiency and storage volume are provided in Appendix C. Provision has also been made for maintenance requirements. The design allows for a maintenance track that would typically be 3.5-4 m wide at a grade of 1:20, as well as a ramp into the pond for sediment dewatering.

Velocity analysis of the sediment basin and wetland was conducted to ensure the size and configuration of the assets result in velocities through the sediment basin of less than 0.5m/s, and the wetland of less than 0.05m/s. The proposed revised asset layout meets this design requirement. Velocity calculations for the assets are provided in Appendix C.

5 Stormwater quality treatment system design and residence time analysis

5.1 MUSIC model setup

The catchments and stormwater treatment performance of the pond have been modelled using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC). The MUSIC model helps determine the design flow volumes following urban development, the amount of pollutants generated and ultimately the performance of treatment measures. The 'fraction impervious' values were calculated by measuring the proposed roof and road areas as a fraction of the subcatchments.

The land use types and corresponding fraction imperviousness adopted are presented in Table 6. In accordance with the ACT's Waterways Water Sensitive Urban Design General Code, Canberra Airport rainfall station was used for the period 1968 to 1977 at a 6 minute timestep. The recommended MUSIC rainfall/runoff parameters and stormwater quality parameters suggested in the General Code were also adopted. The design treatment system schematic is provided in Figure 4.

Table 6. Fraction Impervious

Catchment	*Fraction impervious adopted*
A	0.4
B	0.45
C	0.4
D	0.8
E	0.5
F	0.45
Total	0.5

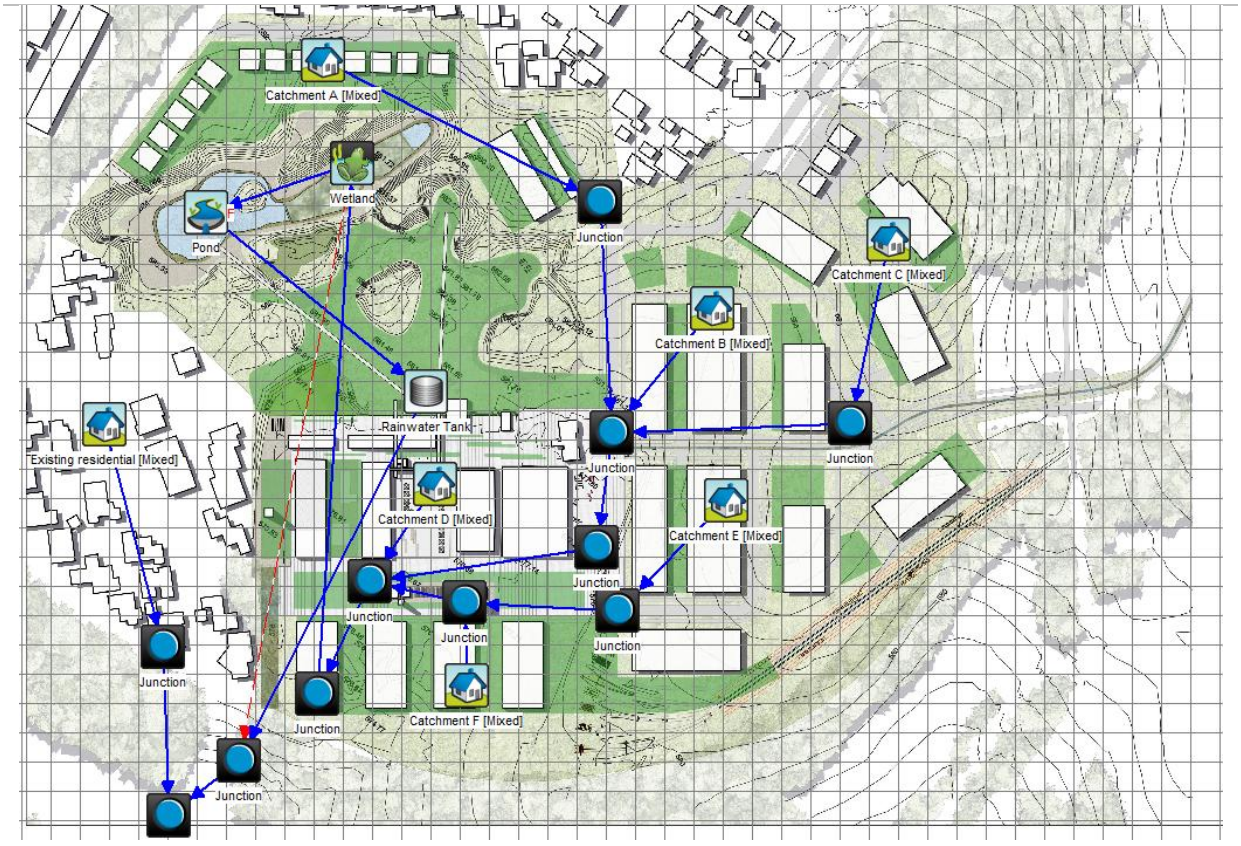


Figure 4. *MUSIC schematic of the Yarralumla Brickworks (Option 2)*

Options 1 and 2 were analysed first to check if water residence times were being met for the pond. The 3 month ARI for catchment A was all diverted into the wetland for Option 1, whilst the combined 3 month ARI for all internal catchments was diverted into the wetland for Option 2. Option 3 looks at whether it is worth tapping into the existing residential catchment, so diverting the 3 month flow from this in addition to the internal catchments.

Water reuse demands were built into the pond node in MUSIC based on a 2.5ML/ha/yr demand for open space irrigation, and an approximate area of 4.2 ha of open space throughout the development (as per the irrigation area diagram provided by McGregor and Coxall). This results in a 10,400 kL annual demand. The tank size was iteratively increased so to meet demand.

5.2 Residence time analysis

The results from the MUSIC modelling were used to analyse the residence time in the pond for Option 1 and Option 2. Analysis was conducted for the time period 1968-1977. The results are shown in Table 7 below. In terms of residence time, the ACT Practice Guidelines for WSUD specify that there should be:

- Sufficient inflow to ensure there is a residence time (turn-over of water) of less than 50 days so to avoid stagnant water and algal blooms
- 20 percentile residence time between 20 and 30 days

Table 7. Residence time results for Options 1 to 3

Option	**Average Summer residence time** Target < 50 days	**20%ile residence time (annual)** Target 20-30 days
1	359 ✘	340 ✘
2	15 ✓	20.6 ✓
3	10.9 ✓	14.9 ✘

Analysis of the residence time (looking at inflows into the pond) shows that for each of the summers between 1968 and 1977 the residence time was less than 50 days for Option 2 and 3 only. Analysis of the annual inflows into the pond results in a 20th percentile of 20.6 days for Option 2 and approximately 14.9 days for Option 3, which means that only Option 2 meets the design criteria (between 20 and 30 days). This analysis shows that the pond configuration and inflows are sufficient to meet the residence time criteria for Option 2 only. This analysis also shows that the internal site catchments are sufficient to maintain a healthy pond (Option 2) without the existing residential catchment to the north being tapped into (Option 3). Option 1 is likely to result in pond water quality issues and should not be pursued.

5.3 MUSIC treatment results

The overall treatment train results for each of the scenarios modelled in MUSIC are shown in Table 8 below.

Table 8. MUSIC results for each treatment asset scenario (including harvesting)

System arrangement	***System performance (% removal)***				***System performance kg/year)***			
Option	**TSS**	**TP**	**TN**	**Gross Pollutant**	**TSS**	**TP**	**TN**	**Gross Pollutant**
1	9.5	9.4	9.4	10.1	880	0.77	11	140
2	80.1	57.3	54.4	94.8	7480	4.7	60.5	1345.6
3*	76.7	52.5	47.7	94.9	9670	5.85	71	1802.9

* Note the treatment results for Option 3 include the external catchment thus while percentages are lower kg load treated are higher.

Modelling results show that Options 2 and 3 will meet stormwater water quality treatment requirements for the proposed residential areas. Option 1 fails to meet the treatment criteria due to the low volume of water directed through the wetland and pond system.

The treatment and demand reliability results show that Options 2 and 3 provide the best reliability in terms of meeting irrigation demands. Tapping into the external residential catchment only provides a small amount of additional water for irrigation (only an additional 0.4ML/yr). Option 1 has a very low reliability of supply for irrigation given the estimated demand.

Table 9. MUSIC results for each treatment asset scenario

Option	WSUD Treatment Measure	Demand supplied (%)
1	Wetland + Pond + 300kL Water tank	4.6
2	Wetland + Pond + 300kL Water tank	71.5
3	Wetland + Pond + 300kL Water tank	75.2

6 Recommendations

Pond residence time modelling shows that the combined internal site catchments are sufficient to maintain a healthy pond (Option 2) and that the additional existing residential catchment to the north is not required to maintain this health (Option 3). The modelling also concluded that Option 1 is likely to result in pond water quality issues, due to the lack of available volume of water to turn the pond over and should not be pursued.

Water quality modelling results show that only Option 2 will meet stormwater quality treatment requirements for the proposed residential areas. However Option 1 fails to meet the treatment criteria due to the low volume of water directed through the pond.

Water reuse demands for open space irrigation show that Option 2 and Option 3 provide 71.5% and 75.2% of the irrigation needs respectively. All scenarios fail to meet the typical industry standard of 80%. However, Options 2 and 3 are close and have the potential to be fine-tuned in the detailed design.

Based on the design analysis above, Option 2 (tapping into all internal catchments within the development), provides the most suitable arrangement owing to its reduced complexity compared to Option 3 and the minimal increase in irrigation demand met by tapping into the existing stormwater main in the residential catchment to the north of the site. The proposed layout is shown in Figure 5 and Figure 6.

As part of subsequent design phases, consideration will need to be given to pond edge effects associated with drawn down and any additional safety benches that may be required during draw down events.

Figure 5. *Concept layout overview*

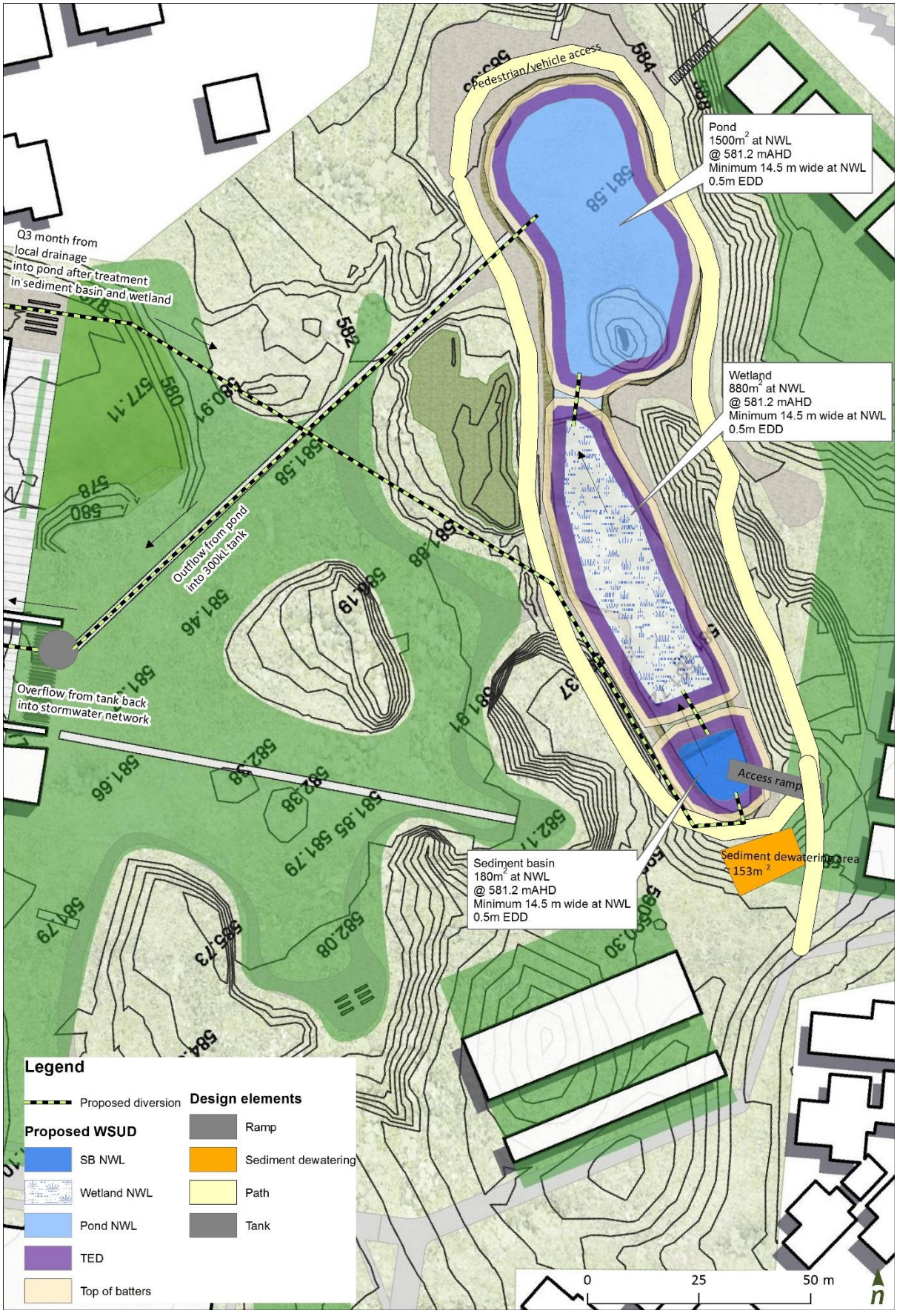


Figure 6. *Concept layout detail*

7 Costing (Option 2)

Volume and cost estimates for the recommended works are provided below in Table 10. The values provided are estimates based on the Australian Construction Handbook (2016), as well as our experience with similar projects. Note the treatment costs of the stormwater (filtration and UV) could be removed if administrative controls (watering between certain hours) are put in place.

Table 10. Cost estimates for the proposed works

Yarralumla Brickworks - Wetland

	Quantity	*Unit*	*Unit Rate*	*Cost*
General items				
Site establishment, sediment and erosion control	1	No	5%	$ 804,873
Subtotal				***$ 804,873***
GPT				
Supply and install < 300 L/s	1	No	$ 25,000	$ 25,000
Subtotal				***$ 25,000***
Wetland and sediment basin				
Excavation	2275.36	m^3	$ 30	$ 68,261
Dispose of excess spoil (clean)	2275.36	m^3	$ 50	$ 113,768
Supply and place clay liner	1,236	m^2	$ 30	$ 37,080
Supply and install 400 mm rock base to sed pond (400 mm thick)	86.4	m^3	$ 60	$ 5,184
Planting (6 plants/sqm)	704	m^2	$ 50	$ 35,200
Planting media (50 mm depth)	35	m^3	$ 60	$ 2,112
Supply and install inlet pipe scour pad	1	No	$ 5,000	$ 5,000
Subtotal				***$ 266,605***
Stormwater drainage works				
Supply and install stormwater diversion pipe / inlet pipe to sed pond	405	m	$ 800	$ 324,000
Supply and install low flow connection b/w sed pond and wetland	1	No	$ 400	$ 400
Supply and install wetland baffle/orifice outlet pit	1	No	$ 10,000	$ 10,000
Supply and install overflow/outlet pipe to pond	5	m	$ 800	$ 4,000
Supply and construct pipe inlet and outlet headwalls	2	No	$ 1,000	$ 2,000
Supply and install new pits	1	No	$ 3,000	$ 3,000
Subtotal				***$ 343,400***
Landscaping				
Planting (4 plants/sqm)	1,124	m^2	$ 20	$ 22,480
Supply and install signage	2	No	$ 5,000	$ 10,000
Supply and install compacted rock path (4 m wide)	1800	m^2	$ 50	$ 90,000
Supply and install seats	3	No	$ 3,000	$ 9,000
Subtotal				***$ 131,480***
Subtotal for all wetland items				**$ 766,485**
Subtotal for all items				**$ 1,571,358**
Other				
Allowance for approvals (heritage, ecology etc.)	1	No	$ 5,000	$ 5,000
Design	1	No	10.0%	$ 233,912
Site investigations (geotech, survey, service detection, potholing, contam, etc)	1	No	5.0%	$ 116,956
Maintenance and establishment period	1	No	15.0%	$ 350,867
Subtotal				***$ 706,735***
Subtotal for all items				**$ 2,278,092**

Contingency			40%	$ 911,237
Total				**$ 3,189,000**

Yarralumla Brickworks - Pond

	Quantity	*Unit*	*Unit Rate*	*Cost*
Pond				
Excavation	1,611	m^3	$ 30	$ 48,330
Dispose of excess spoil offsite (clean)	1,611	m^3	$ 50	$ 80,550
Supply and place clay liner	1,500	m^2	$ 30	$ 45,000
Supply and install 400 mm rock base to pond (400 mm thick)	600	m^3	$ 60	$ 36,000
Planting (6 plants/sqm)	702	m^2	$ 50	$ 35,100
Planting media (50 mm depth)	225	m^3	$ 60	$ 13,478
Supply and install inlet pipe scour pad	1	No	$ 5,000	$ 5,000
Subtotal				***$ 263,458***
Stormwater drainage works				
Supply and install pond baffle/orifice outlet pit	1	No	$ 10,000	$ 10,000
Supply and install overflow/outlet pipe to tank	140	m	$ 800	$ 112,000
Supply and construct pipe inlet and outlet headwalls	1	No	$ 1,000	$ 1,000
Subtotal				***$ 123,000***
Landscaping				
Planting (4 plants/sqm)	840	m^2	$ 20	$ 16,800
Subtotal				***$ 16,800***
Subtotal for all pond items				**$ 403,258**
Harvesting storage				
Supply and install tank 300KL	1	No	$ 75,000	$ 75,000
Subtotal				***$ 75,000***
Harvesting distribution/treatment				
Harvesting pond offtake headwall, pipe, wet well, senor and control panel	1	No	$ 40,000	$ 40,000
Power supply to offtake pump including conduit and cabling (assuming close proximity)	1	m	$5,000	$ 5,000
Offtake pump including guiderails and accessories	1	No	$40,000	$ 40,000
Distribution main	230	Lin m	$150	$ 34,500
PLC controls	1	No	$20,000	$ 20,000
Automatic filter and UV disinfection	1	No	$150,000	$ 150,000
Subtotal				***$ 289,500***
Subtotal for all harvesting items				**$ 364,500**
Subtotal for all items				**$ 767,758**
Contingency			40%	$ 307,103
Total				**$ 1,075,000**

Total for wetland and pond	**$ 4,264,000**

Appendix A
Development plan layouts

Figure 7. *Irrigation Area Diagram*

Appendix B
Rational calculations

Rational calculations

For the flows provided in Table 2, the rational method has been adopted. The calculations made are presented here.

Table 11. Rational calculations

		Subcatchments								
	Sub catchment:	A	B	C	D	E	F	**Total**	Existing residential catchment	Total (internal + existing residential)
Parameter	Catchment area, ha	1.21	1.53	2.26	1.91	1.53	1.40	9.8	2.6	12.4
	Fraction impervious	0.4	0.45	0.4	0.8	0.5	0.45	0.51	0.7	0.55
	Length, m	335	138	295	152	129	209	770	318	770
	Drop, m	7	7	11	5	4	5	18	18	18
	Slope m/m	0.021	0.051	0.037	0.033	0.031	0.024	0.023	0.057	0.023
	Average pipe diameter, mm	600	600	600	600	600	600	600	600	600
	Velocity, m/s	3.1	4.9	4.2	3.9	3.8	3.4	3.3	5.2	3.3
	Time of concentration, min	8.8	7.5	8.2	7.6	7.6	8.0	10.9	8.0	10.9
Intensity, mm/hr	I 1 year	44.6	47.6	46.0	47.2	47.4	46.3	40.7	46.3	40.7
	I 5 year	79.5	85.2	82.1	84.5	84.8	82.7	72.3	82.8	72.3
	I 100 year	155.3	167.4	160.9	165.8	166.5	162.2	140.3	162.3	140.3
Discharge, m^3/s	Q 1 year	0.06	0.08	0.11	0.15	0.09	0.07	0.49	0.19	0.66
	Q 5 year	0.12	0.18	0.23	0.32	0.19	0.16	1.02	0.40	1.38
	Q 100 year	0.30	0.44	0.58	0.80	0.46	0.39	2.51	0.99	3.39

Appendix C
Treatment asset calculations

Pond analysis

The sediment basin has been sized to ensure a capture efficiency greater than 95% for the 3 month flow and provide adequate sediment storage. The procedure outlined in WSUD Engineering Procedures 2005 has been followed.

Table 12. Sediment basin calculations

	Parameter	Option 2	Option 3
Conditions	Contributing catchment (ha)	9.8	12.4
	Area of pond (m^2)	180	180
Capture Efficiency	Settling Velocity of Target Sediment (mm/s) [Particle size 125 µm]	11	11
	Hydraulic Efficiency (λ)	0.4	0.4
	Permanent Pool Depth, dp (m)	1.5	1.5
	Extended detention depth, de	0.5	0.5
	Number of CSTR's, n [From hydraulic efficiency]	1.7	1.7
	Depth below permanent pool that is sufficient to retain sediment, d* (m)	1	1
	Design Discharge (m3/s) [Q 3 month]	0.204	0.276
	Capture Efficiency	97.3 %	92
	Check (> 95%)	OK	Not OK
Sediment storage	Sediment Loading Rate, Lo (m^3/ha/yr)	1.6	1.6
	Desired clean-out frequency, Fr	5	5
	Storage volume required, St	76	92
	Available sediment storage volume	135	135
	Check (Available storage > required storage)	OK	OK
Sediment dewatering	Depth for dewatering area (m)	0.5	0.5
	Area required for dewatering (m^2)	153	183

Velocity Calculations

The velocities through the sediment basin and wetland are considered here. A flow depth of 0.5 m, which is the extended detention depth, has been assumed for all flows, which is a conservative approach (as a calculated smaller flow area will result in higher calculated velocities).

A manual calculation has been used to check the flow velocities through the assets for the concept design. This calculates the flow area from the flow depth (between the extended detention depth and normal water level) and the average width in that area. The average width is determined from the narrowest part of the sediment basin and wetland. Table 13 shows the calculations for the both.

Table 13. Velocity calculation – sediment basin

			Pond		
	Parameter	**Q 3 month**	**Q 1 year**	**Q 5 year**	**Q 100**
Flow conditions	Design Flow (m^3/s)	0.205	0.49	1.02	2.51
	Flow depth (m)	0.5	0.5	0.5	0.5
Sediment pond	Width at NWL (m)	14.5	14.5	14.5	14.5
	Width at EDD (m)	20.5	20.5	20.5	20.5
	Average width (m)	17.5	17.5	17.5	17.5
	Flow Area (m^2)	8.8	8.8	8.8	8.8
	Flow Velocity (m/s)	0.02	0.06	0.12	0.29
	Check	OK <0.5	OK <0.5	OK <0.5	OK <0.5

Table 14. Velocity calculations - wetland

			Pond		
	Parameter	**Q 3 month**	**Q 1 year**	**Q 5 year**	**Q 100**
Flow conditions	Design Flow (m^3/s)	0.20	0.19	1.35	
	Flow depth (m)	0.5	0.5	0.5	0.5
Wetland	Width at NWL (m)	14.5	14.5	14.5	14.5
	Width at EDD (m)	20.5	20.5	20.5	20.5
	Average width (m)	17.5	17.5	17.5	17.5
	Flow Area (m^2)	8.8	8.8	8.8	8.8
	Flow Velocity (m/s)	0.023	0.06	0.12	0.29
	Check	OK <0.05	OK <0.5	OK <0.5	OK <0.5

ADVANCED DRAFT DESIGN REPORT:

Yarralumla Brickworks stormwater treatment systems

March 2022

Document history

Revision:

Revision no.	05
Author/s	Advait Madav Jenny Butcher Oliver Light David Barratt
Checked	Oliver Light

Revision no.	04
Author/s	Advait Madav Jenny Butcher David Barratt
Checked	Jenny Butcher
Approved	David Barratt

Revision no.	03
Author/s	Advait Madav Jenny Butcher David Barratt
Checked	Jenny Butcher
Approved	David Barratt

Revision no.	02
Author/s	Advait Madav Jenny Butcher David Barratt
Checked	Jenny Butcher
Approved	David Barratt

Revision no.	01
Author/s	Advait Madav Jenny Butcher David Barratt
Checked	Jenny Butcher
Approved	David Barratt

Distribution:

Revision no.	01
Issue date	06/07/2020
Issued to	David Murphy (BLOC)
Description:	Draft design report

Revision no.	02
Issue date	28/02/2021
Issued to	David Murphy (BLOC)
Description:	Advanced draft design report

Revision no.	03
Issue date	07/07/2021
Description:	Revised advanced draft design report

Revision no.	04
Issue date	09/07/2021
Issued to	Alex Moulis (DOMA); David Murphy (BLOC)
Description:	Revised advanced draft design report (Updated masterplan)

Revision no.	05a
Issue date	11/02/2022
Issued to	Alex Moulis (DOMA); David Murphy (BLOC)
Description:	Revised advanced draft design report (Updated masterplan)

Revision no.	05b
Issue date	31/03/2022
Issued to	Alex Moulis (DOMA); David Murphy (BLOC)
Description:	Revised advanced draft design report (Updated masterplan)

Contents

1 Introduction 3

1.1 Project background 3

1.2 Stormwater treatment concept design work undertaken to date 4

2 Wetland and Pond Treatment System 5

2.1 Catchment delineation 5

2.2 Overview of stormwater treatment strategy 5

2.3 Design considerations 6

2.4 Diversion analysis 7

2.5 Asset parameters 7

2.6 Tank analysis 7

2.7 Pollutant load reduction results 8

2.8 Residence time analysis 8

3 Advanced draft design of treatment asset 9

4 Discussion and recommendations 11

5 References 12

Figures

Figure 1. *Site context* 3

Figure 2. *Catchment delineation* 5

Figure 3. *MUSIC model of treatment approach* 6

Figure 4. *Diversion analysis* 7

Figure 5. *Catchment D storage tank reliability* 8

Figure 6. *Advanced draft design - overview* 9

Figure 7. *Advanced draft design* 10

Tables

Table 1. Treatment train performance results from MUSIC 1

Table 2. Indicative treatment asset parameters 7

Table 3. Treatment train results 8

SUMMARY

Alluvium was engaged by BLOC to develop a surface water management strategy for the Yarralumla Brickworks development site. The objective of the project is to develop management strategies for stormwater quality based on the ACT Practice Guidelines for WSUD (2016) and ACT Waterways: Water Sensitive Urban Design General Code (Effective 21 February 2020).

Proposed water quality treatment measures to meet water quality targets

The proposed approach is as follows:

- The existing quarry pond will be converted to accommodate a sediment basin (SB), constructed wetland and pond.
- The flows from catchment G (single dwelling T6-T20) will be directly diverted to the treatment assets via a gravity fed stormwater pipe between lots 10 and 11
- Additional runoff from the western developed surfaces will be diverted to the low point near the north-west boundary and pumped to the treatment assets. High flows will be bypassed to an on-site detention tank. The size of the detention tank needs to be refined at a later stage, to retard peak flows.
- Treated stormwater from the pond will be stored in an on-site retention tank for landscape irrigation purposes.
- Installation of a 200kL rainwater tank in catchment D for open space irrigation.

The overall treatment train performance results for the above configuration were modelled in MUSIC are shown in Table 1. The proposed sediment basin, wetland and pond (including the irrigation reuse throughout the catchment) meet the overall development's stormwater treatment requirements for TSS, TP and TN at the proposed diversion rate.

Table 1. Treatment train performance results from MUSIC

Pollutant	*Source load*	*Residual load*	*% reduction*	*% reduction target*
Total Suspended Solids (kg/yr)	10,700	1920	82	80
Total Phosphorus (kg/yr)	9.94	3.87	60.1	60
Total Nitrogen (kg/yr)	131	36	72.5	45
Gross pollutants (kg/yr)	1710	171	90	90

Diverting a 0.1m^3/s flow to the SB/wetland/pond treatment system from the low point of the development will ensure sufficient turnover in the pond to avoid stagnation.

The presented strategy is the preferred approach at the site due to its significant reduction in pollutants, high reliability for meeting landscape irrigation demands, and low risk of deterioration of pond water quality due to algal blooms (i.e., reliable inflows to the pond).

Stormwater reuse opportunities and initiatives

As well as meeting required pollutant reduction treatment targets, the proposed SB/wetland/pond treatment system in combination with a 200kL rainwater harvesting tank will significantly reduce potable water use for irrigation purposes. Flows up to 5 year average recurrence intervals / AEP 20% from catchment G are diverted to the SB/wetland/pond treatment system via gravity feed. However, due to site's topography, the strategy also relies on the efficient working of a pump installed at the stormwater collection point (G). In case of pump failure, stormwater will be stored in the on-site detention tank, which mitigates the potential for erosion/pollution threat to the downstream stormwater network.

Diverting a 0.035m^3/s flow to the SB/wetland/pond treatment system from the low point on the development, in combination with a 500kL tank ensures an 80-85% reliability of irrigation demand from the open space

surrounding the pond. Installation of a 200kL rainwater tank in catchment D ensures 70%-75% irrigation reliability for open space irrigation in and around Precinct 5.

The scope of the analysis to date does not cover detailed hydrologic modelling. This needs to be undertaken to more accurately assess peak flows, peak storage levels and critical durations for sizing detention storage.

1 Introduction

Alluvium was engaged by BLOC to develop a surface water management strategy for the Yarralumla Brickworks development site. The objective of the project is to develop management strategies for stormwater quality based on the ACT Practice Guidelines for WSUD (2016) and ACT Waterways: Water Sensitive Urban Design General Code (Effective 21 February 2020).

Through meeting this objective, the SWMS will act as a critical component of the development planning and urban design process and ensure stormwater is managed in accordance with code requirements in the ACT.

Runoff from proposed developments in the ACT is required to be treated before entering receiving waterbodies. The ACT Practice Guidelines for WSUD (2016) were used to identify stormwater quality treatment targets for the development site. The reduction targets are:

- Suspended solids reduced by at least 60% of the mean annual load
- Total phosphorous reduced by at least 45% of the mean annual load
- Total nitrogen reduced by at least 40% of the mean annual load.

However, as per Green Star Rating Credit 24A.1.2.1, the following minimum reductions in total pollutant load from the developed part of the project site must be achieved, when compared to untreated stormwater runoff.

- Suspended solids reduced by at least 80% of the mean annual load
- Total phosphorous reduced by at least 60% of the mean annual load
- Total nitrogen reduced by at least 45% of the mean annual load.
- Total gross pollutant reduced by at least 90% of the mean annual load.

1.1 Project background

The Yarralumla Brickworks site covers an area of approximately 16 hectares and is generally bounded by Bentham Street to the north, the Royal Canberra Golf Course to the west, and connects to Denman Street to the south-east (Figure 1). There are remnants of the former Yarralumla Brickworks Railway, and a depression currently exists at the site of a former quarry. This is where a pond has been proposed to be instituted.

Figure 1. *Site context*

In the absence of sufficient flow in the pond, nutrients and sediments entering the system can lead to an increased risk of algal blooms. In addition, increased pollutant load discharging from the development area can have serious implications on downstream receiving waters, also including algal blooms, and therefore needs to be managed. Thus, it is essential to understand and manage the pond residence time and turnover.

Pond residence time and turnover targets are:

- Sufficient inflow to ensure there is a Summer residence time (turn-over of water) of less than 50 days so as to avoid stagnant water and algal blooms
- Sufficient inflow to ensure a 20th percentile annual residence time of between 20 and 30 days.

1.2 Stormwater treatment concept design work undertaken to date

Alluvium developed a proof of concept for an amenity and stormwater treatment pond and wetland in support of a development tender for the Yarralumla Brickworks site in 2016.

Based on earlier findings and discussion with BLOC, Alluvium developed two concept level options for managing stormwater on site (based on masterplan 31st March 2020). These were:

- Option 1: Sediment basin + wetland treatment system + pond

  This option was based on receiving inflow from the combined subcatchments within the site, with the 4EY (4 Exceedances per Year) flow being diverted into a sediment basin, then flowing into a macrophyte zone (wetland), and finally into a pond, all situated in the existing depression.

- Option 2: Sediment basin + pond + bioretention system

  This option proposed two treatment assets – a sediment basin providing pre-treatment for a pond in the existing depression, and a bioretention asset in landscape development area 4 (the Heritage Precinct).

Given pipe depths and cover requirements, diverting stormwater from the drainage system in the Heritage Precinct into the proposed bioretention assets resulted in deep assets with large batter footprints. Alluvium therefore recommended Option 1, which also achieved greater reductions in pollutants, a higher reliability for meeting landscape irrigation demands, and a lower risk of deterioration of the pond due to algal blooms (i.e., more reliable inflows to the pond).

A draft stormwater treatment strategy was presented to David Murphy (BLOC), Alex Moulis (Doma Group), and Bernie Cusack (Sellick Consultants) in June 2020. Based on discussions at the meeting and following, Alluvium refined the strategy and explored additional options for on-site stormwater management. An advanced draft strategy was provided to BLOC in June 2020.

Alluvium (David Barratt and Advait Madav) attended a meeting with BLOC, DOMA, and Sellick Consultants to finalise the water quality outcomes and the preferred strategy in February 2021. A revised strategy was delivered in July 2021 following some changes to the development concept masterplan.

This report outlines the final proposed development stormwater treatment strategy, based on the agreed approach and the latest development masterplan provided on 1 February 2022.

2 Wetland and Pond Treatment System

2.1 Catchment delineation

The development site was delineated into 9 sub catchments based on topography, the concept drainage layout and lot typology (Figure 2). These catchments were further broken into roof, road and open space for the purposes of the treatment modelling.

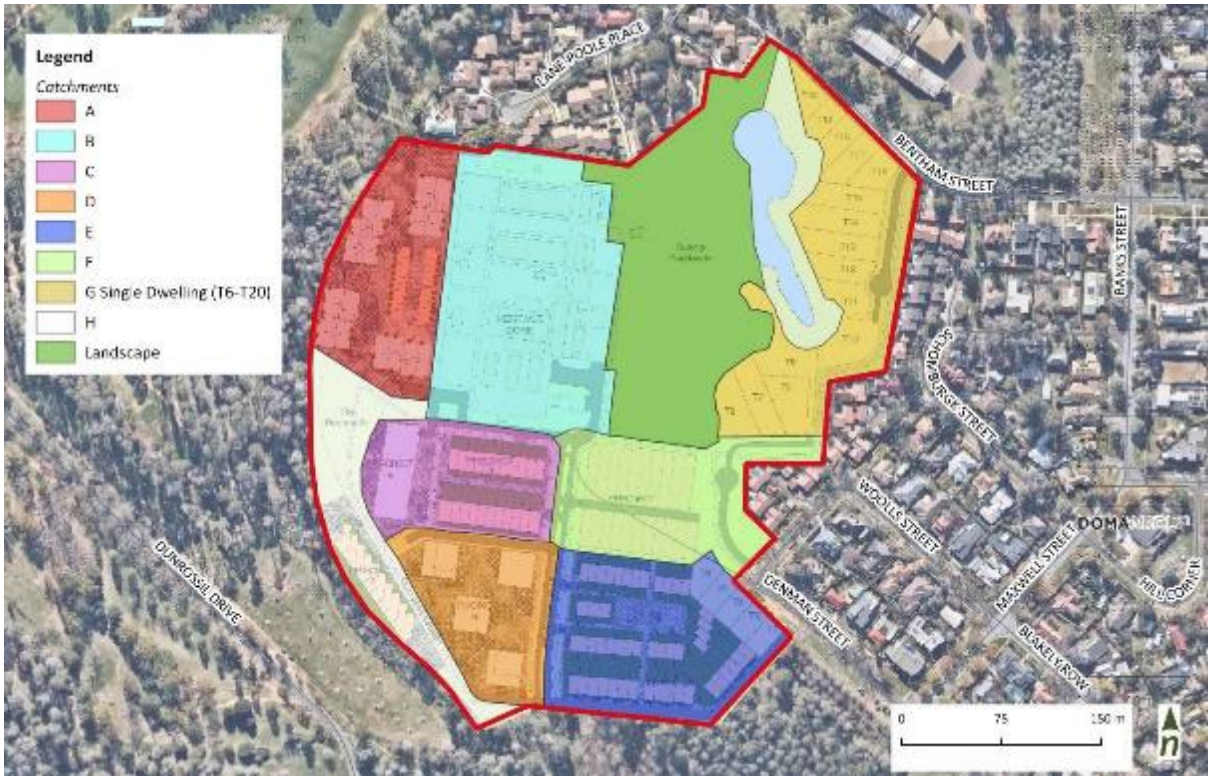


Figure 2. *Catchment delineation*

2.2 Overview of stormwater treatment strategy

This section provides an overview of stormwater treatment strategy. Please refer to Figure 2 for catchment delineation and Figure 3 for a schematic of the treatment model (Model for Urban Stormwater Improvement Conceptualisation; MUSIC). The approach is as follows:

- The existing quarry pond will be converted to accommodate a sediment basin (SB), wetland and pond.
- The flows from catchment G ‘single dwelling T6-T20’ will be directly diverted to treatment assets via gravity feed.
- Diverting the required flow from the development at the low point in the north-west boundary and pumping this flow to the treatment assets. High flows are bypassed to an on-site detention tank. The size of detention tank needs to be refined at later stage to retard the necessary peak flows.
- Treated stormwater from the pond will enter the on-site retention tank for landscape irrigation (passive irrigation) purposes.
- Installation of a 200kL rainwater tank in Precinct 5 for open space irrigation (passive irrigation).

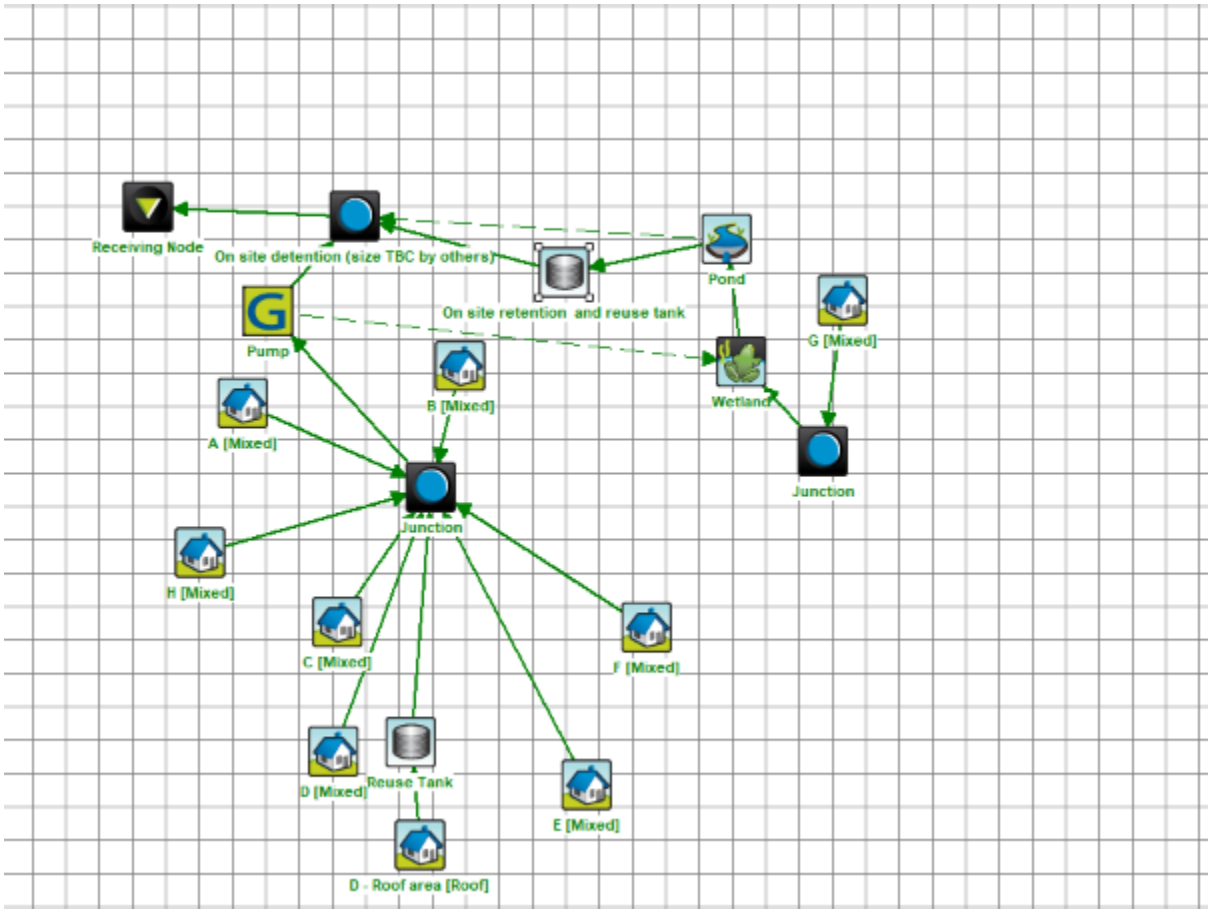


Figure 3. *MUSIC model of treatment approach*

2.3 Design considerations

Key design considerations include the following:

- Consideration of depth and inundation frequency in the wetland to ensure the health of fringing vegetation.
- Pre-treatment of the diverted stormwater to ensure minimal nutrients and sediments are entering the pond, thus reducing the risk of algal blooms. This occurs through the sediment basin and wetland.
- Sufficient inflow to the pond to ensure there is a minimum residence time (turn-over of water) of less than 50 days in Summer and a yearly 20%ile residence time between 20 and 30 days to avoid stagnant water and algal blooms.
- Sediment capture efficiency of a minimum of 95% for the sediment basin
- Sediment removal frequency for the sediment basin of at least once every 5 years
- Velocities through the wetland are less than 0.05m/s and less than 0.5 m/s in the sediment basin.
- A maximum Extended Detention Depth (EDD) of 0.35m in the wetland and sediment basin
- A minimum 72-hour detention time in the wetland to ensure adequate contact with vegetation and uptake of nutrients.
- An access ramp into the sediment basin for maintenance access
- A sediment dewatering area located next to the sediment basin
- Appropriate batters on all assets to ensure public safety (minimum of 1 in 5, safety bench of 1 in 8 for 350mm below the Normal Water Level)
- Reuse of water from onsite retention tank (500kL) and storage tanks (200kL for catchment D) for landscape irrigation (active).
- Target demand reliability of 80% for reuse from onsite retention tank.

2.4 Diversion analysis

Alluvium undertook a diversion analysis to understand the amount of stormwater that needs to be diverted to meet required pollutant reduction targets (Figure 4), as well as the residence time targets in the pond.

Alluvium recommends a diversion rate of 0.1m^3/s for on-site stormwater treatment for this proposed asset configuration.

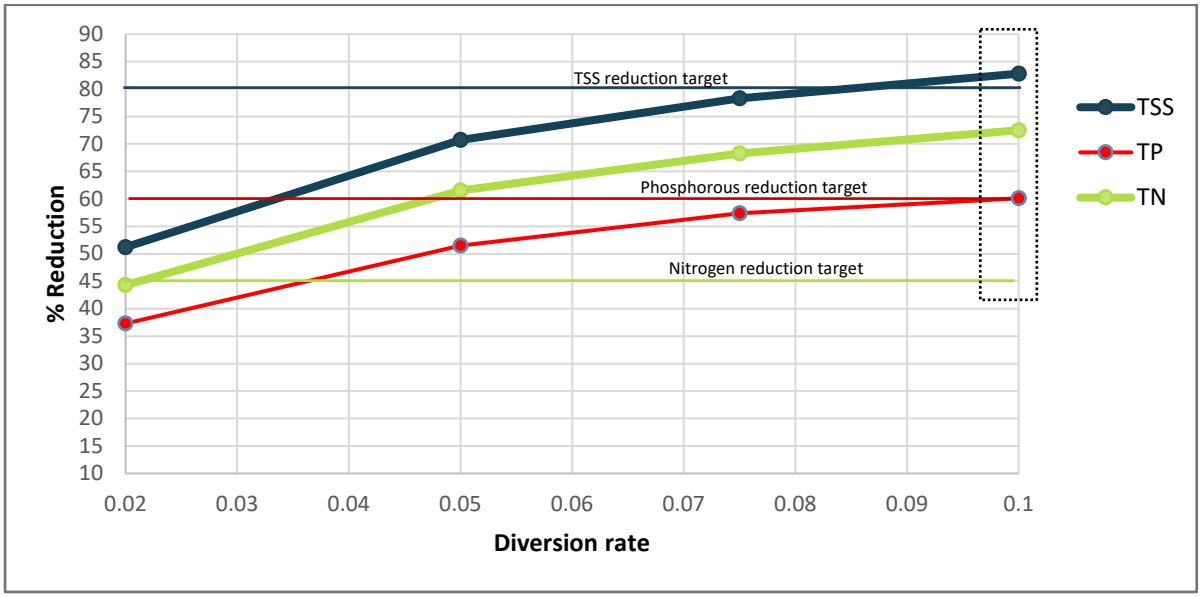


Figure 4. *Diversion analysis*

2.5 Asset parameters

Indicative design parameters of the treatment asset are provided in Table 1.

Table 2. Indicative treatment asset parameters

	Pond	***Wetland***	***Sediment Basin (SB)***
Treatment area (NWL), m^2	1500	1050	250
Average depth, m	1	0.4	1.0
Volume, m^3	1500	420	250
Extended detention, m	0.35	0.35	0.35
Freeboard, m	0.3	0.3	0.3
Extended detention time (hours)		72	

2.6 Tank analysis

Alluvium has proposed precinct scale storage tanks for open space irrigation. A demand of 2.5 ML/ha/yr for irrigation (landscape and amenities) have been adopted for storage tanks in catchment D. These tanks will harvest water from the buildings within the catchment.

A tank reliability analysis is presented in Figure 5. This analysis shows the relationship between increasing tank size and the impact on meeting the demands applied to them. Generally, having a larger tank will increase the % of demand met, but there will be a point of diminishing returns. The intent of this analysis is to determine the ideal tank size such that demand reliability is increased, but costs of tanks do not unnecessarily increase.

The storage analysis for catchments D indicate that a tank size between 200kL-300 kL storage (total) is likely to meet 70%-80% of irrigation demand. There is an opportunity to select a suitable tank size depending on available space and constraints.

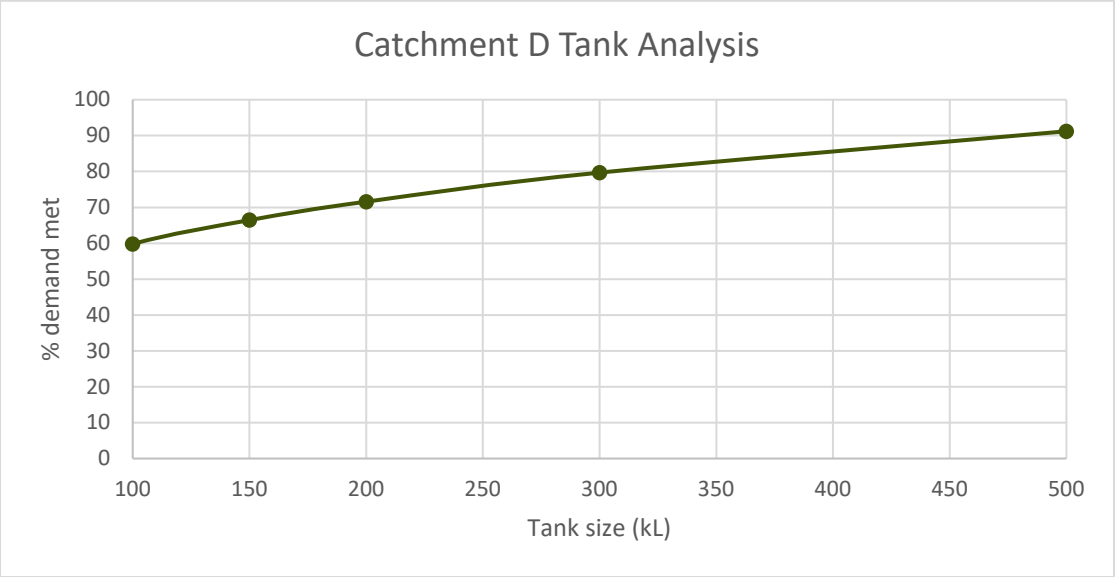


Figure 5. *Catchment D storage tank reliability*

The analysis also indicated that a 500kL retention tank receiving treated flows from the pond will be able to supply water for irrigation purposes (the green space surrounding the pond) with an 83% reliability.

2.7 Pollutant load reduction results

The overall treatment train results for the above scenario modelled in MUSIC are shown in Table 2. A litter trap/GPT could be installed at the stormwater collection point (G Node) prior to pumping to the treatment SB, wetland and pond to achieve the Gross Pollutant reduction target. The proposed sediment basin, wetland and pond (including the irrigation reuse throughout the catchment) meet the overall development's stormwater treatment requirements for TSS, TP and TN at the proposed diversion rate.

Table 3. Treatment train results

Pollutant	*Source load*	*Residual load*	*% reduction*	*% reduction target*
Total Suspended Solids (kg/yr)	10,700	1920	82	80
Total Phosphorus (kg/yr)	9.94	3.87	60.1	60
Total Nitrogen (kg/yr)	131	36	72.5	45
Gross pollutants (kg/yr)	1710	171	90	90

2.8 Residence time analysis

The results from the MUSIC modelling were used to analyse the residence time in the pond. The analysis considers:

- Inflows into the pond
- Volume of pond
- Turnover of water

The results indicate that a diversion of 0.1m^3/s for a proposed volume of 1500m^3 will result in an average summer residence time of 13.2 days, which well exceeds the average summer residence time target of < 50 days.

3 Advanced draft design of treatment asset

An advanced draft design for the stormwater treatment strategy is presented below.

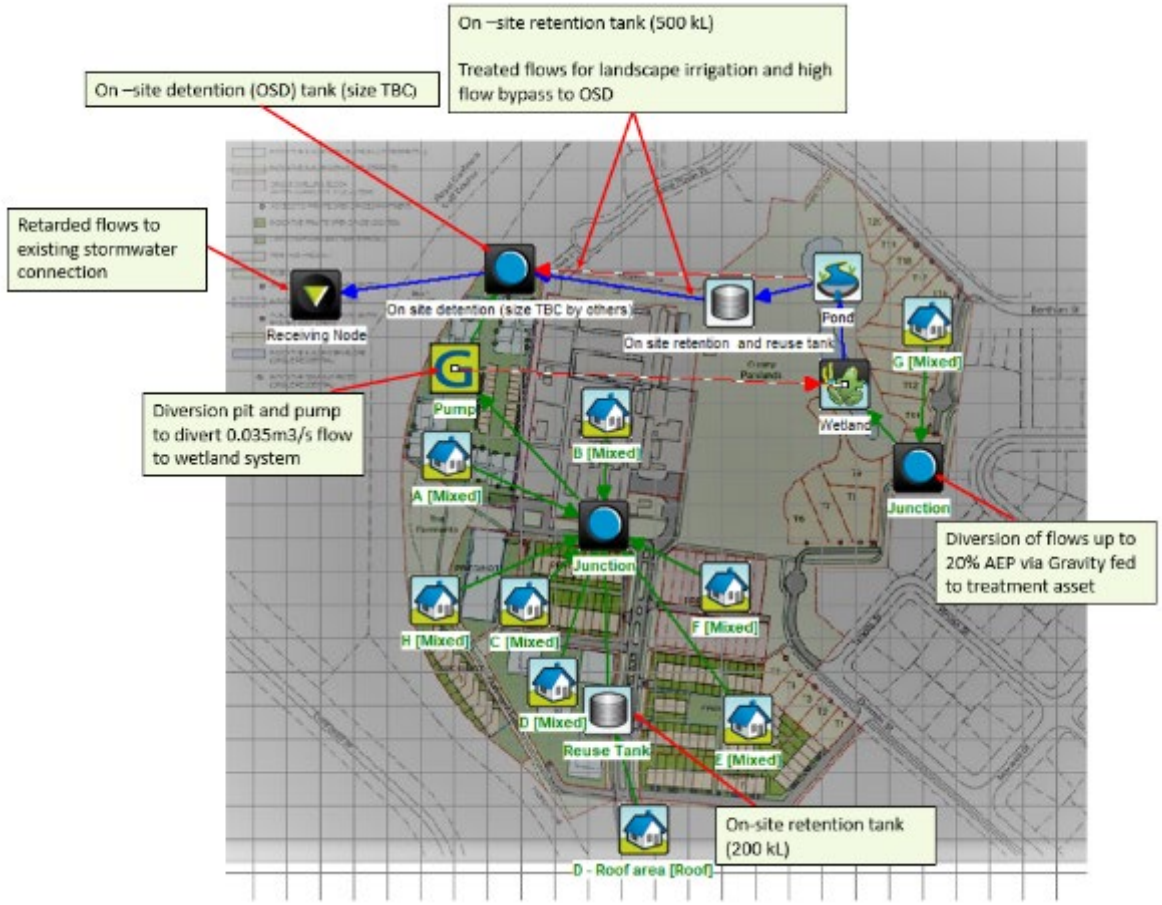


Figure 6. *Advanced draft design - overview*

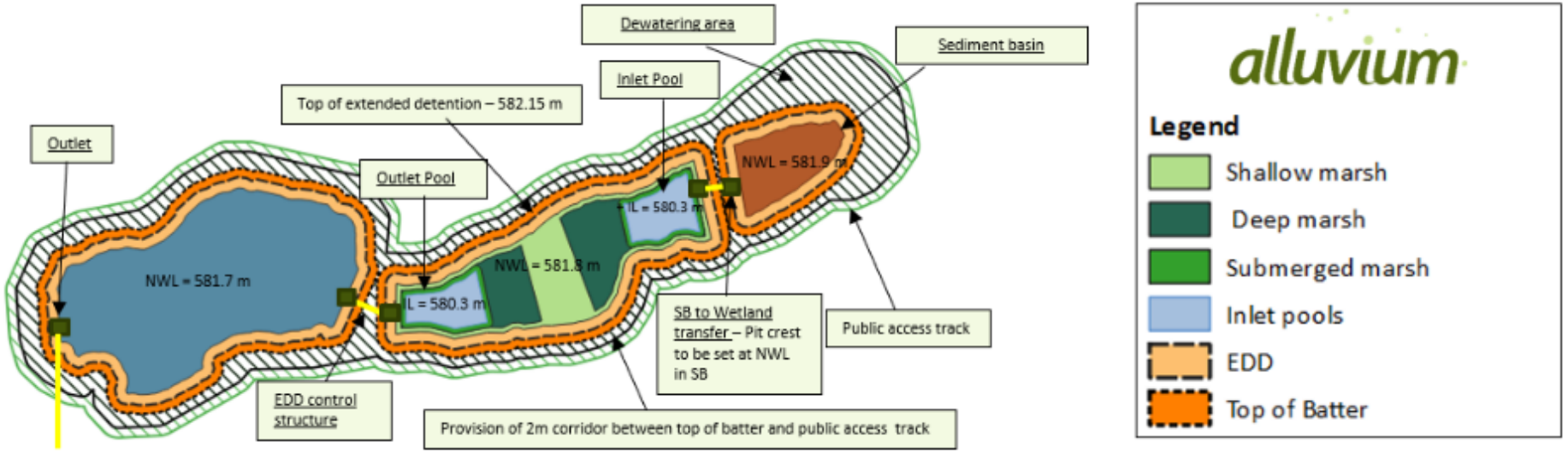


Figure 7. *Advanced draft design*

4 Discussion and recommendations

The sediment basin, wetland and pond treatment system in combination with tanks for on-site stormwater reuse provides the required pollutant reduction for the development. Installation of a 200kL tank in catchment D reduces the reliance on the SB/wetland/pond treatment system to meet water quality treatment targets. However, the SB/wetland/pond treatment system provides redundancy for ensuring of water quality treatment targets are met should rainwater tank usage be lower and/or less effective than anticipated. The capacity to pump water into that system, provides certainty of appropriate pond turnover.

Diverting a 0.1m^3/s flow to the SB/wetland/pond treatment system from the low point on the development ensures:

- Adequate pollutant reduction for the entire development
- Sufficient turnover in the pond
- 80-85% reliability of irrigation demand from the open space surrounding the pond through a 500kL tank
- The reliability of inflows to system.

As well as meeting required pollutant reduction treatment targets, the SB/wetland/pond treatment system in combination with rainwater harvesting results in reduced potable water use and increased greening and cooling benefits. Stormwater from new road and paved surfaces could be harvested into raingarden or bioretention treatment systems within the precinct. This would increase the total level of stormwater treatment and further contribute to cooling and other landscape amenity benefits.

The presented strategy is the preferred approach at the site due to its significant reduction in pollutants, high reliability for meeting landscape irrigation demands, and low risk of deterioration of pond due to algal blooms (i.e., reliable inflows to the pond).

The scope of the analysis to date does not cover detailed hydrologic modelling. This needs to be undertaken to assess peak flows, peak storage levels and critical durations for sizing detention storage. While the preliminary RORB modelling was performed and provided a suitable estimate of flows for the concept for assessment purposes, more detailed modelling incorporating the pipe network will be required to refine the design of on-site detention facilities to mitigate against potential impacts on the downstream stormwater system. However, the post-development peak Average Recurrence Interval (ARI) event discharge from the project site will not exceed the predevelopment peak ARI event discharge.

Flows up to 5 year average recurrence intervals / 20% AEP from the single dwelling 'T6-T20' catchment are diverted to the SB/wetland/pond treatment system via gravity feed. However, due to site's topography, the strategy also relies on the efficient working of a pump installed at the stormwater collection point (G). To mitigate the risk of pump failure, stormwater will be stored in the on-site detention tanks, which mitigates against erosion/pollution threat to the downstream stormwater network. Alluvium also strongly recommends an ongoing maintenance plan and routine inspection of the pump is developed and implemented.

5 References

Alluvium Consulting (2016). Surface Water management strategy Phase 1

ACT Government (2018). ACT Territory Development Master Plan

ACT Government (2019). Municipal Infrastructure Standards 08: Stormwater

ACT Government (2020). Waterways: Water Sensitive Urban Design General Code

DOMA Group (2021). The Development Masterplan

Sellick Consultants (2020). Stormwater Masterplan

ACT Planning and Land Authority (2016). The ACT Practice Guidelines for WSUD

Attachment A
Landscape Masterplan – 2022

In accepting and utilising this document the recipient agrees that SJB Architecture (NSW) Pty. Ltd. ACN 081 094 724 T/A SJB Architects, retain all common law, statutory law and other rights including copyright and intellectual property rights. The recipient agrees not to use this document for any purpose other than its intended use; to waive all claims against SJB Architects resulting from unauthorised changes; or to reuse the document on other projects without the prior written consent of SJB Architects. Under no circumstances shall transfer of this document be deemed a sale. SJB Architects makes no warranties of fitness for any purpose. The Builder/Contractor shall verify job dimensions prior to any work commencing. Use figured dimensions only. Do not scale drawings.
Nominated Architects: Adam Haddow-7188 | John Pradel-7004

FOR APPROVAL

Rev	Date	Revision	By	Chk.
6	31/03/2020	CONCEPT EDP SUBMISSION	EW	DM
7	28/04/2020	CONCEPT EDP SUBMISSION	EW	DM
8	08/05/2020	CONCEPT EDP SUBMISSION	EW	DM
9	08/05/2020	CONCEPT EDP SUBMISSION	EW	DM
10	01/06/2020	ESPDD SUBMISSION	EW	DM
11	10/07/2020	ESPDD SUBMISSION	EW	DM
12	20/07/2020	ESPDD SUBMISSION	EW	DM
13	30/10/2020	COMMUNITY CONSULTATION	EW	DM
14	17/11/2020	UPDATED BUILDING OUTLINES	EW	DM
15	22/03/2021	REVISED EDP SUBMISSION	EW	DM
16	30/03/2021	REVISED EDP SUBMISSION	EW	DM
17	23.04.2021	REVISED CAD BASEFILE	EW	DM
18	31.05.2021	REVISED EDP SUBMISSION	EW	DM
19	11.06.2021	REVISED EDP SUBMISSION	EW	DM
20	17.06.2021	REVISED EDP SUBMISSION	EW	DM
21	06.07.2021	DRAFT EDP	EW	DM
22	28.01.2021	DRAFT EDP	EW	DM
23	25.03.2022	DRAFT EDP	EW	DM
24	22.04.2022	DRAFT EDP	EW	DM
25	13.05.2022	DRAFT EDP	EW	DM
26	19.05.2022	DRAFT EDP	EW	DM
27	10.06.2022	DRAFT EDP	EW	DM
28	10.06.2022	DRAFT EDP	EW	DM
29	14.06.2022	DRAFT EDP	EW	DM
30	20.07.2022	DRAFT EDP	EW	DM

Client

DOMAGROUP

Project

YARRALUMLA BRICKWORKS

Building

SITE WIDE

Drawing Name

DRAFT EDP - DEVELOPMENT INTENTIONS PLANS

Date	Scale	Sheet Size
20.07.2022	1 : 1000	**@ A1**

Drawn	Chk.
WG	**ML**

Job No.	Drawing No.	Revision
5479	**X-A-0271**	**/ 30**

SJB Architects
Level 2
490 Crown Street
Surry Hills NSW
2010 Australia
T 61 2 9380 9911
F 61 2 9380 9922
www.sjb.com.au

Attachment B
Water Sensitive Urban Design estate development checklist

DA No. ..... Estate Name: Canberra Brickworks Redevelopment

Stage ..... Suburb/District: Yarralumla/Canberra Central Nearest Streets: Denman street

Applicant Name ..... Company BLOC

Developer Name DOMA

WSUD Concept Plan required as 1:1000 scale. **Attachment C**

Mains water use

Mandatory provisions for rating plumbing fittings and appliances for individual dwellings, such as in Lease and Development Conditions? N

Estimated mains water use reduction using the Design Response Report, BASIX, Green Star or other assessment tool/spreadsheet: 40%

Mains water savings proposed in the design of the public realm? Y

Description: Rainwater tanks and on-site retention tanks

Stormwater management

Development area	142750m^2
Impervious areas – Roof areas Roof connected to rainwater storage Roof area not connected to storage Total	 2737 m^2 31405.5 m^2 34142.5 m^2
Impervious areas - Paved areas Hard paved areas Permeable / porous paving Total	 12656. m^2 0 m^2 12656.m^2
Total impervious areas (with a 50% reduction applied to permeable/porous paving areas)	44061.55 m^2

*Development area doesn't include already developed heritage precinct which will be retained on site. However, the site has been included in stormwater treatment modelling.

Analysis / modelling results for sediment, nutrient and runoff volumes

	Existing conditions	Development with no WSUDmeasures	Developmentwith WSUD measures	% Reductionwith WSUD measures
Suspended solidsexport (kg/yr)	4690	10700	3920	63.3
Phosphorus export(kg/yr)	4.72	9.94	5.39	45.8
Nitrogen export (kg/yr)	59	131	59.2	54.7
Peak flow for 3 monthsARI storm (m^3/s)	0.07	0.4	0.04	90.7
Peak flow for 5 yearsARI storm (m^3/s)	0.3	1.6	0.2	88.4
Peak flow for 100 yearsARI storm (m^3/s)	0.6	3.3	0.5	84.4

Pond / Wetland proposals[1]

	RL (m AHD)	Surface area (m2)	Volume (m3)
Pond invert	580.8	0	0
NWL(1)	581.8	5000	5000
TWL(2) – 3 months ARI storm *(3 month flows from gravity-fed catchment, plus pumped flows from detention tank)*	582.01	5304	6070
TWL(2) – 100 years ARI storm *(5year flows from gravity-fed catchment, plus pumped flows from detention tanks)*	582.15	5616	6680

(1) NWL = Normal water level prior to storms

(2) TWL = Top water level

	Inflow	Outflow
1 year ARI flow	0.21	0.06
5 years ARI flow	0.25	0.07
100 years ARI flow	0.25	0.10

Catchment area to pond for small storms up to 3 months ARI = 15.57 Ha

Catchment area to pond for large storms up to 100 years ARI = 15.57 Ha

Percentage urbanised = 96%

Percentage impervious = 48%

[1] As the flow entering the pond/wetland are constrained by pipe capacity, the volumes for 3-month ARI and 100 year ARI haven't changed significantly

Extended detention = Volume at TWL (target 3 months ARI flow) – Volume at NWL

=1070m^3

Retardation storage = Volume at TWL (100 years ARI flow) – Volume at TWL (3 months ARI flow)

= 610m^3

Macrophyte zone area (less than 600 mm depth at NWL) = 80%

Plant species proposed (list and include % of total planting area):

Botanical Name	Common Name	Plants per m2	% of species per m2
SUBMERGED MARSH - 0.35m to 0.7m below NWL		1	
Myriophyllum salsugineam	Water-milfoil	600cm3 containers	20%
Potamogeton ochreatus	Blunt Pondweed		30%
Vallisneria australis	Eel-grass		50%
Subtotal planting			***100%***
DEEP MARSH - 0.15 to 0.35m below NWL		2	
Baumea articulata	Jointed Club-rush	600cm3 containers	20%
Bolboschoenus fluviatilis	Tall Club-rush		20%
Bolboschoenus medianus	Marsh Club-rush		10%
Cladium procerum	Leafy Twig-rush		10%
Eleocharis sphacelata	Tall Spike-rush		20%
Schoenoplectus tabernaemontani	River Club-rush		20%
Subtotal planting			***100%***
SHALLOW MARSH - 0.0 to 0.15m below NWL		2	
Baumea articulata	Jointed Club-rush	600cm3 containers	10%
Bolboschoenus caldwellii	Sea Club-rush		
Bolboschoenus fluviatilis	Tall Club-rush		10%
Bolboschoenus medianus	Marsh Club-rush		10%
Cladium procerum	Leafy Twig-rush		20%
Eleocharis acuta	Commone spike-rush		
Eleocharis sphacelata	Tall Spike-rush		10%
Schoenoplectus tabernaemontani	River Club-rush		20%
Triglochin procerum	Water Ribbons		20%
Subtotal planting			***100%***
EPHEMERAL PLANTING - NWL to 0.35m above NWL	Jute Mat	6	
Baumea rubiginosa	Soft Twig-rush	200cm3 containers	10%
Carex appressa	Tall Sedge		10%
Carex fasicularis	Sedge		20%
Juncus amabilis	Hollow Rush		10%
Juncus gregiflorus	Rush		10%
Juncus pallidus	Pale Rush		10%
Lythrum salicaria	Purple Loosestrife		5%
Lycopus australis	Australian gypsywort		5%
Gahnia sieberiana	Red-fruited Saw-sedge		

Botanical Name	Common Name	Plants per m2	% of species per m2
Persicaria decipiens	Slender knotweed		10%
Poa labillardierei	Common Tussock		10%
Subtotal planting			***100%***
EMBANKMENT PLANTING -0.35m to 2.0+m above NWL	Mulch	6	
Acaena novae-zelandiae	Bridgee-widgee		20%
Gahnia sieberiana	Red-fruited Saw-sedge		10%
Goodenia ovata	Hop Goodenia		10%
Lomandra longifolia	Spiny-headed Matt-rush		20%
Microlaena stipoides var. stopoides	Weeping Grass		20%
Poa labillardierei var. labillardierei	Common Tussock-grass		20%
Subtotal planting			***100%***
SHADY EMBANKMENT PLANTING	Mulch	2	
Melaleuca ericifolia	Swamp paperbark		*50%*
Acaena novae-zelandiae	Bridgee-widgee		*50%*
			100%

Wastewater reuse (optional)

Wastewater reuse proposed?	N
Type of reuse	
Untreated greywater (direct use on garden only)	N
Treated greywater	N
Community reuse facility (if available)	N
Uses for wastewater	
Garden use	N
Toilet flushing	N
Laundry use	N
other	N
Estimated annual reuse	NA

Summary of WSUD Code targets and achievements

	Target	Achieved
Mains water use reduction	40%	40%
Reduction in suspended solids	60%	63.3%
Reduction in total phosphorus	45%	45.8%
Reduction in total nitrogen	40%	54.7%
Effluent reuse	optional	NA

Element 1: Mains water use reduction

1.1 Mains Water Use Reduction Target	
Rule	**Result**
R1 This rule applies to all development currently connected or intended to be connected to mains water supply except any of the following: a) development subject to the estate development code b) development for minor alterations or extensions involving 50% or less of the existing floor area. Development achieves a minimum 40% reduction in mains water consumption compared to an equivalent development constructed in 2003.	Achieved

Element 2: Stormwater Quantity

2.4 On-site stormwater detention for estate development plans	
Criterion	**Result**
C5 This criterion applies to estate development plans. Stormwater detention measures are provided and the peak rate of stormwater runoff from the estate does not exceed the peak rate of runoff from an unmitigated (rural) site of the same area for minor and major storms.	Achieved

Element 3: Stormwater Quality

3.1 Stormwater Quality Target – sites greater than 2000m^2	
Rule	**Result**
R6 This rule applies to development for all of the following: a) where the development site is greater than 2,000m^2 b) where development involves works that have potential to alter the stormwater regime for the site. The average annual stormwater pollutant export is reduced when compared with an urban catchment of the same area with no water quality management controls for all of the following: a) gross pollutants by at least 90% b) suspended solids by at least 60% c) total phosphorous by at least 45% d) total nitrogen by at least 40%.	Achieved

Element 4 Climate change adaptation

4.1 Nuisance flooding – sites greater than 2000m^2	
Criterion	**Result**
C8 This criterion applies to development on sites greater than 2,000m^2 involving works that have potential to alter the existing drainage and overland flow regime for the site.	Achieved

Overland flow paths are provided and achieve all of the following: a) accommodate overland stormwater flows up to the 1%AEP b) reduce nuisance flooding.	

4.2 Green/living infrastructure	
Rule	**Result**
R9 This rule applies to at least one of the following developments: a) Development on sites greater than 2000m^2 involving works that have potential to alter the stormwater regime for the site b) Development within existing urban areas that increase the impervious area of the site by 100m^2 or more. Development achieves a minimum of 20% of the site area to be permeable.	Achieved

Element 5: Entity (Government agency) Endorsement

5.1 Water infrastructure	
Criterion	**Result**
C10 This criterion applies to development that will result in municipal water sensitive urban design infrastructure being handed to the ACT Government. An operation and maintenance plan is to be endorsed by the ACT Government for the water sensitive urban design assets that are to be handed to the ACT Government.	Not Applicable

Attachment C
Water Sensitive Urban Design draft Plan

ARI event	Existing	Developed	WSUD intervention
3-month (m3/s)	0.07	0.43	0.04
5 year (m3/s)	0.26	1.64	0.19

Existing quarry pond converted to accommodate a sediment basin (SB), wetland and pond.

Asset	Pond	Wetland	Sediment Basin
Treatment area (m2)	1500	1050	250
Volume (m3)	1500	420	250

To existing stormwater network (minor and major flows retared to pre-development levels)

High flows bypassed to an on-site detention tank (size TBC during detailed design)

Divert 0.035 m3/s to treatment asset via pump

	TSS	TP	TN
% reduction target	60	45	40
% target achieved	63.3	45.8	54.7

Treated stormwater to enter the on-site retention tank (500 kL) for landscape irrigation purposes.

Flows upto ARI 5 years / AEP 20% from 'single dwelling 'T6-T20' nd road runoff diverted to treatment assets via gravity feed.

Installation of storage tanks (200 kL) for local open space irrigation

Legend

- Shallow marsh
- Deep marsh
- Submerged marsh
- Inlet pools
- Extended Detention Depth
- Top of Batter
- Pedestrian access
- Access Track
- Indicative overland flow path

WSUD pipe network

- Diversion pipe
- High flow bypass
- Irrigation pipe

WSUD Civil Asset

- On-Site detention tank
- Pump
- On-Site retention tank
- Stormwater flow

0 75 150 m

n

alluvium

Canberra Brickworks: Groundwater Investigation-Addendum Report

Canberra Brickwork Precinct, Yarralumla, ACT

3002523

For: Land Development Agency

Project Name:	Canberra Brickworks Site Investigation, Yarralumla, ACT
Internal Reference:	3002523 – Groundwater Addendum Report
Report prepared for:	Land Development Agency

REVIEWS AND APPROVALS FOR ISSUE

Revision	Date	Author	Reviewer	Approval
0	27/10/2016	Ryan O'Leary	Graham Ohmsen	Graham Ohmsen
1	1/11/2016	Ryan O'Leary	Graham Ohmsen	Mechelle Swanepoel
2	3/11/2016	Ryan O'Leary	Graham Ohmsen	Mechelle Swanepoel

Executive Summary

Land Development Agency (LDA) commissioned SMEC Australia Pty Ltd (SMEC) to conduct an environmental site investigation of the Canberra Brickworks to determine the extent and quantity of contamination present at the site. The works involved examination of soil, surface and groundwater. This report is an addendum to the main report for the Canberra Brickworks.

The examination of groundwater involved installation of eight groundwater monitoring wells across the site, which were installed between 13 and 22 September 2016. Wells were installed to depths between 4.575 m bgl and 15.670 m bgl. Surface water samples were collected from three locations from the quarry area on 22 September and groundwater samples collected between 28 September and 17 October 2016.

Surface water was present as an ephemeral water body in the Pit area at the time of sampling. Standing water levels (SWL) ranged between 571.70 m AHD (M-6) to 582.86 m AHD (M-5). Groundwater was not recorded in two wells (M-1 and M-8) at the time of sampling.

The results of the physico-chemical parameters showed that there was an appreciable difference in pH between the surface water samples (3.96-3.99) and those from the groundwater (5.94 and 6.99). The difference in measured pH between the surface water and groundwater samples may be the result of the influence of organic acids derived from the breakdown of organic matter in the surface water body. Other possible factors which may account for the observed difference may include the potential for buffering and control of groundwater pH from the fill material and bedrock.

Other parameters, such as dissolved oxygen and redox potential indicated that both surface water and groundwater were relatively well oxygenated. The temperature of the groundwater exhibited a range of almost 6°C, from 14.4°C (M-5) to 20°C (M-7).

The analytical results for surface water samples indicated that BTEXN, TRH, PAH, OPP, OCP and PCB were below analytical detection limits. Of the metals, only zinc in W-2 (25 µg/L) and W-3 (22 µg/L) was found to exceed the NEPM EIL (amended 2013) screening criteria for fresh water. All other metals were either ***below*** detection limits or ***below*** the relevant assessment criteria.

The analytical results for the groundwater indicated that several of the COPC, namely TRH, PAH, OCP, OPP and PCB were all ***below*** the analytical limit of detection. The analysis revealed the presence of benzene above analytical detection limits in two samples, M-2 (1.0 µg/L) and M-7 (1.1 µg/L). These detections were below the NEPM EIL (2013) and ANZECC (2000) criteria values of 950 µg/L.

A number of exceedances for metals were recorded in the groundwater samples. The concentrations of Cd (1.3 µg/L), Cu (4 µg/L), Ni (20 µg/L) and Zn (67 µg/L) in monitoring well M-2 were found to exceed the respective NEPM (2013) EIL assessment criteria values of 0.2 µg/L, 1.4 µg/L, 11 µg/L and 8 µg/L, respectively. Zinc was also found to exceed the EIL criteria in M-3 (21 µg/L) and M-5 (18 µg/L), whilst copper in M-3 (2 µg/L) and nickel in M-6 (13 µg/L) and M-7 (12 µg/L) also exceeded the criteria. These results are not considered to represent a significant environmental risk.

The detection of metal levels above the NEPM EIL freshwater assessment criteria may be a reflection of natural conditions or may reflect the presence of contaminated material similar to that identified in the surface material from within the kilns, which contained higher concentrations of cadmium and zinc. However, it is recommended that further monitoring should be conducted to determine the long-term trend for these metals.

Furthermore, it is recommended that additional sampling and analysis of the surface and groundwater be conducted, particularly to confirm the presence of benzene in monitoring wells M-2 and M-7. This is considered important, as benzene was not reported in any soil samples and its presence in the groundwater will require further investigation to enable a better understanding of the possible

source(s). It is also recommended that another two wells are constructed down gradient of the identified UST (AEC-7 in the Soil Assessment Report) during the investigation, decommission and removal works.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

1. INTRODUCTION 1

1.1 Preamble 1

1.2 Previous Work 1

1.3 Objectives 1

1.4 Scope of Works 1

1.5 Legislative Framework 1

1.6 Environmental Standards and Guidelines 1

1.7 Report Limitations 2

2. SITE CHARACTERISTICS 3

2.1 Geology 3

2.2 Regional Hydrology and Hydrogeology 3

2.3 Contaminants of Potential Concern 3

3. METHOD 5

3.1 Rationale 5

3.2 Monitoring Well Construction 5

3.3 Groundwater Well Development 6

3.1.1 Standing Water Levels 6

3.4 Groundwater Sampling 6

3.5 Surface Water 7

3.6 Implications and Limitations 7

4. QUALITY ASSURANCE AND QUALITY CONTROL 8

4.1 QA/QC Summary 9

5. RESULTS 11

5.1 Field Parameters 11

5.1.1 Surface Water 11

5.1.2 Groundwater 11

5.2 Analytical Results 13

5.2.1 Surface Water 13

5.2.2 Groundwater 13

6. DISCUSSION AND CONCLUSIONS 15

6.1 Rainfall 15

6.2 Conclusions 15

7. REFERENCES 17

APPENDIX B – FIGURES 198

APPENDIX B – WELL CONSTRUCTION LOGS 19

APPENDIX C – RESULTS TABLES 20

APPENDIX D – LABORATORY REPORTS 21

APPENDIX E – CALIBRATION CERTIFICATES 22

APPENDIX F - WELL DEVELOPMENT AND GROUNDWATER SAMPLING SHEETS 23

1. INTRODUCTION

1.1 Preamble

Land Development Authority (LDA) engaged SMEC Australia Pty Ltd (SMEC) to conduct a Site Investigation (SI) for land parcels comprising the former Canberra Brickworks (the Site), located at Denman Street Yarralumla, ACT. The present investigation was conducted to provide LDA with information on the locations and concentrations of a number of targeted contaminants in soil and groundwater and the lateral and vertical extent of fill material. The information obtained from this investigation will provide a better understanding of the current status of the site and form the basis for a more detailed and targeted detailed site investigation, if required.

1.2 Previous Work

This addendum report compliments the main report 'Canberra Brickworks Site Investigation' submitted to LDA 26 October 2016, as agreed by the auditor (L. Jorstad).

1.3 Objectives

The activities of the groundwater and surface water investigation were conducted as part of the overall site investigation by SMEC between 5 September and 17 October 2016. The objective of the water component of the site investigation was to provide a baseline on the quality of water below the Site to enable an understanding of underlying conditions and make a determination about the suitability of the Site and associated conditions for the proposed end use.

1.4 Scope of Works

To meet the requirements of the SAQP, the following scope of work was undertaken:

- Installation of eight groundwater monitoring wells to a maximum depth of 15.0 m bgl or until refusal
- Development and purging of the wells
- Sampling and analysis for Contaminants of Potential Concern (CoPC)
- Comparison of results against assessment criteria to determine level of risk
- Compilation of this addendum report detailing results and implications.

1.5 Legislative Framework

The overall investigation will be undertaken in general accordance with the following ACT EPA endorsed legislation and guidance

- ACT Government, *Environment Protection Act* (1997)
- ACT Government, *Environment Protection Regulation* (2005)
- ACT EPA, *Contaminated Sites Environmental Protection Policy* (2009)

1.6 Environmental Standards and Guidelines

This report was prepared in general accordance with the requirements of the guidelines endorsed by the ACT Environment Protection Authority (EPA) which includes the following:

- ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*

- National Environment Protection Council National Environment Protection (*Assessment of Site Contamination*) Measure (1999, amended 2013) Schedule B(1) *Guideline on Investigation Levels for Soil and Groundwater*
- National Environment Protection Council National Environment Protection (*Assessment of Site Contamination*) Measure (1999, amended 2013) Schedule B(5a) *Ecological Risk Assessment*

1.7 Report Limitations

This report was based on the Scope of Work outlined in Section 1.4. SMEC prepared this report in a manner consistent with the normal level of care and expertise exercised by members of the environmental profession.

This report relates only to the objectives stated and does not relate to any other work undertaken for the Client. Site conditions upon which inferences in this report are drawn may change with time and space. The absence of any identified hazardous or toxic materials on the subject property should not be interpreted as a guarantee that such materials do not exist on the Site.

All conclusions regarding the property area are the professional opinions of SMEC, subject to the qualifications in the report. While normal assessments of data reliability have been made, SMEC assumes no responsibility or liability for errors in any data obtained from regulatory agencies, statements from sources outside of SMEC, or developments resulting from situations outside the scope of this project.

The client acknowledges that this report is for the exclusive use of Land Development Authority.

2. SITE CHARACTERISTICS

Details pertaining to the characteristics of the site are detailed in the main report *Canberra Brickworks Site Investigation*, Yarralumla, ACT, dated 24 October 2016. The topics discussed below only pertain to the groundwater and their potential influence.

2.1 Geology

The *Geology of Canberra 1:100, 000 Sheet 8287* (1992) shows that the Canberra brickworks is underlain by calcareous and tuffaceous mudstone and siltstone of the Late Silurian Yarralumla Formation. The formation outcrops within and adjacent to the pit area of the site.

2.2 Regional Hydrology and Hydrogeology

Review of the *1:100,000 Hydrology of the Australian Capital Territory and Environs* (1984) indicated that the groundwater beneath the Site is generally present in fractured rock. The quality tends to be variable and was described as 500 - 1,000 mg/l TDS. The yield was described as approximately 1.0 l/s.

A search of the Environment and Sustainable Development Department (ESDD) Groundwater Bore database indicated that three registered abstraction and one investigation/monitoring groundwater were located within a 2 km radius of the Site. The details of the registered groundwater bores is presented in Table 2.1. No registered groundwater bores were located within the Site.

Table 2.1 Groundwater Bore Survey Details

Bore ID	Purpose	Construction Date	Depth (m)	Water Level
WU36	PRIVATE	Unknown	43	35
WU105	PRIVATE	Unknown		
WU609	PRIVATE	Unknown		
WODEN 3	PRIVATE	Unknown		

2.3 Contaminants of Potential Concern

Based on the Site history and background data review, SMEC (in conjunction with the SAQP prepared by AECOM) have identified the following CoPC that may be present in the groundwater and surface water at the site.

Table 2.2 Contaminants of Potential Concern

CoPC	Context
Organochlorine Pesticides (OCP), Organophosphorus Pesticides (OPP)	OCPs / OPPs are persistent and bio-accumulative in the environment. They were formerly used as pest control for crops, livestock and buildings. As the site was historically used for grazing, there may be OCP / OPPs present in the surface and groundwater
Heavy metals	May be present on Site as a result of historical industrial activity or in imported fill. Some elevated background levels of metals are also known to be present naturally in the environment. There is potential that previous site activities including the Brickworks itself, may have resulted in metals being present of Site.

Total Recoverable Hydrocarbons, benzene, toluene, ethylbenzene, xylene (BTEX)	There are a number of potential sources of hydrocarbon contamination used over the years including heating oil, oils and greases, TRH (BTEXN) associated with the use of fuels and lubricants and former UST are potentially present. In addition, there is also potential for hydrocarbons to be present in imported fill.
Polycyclic Aromatic Hydrocarbons (PAH), Phenols	Derived from partially combusted organic materials, also from coal used as fuel in the kilns and ash buried across the site. May have potentially leached into the groundwater. There is also potential for PAHs and phenols to be present in any imported fill present at the Site.
Polychlorinated biphenyls (PCB)	May be associated with buried wastes from buildings and potential transformers and associated oils as well as imported fill.

3. METHOD

3.1 Rationale

The location and depth of the groundwater monitoring wells was initially determined as part of the SAQP developed by AECOM (2016). The rationale for the number, depth and location of the monitoring wells was based on targeted/judgemental approach to characterise site boundary conditions.

The monitoring wells were initially planned to be installed to a maximum depth of 15 m, in accordance with agreement with the Auditor. The final depth for the wells varied due to the ground conditions and actual depth of groundwater. The groundwater monitoring wells were augered until refusal. Where refusal was encountered the method changed to wash boring to continue to the prescribed depth.

Where groundwater was encountered using the augering, the screen casing, sand filter pack and bentonite were installed. Sand was placed around the casing to 1m below ground level as groundwater would move through the sand filter pack. The bentonite was placed from 1m below ground surface to surface level.

The wells were then concreted off at the base and monuments installed. As a result of the variable groundwater depth encountered during the well drilling, the final depth of each well differed from the original scoped depth of 15 m. The location of the monitoring wells was subsequently surveyed by licensed surveyor LANDdata Surveys on 14 October 2016. The information and location of each well wells and the surface water sampling locations is shown in **Figure 1, Appendix A.**

3.2 Monitoring Well Construction

Eight groundwater monitoring wells were installed across the site by GE Drilling, the locations of which are shown in Figure 1.

- Monitoring wells were installed to depths between 5.5-15 m bgl
- Wells were constructed when using augering following encountering groundwater
- Screening of wells was conducted through the installation of 0.4 mm slotted µPVC tubing across a 3 m length
- Following initial installation, monitoring wells were left for a period of one to three days before development
- Following development, wells were left for a period of seven days before purging and sampling
- Following completion, the location of each monitoring well was recorded by GPS and a monument was installed on each well.

The thickness of the sand pack in each well was determined by the measured depth to groundwater (where applicable). In the wells where wash-boring was used, the thickness of the sand pack was increased due to the inability to accurately determine the depth to groundwater. This was a conservative approach which resulted in the sand pack being up to 14 m thick for M-2, M-6, M-7 and M-8 which included the portion around the well screen. The use of a larger sand pack in the wells also provided a level of hydraulic connectivity with the groundwater which served to compensate for the possible screening across the incorrect interval in wells where wash-boring was used. There were no water bearing zones encountered while drilling through fill material, weathered rock and rock. Wash boring commenced on refusal of conventional drilling mechanisms. Striking of groundwater through wash boring could not be determined hence the 3m screen was used at the bottom of each well with the sand filter pack being up to 14m to allow for groundwater infiltration. The standing water level was only determined during well development and sampling.

3.3 Groundwater Well Development

Following construction, the monitoring wells were developed and volumes calculated using the equation below for each of the monitoring wells:

$$\text{Bore volume} = \pi r^2 h \ (m^3)$$

Where;

r = well radius (half diameter) in metres

h = height of water column = TD - SWL

The volume of water removed from each well for development ranged between 3.9 L (M-3) to 25 L (M-2). Water quality parameters were not measured during the development stage.

The well development sheet, including volumes removed, is provided in Appendix F.

3.1.1 Standing Water Levels

Groundwater depths following development ranged between 1.198-10.547 m bTOC with the exception of wells M-1 and M-8 which were dry. The standing water levels in the deeper monitoring wells M-2 (573.31 m AHD), M6 (571.70 m AHD) and M-7 (573.88 m AHD) appear to have similar elevations, suggesting there may be a degree of connectivity between these points. The difference in SWL in the shallow wells M-3 (574.67 m AHD), M4 (576.75 m AHD) and M-5 (582.86 m AHD) is greater than observed in the deeper wells. Water levels in shallow groundwater systems tend to mimic topography which can be seen in this instance. Bedrock outcrops in the vicinity of M-5, exhibiting strong folding and bedding planes, with commensurate fracturing, providing preferential pathways for penetration of water from the surface.

The depth of the monitoring wells and screening range is provided in Table 3.1. Well construction logs are provided in **Appendix B**.

Table 3.1 Groundwater Monitoring Well Data

Monitoring Well	Date Installed	Depth of well (m)	Screen Depth (m)	Well Elevation (ToC m AHD)	Standing Water Level (m AHD)	Depth to Groundwater (m TOC)
M1	15-22/09/2016	8.5	5.5-8.5	582.78	N.A.	N.D. (dry)
M2	13-14/09/2016	15	12-15	577.40	573.31	4.091
M3	13/09/2016	5.5	1.0-4.0	577.61	574.67	2.741
M4	22/09/2016	4.0	1.0-4.0	577.95	576.75	1.198
M5	15/09/2016	5.5	2.5-5.5	584.82	582.86	1.965
M6	14/09/2016	15	12-15	585.25	571.70	10.547
M7	21-22/09/2016	14.7	11.7-14.7	582.44	573.88	8.565
M8	21/09/2016	15	12-15	587.43	N.A.	N.D. (dry)

3.4 Groundwater Sampling

Groundwater sampling was conducted over the period 28 September to 17 October 2016. The delays in completing the sampling within the initial proposed sampling timeframe was due to breakdown of the drilling equipment. This resulted in the monitoring wells be installed over a longer period of time than originally anticipated.

The depth to groundwater (standing water level to top of the casing) was measured using an interface probe. The total depth of the well was measured at the same time.

Purging of all the wells was undertaken using new bailers at each location.

A bladder pump was used for the collection of the groundwater samples in all the wells due to the depth (up to 15 metres) of some of the wells. Samples were collected directly into laboratory prepared plastic and glass bottle containers. Filtering of the groundwater samples for metals was undertaken by the laboratory.

Preservatives were in sample bottles used for total Phenols (H_2SO_4) and the 2 x 40 ml vials for BTEXN (sodium thiosulfate, $NaSO_3$). No preservatives were used in sample bottles used for the collection of water samples requiring laboratory filtering and subsequent analysis for heavy metals. These samples were collected in acid washed bottles.

Water quality parameters (pH, Redox, dissolved oxygen, conductivity, temperature) were measured in the field using a multi-probe water quality meter. The following criteria were used to determine when the water quality parameters had stabilised and ready for sample collection:

	pH	EC (µS/cm)	Redox (mV)	DO (ppm)	Temperature (°C)
Acceptable Variation	+/- 0.1	+/-10%	+/-10%	+/-10%	+/- 0.5

None of the wells that could be sampled (i.e. with the exception of M-1 and M-8), purged dry prior to groundwater sampling. The groundwater sampling sheets are attached in **Appendix F**.

3.5 Surface Water

Three surface water samples were collected on 22 September 2016 from the ephemeral water body in the Pit area. The water body is present within an excavation within the bedrock which was dug to accommodate a model railway line and associated 'lake'. Water quality parameters mere measured in the field at the time of collection using a multi probe water quality meter. There was free standing water in this body at the time of sampling, which was up to approximately 1 m deep. There was also abundant vegetation and wildlife in the water body, including frogs and birds.

The edges of the water body contained abundant vegetation and minor algae whilst the main part of the water body appeared relatively clean. The hydraulic connectivity between the water body and the surrounding ground, including fill material was not readily identifiable due to the folded and fractured nature of the bedrock and variable thickness of fill material. The location of the surface water samples is shown in **Figure 1, Appendix A.**

3.6 Implications and Limitations

The use of wash boring as the method for drilling the deeper monitoring wells introduces a number implications for the sampling and analysis of the groundwater. Firstly, there is a potential for water introduced into the system during the initial installation of the wells to influence the physico-chemical parameters of the groundwater, such as conductivity and also introduce contaminants.

The use of extended sand packs in the wells due to t eh inability to identify the groundwater levels during construction and installation may also affect the initial measurements of groundwater depth as the wells may not have attained equilibrium between development and sampling. As such, data from further sampling may resolve this issue. Further sampling may also resolve the potential impacts resulting from wash-boring, as any residual water may be flushed out of the system over a period of time.

4. QUALITY ASSURANCE AND QUALITY CONTROL

Quality assurance (QA) is defined as the planning process and systematic actions undertaken to ensure the representativeness of a field sampling event. These processes are assessed against the Quality Controls (QC) which measures the success of the QA procedures against the data quality indicators (DQI).

The field and laboratory QA/QC, DQIs and data acceptability have been adopted from the ASC NEPM 2013. A review of the field and laboratory QA/QC performance is provided below.

Table 4.1 QA/QC Protocols and Specifications

Field DQI	Comment
Use of a suitably qualified and experienced samplers	The inspection and sampling activities were undertaken by SMEC Environmental Scientists Ryan O'Leary between 28 September and 17 October 2016
Appropriate decontamination of reusable equipment and use of blank (field and rinsate) samples	The groundwater monitoring equipment which was placed down the monitoring well (dip-meter/interface probe and all other equipment) was decontaminated before use at each location using Decon 90. No rinsate samples were collected. Given that the equipment was decontaminated appropriately this is deemed sufficient.
Fresh nitrile glove use between each sample	Soil samples were collected using a new disposable nitrile glove for each sample, to avoid risks from cross-contamination
Standard operating procedures and field documentation used	All field activities were undertaken in accordance with SMEC practices and ACT EPA approved guidelines
Samples kept under completed Chain of Custody (CoC) documentation	Samples were recorded and kept under a signed COC until receipt by the laboratory. A copy of the signed CoC is attached in **Appendix D**.
Collection of field split samples at the appropriate rate for duplicate 1:20 and triplicate 1:20	One intra-laboratory replicate samples and one inter-laboratory samples were analysed during the works. This constitutes a duplicate sample ratio of 1:9 and a triplicate sample ratio of 1:9.
Calibration of field equipment	Calibration certificates for the dip-meter/interface probe and water quality meter are provided in **Appendix E**. Calibration of the water quality meter probe was undertaken using the pH 4.0 calibration solution provided by ThermoFisher Scientific.
Use of laboratory prepared trip spike for volatile analysis	No trip spike samples were used during this investigation.
Use of laboratory prepared trip blank for volatile analysis	No trip blank samples were used during this investigation.
Laboratory DQI	**Comment**
Appropriate laboratory supplied containers and preservatives used Samples received in a good condition	All samples were received in appropriately pre-treated and preserved containers.
Samples extracted within holding time	All samples were extracted within the relevant holding time for the CoPC

Field DQI	Comment
Laboratory accreditation and analytical methods used	SGS (primary) and ALAS (secondary) are NATA accredited laboratories for the analysis of the required CoPC. The analytical methods used are described in the attached laboratory certificate in **Appendix D**.
Laboratory Limit of Reporting (LOR) to be less than the assessment criteria	The LOR is less than the adopted assessment criteria.
Relative percent differences (RPDs) within the acceptable ranges. Acceptable RPDs: 80% (1-10 x LOR), 50% (10-30 x LOR) and 30% (>30 x LOR) Laboratory Control Spike (LCS) analysis at a rate of 1:20, recoveries to be within 70-130% Matrix Spike Recoveries (MSR) analysis at a rate of 1:20, recoveries to be within 70-130%	A review of the laboratory quality control report indicated that the rates and recoveries of the laboratory QC samples met the DQIs. A copy of the Laboratory Quality Control Report and Interpretive Quality Control Report is attached in **Appendix D**.
Method Blank (MB) samples to less than the laboratory detection limit	
Surrogate Recoveries (SR) to be within 70-130% Laboratory duplicate samples analysis at one per process batch, or two if the process batch exceeds 10 samples	

4.1 QA/QC Summary

A review of the QA data from the laboratory indicated that the requirements detailed in AS4482.1 (2005) and NEPM (2013) Schedule B (2) were generally met. A summary of the main points from the QA/QC procedure is detailed below.

- Samples were received within appropriate holding times
- Samples were received in appropriate containers and chilled
- The number of duplicate samples (1) met the sampling requirement of 1:20
- The number of inter-laboratory triplicate samples (1) met the requirement of 1:20
- No trip spike samples were analysed for the investigation. This **did not** meet the requirement of one per day
- No trip blank samples were analysed for the investigation. This **did not** meet the requirement of one per day
- RPD between primary and duplicate samples and primary and triplicate was between 4-11%
- Laboratory surrogate samples were within the required range of 70-130%
- Laboratory internal duplicate samples were acceptable
- Laboratory matrix spikes generally met the recovery value of 70-130%
- Laboratory LOR was less than the assessment criteria for all CoPC

- The groundwater monitoring equipment which was placed down the monitoring well (dip-meter/interface probe and all other equipment) was decontaminated before use at each location using Decon 90.

The lack of trip blank and trip spike samples may have resulted in under-stating the concentration of benzene in the groundwater as the detected levels were marginally above the analytical detection limit of 0.5µg/L. The overall impact is considered to be low as the reported concentration was well below the relevant ecological/environmental screening levels and the potential for extraction of groundwater for potable use is minimal due to mains water being supplied to residential settings.

In summary, the data from the analysis of water samples is considered suitable for use.

5. RESULTS

The results from the field measurement of physico-chemical water quality parameters for surface water and groundwater and the analytical results from both are detailed below. Two wells were found to be dry (M-1 and M-8) at the time of sampling.

5.1 Field Parameters

5.1.1 Surface Water

Three surface water samples were collected on 22 September 2016, from the quarry portion of the Site. The physical conditions of the water at sampling was generally quite clear, with small amount of sediment/turbidity. The condition of the water body in the vicinity of the sampling locations was observed to contain a range of water plants with minor algae and fauna also present. The water quality parameters measured upon collection are shown in Table 5.1.

Table 5.1 Surface Water Quality Parameters

Surface Water	Date	pH	Conductivity (µS/cm)	DO (ppm)	Redox (mV)
W-1	22/09/2016	3.99	166	7.9	344
W-2	22/09/2016	3.97	93.3	7.97	320
W-3	22/09/2016	3.96	115	8.19	296

The results from the field measurements indicated that the surface water was relatively acidic, with pH being relatively constant, ranging between 3.96-3.99. The water was well oxygenated (DO 7.9-8.19 ppm) and quite fresh, with conductivity between 93.3-166 µS/cm.

5.1.2 Groundwater

Groundwater wells were installed between 13 and 22 September 2016. The wells were surveyed and the measurement between the survey height and the top of casing was subsequently conducted resulting in an accurate determination of the total height to top of casing. The data showing well installation date, elevation of the top of casing, well depths and standing water levels are presented in Table 5.2.

Table 5.2 Groundwater Wells: Installation and Development

Well	Date Installed	Elevation (m AHD)[1]	Standing Water Level (m AHD)	SWL (m bTOC)	Water Volume Removed During Development (L)	Comments
M-1	15-22/09/2016	582.78	N.A.	0	-	Dry
M-2	13-14/09/2016	577.40	573.31	4.091	25	-
M-3	13/09/2016	577.61	574.67	2.741	3.9	-
M-4	22/09/2016	577.95	576.75	1.198	7.1	-
M-5	15/09/2016	584.82	582.86	1.965	5.7	-
M-6	14/09/2016	585.25	571.70	10.547	10.1	-
M-7	21-22/09/2016	582.44	573.88	8.565	12.8	-
M-8	21/09/2016	587.43	572.33	15.096	-	Dry

1. ToC elevation determined after measurement of casing above ground and surveying of well

The groundwater elevation was found to vary quite markedly across the site, from 571.70 m AHD (M-6) to 582.86 m AHD (M-5).

Following completion, the wells were sampled between 28 September and 17 October 2016. Two wells were found to be dry following development. No groundwater was encountered in these wells pre-development. The driller thought he had encountered groundwater at M1 and wash boring occurred at M8. This was despite there being prolonged periods of rainfall between 22-29 September when 66.2 mm of rainfall was recorded. The absence of water in M-1 may be due to the nature of the sub-surface conditions, including the degree of fracturing and/or folding which may influence the permeability of the bedrock and hence transmissivity of groundwater.

The variability in depth to groundwater and the underlying geology may also exert an influence on the groundwater flow direction. An initial assessment of flow direction indicated that groundwater may flow to the south-east, based on the measured groundwater elevation. The variability in ground conditions and measured depth to groundwater across the site suggests that the connectivity between wells may be restricted or not be present and that depth to groundwater is reflective of ground conditions in the immediate vicinity of the monitoring wells.

The results showed that there was an appreciable difference in pH between the surface water samples and those from the groundwater which all ranged between 6.50 and 6.99, except for one being M-3 which had a pH of 5.95. The temperature of the groundwater also exhibited a range of almost 6°C, with measured temperatures ranging from 14.4°C (M-5) to 20°C (M-7). The water was purged into a plastic measuring cup and the temperature taken using probes. The temperature variation may reflect the ambient air temperature during purging (hotter during midday and cooler in morning and late afternoon). The physico-chemical parameters are presented in Table 5.3.

Table 5.3 Groundwater Quality Parameters

Well	Date Sampled	pH	Conductivity (µS/cm)	DO (ppm)	Redox (mV)	T (°C)	Comment
M-1	17/10/2016	n.d.	n.d.	n.d.	n.d.	n.d.	Dry
M-2	28/09/2016	6.89	1923	2.25	94	18.9	-
M-3	28/09/2016	5.94	887	9.17	142	16.6	-
M-4	17/10/2016	6.60	633	2.94	115	15.5	-
M-5	17/10/2016	6.99	440	2.89	96	14.4	-
M-6	17/10/2016	6.91	2250	5.30	129	15.2	-
M-7	17/10/2016	6.50	455	7.83	136	20	-
M-8	17/10/2016	n.d.	n.d.	n.d.	n.d.	n.d.	Dry

The oxygenation of the groundwater varied, with dissolved oxygen concentrations between 2.25 ppm (M-2) to 9.17 ppm (M-3). The redox potential was relatively stable between wells, ranging between 94 mV (M-2) to 142 mV (M-3). The conductivity exhibited a larger range, with results between 440 µS/cm (M-5) to 2, 250 µS/cm (M-6).

The variability in conductivity recorded in the monitoring wells may be due to the presence of dissolved material in the vicinity of individual wells. The lowest conductivities were measured in M-5 (440 mV) and M-7 (455 mV), located in the northern corner and southern portion of the site, respectively. There does not appear to be an observable correlation between any of the measured parameters or with depth to groundwater. The slightly lower conductivity data from the shallower monitoring wells M-3, M-4 and M-5 may be due to infiltration of surface water, which would serve to dilute any water which may have higher conductivity.

The EC for M-7 is considerably lower than the comparative deeper wells (M-2 and M-6). This may be due to the fact that M-7 was installed in clean soil with no fill whereas M-2 and M-6 contained fill material to 3m and 1.5m, respectively. This may have influenced the resultant conductivity measurement. The variability in the measured conductivity between the deeper wells may also be a reflection of the initial drilling and installation and it is recommended that the conductivity be measured during future sampling

events to determine whether the method of installation (wash boring) had an influence on the measured conductivity.

The presence of trace amounts of metals is not considered to influence the measured conductivity. The observed conductivity may also be due to the presence of other substance(s) within the water column that were not included in the CoPC. Should a similar range be measured in a future sampling event, it is suggested that total dissolved solids (TDS) be included in the analytical suite to provide information on the potential reasons for the variability in conductivity.

In future if conductivity results are similar to those measured in the initial sampling round, analysis of major ions should be considered to provide more information on the water chemistry. This information could be plotted on a Piper or Durov diagram to identify any possible differences or similarities.

5.2 Analytical Results

5.2.1 Surface Water

The results from the surface water samples indicated that BTEXN, TRH, PAH, OPP, OCP and PCB were ***below*** analytical detection limits. Of the metals, only zinc in W-2 (25 µg/L) and W-3 (22 µg/L) was found to exceed the NEPM (2013) screening criteria for fresh water. All other metals were either ***below*** detection limits or ***below*** assessment criteria.

5.2.2 Groundwater

The analytical results for the groundwater indicated that several of the COPC, namely TRH, PAH, OCP, OPP and PCB were all ***below*** the analytical limit of detection. The analysis revealed the presence of benzene above analytical detection limits in two samples, M-2 (1.0 µg/L) and M-7 (1.1 µg/L). These detections were below the NEPM EIL (2013) and ANZECC (2000) criteria values of 950 µg/L. The benzene concentration in M-2 was above the drinking water guideline value of 1.0 µg/L. The Australian Drinking Water Guidelines were not applicable as the groundwater is not extracted for consumption as potable water is supplied by mains.

The identification of metals in the groundwater samples may be a reflection of the variability in the type and thickness of fill material in the vicinity of each well. The reported presence of elevated levels of cadmium, zinc and chromium in surface samples may be responsible for the observed presence in the groundwater if similar impacted material was buried in the areas in the vicinity of the monitoring wells. These elements exhibit higher solubility than lead compounds which may also explain why lead was not reported in the groundwater samples. Heavy metals exceedances are summarised in Table 5.4.

Table 5.4 Heavy Metal Exceedances in Groundwater

Monitoring Well	Cd	Cu	Ni	Zn
NEPM (2013) criteria[1]	**0.2**	**1.4**	**11**	**8**
M-2	1.3	4	20	67
M-3	-	-	-	21
M-5	-	2	-	18
M-6	-	-	13	-
M-7	-	-	12	-

All units in µg/L
1. Criteria for fresh water

Other possible reasons for the presence of heavy metals in the groundwater may be evidence of leachate from the adjacent asbestos dump or a reflection of the local geology. There is potential for

metals to be associated with the asbestos dump, however this cannot be confirmed as the current investigation did not include the dump area.

The presence of benzene in M-2 (1.0 µg/L) and M-7 (1.1 µg/L) is somewhat unusual as there was no benzene detected in any surface soil sample or any other monitoring well, however it is noted that both these locations are down gradient of the identified UST further north. There are no other obvious sources of benzene. Alternatively, the presence of benzene at concentrations marginally above the analytical detection limit may be a result of contamination within the analysing laboratory. The presence of benzene is an issue that will require further groundwater sampling to develop a better understanding of the potential source(s) of this CoPC.

6. DISCUSSION AND CONCLUSIONS

The investigation of groundwater quality at the Site indicated that the presence of COPC was limited to benzene and metals. Metals are naturally occurring substances and their presence in groundwater (and soil) is ubiquitous. The presence of metals cadmium, copper, nickel and zinc may be a reflection of the underlying geology or may also include an anthropogenic component. At this point, it is not possible to identify a particular source for the identified metals.

6.1 Rainfall

Three periods of high rainfall occurred during the well installation which may have influenced the observed results. Rainfall data from Bureau of Meteorology for Parliament House, the nearest meteorological station, revealed that 66.2 mm rainfall occurred:

- 22 September: 22.2 mm
- 29 September: 19.8 mm
- 30 September: 24.2 mm

Given that the observed ground conditions were quite porous due to the underlying fill material and the relatively fractured bedrock, the elevated rainfall may have leached some metals from the material, or transported from further afield, resulting in the observed concentrations in the groundwater.

The results for surface water, particularly the physico-chemical parameter pH, exhibited appreciable difference with the groundwater results. This may be due to the presence of organic acids derived from decayed vegetation contributing to the observed pH in the surface water. The surface waters samples were collected from the edges of the water body, where the potential for organic matter to influence the measured pH may be greater than in deeper parts of the water body.

The absence of water in groundwater well M-1 was unusual, given that elevation of this well (582.6 m) is lower than other wells in which groundwater was present, such as M-5 and M-6 (elevation 584 m). The absence of water in this well may be due to the underlying geology, which exhibits folding and fracturing in outcrop.

The connectivity of groundwater between the monitoring wells has not been confirmed. The variability in the thickness of fill material across the site coupled with the folded and fractured nature of the underlying bedrock may exert an influence on the presence/absence of groundwater in each well. A similar explanation may account for the absence of groundwater in monitoring wells particularly M-1 which is located in the Pit area. The absence of groundwater in monitoring well M-8 may be due to the location at the highest elevation of any of the wells (586.70 m AHD) and in ground with no identified fill material.

The identification of benzene in M-2 and M-7 was not considered to have appreciable implications for the nearest registered groundwater bores. A potential source for the benzene may be the former UST uncovered during the site investigation. No information was available to determine the substance stored within the UST. Therefore it is suggested that further sampling and investigation be conducted to allow assessment of the potential sources and implications arising from the identification of this CoPC. It is also recommended that total dissolved solids (TDS) be included in the analytical suite to provide information on the potential reasons for the variability in conductivity identified between wells.

6.2 Conclusions

Land Development Agency (LDA) commissioned Snowy Mountains Engineering Corporation (SMEC) to conduct an environmental site investigation of the Canberra Brickworks to determine the extent and quantity of contamination present at the site. The works involved examination of soil, surface and groundwater.

The examination of groundwater involved installation of eight groundwater monitoring wells across the site, which were installed between 13 and 22 September 2016. Wells were installed to depths between 4.575 m bgl and 15.670 m bgl. Surface water samples were collected on 22 September and groundwater samples collected between 28 September and 17 October 2016.

Surface water was present as an ephemeral water body in the Pit area at the time of sampling. Depth to groundwater ranged between 1.198 m bTOC (M-4) to 10.547 m bTOC (M-6). Groundwater was not recorded in two wells (M-1 and M-8).

The results of the physico-chemical parameters showed that there was an appreciable difference in pH between the surface water samples (3.96-3.99) and those from the groundwater (5.94 and 6.99). The difference in measured pH between the surface water and groundwater samples may be the result of the influence of organic acids derived from the breakdown of organic matter in the surface water body. Other possible factors which may account for the observed difference may include the potential for buffering and control of groundwater pH from the fill material and bedrock.

Other parameters, such as dissolved oxygen and redox potential indicated that both surface water and groundwater were relatively well oxygenated. The temperature of the groundwater exhibited a range of almost 6°C, from 14.4°C (M-5) to 20°C (M-7).

The analytical results for surface water samples indicated that BTEXN, TRH, PAH, OPP, OCP and PCB were below analytical detection limits. Of the metals, only zinc in W-2 (25 µg/L) and W-3 (22 µg/L) was found to exceed the NEPM EIL (amended 2013) screening criteria for fresh water. All other metals were either ***below*** detection limits or ***below*** the relevant assessment criteria.

The analytical results for the groundwater indicated that several of the COPC, namely TRH, PAH, OCP, OPP and PCB were all ***below*** the analytical limit of detection. The analysis revealed the presence of benzene above analytical detection limits in two samples, M-2 (1.0 µg/L) and M-7 (1.1 µg/L). These detections were below the NEPM EIL (2013) and ANZECC (2000) criteria values of 950 µg/L.

A number of exceedances for metals were recorded in the groundwater samples. The concentrations of Cd (1.3 µg/L), Cu (4 µg/L), Ni (20 µg/L) and Zn (67 µg/L) in monitoring well M-2 were found to exceed the respective NEPM (2013) EIL assessment criteria values of 0.2 µg/L, 1.4 µg/L, 11 µg/L and 8 µg/L, respectively. Zinc was also found to exceed the EIL criteria in M-3 (21 µg/L) and M-5 (18 µg/L), whilst copper in M-3 (2 µg/L) and nickel in M-6 (13 µg/L) and M-7 (12 µg/L) also exceeded the criteria. These results are not considered to represent a significant environmental risk.

The detection of metal levels above the NEPM EIL freshwater assessment criteria may be a reflection of natural conditions or may reflect the presence of contaminated material similar to that identified in the surface material from within the kilns, which contained higher concentrations of cadmium and zinc. However, it is recommended that further monitoring should be conducted to determine the long-term trend for these metals.

Furthermore, it is recommended that additional sampling and analysis of the surface and groundwater be conducted, particularly to confirm the presence of benzene in monitoring wells M-2 and M-7. This is considered important, as benzene was not reported in any soil samples and its presence in the groundwater will require further investigation to enable a better understanding of the possible source(s). It is also recommended that another two wells are constructed down gradient of the identified UST (AEC-7 in the Soil Assessment Report) during the investigation, decommission and removal works.

7. REFERENCES

ASRIS (2011) *Australian Soil Resource Information System* (http://www.asris.csiro.au/). Accessed 15 September 2016

ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality

Australian Standard AS4482.1 (2005) *Guide to the investigation and sampling of potentially contaminated soils: Part 1 – Non-volatile and semi volatile compounds*

Bureau of Mineral Resources (1992) *Geology of Canberra 1:100 000 Sheet 8287*

Evans WR (1984) *Hydrogeology of the Australian Capital Territory and Environs.* Bureau of Mineral Resources, Geology and Geophysics, Canberra

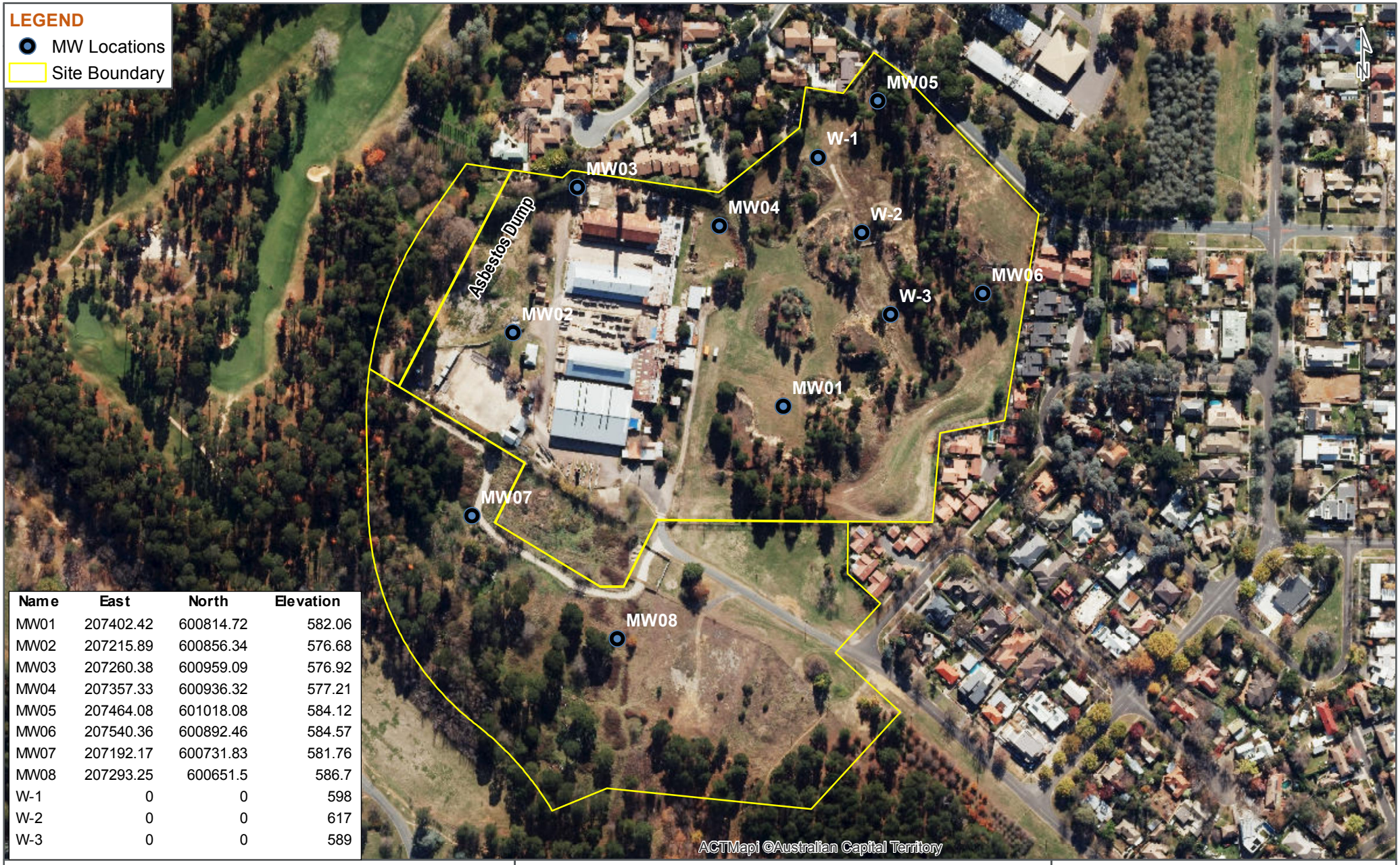
National Environment Protection Council (1999, amended 2013) National Environmental Protection Measures (NEMP) *Schedule B (1) Guideline Levels for Soil and Groundwater*

National Environment Protection Council (1999, amended 2013) National Environmental Protection Measures (NEMP) *Schedule B (5) Ecological Risk Assessment*

National Uniform Licensing Committee (2012) *Minimum Construction Requirements for Water Bores in Australia.* National Water Commission, Canberra

Western Australian Department Health (2009) Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia

APPENDIX A – FIGURES



Name	East	North	Elevation
MW01	207402.42	600814.72	582.06
MW02	207215.89	600856.34	576.68
MW03	207260.38	600959.09	576.92
MW04	207357.33	600936.32	577.21
MW05	207464.08	601018.08	584.12
MW06	207540.36	600892.46	584.57
MW07	207192.17	600731.83	581.76
MW08	207293.25	600651.5	586.7
W-1	0	0	598
W-2	0	0	617
W-3	0	0	589

FIG NO. 2

FIGURE TITLE Canberra Brickswork Sampling Plan Contamination

DATE 01/11/2016

0 25 50 100
1:3,485 Meters

PAGE SIZE A4

COORDINATE SYSTEM GDA 1994 MGA Zone 55

PROJECT NO. 3002523

PROJECT TITLE Canberra Brickworks

SOURCES ACTMapi

CREATED BY N.Crook

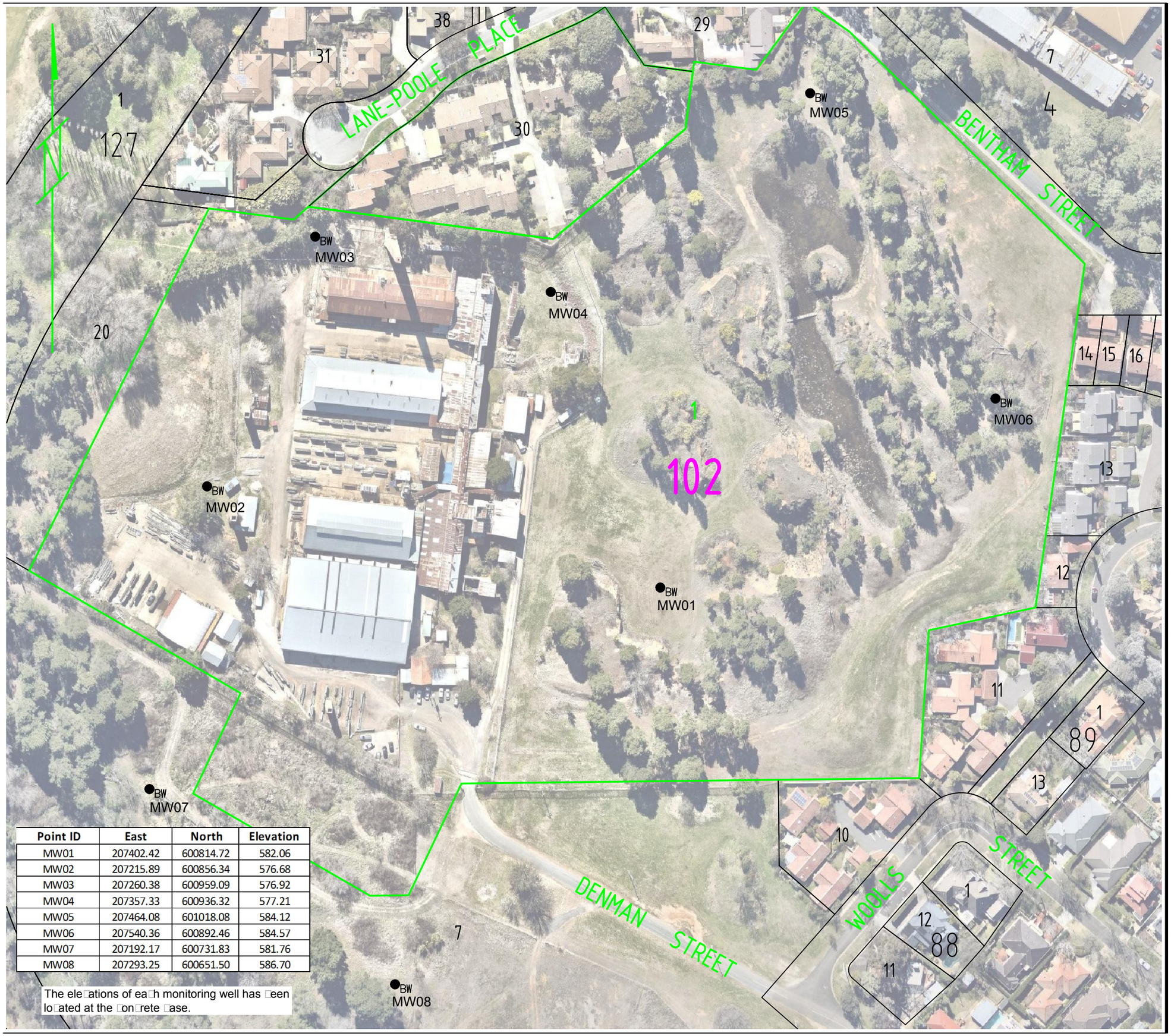
© SMEC Australia Pty Ltd 2016.
All Rights Reserved

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, this map contains data from a number of sources - no warranty is given that the information contained on this map is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of all information prior to using it. This map is not a design document.

SMEC

Location: X:\PROJECT\3002523 Canberra Brickworks Phase 2 Contamination and Geotech\6 Delivery\6.2 Figures and Result Tables\6.2.1 GIS\Figure 2_Contam_Overall_010116 - New.mxd

Last updated by: AA10448 on 1/11/2016 at 12:17



Point ID	East	North	Elevation
MW01	207402.42	600814.72	582.06
MW02	207215.89	600856.34	576.68
MW03	207260.38	600959.09	576.92
MW04	207357.33	600936.32	577.21
MW05	207464.08	601018.08	584.12
MW06	207540.36	600892.46	584.57
MW07	207192.17	600731.83	581.76
MW08	207293.25	600651.50	586.70

The ele□ations of ea□h monitoring well has □een lo□ated at the □on□rete □ase.

CLIENT

SMEC AUSTRALIA PTY LTD

DISCLAIMER:
This □lan of sur□ey and its asso□iated digital data was □re□ared under instru□tion to meet s□e□ifi□ation as agreed. This information should not □e used or relied u□on □y any other □arty.

REVISION		DATE

For the □ur□ose of this □lan, the □oundary information shown is from A□tma□ digital data □ase only. Boundaries ha□e not □een sur□eyed therefore further sur□ey and mar□ing of □oundaries may □e re□uired.

The redu□ed le□els in this sur□ey are □ased on lo□al datum deri□ed through GPS □onne□tion to □u□lished sur□ey □ontrol mar□s with Australian Height Datum □alues.

Contour Inter□al

Datum A.H.D

BM SR 863

RL 589.512

S□ale 0 50 100

1:1500

LANDdata SURVEYS
T: (02) 6202 7600
11-13 Lawry Pla□e
MAC□UARIE, ACT 2614

INCORPORATING :
WILLIAM L. BACKHOUSE
SURVEYORS, PLANNERS & DEVELOPMENT CONSULTANTS.
T: (02) 9634 2866
Suite 8, 38 Broo□hollow A□e.,
Norwest Business Par□
Baul□ham Hills, NSW 2153

Sur□eyed	I Stewart	14/10/2016
Drawn	I Stewart	17/10/2016
Che□□ed		
A□□ro□ed		

Sur□eyor, Registered under the Sur□eyors A□t 2007.

YARRALUMLA BRICKWORKS

PLAN SHOWING
LOCATION OF MONITORING WELLS
BLOCK 1, SECTION 102
DIVISION OF YARRALUMLA

Proj No. 10013.01 **Rev**

Sheet No. 1 of 1 10013.01_001.dwg

© LANDdata SURVEYS Pty Limited ABN 97 118 699 728 A3

APPENDIX B – WELL CONSTRUCTION LOGS

GEOLOGICAL LOG OF GROUNDWATER BORE HOLE

HOLE No:	**M1**
SHEET No:	1 of 1
PROJECT No:	

PROJECT : 3002523
PURPOSE : Environmental
LOCATION :

CLIENT : Land Development Agency
POSITION :
FINAL DEPTH: 8.5m

SURFACE ELEVATION :
TOP OF CASING:
ANGLE FROM HORIZONTAL : 90°

Drilling		Depth		SUBSTANCE		Well Construction	OTHER OBSERVATIONS
Method	Support	Depth (m)	Graphic Log	Description NAME: grain size / plasticity, color, structure, minor components	Well Construction Details	Construction notes	Notes (Structure, origin, etc)
				FILL GRAVELLY CLAYEY SAND WITH SOME GRAVELS			
				BROWN TO YELLOW GRAVELLY CLAYEY SAND		Bentonite	
		1		LIGHT BROWN COARSE GRAVEL			
				LIGHT BROWN COARSE GRAVEL			
		2					
				BEDROCK (40%) 1- 10MM SANDY GRAVELS , LIGHT BROWN FINE GRAVEL			
		3				Filter Pack	
				BEDROCK (15%) 1- 5MM SANDY GRAVELS			
		4					
				BEDROCK GRAVELLY SAND (10%) COARSE 1-3MM IN DIAMETER, LIGHT BROWN FINE GRAVEL			
		5					
		6					
						Screen	
		7					
		8					
		9					

Notes: ▶ Inflow ▽ Standing Water Level

CONTRACTOR:
EQUIPMENT: Mobile Drill Rig

COMMENCED: 15/09/2016
COMPLETED: 22/09/2016

LOGGED BY: RO
CHECKED BY: GO

GEOLOGICAL LOG OF GROUNDWATER BORE HOLE

HOLE No:	**M2**
SHEET No:	1 of 1
PROJECT No:	

PROJECT : 3002523
PURPOSE : Environmental
LOCATION :

CLIENT : Land Development Agency
POSITION :
FINAL DEPTH: 15m

SURFACE ELEVATION :
TOP OF CASING:
ANGLE FROM HORIZONTAL : 90°

Drilling		Depth		SUBSTANCE		Well Construction	OTHER OBSERVATIONS
Method	Support	Depth (m)	Graphic Log	Description NAME: grain size / plasticity, color, structure, minor components	Well Construction Details	Construction notes	Notes (Structure, origin, etc)
		0		CONCRETE		Bentonite	
				GRAVELLY SANDY CLAY , SLIGHTLY MOIST PLASTICITY PID 0.0 ppm			
		1		DARK BROWN WET SILTY CLAY MED PLASTICITY			
				BROWN ORANGE SILTY CLAY MEDIUM PLASTICITY PID 0.0 ppm			
		2		LOW PLASTICITY SILTY CLAY			
				LOW PLASTICITY YELLOW SILTY CLAY			
		3		SANDY GRAVELLY CLAY GRAVELS UP TO 5MM IN DIAMETER - YELLOW MUTTING LOW PLASTICITY			
				CLAYEY SAND			
		4		WEATHERED ROCK - QUARTZ - FINE GRAVEL PID 0.0 ppm			
		5				Filter Pack	
		6					
		7				Standing Water Level	
		8					
		9					
		10					
		11					
		12					
		13				Screen	
		14					
		15					
		16					

Notes: ▶ Inflow ▽ Standing Water Level

CONTRACTOR:
EQUIPMENT: Mobile Drill Rig

COMMENCED: 13/09/2016
COMPLETED: 14/09/2016

LOGGED BY: RO
CHECKED BY: GO

GEOLOGICAL LOG OF GROUNDWATER BORE HOLE

HOLE No:	**M3**
SHEET No:	1 of 1
PROJECT No:	

PROJECT : 3002523
PURPOSE : Environmental
LOCATION :

CLIENT : Land Development Agency
POSITION :
FINAL DEPTH: 5.5m

SURFACE ELEVATION :
TOP OF CASING:
ANGLE FROM HORIZONTAL : 90°

Drilling		Depth			SUBSTANCE	Well Construction		OTHER OBSERVATIONS
Method	Support	Depth (m)		Graphic Log	Description NAME: grain size / plasticity, color, structure, minor components	Well Construction Details	Construction notes	Notes (Structure, origin, etc)
		0			FILL TOPSOIL			
					GRAVELLY SANDY CLAY BRICKS CONCRETE PID 0.1 ppm		Bentonite	
		1			POORLY GRADED SANDY GRAVEL			
					SANDY CLAY YELLOW TO BROWN PID 0.0 ppm			
		2			WET CLAYEY SANDY GRAVEL		Screen	
					SANDY CLAY		Standing Water Level	
		3						
		4					Filter Pack	
					CLAYEY SAND YELLOW TO BROWN SOME ROCK FRAGMENTS			
		5						
		6						

Notes: ▶ Inflow ▽ Standing Water Level

CONTRACTOR:
EQUIPMENT: Mobile Drill Rig

COMMENCED: 13/09/2016
COMPLETED: 13/09/2016

LOGGED BY: RO
CHECKED BY: GO

GEOLOGICAL LOG OF GROUNDWATER BORE HOLE

HOLE No:	**M4**
SHEET No:	1 of 1
PROJECT No:	

PROJECT : 3002523
PURPOSE : Environmental
LOCATION :

CLIENT : Land Development Agency
POSITION :
FINAL DEPTH: 4m

SURFACE ELEVATION :
TOP OF CASING:
ANGLE FROM HORIZONTAL : 90°

Drilling		Depth			SUBSTANCE	Well Construction		OTHER OBSERVATIONS
Method	Support	Depth (m)		Graphic Log	Description NAME: grain size / plasticity, color, structure, minor components	Well Construction Details	Construction notes	Notes (Structure, origin, etc)
					Fill Grass cover , sandy clay wih gravels medium plasticity PID 0.0 ppm			
					Fill sandy clay with gravels 5-12mm , pieces of bolt in fill PID 0.0 ppm		Bentonite	
		1			Wet light brown clay PID 0.0 ppm			
		2					Standing Water Level	
		3					Screen	
		4						

Notes: ▶ Inflow ▽ Standing Water Level

CONTRACTOR:
EQUIPMENT: Mobile Drill Rig

COMMENCED: 22/09/2016
COMPLETED: 22/09/2016

LOGGED BY: RO
CHECKED BY: GO

GEOLOGICAL LOG OF GROUNDWATER BORE HOLE

HOLE No:	**M5**
SHEET No:	1 of 1
PROJECT No:	

PROJECT : 3002523
PURPOSE : Environmental
LOCATION :

CLIENT : Land Development Agency
POSITION :
FINAL DEPTH: 5.5m

SURFACE ELEVATION :
TOP OF CASING:
ANGLE FROM HORIZONTAL : 90°

Drilling		Depth		SUBSTANCE	Well Construction	OTHER OBSERVATIONS
Method	Support	Depth (m)	Graphic Log	Description NAME: grain size / plasticity, color, structure, minor components	Well Construction Details Construction notes	Notes (Structure, origin, etc)
				Fill - sandy gravelly light brown clay , some gravel PID 0.0 ppm		
				Fill - silty sandy clay , light brown medium plasticity PID 0.0 ppm	Bentonite	
		1		Siltstone rock , very fine medium soft light grey brown		
				Light grey limestone PID 0.0 ppm	Filter Pack	
		2		Siltstone , light brown, highly weathered , dry PID 0.0 ppm		
		3			Standing Water Level	
		4		Silty clay , brown moist, medium to high plasticity PID 0.0 ppm	Screen	
		5				
		6				

Notes: ▶ Inflow ▽ Standing Water Level

CONTRACTOR:
EQUIPMENT: Mobile Drill Rig

COMMENCED: 15/09/2016
COMPLETED: 15/09/2016

LOGGED BY: RO
CHECKED BY: GO

GEOLOGICAL LOG OF GROUNDWATER BORE HOLE

HOLE No:	**M6**
SHEET No:	1 of 1
PROJECT No:	

PROJECT : 3002523
PURPOSE : Environmental
LOCATION :

CLIENT : Land Development Agency
POSITION :
FINAL DEPTH: 15m

SURFACE ELEVATION :
TOP OF CASING:
ANGLE FROM HORIZONTAL : 90°

Drilling		Depth		SUBSTANCE	Well Construction	OTHER OBSERVATIONS
Method	Support	Depth (m)	Graphic Log	Description NAME: grain size / plasticity, color, structure, minor components	Well Construction Details Construction notes	Notes (Structure, origin, etc)
		0		Fill - gravelly sandy clay , gravels 1-5mm PID 0.8 ppm	Bentonite	
		1		Brown siltstone		
		2		Extremely weathered shale PID 0.1 ppm		
		3				
		4		Weathered siltstone , light brown PID 0.0 pppm		
		5				
		6		Layers of limestone , wash box from 5.5m	Filter Pack	
		7				
		8				
		9				
		10				
		11				
		12			Standing Water Level	
		13				
		14			Screen	
		15				
		16				

Notes: ▶ Inflow ▽ Standing Water Level

CONTRACTOR:
EQUIPMENT: Mobile Drill Rig

COMMENCED: 14/09/2016
COMPLETED: 14/09/2016

LOGGED BY: RO
CHECKED BY: GO

GEOLOGICAL LOG OF GROUNDWATER BORE HOLE

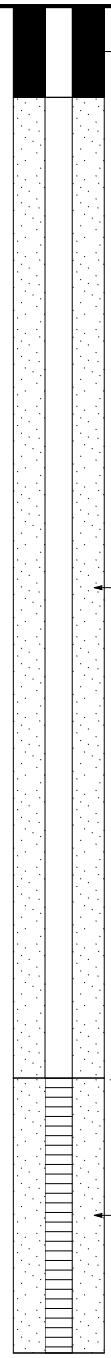
HOLE No:	**M7**
SHEET No:	1 of 1
PROJECT No:	

PROJECT : 3002523
PURPOSE : Environmental
LOCATION :

CLIENT : Land Development Agency
POSITION :
FINAL DEPTH: 15m

SURFACE ELEVATION :
TOP OF CASING:
ANGLE FROM HORIZONTAL : 90°

Drilling		Depth			SUBSTANCE	Well Construction	OTHER OBSERVATIONS
Method	Support	Depth (m)		Graphic Log	Description NAME: grain size / plasticity, color, structure, minor components	Well Construction Details Construction notes	Notes (Structure, origin, etc)
		0			Orange brown , moist sandy clay medium plasticity PID 0.0 ppm	Bentonite	
		1			Brown silty sandy clay , moist medium plasticity PID 0.0 ppm		
		2			Rock		
		3					
		4					
		5					
		6				Filter Pack	
		7					
		8					
		9					
		10			Wash boring		
		11					
		12				Standing Water Level	
		13					
		14				Screen	
		15					
		16					



Notes: ▶ Inflow ▽ Standing Water Level

CONTRACTOR:
EQUIPMENT: Mobile Drill Rig

COMMENCED: 21/09/2016
COMPLETED: 22/09/2016

LOGGED BY: RO
CHECKED BY: GO

GEOLOGICAL LOG OF GROUNDWATER BORE HOLE

HOLE No:	**M8**
SHEET No:	1 of 1
PROJECT No:	

PROJECT : 3002523
PURPOSE : Environmental
LOCATION :

CLIENT : Land Development Agency
POSITION :
FINAL DEPTH: 15m

SURFACE ELEVATION :
TOP OF CASING:
ANGLE FROM HORIZONTAL : 90°

Drilling		Depth			SUBSTANCE	Well Construction	OTHER OBSERVATIONS
Method	Support	Depth (m)	Graphic Log	Description NAME: grain size / plasticity, color, structure, minor components	Well Construction Details	Construction notes	Notes (Structure, origin, etc)
		0		Dark brown sandy clay PID 0.0 ppm		Bentonite	
				Dark brown sandy clay, some gravels 2.5mm diameter			
		1		Filthy sandy clay PID 0.0ppm			
				Sandy clay some rock			
		2		Volcanic rock			
		3					
		4		Siltstone, start of wash broing			
		5					
				Harder rock			
		6				Filter Pack	
		7					
		8					
		9					
		10					
		11					
		12					
		13				Screen	
		14					
		15					
		16					

Notes: ▶ Inflow ▽ Standing Water Level

CONTRACTOR:
EQUIPMENT: Mobile Drill Rig

COMMENCED: 21/09/2016
COMPLETED: 21/09/2016

LOGGED BY: RO
CHECKED BY: GO

APPENDIX C – RESULTS TABLES

		VOC's								Metals								Organochlorine Pesticides																													
		Benzene	Toluene	Ethylbenzene	Xylene (m & p)	Xylene (o)	Xylene Total	Total BTEXN	Naphthalene	Arsenic (Filtered)	Cadmium (Filtered)	Chromium (III+VI) (Filtered)	Copper (Filtered)	Lead (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Zinc (Filtered)	Alpha BHC	Aldrin	Chlordane	gamma-Chlordane	b-BHC	d-BHC	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan suiphate	Endrin	Endrin aldehyde	Endrin ketone	Heptachlor	Heptachlor epoxide	Hexachlorobenzene	Lindane	Methoxychlor	Mirex	o,p-DDD	o,p'-DDE	DDD	DDT	trans-Nonachlor
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
LOR		0.5	0.5	0.5	1	0.5	1.5	3	0.5	1	0.1	1	1	1	0.1	1	5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
NEPM 2013 Schedule B1, Table 1C Groundwater Investigation Levels		**950**			**200**	**350**			**16**	**13**	**0.2**	**1**	**1.4**	**3.4**	**0.06**	**11**	**8**			**0.03**					**0.03**	**0.03**		**0.01**			**0.01**			**0.2**						**0.006**	
CRC CARE 2011 Table 1A(4) GW HSLs for Vapour Intrusion (HSL-A 4-8m, Clay)		**800**																																							
Field ID	**Sampled Date**																																								
M2	28/09/2016	**1**	<0.5	<0.5	<1	<0.5	<1.5	<3	<0.5	<1	**1.3**	<1	**4**	<1	<0.1	**20**	**67**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
M3	28/09/2016	<0.5	<0.5	<0.5	<1	<0.5	<1.5	<3	<0.5	<1	<0.1	<1	**1**	<1	<0.1	**2**	**21**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
M4	17/10/2016	<0.5	<0.5	<0.5	<1	<0.5	<1.5	<3	<0.5	<1	<0.1	<1	**1**	<1	<0.1	**2**	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
M5	17/10/2016	<0.5	<0.5	<0.5	<1	<0.5	<1.5	<3	<0.5	<1	<0.1	<1	**2**	<1	<0.1	**1**	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
M6	17/10/2016	<0.5	<0.5	<0.5	<1	<0.5	<1.5	<3	<0.5	<1	**0.2**	<1	**1**	<1	<0.1	**13**	**18**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
M7	17/10/2016	**1.1**	<0.5	<0.5	<1	<0.5	<1.5	<3	<0.5	<1	**0.2**	<1	**1**	<1	<0.1	**12**	**8**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
W1	22/09/2016	<0.5	<0.5	<0.5	<1	<0.5	<1.5	<3	<0.5	**1**	<0.1	<1	<1	<1	<0.1	**1**	**25**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
W2	22/09/2016	<0.5	<0.5	<0.5	<1	<0.5	<1.5	<3	<0.5	<1	<0.1	<1	**1**	<1	<0.1	<1	**5**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
W3	22/09/2016	<0.5	<0.5	<0.5	<1	<0.5	<1.5	<3	<0.5	<1	<0.1	<1	**1**	<1	<0.1	**1**	**22**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
QC22	28/09/2016	**0.8**	<0.5	<0.5	<1	<0.5	<1.5	<3	<0.5	<1	**1.4**	<1	**4**	<1	<0.1	**20**	**64**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
QC23	28/09/2016	<1	<2	<2	<2	<2	<2	<1	<5	<1	**1.4**	<1	**5**	<1	<0.1	**20**	**72**	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2	-	-	-	<0.5	<2	-

Notes: **Bold font is where > LOR**

Orange highlight is where value is > NEPM 2013 Schedule B1, Table 1C criteria

IS - Insufficient sample for analysis

		Organophosphorous Pesticides												PAH																		Phenols	TPH											
		Azinophos methyl	Bromophos-ethyl	Chlorpyrifos	Diazinon	Dichlorvos	Dimethoate	Ethion	Fenitrothion	Isodrin	Malathion	Methidathion	Parathion	1-Methylnaphthalene	2-methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(b+j)fluoranthene	Benzo(a) pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene	Total PAHs	Total Phenols	C6 - C9	C6-C10	C6-C10 less BTEX (F1)	C10 - C14	C15 - C28	C29-C36	TRH C37-C40	C10-C16 (F2)	C16-C34 (F3)	C34-C40 (F4)	C10 - C36 (Total)	C10 - C40 (Total)
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
LOR		0.2	0.2	0.2	0.5	0.5	0.5	0.2	0.2	0.1	0.2	0.5	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	10	40	50	50	50	200	50	200	60	500	500	450	650
NEPM 2013 Schedule B1, Table 1C Groundwater Investigation Levels				**0.01**	**0.01**		**0.15**		**0.2**		**0.05**		**0.004**																				**320**											
CRC CARE 2011 Table 1A(4) GW HSLs for Vapour Intrusion (HSL-A 4-8m, Clay)																																										
Field ID	**Sampled Date**																																										
M2	28/09/2016	<0.2	<0.2	<0.2	<0.5	<0.5	<0.5	<0.2	<0.2	<0.1	<0.2	<0.5	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<10	<40	<50	<50	<50	<200	<200	<200	<60	<500	<500	<450	<650
M3	28/09/2016	<0.2	<0.2	<0.2	<0.5	<0.5	<0.5	<0.2	<0.2	<0.1	<0.2	<0.5	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<10	<40	<50	<50	<50	<200	<200	<200	<60	<500	<500	<450	<650
M4	17/10/2016	<0.2	<0.2	<0.2	<0.5	<0.5	<0.5	<0.2	<0.2	<0.1	<0.2	<0.5	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<10	<40	<50	<50	<50	<200	<200	<200	<60	<500	<500	<450	<650
M5	17/10/2016	<0.2	<0.2	<0.2	<0.5	<0.5	<0.5	<0.2	<0.2	<0.1	<0.2	<0.5	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<10	<40	<50	<50	<50	<200	<200	<200	<60	<500	<500	<450	<650
M6	17/10/2016	<0.2	<0.2	<0.2	<0.5	<0.5	<0.5	<0.2	<0.2	<0.1	<0.2	<0.5	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<10	<40	<50	<50	<50	<200	<200	<200	<60	<500	<500	<450	<650
M7	17/10/2016	<0.2	<0.2	<0.2	<0.5	<0.5	<0.5	<0.2	<0.2	<0.1	<0.2	<0.5	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<10	<40	<50	<50	<50	<200	<200	<200	<60	<500	<500	<450	<650
W1	22/09/2016	<0.2	<0.2	<0.2	<0.5	<0.5	<0.5	<0.2	<0.2	<0.1	<0.2	<0.5	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<10	<40	<50	<50	<50	<200	<200	<200	<60	<500	<500	<450	<650
W2	22/09/2016	<0.2	<0.2	<0.2	<0.5	<0.5	<0.5	<0.2	<0.2	<0.1	<0.2	<0.5	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<10	<40	<50	<50	<50	<200	<200	<200	<60	<500	<500	<450	<650
W3	22/09/2016	<0.2	<0.2	<0.2	<0.5	<0.5	<0.5	<0.2	<0.2	<0.1	<0.2	<0.5	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	IS	<40	<50	<50	<50	<200	<200	<200	<60	<500	<500	<450	<650
QC22	28/09/2016	<0.2	<0.2	<0.2	<0.5	<0.5	<0.5	<0.2	<0.2	<0.1	<0.2	<0.5	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	**20**	<40	<50	<50	<50	<200	<200	<200	<0.06	<0.5	<0.5	<450	<650
QC23	28/09/2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	<0.5	-	<2	-	-	<1	<1	<1	<1	<1	<0.5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.5	-	<20	<20	<20	<50	<100	<50	-	<100	<100	<100	<50	<100

Notes: **Bold font is where > LOR**

Orange highlight is where v

IS - Insufficient sample for a

Table 2: Quality Assurance/Quality Control

		VOC's								Metals								Organochlorine Pesticides																													
		Benzene	Toluene	Ethylbenzene	Xylene (m & p)	Xylene (o)	Xylene Total	Total BTEXN	Naphthalene	Arsenic (Filtered)	Cadmium (Filtered)	Chromium (III+VI) (Filtered)	Copper (Filtered)	Lead (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Zinc (Filtered)	Alpha BHC	Aldrin	Chlordane	gamma-Chlordane	b-BHC	d-BHC	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulphate	Endrin	Endrin aldehyde	Endrin ketone	Heptachlor	Heptachlor epoxide	Hexachlorobenzene	Lindane	Methoxychlor	Mirex	o,p-DDD	o,p'-DDE	DDD	DDT	trans-Nonachlor
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Field ID	**Sampled Date**																																									
M2	28/09/2016	1	<0.5	<0.5	<1	<0.5	<1.5	<3	<0.5	<1	1.3	<1	4	<1	<0.1	20	67	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
QC22	28/09/2016	0.8	<0.5	<0.5	<1	<0.5	<1.5	<3	<0.5	<1	1.4	<1	4	<1	<0.1	20	64	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
RPD %		11	nc	nc	nc	nc	nc	nc	nc	nc	4	nc	0	nc	nc	0	2	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
M2	28/09/2016	1	<0.5	<0.5	<1	<0.5	<1.5	<3	<0.5	<1	1.3	<1	4	<1	<0.1	20	67	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
QC23	28/09/2016	<1	<2	<2	<2	<2	<2	<1	<5	<1	1.4	<1	5	<1	<0.1	20	72	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2	-	-	-	<0.5	<2	-
RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	11	nc	nc	0	4	nc	nc	nc	-	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	-	-	-	nc	nc	-
QC22	28/09/2016	0.8	<0.5	<0.5	<1	<0.5	<1.5	<3	<0.5	<1	1.4	<1	4	<1	<0.1	20	64	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
QC23	28/09/2016	<1	<2	<2	<2	<2	<2	<1	<5	<1	1.4	<1	5	<1	<0.1	20	72	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2	-	-	-	<0.5	<2	-
RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	0	nc	11	nc	nc	0	6	nc	nc	nc	-	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	-	-	-	nc	nc	-

Notes: nc - not calculated

Table 2: Quality Assurance/Quality Control

Organophosphorous Pesticides												
Azinophos methyl	Bromophos-ethyl	Chlorpyrifos	Diazinon	Dichlorvos	Dimethoate	Ethion	Fenitrothion	Isodrin	Malathion	Methidathion	Parathion
µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
<0.2	<0.2	<0.2	<0.5	<0.5	<0.5	<0.2	<0.2	<0.1	<0.2	<0.5	<0.2
<0.2	<0.2	<0.2	<0.5	<0.5	<0.5	<0.2	<0.2	<0.1	<0.2	<0.5	<0.2
nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
<0.2	<0.2	<0.2	<0.5	<0.5	<0.5	<0.2	<0.2	<0.1	<0.2	<0.5	<0.2
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	<0.5	-	<2
nc	nc	nc	nc	nc	nc	nc	-	-	nc	-	nc
<0.2	<0.2	<0.2	<0.5	<0.5	<0.5	<0.2	<0.2	<0.1	<0.2	<0.5	<0.2
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	<0.5	-	<2
nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc

PAH																									
1-Methylnaphthalene	2-methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(b+j)fluoranthene	Benzo(a) pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene	Total PAHs
µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1
nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1
-	-	<1	<1	<1	<1	<1	<0.5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.5
-	-	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1
-	-	<1	<1	<1	<1	<1	<0.5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.5
-	-	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc

Phenols	TPH											
Total Phenols	C6 - C9	C6-C10	C6-C10 less BTEX (F1)	C10 - C14	C15 - C28	C29-C36	TRH C37-C40	C10-C16 (F2)	C16-C34 (F3)	C34-C40 (F4)	C10 - C36 (Total)	C10 - C40 (Total)
µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
<10	<40	<50	<50	<50	<200	<200	<200	<60	<500	<500	<450	<650
20	<40	<50	<50	<50	<200	<200	<0.2	<0.06	<0.5	<0.5	<450	<650
nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
<10	<40	<50	<50	<50	<200	<200	<200	<60	<500	<500	<450	<650
-	<20	<0.02	<0.02	<50	<100	<50	-	<0.1	<0.1	<0.1	<50	<100
-	nc	nc	nc	nc	nc	nc	-	nc	nc	nc	nc	nc
20	<40	<50	<50	<50	<200	<200	<0.2	<0.06	<0.5	<0.5	<450	<650
-	<20	<0.02	<0.02	<50	<100	<50	-	<0.1	<0.1	<0.1	<50	<100
-	nc	nc	nc	nc	nc	nc	-	nc	nc	nc	nc	nc

APPENDIX D – LABORATORY REPORTS

source: M630_SR_20160928105238.pdf page: 1 SGS Ref: SE157545_COC

E-MAILED
27/9/16 @ T: 09

SGS

CHAIN OF CUSTODY & ANALYSIS REQUEST

SGS Environmental Services
Unit 16, 33 Maddox Street
Alexandria NSW 2015
Telephone No: (02) 85940400
Facsimile No: (02) 85940499
Email: au.samplereceipt.sydney@sgs.com

Company Name:	SMEC	Project Name/No:	3002523 – Canberra Brickworks
Address:	Suite 2, Level 1, 243 Northbourne Avenue, Lyneham,	Purchase Order No:	
	ACT, 2602, Australia	Results Required By:	Ryan O'Leary
		Telephone:	+61 2 6234 1963 / 0400 240 023
Contact Name:	Ryan O'Leary	Facsimile:	
		Email Results:	Ryan.O'Leary@smec.com

Client Sample ID	Date Sampled	Lab Sample ID	WATER	SOIL		NO OF CONTAINERS	Asbestos ID	BTEXN	OPPs	OCPs	PHAs/Phenols	8 Metals - As, Cd, Cr, Cu, Ni, Pb, Zn, Hg	TPH/TRH	On Hold								Comment
M7_0.2-0.3	22/9/2016	1		✓		Jar & Bag	√	√	√	√	√	√	√									
M7_0.9-1.0	22/9/2016			✓		Jar								√								
M8_0.2-0.3	22/9/2016	2		✓		Jar & bag	√															
M8_0.7-0.8	22/9/2016	3		✓		Jar		√	√	√	√	√	√									
M8_1.1-1.2	22/9/2016			✓		Jar								√								
M8_1.6-1.7	22/9/2016			✓		Jar								√								
M8_2.2-2.3	22/9/2016			✓		Jar								√								
M8_4.2-4.3	22/9/2016			✓		Jar								√								
HA/GB1_0.15-0.25	22/9/2016	4		✓		Jar		√	√	√	√	√	√									
W1	22/9/2016	5		✓		Jar & bag	√	√	√	√	√	√	√									

SGS EHS Alexandria Laboratory

SE157545 COC
Received: 23 – Sep – 2016

Relinquished By: Ryan O'Leary	Date/Time: 22/9/2016 16:00	Received By:	Date/Time 23/09/16 @ 10:50
Relinquished By:	Date/Time:	Received By:	Date/Time
Samples Intact: Yes/ No	Temperature: Ambient / Chilled	Sample Cooler Sealed: Yes/ No	Laboratory Quotation No:
	Comments: AS PER SGS QUOTE NUMBER SY1 – 60413 – 2-IS DATED 13TH APRIL 2016	**STANDARD TAT PLEASE (5 DAY)**	

SGS

CHAIN OF CUSTODY & ANALYSIS REQUEST

SGS Environmental Services
Unit 16, 33 Maddox Street
Alexandria NSW 2015
Telephone No: (02) 85940400
Facsimile No: (02) 85940499
Email: au.samplereceipt.sydney@sgs.com

Company Name:	SMEC	Project Name/No:	3002523 – Canberra Brickworks
Address:	Suite 2, Level 1, 243 Northbourne Avenue, Lyneham, ACT, 2602, Australia	Purchase Order No:	
		Results Required By:	Ryan O'Leary
		Telephone:	+61 2 6234 1963 / 0400 240 023
Contact Name:	Ryan O'Leary	Facsimile:	
		Email Results:	Ryan.O'Leary@smec.com

Client Sample ID	Date Sampled	Lab Sample ID	WATER	SOIL		NO OF CONTAINERS	Asbestos ID	BTEXN	OPPs	OCPs	PAHs/Phenols	8H Metals - As, Cd, Cr, Cu, Ni, Pb, Zn, Hg	TPH/TRH	On Hold	PAH							Comment
W2	22/9/2016	6		✓		Jar & bag	√	√	√	√	√	√	√									
W3	22/9/2016	7		✓		Jar & bag	√	√	√	√	√	√	√									
W1	22/9/2016	8	✓			Bottles		√	√	√	√	√	√									
W2	22/9/2016	9	✓			Bottles		√	√	√	√	√	√									
W3	22/9/2016	10	✓			Bottles		√	√	√	√	√	√									
QC 18 (Trip Blank)	22/9/2016	11				Vial							√		√							
QC 19 (Trip Spike)	22/9/2016	12				Vial							√		√							

Relinquished By: Ryan O'Leary	Date/Time: 22/9/2016 16:00	Received By:	Date/Time 23/09/16 @ 10:50
Relinquished By:	Date/Time:	Received By:	Date/Time
Samples Intact: Yes/ No	Temperature: Ambient / Chilled	Sample Cooler Sealed: Yes/ No	Laboratory Quotation No:
	Comments: AS PER SGS QUOTE NUMBER SY1 – 60413 – 2-IS DATED 13TH APRIL 2016	**STANDARD TAT PLEASE (5 DAY)**	

SAMPLE RECEIPT ADVICE

SE157545

CLIENT DETAILS

Contact	Ryan O'Leary
Client	SMEC AUSTRALIA PTY LTD
Address	Sun Micro Building Suite 2, Level 1 243 Northbourne Avenue ACT 2602
Telephone	02 6234 1963
Facsimile	02 6234 1966
Email	Ryan.O'Leary@smec.com
Project	**3002523 - Canberra Brickworks**
Order Number	**SY1-60413-2-IS**
Samples	12

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
Samples Received	Fri 23/9/2016
Report Due	Wed 5/10/2016
SGS Reference	**SE157545**

SUBMISSION DETAILS

This is to confirm that 12 samples were received on Friday 23/9/2016. Results are expected to be ready by Wednesday 5/10/2016. Please quote SGS reference SE157545 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Sample counts by matrix	9 Soil, 3 Water	Type of documentation received	COC
Date documentation received	27/9/16@5:09pm	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	8.3°C
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	Ice Bricks	Samples clearly labelled	Yes
Complete documentation received	Yes	Number of eskies/boxes received	

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

COC received at 27/9/16 @ 5:09pm. Request was not registered until the next business day.
5 soil samples have been placed on hold.
For W3, 125mL H2SO4 P/B was not received. Total Phenols will not be analysed.
One vial received broken for W2.
Trip Blank and Spike will only be analyzed for TRH/BTEX and BTEX respectively.

To the extent not inconsistent with the other provisions of this document and unless specifically agreed otherwise in writing by SGS, all SGS services are rendered in accordance with the applicable SGS General Conditions of Service accessible at http://www.sgs.com/en/terms-and-conditions as at the date of this document. Attention is drawn to the limitations of liability and to the clauses of indemnification.

SAMPLE RECEIPT ADVICE

SE157545

CLIENT DETAILS

Client SMEC AUSTRALIA PTY LTD

Project 3002523 - Canberra Brickworks

SUMMARY OF ANALYSIS

No.	Sample ID	OC Pesticides in Soil	OP Pesticides in Soil	PAH (Polynuclear Aromatic Hydrocarbons) in Soil	Total Phenolics in Soil	Total Recoverable Metals in Soil/Waste	TRH (Total Recoverable Hydrocarbons) in Soil	VOC's in Soil	Volatile Petroleum Hydrocarbons in Soil
001	M7_0.2-0.3	28	13	26	1	7	10	12	8
003	M8_0.7-0.8	28	13	26	1	7	10	12	8
004	HA/GB1_0.15-0.25	28	13	26	1	7	10	12	8
005	W1	28	13	26	1	7	10	12	8
006	W2	28	13	26	1	7	10	12	8
007	W3	28	13	26	1	7	10	12	8
011	QC18 (Trip Blank)	-	-	-	-	-	10	12	8
012	QC19 (Trip Spike)	-	-	-	-	-	-	12	-

CONTINUED OVERLEAF

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

SAMPLE RECEIPT ADVICE

SE157545

CLIENT DETAILS

Client SMEC AUSTRALIA PTY LTD

Project 3002523 - Canberra Brickworks

SUMMARY OF ANALYSIS

No.	Sample ID	Fibre Identification in soil	Mercury in Soil	Moisture Content	VOCs in Water	Volatile Petroleum Hydrocarbons in Water
001	M7_0.2-0.3	2	1	1	-	-
002	M8_0.2-0.3	2	-	-	-	-
003	M8_0.7-0.8	-	1	1	-	-
004	HA/GB1_0.15-0.25	-	1	1	-	-
005	W1	2	1	1	-	-
006	W2	2	1	1	-	-
007	W3	2	1	1	-	-
008	W1	-	-	-	12	8
009	W2	-	-	-	12	8
010	W3	-	-	-	12	8
011	QC18 (Trip Blank)	-	-	1	-	-

CONTINUED OVERLEAF

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

SAMPLE RECEIPT ADVICE

SE157545

CLIENT DETAILS

Client SMEC AUSTRALIA PTY LTD

Project 3002523 - Canberra Brickworks

SUMMARY OF ANALYSIS

No.	Sample ID	Mercury (dissolved) in Water	OC Pesticides in Water	OP Pesticides in Water	PAH (Polynuclear Aromatic Hydrocarbons) in Water	Total Phenolics in Water	Trace Metals (Dissolved) in Water by ICPMS	TRH (Total Recoverable Hydrocarbons) in Water
008	W1	1	28	13	22	1	7	9
009	W2	1	28	13	22	1	7	9
010	W3	1	28	13	22	-	7	9

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Ryan O'Leary
Client	SMEC AUSTRALIA PTY LTD
Address	Sun Micro Building Suite 2, Level 1 243 Northbourne Avenue ACT 2602
Telephone	02 6234 1963
Facsimile	02 6234 1966
Email	Ryan.O'Leary@smec.com
Project	**3002523 - Canberra Brickworks**
Order Number	**SY1-60413-2-IS**
Samples	12

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE157545 R0**
Date Received	23/9/2016
Date Reported	11/10/2016

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(4354).

No respirable fibres detected in all soil samples using trace analysis technique.

Asbestos analysed by Approved Identifier Ravee Sivasubramaniam .

SIGNATORIES

Andy Sutton
Senior Organic Chemist

Bennet Lo
Senior Organic Chemist/Metals Chemist

Dong Liang
Metals/Inorganics Team Leader

Kamrul Ahsan
Senior Chemist

Ly Kim Ha
Organic Section Head

Ravee Sivasubramaniam
Hygiene Team Leader

VOC's in Soil [AN433] Tested: 29/9/2016

PARAMETER	UOM	LOR	M7_0.2-0.3 SOIL - 22/9/2016 SE157545.001	M8_0.7-0.8 SOIL - 22/9/2016 SE157545.003	HA/GB1_0.15-0.25 SOIL - 22/9/2016 SE157545.004	W1 SOIL - 22/9/2016 SE157545.005	W2 SOIL - 22/9/2016 SE157545.006
Benzene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Toluene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ethylbenzene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
m/p-xylene	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
o-xylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Xylenes*	mg/kg	0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Total BTEX	mg/kg	0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Naphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1

PARAMETER	UOM	LOR	W3 SOIL - 22/9/2016 SE157545.007	QC18 (Trip Blank) SOIL - 22/9/2016 SE157545.011	QC19 (Trip Spike) SOIL - 22/9/2016 SE157545.012
Benzene	mg/kg	0.1	<0.1	<0.1	[79%]
Toluene	mg/kg	0.1	<0.1	<0.1	[80%]
Ethylbenzene	mg/kg	0.1	<0.1	<0.1	[93%]
m/p-xylene	mg/kg	0.2	<0.2	<0.2	[84%]
o-xylene	mg/kg	0.1	<0.1	<0.1	[98%]
Total Xylenes*	mg/kg	0.3	<0.3	<0.3	-
Total BTEX	mg/kg	0.6	<0.6	<0.6	-
Naphthalene	mg/kg	0.1	<0.1	<0.1	-

Volatile Petroleum Hydrocarbons in Soil [AN433] Tested: 29/9/2016

PARAMETER	UOM	LOR	M7_0.2-0.3 SOIL - 22/9/2016 SE157545.001	M8_0.7-0.8 SOIL - 22/9/2016 SE157545.003	HA/GB1_0.15-0.25 SOIL - 22/9/2016 SE157545.004	W1 SOIL - 22/9/2016 SE157545.005	W2 SOIL - 22/9/2016 SE157545.006
TRH C6-C9	mg/kg	20	<20	<20	<20	<20	<20
Benzene (F0)	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TRH C6-C10	mg/kg	25	<25	<25	<25	<25	<25
TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25	<25	<25	<25	<25

PARAMETER	UOM	LOR	W3 SOIL - 22/9/2016 SE157545.007	QC18 (Trip Blank) SOIL - 22/9/2016 SE157545.011
TRH C6-C9	mg/kg	20	<20	<20
Benzene (F0)	mg/kg	0.1	<0.1	<0.1
TRH C6-C10	mg/kg	25	<25	<25
TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25	<25

TRH (Total Recoverable Hydrocarbons) in Soil [AN403] Tested: 29/9/2016

PARAMETER	UOM	LOR	M7_0.2-0.3 SOIL - 22/9/2016 SE157545.001	M8_0.7-0.8 SOIL - 22/9/2016 SE157545.003	HA/GB1_0.15-0.25 SOIL - 22/9/2016 SE157545.004	W1 SOIL - 22/9/2016 SE157545.005	W2 SOIL - 22/9/2016 SE157545.006
TRH C10-C14	mg/kg	20	<20	<20	<20	<20	<20
TRH C15-C28	mg/kg	45	<45	<45	<45	<45	<45
TRH C29-C36	mg/kg	45	<45	<45	<45	<45	<45
TRH C37-C40	mg/kg	100	<100	<100	<100	<100	<100
TRH >C10-C16 (F2)	mg/kg	25	<25	<25	<25	<25	<25
TRH >C10-C16 (F2) - Naphthalene	mg/kg	25	<25	<25	<25	<25	<25
TRH >C16-C34 (F3)	mg/kg	90	<90	<90	<90	<90	<90
TRH >C34-C40 (F4)	mg/kg	120	<120	<120	<120	<120	<120
TRH C10-C36 Total	mg/kg	110	<110	<110	<110	<110	<110
TRH C10-C40 Total	mg/kg	210	<210	<210	<210	<210	<210

PARAMETER	UOM	LOR	W3 SOIL - 22/9/2016 SE157545.007	QC18 (Trip Blank) SOIL - 22/9/2016 SE157545.011
TRH C10-C14	mg/kg	20	<20	<20
TRH C15-C28	mg/kg	45	<45	<45
TRH C29-C36	mg/kg	45	<45	<45
TRH C37-C40	mg/kg	100	<100	<100
TRH >C10-C16 (F2)	mg/kg	25	<25	<25
TRH >C10-C16 (F2) - Naphthalene	mg/kg	25	<25	<25
TRH >C16-C34 (F3)	mg/kg	90	<90	<90
TRH >C34-C40 (F4)	mg/kg	120	<120	<120
TRH C10-C36 Total	mg/kg	110	<110	<110
TRH C10-C40 Total	mg/kg	210	<210	<210

PAH (Polynuclear Aromatic Hydrocarbons) in Soil [AN420] Tested: 29/9/2016

PARAMETER	UOM	LOR	M7_0.2-0.3 SOIL - 22/9/2016 SE157545.001	M8_0.7-0.8 SOIL - 22/9/2016 SE157545.003	HA/GB1_0.15-0.25 SOIL - 22/9/2016 SE157545.004	W1 SOIL - 22/9/2016 SE157545.005	W2 SOIL - 22/9/2016 SE157545.006
Naphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b&j)fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(ah)anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Carcinogenic PAHs, BaP TEQ <LOR=0	TEQ	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Carcinogenic PAHs, BaP TEQ <LOR=LOR	TEQ (mg/kg)	0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Carcinogenic PAHs, BaP TEQ <LOR=LOR/2	TEQ (mg/kg)	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Total PAH (18)	mg/kg	0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Total PAH (NEPM/WHO 16)	mg/kg	0.8	<0.8	<0.8	<0.8	<0.8	<0.8

PARAMETER	UOM	LOR	W3 SOIL - 22/9/2016 SE157545.007
Naphthalene	mg/kg	0.1	<0.1
2-methylnaphthalene	mg/kg	0.1	<0.1
1-methylnaphthalene	mg/kg	0.1	<0.1
Acenaphthylene	mg/kg	0.1	<0.1
Acenaphthene	mg/kg	0.1	<0.1
Fluorene	mg/kg	0.1	<0.1
Phenanthrene	mg/kg	0.1	<0.1
Anthracene	mg/kg	0.1	<0.1
Fluoranthene	mg/kg	0.1	<0.1
Pyrene	mg/kg	0.1	<0.1
Benzo(a)anthracene	mg/kg	0.1	<0.1
Chrysene	mg/kg	0.1	<0.1
Benzo(b&j)fluoranthene	mg/kg	0.1	<0.1
Benzo(k)fluoranthene	mg/kg	0.1	<0.1
Benzo(a)pyrene	mg/kg	0.1	<0.1
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	<0.1
Dibenzo(ah)anthracene	mg/kg	0.1	<0.1
Benzo(ghi)perylene	mg/kg	0.1	<0.1
Carcinogenic PAHs, BaP TEQ <LOR=0	TEQ	0.2	<0.2
Carcinogenic PAHs, BaP TEQ <LOR=LOR	TEQ (mg/kg)	0.3	<0.3
Carcinogenic PAHs, BaP TEQ <LOR=LOR/2	TEQ (mg/kg)	0.2	<0.2
Total PAH (18)	mg/kg	0.8	<0.8
Total PAH (NEPM/WHO 16)	mg/kg	0.8	<0.8

OC Pesticides in Soil [AN400/AN420] Tested: 29/9/2016

PARAMETER	UOM	LOR	M7_0.2-0.3 SOIL - 22/9/2016 SE157545.001	M8_0.7-0.8 SOIL - 22/9/2016 SE157545.003	HA/GB1_0.15-0.25 SOIL - 22/9/2016 SE157545.004	W1 SOIL - 22/9/2016 SE157545.005	W2 SOIL - 22/9/2016 SE157545.006
Hexachlorobenzene (HCB)	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Alpha BHC	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lindane	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Beta BHC	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Delta BHC	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor epoxide	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
o,p'-DDE	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Alpha Endosulfan	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Gamma Chlordane	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Alpha Chlordane	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
trans-Nonachlor	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
p,p'-DDE	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Endrin	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
o,p'-DDD	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
o,p'-DDT	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Beta Endosulfan	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
p,p'-DDD	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
p,p'-DDT	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan sulphate	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Ketone	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Isodrin	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Mirex	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1

OC Pesticides in Soil [AN400/AN420] Tested: 29/9/2016 (continued)

PARAMETER	UOM	LOR	W3 SOIL - 22/9/2016 SE157545.007
Hexachlorobenzene (HCB)	mg/kg	0.1	<0.1
Alpha BHC	mg/kg	0.1	<0.1
Lindane	mg/kg	0.1	<0.1
Heptachlor	mg/kg	0.1	<0.1
Aldrin	mg/kg	0.1	<0.1
Beta BHC	mg/kg	0.1	<0.1
Delta BHC	mg/kg	0.1	<0.1
Heptachlor epoxide	mg/kg	0.1	<0.1
o,p'-DDE	mg/kg	0.1	<0.1
Alpha Endosulfan	mg/kg	0.2	<0.2
Gamma Chlordane	mg/kg	0.1	<0.1
Alpha Chlordane	mg/kg	0.1	<0.1
trans-Nonachlor	mg/kg	0.1	<0.1
p,p'-DDE	mg/kg	0.1	<0.1
Dieldrin	mg/kg	0.2	<0.2
Endrin	mg/kg	0.2	<0.2
o,p'-DDD	mg/kg	0.1	<0.1
o,p'-DDT	mg/kg	0.1	<0.1
Beta Endosulfan	mg/kg	0.2	<0.2
p,p'-DDD	mg/kg	0.1	<0.1
p,p'-DDT	mg/kg	0.1	<0.1
Endosulfan sulphate	mg/kg	0.1	<0.1
Endrin Aldehyde	mg/kg	0.1	<0.1
Methoxychlor	mg/kg	0.1	<0.1
Endrin Ketone	mg/kg	0.1	<0.1
Isodrin	mg/kg	0.1	<0.1
Mirex	mg/kg	0.1	<0.1

OP Pesticides in Soil [AN400/AN420] Tested: 29/9/2016

PARAMETER	UOM	LOR	M7_0.2-0.3 SOIL - 22/9/2016 SE157545.001	M8_0.7-0.8 SOIL - 22/9/2016 SE157545.003	HA/GB1_0.15-0.25 SOIL - 22/9/2016 SE157545.004	W1 SOIL - 22/9/2016 SE157545.005	W2 SOIL - 22/9/2016 SE157545.006
Dichlorvos	mg/kg	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dimethoate	mg/kg	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Diazinon (Dimpylate)	mg/kg	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fenitrothion	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Malathion	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Chlorpyrifos (Chlorpyrifos Ethyl)	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Parathion-ethyl (Parathion)	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Bromophos Ethyl	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Methidathion	mg/kg	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethion	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Azinphos-methyl (Guthion)	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2

PARAMETER	UOM	LOR	W3 SOIL - 22/9/2016 SE157545.007
Dichlorvos	mg/kg	0.5	<0.5
Dimethoate	mg/kg	0.5	<0.5
Diazinon (Dimpylate)	mg/kg	0.5	<0.5
Fenitrothion	mg/kg	0.2	<0.2
Malathion	mg/kg	0.2	<0.2
Chlorpyrifos (Chlorpyrifos Ethyl)	mg/kg	0.2	<0.2
Parathion-ethyl (Parathion)	mg/kg	0.2	<0.2
Bromophos Ethyl	mg/kg	0.2	<0.2
Methidathion	mg/kg	0.5	<0.5
Ethion	mg/kg	0.2	<0.2
Azinphos-methyl (Guthion)	mg/kg	0.2	<0.2

Total Phenolics in Soil [AN289] Tested: 29/9/2016

PARAMETER	UOM	LOR	M7_0.2-0.3 SOIL - 22/9/2016 SE157545.001	M8_0.7-0.8 SOIL - 22/9/2016 SE157545.003	HA/GB1_0.15-0.25 SOIL - 22/9/2016 SE157545.004	W1 SOIL - 22/9/2016 SE157545.005	W2 SOIL - 22/9/2016 SE157545.006
Total Phenols	mg/kg	0.1	**2.3**	<0.1	<0.1	<0.1	**0.4**

PARAMETER	UOM	LOR	W3 SOIL - 22/9/2016 SE157545.007
Total Phenols	mg/kg	0.1	**1.8**

Total Recoverable Metals in Soil/Waste Solids/Materials by ICPOES [AN040/AN320] Tested: 4/10/2016

PARAMETER	UOM	LOR	M7_0.2-0.3 SOIL - 22/9/2016 SE157545.001	M8_0.7-0.8 SOIL - 22/9/2016 SE157545.003	HA/GB1_0.15-0.25 SOIL - 22/9/2016 SE157545.004	W1 SOIL - 22/9/2016 SE157545.005	W2 SOIL - 22/9/2016 SE157545.006
Arsenic, As	mg/kg	3	3	9	7	12	5
Cadmium, Cd	mg/kg	0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Chromium, Cr	mg/kg	0.3	33	24	14	17	9.7
Copper, Cu	mg/kg	0.5	13	12	14	15	12
Lead, Pb	mg/kg	1	19	54	28	33	22
Nickel, Ni	mg/kg	0.5	9.8	13	21	16	7.9
Zinc, Zn	mg/kg	0.5	26	58	22	78	34

PARAMETER	UOM	LOR	W3 SOIL - 22/9/2016 SE157545.007
Arsenic, As	mg/kg	3	5
Cadmium, Cd	mg/kg	0.3	<0.3
Chromium, Cr	mg/kg	0.3	14
Copper, Cu	mg/kg	0.5	11
Lead, Pb	mg/kg	1	25
Nickel, Ni	mg/kg	0.5	9.4
Zinc, Zn	mg/kg	0.5	44

Mercury in Soil [AN312] Tested: 4/10/2016

PARAMETER	UOM	LOR	M7_0.2-0.3 SOIL - 22/9/2016 SE157545.001	M8_0.7-0.8 SOIL - 22/9/2016 SE157545.003	HA/GB1_0.15-0.25 SOIL - 22/9/2016 SE157545.004	W1 SOIL - 22/9/2016 SE157545.005	W2 SOIL - 22/9/2016 SE157545.006
Mercury	mg/kg	0.05	<0.05	<0.05	<0.05	<0.05	<0.05

PARAMETER	UOM	LOR	W3 SOIL - 22/9/2016 SE157545.007
Mercury	mg/kg	0.05	<0.05

Moisture Content [AN002] Tested: 30/9/2016

PARAMETER	UOM	LOR	M7_0.2-0.3 SOIL - 22/9/2016 SE157545.001	M8_0.7-0.8 SOIL - 22/9/2016 SE157545.003	HA/GB1_0.15-0.25 SOIL - 22/9/2016 SE157545.004	W1 SOIL - 22/9/2016 SE157545.005	W2 SOIL - 22/9/2016 SE157545.006
% Moisture	%w/w	0.5	20	16	8.9	26	20

PARAMETER	UOM	LOR	W3 SOIL - 22/9/2016 SE157545.007	QC18 (Trip Blank) SOIL - 22/9/2016 SE157545.011
% Moisture	%w/w	0.5	24	<0.5

Fibre Identification in soil [AN602] Tested: 4/10/2016

PARAMETER	UOM	LOR	M7_0.2-0.3 SOIL - 22/9/2016 SE157545.001	M8_0.2-0.3 SOIL - 22/9/2016 SE157545.002	W1 SOIL - 22/9/2016 SE157545.005	W2 SOIL - 22/9/2016 SE157545.006	W3 SOIL - 22/9/2016 SE157545.007
Asbestos Detected	No unit	-	No	No	No	No	No
Estimated Fibres*	%w/w	0.01	<0.01	<0.01	<0.01	<0.01	<0.01

VOCs in Water [AN433] Tested: 30/9/2016

PARAMETER	UOM	LOR	W1 WATER - 22/9/2016 SE157545.008	W2 WATER - 22/9/2016 SE157545.009	W3 WATER - 22/9/2016 SE157545.010
Benzene	µg/L	0.5	<0.5	<0.5	<0.5
Toluene	µg/L	0.5	<0.5	<0.5	<0.5
Ethylbenzene	µg/L	0.5	<0.5	<0.5	<0.5
m/p-xylene	µg/L	1	<1	<1	<1
o-xylene	µg/L	0.5	<0.5	<0.5	<0.5
Total Xylenes	µg/L	1.5	<1.5	<1.5	<1.5
Total BTEX	µg/L	3	<3	<3	<3
Naphthalene	µg/L	0.5	<0.5	<0.5	<0.5

Volatile Petroleum Hydrocarbons in Water [AN433] Tested: 30/9/2016

PARAMETER	UOM	LOR	W1 WATER - 22/9/2016 SE157545.008	W2 WATER - 22/9/2016 SE157545.009	W3 WATER - 22/9/2016 SE157545.010
TRH C6-C9	µg/L	40	<40	<40	<40
Benzene (F0)	µg/L	0.5	<0.5	<0.5	<0.5
TRH C6-C10	µg/L	50	<50	<50	<50
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<50	<50

TRH (Total Recoverable Hydrocarbons) in Water [AN403] Tested: 29/9/2016

PARAMETER	UOM	LOR	W1 WATER - 22/9/2016 SE157545.008	W2 WATER - 22/9/2016 SE157545.009	W3 WATER - 22/9/2016 SE157545.010
TRH C10-C14	µg/L	50	<50	<50	<50
TRH C15-C28	µg/L	200	<200	<200	<200
TRH C29-C36	µg/L	200	<200	<200	<200
TRH C37-C40	µg/L	200	<200	<200	<200
TRH >C10-C16 (F2)	µg/L	60	<60	<60	<60
TRH >C16-C34 (F3)	µg/L	500	<500	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500
TRH C10-C36	µg/L	450	<450	<450	<450
TRH C10-C40	µg/L	650	<650	<650	<650

PAH (Polynuclear Aromatic Hydrocarbons) in Water [AN420] Tested: 29/9/2016

PARAMETER	UOM	LOR	W1 WATER - 22/9/2016 SE157545.008	W2 WATER - 22/9/2016 SE157545.009	W3 WATER - 22/9/2016 SE157545.010
Naphthalene	µg/L	0.1	<0.1	<0.1	<0.1
2-methylnaphthalene	µg/L	0.1	<0.1	<0.1	<0.1
1-methylnaphthalene	µg/L	0.1	<0.1	<0.1	<0.1
Acenaphthylene	µg/L	0.1	<0.1	<0.1	<0.1
Acenaphthene	µg/L	0.1	<0.1	<0.1	<0.1
Fluorene	µg/L	0.1	<0.1	<0.1	<0.1
Phenanthrene	µg/L	0.1	<0.1	<0.1	<0.1
Anthracene	µg/L	0.1	<0.1	<0.1	<0.1
Fluoranthene	µg/L	0.1	<0.1	<0.1	<0.1
Pyrene	µg/L	0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	µg/L	0.1	<0.1	<0.1	<0.1
Chrysene	µg/L	0.1	<0.1	<0.1	<0.1
Benzo(b&j)fluoranthene	µg/L	0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	µg/L	0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	µg/L	0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	µg/L	0.1	<0.1	<0.1	<0.1
Dibenzo(ah)anthracene	µg/L	0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	µg/L	0.1	<0.1	<0.1	<0.1
Total PAH (18)	µg/L	1	<1	<1	<1

OC Pesticides in Water [AN400/AN420] Tested: 29/9/2016

PARAMETER	UOM	LOR	W1 WATER - 22/9/2016 SE157545.008	W2 WATER - 22/9/2016 SE157545.009	W3 WATER - 22/9/2016 SE157545.010
Hexachlorobenzene (HCB)	µg/L	0.1	<0.1	<0.1	<0.1
Alpha BHC	µg/L	0.1	<0.1	<0.1	<0.1
Lindane (gamma BHC)	µg/L	0.1	<0.1	<0.1	<0.1
Heptachlor	µg/L	0.1	<0.1	<0.1	<0.1
Aldrin	µg/L	0.1	<0.1	<0.1	<0.1
Beta BHC	µg/L	0.1	<0.1	<0.1	<0.1
Delta BHC	µg/L	0.1	<0.1	<0.1	<0.1
Heptachlor epoxide	µg/L	0.1	<0.1	<0.1	<0.1
o,p'-DDE	µg/L	0.1	<0.1	<0.1	<0.1
Alpha Endosulfan	µg/L	0.1	<0.1	<0.1	<0.1
Gamma Chlordane	µg/L	0.1	<0.1	<0.1	<0.1
Alpha Chlordane	µg/L	0.1	<0.1	<0.1	<0.1
trans-Nonachlor	µg/L	0.1	<0.1	<0.1	<0.1
p,p'-DDE	µg/L	0.1	<0.1	<0.1	<0.1
Dieldrin	µg/L	0.1	<0.1	<0.1	<0.1
Endrin	µg/L	0.1	<0.1	<0.1	<0.1
o,p'-DDD	µg/L	0.1	<0.1	<0.1	<0.1
o,p'-DDT	µg/L	0.1	<0.1	<0.1	<0.1
Beta Endosulfan	µg/L	0.1	<0.1	<0.1	<0.1
p,p'-DDD	µg/L	0.1	<0.1	<0.1	<0.1
p,p'-DDT	µg/L	0.1	<0.1	<0.1	<0.1
Endosulfan sulphate	µg/L	0.1	<0.1	<0.1	<0.1
Endrin aldehyde	µg/L	0.1	<0.1	<0.1	<0.1
Methoxychlor	µg/L	0.1	<0.1	<0.1	<0.1
Endrin ketone	µg/L	0.1	<0.1	<0.1	<0.1
Isodrin	µg/L	0.1	<0.1	<0.1	<0.1
Mirex	µg/L	0.1	<0.1	<0.1	<0.1

OP Pesticides in Water [AN400/AN420] Tested: 29/9/2016

PARAMETER	UOM	LOR	W1 WATER - 22/9/2016 SE157545.008	W2 WATER - 22/9/2016 SE157545.009	W3 WATER - 22/9/2016 SE157545.010
Dichlorvos	µg/L	0.5	<0.5	<0.5	<0.5
Dimethoate	µg/L	0.5	<0.5	<0.5	<0.5
Diazinon (Dimpylate)	µg/L	0.5	<0.5	<0.5	<0.5
Fenitrothion	µg/L	0.2	<0.2	<0.2	<0.2
Malathion	µg/L	0.2	<0.2	<0.2	<0.2
Chlorpyrifos (Chlorpyrifos Ethyl)	µg/L	0.2	<0.2	<0.2	<0.2
Parathion-ethyl (Parathion)	µg/L	0.2	<0.2	<0.2	<0.2
Bromophos Ethyl	µg/L	0.2	<0.2	<0.2	<0.2
Methidathion	µg/L	0.5	<0.5	<0.5	<0.5
Ethion	µg/L	0.2	<0.2	<0.2	<0.2
Azinphos-methyl	µg/L	0.2	<0.2	<0.2	<0.2

Total Phenolics in Water [AN289] Tested: 30/9/2016

PARAMETER	UOM	LOR	W1 WATER - 22/9/2016 SE157545.008	W2 WATER - 22/9/2016 SE157545.009	W3 WATER - 22/9/2016 SE157545.010
Total Phenols	mg/L	0.01	<0.01	<0.01	IS

Trace Metals (Dissolved) in Water by ICPMS [AN318] Tested: 29/9/2016

PARAMETER	UOM	LOR	W1 WATER - 22/9/2016 SE157545.008	W2 WATER - 22/9/2016 SE157545.009	W3 WATER - 22/9/2016 SE157545.010
Arsenic, As	µg/L	1	1	<1	<1
Cadmium, Cd	µg/L	0.1	<0.1	<0.1	<0.1
Chromium, Cr	µg/L	1	<1	<1	<1
Copper, Cu	µg/L	1	<1	1	1
Lead, Pb	µg/L	1	<1	<1	<1
Nickel, Ni	µg/L	1	1	<1	1
Zinc, Zn	µg/L	5	25	5	22

Mercury (dissolved) in Water [AN311(Perth)/AN312] Tested: 4/10/2016

PARAMETER	UOM	LOR	W1 WATER - 22/9/2016 SE157545.008	W2 WATER - 22/9/2016 SE157545.009	W3 WATER - 22/9/2016 SE157545.010
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN020	Unpreserved water sample is filtered through a 0.45µm membrane filter and acidified with nitric acid similar to APHA3030B.
AN040/AN320	A portion of sample is digested with nitric acid to decompose organic matter and hydrochloric acid to complete the digestion of metals. The digest is then analysed by ICP OES with metals results reported on the dried sample basis. Based on USEPA method 200.8 and 6010C.
AN040	A portion of sample is digested with Nitric acid to decompose organic matter and Hydrochloric acid to complete the digestion of metals and then filtered for analysis by ASS or ICP as per USEPA Method 200.8.
AN289	Analysis of Total Phenols in Soil Sediment and Water: Steam distillable phenols react with 4-aminoantipyrine at pH 7.9±0.1 in the presence of potassium ferricyanide to form a coloured antipyrine dye analysed by Discrete Analyser. Reference APHA 5530 B/D.
AN311(Perth)/AN312	Mercury by Cold Vapour AAS in Waters: Mercury ions are reduced by stannous chloride reagent in acidic solution to elemental mercury. This mercury vapour is purged by nitrogen into a cold cell in an atomic absorption spectrometer or mercury analyser. Quantification is made by comparing absorbances to those of the calibration standards. Reference APHA 3112/3500.
AN312	Mercury by Cold Vapour AAS in Soils: After digestion with nitric acid, hydrogen peroxide and hydrochloric acid , mercury ions are reduced by stannous chloride reagent in acidic solution to elemental mercury. This mercury vapour is purged by nitrogen into a cold cell in an atomic absorption spectrometer or mercury analyser . Quantification is made by comparing absorbances to those of the calibration standards. Reference APHA 3112/3500
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN400	OC and OP Pesticides by GC-ECD: The determination of organochlorine (OC) and organophosphorus (OP) pesticides and polychlorinated biphenyls (PCBs) in soils, sludges and groundwater. (Based on USEPA methods 3510, 3550, 8140 and 8080.)
AN403	Total Recoverable Hydrocarbons: Determination of Hydrocarbons by gas chromatography after a solvent extraction. Detection is by flame ionisation detector (FID) that produces an electronic signal in proportion to the combustible matter passing through it. Total Recoverable Hydrocarbons (TRH) are routinely reported as four alkane groupings based on the carbon chain length of the compounds: C6-C9, C10-C14, C15-C28 and C29-C36 and in recognition of the NEPM 1999 (2013), >C10-C16 (F2), >C16-C34 (F3) and >C34-C40 (F4). F2 is reported directly and also corrected by subtracting Naphthalene (from VOC method AN433) where available.
AN403	Additionally, the volatile C6-C9 fraction may be determined by a purge and trap technique and GC/MS because of the potential for volatiles loss. Total Petroleum Hydrocarbons (TPH) follows the same method of analysis after silica gel cleanup of the solvent extract. Aliphatic/Aromatic Speciation follows the same method of analysis after fractionation of the solvent extract over silica with differential polarity of the eluent solvents .
AN403	The GC/FID method is not well suited to the analysis of refined high boiling point materials (ie lubricating oils or greases) but is particularly suited for measuring diesel, kerosene and petrol if care to control volatility is taken. This method will detect naturally occurring hydrocarbons, lipids, animal fats, phenols and PAHs if they are present at sufficient levels, dependent on the use of specific cleanup /fractionation techniques. Reference USEPA 3510B, 8015B.
AN420	(SVOCs) including OC, OP, PCB, Herbicides, PAH, Phthalates and Speciated Phenols (etc) in soils, sediments and waters are determined by GCMS/ECD technique following appropriate solvent extraction process (Based on USEPA 3500C and 8270D).
AN420	SVOC Compounds: Semi-Volatile Organic Compounds (SVOCs) including OC, OP, PCB, Herbicides, PAH, Phthalates and Speciated Phenols in soils, sediments and waters are determined by GCMS /ECD technique following appropriate solvent extraction process (Based on USEPA 3500C and 8270D).
AN433	VOCs and C6-C9 Hydrocarbons by GC-MS P&T: VOC`s are volatile organic compounds. The sample is presented to a gas chromatograph via a purge and trap (P&T) concentrator and autosampler and is detected with a Mass Spectrometer (MSD). Solid samples are initially extracted with methanol whilst liquid samples are processed directly. References: USEPA 5030B, 8020A, 8260.
AN602	Qualitative identification of chrysotile, amosite and crocidolite in bulk samples by polarised light microscopy (PLM) in conjunction with dispersion staining (DS). AS4964 provides the basis for this document. Unequivocal identification of the asbestos minerals present is made by obtaining sufficient diagnostic `clues`, which provide a reasonable degree of certainty, dispersion staining is a mandatory `clue` for positive identification. If sufficient `clues` are absent, then positive identification of asbestos is not possible. This procedure requires removal of suspect fibres/bundles from the sample which cannot be returned.
AN602	Fibres/material that cannot be unequivocably identified as one of the three asbestos forms, will be reported as unknown mineral fibres (umf).

AN602	AS4964.2004 Method for the Qualitative Identification of Asbestos in Bulk Samples, Section 8.4, Trace Analysis Criteria, Note 4 states:"Depending upon sample condition and fibre type, the detection limit of this technique has been found to lie generally in the range of 1 in 1,000 to 1 in 10,000 parts by weight, equivalent to 1 to 0.1 g/kg."
AN602	The sample can be reported “no asbestos found at the reporting limit of 0.1 g/kg” (<0.01%w/w) where AN602 section 4.5 of this method has been followed, and if- (a) no trace asbestos fibres have been detected (i.e. no ‘respirable’ fibres): (b) the estimated weight of non-respirable asbestos fibre bundles and/or the estimated weight of asbestos in asbestos-containing materials are found to be less than 0.1g/kg: and (c) these non-respirable asbestos fibre bundles and/or the asbestos containing materials are only visible under stereo-microscope viewing conditions.

FOOTNOTES

*	NATA accreditation does not cover the performance of this service.	-	Not analysed.	UOM	Unit of Measure.
		NVL	Not validated.	LOR	Limit of Reporting.
**	Indicative data, theoretical holding time exceeded.	IS	Insufficient sample for analysis.	↑↓	Raised/lowered Limit of Reporting.
		LNR	Sample listed, but not received.		

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/en/terms-and-conditions. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

This report must not be reproduced, except in full.

STATEMENT OF QA/QC PERFORMANCE

SE157545 R0

CLIENT DETAILS

Contact	Ryan O'Leary
Client	SMEC AUSTRALIA PTY LTD
Address	Sun Micro Building Suite 2, Level 1 243 Northbourne Avenue ACT 2602
Telephone	02 6234 1963
Facsimile	02 6234 1966
Email	Ryan.O'Leary@smec.com
Project	**3002523 - Canberra Brickworks**
Order Number	**SY1-60413-2-IS**
Samples	12

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE157545 R0**
Date Received	23 Sep 2016
Date Reported	11 Oct 2016

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document and was supplied by the Client.
This QA/QC Statement must be read in conjunction with the referenced Analytical Report.
The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met with the exception of the following:

Extraction Date	VOCs in Water	3 items
	Volatile Petroleum Hydrocarbons in Water	3 items
Duplicate	VOCs in Water	1 item
	Volatile Petroleum Hydrocarbons in Water	1 item

SAMPLE SUMMARY

Sample counts by matrix	9 Soil, 3 Water	Type of documentation received	COC
Date documentation received	27/9/16@5:09pm	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	8.3°C
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	Ice Bricks	Samples clearly labelled	Yes
Complete documentation received	Yes	Number of eskies/boxes received	

HOLDING TIME SUMMARY

SE157545 R0

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS “Field Sampling Guide for Containers and Holding Time” (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Fibre Identification in soil

Method: ME-(AU)-[ENV]AN602

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M7_0.2-0.3	SE157545.001	LB111013	22 Sep 2016	23 Sep 2016	22 Sep 2017	04 Oct 2016	22 Sep 2017	05 Oct 2016
M8_0.2-0.3	SE157545.002	LB111013	22 Sep 2016	23 Sep 2016	22 Sep 2017	04 Oct 2016	22 Sep 2017	05 Oct 2016
W1	SE157545.005	LB111013	22 Sep 2016	23 Sep 2016	22 Sep 2017	04 Oct 2016	22 Sep 2017	05 Oct 2016
W2	SE157545.006	LB111013	22 Sep 2016	23 Sep 2016	22 Sep 2017	04 Oct 2016	22 Sep 2017	05 Oct 2016
W3	SE157545.007	LB111013	22 Sep 2016	23 Sep 2016	22 Sep 2017	04 Oct 2016	22 Sep 2017	05 Oct 2016

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311(Perth)/AN312

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
W1	SE157545.008	LB110970	22 Sep 2016	23 Sep 2016	20 Oct 2016	04 Oct 2016	20 Oct 2016	05 Oct 2016
W2	SE157545.009	LB110970	22 Sep 2016	23 Sep 2016	20 Oct 2016	04 Oct 2016	20 Oct 2016	05 Oct 2016
W3	SE157545.010	LB110970	22 Sep 2016	23 Sep 2016	20 Oct 2016	04 Oct 2016	20 Oct 2016	05 Oct 2016

Mercury in Soil

Method: ME-(AU)-[ENV]AN312

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M7_0.2-0.3	SE157545.001	LB110977	22 Sep 2016	23 Sep 2016	20 Oct 2016	04 Oct 2016	20 Oct 2016	05 Oct 2016
M8_0.7-0.8	SE157545.003	LB110977	22 Sep 2016	23 Sep 2016	20 Oct 2016	04 Oct 2016	20 Oct 2016	05 Oct 2016
HA/GB1_0.15-0.25	SE157545.004	LB110977	22 Sep 2016	23 Sep 2016	20 Oct 2016	04 Oct 2016	20 Oct 2016	05 Oct 2016
W1	SE157545.005	LB110977	22 Sep 2016	23 Sep 2016	20 Oct 2016	04 Oct 2016	20 Oct 2016	05 Oct 2016
W2	SE157545.006	LB110977	22 Sep 2016	23 Sep 2016	20 Oct 2016	04 Oct 2016	20 Oct 2016	05 Oct 2016
W3	SE157545.007	LB110977	22 Sep 2016	23 Sep 2016	20 Oct 2016	04 Oct 2016	20 Oct 2016	05 Oct 2016

Moisture Content

Method: ME-(AU)-[ENV]AN002

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M7_0.2-0.3	SE157545.001	LB110857	22 Sep 2016	23 Sep 2016	06 Oct 2016	30 Sep 2016	05 Oct 2016	05 Oct 2016
M8_0.7-0.8	SE157545.003	LB110857	22 Sep 2016	23 Sep 2016	06 Oct 2016	30 Sep 2016	05 Oct 2016	05 Oct 2016
HA/GB1_0.15-0.25	SE157545.004	LB110857	22 Sep 2016	23 Sep 2016	06 Oct 2016	30 Sep 2016	05 Oct 2016	05 Oct 2016
W1	SE157545.005	LB110857	22 Sep 2016	23 Sep 2016	06 Oct 2016	30 Sep 2016	05 Oct 2016	05 Oct 2016
W2	SE157545.006	LB110857	22 Sep 2016	23 Sep 2016	06 Oct 2016	30 Sep 2016	05 Oct 2016	05 Oct 2016
W3	SE157545.007	LB110857	22 Sep 2016	23 Sep 2016	06 Oct 2016	30 Sep 2016	05 Oct 2016	05 Oct 2016
QC18 (Trip Blank)	SE157545.011	LB110857	22 Sep 2016	23 Sep 2016	06 Oct 2016	30 Sep 2016	05 Oct 2016	05 Oct 2016

OC Pesticides in Soil

Method: ME-(AU)-[ENV]AN400/AN420

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M7_0.2-0.3	SE157545.001	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
M8_0.7-0.8	SE157545.003	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
HA/GB1_0.15-0.25	SE157545.004	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
W1	SE157545.005	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
W2	SE157545.006	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
W3	SE157545.007	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
QC18 (Trip Blank)	SE157545.011	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016

OC Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
W1	SE157545.008	LB110738	22 Sep 2016	23 Sep 2016	29 Sep 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
W2	SE157545.009	LB110738	22 Sep 2016	23 Sep 2016	29 Sep 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
W3	SE157545.010	LB110738	22 Sep 2016	23 Sep 2016	29 Sep 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016

OP Pesticides in Soil

Method: ME-(AU)-[ENV]AN400/AN420

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M7_0.2-0.3	SE157545.001	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
M8_0.7-0.8	SE157545.003	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
HA/GB1_0.15-0.25	SE157545.004	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
W1	SE157545.005	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
W2	SE157545.006	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
W3	SE157545.007	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
QC18 (Trip Blank)	SE157545.011	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016

OP Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
W1	SE157545.008	LB110738	22 Sep 2016	23 Sep 2016	29 Sep 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016
W2	SE157545.009	LB110738	22 Sep 2016	23 Sep 2016	29 Sep 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016
W3	SE157545.010	LB110738	22 Sep 2016	23 Sep 2016	29 Sep 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016

HOLDING TIME SUMMARY

SE157545 R0

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS “Field Sampling Guide for Containers and Holding Time” (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

PAH (Polynuclear Aromatic Hydrocarbons) in Soil

Method: ME-(AU)-[ENV]AN420

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M7_0.2-0.3	SE157545.001	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
M8_0.7-0.8	SE157545.003	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
HA/GB1_0.15-0.25	SE157545.004	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
W1	SE157545.005	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
W2	SE157545.006	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
W3	SE157545.007	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
QC18 (Trip Blank)	SE157545.011	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016

PAH (Polynuclear Aromatic Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN420

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
W1	SE157545.008	LB110738	22 Sep 2016	23 Sep 2016	29 Sep 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016
W2	SE157545.009	LB110738	22 Sep 2016	23 Sep 2016	29 Sep 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016
W3	SE157545.010	LB110738	22 Sep 2016	23 Sep 2016	29 Sep 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016

Total Phenolics in Soil

Method: ME-(AU)-[ENV]AN289

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M7_0.2-0.3	SE157545.001	LB110743	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	06 Oct 2016	05 Oct 2016
M8_0.7-0.8	SE157545.003	LB110743	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	06 Oct 2016	05 Oct 2016
HA/GB1_0.15-0.25	SE157545.004	LB110743	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	06 Oct 2016	05 Oct 2016
W1	SE157545.005	LB110743	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	06 Oct 2016	05 Oct 2016
W2	SE157545.006	LB110743	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	06 Oct 2016	05 Oct 2016
W3	SE157545.007	LB110743	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	06 Oct 2016	05 Oct 2016

Total Phenolics in Water

Method: ME-(AU)-[ENV]AN289

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
W1	SE157545.008	LB110849	22 Sep 2016	23 Sep 2016	20 Oct 2016	30 Sep 2016	20 Oct 2016	30 Sep 2016
W2	SE157545.009	LB110849	22 Sep 2016	23 Sep 2016	20 Oct 2016	30 Sep 2016	20 Oct 2016	30 Sep 2016

Total Recoverable Metals in Soil/Waste Solids/Materials by ICPOES

Method: ME-(AU)-[ENV]AN040/AN320

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M7_0.2-0.3	SE157545.001	LB111001	22 Sep 2016	23 Sep 2016	21 Mar 2017	04 Oct 2016	21 Mar 2017	11 Oct 2016
M8_0.7-0.8	SE157545.003	LB111001	22 Sep 2016	23 Sep 2016	21 Mar 2017	04 Oct 2016	21 Mar 2017	11 Oct 2016
HA/GB1_0.15-0.25	SE157545.004	LB111001	22 Sep 2016	23 Sep 2016	21 Mar 2017	04 Oct 2016	21 Mar 2017	11 Oct 2016
W1	SE157545.005	LB111001	22 Sep 2016	23 Sep 2016	21 Mar 2017	04 Oct 2016	21 Mar 2017	11 Oct 2016
W2	SE157545.006	LB111001	22 Sep 2016	23 Sep 2016	21 Mar 2017	04 Oct 2016	21 Mar 2017	11 Oct 2016
W3	SE157545.007	LB111001	22 Sep 2016	23 Sep 2016	21 Mar 2017	04 Oct 2016	21 Mar 2017	11 Oct 2016

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
W1	SE157545.008	LB110745	22 Sep 2016	23 Sep 2016	21 Mar 2017	29 Sep 2016	21 Mar 2017	29 Sep 2016
W2	SE157545.009	LB110745	22 Sep 2016	23 Sep 2016	21 Mar 2017	29 Sep 2016	21 Mar 2017	29 Sep 2016
W3	SE157545.010	LB110745	22 Sep 2016	23 Sep 2016	21 Mar 2017	29 Sep 2016	21 Mar 2017	29 Sep 2016

TRH (Total Recoverable Hydrocarbons) in Soil

Method: ME-(AU)-[ENV]AN403

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M7_0.2-0.3	SE157545.001	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
M8_0.7-0.8	SE157545.003	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
HA/GB1_0.15-0.25	SE157545.004	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
W1	SE157545.005	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
W2	SE157545.006	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
W3	SE157545.007	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016
QC18 (Trip Blank)	SE157545.011	LB110824	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	05 Oct 2016

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
W1	SE157545.008	LB110738	22 Sep 2016	23 Sep 2016	29 Sep 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016
W2	SE157545.009	LB110738	22 Sep 2016	23 Sep 2016	29 Sep 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016
W3	SE157545.010	LB110738	22 Sep 2016	23 Sep 2016	29 Sep 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016

VOC's in Soil

Method: ME-(AU)-[ENV]AN433

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M7_0.2-0.3	SE157545.001	LB110735	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016
M8_0.7-0.8	SE157545.003	LB110735	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016
HA/GB1_0.15-0.25	SE157545.004	LB110735	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016

HOLDING TIME SUMMARY

SE157545 R0

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS “Field Sampling Guide for Containers and Holding Time” (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

VOC's in Soil (continued)

Method: ME-(AU)-[ENV]AN433

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
W1	SE157545.005	LB110735	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016
W2	SE157545.006	LB110735	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016
W3	SE157545.007	LB110735	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016
QC18 (Trip Blank)	SE157545.011	LB110735	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016
QC19 (Trip Spike)	SE157545.012	LB110735	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016

VOCs in Water

Method: ME-(AU)-[ENV]AN433

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
W1	SE157545.008	LB110850	22 Sep 2016	23 Sep 2016	29 Sep 2016	30 Sep 2016†	09 Nov 2016	04 Oct 2016
W2	SE157545.009	LB110850	22 Sep 2016	23 Sep 2016	29 Sep 2016	30 Sep 2016†	09 Nov 2016	04 Oct 2016
W3	SE157545.010	LB110850	22 Sep 2016	23 Sep 2016	29 Sep 2016	30 Sep 2016†	09 Nov 2016	04 Oct 2016

Volatile Petroleum Hydrocarbons in Soil

Method: ME-(AU)-[ENV]AN433

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M7_0.2-0.3	SE157545.001	LB110735	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016
M8_0.7-0.8	SE157545.003	LB110735	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016
HA/GB1_0.15-0.25	SE157545.004	LB110735	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016
W1	SE157545.005	LB110735	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016
W2	SE157545.006	LB110735	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016
W3	SE157545.007	LB110735	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016
QC18 (Trip Blank)	SE157545.011	LB110735	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016
QC19 (Trip Spike)	SE157545.012	LB110735	22 Sep 2016	23 Sep 2016	06 Oct 2016	29 Sep 2016	08 Nov 2016	30 Sep 2016

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
W1	SE157545.008	LB110850	22 Sep 2016	23 Sep 2016	29 Sep 2016	30 Sep 2016†	09 Nov 2016	04 Oct 2016
W2	SE157545.009	LB110850	22 Sep 2016	23 Sep 2016	29 Sep 2016	30 Sep 2016†	09 Nov 2016	04 Oct 2016
W3	SE157545.010	LB110850	22 Sep 2016	23 Sep 2016	29 Sep 2016	30 Sep 2016†	09 Nov 2016	04 Oct 2016

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

OC Pesticides in Soil

Method: ME-(AU)-[ENV]AN400/AN420

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Tetrachloro-m-xylene (TCMX) (Surrogate)	M7_0.2-0.3	SE157545.001	%	60 - 130%	85
	M8_0.7-0.8	SE157545.003	%	60 - 130%	82
	HA/GB1_0.15-0.25	SE157545.004	%	60 - 130%	79
	W1	SE157545.005	%	60 - 130%	88
	W2	SE157545.006	%	60 - 130%	85
	W3	SE157545.007	%	60 - 130%	91

OC Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Tetrachloro-m-xylene (TCMX) (Surrogate)	W1	SE157545.008	%	40 - 130%	59
	W2	SE157545.009	%	40 - 130%	61
	W3	SE157545.010	%	40 - 130%	40

OP Pesticides in Soil

Method: ME-(AU)-[ENV]AN400/AN420

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
2-fluorobiphenyl (Surrogate)	M7_0.2-0.3	SE157545.001	%	60 - 130%	76
	M8_0.7-0.8	SE157545.003	%	60 - 130%	80
	HA/GB1_0.15-0.25	SE157545.004	%	60 - 130%	78
	W1	SE157545.005	%	60 - 130%	80
	W2	SE157545.006	%	60 - 130%	80
	W3	SE157545.007	%	60 - 130%	80
d14-p-terphenyl (Surrogate)	M7_0.2-0.3	SE157545.001	%	60 - 130%	86
	M8_0.7-0.8	SE157545.003	%	60 - 130%	90
	HA/GB1_0.15-0.25	SE157545.004	%	60 - 130%	96
	W1	SE157545.005	%	60 - 130%	92
	W2	SE157545.006	%	60 - 130%	92
	W3	SE157545.007	%	60 - 130%	92

OP Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
2-fluorobiphenyl (Surrogate)	W1	SE157545.008	%	40 - 130%	52
	W2	SE157545.009	%	40 - 130%	68
	W3	SE157545.010	%	40 - 130%	40
d14-p-terphenyl (Surrogate)	W1	SE157545.008	%	40 - 130%	82
	W2	SE157545.009	%	40 - 130%	62
	W3	SE157545.010	%	40 - 130%	48

PAH (Polynuclear Aromatic Hydrocarbons) in Soil

Method: ME-(AU)-[ENV]AN420

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
2-fluorobiphenyl (Surrogate)	M7_0.2-0.3	SE157545.001	%	70 - 130%	76
	M8_0.7-0.8	SE157545.003	%	70 - 130%	80
	HA/GB1_0.15-0.25	SE157545.004	%	70 - 130%	78
	W1	SE157545.005	%	70 - 130%	80
	W2	SE157545.006	%	70 - 130%	80
	W3	SE157545.007	%	70 - 130%	80
d14-p-terphenyl (Surrogate)	M7_0.2-0.3	SE157545.001	%	70 - 130%	86
	M8_0.7-0.8	SE157545.003	%	70 - 130%	90
	HA/GB1_0.15-0.25	SE157545.004	%	70 - 130%	96
	W1	SE157545.005	%	70 - 130%	92
	W2	SE157545.006	%	70 - 130%	92
	W3	SE157545.007	%	70 - 130%	92
d5-nitrobenzene (Surrogate)	M7_0.2-0.3	SE157545.001	%	70 - 130%	76
	M8_0.7-0.8	SE157545.003	%	70 - 130%	78
	HA/GB1_0.15-0.25	SE157545.004	%	70 - 130%	76
	W1	SE157545.005	%	70 - 130%	78
	W2	SE157545.006	%	70 - 130%	76
	W3	SE157545.007	%	70 - 130%	78

PAH (Polynuclear Aromatic Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN420

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
2-fluorobiphenyl (Surrogate)	W1	SE157545.008	%	40 - 130%	52
	W2	SE157545.009	%	40 - 130%	68
	W3	SE157545.010	%	40 - 130%	40

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

PAH (Polynuclear Aromatic Hydrocarbons) in Water (continued)

Method: ME-(AU)-[ENV]AN420

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
d14-p-terphenyl (Surrogate)	W1	SE157545.008	%	40 - 130%	82
	W2	SE157545.009	%	40 - 130%	62
	W3	SE157545.010	%	40 - 130%	48
d5-nitrobenzene (Surrogate)	W1	SE157545.008	%	40 - 130%	52
	W2	SE157545.009	%	40 - 130%	64
	W3	SE157545.010	%	40 - 130%	46

VOC's in Soil

Method: ME-(AU)-[ENV]AN433

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Bromofluorobenzene (Surrogate)	M7_0.2-0.3	SE157545.001	%	60 - 130%	108
	M8_0.7-0.8	SE157545.003	%	60 - 130%	107
	HA/GB1_0.15-0.25	SE157545.004	%	60 - 130%	106
	W1	SE157545.005	%	60 - 130%	109
	W2	SE157545.006	%	60 - 130%	116
	W3	SE157545.007	%	60 - 130%	109
	QC18 (Trip Blank)	SE157545.011	%	60 - 130%	108
	QC19 (Trip Spike)	SE157545.012	%	60 - 130%	108
d4-1,2-dichloroethane (Surrogate)	M7_0.2-0.3	SE157545.001	%	60 - 130%	82
	M8_0.7-0.8	SE157545.003	%	60 - 130%	93
	HA/GB1_0.15-0.25	SE157545.004	%	60 - 130%	106
	W1	SE157545.005	%	60 - 130%	99
	W2	SE157545.006	%	60 - 130%	102
	W3	SE157545.007	%	60 - 130%	102
	QC18 (Trip Blank)	SE157545.011	%	60 - 130%	117
	QC19 (Trip Spike)	SE157545.012	%	60 - 130%	121
d8-toluene (Surrogate)	M7_0.2-0.3	SE157545.001	%	60 - 130%	105
	M8_0.7-0.8	SE157545.003	%	60 - 130%	78
	HA/GB1_0.15-0.25	SE157545.004	%	60 - 130%	89
	W1	SE157545.005	%	60 - 130%	76
	W2	SE157545.006	%	60 - 130%	84
	W3	SE157545.007	%	60 - 130%	77
	QC18 (Trip Blank)	SE157545.011	%	60 - 130%	89
	QC19 (Trip Spike)	SE157545.012	%	60 - 130%	72
Dibromofluoromethane (Surrogate)	M7_0.2-0.3	SE157545.001	%	60 - 130%	79
	M8_0.7-0.8	SE157545.003	%	60 - 130%	108
	HA/GB1_0.15-0.25	SE157545.004	%	60 - 130%	79
	W1	SE157545.005	%	60 - 130%	72
	W2	SE157545.006	%	60 - 130%	74
	W3	SE157545.007	%	60 - 130%	76
	QC18 (Trip Blank)	SE157545.011	%	60 - 130%	91
	QC19 (Trip Spike)	SE157545.012	%	60 - 130%	92

VOCs in Water

Method: ME-(AU)-[ENV]AN433

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Bromofluorobenzene (Surrogate)	W1	SE157545.008	%	40 - 130%	93
	W2	SE157545.009	%	40 - 130%	93
	W3	SE157545.010	%	40 - 130%	91
d4-1,2-dichloroethane (Surrogate)	W1	SE157545.008	%	40 - 130%	97
	W2	SE157545.009	%	40 - 130%	96
	W3	SE157545.010	%	40 - 130%	98
d8-toluene (Surrogate)	W1	SE157545.008	%	40 - 130%	93
	W2	SE157545.009	%	40 - 130%	95
	W3	SE157545.010	%	40 - 130%	93
Dibromofluoromethane (Surrogate)	W1	SE157545.008	%	40 - 130%	103
	W2	SE157545.009	%	40 - 130%	103
	W3	SE157545.010	%	40 - 130%	105

Volatile Petroleum Hydrocarbons in Soil

Method: ME-(AU)-[ENV]AN433

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Bromofluorobenzene (Surrogate)	M7_0.2-0.3	SE157545.001	%	60 - 130%	108
	M8_0.7-0.8	SE157545.003	%	60 - 130%	107
	HA/GB1_0.15-0.25	SE157545.004	%	60 - 130%	106

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Volatile Petroleum Hydrocarbons in Soil (continued)

Method: ME-(AU)-[ENV]AN433

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Bromofluorobenzene (Surrogate)	W1	SE157545.005	%	60 - 130%	109
	W2	SE157545.006	%	60 - 130%	116
	W3	SE157545.007	%	60 - 130%	109
	QC18 (Trip Blank)	SE157545.011	%	60 - 130%	108
d4-1,2-dichloroethane (Surrogate)	M7_0.2-0.3	SE157545.001	%	60 - 130%	82
	M8_0.7-0.8	SE157545.003	%	60 - 130%	93
	HA/GB1_0.15-0.25	SE157545.004	%	60 - 130%	106
	W1	SE157545.005	%	60 - 130%	99
	W2	SE157545.006	%	60 - 130%	102
	W3	SE157545.007	%	60 - 130%	102
	QC18 (Trip Blank)	SE157545.011	%	60 - 130%	117
d8-toluene (Surrogate)	M7_0.2-0.3	SE157545.001	%	60 - 130%	105
	M8_0.7-0.8	SE157545.003	%	60 - 130%	78
	HA/GB1_0.15-0.25	SE157545.004	%	60 - 130%	89
	W1	SE157545.005	%	60 - 130%	76
	W2	SE157545.006	%	60 - 130%	84
	W3	SE157545.007	%	60 - 130%	77
	QC18 (Trip Blank)	SE157545.011	%	60 - 130%	89
Dibromofluoromethane (Surrogate)	M7_0.2-0.3	SE157545.001	%	60 - 130%	79
	M8_0.7-0.8	SE157545.003	%	60 - 130%	108
	HA/GB1_0.15-0.25	SE157545.004	%	60 - 130%	79
	W1	SE157545.005	%	60 - 130%	72
	W2	SE157545.006	%	60 - 130%	74
	W3	SE157545.007	%	60 - 130%	76
	QC18 (Trip Blank)	SE157545.011	%	60 - 130%	91

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Bromofluorobenzene (Surrogate)	W1	SE157545.008	%	40 - 130%	93
	W2	SE157545.009	%	40 - 130%	93
	W3	SE157545.010	%	40 - 130%	91
d4-1,2-dichloroethane (Surrogate)	W1	SE157545.008	%	60 - 130%	97
	W2	SE157545.009	%	60 - 130%	96
	W3	SE157545.010	%	60 - 130%	98
d8-toluene (Surrogate)	W1	SE157545.008	%	40 - 130%	93
	W2	SE157545.009	%	40 - 130%	95
	W3	SE157545.010	%	40 - 130%	93
Dibromofluoromethane (Surrogate)	W1	SE157545.008	%	40 - 130%	103
	W2	SE157545.009	%	40 - 130%	103
	W3	SE157545.010	%	40 - 130%	105

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311(Perth)/AN312

Sample Number	Parameter	Units	LOR	Result
LB110970.001	Mercury	mg/L	0.0001	<0.0001

Mercury in Soil

Method: ME-(AU)-[ENV]AN312

Sample Number	Parameter	Units	LOR	Result
LB110977.001	Mercury	mg/kg	0.05	<0.05

OC Pesticides in Soil

Method: ME-(AU)-[ENV]AN400/AN420

Sample Number		Parameter	Units	LOR	Result
LB110824.001		Hexachlorobenzene (HCB)	mg/kg	0.1	<0.1
		Alpha BHC	mg/kg	0.1	<0.1
		Lindane	mg/kg	0.1	<0.1
		Heptachlor	mg/kg	0.1	<0.1
		Aldrin	mg/kg	0.1	<0.1
		Beta BHC	mg/kg	0.1	<0.1
		Delta BHC	mg/kg	0.1	<0.1
		Heptachlor epoxide	mg/kg	0.1	<0.1
		Alpha Endosulfan	mg/kg	0.2	<0.2
		Gamma Chlordane	mg/kg	0.1	<0.1
		Alpha Chlordane	mg/kg	0.1	<0.1
		p,p'-DDE	mg/kg	0.1	<0.1
		Dieldrin	mg/kg	0.2	<0.2
		Endrin	mg/kg	0.2	<0.2
		Beta Endosulfan	mg/kg	0.2	<0.2
		p,p'-DDD	mg/kg	0.1	<0.1
		p,p'-DDT	mg/kg	0.1	<0.1
		Endosulfan sulphate	mg/kg	0.1	<0.1
		Endrin Aldehyde	mg/kg	0.1	<0.1
		Methoxychlor	mg/kg	0.1	<0.1
		Endrin Ketone	mg/kg	0.1	<0.1
		Isodrin	mg/kg	0.1	<0.1
		Mirex	mg/kg	0.1	<0.1
	Surrogates	Tetrachloro-m-xylene (TCMX) (Surrogate)	%	-	85

OC Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Sample Number	Parameter	Units	LOR	Result
LB110738.001	Hexachlorobenzene (HCB)	µg/L	0.1	<0.1
	Alpha BHC	µg/L	0.1	<0.1
	Lindane (gamma BHC)	µg/L	0.1	<0.1
	Heptachlor	µg/L	0.1	<0.1
	Aldrin	µg/L	0.1	<0.1
	Beta BHC	µg/L	0.1	<0.1
	Delta BHC	µg/L	0.1	<0.1
	Heptachlor epoxide	µg/L	0.1	<0.1
	Alpha Endosulfan	µg/L	0.1	<0.1
	Gamma Chlordane	µg/L	0.1	<0.1
	Alpha Chlordane	µg/L	0.1	<0.1
	p,p'-DDE	µg/L	0.1	<0.1
	Dieldrin	µg/L	0.1	<0.1
	Endrin	µg/L	0.1	<0.1
	Beta Endosulfan	µg/L	0.1	<0.1
	p,p'-DDD	µg/L	0.1	<0.1
	p,p'-DDT	µg/L	0.1	<0.1
	Endosulfan sulphate	µg/L	0.1	<0.1
	Endrin aldehyde	µg/L	0.1	<0.1
	Methoxychlor	µg/L	0.1	<0.1
	Endrin ketone	µg/L	0.1	<0.1
	Isodrin	µg/L	0.1	<0.1
	Mirex	µg/L	0.1	<0.1

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

OC Pesticides in Water (continued)

Method: ME-(AU)-[ENV]AN400/AN420

Sample Number		Parameter	Units	LOR	Result
LB110738.001	Surrogates	Tetrachloro-m-xylene (TCMX) (Surrogate)	%	-	78

OP Pesticides in Soil

Method: ME-(AU)-[ENV]AN400/AN420

Sample Number		Parameter	Units	LOR	Result
LB110824.001		Dichlorvos	mg/kg	0.5	<0.5
		Dimethoate	mg/kg	0.5	<0.5
		Diazinon (Dimpylate)	mg/kg	0.5	<0.5
		Fenitrothion	mg/kg	0.2	<0.2
		Malathion	mg/kg	0.2	<0.2
		Chlorpyrifos (Chlorpyrifos Ethyl)	mg/kg	0.2	<0.2
		Parathion-ethyl (Parathion)	mg/kg	0.2	<0.2
		Bromophos Ethyl	mg/kg	0.2	<0.2
		Methidathion	mg/kg	0.5	<0.5
		Ethion	mg/kg	0.2	<0.2
		Azinphos-methyl (Guthion)	mg/kg	0.2	<0.2
	Surrogates	2-fluorobiphenyl (Surrogate)	%	-	80
		d14-p-terphenyl (Surrogate)	%	-	94

OP Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Sample Number		Parameter	Units	LOR	Result
LB110738.001		Dichlorvos	µg/L	0.5	<0.5
		Dimethoate	µg/L	0.5	<0.5
		Diazinon (Dimpylate)	µg/L	0.5	<0.5
		Fenitrothion	µg/L	0.2	<0.2
		Malathion	µg/L	0.2	<0.2
		Chlorpyrifos (Chlorpyrifos Ethyl)	µg/L	0.2	<0.2
		Parathion-ethyl (Parathion)	µg/L	0.2	<0.2
		Bromophos Ethyl	µg/L	0.2	<0.2
		Methidathion	µg/L	0.5	<0.5
		Ethion	µg/L	0.2	<0.2
		Azinphos-methyl	µg/L	0.2	<0.2
	Surrogates	2-fluorobiphenyl (Surrogate)	%	-	72
		d14-p-terphenyl (Surrogate)	%	-	110

PAH (Polynuclear Aromatic Hydrocarbons) in Soil

Method: ME-(AU)-[ENV]AN420

Sample Number		Parameter	Units	LOR	Result
LB110824.001		Naphthalene	mg/kg	0.1	<0.1
		2-methylnaphthalene	mg/kg	0.1	<0.1
		1-methylnaphthalene	mg/kg	0.1	<0.1
		Acenaphthylene	mg/kg	0.1	<0.1
		Acenaphthene	mg/kg	0.1	<0.1
		Fluorene	mg/kg	0.1	<0.1
		Phenanthrene	mg/kg	0.1	<0.1
		Anthracene	mg/kg	0.1	<0.1
		Fluoranthene	mg/kg	0.1	<0.1
		Pyrene	mg/kg	0.1	<0.1
		Benzo(a)anthracene	mg/kg	0.1	<0.1
		Chrysene	mg/kg	0.1	<0.1
		Benzo(a)pyrene	mg/kg	0.1	<0.1
		Indeno(1,2,3-cd)pyrene	mg/kg	0.1	<0.1
		Dibenzo(ah)anthracene	mg/kg	0.1	<0.1
		Benzo(ghi)perylene	mg/kg	0.1	<0.1
		Total PAH (18)	mg/kg	0.8	<0.8
	Surrogates	d5-nitrobenzene (Surrogate)	%	-	84
		2-fluorobiphenyl (Surrogate)	%	-	80
		d14-p-terphenyl (Surrogate)	%	-	94

PAH (Polynuclear Aromatic Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN420

Sample Number		Parameter	Units	LOR	Result
LB110738.001		Naphthalene	µg/L	0.1	<0.1
		2-methylnaphthalene	µg/L	0.1	<0.1
		1-methylnaphthalene	µg/L	0.1	<0.1
		Acenaphthylene	µg/L	0.1	<0.1

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

PAH (Polynuclear Aromatic Hydrocarbons) in Water (continued)

Method: ME-(AU)-[ENV]AN420

Sample Number		Parameter	Units	LOR	Result
LB110738.001		Acenaphthene	µg/L	0.1	<0.1
		Fluorene	µg/L	0.1	<0.1
		Phenanthrene	µg/L	0.1	<0.1
		Anthracene	µg/L	0.1	<0.1
		Fluoranthene	µg/L	0.1	<0.1
		Pyrene	µg/L	0.1	<0.1
		Benzo(a)anthracene	µg/L	0.1	<0.1
		Chrysene	µg/L	0.1	<0.1
		Benzo(a)pyrene	µg/L	0.1	<0.1
		Indeno(1,2,3-cd)pyrene	µg/L	0.1	<0.1
		Dibenzo(ah)anthracene	µg/L	0.1	<0.1
		Benzo(ghi)perylene	µg/L	0.1	<0.1
	Surrogates	d5-nitrobenzene (Surrogate)	%	-	76
		2-fluorobiphenyl (Surrogate)	%	-	72
		d14-p-terphenyl (Surrogate)	%	-	110

Total Phenolics in Soil

Method: ME-(AU)-[ENV]AN289

Sample Number	Parameter	Units	LOR	Result
LB110743.001	Total Phenols	mg/kg	0.1	<0.1

Total Phenolics in Water

Method: ME-(AU)-[ENV]AN289

Sample Number	Parameter	Units	LOR	Result
LB110849.001	Total Phenols	mg/L	0.01	<0.01

Total Recoverable Metals in Soil/Waste Solids/Materials by ICPOES

Method: ME-(AU)-[ENV]AN040/AN320

Sample Number	Parameter	Units	LOR	Result
LB111001.001	Arsenic, As	mg/kg	3	<3
	Cadmium, Cd	mg/kg	0.3	<0.3
	Chromium, Cr	mg/kg	0.3	<0.3
	Copper, Cu	mg/kg	0.5	<0.5
	Lead, Pb	mg/kg	1	<1
	Nickel, Ni	mg/kg	0.5	<0.5
	Zinc, Zn	mg/kg	0.5	<0.5

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Number	Parameter	Units	LOR	Result
LB110745.001	Arsenic, As	µg/L	1	<1
	Cadmium, Cd	µg/L	0.1	<0.1
	Chromium, Cr	µg/L	1	<1
	Copper, Cu	µg/L	1	<1
	Lead, Pb	µg/L	1	<1
	Nickel, Ni	µg/L	1	<1
	Zinc, Zn	µg/L	5	<5

TRH (Total Recoverable Hydrocarbons) in Soil

Method: ME-(AU)-[ENV]AN403

Sample Number	Parameter	Units	LOR	Result
LB110824.001	TRH C10-C14	mg/kg	20	<20
	TRH C15-C28	mg/kg	45	<45
	TRH C29-C36	mg/kg	45	<45
	TRH C37-C40	mg/kg	100	<100
	TRH C10-C36 Total	mg/kg	110	<110

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Sample Number	Parameter	Units	LOR	Result
LB110738.001	TRH C10-C14	µg/L	50	<50
	TRH C15-C28	µg/L	200	<200
	TRH C29-C36	µg/L	200	<200
	TRH C37-C40	µg/L	200	<200

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

VOC's in Soil

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result
LB110735.001	Monocyclic Aromatic	Benzene	mg/kg	0.1	<0.1
	Hydrocarbons	Toluene	mg/kg	0.1	<0.1
		Ethylbenzene	mg/kg	0.1	<0.1
		m/p-xylene	mg/kg	0.2	<0.2
		o-xylene	mg/kg	0.1	<0.1
	Polycyclic VOCs	Naphthalene	mg/kg	0.1	<0.1
	Surrogates	Dibromofluoromethane (Surrogate)	%	-	97
		d4-1,2-dichloroethane (Surrogate)	%	-	129
		d8-toluene (Surrogate)	%	-	74
		Bromofluorobenzene (Surrogate)	%	-	114
	Totals	Total BTEX	mg/kg	0.6	<0.6

VOCs in Water

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result
LB110850.001	Monocyclic Aromatic	Benzene	µg/L	0.5	<0.5
	Hydrocarbons	Toluene	µg/L	0.5	<0.5
		Ethylbenzene	µg/L	0.5	<0.5
		m/p-xylene	µg/L	1	<1
		o-xylene	µg/L	0.5	<0.5
	Polycyclic VOCs	Naphthalene	µg/L	0.5	<0.5
	Surrogates	Dibromofluoromethane (Surrogate)	%	-	99
		d4-1,2-dichloroethane (Surrogate)	%	-	91
		d8-toluene (Surrogate)	%	-	99
		Bromofluorobenzene (Surrogate)	%	-	93

Volatile Petroleum Hydrocarbons in Soil

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result
LB110735.001		TRH C6-C9	mg/kg	20	<20
	Surrogates	Dibromofluoromethane (Surrogate)	%	-	97
		d4-1,2-dichloroethane (Surrogate)	%	-	129
		d8-toluene (Surrogate)	%	-	74

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result
LB110850.001		TRH C6-C9	µg/L	40	<40
	Surrogates	Dibromofluoromethane (Surrogate)	%	-	99
		d4-1,2-dichloroethane (Surrogate)	%	-	91
		d8-toluene (Surrogate)	%	-	99
		Bromofluorobenzene (Surrogate)	%	-	93

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311(Perth)/AN312

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE157544.005	LB110970.014	Mercury	µg/L	0.0001	<0.0001	0.0000	200	24

Mercury in Soil

Method: ME-(AU)-[ENV]AN312

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE157535.001	LB110977.014	Mercury	mg/kg	0.05	<0.01	<0.01	200	0
SE157545.007	LB110977.024	Mercury	mg/kg	0.05	<0.05	<0.05	200	0

Moisture Content

Method: ME-(AU)-[ENV]AN002

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE157527.002	LB110857.011	% Moisture	%w/w	0.5	5.9	5.6	47	5
SE157533.002	LB110857.022	% Moisture	%w/w	0.5	43.7	41.7	32	5
SE157545.001	LB110857.033	% Moisture	%w/w	0.5	20	21	35	3
SE157545.011	LB110857.040	% Moisture	%w/w	0.5	<0.5	<0.5	200	0

PAH (Polynuclear Aromatic Hydrocarbons) in Soil

Method: ME-(AU)-[ENV]AN420

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE157527.008	LB110824.024		Naphthalene	mg/kg	0.1	<0.1	0.01	200	0
			2-methylnaphthalene	mg/kg	0.1	<0.1	0	200	0
			1-methylnaphthalene	mg/kg	0.1	<0.1	0	200	0
			Acenaphthylene	mg/kg	0.1	<0.1	0.02	200	0
			Acenaphthene	mg/kg	0.1	<0.1	0	200	0
			Fluorene	mg/kg	0.1	<0.1	0	200	0
			Phenanthrene	mg/kg	0.1	0.2	0.12	99	34
			Anthracene	mg/kg	0.1	<0.1	0.02	200	0
			Fluoranthene	mg/kg	0.1	0.5	0.34	54	36
			Pyrene	mg/kg	0.1	0.5	0.42	52	15
			Benzo(a)anthracene	mg/kg	0.1	0.3	0.2	69	43
			Chrysene	mg/kg	0.1	0.2	0.15	81	46
			Benzo(b&j)fluoranthene	mg/kg	0.1	0.3	0.18	75	36
			Benzo(k)fluoranthene	mg/kg	0.1	0.1	0.07	125	33
			Benzo(a)pyrene	mg/kg	0.1	0.2	0.13	87	51
			Indeno(1,2,3-cd)pyrene	mg/kg	0.1	0.1	0.07	141	10
			Dibenzo(ah)anthracene	mg/kg	0.1	<0.1	0.01	200	0
			Benzo(ghi)perylene	mg/kg	0.1	0.1	0.06	155	0
			Carcinogenic PAHs, BaP TEQ <LOR=0	TEQ (mg/kg)	0.2	0.3	0.1765	93	42
			Carcinogenic PAHs, BaP TEQ <LOR=LOR	TEQ (mg/kg)	0.3	0.4	0.2875	96	30
			Carcinogenic PAHs, BaP TEQ <LOR=LOR/2	TEQ (mg/kg)	0.2	0.4	0.232	78	42
			Total PAH (18)	mg/kg	0.8	2.5	1.61	69	45
		Surrogates	d5-nitrobenzene (Surrogate)	mg/kg	-	0.4	0.41	30	5
			2-fluorobiphenyl (Surrogate)	mg/kg	-	0.4	0.43	30	2
			d14-p-terphenyl (Surrogate)	mg/kg	-	0.5	0.4	30	16

Total Phenolics in Soil

Method: ME-(AU)-[ENV]AN289

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE157545.001	LB110743.004	Total Phenols	mg/kg	0.1	2.3	2.3	19	0

Total Recoverable Metals in Soil/Waste Solids/Materials by ICPOES

Method: ME-(AU)-[ENV]AN040/AN320

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE157605.009	LB111001.024	Arsenic, As	mg/kg	3	3.44071258054	.5183056029	55	27
		Cadmium, Cd	mg/kg	0.3	0.39559060230	.4120273720	104	4
		Chromium, Cr	mg/kg	0.3	26.284316075	24.831465617	32	6
		Copper, Cu	mg/kg	0.5	27.283889000	24.719703352	32	10
		Lead, Pb	mg/kg	1	18.707944198	20.038330323	35	7
		Nickel, Ni	mg/kg	0.5	28.220406929	26.748952411	32	5
		Zinc, Zn	mg/kg	0.5	00.190743352	08.957737647	32	8

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Original	Duplicate	Parameter	Units	LOR

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Trace Metals (Dissolved) in Water by ICPMS (continued)

Method: ME-(AU)-[ENV]AN318

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE157499.003	LB110745.014		Arsenic, As	µg/L	1	<1	<1	200	0
			Cadmium, Cd	µg/L	0.1	<0.1	<0.1	200	0
			Chromium, Cr	µg/L	1	<1	<1	200	0
			Copper, Cu	µg/L	1	<1	<1	200	0
			Lead, Pb	µg/L	1	<1	<1	200	0
			Nickel, Ni	µg/L	1	<1	<1	200	0
			Zinc, Zn	µg/L	5	<5	<5	200	0
SE157566.002	LB110745.028		Arsenic, As	µg/L	1	2	2	70	1
			Cadmium, Cd	µg/L	0.1	<0.1	<0.1	200	0
			Chromium, Cr	µg/L	1	<1	<1	200	0
			Copper, Cu	µg/L	1	2	2	79	6
			Lead, Pb	µg/L	1	<1	<1	200	0
			Nickel, Ni	µg/L	1	36	36	18	0
			Zinc, Zn	µg/L	5	35	34	29	2
SE157580.032	LB110745.031		Arsenic, As	µg/L	1	<1	<1	200	0
			Cadmium, Cd	µg/L	0.1	<0.1	<0.1	200	0
			Chromium, Cr	µg/L	1	<1	<1	200	0
			Copper, Cu	µg/L	1	<1	<1	166	0
			Lead, Pb	µg/L	1	<1	<1	200	0
			Nickel, Ni	µg/L	1	<1	<1	200	0
			Zinc, Zn	µg/L	5	<5	<5	152	0

TRH (Total Recoverable Hydrocarbons) in Soil

Method: ME-(AU)-[ENV]AN403

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE157527.008	LB110824.024		TRH C10-C14	mg/kg	20	<20	0	200	0
			TRH C15-C28	mg/kg	45	<45	0	200	0
			TRH C29-C36	mg/kg	45	<45	0	200	0
			TRH C37-C40	mg/kg	100	<100	0	200	0
			TRH C10-C36 Total	mg/kg	110	<110	0	200	0
			TRH C10-C40 Total	mg/kg	210	<210	0	200	0
		TRH F Bands	TRH >C10-C16 (F2)	mg/kg	25	<25	0	200	0
			TRH >C10-C16 (F2) - Naphthalene	mg/kg	25	<25	0	200	0
			TRH >C16-C34 (F3)	mg/kg	90	<90	0	200	0
			TRH >C34-C40 (F4)	mg/kg	120	<120	0	200	0
SE157545.011	LB110824.022		TRH C10-C14	mg/kg	20	<20	<20	200	0
			TRH C15-C28	mg/kg	45	<45	<45	200	0
			TRH C29-C36	mg/kg	45	<45	<45	200	0
			TRH C37-C40	mg/kg	100	<100	<100	200	0
			TRH C10-C36 Total	mg/kg	110	<110	<110	200	0
			TRH C10-C40 Total	mg/kg	210	<210	<210	200	0
		TRH F Bands	TRH >C10-C16 (F2)	mg/kg	25	<25	<25	200	0
			TRH >C10-C16 (F2) - Naphthalene	mg/kg	25	<25	<25	200	0
			TRH >C16-C34 (F3)	mg/kg	90	<90	<90	200	0
			TRH >C34-C40 (F4)	mg/kg	120	<120	<120	200	0

VOC's in Soil

Method: ME-(AU)-[ENV]AN433

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE157559.002	LB110735.014	Monocyclic	Benzene	mg/kg	0.1	<0.1	<0.1	200	0
		Aromatic	Toluene	mg/kg	0.1	<0.1	<0.1	200	0
			Ethylbenzene	mg/kg	0.1	<0.1	<0.1	200	0
			m/p-xylene	mg/kg	0.2	<0.2	<0.2	200	0
			o-xylene	mg/kg	0.1	<0.1	<0.1	200	0
		Polycyclic	Naphthalene	mg/kg	0.1	<0.1	<0.1	200	0
		Surrogates	Dibromofluoromethane (Surrogate)	mg/kg	-	4.4	4.2	50	4
			d4-1,2-dichloroethane (Surrogate)	mg/kg	-	5.8	5.6	50	4
			d8-toluene (Surrogate)	mg/kg	-	4.4	3.9	50	12
			Bromofluorobenzene (Surrogate)	mg/kg	-	5.5	5.4	50	3
		Totals	Total Xylenes*	mg/kg	0.3	<0.3	<0.3	200	0
			Total BTEX	mg/kg	0.6	<0.6	<0.6	200	0
SE157567.004	LB110735.020	Monocyclic	Benzene	mg/kg	0.1	<0.1	<0.1	200	0
		Aromatic	Toluene	mg/kg	0.1	<0.1	<0.1	200	0
			Ethylbenzene	mg/kg	0.1	<0.1	<0.1	200	0

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

VOC's in Soil (continued)

Method: ME-(AU)-[ENV]AN433

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE157567.004	LB110735.020	Monocyclic	m/p-xylene	mg/kg	0.2	<0.2	<0.2	200	0
		Aromatic	o-xylene	mg/kg	0.1	<0.1	<0.1	200	0
		Polycyclic	Naphthalene	mg/kg	0.1	<0.1	<0.1	200	0
		Surrogates	Dibromofluoromethane (Surrogate)	mg/kg	-	4.2	3.9	50	6
			d4-1,2-dichloroethane (Surrogate)	mg/kg	-	4.2	3.7	50	14
			d8-toluene (Surrogate)	mg/kg	-	4.5	3.9	50	13
			Bromofluorobenzene (Surrogate)	mg/kg	-	4.3	4.6	50	7
		Totals	Total Xylenes*	mg/kg	0.3	<0.3	<0.3	200	0
			Total BTEX	mg/kg	0.6	<0.6	<0.6	200	0

VOCs in Water

Method: ME-(AU)-[ENV]AN433

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE157560.001	LB110850.018	Monocyclic	Benzene	µg/L	0.5	1.0	2.0	63	64 ③
		Aromatic	Toluene	µg/L	0.5	<0.5	<0.5	200	0
			Ethylbenzene	µg/L	0.5	<0.5	<0.5	200	0
			m/p-xylene	µg/L	1	<1	<1	200	0
			o-xylene	µg/L	0.5	<0.5	<0.5	200	0
		Polycyclic	Naphthalene	µg/L	0.5	<0.5	<0.5	200	0
		Surrogates	Dibromofluoromethane (Surrogate)	µg/L	-	5.1	4.8	30	6
			d4-1,2-dichloroethane (Surrogate)	µg/L	-	4.7	4.8	30	3
			d8-toluene (Surrogate)	µg/L	-	4.5	5.2	30	13
			Bromofluorobenzene (Surrogate)	µg/L	-	4.8	5.0	30	5

Volatile Petroleum Hydrocarbons in Soil

Method: ME-(AU)-[ENV]AN433

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE157559.002	LB110735.014		TRH C6-C10	mg/kg	25	<25	<25	200	0
			TRH C6-C9	mg/kg	20	<20	<20	200	0
		Surrogates	Dibromofluoromethane (Surrogate)	mg/kg	-	4.4	4.2	30	4
			d4-1,2-dichloroethane (Surrogate)	mg/kg	-	5.8	5.6	30	4
			d8-toluene (Surrogate)	mg/kg	-	4.4	3.9	30	12
			Bromofluorobenzene (Surrogate)	mg/kg	-	5.5	5.4	30	3
		VPH F Bands	Benzene (F0)	mg/kg	0.1	<0.1	<0.1	200	0
			TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25	<25	200	0
SE157567.004	LB110735.020		TRH C6-C10	mg/kg	25	120	89	54	31
			TRH C6-C9	mg/kg	20	72	54	62	30
		Surrogates	Dibromofluoromethane (Surrogate)	mg/kg	-	4.2	3.9	30	6
			d4-1,2-dichloroethane (Surrogate)	mg/kg	-	4.2	3.7	30	14
			d8-toluene (Surrogate)	mg/kg	-	4.5	3.9	30	13
			Bromofluorobenzene (Surrogate)	mg/kg	-	4.3	4.6	30	7
		VPH F Bands	Benzene (F0)	mg/kg	0.1	<0.1	<0.1	200	0
			TRH C6-C10 minus BTEX (F1)	mg/kg	25	120	89	54	31

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE157560.001	LB110850.018		TRH C6-C10	µg/L	50	66	80	99	19
			TRH C6-C9	µg/L	40	66	80	85	19
		Surrogates	Dibromofluoromethane (Surrogate)	µg/L	-	5.1	4.8	30	6
			d4-1,2-dichloroethane (Surrogate)	µg/L	-	4.7	4.8	30	3
			d8-toluene (Surrogate)	µg/L	-	4.5	5.2	30	13
			Bromofluorobenzene (Surrogate)	µg/L	-	4.8	5.0	30	5
		VPH F Bands	Benzene (F0)	µg/L	0.5	1.0	2.0	63	64 ③
			TRH C6-C10 minus BTEX (F1)	µg/L	50	65	78	100	18

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Mercury in Soil

Method: ME-(AU)-[ENV]AN312

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110977.002	Mercury	mg/kg	0.05	0.20	0.2	70 - 130	102

OC Pesticides in Soil

Method: ME-(AU)-[ENV]AN400/AN420

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110824.002		Heptachlor	mg/kg	0.1	0.2	0.2	60 - 140	112
		Aldrin	mg/kg	0.1	0.2	0.2	60 - 140	104
		Delta BHC	mg/kg	0.1	0.2	0.2	60 - 140	108
		Dieldrin	mg/kg	0.2	<0.2	0.2	60 - 140	92
		Endrin	mg/kg	0.2	0.2	0.2	60 - 140	115
		p,p'-DDT	mg/kg	0.1	0.2	0.2	60 - 140	125
	Surrogates	Tetrachloro-m-xylene (TCMX) (Surrogate)	mg/kg	-	0.13	0.15	40 - 130	83

OC Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110738.002		Heptachlor	µg/L	0.1	0.3	0.2	60 - 140	125
		Aldrin	µg/L	0.1	0.2	0.2	60 - 140	118
		Delta BHC	µg/L	0.1	0.2	0.2	60 - 140	117
		Dieldrin	µg/L	0.1	0.2	0.2	60 - 140	119
		Endrin	µg/L	0.1	0.3	0.2	60 - 140	125
		p,p'-DDT	µg/L	0.1	0.2	0.2	60 - 140	117
	Surrogates	Tetrachloro-m-xylene (TCMX) (Surrogate)	µg/L	-	0.14	0.15	40 - 130	96

OP Pesticides in Soil

Method: ME-(AU)-[ENV]AN400/AN420

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110824.002		Dichlorvos	mg/kg	0.5	1.7	2	60 - 140	85
		Diazinon (Dimpylate)	mg/kg	0.5	1.7	2	60 - 140	83
		Chlorpyrifos (Chlorpyrifos Ethyl)	mg/kg	0.2	1.7	2	60 - 140	87
		Ethion	mg/kg	0.2	1.5	2	60 - 140	76
	Surrogates	2-fluorobiphenyl (Surrogate)	mg/kg	-	0.4	0.5	40 - 130	74
		d14-p-terphenyl (Surrogate)	mg/kg	-	0.4	0.5	40 - 130	82

OP Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110738.002		Dichlorvos	µg/L	0.5	8.6	8	60 - 140	107
		Diazinon (Dimpylate)	µg/L	0.5	8.6	8	60 - 140	107
		Chlorpyrifos (Chlorpyrifos Ethyl)	µg/L	0.2	8.7	8	60 - 140	109
		Ethion	µg/L	0.2	8.2	8	60 - 140	103
	Surrogates	2-fluorobiphenyl (Surrogate)	µg/L	-	0.4	0.5	40 - 130	76
		d14-p-terphenyl (Surrogate)	µg/L	-	0.4	0.5	40 - 130	72

PAH (Polynuclear Aromatic Hydrocarbons) in Soil

Method: ME-(AU)-[ENV]AN420

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110824.002		Naphthalene	mg/kg	0.1	3.6	4	60 - 140	90
		Acenaphthylene	mg/kg	0.1	3.5	4	60 - 140	88
		Acenaphthene	mg/kg	0.1	3.5	4	60 - 140	88
		Phenanthrene	mg/kg	0.1	3.6	4	60 - 140	89
		Anthracene	mg/kg	0.1	3.6	4	60 - 140	89
		Fluoranthene	mg/kg	0.1	3.6	4	60 - 140	90
		Pyrene	mg/kg	0.1	3.5	4	60 - 140	87
		Benzo(a)pyrene	mg/kg	0.1	3.8	4	60 - 140	95
	Surrogates	d5-nitrobenzene (Surrogate)	mg/kg	-	0.4	0.5	40 - 130	74
		2-fluorobiphenyl (Surrogate)	mg/kg	-	0.4	0.5	40 - 130	74
		d14-p-terphenyl (Surrogate)	mg/kg	-	0.4	0.5	40 - 130	82

PAH (Polynuclear Aromatic Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN420

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110738.002	Naphthalene	µg/L	0.1	32	40	60 - 140	79
	Acenaphthylene	µg/L	0.1	36	40	60 - 140	89
	Acenaphthene	µg/L	0.1	35	40	60 - 140	88
	Phenanthrene	µg/L	0.1	36	40	60 - 140	89
	Anthracene	µg/L	0.1	33	40	60 - 140	81
	Fluoranthene	µg/L	0.1	36	40	60 - 140	91

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

PAH (Polynuclear Aromatic Hydrocarbons) in Water (continued)

Method: ME-(AU)-[ENV]AN420

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110738.002		Pyrene	µg/L	0.1	34	40	60 - 140	86
		Benzo(a)pyrene	µg/L	0.1	33	40	60 - 140	82
	Surrogates	d5-nitrobenzene (Surrogate)	µg/L	-	0.4	0.5	40 - 130	70
		2-fluorobiphenyl (Surrogate)	µg/L	-	0.4	0.5	40 - 130	76
		d14-p-terphenyl (Surrogate)	µg/L	-	0.4	0.5	40 - 130	72

Total Phenolics in Soil

Method: ME-(AU)-[ENV]AN289

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110743.002	Total Phenols	mg/kg	0.1	2.2	2.5	70 - 130	87

Total Phenolics in Water

Method: ME-(AU)-[ENV]AN289

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110849.002	Total Phenols	mg/L	0.01	0.22	0.25	80 - 120	88

Total Recoverable Metals in Soil/Waste Solids/Materials by ICPOES

Method: ME-(AU)-[ENV]AN040/AN320

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB111001.002	Arsenic, As	mg/kg	3	49	50	80 - 120	99
	Cadmium, Cd	mg/kg	0.3	51	50	80 - 120	102
	Chromium, Cr	mg/kg	0.3	50	50	80 - 120	99
	Copper, Cu	mg/kg	0.5	51	50	80 - 120	101
	Lead, Pb	mg/kg	1	50	50	80 - 120	101
	Nickel, Ni	mg/kg	0.5	50	50	80 - 120	100
	Zinc, Zn	mg/kg	0.5	51	50	80 - 120	101

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110745.002	Arsenic, As	µg/L	1	20	20	80 - 120	101
	Cadmium, Cd	µg/L	0.1	22	20	80 - 120	110
	Chromium, Cr	µg/L	1	23	20	80 - 120	113
	Copper, Cu	µg/L	1	23	20	80 - 120	114
	Lead, Pb	µg/L	1	23	20	80 - 120	113
	Nickel, Ni	µg/L	1	21	20	80 - 120	105
	Zinc, Zn	µg/L	5	20	20	80 - 120	100

TRH (Total Recoverable Hydrocarbons) in Soil

Method: ME-(AU)-[ENV]AN403

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110824.002		TRH C10-C14	mg/kg	20	38	40	60 - 140	95
		TRH C15-C28	mg/kg	45	<45	40	60 - 140	100
		TRH C29-C36	mg/kg	45	<45	40	60 - 140	103
	TRH F Bands	TRH >C10-C16 (F2)	mg/kg	25	39	40	60 - 140	98
		TRH >C16-C34 (F3)	mg/kg	90	<90	40	60 - 140	108
		TRH >C34-C40 (F4)	mg/kg	120	<120	20	60 - 140	100

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110738.002		TRH C10-C14	µg/L	50	920	1200	60 - 140	77
		TRH C15-C28	µg/L	200	1200	1200	60 - 140	103
		TRH C29-C36	µg/L	200	1400	1200	60 - 140	119
	TRH F Bands	TRH >C10-C16 (F2)	µg/L	60	1100	1200	60 - 140	88
		TRH >C16-C34 (F3)	µg/L	500	1400	1200	60 - 140	115
		TRH >C34-C40 (F4)	µg/L	500	740	600	60 - 140	123

VOC's in Soil

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110735.002	Monocyclic	Benzene	mg/kg	0.1	2.5	2.9	60 - 140	86
	Aromatic	Toluene	mg/kg	0.1	2.1	2.9	60 - 140	72
		Ethylbenzene	mg/kg	0.1	2.2	2.9	60 - 140	76
		m/p-xylene	mg/kg	0.2	5.8	5.8	60 - 140	101
		o-xylene	mg/kg	0.1	2.6	2.9	60 - 140	90
	Surrogates	Dibromofluoromethane (Surrogate)	mg/kg	-	4.7	5	60 - 140	94

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

VOC's in Soil (continued)

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110735.002	Surrogates	d4-1,2-dichloroethane (Surrogate)	mg/kg	-	6.0	5	60 - 140	119
		d8-toluene (Surrogate)	mg/kg	-	3.5	5	60 - 140	70
		Bromofluorobenzene (Surrogate)	mg/kg	-	5.6	5	60 - 140	113

VOCs in Water

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110850.002	Monocyclic	Benzene	µg/L	0.5	50	45.45	60 - 140	110
	Aromatic	Toluene	µg/L	0.5	50	45.45	60 - 140	110
		Ethylbenzene	µg/L	0.5	50	45.45	60 - 140	110
		m/p-xylene	µg/L	1	100	90.9	60 - 140	110
		o-xylene	µg/L	0.5	50	45.45	60 - 140	109
	Surrogates	Dibromofluoromethane (Surrogate)	µg/L	-	5.0	5	60 - 140	99
		d4-1,2-dichloroethane (Surrogate)	µg/L	-	5.0	5	60 - 140	100
		d8-toluene (Surrogate)	µg/L	-	4.7	5	60 - 140	93
		Bromofluorobenzene (Surrogate)	µg/L	-	4.7	5	60 - 140	94

Volatile Petroleum Hydrocarbons in Soil

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110735.002		TRH C6-C10	mg/kg	25	<25	24.65	60 - 140	97
		TRH C6-C9	mg/kg	20	20	23.2	60 - 140	87
	Surrogates	Dibromofluoromethane (Surrogate)	mg/kg	-	4.7	5	60 - 140	94
		d4-1,2-dichloroethane (Surrogate)	mg/kg	-	6.0	5	60 - 140	119
		d8-toluene (Surrogate)	mg/kg	-	3.5	5	60 - 140	70
		Bromofluorobenzene (Surrogate)	mg/kg	-	5.6	5	60 - 140	113
	VPH F Bands	TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25	7.25	60 - 140	121

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110850.002		TRH C6-C10	µg/L	50	940	946.63	60 - 140	99
		TRH C6-C9	µg/L	40	770	818.71	60 - 140	94
	Surrogates	Dibromofluoromethane (Surrogate)	µg/L	-	4.9	5	60 - 140	98
		d4-1,2-dichloroethane (Surrogate)	µg/L	-	5.0	5	60 - 140	101
		d8-toluene (Surrogate)	µg/L	-	5.1	5	60 - 140	102
		Bromofluorobenzene (Surrogate)	µg/L	-	5.0	5	60 - 140	101
	VPH F Bands	TRH C6-C10 minus BTEX (F1)	µg/L	50	630	639.67	60 - 140	99

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub -sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Mercury in Soil

Method: ME-(AU)-[ENV]AN312

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE157527.001	LB110977.004	Mercury	mg/kg	0.05	0.26	0.09	0.2	85

OC Pesticides in Soil

Method: ME-(AU)-[ENV]AN400/AN420

QC Sample	Sample Number		Parameter	Units	LOR	Original	Spike	Recovery%
SE157527.001	LB110824.023		Hexachlorobenzene (HCB)	mg/kg	0.1	<0.1	-	-
			Alpha BHC	mg/kg	0.1	<0.1	-	-
			Lindane	mg/kg	0.1	<0.1	-	-
			Heptachlor	mg/kg	0.1	<0.1	0.2	119
			Aldrin	mg/kg	0.1	<0.1	0.2	110
			Beta BHC	mg/kg	0.1	<0.1	-	-
			Delta BHC	mg/kg	0.1	<0.1	0.2	119
			Heptachlor epoxide	mg/kg	0.1	<0.1	-	-
			o,p'-DDE	mg/kg	0.1	<0.1	-	-
			Alpha Endosulfan	mg/kg	0.2	<0.2	-	-
			Gamma Chlordane	mg/kg	0.1	<0.1	-	-
			Alpha Chlordane	mg/kg	0.1	<0.1	-	-
			trans-Nonachlor	mg/kg	0.1	<0.1	-	-
			p,p'-DDE	mg/kg	0.1	<0.1	-	-
			Dieldrin	mg/kg	0.2	<0.2	0.2	89
			Endrin	mg/kg	0.2	<0.2	0.2	120
			o,p'-DDD	mg/kg	0.1	<0.1	-	-
			o,p'-DDT	mg/kg	0.1	<0.1	-	-
			Beta Endosulfan	mg/kg	0.2	<0.2	-	-
			p,p'-DDD	mg/kg	0.1	<0.1	-	-
			p,p'-DDT	mg/kg	0.1	<0.1	0.2	124
			Endosulfan sulphate	mg/kg	0.1	<0.1	-	-
			Endrin Aldehyde	mg/kg	0.1	<0.1	-	-
			Methoxychlor	mg/kg	0.1	<0.1	-	-
			Endrin Ketone	mg/kg	0.1	<0.1	-	-
			Isodrin	mg/kg	0.1	<0.1	-	-
			Mirex	mg/kg	0.1	<0.1	-	-
		Surrogates	Tetrachloro-m-xylene (TCMX) (Surrogate)	mg/kg	-	0.13	-	83

OP Pesticides in Soil

Method: ME-(AU)-[ENV]AN400/AN420

QC Sample	Sample Number		Parameter	Units	LOR	Original	Spike	Recovery%
SE157527.001	LB110824.023		Dichlorvos	mg/kg	0.5	<0.5	2	85
			Dimethoate	mg/kg	0.5	<0.5	-	-
			Diazinon (Dimpylate)	mg/kg	0.5	<0.5	2	77
			Fenitrothion	mg/kg	0.2	<0.2	-	-
			Malathion	mg/kg	0.2	<0.2	-	-
			Chlorpyrifos (Chlorpyrifos Ethyl)	mg/kg	0.2	<0.2	2	89
			Parathion-ethyl (Parathion)	mg/kg	0.2	<0.2	-	-
			Bromophos Ethyl	mg/kg	0.2	<0.2	-	-
			Methidathion	mg/kg	0.5	<0.5	-	-
			Ethion	mg/kg	0.2	<0.2	2	73
			Azinphos-methyl (Guthion)	mg/kg	0.2	<0.2	-	-
		Surrogates	2-fluorobiphenyl (Surrogate)	mg/kg	-	0.4	-	84
			d14-p-terphenyl (Surrogate)	mg/kg	-	0.4	-	96

PAH (Polynuclear Aromatic Hydrocarbons) in Soil

Method: ME-(AU)-[ENV]AN420

QC Sample	Sample Number	Parameter	Units	LOR	Original	Spike	Recovery%
SE157527.001	LB110824.023	Naphthalene	mg/kg	0.1	<0.1	4	101
		2-methylnaphthalene	mg/kg	0.1	<0.1	-	-
		1-methylnaphthalene	mg/kg	0.1	<0.1	-	-
		Acenaphthylene	mg/kg	0.1	<0.1	4	98
		Acenaphthene	mg/kg	0.1	<0.1	4	101
		Fluorene	mg/kg	0.1	<0.1	-	-
		Phenanthrene	mg/kg	0.1	<0.1	4	103
		Anthracene	mg/kg	0.1	<0.1	4	101
		Fluoranthene	mg/kg	0.1	0.3	4	114

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub -sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

PAH (Polynuclear Aromatic Hydrocarbons) in Soil (continued)

Method: ME-(AU)-[ENV]AN420

QC Sample	Sample Number		Parameter	Units	LOR	Original	Spike	Recovery%
SE157527.001	LB110824.023		Pyrene	mg/kg	0.1	0.2	4	102
			Benzo(a)anthracene	mg/kg	0.1	0.2	-	-
			Chrysene	mg/kg	0.1	0.1	-	-
			Benzo(b&j)fluoranthene	mg/kg	0.1	0.2	-	-
			Benzo(k)fluoranthene	mg/kg	0.1	0.1	-	-
			Benzo(a)pyrene	mg/kg	0.1	0.2	4	105
			Indeno(1,2,3-cd)pyrene	mg/kg	0.1	0.1	-	-
			Dibenzo(ah)anthracene	mg/kg	0.1	<0.1	-	-
			Benzo(ghi)perylene	mg/kg	0.1	0.1	-	-
			Carcinogenic PAHs, BaP TEQ <LOR=0	TEQ	0.2	0.2	-	-
			Carcinogenic PAHs, BaP TEQ <LOR=LOR	TEQ (mg/kg)	0.3	0.3	-	-
			Carcinogenic PAHs, BaP TEQ <LOR=LOR/2	TEQ (mg/kg)	0.2	0.3	-	-
			Total PAH (18)	mg/kg	0.8	1.5	-	-
		Surrogates	d5-nitrobenzene (Surrogate)	mg/kg	-	0.4	-	84
			2-fluorobiphenyl (Surrogate)	mg/kg	-	0.4	-	84
			d14-p-terphenyl (Surrogate)	mg/kg	-	0.4	-	96

Total Phenolics in Soil

Method: ME-(AU)-[ENV]AN289

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE157443.013	LB110743.015	Total Phenols	mg/kg	0.1	2.4	<0.1	2.5	95

Total Phenolics in Water

Method: ME-(AU)-[ENV]AN289

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE155387.002	LB110849.010	Total Phenols	mg/L	0.01	0.22	<0.01	0.25	86

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE157471.013	LB110745.004	Arsenic, As	µg/L	1	20	<1	20	102
		Cadmium, Cd	µg/L	0.1	22	<0.1	20	112
		Chromium, Cr	µg/L	1	23	<1	20	114
		Copper, Cu	µg/L	1	23	<1	20	115
		Lead, Pb	µg/L	1	22	<1	20	112
		Nickel, Ni	µg/L	1	21	<1	20	105
		Zinc, Zn	µg/L	5	22	<5	20	101

TRH (Total Recoverable Hydrocarbons) in Soil

Method: ME-(AU)-[ENV]AN403

QC Sample	Sample Number		Parameter	Units	LOR	Original	Spike	Recovery%
SE157526.001	LB110824.023		TRH C10-C14	mg/kg	20	<20	40	95
			TRH C15-C28	mg/kg	45	<45	40	120
			TRH C29-C36	mg/kg	45	<45	40	108
			TRH C37-C40	mg/kg	100	<100	-	-
			TRH C10-C36 Total	mg/kg	110	<110	-	-
			TRH C10-C40 Total	mg/kg	210	<210	-	-
		TRH F Bands	TRH >C10-C16 (F2)	mg/kg	25	<25	40	95
			TRH >C10-C16 (F2) - Naphthalene	mg/kg	25	<25	-	-
			TRH >C16-C34 (F3)	mg/kg	90	<90	40	133
			TRH >C34-C40 (F4)	mg/kg	120	<120	-	-

VOC's in Soil

Method: ME-(AU)-[ENV]AN433

QC Sample	Sample Number		Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE157545.001	LB110735.004	Monocyclic	Benzene	mg/kg	0.1	2.1	<0.1	2.9	73
		Aromatic	Toluene	mg/kg	0.1	1.9	<0.1	2.9	65
			Ethylbenzene	mg/kg	0.1	1.9	<0.1	2.9	64
			m/p-xylene	mg/kg	0.2	4.7	<0.2	5.8	81
			o-xylene	mg/kg	0.1	2.2	<0.1	2.9	74
		Polycyclic	Naphthalene	mg/kg	0.1	<0.1	<0.1	-	-
		Surrogates	Dibromofluoromethane (Surrogate)	mg/kg	-	4.9	4.0	-	97
			d4-1,2-dichloroethane (Surrogate)	mg/kg	-	4.5	4.1	-	91

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub -sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

VOC's in Soil (continued)

Method: ME-(AU)-[ENV]AN433

QC Sample	Sample Number		Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE157545.001	LB110735.004	Surrogates	d8-toluene (Surrogate)	mg/kg	-	4.0	5.3	-	80
			Bromofluorobenzene (Surrogate)	mg/kg	-	5.3	5.4	-	107
		Totals	Total Xylenes*	mg/kg	0.3	6.8	<0.3	-	-
			Total BTEX	mg/kg	0.6	13	<0.6	-	-

Volatile Petroleum Hydrocarbons in Soil

Method: ME-(AU)-[ENV]AN433

QC Sample	Sample Number		Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE157545.001	LB110735.004		TRH C6-C10	mg/kg	25	<25	<25	24.65	83
			TRH C6-C9	mg/kg	20	<20	<20	23.2	80
		Surrogates	Dibromofluoromethane (Surrogate)	mg/kg	-	4.9	4.0	-	97
			d4-1,2-dichloroethane (Surrogate)	mg/kg	-	4.5	4.1	-	91
			d8-toluene (Surrogate)	mg/kg	-	4.0	5.3	-	80
			Bromofluorobenzene (Surrogate)	mg/kg	-	5.3	5.4	-	107
		VPH F	Benzene (F0)	mg/kg	0.1	2.1	<0.1	-	-
		Bands	TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25	<25	7.25	108

MATRIX SPIKE DUPLICATES

SE157545 R0

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.

Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here: http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical Documents/MP-AU-ENV-QU-022 QA QC Plan.pdf

*	NATA accreditation does not cover tthe performance of this service.
-	Sample not analysed for this analyte.

IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
LOR	Limit of reporting.
QFH	QC result is above the upper tolerance.
QFL	QC result is below the lower tolerance.

①	At least 2 of 3 surrogates are within acceptance criteria.
②	RPD failed acceptance criteria due to sample heterogeneity.
③	Results less than 5 times LOR preclude acceptance criteria for RPD.
④	Recovery failed acceptance criteria due to matrix interference.
⑤	Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
⑥	LOR was raised due to sample matrix interference.
⑦	LOR was raised due to dilution of significantly high concentration of analyte in sample.
⑧	Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
⑨	Recovery failed acceptance criteria due to sample heterogeneity.
⑩	LOR was raised due to high conductivity of the sample (required dilution).
†	Refer to Analytical Report comments for further information.

This document is issued, on the Client's behalf, by the Company under its General Conditions of Service, available on request and accessible at http://www.sgs.com/en/terms-and-conditions. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any other holder of this document is advised that information contained herein reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

This test report shall not be reproduced, except in full.

source: M630_SR_20160930122040.pdf page: 4 SGS Ref: SE157659_COC

SGS

CHAIN OF CUSTODY & ANALYSIS REQUEST

SGS Environmental Services
Unit 16, 33 Maddox Street
Alexandria NSW 2015
Telephone No: (02) 85940400
Facsimile No: (02) 85940499
Email: au.samplereceipt.sydney@sgs.com

Company Name: SMEC
Address: Suite 2, Level 1, 243 Northbourne Avenue, Lyneham, ACT, 2602, Australia
Contact Name: Ryan O'Leary

Project Name/No: 3002523 – Canberra Brickworks
Purchase Order No:
Results Required By: Ryan O'Leary
Telephone: +61 2 6234 1963 / 0400 240 023
Facsimile:
Email Results: Ryan.O'Leary@smec.com

Client Sample ID	Date Sampled	Lab Sample ID	WATER	SOIL		NO OF CONTAINERS	BTEXN	OPPs	OCPs	PAHs/Phenols	8H Metals - As, Cd, Cr, Cu, Ni, Pb, Zn, Hg	TPH/TRH	Comment
M2	28/9/2016	1	✓			5	√	√	√	√	√	√	
M3	28/9/2016	2	✓			5	√	√	√	√	√	√	
QC22	28/9/2016	3	✓			5	√	√	√	√	√	√	
QC23	28/9/2016		✓			5	√	√	√	√	√	√	Please send to ALS Sydney

SGS EHS Alexandria Laboratory
SE157659 COC
Received: 30 – Sep – 2016

Relinquished By: Ryan O'Leary	Date/Time: 29/9/2016 16:00	Received By:	Date/Time
Relinquished By:	Date/Time:	Received By:	Date/Time 30/9/16 @ 10:00
Samples Intact: Yes/ No	Temperature: Ambient / Chilled 16.8	Sample Cooler Sealed: Yes/ No	Laboratory Quotation No:
	Comments: AS PER SGS QUOTE NUMBER SY1 – 60413 – 2-IS DATED 13TH APRIL 2016 **Laboratory to filter metals and report as dissolved**	**STANDARD TAT PLEASE (5 DAY)**	

SAMPLE RECEIPT ADVICE

SE157659

CLIENT DETAILS

Contact	Ryan O'Leary
Client	SMEC AUSTRALIA PTY LTD
Address	Sun Micro Building Suite 2, Level 1 243 Northbourne Avenue ACT 2602
Telephone	02 6234 1963
Facsimile	02 6234 1966
Email	Ryan.O'Leary@smec.com
Project	**3002523 - Canberra Brickworks**
Order Number	**SY1-60413-2-IS**
Samples	3

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
Samples Received	Fri 30/9/2016
Report Due	Mon 10/10/2016
SGS Reference	**SE157659**

SUBMISSION DETAILS

This is to confirm that 3 samples were received on Friday 30/9/2016. Results are expected to be ready by Monday 10/10/2016. Please quote SGS reference SE157659 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Sample counts by matrix	3 Water	Type of documentation received	COC
Date documentation received	30/9/2016	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	16.8°C
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	Ice Bricks	Samples clearly labelled	Yes
Complete documentation received	Yes	Number of eskies/boxes received	

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

QC23 has been forwarded to ALS Sydney.

To the extent not inconsistent with the other provisions of this document and unless specifically agreed otherwise in writing by SGS, all SGS services are rendered in accordance with the applicable SGS General Conditions of Service accessible at http://www.sgs.com/en/terms-and-conditions as at the date of this document. Attention is drawn to the limitations of liability and to the clauses of indemnification.

SAMPLE RECEIPT ADVICE

SE157659

CLIENT DETAILS

Client SMEC AUSTRALIA PTY LTD

Project 3002523 - Canberra Brickworks

SUMMARY OF ANALYSIS

No.	Sample ID	OC Pesticides in Water	OP Pesticides in Water	PAH (Polynuclear Aromatic Hydrocarbons) in Water	Total Phenolics in Water	Trace Metals (Dissolved) in Water by ICPMS	TRH (Total Recoverable Hydrocarbons) in Water	VOCs in Water	Volatile Petroleum Hydrocarbons in Water
001	M2	28	13	22	1	7	9	12	8
002	M3	28	13	22	1	7	9	12	8
003	QC22	28	13	22	1	7	9	12	8

CONTINUED OVERLEAF

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

SAMPLE RECEIPT ADVICE

SE157659

CLIENT DETAILS

Client SMEC AUSTRALIA PTY LTD

Project 3002523 - Canberra Brickworks

SUMMARY OF ANALYSIS

No.	Sample ID	Mercury (dissolved) in Water
001	M2	1
002	M3	1
003	QC22	1

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Ryan O'Leary
Client	SMEC AUSTRALIA PTY LTD
Address	Sun Micro Building Suite 2, Level 1 243 Northbourne Avenue ACT 2602
Telephone	02 6234 1963
Facsimile	02 6234 1966
Email	Ryan.O'Leary@smec.com
Project	**3002523 - Canberra Brickworks**
Order Number	**SY1-60413-2-IS**
Samples	3

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE157659 R0**
Date Received	30/9/2016
Date Reported	10/10/2016

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(4354).

SIGNATORIES

Andy Sutton
Senior Organic Chemist

Dong Liang
Metals/Inorganics Team Leader

Kamrul Ahsan
Senior Chemist

Ly Kim Ha
Organic Section Head

VOCs in Water [AN433] Tested: 4/10/2016

PARAMETER	UOM	LOR	M2 WATER - 28/9/2016 SE157659.001	M3 WATER - 28/9/2016 SE157659.002	QC22 WATER - 28/9/2016 SE157659.003
Benzene	µg/L	0.5	**1.0**	<0.5	**0.8**
Toluene	µg/L	0.5	<0.5	<0.5	<0.5
Ethylbenzene	µg/L	0.5	<0.5	<0.5	<0.5
m/p-xylene	µg/L	1	<1	<1	<1
o-xylene	µg/L	0.5	<0.5	<0.5	<0.5
Total Xylenes	µg/L	1.5	<1.5	<1.5	<1.5
Total BTEX	µg/L	3	<3	<3	<3
Naphthalene	µg/L	0.5	<0.5	<0.5	<0.5

Volatile Petroleum Hydrocarbons in Water [AN433] Tested: 4/10/2016

PARAMETER	UOM	LOR	M2 WATER - 28/9/2016 SE157659.001	M3 WATER - 28/9/2016 SE157659.002	QC22 WATER - 28/9/2016 SE157659.003
TRH C6-C9	µg/L	40	<40	<40	<40
Benzene (F0)	µg/L	0.5	**1.0**	<0.5	**0.8**
TRH C6-C10	µg/L	50	<50	<50	<50
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<50	<50

TRH (Total Recoverable Hydrocarbons) in Water [AN403] Tested: 4/10/2016

PARAMETER	UOM	LOR	M2 WATER - 28/9/2016 SE157659.001	M3 WATER - 28/9/2016 SE157659.002	QC22 WATER - 28/9/2016 SE157659.003
TRH C10-C14	µg/L	50	<50	<50	<50
TRH C15-C28	µg/L	200	<200	<200	<200
TRH C29-C36	µg/L	200	<200	<200	<200
TRH C37-C40	µg/L	200	<200	<200	<200
TRH >C10-C16 (F2)	µg/L	60	<60	<60	<60
TRH >C16-C34 (F3)	µg/L	500	<500	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500
TRH C10-C36	µg/L	450	<450	<450	<450
TRH C10-C40	µg/L	650	<650	<650	<650

PAH (Polynuclear Aromatic Hydrocarbons) in Water [AN420] Tested: 4/10/2016

PARAMETER	UOM	LOR	M2 WATER - 28/9/2016 SE157659.001	M3 WATER - 28/9/2016 SE157659.002	QC22 WATER - 28/9/2016 SE157659.003
Naphthalene	µg/L	0.1	<0.1	<0.1	<0.1
2-methylnaphthalene	µg/L	0.1	<0.1	<0.1	<0.1
1-methylnaphthalene	µg/L	0.1	<0.1	<0.1	<0.1
Acenaphthylene	µg/L	0.1	<0.1	<0.1	<0.1
Acenaphthene	µg/L	0.1	<0.1	<0.1	<0.1
Fluorene	µg/L	0.1	<0.1	<0.1	<0.1
Phenanthrene	µg/L	0.1	<0.1	<0.1	<0.1
Anthracene	µg/L	0.1	<0.1	<0.1	<0.1
Fluoranthene	µg/L	0.1	<0.1	<0.1	<0.1
Pyrene	µg/L	0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	µg/L	0.1	<0.1	<0.1	<0.1
Chrysene	µg/L	0.1	<0.1	<0.1	<0.1
Benzo(b&j)fluoranthene	µg/L	0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	µg/L	0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	µg/L	0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	µg/L	0.1	<0.1	<0.1	<0.1
Dibenzo(ah)anthracene	µg/L	0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	µg/L	0.1	<0.1	<0.1	<0.1
Total PAH (18)	µg/L	1	<1	<1	<1

OC Pesticides in Water [AN400/AN420] Tested: 4/10/2016

PARAMETER	UOM	LOR	M2 WATER - 28/9/2016 SE157659.001	M3 WATER - 28/9/2016 SE157659.002	QC22 WATER - 28/9/2016 SE157659.003
Hexachlorobenzene (HCB)	µg/L	0.1	<0.1	<0.1	<0.1
Alpha BHC	µg/L	0.1	<0.1	<0.1	<0.1
Lindane (gamma BHC)	µg/L	0.1	<0.1	<0.1	<0.1
Heptachlor	µg/L	0.1	<0.1	<0.1	<0.1
Aldrin	µg/L	0.1	<0.1	<0.1	<0.1
Beta BHC	µg/L	0.1	<0.1	<0.1	<0.1
Delta BHC	µg/L	0.1	<0.1	<0.1	<0.1
Heptachlor epoxide	µg/L	0.1	<0.1	<0.1	<0.1
o,p'-DDE	µg/L	0.1	<0.1	<0.1	<0.1
Alpha Endosulfan	µg/L	0.1	<0.1	<0.1	<0.1
Gamma Chlordane	µg/L	0.1	<0.1	<0.1	<0.1
Alpha Chlordane	µg/L	0.1	<0.1	<0.1	<0.1
trans-Nonachlor	µg/L	0.1	<0.1	<0.1	<0.1
p,p'-DDE	µg/L	0.1	<0.1	<0.1	<0.1
Dieldrin	µg/L	0.1	<0.1	<0.1	<0.1
Endrin	µg/L	0.1	<0.1	<0.1	<0.1
o,p'-DDD	µg/L	0.1	<0.1	<0.1	<0.1
o,p'-DDT	µg/L	0.1	<0.1	<0.1	<0.1
Beta Endosulfan	µg/L	0.1	<0.1	<0.1	<0.1
p,p'-DDD	µg/L	0.1	<0.1	<0.1	<0.1
p,p'-DDT	µg/L	0.1	<0.1	<0.1	<0.1
Endosulfan sulphate	µg/L	0.1	<0.1	<0.1	<0.1
Endrin aldehyde	µg/L	0.1	<0.1	<0.1	<0.1
Methoxychlor	µg/L	0.1	<0.1	<0.1	<0.1
Endrin ketone	µg/L	0.1	<0.1	<0.1	<0.1
Isodrin	µg/L	0.1	<0.1	<0.1	<0.1
Mirex	µg/L	0.1	<0.1	<0.1	<0.1

OP Pesticides in Water [AN400/AN420] Tested: 4/10/2016

PARAMETER	UOM	LOR	M2 WATER - 28/9/2016 SE157659.001	M3 WATER - 28/9/2016 SE157659.002	QC22 WATER - 28/9/2016 SE157659.003
Dichlorvos	µg/L	0.5	<0.5	<0.5	<0.5
Dimethoate	µg/L	0.5	<0.5	<0.5	<0.5
Diazinon (Dimpylate)	µg/L	0.5	<0.5	<0.5	<0.5
Fenitrothion	µg/L	0.2	<0.2	<0.2	<0.2
Malathion	µg/L	0.2	<0.2	<0.2	<0.2
Chlorpyrifos (Chlorpyrifos Ethyl)	µg/L	0.2	<0.2	<0.2	<0.2
Parathion-ethyl (Parathion)	µg/L	0.2	<0.2	<0.2	<0.2
Bromophos Ethyl	µg/L	0.2	<0.2	<0.2	<0.2
Methidathion	µg/L	0.5	<0.5	<0.5	<0.5
Ethion	µg/L	0.2	<0.2	<0.2	<0.2
Azinphos-methyl	µg/L	0.2	<0.2	<0.2	<0.2

Total Phenolics in Water [AN289] Tested: 5/10/2016

PARAMETER	UOM	LOR	M2 WATER - 28/9/2016 SE157659.001	M3 WATER - 28/9/2016 SE157659.002	QC22 WATER - 28/9/2016 SE157659.003
Total Phenols	mg/L	0.01	<0.01	<0.01	**0.02**

Trace Metals (Dissolved) in Water by ICPMS [AN318] Tested: 5/10/2016

PARAMETER	UOM	LOR	M2 WATER - 28/9/2016 SE157659.001	M3 WATER - 28/9/2016 SE157659.002	QC22 WATER - 28/9/2016 SE157659.003
Arsenic, As	µg/L	1	<1	<1	<1
Cadmium, Cd	µg/L	0.1	**1.3**	<0.1	**1.4**
Chromium, Cr	µg/L	1	<1	<1	<1
Copper, Cu	µg/L	1	**4**	**1**	**4**
Lead, Pb	µg/L	1	<1	<1	<1
Nickel, Ni	µg/L	1	**20**	**2**	**20**
Zinc, Zn	µg/L	5	**67**	**21**	**64**

Mercury (dissolved) in Water [AN311(Perth)/AN312] Tested: 6/10/2016

PARAMETER	UOM	LOR	M2 WATER - 28/9/2016 SE157659.001	M3 WATER - 28/9/2016 SE157659.002	QC22 WATER - 28/9/2016 SE157659.003
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001

METHOD	METHODOLOGY SUMMARY
AN020	Unpreserved water sample is filtered through a 0.45µm membrane filter and acidified with nitric acid similar to APHA3030B.
AN289	Analysis of Total Phenols in Soil Sediment and Water: Steam distillable phenols react with 4-aminoantipyrine at pH 7.9±0.1 in the presence of potassium ferricyanide to form a coloured antipyrine dye analysed by Discrete Analyser. Reference APHA 5530 B/D.
AN311(Perth)/AN312	Mercury by Cold Vapour AAS in Waters: Mercury ions are reduced by stannous chloride reagent in acidic solution to elemental mercury. This mercury vapour is purged by nitrogen into a cold cell in an atomic absorption spectrometer or mercury analyser. Quantification is made by comparing absorbances to those of the calibration standards. Reference APHA 3112/3500.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN400	OC and OP Pesticides by GC-ECD: The determination of organochlorine (OC) and organophosphorus (OP) pesticides and polychlorinated biphenyls (PCBs) in soils, sludges and groundwater. (Based on USEPA methods 3510, 3550, 8140 and 8080.)
AN403	Total Recoverable Hydrocarbons: Determination of Hydrocarbons by gas chromatography after a solvent extraction. Detection is by flame ionisation detector (FID) that produces an electronic signal in proportion to the combustible matter passing through it. Total Recoverable Hydrocarbons (TRH) are routinely reported as four alkane groupings based on the carbon chain length of the compounds: C6-C9, C10-C14, C15-C28 and C29-C36 and in recognition of the NEPM 1999 (2013), >C10-C16 (F2), >C16-C34 (F3) and >C34-C40 (F4). F2 is not corrected for Naphthalene.
AN403	Additionally, the volatile C6-C9/C6-C10 fractions may be determined by a purge and trap technique and GC/MS because of the potential for volatiles loss. Total Petroleum Hydrocarbons (TPH) follows the same method of analysis after silica gel cleanup of the solvent extract. Aliphatic/Aromatic Speciation follows the same method of analysis after fractionation of the solvent extract over silica with differential polarity of the eluent solvents .
AN403	The GC/FID method is not well suited to the analysis of refined high boiling point materials (ie lubricating oils or greases) but is particularly suited for measuring diesel, kerosene and petrol if care to control volatility is taken. This method will detect naturally occurring hydrocarbons, lipids, animal fats, phenols and PAHs if they are present at sufficient levels, dependent on the use of specific cleanup/fractionation techniques. Reference USEPA 3510B, 8015B.
AN420	(SVOCs) including OC, OP, PCB, Herbicides, PAH, Phthalates and Speciated Phenols (etc) in soils, sediments and waters are determined by GCMS/ECD technique following appropriate solvent extraction process (Based on USEPA 3500C and 8270D).
AN420	SVOC Compounds: Semi-Volatile Organic Compounds (SVOCs) including OC, OP, PCB, Herbicides, PAH, Phthalates and Speciated Phenols in soils, sediments and waters are determined by GCMS/ECD technique following appropriate solvent extraction process (Based on USEPA 3500C and 8270D).
AN433	VOCs and C6-C9 Hydrocarbons by GC-MS P&T: VOC`s are volatile organic compounds. The sample is presented to a gas chromatograph via a purge and trap (P&T) concentrator and autosampler and is detected with a Mass Spectrometer (MSD). Solid samples are initially extracted with methanol whilst liquid samples are processed directly. References: USEPA 5030B, 8020A, 8260.

FOOTNOTES

*	NATA accreditation does not cover the performance of this service.	-	Not analysed.	UOM	Unit of Measure.
		NVL	Not validated.	LOR	Limit of Reporting.
**	Indicative data, theoretical holding time exceeded.	IS	Insufficient sample for analysis.	↑↓	Raised/lowered Limit of Reporting.
		LNR	Sample listed, but not received.		

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/en/terms-and-conditions. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

This report must not be reproduced, except in full.

STATEMENT OF QA/QC PERFORMANCE

SE157659 R0

CLIENT DETAILS

Contact	Ryan O'Leary
Client	SMEC AUSTRALIA PTY LTD
Address	Sun Micro Building Suite 2, Level 1 243 Northbourne Avenue ACT 2602
Telephone	02 6234 1963
Facsimile	02 6234 1966
Email	Ryan.O'Leary@smec.com
Project	**3002523 - Canberra Brickworks**
Order Number	**SY1-60413-2-IS**
Samples	3

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE157659 R0**
Date Received	30 Sep 2016
Date Reported	10 Oct 2016

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document and was supplied by the Client.
This QA/QC Statement must be read in conjunction with the referenced Analytical Report.
The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met (within the SGS Alexandria Environmental laboratory).

SAMPLE SUMMARY

HOLDING TIME SUMMARY

SE157659 R0

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS “Field Sampling Guide for Containers and Holding Time” (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311(Perth)/AN312

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M2	SE157659.001	LB111204	28 Sep 2016	30 Sep 2016	26 Oct 2016	06 Oct 2016	26 Oct 2016	07 Oct 2016
M3	SE157659.002	LB111204	28 Sep 2016	30 Sep 2016	26 Oct 2016	06 Oct 2016	26 Oct 2016	07 Oct 2016
QC22	SE157659.003	LB111204	28 Sep 2016	30 Sep 2016	26 Oct 2016	06 Oct 2016	26 Oct 2016	07 Oct 2016

OC Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M2	SE157659.001	LB110969	28 Sep 2016	30 Sep 2016	05 Oct 2016	04 Oct 2016	13 Nov 2016	06 Oct 2016
M3	SE157659.002	LB110969	28 Sep 2016	30 Sep 2016	05 Oct 2016	04 Oct 2016	13 Nov 2016	06 Oct 2016
QC22	SE157659.003	LB110969	28 Sep 2016	30 Sep 2016	05 Oct 2016	04 Oct 2016	13 Nov 2016	06 Oct 2016

OP Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M2	SE157659.001	LB110969	28 Sep 2016	30 Sep 2016	05 Oct 2016	04 Oct 2016	13 Nov 2016	05 Oct 2016
M3	SE157659.002	LB110969	28 Sep 2016	30 Sep 2016	05 Oct 2016	04 Oct 2016	13 Nov 2016	05 Oct 2016
QC22	SE157659.003	LB110969	28 Sep 2016	30 Sep 2016	05 Oct 2016	04 Oct 2016	13 Nov 2016	05 Oct 2016

PAH (Polynuclear Aromatic Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN420

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M2	SE157659.001	LB110969	28 Sep 2016	30 Sep 2016	05 Oct 2016	04 Oct 2016	13 Nov 2016	05 Oct 2016
M3	SE157659.002	LB110969	28 Sep 2016	30 Sep 2016	05 Oct 2016	04 Oct 2016	13 Nov 2016	05 Oct 2016
QC22	SE157659.003	LB110969	28 Sep 2016	30 Sep 2016	05 Oct 2016	04 Oct 2016	13 Nov 2016	05 Oct 2016

Total Phenolics in Water

Method: ME-(AU)-[ENV]AN289

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M2	SE157659.001	LB111042	28 Sep 2016	30 Sep 2016	26 Oct 2016	05 Oct 2016	26 Oct 2016	05 Oct 2016
M3	SE157659.002	LB111042	28 Sep 2016	30 Sep 2016	26 Oct 2016	05 Oct 2016	26 Oct 2016	05 Oct 2016
QC22	SE157659.003	LB111042	28 Sep 2016	30 Sep 2016	26 Oct 2016	05 Oct 2016	26 Oct 2016	05 Oct 2016

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M2	SE157659.001	LB111038	28 Sep 2016	30 Sep 2016	27 Mar 2017	05 Oct 2016	27 Mar 2017	06 Oct 2016
M3	SE157659.002	LB111038	28 Sep 2016	30 Sep 2016	27 Mar 2017	05 Oct 2016	27 Mar 2017	06 Oct 2016
QC22	SE157659.003	LB111038	28 Sep 2016	30 Sep 2016	27 Mar 2017	05 Oct 2016	27 Mar 2017	06 Oct 2016

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M2	SE157659.001	LB110969	28 Sep 2016	30 Sep 2016	05 Oct 2016	04 Oct 2016	13 Nov 2016	05 Oct 2016
M3	SE157659.002	LB110969	28 Sep 2016	30 Sep 2016	05 Oct 2016	04 Oct 2016	13 Nov 2016	05 Oct 2016
QC22	SE157659.003	LB110969	28 Sep 2016	30 Sep 2016	05 Oct 2016	04 Oct 2016	13 Nov 2016	05 Oct 2016

VOCs in Water

Method: ME-(AU)-[ENV]AN433

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M2	SE157659.001	LB110965	28 Sep 2016	30 Sep 2016	05 Oct 2016	04 Oct 2016	13 Nov 2016	10 Oct 2016
M3	SE157659.002	LB110965	28 Sep 2016	30 Sep 2016	05 Oct 2016	04 Oct 2016	13 Nov 2016	10 Oct 2016
QC22	SE157659.003	LB110965	28 Sep 2016	30 Sep 2016	05 Oct 2016	04 Oct 2016	13 Nov 2016	10 Oct 2016

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M2	SE157659.001	LB110965	28 Sep 2016	30 Sep 2016	05 Oct 2016	04 Oct 2016	13 Nov 2016	10 Oct 2016
M3	SE157659.002	LB110965	28 Sep 2016	30 Sep 2016	05 Oct 2016	04 Oct 2016	13 Nov 2016	10 Oct 2016
QC22	SE157659.003	LB110965	28 Sep 2016	30 Sep 2016	05 Oct 2016	04 Oct 2016	13 Nov 2016	10 Oct 2016

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

OC Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Tetrachloro-m-xylene (TCMX) (Surrogate)	M2	SE157659.001	%	40 - 130%	62
	M3	SE157659.002	%	40 - 130%	64
	QC22	SE157659.003	%	40 - 130%	62

OP Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
2-fluorobiphenyl (Surrogate)	M2	SE157659.001	%	40 - 130%	52
	M3	SE157659.002	%	40 - 130%	68
	QC22	SE157659.003	%	40 - 130%	68
d14-p-terphenyl (Surrogate)	M2	SE157659.001	%	40 - 130%	66
	M3	SE157659.002	%	40 - 130%	86
	QC22	SE157659.003	%	40 - 130%	76

PAH (Polynuclear Aromatic Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN420

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
2-fluorobiphenyl (Surrogate)	M2	SE157659.001	%	40 - 130%	52
	M3	SE157659.002	%	40 - 130%	68
	QC22	SE157659.003	%	40 - 130%	68
d14-p-terphenyl (Surrogate)	M2	SE157659.001	%	40 - 130%	66
	M3	SE157659.002	%	40 - 130%	86
	QC22	SE157659.003	%	40 - 130%	76
d5-nitrobenzene (Surrogate)	M2	SE157659.001	%	40 - 130%	52
	M3	SE157659.002	%	40 - 130%	66
	QC22	SE157659.003	%	40 - 130%	64

VOCs in Water

Method: ME-(AU)-[ENV]AN433

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Bromofluorobenzene (Surrogate)	M2	SE157659.001	%	40 - 130%	90
	M3	SE157659.002	%	40 - 130%	91
	QC22	SE157659.003	%	40 - 130%	90
d4-1,2-dichloroethane (Surrogate)	M2	SE157659.001	%	40 - 130%	112
	M3	SE157659.002	%	40 - 130%	107
	QC22	SE157659.003	%	40 - 130%	101
d8-toluene (Surrogate)	M2	SE157659.001	%	40 - 130%	95
	M3	SE157659.002	%	40 - 130%	97
	QC22	SE157659.003	%	40 - 130%	84
Dibromofluoromethane (Surrogate)	M2	SE157659.001	%	40 - 130%	116
	M3	SE157659.002	%	40 - 130%	109
	QC22	SE157659.003	%	40 - 130%	114

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Bromofluorobenzene (Surrogate)	M2	SE157659.001	%	40 - 130%	90
	M3	SE157659.002	%	40 - 130%	91
	QC22	SE157659.003	%	40 - 130%	90
d4-1,2-dichloroethane (Surrogate)	M2	SE157659.001	%	60 - 130%	112
	M3	SE157659.002	%	60 - 130%	107
	QC22	SE157659.003	%	60 - 130%	101
d8-toluene (Surrogate)	M2	SE157659.001	%	40 - 130%	95
	M3	SE157659.002	%	40 - 130%	97
	QC22	SE157659.003	%	40 - 130%	84
Dibromofluoromethane (Surrogate)	M2	SE157659.001	%	40 - 130%	116
	M3	SE157659.002	%	40 - 130%	109
	QC22	SE157659.003	%	40 - 130%	114

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311(Perth)/AN312

Sample Number	Parameter	Units	LOR	Result
LB111204.001	Mercury	mg/L	0.0001	<0.0001

OC Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Sample Number		Parameter	Units	LOR	Result
LB110969.001		Hexachlorobenzene (HCB)	µg/L	0.1	<0.1
		Alpha BHC	µg/L	0.1	<0.1
		Lindane (gamma BHC)	µg/L	0.1	<0.1
		Heptachlor	µg/L	0.1	<0.1
		Aldrin	µg/L	0.1	<0.1
		Beta BHC	µg/L	0.1	<0.1
		Delta BHC	µg/L	0.1	<0.1
		Heptachlor epoxide	µg/L	0.1	<0.1
		Alpha Endosulfan	µg/L	0.1	<0.1
		Gamma Chlordane	µg/L	0.1	<0.1
		Alpha Chlordane	µg/L	0.1	<0.1
		p,p'-DDE	µg/L	0.1	<0.1
		Dieldrin	µg/L	0.1	<0.1
		Endrin	µg/L	0.1	<0.1
		Beta Endosulfan	µg/L	0.1	<0.1
		p,p'-DDD	µg/L	0.1	<0.1
		p,p'-DDT	µg/L	0.1	<0.1
		Endosulfan sulphate	µg/L	0.1	<0.1
		Endrin aldehyde	µg/L	0.1	<0.1
		Methoxychlor	µg/L	0.1	<0.1
		Endrin ketone	µg/L	0.1	<0.1
		Isodrin	µg/L	0.1	<0.1
		Mirex	µg/L	0.1	<0.1
	Surrogates	Tetrachloro-m-xylene (TCMX) (Surrogate)	%	-	75

OP Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Sample Number		Parameter	Units	LOR	Result
LB110969.001		Dichlorvos	µg/L	0.5	<0.5
		Dimethoate	µg/L	0.5	<0.5
		Diazinon (Dimpylate)	µg/L	0.5	<0.5
		Fenitrothion	µg/L	0.2	<0.2
		Malathion	µg/L	0.2	<0.2
		Chlorpyrifos (Chlorpyrifos Ethyl)	µg/L	0.2	<0.2
		Parathion-ethyl (Parathion)	µg/L	0.2	<0.2
		Bromophos Ethyl	µg/L	0.2	<0.2
		Methidathion	µg/L	0.5	<0.5
		Ethion	µg/L	0.2	<0.2
		Azinphos-methyl	µg/L	0.2	<0.2
	Surrogates	2-fluorobiphenyl (Surrogate)	%	-	72
		d14-p-terphenyl (Surrogate)	%	-	94

PAH (Polynuclear Aromatic Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN420

Sample Number	Parameter	Units	LOR	Result
LB110969.001	Naphthalene	µg/L	0.1	<0.1
	2-methylnaphthalene	µg/L	0.1	<0.1
	1-methylnaphthalene	µg/L	0.1	<0.1
	Acenaphthylene	µg/L	0.1	<0.1
	Acenaphthene	µg/L	0.1	<0.1
	Fluorene	µg/L	0.1	<0.1
	Phenanthrene	µg/L	0.1	<0.1
	Anthracene	µg/L	0.1	<0.1
	Fluoranthene	µg/L	0.1	<0.1
	Pyrene	µg/L	0.1	<0.1
	Benzo(a)anthracene	µg/L	0.1	<0.1
	Chrysene	µg/L	0.1	<0.1
	Benzo(a)pyrene	µg/L	0.1	<0.1

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

PAH (Polynuclear Aromatic Hydrocarbons) in Water (continued)

Method: ME-(AU)-[ENV]AN420

Sample Number		Parameter	Units	LOR	Result
LB110969.001		Indeno(1,2,3-cd)pyrene	µg/L	0.1	<0.1
		Dibenzo(ah)anthracene	µg/L	0.1	<0.1
		Benzo(ghi)perylene	µg/L	0.1	<0.1
	Surrogates	d5-nitrobenzene (Surrogate)	%	-	74
		2-fluorobiphenyl (Surrogate)	%	-	72
		d14-p-terphenyl (Surrogate)	%	-	94

Total Phenolics in Water

Method: ME-(AU)-[ENV]AN289

Sample Number	Parameter	Units	LOR	Result
LB111042.001	Total Phenols	mg/L	0.01	<0.01

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Number	Parameter	Units	LOR	Result
LB111038.001	Arsenic, As	µg/L	1	<1
	Cadmium, Cd	µg/L	0.1	<0.1
	Chromium, Cr	µg/L	1	<1
	Copper, Cu	µg/L	1	<1
	Lead, Pb	µg/L	1	<1
	Nickel, Ni	µg/L	1	<1
	Zinc, Zn	µg/L	5	<5

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Sample Number	Parameter	Units	LOR	Result
LB110969.001	TRH C10-C14	µg/L	50	<50
	TRH C15-C28	µg/L	200	<200
	TRH C29-C36	µg/L	200	<200
	TRH C37-C40	µg/L	200	<200

VOCs in Water

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result
LB110965.001	Monocyclic Aromatic	Benzene	µg/L	0.5	<0.5
	Hydrocarbons	Toluene	µg/L	0.5	<0.5
		Ethylbenzene	µg/L	0.5	<0.5
		m/p-xylene	µg/L	1	<1
		o-xylene	µg/L	0.5	<0.5
	Polycyclic VOCs	Naphthalene	µg/L	0.5	<0.5
	Surrogates	Dibromofluoromethane (Surrogate)	%	-	106
		d4-1,2-dichloroethane (Surrogate)	%	-	103
		d8-toluene (Surrogate)	%	-	96
		Bromofluorobenzene (Surrogate)	%	-	89

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result
LB110965.001		TRH C6-C9	µg/L	40	<40
	Surrogates	Dibromofluoromethane (Surrogate)	%	-	106
		d4-1,2-dichloroethane (Surrogate)	%	-	103
		d8-toluene (Surrogate)	%	-	96
		Bromofluorobenzene (Surrogate)	%	-	89

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311(Perth)/AN312

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE157685.006	LB111204.014	Mercury	µg/L	0.0001	-0.0028	-0.0022	200	0
SE157752.009	LB111204.024	Mercury	µg/L	0.0001	0.0278	0.025	200	11

Total Phenolics in Water

Method: ME-(AU)-[ENV]AN289

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE157610.002	LB111042.004	Total Phenols	mg/L	0.01	0.03	0.03	162	0

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE157685.006	LB111038.021	Arsenic, As	µg/L	1	-0.003	-0.006	200	0
		Cadmium, Cd	µg/L	0.1	-0.001	-0.001	200	0
		Chromium, Cr	µg/L	1	-0.018	-0.013	200	0
		Copper, Cu	µg/L	1	-0.276	-0.309	200	0
		Lead, Pb	µg/L	1	0.004	-0.007	200	0
		Nickel, Ni	µg/L	1	-0.042	-0.051	200	0
		Zinc, Zn	µg/L	5	1.482	1.065	200	0

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

OC Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110969.002		Heptachlor	µg/L	0.1	0.2	0.2	60 - 140	119
		Aldrin	µg/L	0.1	0.2	0.2	60 - 140	122
		Delta BHC	µg/L	0.1	0.2	0.2	60 - 140	116
		Dieldrin	µg/L	0.1	0.2	0.2	60 - 140	125
		Endrin	µg/L	0.1	0.2	0.2	60 - 140	104
		p,p'-DDT	µg/L	0.1	0.2	0.2	60 - 140	107
	Surrogates	Tetrachloro-m-xylene (TCMX) (Surrogate)	µg/L	-	0.15	0.15	40 - 130	97

OP Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110969.002		Dichlorvos	µg/L	0.5	9.5	8	60 - 140	118
		Diazinon (Dimpylate)	µg/L	0.5	9.6	8	60 - 140	121
		Chlorpyrifos (Chlorpyrifos Ethyl)	µg/L	0.2	9.1	8	60 - 140	114
		Ethion	µg/L	0.2	9.9	8	60 - 140	124
	Surrogates	2-fluorobiphenyl (Surrogate)	µg/L	-	0.4	0.5	40 - 130	74
		d14-p-terphenyl (Surrogate)	µg/L	-	0.5	0.5	40 - 130	90

PAH (Polynuclear Aromatic Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN420

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110969.002		Naphthalene	µg/L	0.1	33	40	60 - 140	82
		Acenaphthylene	µg/L	0.1	38	40	60 - 140	95
		Acenaphthene	µg/L	0.1	39	40	60 - 140	99
		Phenanthrene	µg/L	0.1	36	40	60 - 140	90
		Anthracene	µg/L	0.1	36	40	60 - 140	89
		Fluoranthene	µg/L	0.1	42	40	60 - 140	104
		Pyrene	µg/L	0.1	30	40	60 - 140	76
		Benzo(a)pyrene	µg/L	0.1	43	40	60 - 140	107
	Surrogates	d5-nitrobenzene (Surrogate)	µg/L	-	0.4	0.5	40 - 130	74
		2-fluorobiphenyl (Surrogate)	µg/L	-	0.4	0.5	40 - 130	74
		d14-p-terphenyl (Surrogate)	µg/L	-	0.5	0.5	40 - 130	90

Total Phenolics in Water

Method: ME-(AU)-[ENV]AN289

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB111042.002	Total Phenols	mg/L	0.01	0.23	0.25	80 - 120	92

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB111038.002	Arsenic, As	µg/L	1	20	20	80 - 120	101
	Cadmium, Cd	µg/L	0.1	22	20	80 - 120	111
	Chromium, Cr	µg/L	1	23	20	80 - 120	116
	Copper, Cu	µg/L	1	23	20	80 - 120	115
	Lead, Pb	µg/L	1	23	20	80 - 120	114
	Nickel, Ni	µg/L	1	21	20	80 - 120	106
	Zinc, Zn	µg/L	5	21	20	80 - 120	105

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110969.002		TRH C10-C14	µg/L	50	930	1200	60 - 140	78
		TRH C15-C28	µg/L	200	1200	1200	60 - 140	99
		TRH C29-C36	µg/L	200	1400	1200	60 - 140	116
	TRH F Bands	TRH >C10-C16 (F2)	µg/L	60	1100	1200	60 - 140	88
		TRH >C16-C34 (F3)	µg/L	500	1300	1200	60 - 140	110
		TRH >C34-C40 (F4)	µg/L	500	720	600	60 - 140	120

VOCs in Water

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110965.002	Monocyclic	Benzene	µg/L	0.5	50	45.45	60 - 140	109
	Aromatic	Toluene	µg/L	0.5	50	45.45	60 - 140	109
		Ethylbenzene	µg/L	0.5	50	45.45	60 - 140	110
		m/p-xylene	µg/L	1	100	90.9	60 - 140	110
		o-xylene	µg/L	0.5	50	45.45	60 - 140	109
	Surrogates	Dibromofluoromethane (Surrogate)	µg/L	-	5.1	5	60 - 140	103

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

VOCs in Water (continued)

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110965.002	Surrogates	d4-1,2-dichloroethane (Surrogate)	µg/L	-	4.9	5	60 - 140	98
		d8-toluene (Surrogate)	µg/L	-	4.9	5	60 - 140	99
		Bromofluorobenzene (Surrogate)	µg/L	-	4.6	5	60 - 140	92

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB110965.002		TRH C6-C10	µg/L	50	940	946.63	60 - 140	100
		TRH C6-C9	µg/L	40	770	818.71	60 - 140	94
	Surrogates	Dibromofluoromethane (Surrogate)	µg/L	-	4.8	5	60 - 140	96
		d4-1,2-dichloroethane (Surrogate)	µg/L	-	5.1	5	60 - 140	102
		d8-toluene (Surrogate)	µg/L	-	5.0	5	60 - 140	99
		Bromofluorobenzene (Surrogate)	µg/L	-	5.2	5	60 - 140	104
	VPH F Bands	TRH C6-C10 minus BTEX (F1)	µg/L	50	640	639.67	60 - 140	100

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub -sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311(Perth)/AN312

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE157659.001	LB111204.004	Mercury	mg/L	0.0001	0.0069	<0.0001	0.008	86

Total Phenolics in Water

Method: ME-(AU)-[ENV]AN289

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE157687.002	LB111042.010	Total Phenols	mg/L	0.01	0.24	0.01363	0.25	92

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE157659.001	LB111038.004	Arsenic, As	µg/L	1	22	<1	20	110
		Cadmium, Cd	µg/L	0.1	24	1.3	20	112
		Chromium, Cr	µg/L	1	22	<1	20	111
		Copper, Cu	µg/L	1	24	4	20	104
		Lead, Pb	µg/L	1	22	<1	20	110
		Nickel, Ni	µg/L	1	39	20	20	94
		Zinc, Zn	µg/L	5	83	67	20	82

MATRIX SPIKE DUPLICATES

SE157659 R0

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.

Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here: http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical Documents/MP-AU-ENV-QU-022 QA QC Plan.pdf

*	NATA accreditation does not cover tthe performance of this service.
-	Sample not analysed for this analyte.

IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
LOR	Limit of reporting.
QFH	QC result is above the upper tolerance.
QFL	QC result is below the lower tolerance.

①	At least 2 of 3 surrogates are within acceptance criteria.
②	RPD failed acceptance criteria due to sample heterogeneity.
③	Results less than 5 times LOR preclude acceptance criteria for RPD.
④	Recovery failed acceptance criteria due to matrix interference.
⑤	Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
⑥	LOR was raised due to sample matrix interference.
⑦	LOR was raised due to dilution of significantly high concentration of analyte in sample.
⑧	Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
⑨	Recovery failed acceptance criteria due to sample heterogeneity.
⑩	LOR was raised due to high conductivity of the sample (required dilution).
†	Refer to Analytical Report comments for further information.

This document is issued, on the Client's behalf, by the Company under its General Conditions of Service, available on request and accessible at http://www.sgs.com/en/terms-and-conditions. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any other holder of this document is advised that information contained herein reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

This test report shall not be reproduced, except in full.

source: M630_SR_20161019122357.pdf page: 15 SGS Ref: SE158210_COC

SGS

CHAIN OF CUSTODY & ANALYSIS REQUEST

SGS Environmental Services
Unit 16, 33 Maddox Street
Alexandria NSW 2015
Telephone No: (02) 85940400
Facsimile No: (02) 85940499
Email: au.samplereceipt.sydney@sgs.com

Company Name:	SMEC	Project Name/No:	3002523 – Canberra Brickworks
Address:	Suite 2, Level 1, 243 Northbourne Avenue, Lyneham, ACT, 2602, Australia	Purchase Order No:	
		Results Required By:	Ryan O'Leary
		Telephone:	+61 2 6234 1963 / 0400 240 023
Contact Name:	Ryan O'Leary	Facsimile:	
		Email Results:	Ryan.O'Leary@smec.com; Graham.Ohmsen@smec.com

Client Sample ID	Date Sampled	Lab Sample ID	WATER	SOIL		NO OF CONTAINERS	BTEXN	OPPs	OCPs	PAHs/Phenols	8H Metals - As, Cd, Cr, Cu, Ni, Pb, Zn, Hg	TPH/TRH					Comment
M4	17/10/16	1	✓			5	√	√	√	√	√	√					
M5	17/10/16	2	✓			5	√	√	√	√	√	√					
M6	17/9/16	3	✓			5	√	√	√	√	√	√					
M7	17/10/16	4	✓			5	√	√	√	√	√	√					

SGS EHS Alexandria Laboratory

SE158210 COC
Received: 19 – Oct – 2016

Relinquished By: Ryan O'Leary	Date/Time: 18/10/2016 10:00	Received By:	Date/Time 19/10/16 @ 11:20
Relinquished By:	Date/Time:	Received By:	Date/Time
Samples Intact: Yes/ No	Temperature: Ambient / Chilled	Sample Cooler Sealed: Yes/ No	Laboratory Quotation No:
	Comments: AS PER SGS QUOTE NUMBER SY1 – 60413 – 2-IS DATED 13TH APRIL 2016 **Laboratory to filter metals and report as dissolved**	**STANDARD TAT PLEASE (5 DAY)**	

SAMPLE RECEIPT ADVICE

SE158210

CLIENT DETAILS

Contact	Ryan O'Leary
Client	SMEC AUSTRALIA PTY LTD
Address	Sun Micro Building Suite 2, Level 1 243 Northbourne Avenue ACT 2602
Telephone	02 6234 1963
Facsimile	02 6234 1966
Email	Ryan.O'Leary@smec.com
Project	**3002523 - Canberra Brickworks**
Order Number	**SY1-60413-2-IS**
Samples	4

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
Samples Received	Wed 19/10/2016
Report Due	Wed 26/10/2016
SGS Reference	**SE158210**

SUBMISSION DETAILS

This is to confirm that 4 samples were received on Wednesday 19/10/2016. Results are expected to be ready by Wednesday 26/10/2016. Please quote SGS reference SE158210 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Sample counts by matrix	4 Water	Type of documentation received	COC
Date documentation received	19/10/2016	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	17.3°C
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	Ice Bricks	Samples clearly labelled	Yes
Complete documentation received	Yes	Number of eskies/boxes received	

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

To the extent not inconsistent with the other provisions of this document and unless specifically agreed otherwise in writing by SGS, all SGS services are rendered in accordance with the applicable SGS General Conditions of Service accessible at http://www.sgs.com/en/terms-and-conditions as at the date of this document. Attention is drawn to the limitations of liability and to the clauses of indemnification.

SAMPLE RECEIPT ADVICE

SE158210

CLIENT DETAILS

Client SMEC AUSTRALIA PTY LTD

Project 3002523 - Canberra Brickworks

SUMMARY OF ANALYSIS

No.	Sample ID	OC Pesticides in Water	OP Pesticides in Water	PAH (Polynuclear Aromatic Hydrocarbons) in Water	Total Phenolics in Water	Trace Metals (Dissolved) in Water by ICPMS	TRH (Total Recoverable Hydrocarbons) in Water	VOCs in Water	Volatile Petroleum Hydrocarbons in Water
001	M4	28	13	22	1	7	9	12	8
002	M5	28	13	22	1	7	9	12	8
003	M6	28	13	22	1	7	9	12	8
004	M7	28	13	22	1	7	9	12	8

CONTINUED OVERLEAF

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

SAMPLE RECEIPT ADVICE

SE158210

CLIENT DETAILS

Client SMEC AUSTRALIA PTY LTD

Project 3002523 - Canberra Brickworks

SUMMARY OF ANALYSIS

No.	Sample ID	Mercury (dissolved) in Water
001	M4	1
002	M5	1
003	M6	1
004	M7	1

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Ryan O'Leary
Client	SMEC AUSTRALIA PTY LTD
Address	Sun Micro Building Suite 2, Level 1 243 Northbourne Avenue ACT 2602
Telephone	02 6234 1963
Facsimile	02 6234 1966
Email	Ryan.O'Leary@smec.com
Project	**3002523 - Canberra Brickworks**
Order Number	**SY1-60413-2-IS**
Samples	4

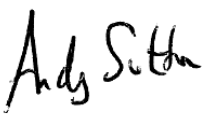
LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE158210 R0**
Date Received	19/10/2016
Date Reported	26/10/2016

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(4354).

SIGNATORIES



Andy Sutton
Senior Organic Chemist

Dong Liang
Metals/Inorganics Team Leader

Kamrul Ahsan
Senior Chemist

Ly Kim Ha
Organic Section Head

VOCs in Water [AN433] Tested: 20/10/2016

PARAMETER	UOM	LOR	M4 WATER - 17/10/2016 SE158210.001	M5 WATER - 17/10/2016 SE158210.002	M6 WATER - 17/10/2016 SE158210.003	M7 WATER - 17/10/2016 SE158210.004
Benzene	µg/L	0.5	<0.5	<0.5	<0.5	**1.1**
Toluene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
m/p-xylene	µg/L	1	<1	<1	<1	<1
o-xylene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
Total Xylenes	µg/L	1.5	<1.5	<1.5	<1.5	<1.5
Total BTEX	µg/L	3	<3	<3	<3	<3
Naphthalene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5

Volatile Petroleum Hydrocarbons in Water [AN433] Tested: 20/10/2016

PARAMETER	UOM	LOR	M4 WATER - 17/10/2016 SE158210.001	M5 WATER - 17/10/2016 SE158210.002	M6 WATER - 17/10/2016 SE158210.003	M7 WATER - 17/10/2016 SE158210.004
TRH C6-C9	µg/L	40	<40	<40	<40	<40
Benzene (F0)	µg/L	0.5	<0.5	<0.5	<0.5	**1.1**
TRH C6-C10	µg/L	50	<50	<50	<50	<50
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<50	<50	<50

TRH (Total Recoverable Hydrocarbons) in Water [AN403] Tested: 20/10/2016

PARAMETER	UOM	LOR	M4 WATER - 17/10/2016 SE158210.001	M5 WATER - 17/10/2016 SE158210.002	M6 WATER - 17/10/2016 SE158210.003	M7 WATER - 17/10/2016 SE158210.004
TRH C10-C14	µg/L	50	<50	<50	<50	<50
TRH C15-C28	µg/L	200	<200	<200	<200	<200
TRH C29-C36	µg/L	200	<200	<200	<200	<200
TRH C37-C40	µg/L	200	<200	<200	<200	<200
TRH >C10-C16 (F2)	µg/L	60	<60	<60	<60	<60
TRH >C16-C34 (F3)	µg/L	500	<500	<500	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	<500
TRH C10-C36	µg/L	450	<450	<450	<450	<450
TRH C10-C40	µg/L	650	<650	<650	<650	<650

PAH (Polynuclear Aromatic Hydrocarbons) in Water [AN420] Tested: 20/10/2016

PARAMETER	UOM	LOR	M4 WATER - 17/10/2016 SE158210.001	M5 WATER - 17/10/2016 SE158210.002	M6 WATER - 17/10/2016 SE158210.003	M7 WATER - 17/10/2016 SE158210.004
Naphthalene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
2-methylnaphthalene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
1-methylnaphthalene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b&j)fluoranthene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(ah)anthracene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Total PAH (18)	µg/L	1	<1	<1	<1	<1

OC Pesticides in Water [AN400/AN420] Tested: 20/10/2016

PARAMETER	UOM	LOR	M4 WATER - 17/10/2016 SE158210.001	M5 WATER - 17/10/2016 SE158210.002	M6 WATER - 17/10/2016 SE158210.003	M7 WATER - 17/10/2016 SE158210.004
Hexachlorobenzene (HCB)	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Alpha BHC	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Lindane (gamma BHC)	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Beta BHC	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Delta BHC	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor epoxide	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
o,p'-DDE	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Alpha Endosulfan	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Gamma Chlordane	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Alpha Chlordane	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
trans-Nonachlor	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
p,p'-DDE	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Endrin	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
o,p'-DDD	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
o,p'-DDT	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Beta Endosulfan	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
p,p'-DDD	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
p,p'-DDT	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan sulphate	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Endrin aldehyde	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Endrin ketone	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Isodrin	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Mirex	µg/L	0.1	<0.1	<0.1	<0.1	<0.1

OP Pesticides in Water [AN400/AN420] Tested: 20/10/2016

PARAMETER	UOM	LOR	M4 WATER - 17/10/2016 SE158210.001	M5 WATER - 17/10/2016 SE158210.002	M6 WATER - 17/10/2016 SE158210.003	M7 WATER - 17/10/2016 SE158210.004
Dichlorvos	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
Dimethoate	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
Diazinon (Dimpylate)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
Fenitrothion	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Malathion	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Chlorpyrifos (Chlorpyrifos Ethyl)	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Parathion-ethyl (Parathion)	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Bromophos Ethyl	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Methidathion	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
Ethion	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Azinphos-methyl	µg/L	0.2	<0.2	<0.2	<0.2	<0.2

Total Phenolics in Water [AN289] Tested: 24/10/2016

PARAMETER	UOM	LOR	M4 WATER - 17/10/2016 SE158210.001	M5 WATER - 17/10/2016 SE158210.002	M6 WATER - 17/10/2016 SE158210.003	M7 WATER - 17/10/2016 SE158210.004
Total Phenols	mg/L	0.01	<0.01	<0.01	<0.01	<0.01

Trace Metals (Dissolved) in Water by ICPMS [AN318] Tested: 20/10/2016

PARAMETER	UOM	LOR	M4 WATER - 17/10/2016 SE158210.001	M5 WATER - 17/10/2016 SE158210.002	M6 WATER - 17/10/2016 SE158210.003	M7 WATER - 17/10/2016 SE158210.004
Arsenic, As	µg/L	1	<1	<1	<1	<1
Cadmium, Cd	µg/L	0.1	<0.1	<0.1	**0.2**	**0.2**
Chromium, Cr	µg/L	1	<1	<1	<1	<1
Copper, Cu	µg/L	1	**1**	**2**	**1**	**1**
Lead, Pb	µg/L	1	<1	<1	<1	<1
Nickel, Ni	µg/L	1	**2**	**1**	**13**	**12**
Zinc, Zn	µg/L	5	<5	<5	**18**	**8**

Mercury (dissolved) in Water [AN311(Perth)/AN312] Tested: 25/10/2016

PARAMETER	UOM	LOR	M4 WATER - 17/10/2016 SE158210.001	M5 WATER - 17/10/2016 SE158210.002	M6 WATER - 17/10/2016 SE158210.003	M7 WATER - 17/10/2016 SE158210.004
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001

METHOD	METHODOLOGY SUMMARY
AN020	Unpreserved water sample is filtered through a 0.45µm membrane filter and acidified with nitric acid similar to APHA3030B.
AN289	Analysis of Total Phenols in Soil Sediment and Water: Steam distillable phenols react with 4-aminoantipyrine at pH 7.9±0.1 in the presence of potassium ferricyanide to form a coloured antipyrine dye analysed by Discrete Analyser. Reference APHA 5530 B/D.
AN311(Perth)/AN312	Mercury by Cold Vapour AAS in Waters: Mercury ions are reduced by stannous chloride reagent in acidic solution to elemental mercury. This mercury vapour is purged by nitrogen into a cold cell in an atomic absorption spectrometer or mercury analyser. Quantification is made by comparing absorbances to those of the calibration standards. Reference APHA 3112/3500.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN400	OC and OP Pesticides by GC-ECD: The determination of organochlorine (OC) and organophosphorus (OP) pesticides and polychlorinated biphenyls (PCBs) in soils, sludges and groundwater. (Based on USEPA methods 3510, 3550, 8140 and 8080.)
AN403	Total Recoverable Hydrocarbons: Determination of Hydrocarbons by gas chromatography after a solvent extraction. Detection is by flame ionisation detector (FID) that produces an electronic signal in proportion to the combustible matter passing through it. Total Recoverable Hydrocarbons (TRH) are routinely reported as four alkane groupings based on the carbon chain length of the compounds: C6-C9, C10-C14, C15-C28 and C29-C36 and in recognition of the NEPM 1999 (2013), >C10-C16 (F2), >C16-C34 (F3) and >C34-C40 (F4). F2 is not corrected for Naphthalene.
AN403	Additionally, the volatile C6-C9/C6-C10 fractions may be determined by a purge and trap technique and GC/MS because of the potential for volatiles loss. Total Petroleum Hydrocarbons (TPH) follows the same method of analysis after silica gel cleanup of the solvent extract. Aliphatic/Aromatic Speciation follows the same method of analysis after fractionation of the solvent extract over silica with differential polarity of the eluent solvents .
AN403	The GC/FID method is not well suited to the analysis of refined high boiling point materials (ie lubricating oils or greases) but is particularly suited for measuring diesel, kerosene and petrol if care to control volatility is taken. This method will detect naturally occurring hydrocarbons, lipids, animal fats, phenols and PAHs if they are present at sufficient levels, dependent on the use of specific cleanup/fractionation techniques. Reference USEPA 3510B, 8015B.
AN420	(SVOCs) including OC, OP, PCB, Herbicides, PAH, Phthalates and Speciated Phenols (etc) in soils, sediments and waters are determined by GCMS/ECD technique following appropriate solvent extraction process (Based on USEPA 3500C and 8270D).
AN420	SVOC Compounds: Semi-Volatile Organic Compounds (SVOCs) including OC, OP, PCB, Herbicides, PAH, Phthalates and Speciated Phenols in soils, sediments and waters are determined by GCMS/ECD technique following appropriate solvent extraction process (Based on USEPA 3500C and 8270D).
AN433	VOCs and C6-C9 Hydrocarbons by GC-MS P&T: VOC`s are volatile organic compounds. The sample is presented to a gas chromatograph via a purge and trap (P&T) concentrator and autosampler and is detected with a Mass Spectrometer (MSD). Solid samples are initially extracted with methanol whilst liquid samples are processed directly. References: USEPA 5030B, 8020A, 8260.

FOOTNOTES

*	NATA accreditation does not cover the performance of this service.	-	Not analysed.	UOM	Unit of Measure.
		NVL	Not validated.	LOR	Limit of Reporting.
**	Indicative data, theoretical holding time exceeded.	IS	Insufficient sample for analysis.	↑↓	Raised/lowered Limit of Reporting.
		LNR	Sample listed, but not received.		

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/en/terms-and-conditions. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

This report must not be reproduced, except in full.

STATEMENT OF QA/QC PERFORMANCE

SE158210 R0

CLIENT DETAILS

Contact	Ryan O'Leary
Client	SMEC AUSTRALIA PTY LTD
Address	Sun Micro Building Suite 2, Level 1 243 Northbourne Avenue ACT 2602
Telephone	02 6234 1963
Facsimile	02 6234 1966
Email	Ryan.O'Leary@smec.com
Project	**3002523 - Canberra Brickworks**
Order Number	**SY1-60413-2-IS**
Samples	4

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE158210 R0**
Date Received	19 Oct 2016
Date Reported	26 Oct 2016

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document and was supplied by the Client.
This QA/QC Statement must be read in conjunction with the referenced Analytical Report.
The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met (within the SGS Alexandria Environmental laboratory).

SAMPLE SUMMARY

HOLDING TIME SUMMARY

SE158210 R0

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311(Perth)/AN312

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M4	SE158210.001	LB112338	17 Oct 2016	19 Oct 2016	14 Nov 2016	25 Oct 2016	14 Nov 2016	25 Oct 2016
M5	SE158210.002	LB112338	17 Oct 2016	19 Oct 2016	14 Nov 2016	25 Oct 2016	14 Nov 2016	25 Oct 2016
M6	SE158210.003	LB112338	17 Oct 2016	19 Oct 2016	14 Nov 2016	25 Oct 2016	14 Nov 2016	25 Oct 2016
M7	SE158210.004	LB112338	17 Oct 2016	19 Oct 2016	14 Nov 2016	25 Oct 2016	14 Nov 2016	25 Oct 2016

OC Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M4	SE158210.001	LB112045	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	26 Oct 2016
M5	SE158210.002	LB112045	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	26 Oct 2016
M6	SE158210.003	LB112045	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	26 Oct 2016
M7	SE158210.004	LB112045	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	26 Oct 2016

OP Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M4	SE158210.001	LB112045	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	25 Oct 2016
M5	SE158210.002	LB112045	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	25 Oct 2016
M6	SE158210.003	LB112045	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	25 Oct 2016
M7	SE158210.004	LB112045	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	25 Oct 2016

PAH (Polynuclear Aromatic Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN420

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M4	SE158210.001	LB112045	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	25 Oct 2016
M5	SE158210.002	LB112045	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	25 Oct 2016
M6	SE158210.003	LB112045	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	25 Oct 2016
M7	SE158210.004	LB112045	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	25 Oct 2016

Total Phenolics in Water

Method: ME-(AU)-[ENV]AN289

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M4	SE158210.001	LB112243	17 Oct 2016	19 Oct 2016	14 Nov 2016	24 Oct 2016	14 Nov 2016	24 Oct 2016
M5	SE158210.002	LB112243	17 Oct 2016	19 Oct 2016	14 Nov 2016	24 Oct 2016	14 Nov 2016	24 Oct 2016
M6	SE158210.003	LB112243	17 Oct 2016	19 Oct 2016	14 Nov 2016	24 Oct 2016	14 Nov 2016	24 Oct 2016
M7	SE158210.004	LB112243	17 Oct 2016	19 Oct 2016	14 Nov 2016	24 Oct 2016	14 Nov 2016	24 Oct 2016

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M4	SE158210.001	LB112043	17 Oct 2016	19 Oct 2016	15 Apr 2017	20 Oct 2016	15 Apr 2017	21 Oct 2016
M5	SE158210.002	LB112043	17 Oct 2016	19 Oct 2016	15 Apr 2017	20 Oct 2016	15 Apr 2017	21 Oct 2016
M6	SE158210.003	LB112043	17 Oct 2016	19 Oct 2016	15 Apr 2017	20 Oct 2016	15 Apr 2017	21 Oct 2016
M7	SE158210.004	LB112043	17 Oct 2016	19 Oct 2016	15 Apr 2017	20 Oct 2016	15 Apr 2017	21 Oct 2016

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M4	SE158210.001	LB112045	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	25 Oct 2016
M5	SE158210.002	LB112045	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	25 Oct 2016
M6	SE158210.003	LB112045	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	25 Oct 2016
M7	SE158210.004	LB112045	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	25 Oct 2016

VOCs in Water

Method: ME-(AU)-[ENV]AN433

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M4	SE158210.001	LB112089	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	26 Oct 2016
M5	SE158210.002	LB112089	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	26 Oct 2016
M6	SE158210.003	LB112089	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	26 Oct 2016
M7	SE158210.004	LB112089	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	26 Oct 2016

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
M4	SE158210.001	LB112089	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	26 Oct 2016
M5	SE158210.002	LB112089	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	26 Oct 2016
M6	SE158210.003	LB112089	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	26 Oct 2016
M7	SE158210.004	LB112089	17 Oct 2016	19 Oct 2016	24 Oct 2016	20 Oct 2016	29 Nov 2016	26 Oct 2016

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

OC Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Tetrachloro-m-xylene (TCMX) (Surrogate)	M4	SE158210.001	%	40 - 130%	56
	M5	SE158210.002	%	40 - 130%	51
	M6	SE158210.003	%	40 - 130%	52
	M7	SE158210.004	%	40 - 130%	55

OP Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
2-fluorobiphenyl (Surrogate)	M4	SE158210.001	%	40 - 130%	54
	M5	SE158210.002	%	40 - 130%	64
	M6	SE158210.003	%	40 - 130%	62
	M7	SE158210.004	%	40 - 130%	68
d14-p-terphenyl (Surrogate)	M4	SE158210.001	%	40 - 130%	102
	M5	SE158210.002	%	40 - 130%	98
	M6	SE158210.003	%	40 - 130%	102
	M7	SE158210.004	%	40 - 130%	74

PAH (Polynuclear Aromatic Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN420

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
2-fluorobiphenyl (Surrogate)	M4	SE158210.001	%	40 - 130%	54
	M5	SE158210.002	%	40 - 130%	64
	M6	SE158210.003	%	40 - 130%	62
	M7	SE158210.004	%	40 - 130%	68
d14-p-terphenyl (Surrogate)	M4	SE158210.001	%	40 - 130%	102
	M5	SE158210.002	%	40 - 130%	98
	M6	SE158210.003	%	40 - 130%	102
	M7	SE158210.004	%	40 - 130%	74
d5-nitrobenzene (Surrogate)	M4	SE158210.001	%	40 - 130%	44
	M5	SE158210.002	%	40 - 130%	54
	M6	SE158210.003	%	40 - 130%	54
	M7	SE158210.004	%	40 - 130%	54

VOCs in Water

Method: ME-(AU)-[ENV]AN433

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Bromofluorobenzene (Surrogate)	M4	SE158210.001	%	40 - 130%	90
	M5	SE158210.002	%	40 - 130%	91
	M6	SE158210.003	%	40 - 130%	91
	M7	SE158210.004	%	40 - 130%	93
d4-1,2-dichloroethane (Surrogate)	M4	SE158210.001	%	40 - 130%	114
	M5	SE158210.002	%	40 - 130%	110
	M6	SE158210.003	%	40 - 130%	102
	M7	SE158210.004	%	40 - 130%	104
d8-toluene (Surrogate)	M4	SE158210.001	%	40 - 130%	90
	M5	SE158210.002	%	40 - 130%	91
	M6	SE158210.003	%	40 - 130%	86
	M7	SE158210.004	%	40 - 130%	76
Dibromofluoromethane (Surrogate)	M4	SE158210.001	%	40 - 130%	116
	M5	SE158210.002	%	40 - 130%	114
	M6	SE158210.003	%	40 - 130%	111
	M7	SE158210.004	%	40 - 130%	108

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Bromofluorobenzene (Surrogate)	M4	SE158210.001	%	40 - 130%	90
	M5	SE158210.002	%	40 - 130%	91
	M6	SE158210.003	%	40 - 130%	91
	M7	SE158210.004	%	40 - 130%	93
d4-1,2-dichloroethane (Surrogate)	M4	SE158210.001	%	60 - 130%	114
	M5	SE158210.002	%	60 - 130%	110
	M6	SE158210.003	%	60 - 130%	102
	M7	SE158210.004	%	60 - 130%	104
d8-toluene (Surrogate)	M4	SE158210.001	%	40 - 130%	90
	M5	SE158210.002	%	40 - 130%	91
	M6	SE158210.003	%	40 - 130%	86

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Volatile Petroleum Hydrocarbons in Water (continued) — **Method: ME-(AU)-[ENV]AN433**

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
d8-toluene (Surrogate)	M7	SE158210.004	%	40 - 130%	76
Dibromofluoromethane (Surrogate)	M4	SE158210.001	%	40 - 130%	116
	M5	SE158210.002	%	40 - 130%	114
	M6	SE158210.003	%	40 - 130%	111
	M7	SE158210.004	%	40 - 130%	108

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311(Perth)/AN312

Sample Number	Parameter	Units	LOR	Result
LB112338.001	Mercury	mg/L	0.0001	<0.0001

OC Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Sample Number		Parameter	Units	LOR	Result
LB112045.001		Hexachlorobenzene (HCB)	µg/L	0.1	<0.1
		Alpha BHC	µg/L	0.1	<0.1
		Lindane (gamma BHC)	µg/L	0.1	<0.1
		Heptachlor	µg/L	0.1	<0.1
		Aldrin	µg/L	0.1	<0.1
		Beta BHC	µg/L	0.1	<0.1
		Delta BHC	µg/L	0.1	<0.1
		Heptachlor epoxide	µg/L	0.1	<0.1
		Alpha Endosulfan	µg/L	0.1	<0.1
		Gamma Chlordane	µg/L	0.1	<0.1
		Alpha Chlordane	µg/L	0.1	<0.1
		p,p'-DDE	µg/L	0.1	<0.1
		Dieldrin	µg/L	0.1	<0.1
		Endrin	µg/L	0.1	<0.1
		Beta Endosulfan	µg/L	0.1	<0.1
		p,p'-DDD	µg/L	0.1	<0.1
		p,p'-DDT	µg/L	0.1	<0.1
		Endosulfan sulphate	µg/L	0.1	<0.1
		Endrin aldehyde	µg/L	0.1	<0.1
		Methoxychlor	µg/L	0.1	<0.1
		Endrin ketone	µg/L	0.1	<0.1
		Isodrin	µg/L	0.1	<0.1
		Mirex	µg/L	0.1	<0.1
	Surrogates	Tetrachloro-m-xylene (TCMX) (Surrogate)	%	-	74

OP Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Sample Number		Parameter	Units	LOR	Result
LB112045.001		Dichlorvos	µg/L	0.5	<0.5
		Dimethoate	µg/L	0.5	<0.5
		Diazinon (Dimpylate)	µg/L	0.5	<0.5
		Fenitrothion	µg/L	0.2	<0.2
		Malathion	µg/L	0.2	<0.2
		Chlorpyrifos (Chlorpyrifos Ethyl)	µg/L	0.2	<0.2
		Parathion-ethyl (Parathion)	µg/L	0.2	<0.2
		Bromophos Ethyl	µg/L	0.2	<0.2
		Methidathion	µg/L	0.5	<0.5
		Ethion	µg/L	0.2	<0.2
		Azinphos-methyl	µg/L	0.2	<0.2
	Surrogates	2-fluorobiphenyl (Surrogate)	%	-	68
		d14-p-terphenyl (Surrogate)	%	-	96

PAH (Polynuclear Aromatic Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN420

Sample Number	Parameter	Units	LOR	Result
LB112045.001	Naphthalene	µg/L	0.1	<0.1
	2-methylnaphthalene	µg/L	0.1	<0.1
	1-methylnaphthalene	µg/L	0.1	<0.1
	Acenaphthylene	µg/L	0.1	<0.1
	Acenaphthene	µg/L	0.1	<0.1
	Fluorene	µg/L	0.1	<0.1
	Phenanthrene	µg/L	0.1	<0.1
	Anthracene	µg/L	0.1	<0.1
	Fluoranthene	µg/L	0.1	<0.1
	Pyrene	µg/L	0.1	<0.1
	Benzo(a)anthracene	µg/L	0.1	<0.1
	Chrysene	µg/L	0.1	<0.1
	Benzo(a)pyrene	µg/L	0.1	<0.1

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

PAH (Polynuclear Aromatic Hydrocarbons) in Water (continued)

Method: ME-(AU)-[ENV]AN420

Sample Number		Parameter	Units	LOR	Result
LB112045.001		Indeno(1,2,3-cd)pyrene	µg/L	0.1	<0.1
		Dibenzo(ah)anthracene	µg/L	0.1	<0.1
		Benzo(ghi)perylene	µg/L	0.1	<0.1
	Surrogates	d5-nitrobenzene (Surrogate)	%	-	96
		2-fluorobiphenyl (Surrogate)	%	-	84
		d14-p-terphenyl (Surrogate)	%	-	114

Total Phenolics in Water

Method: ME-(AU)-[ENV]AN289

Sample Number	Parameter	Units	LOR	Result
LB112243.001	Total Phenols	mg/L	0.01	<0.01

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Number	Parameter	Units	LOR	Result
LB112043.001	Arsenic, As	µg/L	1	<1
	Cadmium, Cd	µg/L	0.1	<0.1
	Chromium, Cr	µg/L	1	<1
	Copper, Cu	µg/L	1	<1
	Lead, Pb	µg/L	1	<1
	Nickel, Ni	µg/L	1	<1
	Zinc, Zn	µg/L	5	<5

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Sample Number	Parameter	Units	LOR	Result
LB112045.001	TRH C10-C14	µg/L	50	<50
	TRH C15-C28	µg/L	200	<200
	TRH C29-C36	µg/L	200	<200
	TRH C37-C40	µg/L	200	<200

VOCs in Water

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result
LB112089.001	Monocyclic Aromatic	Benzene	µg/L	0.5	<0.5
	Hydrocarbons	Toluene	µg/L	0.5	<0.5
		Ethylbenzene	µg/L	0.5	<0.5
		m/p-xylene	µg/L	1	<1
		o-xylene	µg/L	0.5	<0.5
	Polycyclic VOCs	Naphthalene	µg/L	0.5	<0.5
	Surrogates	Dibromofluoromethane (Surrogate)	%	-	106
		d4-1,2-dichloroethane (Surrogate)	%	-	106
		d8-toluene (Surrogate)	%	-	101
		Bromofluorobenzene (Surrogate)	%	-	97

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result
LB112089.001		TRH C6-C9	µg/L	40	<40
	Surrogates	Dibromofluoromethane (Surrogate)	%	-	106
		d4-1,2-dichloroethane (Surrogate)	%	-	106
		d8-toluene (Surrogate)	%	-	101
		Bromofluorobenzene (Surrogate)	%	-	97

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311(Perth)/AN312

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE158209.001	LB112338.014	Mercury	µg/L	0.0001	<0.0001	<0.0001	200	0

Total Phenolics in Water

Method: ME-(AU)-[ENV]AN289

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE158210.001	LB112243.004	Total Phenols	mg/L	0.01	<0.01	<0.01	200	0

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE158225.001	LB112043.009	Arsenic, As	µg/L	1	2	2	59	2
		Cadmium, Cd	µg/L	0.1	<0.1	<0.1	200	0
		Chromium, Cr	µg/L	1	2	2	58	1
		Copper, Cu	µg/L	1	2	2	79	2
		Lead, Pb	µg/L	1	2	2	64	3
		Nickel, Ni	µg/L	1	2	2	58	0
		Zinc, Zn	µg/L	5	9	8	75	14

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

OC Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB112045.002		Heptachlor	µg/L	0.1	0.2	0.2	60 - 140	109
		Aldrin	µg/L	0.1	0.2	0.2	60 - 140	100
		Delta BHC	µg/L	0.1	0.2	0.2	60 - 140	112
		Dieldrin	µg/L	0.1	0.2	0.2	60 - 140	104
		Endrin	µg/L	0.1	0.2	0.2	60 - 140	102
		p,p'-DDT	µg/L	0.1	0.2	0.2	60 - 140	123
	Surrogates	Tetrachloro-m-xylene (TCMX) (Surrogate)	µg/L	-	0.12	0.15	40 - 130	77

OP Pesticides in Water

Method: ME-(AU)-[ENV]AN400/AN420

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB112045.002		Dichlorvos	µg/L	0.5	7.0	8	60 - 140	88
		Diazinon (Dimpylate)	µg/L	0.5	6.7	8	60 - 140	83
		Chlorpyrifos (Chlorpyrifos Ethyl)	µg/L	0.2	7.1	8	60 - 140	89
		Ethion	µg/L	0.2	6.4	8	60 - 140	80
	Surrogates	2-fluorobiphenyl (Surrogate)	µg/L	-	0.3	0.5	40 - 130	66
		d14-p-terphenyl (Surrogate)	µg/L	-	0.5	0.5	40 - 130	106

PAH (Polynuclear Aromatic Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN420

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB112045.002		Naphthalene	µg/L	0.1	28	40	60 - 140	70
		Acenaphthylene	µg/L	0.1	32	40	60 - 140	79
		Acenaphthene	µg/L	0.1	29	40	60 - 140	74
		Phenanthrene	µg/L	0.1	33	40	60 - 140	82
		Anthracene	µg/L	0.1	40	40	60 - 140	100
		Fluoranthene	µg/L	0.1	35	40	60 - 140	88
		Pyrene	µg/L	0.1	45	40	60 - 140	112
		Benzo(a)pyrene	µg/L	0.1	36	40	60 - 140	89
	Surrogates	d5-nitrobenzene (Surrogate)	µg/L	-	0.5	0.5	40 - 130	106
		2-fluorobiphenyl (Surrogate)	µg/L	-	0.3	0.5	40 - 130	64
		d14-p-terphenyl (Surrogate)	µg/L	-	0.4	0.5	40 - 130	88

Total Phenolics in Water

Method: ME-(AU)-[ENV]AN289

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB112243.002	Total Phenols	mg/L	0.01	0.23	0.25	80 - 120	93

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB112043.002	Arsenic, As	µg/L	1	20	20	80 - 120	102
	Cadmium, Cd	µg/L	0.1	21	20	80 - 120	104
	Chromium, Cr	µg/L	1	21	20	80 - 120	107
	Copper, Cu	µg/L	1	22	20	80 - 120	109
	Lead, Pb	µg/L	1	22	20	80 - 120	109
	Nickel, Ni	µg/L	1	21	20	80 - 120	106
	Zinc, Zn	µg/L	5	21	20	80 - 120	107

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB112045.002		TRH C10-C14	µg/L	50	940	1200	60 - 140	78
		TRH C15-C28	µg/L	200	1200	1200	60 - 140	102
		TRH C29-C36	µg/L	200	1300	1200	60 - 140	111
	TRH F Bands	TRH >C10-C16 (F2)	µg/L	60	1100	1200	60 - 140	90
		TRH >C16-C34 (F3)	µg/L	500	1300	1200	60 - 140	109
		TRH >C34-C40 (F4)	µg/L	500	690	600	60 - 140	115

VOCs in Water

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB112089.002	Monocyclic	Benzene	µg/L	0.5	50	45.45	60 - 140	111
	Aromatic	Toluene	µg/L	0.5	50	45.45	60 - 140	111
		Ethylbenzene	µg/L	0.5	51	45.45	60 - 140	112
		m/p-xylene	µg/L	1	100	90.9	60 - 140	111
		o-xylene	µg/L	0.5	51	45.45	60 - 140	112
	Surrogates	Dibromofluoromethane (Surrogate)	µg/L	-	4.6	5	60 - 140	92

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

VOCs in Water (continued)

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB112089.002	Surrogates	d4-1,2-dichloroethane (Surrogate)	µg/L	-	4.5	5	60 - 140	90
		d8-toluene (Surrogate)	µg/L	-	4.7	5	60 - 140	94
		Bromofluorobenzene (Surrogate)	µg/L	-	5.0	5	60 - 140	101

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB112089.002		TRH C6-C10	µg/L	50	930	946.63	60 - 140	98
		TRH C6-C9	µg/L	40	750	818.71	60 - 140	91
	Surrogates	Dibromofluoromethane (Surrogate)	µg/L	-	4.6	5	60 - 140	92
		d4-1,2-dichloroethane (Surrogate)	µg/L	-	4.5	5	60 - 140	90
		d8-toluene (Surrogate)	µg/L	-	4.7	5	60 - 140	94
		Bromofluorobenzene (Surrogate)	µg/L	-	5.0	5	60 - 140	101
	VPH F Bands	TRH C6-C10 minus BTEX (F1)	µg/L	50	620	639.67	60 - 140	97

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub -sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311(Perth)/AN312

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE158209.002	LB112338.016	Mercury	mg/L	0.0001	0.0080	<0.0001	0.008	100

Total Phenolics in Water

Method: ME-(AU)-[ENV]AN289

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE158199.001	LB112243.010	Total Phenols	mg/L	0.01	0.23	0.01	0.25	89

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE158210.001	LB112043.004	Arsenic, As	µg/L	1	22	<1	20	110
		Cadmium, Cd	µg/L	0.1	21	<0.1	20	105
		Chromium, Cr	µg/L	1	22	<1	20	107
		Copper, Cu	µg/L	1	22	1	20	103
		Lead, Pb	µg/L	1	21	<1	20	106
		Nickel, Ni	µg/L	1	22	2	20	102
		Zinc, Zn	µg/L	5	22	<5	20	102

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.

Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here: http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical Documents/MP-AU-ENV-QU-022 QA QC Plan.pdf

*	NATA accreditation does not cover tthe performance of this service.
-	Sample not analysed for this analyte.

IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
LOR	Limit of reporting.
QFH	QC result is above the upper tolerance.
QFL	QC result is below the lower tolerance.

①	At least 2 of 3 surrogates are within acceptance criteria.
②	RPD failed acceptance criteria due to sample heterogeneity.
③	Results less than 5 times LOR preclude acceptance criteria for RPD.
④	Recovery failed acceptance criteria due to matrix interference.
⑤	Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
⑥	LOR was raised due to sample matrix interference.
⑦	LOR was raised due to dilution of significantly high concentration of analyte in sample.
⑧	Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
⑨	Recovery failed acceptance criteria due to sample heterogeneity.
⑩	LOR was raised due to high conductivity of the sample (required dilution).
†	Refer to Analytical Report comments for further information.

This document is issued, on the Client's behalf, by the Company under its General Conditions of Service, available on request and accessible at http://www.sgs.com/en/terms-and-conditions. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any other holder of this document is advised that information contained herein reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

This test report shall not be reproduced, except in full.

SGS

CHAIN OF CUSTODY & ANALYSIS REQUEST

SGS Environmental Services
Unit 16, 33 Maddox Street
Alexandria NSW 2015
Telephone No: (02) 85940400
Facsimile No: (02) 85940499
Email: au.samplereceipt.sydney@sgs.com

Company Name:	SMEC	Project Name/No:	3002523 – Canberra Brickworks
Address:	Suite 2, Level 1, 243 Northbourne Avenue, Lyneham, ACT, 2602, Australia	Purchase Order No:	
		Results Required By:	Ryan O'Leary
Contact Name:	Ryan O'Leary	Telephone:	+61 2 6234 1963 / 0400 240 023
		Facsimile:	
		Email Results:	Ryan.O'Leary@smec.com

Client Sample ID	Date Sampled	Lab Sample ID	WATER	SOIL		NO OF CONTAINERS	BTEXN	OPPs	OCPs	PAHs/Phenols	8H Metals - As, Cd, Cr, Cu, Ni, Pb, Zn, Hg	TPH/TRH	Comment
M2	28/9/2016		✓			5	√	√	√	√	√	√	
M3	28/9/2016		✓			5	√	√	√	√	√	√	
QC22	28/9/2016		✓			5	√	√	√	√	√	√	
QC23	28/9/2016		✓			5	√	√	√	√	√	√	Please send to ALS Sydney

Environmental Division
Sydney
Work Order Reference
ES1622123

Telephone : + 61-2-8784 8555

Relinquished By: Ryan O'Leary	Date/Time: 29/9/2016 16:00	Received By: Jessie	Date/Time 30/9/16 15:50
Relinquished By:	Date/Time:	Received By:	Date/Time 30/9/16 @ 10:00
Samples Intact: Yes/ No	Temperature: Ambient / Chilled 16.9	Sample Cooler Sealed: Yes/ No	Laboratory Quotation No:
	Comments: AS PER SGS QUOTE NUMBER SY1 – 60413 – 2-IS DATED 13TH APRIL 2016 **Laboratory to filter metals and report as dissolved**	**STANDARD TAT PLEASE (5 DAY)**	confirmed total Phenols as per Ryan. 4/10/16 cwe. ES1622123

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **ES1622123**

Client	: **SMEC AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: RYAN O'LEARY	Contact	:
Address	: P O BOX 1654 FYSHWICK ACT, AUSTRALIA 2609	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: ryan.o'leary@smec.com	E-mail	:
Telephone	: +61 02 9925 5555	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 9925 5566	Facsimile	: +61-2-8784 8500
Project	: 3002523 - CANBERRA BRICKWORKS	Page	: 1 of 2
Order number	: ----	Quote number	: ES2015SMEAUS0024 (EN/025/15)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	:		

Dates

Date Samples Received	: 30-Sep-2016 3:50 PM	Issue Date	: 04-Oct-2016
Client Requested Due Date	: 10-Oct-2016	Scheduled Reporting Date	: **10-Oct-2016**

Delivery Details

Mode of Delivery	: Undefined	Security Seal	: Not intact.
No. of coolers/boxes	: ----	Temperature	: 1.0' C - Ice Bricks present
Receipt Detail	:	No. of samples received / analysed	: 1 / 1

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**
- **Sample(s) requiring volatile organic compound analysis received in airtight containers (ZHE).**
- Please direct any queries you have regarding this work order to the above ALS laboratory contact.
- Analytical work for this work order will be conducted at ALS Sydney.
- Sample Disposal - Aqueous (14 days), Solid (60 days) from date of completion of work order.

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default to 15:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory for processing purposes and will be shown bracketed without a time component.

Matrix: **WATER**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	WATER - EP035G Total Phenol by Discrete Analyser	WATER - W-12 OC/OP Pesticides	WATER - W-26 TRH/BTEXN/PAH/8 Metals
ES1622123-001	[28-Sep-2016]	QC23	✓	✓	✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

RYAN O'LEARY

- *AU Certificate of Analysis - NATA (COA)	Email	ryan.o'leary@smec.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	ryan.o'leary@smec.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	ryan.o'leary@smec.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	ryan.o'leary@smec.com
- A4 - AU Tax Invoice (INV)	Email	ryan.o'leary@smec.com
- Chain of Custody (CoC) (COC)	Email	ryan.o'leary@smec.com
- EDI Format - ESDAT (ESDAT)	Email	ryan.o'leary@smec.com

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1622123**	Page	: 1 of 7
Client	: **SMEC AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: RYAN O'LEARY	Contact	:
Address	: P O BOX 1654 FYSHWICK ACT, AUSTRALIA 2609	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 9925 5555	Telephone	: +61-2-8784 8555
Project	: 3002523 - CANBERRA BRICKWORKS	Date Samples Received	: 30-Sep-2016 15:50
Order number	: ----	Date Analysis Commenced	: 04-Oct-2016
C-O-C number	: ----	Issue Date	: 10-Oct-2016 16:08
Sampler	: ----		
Site	: ----		
Quote number	: ----		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Wisam Marassa	Inorganics Coordinator	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	QC23	----	----	----	----
				Client sampling date / time	[28-Sep-2016]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1622123-001	--------	--------	--------	--------
					Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		**0.0014**	----	----	----	----
Chromium	7440-47-3	0.001	mg/L		<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L		**0.005**	----	----	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L		**0.020**	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.072**	----	----	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EP035G: Total Phenol by Discrete Analyser									
Phenols (Total)	----	0.05	mg/L		<0.05	----	----	----	----
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.5	µg/L		<0.5	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L		<0.5	----	----	----	----
beta-BHC	319-85-7	0.5	µg/L		<0.5	----	----	----	----
gamma-BHC	58-89-9	0.5	µg/L		<0.5	----	----	----	----
delta-BHC	319-86-8	0.5	µg/L		<0.5	----	----	----	----
Heptachlor	76-44-8	0.5	µg/L		<0.5	----	----	----	----
Aldrin	309-00-2	0.5	µg/L		<0.5	----	----	----	----
Heptachlor epoxide	1024-57-3	0.5	µg/L		<0.5	----	----	----	----
trans-Chlordane	5103-74-2	0.5	µg/L		<0.5	----	----	----	----
alpha-Endosulfan	959-98-8	0.5	µg/L		<0.5	----	----	----	----
cis-Chlordane	5103-71-9	0.5	µg/L		<0.5	----	----	----	----
Dieldrin	60-57-1	0.5	µg/L		<0.5	----	----	----	----
4.4`-DDE	72-55-9	0.5	µg/L		<0.5	----	----	----	----
Endrin	72-20-8	0.5	µg/L		<0.5	----	----	----	----
beta-Endosulfan	33213-65-9	0.5	µg/L		<0.5	----	----	----	----
4.4`-DDD	72-54-8	0.5	µg/L		<0.5	----	----	----	----
Endrin aldehyde	7421-93-4	0.5	µg/L		<0.5	----	----	----	----
Endosulfan sulfate	1031-07-8	0.5	µg/L		<0.5	----	----	----	----
4.4`-DDT	50-29-3	2	µg/L		<2.0	----	----	----	----
Endrin ketone	53494-70-5	0.5	µg/L		<0.5	----	----	----	----
Methoxychlor	72-43-5	2	µg/L		<2.0	----	----	----	----
^ **Total Chlordane (sum)**	----	0.5	µg/L		<0.5	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	QC23	----	----	----	----
				Client sampling date / time	[28-Sep-2016]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1622123-001	--------	--------	--------	--------
					Result	----	----	----	----
EP068A: Organochlorine Pesticides (OC) - Continued									
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.5	µg/L		<0.5	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L		<0.5	----	----	----	----
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.5	µg/L		<0.5	----	----	----	----
Demeton-S-methyl	919-86-8	0.5	µg/L		<0.5	----	----	----	----
Monocrotophos	6923-22-4	2	µg/L		<2.0	----	----	----	----
Dimethoate	60-51-5	0.5	µg/L		<0.5	----	----	----	----
Diazinon	333-41-5	0.5	µg/L		<0.5	----	----	----	----
Chlorpyrifos-methyl	5598-13-0	0.5	µg/L		<0.5	----	----	----	----
Parathion-methyl	298-00-0	2	µg/L		<2.0	----	----	----	----
Malathion	121-75-5	0.5	µg/L		<0.5	----	----	----	----
Fenthion	55-38-9	0.5	µg/L		<0.5	----	----	----	----
Chlorpyrifos	2921-88-2	0.5	µg/L		<0.5	----	----	----	----
Parathion	56-38-2	2	µg/L		<2.0	----	----	----	----
Pirimphos-ethyl	23505-41-1	0.5	µg/L		<0.5	----	----	----	----
Chlorfenvinphos	470-90-6	0.5	µg/L		<0.5	----	----	----	----
Bromophos-ethyl	4824-78-6	0.5	µg/L		<0.5	----	----	----	----
Fenamiphos	22224-92-6	0.5	µg/L		<0.5	----	----	----	----
Prothiofos	34643-46-4	0.5	µg/L		<0.5	----	----	----	----
Ethion	563-12-2	0.5	µg/L		<0.5	----	----	----	----
Carbophenothion	786-19-6	0.5	µg/L		<0.5	----	----	----	----
Azinphos Methyl	86-50-0	0.5	µg/L		<0.5	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1	µg/L		<1.0	----	----	----	----
Acenaphthylene	208-96-8	1	µg/L		<1.0	----	----	----	----
Acenaphthene	83-32-9	1	µg/L		<1.0	----	----	----	----
Fluorene	86-73-7	1	µg/L		<1.0	----	----	----	----
Phenanthrene	85-01-8	1	µg/L		<1.0	----	----	----	----
Anthracene	120-12-7	1	µg/L		<1.0	----	----	----	----
Fluoranthene	206-44-0	1	µg/L		<1.0	----	----	----	----
Pyrene	129-00-0	1	µg/L		<1.0	----	----	----	----
Benz(a)anthracene	56-55-3	1	µg/L		<1.0	----	----	----	----
Chrysene	218-01-9	1	µg/L		<1.0	----	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L		<1.0	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	QC23	----	----	----	----
				Client sampling date / time	[28-Sep-2016]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1622123-001	--------	--------	--------	--------
					Result	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Benzo(k)fluoranthene	207-08-9	1	µg/L		<1.0	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L		<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L		<1.0	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	1	µg/L		<1.0	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	1	µg/L		<1.0	----	----	----	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	µg/L		<0.5	----	----	----	----
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	µg/L		<0.5	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	----	----	----	----
C10 - C14 Fraction	----	50	µg/L		<50	----	----	----	----
C15 - C28 Fraction	----	100	µg/L		<100	----	----	----	----
C29 - C36 Fraction	----	50	µg/L		<50	----	----	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L		<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	----	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L		<20	----	----	----	----
>C10 - C16 Fraction	----	100	µg/L		<100	----	----	----	----
>C16 - C34 Fraction	----	100	µg/L		<100	----	----	----	----
>C34 - C40 Fraction	----	100	µg/L		<100	----	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L		<100	----	----	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L		<100	----	----	----	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	----	----	----	----
Toluene	108-88-3	2	µg/L		<2	----	----	----	----
Ethylbenzene	100-41-4	2	µg/L		<2	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	----	----	----	----
ortho-Xylene	95-47-6	2	µg/L		<2	----	----	----	----
^ **Total Xylenes**	1330-20-7	2	µg/L		<2	----	----	----	----
^ **Sum of BTEX**	----	1	µg/L		<1	----	----	----	----
Naphthalene	91-20-3	5	µg/L		<5	----	----	----	----
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.5	%		**113**	----	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)				Client sample ID	QC23	----	----	----	----
				Client sampling date / time	[28-Sep-2016]	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*		ES1622123-001	--------	--------	--------	--------
					Result	----	----	----	----
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.5	%		**117**	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	1	%		**25.8**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	1	%		**60.6**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	1	%		**44.0**	----	----	----	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	1	%		**75.9**	----	----	----	----
Anthracene-d10	1719-06-8	1	%		**71.4**	----	----	----	----
4-Terphenyl-d14	1718-51-0	1	%		**84.1**	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**110**	----	----	----	----
Toluene-D8	2037-26-5	2	%		**115**	----	----	----	----
4-Bromofluorobenzene	460-00-4	2	%		**111**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	30	120
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	27	129
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **ES1622123**	Page	: 1 of 7
Client	: **SMEC AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: RYAN O'LEARY	Contact	:
Address	: P O BOX 1654 FYSHWICK ACT, AUSTRALIA 2609	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 9925 5555	Telephone	: +61-2-8784 8555
Project	: 3002523 - CANBERRA BRICKWORKS	Date Samples Received	: 30-Sep-2016
Order number	: ----	Date Analysis Commenced	: 04-Oct-2016
C-O-C number	: ----	Issue Date	: 10-Oct-2016
Sampler	: ----		
Site	: ----		
Quote number	: ----		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Wisam Marassa	Inorganics Coordinator	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 608766)									
ES1622054-002	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	0.0004	0.0003	34.2	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.001	<0.001	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.023	0.023	0.00	0% - 20%
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.025	0.025	0.00	0% - 20%
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.269	0.267	0.924	0% - 20%
ES1622287-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0010	<0.0010	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.010	<0.010	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	0.106	0.117	9.42	0% - 50%
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.010	<0.010	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.010	<0.010	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.011	<0.010	10.2	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	4.43	4.80	7.92	0% - 20%
EG035F: Dissolved Mercury by FIMS (QC Lot: 608765)									
ES1622059-108	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
ES1622054-002	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EP035G: Total Phenol by Discrete Analyser (QC Lot: 606179)									
EP1609290-001	Anonymous	EP035G: Phenols (Total)	----	0.05	mg/L	<0.05	<0.05	0.00	No Limit
ES1622162-001	Anonymous	EP035G: Phenols (Total)	----	0.05	mg/L	<0.05	0.30	143	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 608112)									
ES1622090-006	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
ES1622090-019	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 608112)									

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 608112) - continued									
ES1622090-006	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
ES1622090-019	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EP080: BTEXN (QC Lot: 608112)									
ES1622090-006	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit
ES1622090-019	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 608766)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	104	85	114
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	100	84	110
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	95.8	85	111
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	97.8	81	111
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	93.8	83	111
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	92.4	82	112
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	96.2	81	117
EG035F: Dissolved Mercury by FIMS (QCLot: 608765)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	98.7	83	105
EP035G: Total Phenol by Discrete Analyser (QCLot: 606179)								
EP035G: Phenols (Total)	----	0.05	mg/L	<0.05	0.5 mg/L	85.0	64	98
EP068A: Organochlorine Pesticides (OC) (QCLot: 604843)								
EP068: alpha-BHC	319-84-6	0.5	µg/L	<0.5	5 µg/L	87.1	65	113
EP068: Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L	<0.5	5 µg/L	83.6	54	114
EP068: beta-BHC	319-85-7	0.5	µg/L	<0.5	5 µg/L	88.3	69	117
EP068: gamma-BHC	58-89-9	0.5	µg/L	<0.5	5 µg/L	88.4	70	112
EP068: delta-BHC	319-86-8	0.5	µg/L	<0.5	5 µg/L	92.5	67	117
EP068: Heptachlor	76-44-8	0.5	µg/L	<0.5	5 µg/L	88.7	63	113
EP068: Aldrin	309-00-2	0.5	µg/L	<0.5	5 µg/L	93.5	66	116
EP068: Heptachlor epoxide	1024-57-3	0.5	µg/L	<0.5	5 µg/L	97.8	59	123
EP068: trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	5 µg/L	100	61	121
EP068: alpha-Endosulfan	959-98-8	0.5	µg/L	<0.5	5 µg/L	101	66	120
EP068: cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	5 µg/L	100	64	120
EP068: Dieldrin	60-57-1	0.5	µg/L	<0.5	5 µg/L	102	66	120
EP068: 4.4`-DDE	72-55-9	0.5	µg/L	<0.5	5 µg/L	106	67	119
EP068: Endrin	72-20-8	0.5	µg/L	<0.5	5 µg/L	95.1	66	122
EP068: beta-Endosulfan	33213-65-9	0.5	µg/L	<0.5	5 µg/L	104	71	119
EP068: 4.4`-DDD	72-54-8	0.5	µg/L	<0.5	5 µg/L	107	72	122
EP068: Endrin aldehyde	7421-93-4	0.5	µg/L	<0.5	5 µg/L	97.3	64	116
EP068: Endosulfan sulfate	1031-07-8	0.5	µg/L	<0.5	5 µg/L	95.4	60	126
EP068: 4.4`-DDT	50-29-3	2	µg/L	<2.0	5 µg/L	82.8	60	122
EP068: Endrin ketone	53494-70-5	0.5	µg/L	<0.5	5 µg/L	97.7	62	124
EP068: Methoxychlor	72-43-5	2	µg/L	<2.0	5 µg/L	89.8	53	127
EP068B: Organophosphorus Pesticides (OP) (QCLot: 604843)								

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP068B: Organophosphorus Pesticides (OP) (QCLot: 604843) - continued								
EP068: Dichlorvos	62-73-7	0.5	µg/L	<0.5	5 µg/L	97.4	69	119
EP068: Demeton-S-methyl	919-86-8	0.5	µg/L	<0.5	5 µg/L	97.0	62	124
EP068: Monocrotophos	6923-22-4	2	µg/L	<2.0	5 µg/L	24.5	20	48
EP068: Dimethoate	60-51-5	0.5	µg/L	<0.5	5 µg/L	97.8	65	121
EP068: Diazinon	333-41-5	0.5	µg/L	<0.5	5 µg/L	97.9	70	120
EP068: Chlorpyrifos-methyl	5598-13-0	0.5	µg/L	<0.5	5 µg/L	91.0	77	119
EP068: Parathion-methyl	298-00-0	2	µg/L	<2.0	5 µg/L	86.7	70	124
EP068: Malathion	121-75-5	0.5	µg/L	<0.5	5 µg/L	104	70	124
EP068: Fenthion	55-38-9	0.5	µg/L	<0.5	5 µg/L	101	68	122
EP068: Chlorpyrifos	2921-88-2	0.5	µg/L	<0.5	5 µg/L	103	75	1196
EP068: Parathion	56-38-2	2	µg/L	<2.0	5 µg/L	94.1	67	121
EP068: Pirimphos-ethyl	23505-41-1	0.5	µg/L	<0.5	5 µg/L	104	69	121
EP068: Chlorfenvinphos	470-90-6	0.5	µg/L	<0.5	5 µg/L	99.3	69	119
EP068: Bromophos-ethyl	4824-78-6	0.5	µg/L	<0.5	5 µg/L	103	63	125
EP068: Fenamiphos	22224-92-6	0.5	µg/L	<0.5	5 µg/L	106	69	125
EP068: Prothiofos	34643-46-4	0.5	µg/L	<0.5	5 µg/L	107	61	111231
EP068: Ethion	563-12-2	0.5	µg/L	<0.5	5 µg/L	108	74	120
EP068: Carbophenothion	786-19-6	0.5	µg/L	<0.5	5 µg/L	98.9	68	124
EP068: Azinphos Methyl	86-50-0	0.5	µg/L	<0.5	5 µg/L	90.7	44	130
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 604842)								
EP075(SIM): Naphthalene	91-20-3	1	µg/L	<1.0	5 µg/L	66.0	50	94
EP075(SIM): Acenaphthylene	208-96-8	1	µg/L	<1.0	5 µg/L	70.2	64	114
EP075(SIM): Acenaphthene	83-32-9	1	µg/L	<1.0	5 µg/L	72.2	62	113
EP075(SIM): Fluorene	86-73-7	1	µg/L	<1.0	5 µg/L	70.0	64	115
EP075(SIM): Phenanthrene	85-01-8	1	µg/L	<1.0	5 µg/L	88.6	63	116
EP075(SIM): Anthracene	120-12-7	1	µg/L	<1.0	5 µg/L	84.8	64	116
EP075(SIM): Fluoranthene	206-44-0	1	µg/L	<1.0	5 µg/L	85.9	64	118
EP075(SIM): Pyrene	129-00-0	1	µg/L	<1.0	5 µg/L	96.3	63	118
EP075(SIM): Benz(a)anthracene	56-55-3	1	µg/L	<1.0	5 µg/L	70.8	64	117
EP075(SIM): Chrysene	218-01-9	1	µg/L	<1.0	5 µg/L	87.8	63	116
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L	<1.0	5 µg/L	71.4	62	119
EP075(SIM): Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	5 µg/L	83.0	63	115
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	5 µg/L	76.9	63	117
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	5 µg/L	77.2	60	118
EP075(SIM): Dibenz(a.h)anthracene	53-70-3	1	µg/L	<1.0	5 µg/L	77.4	61	117
EP075(SIM): Benzo(g.h.i)perylene	191-24-2	1	µg/L	<1.0	5 µg/L	75.5	59	118
EP080/071: Total Petroleum Hydrocarbons (QCLot: 604841)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	2000 µg/L	94.2	76	116

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 604841) - continued								
EP071: C15 - C28 Fraction	----	100	µg/L	<100	3000 µg/L	99.5	83	109
EP071: C29 - C36 Fraction	----	50	µg/L	<50	2000 µg/L	93.7	75	113
EP080/071: Total Petroleum Hydrocarbons (QCLot: 608112)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	260 µg/L	83.2	75	127
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 604841)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	2500 µg/L	99.4	76	114
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	3500 µg/L	95.3	81	111
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	1500 µg/L	101	77	119
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 608112)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	310 µg/L	86.9	75	127
EP080: BTEXN (QCLot: 608112)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	88.6	70	122
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	89.1	69	123
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	91.4	70	120
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	10 µg/L	89.4	69	121
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	88.0	72	122
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	100	70	120

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Recovery Limits (%): Low	Recovery Limits (%): High
EG020F: Dissolved Metals by ICP-MS (QCLot: 608766)							
ES1622054-003	Anonymous	EG020A-F: Arsenic	7440-38-2	1 mg/L	107	70	130
		EG020A-F: Cadmium	7440-43-9	0.25 mg/L	107	70	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	102	70	130
		EG020A-F: Copper	7440-50-8	1 mg/L	104	70	130
		EG020A-F: Lead	7439-92-1	1 mg/L	104	70	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	98.8	70	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	108	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 608765)							
ES1622054-001	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	88.7	70	130
EP035G: Total Phenol by Discrete Analyser (QCLot: 606179)							

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EP035G: Total Phenol by Discrete Analyser (QCLot: 606179) - continued							
EP1609290-001	Anonymous	EP035G: Phenols (Total)	----	0.42 mg/L	86.2	70	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 608112)							
ES1622090-006	Anonymous	EP080: C6 - C9 Fraction	----	325 µg/L	84.6	70	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 608112)							
ES1622090-006	Anonymous	EP080: C6 - C10 Fraction	C6_C10	375 µg/L	85.4	70	130
EP080: BTEXN (QCLot: 608112)							
ES1622090-006	Anonymous	EP080: Benzene	71-43-2	25 µg/L	76.8	70	130
		EP080: Toluene	108-88-3	25 µg/L	84.2	70	130
		EP080: Ethylbenzene	100-41-4	25 µg/L	91.1	70	130
		EP080: meta- & para-Xylene	108-38-3 106-42-3	25 µg/L	89.3	70	130
		EP080: ortho-Xylene	95-47-6	25 µg/L	92.3	70	130
		EP080: Naphthalene	91-20-3	25 µg/L	91.4	70	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **ES1622123**	Page	: 1 of 5
Client	: **SMEC AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: RYAN O'LEARY	Telephone	: +61-2-8784 8555
Project	: 3002523 - CANBERRA BRICKWORKS	Date Samples Received	: 30-Sep-2016
Site	: ----	Issue Date	: 10-Oct-2016
Sampler	: ----	No. of samples received	: 1
Order number	: ----	No. of samples analysed	: 1

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type / Method	Count QC	Count Regular	Rate (%) Actual	Rate (%) Expected	Quality Control Specification
Laboratory Duplicates (DUP)					
PAH/Phenols (GC/MS - SIM)	0	8	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	0	1	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	12	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
PAH/Phenols (GC/MS - SIM)	0	8	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	0	1	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	12	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / ***Container*** / Client Sample ID(s)	***Sample Date***	*Extraction / Preparation* ***Date extracted***	*Due for extraction*	*Evaluation*	*Analysis* ***Date analysed***	*Due for analysis*	*Evaluation*
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)							
QC23	**28-Sep-2016**	**----**	----	----	**07-Oct-2016**	27-Mar-2017	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)							
QC23	**28-Sep-2016**	**----**	----	----	**10-Oct-2016**	26-Oct-2016	✓
EP035G: Total Phenol by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EP035G)							
QC23	**28-Sep-2016**	**05-Oct-2016**	26-Oct-2016	✓	**05-Oct-2016**	26-Oct-2016	✓
EP068A: Organochlorine Pesticides (OC)							
Amber Glass Bottle - Unpreserved (EP068)							
QC23	**28-Sep-2016**	**04-Oct-2016**	05-Oct-2016	✓	**06-Oct-2016**	13-Nov-2016	✓
EP068B: Organophosphorus Pesticides (OP)							
Amber Glass Bottle - Unpreserved (EP068)							
QC23	**28-Sep-2016**	**04-Oct-2016**	05-Oct-2016	✓	**06-Oct-2016**	13-Nov-2016	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP075(SIM))							
QC23	**28-Sep-2016**	**04-Oct-2016**	05-Oct-2016	✓	**06-Oct-2016**	13-Nov-2016	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP071)							
QC23	**28-Sep-2016**	**04-Oct-2016**	05-Oct-2016	✓	**06-Oct-2016**	13-Nov-2016	✓
Clear glass VOC vial - HCl (EP080)							
QC23	**28-Sep-2016**	**07-Oct-2016**	12-Oct-2016	✓	**07-Oct-2016**	12-Oct-2016	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber Glass Bottle - Unpreserved (EP071)							
QC23	**28-Sep-2016**	**04-Oct-2016**	05-Oct-2016	✓	**06-Oct-2016**	13-Nov-2016	✓
Clear glass VOC vial - HCl (EP080)							
QC23	**28-Sep-2016**	**07-Oct-2016**	12-Oct-2016	✓	**07-Oct-2016**	12-Oct-2016	✓
EP080: BTEXN							
Clear glass VOC vial - HCl (EP080)							
QC23	**28-Sep-2016**	**07-Oct-2016**	12-Oct-2016	✓	**07-Oct-2016**	12-Oct-2016	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Dissolved Mercury by FIMS	EG035F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	8	**0.00**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	0	1	**0.00**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
Total Phenol by Discrete Analyser	EP035G	2	9	**22.22**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	12	**0.00**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Dissolved Mercury by FIMS	EG035F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phenol by Discrete Analyser	EP035G	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Dissolved Mercury by FIMS	EG035F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phenol by Discrete Analyser	EP035G	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Dissolved Mercury by FIMS	EG035F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	8	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	0	1	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
Total Phenol by Discrete Analyser	EP035G	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	12	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Phenol by Discrete Analyser	EP035G	WATER	In house: Referenced to APHA 5530 B&D. Steam distillable Phenols are reacted with 4-aminoantipyrine. The resultant colour intensity is measured by Seal. This method is compliant with NEPM (2013) Schedule B(3)
Pesticides by GCMS	EP068	WATER	In house: Referenced to USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	In house: Referenced to USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
Phenols After Microdistillation	EP035D	WATER	In house: Referenced to APHA 5530 A, B&D pH adjusted Steam distillable Phenolic compounds. The resultant colour intensity is measured by Discrete Analyser.
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for sparging.

APPENDIX E – CALIBRATION CERTIFICATES

Oil / Water Interface Meter

Instrument Geotech Interface Meter (60M)
Serial No. 4427

airmet
Air-Met Scientific Pty Ltd
1300 137 067

Item	Test	Pass	Comments
Battery	Compartment	✓	
	Capacity	✓	
Probe	Cleaned/Decon.	✓	
	Operation	✓	
Connectors	Condition	✓	
		✓	
Tape Check	Cleaned	✓	
Connectors	Checked for cuts	✓	
Instrument Test	At surface level	✓	

Certificate of Calibration

This is to certify that the above instrument has been cleaned and tested.

Calibrated by: **Jiayi Fu**

Calibration date: **12/09/2016**

Next calibration due: **11/11/2016**

ThermoFisher SCIENTIFIC

The world leader in serving science

RENTALS

Equipment Certification Report – TPS 90FLMV Water Quality Meter

This Water Quality Meter has been performance checked and calibrated as follows:

Sensor	Concentration	Span 1	Span 2	Traceability Lot #	Pass?
pH	pH 7.00 / pH 4.00	7.00 pH	4.00 pH	/	☑
Conductivity	12.88mS/cm	0 mS/cm	12.88 mS/cm		☑
TDS	36 ppk	0 ppk	36 ppk		☑
Dissolved Oxygen	Sodium Sulphite / Air	0 ppm in Sodium Sulphite	8.55 ppm Saturation in Air		☑

Check only

Redox (ORP) *	Electrode operability test	240mV +/- 10%	240 mV		☑

* This meter uses an Ag/AgCl ORP electrode. To convert readings to SHE (Standard Hydrogen Electrode), add 199mV to the mV reading.

☑ Battery Status 8.1 V (min 7.2V)
☑ Electrical Safety Tag attached (AS/NZS 3760)

☑ Temperature 22.7 °C
☑ Electrodes Cleaned and checked

Tag No: 000813

Valid to: 8/11/16

Date: 19/09/2016

Signed: _____

Please check that the following items are received and that all items are cleaned and decontaminated before return. A minimum $30 cleaning / service / repair charge may be applied to any unclean or damaged items. Items not returned will be billed for at the full replacement cost.

Sent	Returned	Item
☑	☐	90FLMV Unit. Ops check/Battery status: 8.1V
☑	☐	pH sensor with wetting cap, 5m
☑	☐	Conductivity/TDS/Temperature K=10 sensor, 5m
☑	☐	Dissolved oxygen YSI5739 sensor with wetting cap, 5m
☑	☐	Redox (ORP) sensor with wetting cap, 5m
☑	☐	Power supply 240V to 12V DC 200mA
☑	☐	Instruction Manual
☑	☐	Quick Guide
☑	☐	Syringe with storage solution for pH and ORP sensors
☑	☐	Carry Case
☑	☐	Check to confirm electrical safety (tag must be valid)

Date: 19/09/2016

Signed: _____

TFS Reference	CS005491	Return Date:	/ /
Customer Reference		Return Time:	
Equipment ID	90FLMVSK	Condition on return:	
Equipment Serial No.	T0798		

Appendix F - WELL DEVELOPMENT AND GROUNDWATER SAMPLING SHEETS

Well Development Sheet

Project Number: 3002523		Project Location: Canberra Brickworks		Sampler: Ryan O'Leary and Jaeger Swanepoel	
Date	**Location**	**Depth to water (m)**	**Total depth (m)**	**Litres purged**	**Comment**
22/09/2016	M1	Dry	8.311	Dry	
22/09/2016	M2	4.091	14.529	25	
22/09/2016	M3	2.741	4.757	3.9	
06/10/2016	M4	1.198	4.815	7.1	
22/09/2016	M5	1.965	4.870	5.7	Water was brown in colour.
22/09/2016	M6	10.547	15.670	10.1	Water is quite clear, slightly turbid.
22/09/2016	M7	15.102	8.565	12.8	
06/10/2016	M8	Dry	15.104	Dry	

Groundwater Sampling Sheet

Well ID: M1

PROJECT NAME: Canberra Brickworks	PURGE DATE: 17/10/16 Dry 15:30
PROJECT NUMBER: 3002523	DATE SAMPLED: Dry 17/10/16
CLIENT: LDA	DEPTH OF WELL (mBTOC): 8.311
WELL CASING DIAMETER (mm): 50	DEPTH TO GROUNDWATER (mBTOC): Dry
CASING HEIGHT ABOVE GROUND LEVEL (m):	DEPTH TO BE PURGED (m): Dry
MONUMENT: ☒ GATIC COVERED: ☐ STAND PIPE: ☐	CHECKED BY: RO

GROUNDWATER PURGING INFORMATION

Purge until field parameters stabilise OR 3-5 casing volumes OR until "dry", whichever occurs first

1 casing volume = 0.5L/m for wells of 25mm diameter
1 casing volume = 2L/m for wells of 50mm diameter
1 casing volume = 8L/m for wells of 100mm diameter

Method/pump type: Bailer ☐ Submersible Pump ☐ Other: ☐

Comment:

Purge Start Time (2400 hr):

Estimated Purge Volume: Litres (3-5) Well Volumes

Actual Purge Volume: Litres

Did well purge dry? No ☐ Yes ☐ if yes, when? Litres

FIELD RESULTS

	Time (24 hr)	pH	EC (S/cm)	Redox (mV)	DO ( )	Turbidity (NTU)	Temperature (°C)
After 1 purge							
After 2 purge							
After 3 purge							
After 4 purge							
After 5 purge							
Acceptable Variation:	n/a	+/- 0.1	+/- 10%	+/- 10%	+/- 10%	+/- 10%	+/- 0.5

Are field results acceptable to allow sampling? Yes ☐ No ☐ If no, why?

SAMPLING DETAILS

Method: Bailer ☐ Submersible Pump ☐ Other:

Equipment: Dedicated/Disposable: ☐ Decontaminated: ☐

Hydrocarbon Sheen? Yes ☐ No ☐

Water Colour: Odour:

Turbidity: Low ☐ Medium ☐ High ☐

LABORATORY ANALYSIS DETAILS

Sample ID:	Duplicate ID:	Triplicate ID:
TPH's ☐	PAH ☐	Metals ☐
BTEX ☐	VOCs ☐	SVOC's ☐
Other:		

GENERAL ENVIRONMENTAL CONDITIONS

Temp: Cold (<5°C) ☐ Cool (<15°C) ☐ Mild (<25°C) ☐ Warm (<35°C) ☐ Hot (<45°C) ☐

Air: Dry ☐ Medium ☐ Humid ☐ Rain ☐

Wind: Still ☐ Slight Breeze ☐ Windy ☐ Strong Wind ☐

Sky: Clear ☐ Scattered ☐ Cloudy ☐

Other comments:

Sampler Name: Purger Name:

Notes:
mBTOC = Meters below top of casing

Groundwater Sampling Sheet

Well ID: M2

PROJECT NAME: Canberra Brickworks	PURGE DATE: 28/09/16
PROJECT NUMBER: 3002523	DATE SAMPLED: 28/09/16
CLIENT: LDA	DEPTH OF WELL (mBTOC): 14.529
WELL CASING DIAMETER (mm): 50	DEPTH TO GROUNDWATER (mBTOC): 7.531
CASING HEIGHT ABOVE GROUND LEVEL (m):	DEPTH TO BE PURGED (m): -
MONUMENT: ☒ GATIC COVERED: ☐ STAND PIPE: ☐	CHECKED BY: RO

GROUNDWATER PURGING INFORMATION

Purge until field parameters stabilise OR 3-5 casing volumes OR until "dry", whichever occurs first

1 casing volume = 0.5L/m for wells of 25mm diameter
1 casing volume = 2L/m for wells of 50mm diameter
1 casing volume = 8L/m for wells of 100mm diameter

Comment:

Method/pump type: Bailer ☐ Submersible Pump ☐ Other: ☒ Bladder pump

Purge Start Time (2400 hr): 10:10

Estimated Purge Volume: 5 Litres (3-5) Well Volumes

Actual Purge Volume: 5 Litres

Did well purge dry? No ☒ Yes ☐ if yes, when? Litres

FIELD RESULTS

	Time (24 hr)	pH	EC (S/cm)	Redox (mV)	DO (ppm)	Turbidity (NTU)	Temperature (°C)
SWL 8.172 After 1 purge 1.0L	10:27	3.51	994	194	7.61	—	18.4
SWL 8.687 After 2 purge 2.0L	10:30	6.97	1002	112	3.51	—	18.2
SWL 8.957 After 3 purge 3.0L	10:33	6.69	1920	110	3.89	—	18.1
SWL 9.501 After 4 purge 4.0L	10:38	6.84	1909	103	2.43	—	18.9
SWL 9.873 After 5 purge 5.0L	10:43	6.89	1923	94	2.25	—	18.9
Acceptable Variation:	n/a	+/- 0.1	+/- 10%	+/- 10%	+/- 10%	+/- 10%	+/- 0.5

Are field results acceptable to allow sampling? Yes ☒ No ☐ If no, why?

SAMPLING DETAILS

Method: Bailer ☐ Submersible Pump ☐ Other: Bladder pump

Equipment: Dedicated/Disposable: ☐ Decontaminated: ☒

Hydrocarbon Sheen? Yes ☐ No ☒

Water Colour: Clear Odour: None

Turbidity: Low ☒ Medium ☐ High ☐

LABORATORY ANALYSIS DETAILS

Sample ID:	Duplicate ID:	Triplicate ID:
TPH's ☐	PAH ☐	Metals ☐
BTEX ☐	VOCs ☐	SVOC's ☐
Other:		

GENERAL ENVIRONMENTAL CONDITIONS

Temp: Cold (<5°C) ☐ Cool (<15°C) ☐ Mild (<25°C) ☐ Warm (<35°C) ☐ Hot (<45°C) ☐

Air: Dry ☐ Medium ☐ Humid ☐ Rain ☐

Wind: Still ☐ Slight Breeze ☐ Windy ☐ Strong Wind ☐

Sky: Clear ☐ Scattered ☐ Cloudy ☐

Other comments:

Sampler Name: RO

Purger Name: RO

Notes:
mBTOC = Meters below top of casing

Groundwater Sampling Sheet

Well ID: M3

PROJECT NAME: Canberra Brickworks	PURGE DATE: 28/09/16
PROJECT NUMBER: 3002523	DATE SAMPLED: 28/09/16
CLIENT: LDA	DEPTH OF WELL (mBTOC): 4.757
WELL CASING DIAMETER (mm): 50	DEPTH TO GROUNDWATER (mBTOC): 3.006
CASING HEIGHT ABOVE GROUND LEVEL (m):	DEPTH TO BE PURGED (m): -
MONUMENT: ☒ GATIC COVERED: ☐ STAND PIPE: ☐	CHECKED BY: RO

GROUNDWATER PURGING INFORMATION

Purge until field parameters stabilise OR 3-5 casing volumes OR until "dry", whichever occurs first

1 casing volume = 0.5L/m for wells of 25mm diameter
1 casing volume = 2L/m for wells of 50mm diameter
1 casing volume = 8L/m for wells of 100mm diameter

Method/pump type: Bailer ☐ Submersible Pump ☐ Other: ☒ Bladder

Comment:

Purge Start Time (2400 hr):

Estimated Purge Volume: 3 Litres (3-5) Well Volumes

Actual Purge Volume: 3 Litres

Did well purge dry? No ☒ Yes ☐ if yes, when? Litres

FIELD RESULTS

	Time (24 hr)	pH	EC (S/cm)	Redox (mV)	DO (ppm)	Turbidity (NTU)	Temperature (°C)
SWL 3.152 After 1 purge 1.0L	13:54	6.03	795	142	9.62	✓	16.7
SWL 3.263 After 2 purge 2.0L	13:59	5.93	832	142	9.24	✓	16.8
SWL 3.408 After 3 purge 3.0L	14:04	5.94	887	142	9.17	✓	16.6
After 4 purge							
After 5 purge							
Acceptable Variation:	n/a	+/- 0.1	+/- 10%	+/- 10%	+/- 10%	+/- 10%	+/- 0.5

Are field results acceptable to allow sampling? Yes ☒ No ☐ If no, why?

SAMPLING DETAILS

Method: Bailer ☐ Submersible Pump ☐ Other: Bladder pump

Equipment: Dedicated/Disposable: ☐ Decontaminated: ☒

Hydrocarbon Sheen? Yes ☐ No ☒

Water Colour: Clear Odour: None

Turbidity: Low ☒ Medium ☐ High ☐

LABORATORY ANALYSIS DETAILS

Sample ID:	Duplicate ID:	Triplicate ID:
TPH's ☐	PAH ☐	Metals ☐
BTEX ☐	VOCs ☐	SVOC's ☐
Other:		

GENERAL ENVIRONMENTAL CONDITIONS

Temp: Cold (<5°C) ☐ Cool (<15°C) ☐ Mild (<25°C) ☐ Warm (<35°C) ☐ Hot (<45°C) ☐

Air: Dry ☐ Medium ☐ Humid ☐ Rain ☐

Wind: Still ☐ Slight Breeze ☐ Windy ☐ Strong Wind ☐

Sky: Clear ☐ Scattered ☐ Cloudy ☐

Other comments:

Sampler Name: RO

Purger Name: RO

Notes:
mBTOC = Meters below top of casing

Groundwater Sampling Sheet

Well ID: M4

PROJECT NAME: Canberra Brickworks	PURGE DATE: 17/10/16
PROJECT NUMBER: 3002523	DATE SAMPLED: 17/10/16
CLIENT: LDA	DEPTH OF WELL (mBTOC): 4.815
WELL CASING DIAMETER (mm): 50	DEPTH TO GROUNDWATER (mBTOC): 1.906
CASING HEIGHT ABOVE GROUND LEVEL (m):	DEPTH TO BE PURGED (m): -
MONUMENT: ☒ GATIC COVERED: ☐ STAND PIPE: ☐	CHECKED BY: RO

GROUNDWATER PURGING INFORMATION

Purge until field parameters stabilise OR 3-5 casing volumes OR until "dry", whichever occurs first

1 casing volume = 0.5L/m for wells of 25mm diameter
1 casing volume = 2L/m for wells of 50mm diameter
1 casing volume = 8L/m for wells of 100mm diameter

Comment:

Method/pump type: Bailer ☐ Submersible Pump ☐ Other: ☒ Bladder Pump

Purge Start Time (2400 hr): 14.30

Estimated Purge Volume: 4 Litres (3-5) Well Volumes

Actual Purge Volume: 4 Litres

Did well purge dry? No ☒ Yes ☐ if yes, when? Litres

FIELD RESULTS

	Time (24 hr)	pH	EC (S/cm)	Redox (mV)	DO (ppm)	Turbidity (NTU)	Temperature (°C)
SWL 1.920 After 1 purge 1.0L	14:40	6.63	230	114	7.82	✓	17.2
SWL 1.922 After 2 purge 2.0L	14:44	6.61	347	115	3.06	✓	16.0
SWL 1.926 After 3 purge 3.0L	14:48	6.61	632	115	3.00	✓	15.6
SWL 1.932 After 4 purge 4.0L	14:52	6.60	633	145	2.94	✓	15.5
After 5 purge							
Acceptable Variation:	n/a	+/- 0.1	+/- 10%	+/- 10%	+/- 10%	+/- 10%	+/- 0.5

Are field results acceptable to allow sampling? Yes ☒ No ☐ If no, why?

SAMPLING DETAILS

Method: Bailer ☐ Submersible Pump ☐ Other: Bladder pump

Equipment: Dedicated/Disposable: ☐ Decontaminated: ☒

Hydrocarbon Sheen? Yes ☐ No ☒

Water Colour: Brown Odour: None

Turbidity: Low ☐ Medium ☐ High ☒

LABORATORY ANALYSIS DETAILS

Sample ID:	Duplicate ID:	Triplicate ID:
TPH's ☐	PAH ☐	Metals ☐
BTEX ☐	VOCs ☐	SVOC's ☐
Other:		

GENERAL ENVIRONMENTAL CONDITIONS

Temp: Cold (<5°C) ☐ Cool (<15°C) ☐ Mild (<25°C) ☐ Warm (<35°C) ☐ Hot (<45°C) ☐

Air: Dry ☐ Medium ☐ Humid ☐ Rain ☐

Wind: Still ☐ Slight Breeze ☐ Windy ☐ Strong Wind ☐

Sky: Clear ☐ Scattered ☐ Cloudy ☐

Other comments:

Sampler Name: RO

Purger Name: RO

Notes:
mBTOC = Meters below top of casing

Groundwater Sampling Sheet

Well ID: MS

PROJECT NAME: Canberra Brickworks	PURGE DATE: 17/10/16
PROJECT NUMBER: 3002523	DATE SAMPLED: 17/10/16
CLIENT: LDA	DEPTH OF WELL (mBTOC): 4.870
WELL CASING DIAMETER (mm): 50	DEPTH TO GROUNDWATER (mBTOC): 1.965
CASING HEIGHT ABOVE GROUND LEVEL (m):	DEPTH TO BE PURGED (m): —
MONUMENT: ☒ GATIC COVERED: ☐ STAND PIPE: ☐	CHECKED BY: RO

GROUNDWATER PURGING INFORMATION

Purge until field parameters stabilise OR 3-5 casing volumes OR until "dry", whichever occurs first

1 casing volume = 0.5L/m for wells of 25mm diameter
1 casing volume = 2L/m for wells of 50mm diameter
1 casing volume = 8L/m for wells of 100mm diameter

Comment:

Method/pump type: Bailer ☐ Submersible Pump ☐ Other: ☒ Bladder Pump

Purge Start Time (2400 hr): 15:25

Estimated Purge Volume: 5.7 Litres (3-5) Well Volumes

Actual Purge Volume: 5.7 Litres

Did well purge dry? No ☒ Yes ☐ if yes, when? Litres

FIELD RESULTS

	Time (24 hr)	pH	EC (S/cm)	Redox (mV)	DO (ppm)	Turbidity (NTU)	Temperature (°C)
SWL 2.803 After 1 purge 1.0L	15:34	6.99	446	106	3.33	/	14.5
SWL 2.817 After 2 purge 2.0L	15:36	7.01	443	102	2.99	/	14.4
SWL 2.790 After 3 purge 3.0L	15:40	6.99	440	96	2.89	/	14.4
After 4 purge							
After 5 purge							
Acceptable Variation:	n/a	+/- 0.1	+/- 10%	+/- 10%	+/- 10%	+/- 10%	+/- 0.5

Are field results acceptable to allow sampling? Yes ☒ No ☐ If no, why?

SAMPLING DETAILS

Method: Bailer ☐ Submersible Pump ☒ Other: Bladder pump

Equipment: Dedicated/Disposable: ☐ Decontaminated: ☒

Hydrocarbon Sheen? Yes ☐ No ☒

Water Colour: Brown Odour: None

Turbidity: Low ☐ Medium ☐ High ☒

LABORATORY ANALYSIS DETAILS

Sample ID:	Duplicate ID:	Triplicate ID:
TPH's ☐	PAH ☐	Metals ☐
BTEX ☐	VOCs ☐	SVOC's ☐
Other:		

GENERAL ENVIRONMENTAL CONDITIONS

Temp: Cold (<5°C) ☐ Cool (<15°C) ☐ Mild (<25°C) ☐ Warm (<35°C) ☐ Hot (<45°C) ☐

Air: Dry ☐ Medium ☐ Humid ☐ Rain ☐

Wind: Still ☐ Slight Breeze ☐ Windy ☐ Strong Wind ☐

Sky: Clear ☐ Scattered ☐ Cloudy ☐

Other comments:

Sampler Name: RO

Purger Name: RO

Notes:
mBTOC = Meters below top of casing

Groundwater Sampling Sheet

Well ID: M6

PROJECT NAME: Canberra Brickworks	PURGE DATE: 17/10/16
PROJECT NUMBER: 3002523	DATE SAMPLED: 17/10/16
CLIENT: LDA	DEPTH OF WELL (mBTOC): 15.67
WELL CASING DIAMETER (mm): 50	DEPTH TO GROUNDWATER (mBTOC): 12.199
CASING HEIGHT ABOVE GROUND LEVEL (m):	DEPTH TO BE PURGED (m): -
MONUMENT: ☒ GATIC COVERED: ☐ STAND PIPE: ☐	CHECKED BY: RO

GROUNDWATER PURGING INFORMATION

Purge until field parameters stabilise OR 3-5 casing volumes OR until "dry", whichever occurs first

1 casing volume = 0.5L/m for wells of 25mm diameter
1 casing volume = 2L/m for wells of 50mm diameter
1 casing volume = 8L/m for wells of 100mm diameter

Comment:

Method/pump type: Bailer ☐ Submersible Pump ☐ Other: ☒ Bladder pump

Purge Start Time (2400 hr): 15:45

Estimated Purge Volume: 2 Litres (3-5) Well Volumes

Actual Purge Volume: 2 Litres

Did well purge dry? No ☒ Yes ☐ if yes, when? Litres

FIELD RESULTS

	Time (24 hr)	pH	EC (S/cm)	Redox (mV)	DO (ppm)	Turbidity (NTU)	Temperature (°C)
SWL 12.459 After 1 purge 1.0L	16:00	6.96	2250	131	5.18	/	14.8
SWL 12.618 After 2 purge 2.0L	16:11	6.91	2250	129	5.30	/	15.2
After 3 purge							
After 4 purge							
After 5 purge							
Acceptable Variation:	n/a	+/- 0.1	+/- 10%	+/- 10%	+/- 10%	+/- 10%	+/- 0.5

Are field results acceptable to allow sampling? Yes ☒ No ☐ If no, why?

SAMPLING DETAILS

Method: Bailer ☐ Submersible Pump ☐ Other: Bladder pump

Equipment: Dedicated/Disposable: ☐ Decontaminated: ☒

Hydrocarbon Sheen? Yes ☐ No ☒

Water Colour: Light brown Odour: None

Turbidity: Low ☐ Medium ☐ High ☒

LABORATORY ANALYSIS DETAILS

Sample ID:	Duplicate ID:	Triplicate ID:
TPH's ☐	PAH ☐	Metals ☐
BTEX ☐	VOCs ☐	SVOC's ☐
Other:		

GENERAL ENVIRONMENTAL CONDITIONS

Temp: Cold (<5°C) ☐ Cool (<15°C) ☐ Mild (<25°C) ☐ Warm (<35°C) ☐ Hot (<45°C) ☐

Air: Dry ☐ Medium ☐ Humid ☐ Rain ☐

Wind: Still ☐ Slight Breeze ☐ Windy ☐ Strong Wind ☐

Sky: Clear ☐ Scattered ☐ Cloudy ☐

Other comments:

Sampler Name: RO

Purger Name: RO

Notes:
mBTOC = Meters below top of casing

Groundwater Sampling Sheet

Well ID: M7

PROJECT NAME: Canberra Brickworks	PURGE DATE: 17/10/16
PROJECT NUMBER: 3002523	DATE SAMPLED: 17/10/16
CLIENT: LDA	DEPTH OF WELL (mBTOC): 15.67
WELL CASING DIAMETER (mm): 50	DEPTH TO GROUNDWATER (mBTOC): 11.600
CASING HEIGHT ABOVE GROUND LEVEL (m):	DEPTH TO BE PURGED (m): -
MONUMENT: ☒ GATIC COVERED: ☐ STAND PIPE: ☐	CHECKED BY: RO

GROUNDWATER PURGING INFORMATION

Purge until field parameters stabilise OR 3-5 casing volumes OR until "dry", whichever occurs first

1 casing volume = 0.5L/m for wells of 25mm diameter
1 casing volume = 2L/m for wells of 50mm diameter
1 casing volume = 8L/m for wells of 100mm diameter

Comment:

Method/pump type: Bailer ☐ Submersible Pump ☐ Other: ☒ Bladder pump

Purge Start Time (2400 hr): 13:40

Estimated Purge Volume: 3 Litres (3-5) Well Volumes

Actual Purge Volume: 3 Litres

Did well purge dry? No ☒ Yes ☐ if yes, when? Litres

FIELD RESULTS

	Time (24 hr)	pH	EC (S/cm)	Redox (mV)	DO (ppm)	Turbidity (NTU)	Temperature (°C)
SWL 12.346 After 1 purge 1.0L	13:50	6.3	362	156	7.91	/	19.5
SWL 12.702 After 2 purge 2.0L	13:53	6.46	403	145	7.84	/	19.8
SWL 13.067 After 3 purge 3.0L	13:56	6.5	445	136	7.83	/	20.0
After 4 purge							
After 5 purge							
Acceptable Variation:	n/a	+/- 0.1	+/- 10%	+/- 10%	+/- 10%	+/- 10%	+/- 0.5

Are field results acceptable to allow sampling? Yes ☒ No ☐ If no, why?

SAMPLING DETAILS

Method: Bailer ☐ Submersible Pump ☒ Other: Bladder pump

Equipment: Dedicated/Disposable: ☐ Decontaminated: ☒

Hydrocarbon Sheen? Yes ☐ No ☒

Water Colour: Brown Odour: None

Turbidity: Low ☐ Medium ☐ High ☒

LABORATORY ANALYSIS DETAILS

Sample ID:	Duplicate ID:	Triplicate ID:
TPH's ☐	PAH ☐	Metals ☐
BTEX ☐	VOCs ☐	SVOC's ☐
Other:		

GENERAL ENVIRONMENTAL CONDITIONS

Temp: Cold (<5°C) ☐ Cool (<15°C) ☐ Mild (<25°C) ☐ Warm (<35°C) ☐ Hot (<45°C) ☐

Air: Dry ☐ Medium ☐ Humid ☐ Rain ☐

Wind: Still ☐ Slight Breeze ☐ Windy ☐ Strong Wind ☐

Sky: Clear ☐ Scattered ☐ Cloudy ☐

Other comments:

Sampler Name: RO

Purger Name: RO

Notes:
mBTOC = Meters below top of casing

Groundwater Sampling Sheet

Well ID: M8

PROJECT NAME: Canberra Brickworks	PURGE DATE: 17/10/16 Dry 15:00
PROJECT NUMBER: 3002523	DATE SAMPLED: Dry 17/10/16
CLIENT: LDA	DEPTH OF WELL (mBTOC): 15.104
WELL CASING DIAMETER (mm): 50	DEPTH TO GROUNDWATER (mBTOC): 15.096 Dry
CASING HEIGHT ABOVE GROUND LEVEL (m):	DEPTH TO BE PURGED (m): Dry
MONUMENT: ☒ GATIC COVERED: ☐ STAND PIPE: ☐	CHECKED BY: RO

GROUNDWATER PURGING INFORMATION

Purge until field parameters stabilise OR 3-5 casing volumes OR until "dry", whichever occurs first

1 casing volume = 0.5L/m for wells of 25mm diameter
1 casing volume = 2L/m for wells of 50mm diameter
1 casing volume = 8L/m for wells of 100mm diameter

Method/pump type: Bailer ☐ Submersible Pump ☐ Other: ☐

Comment:

Purge Start Time (2400 hr):

Estimated Purge Volume: Litres (3-5) Well Volumes

Actual Purge Volume: Litres

Did well purge dry? No ☐ Yes ☐ if yes, when? Litres

FIELD RESULTS

	Time (24 hr)	pH	EC (S/cm)	Redox (mV)	DO ( )	Turbidity (NTU)	Temperature (°C)
After 1 purge							
After 2 purge							
After 3 purge							
After 4 purge							
After 5 purge							
Acceptable Variation:	n/a	+/- 0.1	+/- 10%	+/- 10%	+/- 10%	+/- 10%	+/- 0.5

Are field results acceptable to allow sampling? Yes ☒ No ☐ If no, why?

SAMPLING DETAILS

Method: Bailer ☐ Submersible Pump ☐ Other:

Equipment: Dedicated/Disposable: ☐ Decontaminated: ☐

Hydrocarbon Sheen? Yes ☐ No ☐

Water Colour: Odour:

Turbidity: Low ☐ Medium ☐ High ☐

LABORATORY ANALYSIS DETAILS

Sample ID:	Duplicate ID:	Triplicate ID:
TPH's ☐	PAH ☐	Metals ☐
BTEX ☐	VOCs ☐	SVOC's ☐
Other:		

GENERAL ENVIRONMENTAL CONDITIONS

Temp: Cold (<5°C) ☐ Cool (<15°C) ☐ Mild (<25°C) ☐ Warm (<35°C) ☐ Hot (<45°C) ☐

Air: Dry ☐ Medium ☐ Humid ☐ Rain ☐

Wind: Still ☐ Slight Breeze ☐ Windy ☐ Strong Wind ☐

Sky: Clear ☐ Scattered ☐ Cloudy ☐

Other comments:

Sampler Name:

Purger Name:

Notes:
mBTOC = Meters below top of casing

Community Engagement Plan

Canberra Brickworks

Client:
Doma Group

Date:
20 June 2017

Contact:
Dan Stewart
Director ACT

Canberra
02 6274 3300

25 Lennox Crossing
Acton ACT 2601

www.elton.com.au
consulting@elton.com.au
Sydney | Canberra | Darwin
ABN 56 003 853 101

Contents

1	INTRODUCTION	4
1.1	The precinct and the community	4
2	A POSITIVE ENGAGEMENT STRATEGY	7
3	THE ENGAGEMENT FRAMEWORK	8
3.1	Engagement history – what we have heard so far	9
4	OUR APPROACH TO ENGAGEMENT	12
4.1	An integrated engagement approach	12
4.2	Stakeholder identification	13
5	ENGAGEMENT PROGRAM	14
5.1	Engagement toolkit	14
5.2	Urban renewal examples	16

FIGURES

Figure 1	Precinct activation	5
Figure 2	Brickworks image	13
Figure 3	Precedent projects	19

TABLES

Table 1	Engagement program milestones	17

1 Introduction

The selection process for the redevelopment of the Canberra Brickworks has involved a number of new initiatives by the Land Development Agency (LDA) to ensure that the views of the community have been incorporated at every stage.

Prior to the two-stage tender being launched, the LDA established a Community Panel to develop a list of objectives to guide the future development of the site – key amongst these is that the unique heritage of the Brickworks site be maintained and enhanced by any new development.

The Community Panel has continued to play a key role through the Request for Proposal (RFP) and Request for Tender (RFT) processes, providing feedback on submissions at each stage.

This Community Engagement Plan (the Plan) has been refined through these processes and demonstrates Doma Group's commitment to integrated engagement with the community, including residents, business owners, and members of the general public.

The Plan reflects Doma Group's intention to engage in a meaningful way with key stakeholders and the broader Canberra public on this significant project. We will succeed in achieving this because Doma Group has an enviable track record of active participation in high quality redevelopments across the ACT, including:

» five successful developments in the Kingston Foreshore area consistent with the Colin Stewart Architects master plan, and

» two other significant precinct developments in nearby Barton — the Realm Precinct on National Circuit and Governor Place on Macquarie Street.

1.1 The precinct and the community

The Canberra Brickworks is a truly unique and special site. The industrial heritage of the site and remaining buildings reflect Canberra's story as a young capital, building infrastructure and homes to support a new and optimistic population. The Brickworks stand out as one of our city's only examples of a manufacturing industry and the site's significant role is still tangible — with remnant infrastructure and spaces speaking of an industriousness in purpose and outcome. The remaining chimney 'stacks' — visible from across Lake Burley Griffin are a constant reminder of our past and the potential for our future.

Doma Group's approach to the conservation, restoration and adaptive reuse of the remaining structures looks to embrace and emphasise this industrial 'crudeness', leaving 'relics' against a backdrop of new buildings, restored structures and quality public realm. In so doing, we aim to emphasise the Brickworks precinct as a place to live and work, and as a unique destination to visit in Canberra – a public centrepiece within an open, landscaped park, plaza and pedestrian network nestled amongst a new, quality residential community.

The ultimate goal of the development is for a vibrant, high quality, diverse and cutting-edge precinct that is active seven days a week. Doma Group aims to not only celebrate and respect the site's industrial history but also to establish a precinct that is:

» well-connected to its immediate neighbourhoods and the broader Canberra community

» adaptable, flexible, accessible and sustainably developed

» underpinned by the infrastructure and resources necessary to give it long-term viability as a place for local creative businesses

» an inspirational place for locals and the wider community to visit and experience

» a platform for ephemeral events, and

» able to take its place comfortably within the local area as more residents choose to move into the area to take advantage of the unique opportunities the location presents.

Figure 1 Precinct activation

Opportunities

The Canberra Brickworks is in a key location and is expected to be a destination for both Canberrans and interstate visitors. Amongst a range of positive attributes, the precinct will particularly benefit from its proximity to:

» increasing residential density in the surrounding suburbs

» surrounding parks and a network of pedestrian paths that provide connectivity to the lake frontage and beyond

» nearby suburbs where urban infill and small-scale residential renewal is increasing population with an associated revival of restaurants, cafes and shops

» the Woden Town Centre

» key transport corridors, including Adelaide Avenue/ Yarra Glen and Cotter Road

» Parliament House and the Parkes/Barton office area, the location of many Australian Government departments and national offices for Australian business and industry

» Lake Burley Griffin, a popular destination for waterfront activities such as picnicking, fishing, model boat sailing, in-line skating, cycling and walking

» other tourist activities, including the Royal Australian Mint, and

» the proposed second stage of light rail.

2 A Positive Engagement Strategy

Our development program demonstrates our commitment to action an integrated engagement strategy to consult, inform and excite the community about the beneficial regeneration and placemaking planned for the iconic Brickworks. We consider that the success of the project will be linked to a positive engagement strategy.

Aligning our Plan with key project milestones will help to mitigate risks and ensure the Brickworks is a successful, sustainable and viable hub for the current locals and future retailers, residents and visitors.

The Plan outlines a range of communication and community consultation activities to support the planning process for the development of the master plan. It offers both a strategic framework to guide consultation, and the practical tools needed to frame communication with stakeholders. It includes:

- a demonstration of Doma Group's commitment to the principles of the International Association for Public Participation (IAP2) spectrum; our incorporation of the fundamental elements of the ACT Government engagement framework Engaging Canberrans - A guide to community engagement; and an acknowledgement of the key issues raised in the Community Panel Parameters and Perspectives Report
- identification of communications and community engagement objectives
- a stakeholder and interests matrix
- regular meetings with the Community Panel – a key sounding board and strategic partner – to ensure engagement with the broader community is as smooth and constructive as possible, and
- a community and stakeholder consultation program, targeting consultation activities to stakeholders at key milestones along the planning timeline.

Activities are designed to inform stakeholders of the latest project news while creating the opportunity for the community to offer meaningful input as part of genuine consultation about the development.

3 The Engagement Framework

The IAP2 Spectrum for public engagement

The International Association for Public Participation (IAP2) Public Participation Spectrum is a well-respected and sound basis for effective community engagement. The model embraces a positive spectrum from information towards collaboration and ultimately empowerment. It was designed by IAP2 to help determine the appropriate level of participation that defines the role of the community and stakeholders in the engagement process.

The spectrum considers the application of a number of different levels of engagement as part of the one consultation strategy, acknowledging that a range of approaches may be appropriate depending on the community or stakeholders engaged. Elton Consulting – a member of IAP2 Australasia – will be coordinating and facilitating this community engagement plan to ensure an exemplary engagement process based on best practice principles.

Engaging Canberrans: A guide to community engagement

The ACT Government's Engaging Canberrans - A guide to community engagement report confirms the government's commitment to the principles of 'Open Government' including transparency in process and information, effective citizen participation and fostering an environment of collaboration with the community. The document espouses best practice principles in crafting and delivering stakeholder engagement strategies and provides guidance to those wishing to consult with the Canberra public.

Doma Group acknowledges the key principles of the document including those that underpin effective community engagement. In particular, we highlight the importance of engaging effectively with special interest groups, of reaching out to those people who may not traditionally 'have a say' and of keeping the community informed not only of the progress of the project development, but also of the outcomes of any engagement processes.

Drawing on the above tenets, our consultation approach will be based on the following best-practice principles:

- the purpose and expectations of the consultation exercise and anticipated outcomes should be clear and understood by all participants
- participants should be aware of what they can and cannot influence
- consultation mechanisms should maximise people's ability to participate
- community and stakeholder consultation activities are as inclusive as possible, in order to ensure they are not subject to manipulation or domination by particular interests
- information should be provided at key project milestones to adequately inform participants' inputs via a range of differing media that broadens the reach to all interest groups
- adequate time, staff support and funds should be made available to support the participation process
- the early identification of any concerns and issues with the project and to work closely with stakeholders to develop measures to address them
- participants must be aware of how their inputs will be used and then how they receive feedback on the outcomes

» thorough and transparent review of the consultation process should occur at critical points throughout the engagement and at its conclusion, and

» access to all levels of the Doma Group development management team at all times.

3.1 Engagement history – what we have heard so far

The Canberra Brickworks has been the subject of public interest and imagination for many years. Public consultation on the proposed redevelopment of the existing heritage Brickworks area and the area beyond those boundaries has been extensive with a number of issues of concern raised by the community. In particular, local residents in the Yarralumla area have been concerned about the impact of any new development on their existing dwellings and neighbourhood infrastructure – including roads and parking.

The ACT Government's intention to prioritise the conservation and adaptive reuse of the heritage brickworks area responds to public concern that this unique site might be left 'unloved' in the centre of new residential mixed use precinct. This RFT process is an opportunity to realise the community's aspirations for a new and very special destination in the heart of Canberra.

Canberra Brickworks and Environs Strategy, May 2011

In 2010-11, Elton Consulting delivered a consultation process for the ACT Land Development Agency to support the development of the Canberra Brickworks and Environs Planning Strategy (2011). The consultation process involved a wide range of opportunities for participation by diverse members of the community and stakeholders and was designed to be both broad and inclusive – providing opportunities for participation by local residents as well as the wider Canberra community.

The process acknowledged the significant architectural and cultural heritage of the site as well as the importance of the Brickworks as a place within the local area including the suburbs of Yarralumla, Curtin and Deakin. It also identified a number of key themes that have carried through the project. These have underpinned Doma Group's vision and planning for the precinct.

» Heritage conservation and preservation

  > Active heritage conservation of the Brickworks site through preservation, restoration, reconstruction and adaptation

  > Incorporate uses that respond to the unique qualities of the place, within the site's heritage fabric

  > Incorporate environmental sustainability, and minimise energy consumption

» Appropriate development

  > Appropriate consideration to size, scale, density and height in residential development

  > More compact forms of urban development

  > Showcase sustainability and incorporate community and cultural facilities

  > Minimise impacts on the surrounding community

  > Appropriate provision of infrastructure to accompany development

» Access and connectivity

  > Appropriate management of additional traffic and cut-throughs (rat-running) in the local area

  > An accessible, connected place that provides enhanced public access to the Brickworks, open space areas, and Lake Burley Griffin

  > Encourage public access, rather than exclusive and closed off

    - Enhanced pedestrian and cycle access and connectivity to the local area
    - Access to public transport
- Open space preservation and maintenance
    - Open spaces should provide landscapes that are long-lasting and sustainable
    - Open space areas should recognise existing walking trails
- Amenity and vibrancy
    - Enhance the amenity of the suburb by creating a place where friends and family can meet and engage in a wide range of activities (such as cafes and markets)
    - The Master Plan should help foster safety and security
    - Some level of Arts community and cultural activities should be accommodated on the site
    - The Brickworks should become a landmark for community and cultural uses
    - Provision of housing should address the needs of an ageing population

Community Parameters and Perspectives Report, March 2016

As part of the Government's consultation on the Canberra Brickworks in 2015, the LDA invited community representatives of groups that have an interest in the Brickworks to determine a set of objectives and parameters to guide the future development of the precinct. The Community Parameters and Perspectives Report (the Report) provides a consolidation of the Panel member's contributions – providing a list of aspirational parameters for the project that aim to ultimately deliver a precinct that will be a 'viable heritage, cultural, arts, leisure and eco-tourism precinct in an urban setting' (Report, p5).

Of note, the Community Panel has outlined concerns that the unique heritage of the Brickwork site be maintained and enhanced by any new development. In addition, the community would like to see quality development that showcases the significant heritage buildings, ensures Pittman Park is a readily accessible public recreation space, and maintains accessible pedestrian and cycle networks permeating through the site and connecting outwards to existing active transport networks and public transport links. The community is concerned that there be minimal disruption to existing, adjacent neighbours during construction, that local environmental issues be taken into account and that the development demonstrate high quality and sustainable built form.

The Report itself recognises that it is 'reflective of the range of views held within the community' and that in some cases there is conflict between the views expressed (Report, p2). This diversity of stakeholder interest is not unusual. It does present some risk for the project.

Doma Group understands that the LDA requires a partner who can successfully:

- implement effective engagement to allay negative community perceptions and
- conceive a design response that is consistent with community expectations.

Drawing on our experience in refining stakeholder requirements for Commonwealth tenants and our extensive private developments that address community engagement and planning response, Doma Group, with the expertise of Elton Consulting, is very well positioned to assist the LDA to reduce the associated risks of community engagement and on-board critical stakeholders to effectively champion the contribution the development offers to the whole Canberra community.

Doma Group has considered the Report and welcomes the opportunity to engage actively with the Community Panel and the ACT Government in designing and delivering a precinct that aligns with the community's aspirations for a revitalised Canberra Brickworks, resolving competing priorities as required. Wherever possible, we have also sought to reflect the feedback received from the LDA and

the detailed comments provided by the Community Panel through the RFP and RFT processes. Our approach to the design, development and activation of this significant heritage precinct reflects our appreciation of the community's concerns raised to date and the Canberra public's vision for the future of the site and we look forward to an enduring and productive working relationship with the Community Panel as this vision is realised.

Doma Group also appreciates the important contribution the current Brickworks tenants have made to the maintenance of the heritage brickworks building and their commitment to the ongoing viability and uniqueness of the site.

4 Our Approach to Engagement

The purpose of the Canberra Brickworks Consultation Plan is to enable the realisation of a project that will:

- rejuvenate a significant site that has long laid dormant as a new destination for the Canberra public
- strengthen Canberra's vision of the Brickworks as a shared precinct that reflects our past and embraces our future as a vibrant and dynamic city, and
- establish a new benchmark for quality design of a residential community that is truly reflective of the principles of the Garden City.

The Plan provides the framework to support the progression of the Canberra Brickworks precinct through the Estate Development Planning (EDP) approval process, through construction and potentially beyond.

The overarching aims of the Community Consultation Plan are to:

- introduce Canberrans to the proposed new Canberra Brickworks precinct
- stimulate discussion and feedback on the precinct design and aspirations
- enthuse and excite the community about the new public precinct
- manage risk through understanding and responding to material issues and stakeholder concerns, and
- establish a shared vision for the Brickworks which people will want to see built and which they will champion.

4.1 An integrated engagement approach

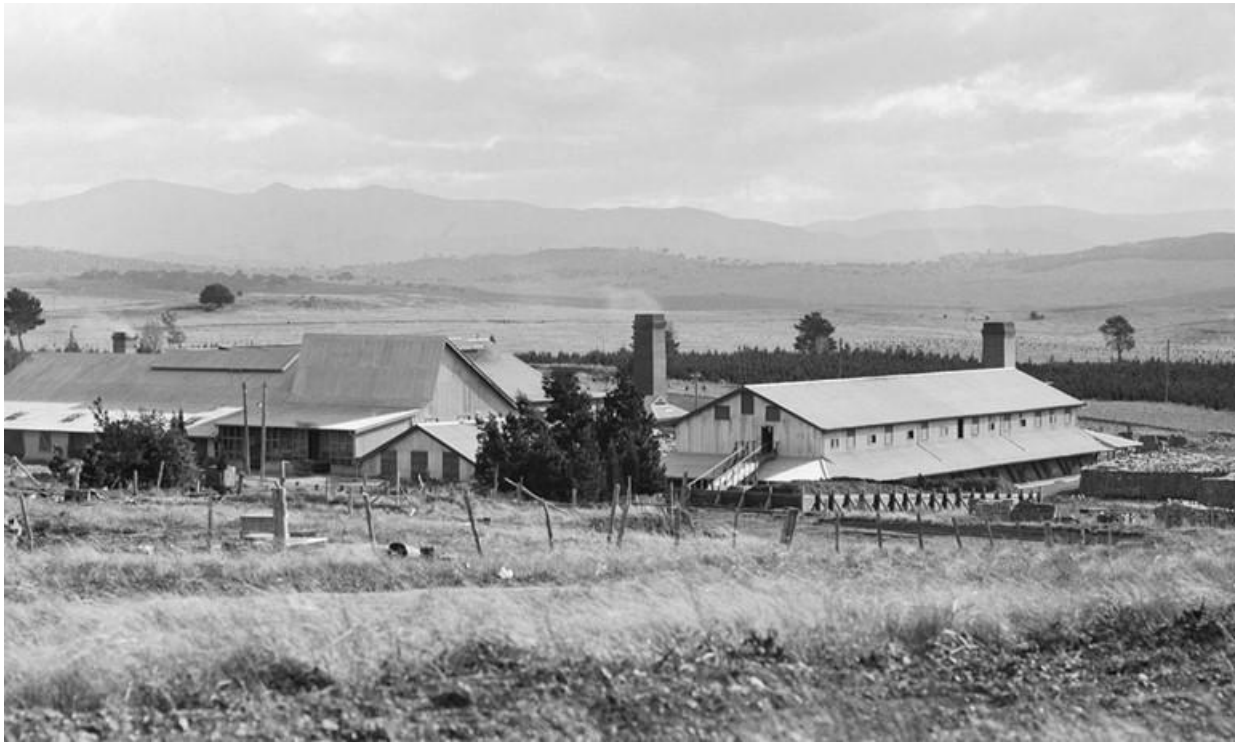
The Canberra Brickworks is a precinct that has captured the imagination of the community for many years. Extensive consultation by the ACT Government over a long period of time has led to a strong understanding of the general aspirations for the site, together with a comprehensive appreciation of the issues of particular interest to a number of key stakeholders. Doma Group proposes an engagement plan that builds on the consultation already conducted and integrates with the ACT Government's existing strategy for consultation with the Canberra public on the development of the site.

As an active Canberra developer, Doma Group has undertaken a number of significant, staged precinct developments including the Realm and Governor Place Precincts in Barton and five developments at the Kingston Foreshore. In doing so, we have managed a range of stakeholders, and delivered developments often in densely populated residential areas. At all times we have been cognisant of the need for clear communication and understanding. Built form quality and attention to detail is the hallmark of the Doma Group brand and is key to the success of our long-term reputation in the Canberra market. Our customers are often repeat and referral buyers.

This community engagement strategy will allow for flexibility and will be adapted to meet the needs and challenges of each phase of the project, from planning and design through to construction and occupation.

Accordingly, the tools employed throughout the project will vary to match the level of communication or issues management required. Guided by Elton Consulting, with significant historical knowledge of key stakeholder issues having completed the previous consultation, Doma Group proposes to target the engagement to suit the key stages of the development and level of information available.

Figure 2 Brickworks image



4.2 Stakeholder identification

Doma Group has identified a range of stakeholders with an interest in the development of the Canberra Brickworks Precinct and has considered their relative interest and levels of influence on the project. Each stakeholder identified for this culturally significant development has a different interest in the project. The Community Engagement Plan will capitalise on common interests and links between stakeholders, while managing risks.

Doma Group has developed the engagement plan while acknowledging that a number of stakeholders including government agencies will already have a solid background appreciation of the project. The Plan anticipates providing regular project updates to all stakeholders with additional individual consultations organised for specific matters/issues as appropriate.

The Yarralumla and Deakin areas include a mix of residential typologies, cultural facilities, retail outlets, small businesses and office buildings. Key stakeholders in this area will likely have a strong opinion and deep interest in the development of the precinct and should be kept regularly informed about the project to minimise delays in the planning approval process and encourage champions for the precinct.

The Canberra Brickworks will also be a popular destination for the broader Canberra community and visitors to Canberra who will be keen to remain updated on the development of this important area. This will be achieved through regular updates via the precinct website and associated media, as well as by utilising existing marketing channels already well-established by the LDA.

5 Engagement program

The high-level engagement program outlined in Table 1 below aligns communication milestones with the Indicative Development Program — each milestone has associated key objectives. Wherever possible and appropriate, our approach will be complementary to and build on any marketing for the precinct conducted by the ACT Government including linking to the LDA precinct website and reference to printed material. Our program is designed over four stages with consultation and engagement at key points throughout:

- awarding of the contract through to Concept Estate Development Plan (EDP)
- draft EDP design development
- EDP lodgement and approval, and
- a two-stage development program.

Should there be a need to add any new components to the Indicative Development Program (such as a requirement for EPBC referral), or if certain aspects are accelerated (e.g. a separate DA for decontamination), the engagement program will be updated accordingly.

5.1 Engagement toolkit

A range of engagement tools are proposed to be used throughout the Canberra Brickworks project. The tools will ensure that all key stakeholders are able to make a meaningful contribution. Importantly, the engagement tools aim to encourage the broader Canberra community to contribute their feedback and maintain interest in the development of the significant precinct.

One-on-one meetings

Doma Group will conduct a range of face to face meetings with key stakeholder groups including Government agency representatives and the Community Panel.

Engagement with the Community Panel

We are committed to developing a positive and enduring relationship with the Community Panel, holding regular monthly meetings throughout the development of the precinct. At the outset, during the RFT stage an inception meeting will highlight the key issues for consideration arising from the Community Parameters Report. Ongoing engagement and information sharing will be achieved through regular, face-to-face meetings, presentations and email updates. Doma will record meeting minutes of the monthly meetings and present these to the LDA as a method of demonstrating continued commitment to meaningful engagement with the Community Panel. A monthly summary of all engagement activities undertaken will be uploaded to the project website.

Brickworks website

Doma Group will establish a new website designed as a deposit for all public information relevant to the development and associated consultation and a place for dynamic community feedback. The website may be tailored to include:

- master plan drawings and explanatory material
- project news feeds / blogs and timelines

- video and image galleries
- social media feeds
- key dates and program for community engagement events
- questions and answers
- quick polls and surveys
- links to virtual reality tours of proposed development
- links to engagement for individual development applications
- project contact details

Public presentations

Presentations to relevant community groups will be conducted at varying stages of development.

Local pop-up 'Kiln Conversations'

'Pop up' displays in local shopping centres located around Canberra including display boards, information sheets and the opportunity to participate in paper or online surveys.

Memory collections

A public call for electronic or hard-copy submissions of photographs, written and oral stories and videos related to the history of the Brickworks to be submitted by email, post or via the website. Any other donations from the public may be housed in the Brickworks museum.

'Meet the Architects' presentation

Public presentation evening, in collaboration with the Institute of Architects and Institute of Landscape Architects, with short presentations by the members of the architects' panel and the project Landscape Architect to discuss the design intent for the site, and their approach.

Quarry Party

A community day time party in Pittman Park at the completion of Stage 1 of the development, celebrating the public re-opening of the site. This might include performances by local musicians, food and beverages offered by the new Brickworks tenants, children's activities in the Rails Playground and potential for artistic demonstrations or installations in Pittman Park and heritage precinct.

5.2 Urban renewal examples

We have provided a consolidation of precedent Brickworks project that have been examined by the project team. These examples will be useful to demonstrate key messages for the scheme and illustrate strategies that have achieved success, and in some cases strategies that have not. This will be useful to guide engagement with the users group to demonstrate how our concepts meet with the Community Parameters in a more tangible and accessible way. It also means that the concepts are more accessible than simply presenting plans — we recognise not all members of the Community Panel may have strong interpretation skills in this regard.

Table 1 Engagement program milestones

MILESTONE	PROGRAM	ACTION	TOOL
Doma Group awarded preferred developer status	April 2017	• Media announcement	• Media kit • Meeting with Community Panel
Concept Delivery Agreement (CDA) between LDA and Doma executed	June 2017	• Liaison with LDA on CDA	• Meeting with Community Panel
Project launch	June/July 2017	• Establish project website and commence public consultation program	• Media kit • Meeting with Community Panel • Establish website, social media etc. • 'Have your say'
Conservation Management Plan	July/August 2017	• Liaison with LDA, Community Panel, National Trust and Heritage Council	• One-on-one meetings with key stakeholders
Concept Estate Development Plan (EDP)	July/August 2017	• Presentation to Community Panel on interpretation of vision and parameters • Public consultation on proposed EDP design	• Public presentations • Local pop-ups and 'kiln conversations' • 'Have your say' • One-on-one meetings with key stakeholders • Meetings with Community Panel • Memory collections
Draft EDP design development	August 2017 – November 2017	• Liaison with LDA on EDP • Liaison with Community Panel on EDP design development	• One-on-one meetings with government • Monthly meetings with Community Panel
	January 2018 – April 2018	• Report back / presentation to key stakeholders on how input has been used in design (including presentation to Community Panel) • Summary report on community engagement to support EDP application	• Monthly meetings with Community Panel • Written report to key stakeholders • Summary consultation report • Website and social media updates

MILESTONE	PROGRAM	ACTION	TOOL
EDP lodgement with EPSDD	May 2018	• Project updates on website	• Website and social media updates • Email updates to key stakeholders • Monthly meetings with Community Panel
EDP approved by EPSDD	November 2018	• Notify stakeholders	• Website and social media updates • Email updates to key stakeholders • Monthly meetings with Community Panel
Stage 1 DA lodgement	May 2018	• Pre-DA engagement consistent with EPSDD requirements • Ongoing engagement with key stakeholders and broader community about individual DAs as well as precinct development / staging updates via website; pop-ups and other events as appropriate	• Website and social media updates • 'Meet the Architects' presentation • Monthly meetings with Community Panel
Stage 2 DA lodgement	Mid 2020	• Pre-DA engagement consistent with EPSDD requirements • Ongoing engagement with key stakeholders and broader community about individual DAs as well as precinct development / staging updates via website; pop-ups and other events as appropriate	• Website and social media updates • 'Meet the Architects' presentation • Monthly meetings with Community Panel
Staging openings	January 2019 – June 2022	• Precinct opening events / marketing as appropriate including celebration in Pittman Park	• Website updates • Quarry Party (end Stage 1) • Monthly meetings with Community Panel

Figure 3 Precedent projects

SITE LOCATION/ HISTORY	SITE SIZE	URBAN RENEWAL USE	SITE / CONTEXT IMAGES
Bowden, Adelaide, South Australia **Revitalisation of former industrial site; brickworks and glassworks** **http://lifemoreinteresting.com.au/** Bowden redefines city living by setting new standards in urban revitalisation for all Australian cities. Bowden's proximity to the CBD is attracting a vibrant mix of people all captivated by the convenience and energy of this thriving place. The 16.3 hectare site in Bowden, has a history of brickmaking, glassworks and other such industries. Since 'Renewal SA' acquired the site, Bowden is transforming into a vibrant inner-city destination blending history and culture with high quality architecture and sustainability, home for 3,500 residents.	16.3 hectares	Houses Terrace houses 1,2 & 3 bedroom apartments Cafes Restaurants Shops Offices Parks Gardens	
Newmarket Brickworks, Brisbane,Queensland **Revitalisation of former brickworks** **http://newmarketbrickworks.com.au/** The Brickworks residential redevelopment is in the inner urban ring suburb of Alderley on the north side of Brisbane. The 46,900sqm site has an industrial history, with a heritage listed, 50 metre tall chimney - a remnant from the former Brickworks company of the early 1900's. This chimney is a landmark for the surrounding region and was an obvious focus of our design.	4.69 hectares 350 proposed dwellings 43% landscaped area	Attached and detached Houses Townhouse Apartments	
Burwood Brickworks, Victoria The 20 hectare site sold for $65 million in May 2014, the site had been vacant for 20 years. The draft Masterplan includes detached and semi-detached homes, terraces, townhouses and apartments. The project intends to integrate with the existing character of Burwood and provide new local amenities and services for the community. It is also planned to be a social hub, and meeting place for new and existing residents and a distinctive address with the highest quality urban development.	20 hectares	Detached and semi-detached homes, terraces, townhouses and apartments	

SITE LOCATION/ HISTORY	SITE SIZE	URBAN RENEWAL USE	SITE / CONTEXT IMAGES
K&D Brickworks, New Town, Hobart, Tasmania **Former K&D (Kemp and Denning Ltd) brickworks site** The 10 hectare site, is located 4km from Hobart CBD, is to be developed for 114 residential lots. Close to schools, public transport, hospitals, doctors and shopping centres, the large site is set across seven titles and includes a disused quarry. Ald Thomas called for a long-term consultation committee of residents and developers to ensure outcomes "that are beneficial to everyone'. The subdivision will be staged across seven existing titles. It will be developed in nine stages ranging from six to 16 lots each.	10 hectares	114 residential lots	
The Grounds of Alexandria, Alexandria, Sydney, NSW **Former industrial precinct** **http://thegrounds.com.au/** The Grounds is located in a former industrial precinct from the 1920s, The Grounds of Alexandria is a landmark coffee roastery, café and sustainable garden known for its abundance of fresh produce and hands-on experiences. Opened in April 2012, the site which spans approximately an acre within the inner west city fringe suburb of Alexandria, hosts a coffee research and education facility, artisan bakery and a permaculture garden of heirloom vegetables, fragrant herbs, fresh fruit and flowers along with a small animal farm. Remaining true to the sites heritage of organic industries, which originally included tanneries, wool washing factories and market gardens, The Grounds provides a wholesome, produce-driven menu that is fresh, fun and innovative. The initial concept of The Grounds was born from entrepreneurial duo Ramzey Choker and Jack Hanna who had a vision to turn the then industrial concrete car park into a thriving urban sanctuary, designed as a welcoming space to bring people together. The Grounds is built on the philosophy of creating experiences for communities through quality products, innovations and an ever-evolving vision.	0.40 hectare	Café Potting Shed Market Place Venue Hire Produce Giftware	
Carriageworks, Eveleigh, Sydney, NSW **Former Eveleigh Rail Yards** **http://carriageworks.com.au/** Carriageworks is the largest and most significant contemporary multi-arts centre of its kind in Australia. The Carriageworks Artistic Program is ambitious, risk taking and provides significant support to leading Australian and international artists through commissioning and presenting contemporary work. The program is artist-led and emerges from Carriageworks' commitment to reflecting social and cultural diversity. Carriageworks is housed in the old Eveleigh Rail Yards at Wilson Street, located within the emerging Redfern Waterloo precinct, and has been developed by the NSW State Government through Arts NSW. The distinctive nineteenth century industrial atmosphere of the former railway carriage and blacksmith workshops have been retained, with many heritage iron and brick details featured in the regeneration of the building.		Performing Arts Venues Theatre Market Place Fashion parades	

SITE LOCATION/ HISTORY	SITE SIZE	URBAN RENEWAL USE	SITE / CONTEXT IMAGES
Salamanca Arts Centre (SAC), Hobart, TAS http://www.salarts.org.au/ Salamanca Arts Centre is Tasmania's multi-arts creative hub and an integral part of the State's arts and creative industries infrastructure. SAC is an engine room for art-making and presentation; a centre for artists and designers in-studios; home to many of Tasmania's leading arts organisations across live performance (theatre, music, dance), film and writing; cultural and commercial galleries and studios for visual arts, crafts and design. SAC connects Tasmanian arts, artists, audiences, and arts-based businesses with national and international audiences, peers and opportunities. An estimated 250,000+ people pass through SAC's doors every year, visiting galleries, exhibitions, performances and community events.		Galleries Artist Studios Theatre Market Place Artisan Shops Cafes	
The Lock-up Cultural Centre, Newcastle, NSW Former Newcastle Police Station http://www.thelockup.org.au/ Located in one of Newcastle's most significant heritage buildings, The Lock-Up is a multidisciplinary contemporary arts space and inner city hub for creative thinking and doing. Listed in the NSW Heritage Register, The Lock-Up was the Newcastle Police Station and lock up from 1861 until its closure in 1982. In 2007, the Lock-Up was unveiled as the The Lock-Up Cultural Centre. This included the gallery space, museum, and residency program. Since this date, the Lock-Up has had an attendance of over 50,000 people. In September 2014 The Lock Up re-launched as a dedicated multidisciplinary contemporary arts centre and inner city hub for creative thinking and doing.		Gallery Space Museum Artist Residency Program Venue Hire	
Gerding Theatre, Portland,Oregon, US Former Armoury https://www.pcs.org/about-the-armory Widely noted as the "crown jewel" of the Brewery Blocks redevelopment, the Gerding Theatre at the Armory's renovation has contributed to the revitalization of the Pearl/River District, providing both a near-term economic benefit of $14.7 million to the community and a projected long-term impact of $100 million in new economic activity over the next decade.		Foyer Theatre	

SITE LOCATION/ HISTORY	SITE SIZE	URBAN RENEWAL USE	SITE / CONTEXT IMAGES
Evergreen Brick Works, Toronto, Canada **Former brickworks - heritage site revitalisation** **http://www.evergreen.ca/get-involved/evergreen-brick-works/** Evergreen transformed Toronto's historic Don Valley Brick Works factory from an underused, deteriorating collection of buildings into a thriving community environmental centre, Evergreen Brick Works. It is a centre for innovation and fresh thinking that inspires future generations to rethink their place in the world and a dynamic place that adapts and grows to meet new urban challenges. Evergreen Brick Works opened in 2010 and is a year-round destination for experiential learning, collaboration, fun and celebration on the themes of Nature, Culture and Community. Transforming the way we think about our cities, the innovative facility demonstrates and promotes practical solutions to make our communities sustainable and more livable, and our urban lifestyles healthier. With the project Evergreen Brick Works heritage site revitalisation an abandoned factory site is reborn - incorporating an education center, exhibition spaces and diverse social services focused on promoting sustainable cities. A clay and shale quarry for one hundred years, the 16.5 hectare area that surrounds the Brick Works has been transformed into a thriving green space, with ponds and nature trails to explore and wander.	16 hectares	Farmers' Market Plant Nursery Greenhouse Community Garden 'Quarry' Garden Gift Shop Café Wood-fired Oven 'The Kilns' Event & Exhibit Space Venue Hire Bike Works Shop Bike Repairs Shop Ice Skating Rink Team Building Venue Education Centre Office Space Electronics Recycling	
Brewery Blocks, Portland, Oregon, US **Former Brewer** **http://www.breweryblocks.com/** The Brewery Blocks, located at the former site of the Blitz-Weinhard Brewery, is a five-block shopping and professional district in Portland's vibrant, post-industrial neighbourhood known as the Pearl District. The Brewery Blocks provides a transition between the Central Business District and the River District and is home to urban retail, creative Class A office space and residential housing. With the combination of historic preservation of the Weinhard Brewhouse and the Armory Building, and an increase in retail and commercial activity, this area has been transformed into a bustling urban neighbourhood. Additionally, it provides a design that is faithful to the industrial character of the former Brewery and the Pearl District, and is consistent with "environmentally friendly" sustainable development concepts.		Retail Dining Offices Residential	

SITE LOCATION/ HISTORY	SITE SIZE	URBAN RENEWAL USE	SITE / CONTEXT IMAGES
Glebe Harbour Apartments, Glebe, Sydney, NSW http://www.sjb.com.au/projects/glebe-harbour The architecture of Glebe Harbour borrows cues from both the surrounding Victorian terrace houses and the typology of the shipping containers that once lined this shore. The rhythm of the terrace house boundary walls have been continued down the hill, offering scale to the redevelopment while visually tying it into the surrounding built fabric. This tectonic element helps to reduce the overall scale of the project ensuring that the buildings are presented as discrete residential addresses.			
Little Bay Cove, Little Bay Cove, Sydney, NSW http://littlebaycove.com.au/overview.php Little Bay Cove is Sydney's newest eastern suburb beachside community which is set on a 13.6 hectare oceanfront land at Little Bay Cove. Little Bay Cove is at the southern end of the Eastern Suburbs coastline, within 6 kilometres of Coogee Beach, 14 kilometres of the CBD, and is next to the Prince Henry community and borders four golf courses. It is poised to be one of Sydney's landmark lifestyle residential developments, comprising approximately 600 apartments, townhouses and land allotments which will be delivered progressively in stages over the next seven years.			
Six Degrees Vault Offices, Argyle Street, Fitzroy, Melbourne, Vic http://www.sixdegrees.com.au/5ow_six-deg-office The design of the Six Degrees office at Federation Walk evolved out of the process of master planning of the vaults precinct. The refurbishment was driven from a heritage point of view, so where possible everything was stripped back to the original finishes. To keep the brick vaults untainted all the new services are hidden in a channel in the floor and the lighting branches out from central hubs to reduce wiring. The vaults dictated the layout, but within that was created a split level, open plan scheme that took advantage of the view out to the Yarra River.		Architectural Practice -Offices/Studios Meeting Area Staff Kitchen Amenities	

www.elton.com.au

Canberra Brickworks and Environs Community Needs Assessment

Final Report

Land Development Agency

February 2015

SGS Economics & Planning

Independent insight.

This report has been prepared for Land Development Agency. SGS Economics and Planning has taken all due care in the preparation of this report. However, SGS and its associated consultants are not liable to any person or entity for any damage or loss that has occurred, or may occur, in relation to that person or entity taking or not taking action in respect of any representation, statement, opinion or advice referred to herein.

SGS Economics and Planning Pty Ltd
ACN 007 437 729
www.sgsep.com.au
Offices in Canberra, Hobart, Melbourne and Sydney

TABLE OF CONTENTS

EXECUTIVE SUMMARY		**5**
Context		5
Current and Future Population		5
Community Facility Needs and Provision		6
Local and District Shops		6
Community Facilities		6
Findings and Recommendations		6
1	**INTRODUCTION**	**9**
1.1.	Project objective	9
1.2.	Canberra Brickworks and Environs site	9
1.3	The Canberra Brickworks and Environs Planning and Development Strategy	9
1.4	Community Needs Assessment scope	11
2	**BACKGROUND**	**12**
2.1	Planning context	12
3	**SOCIAL INFRASTRUCTURE DEMAND AND SUPPLY**	**16**
3.1	Factors impacting on demand for social infrastructure	16
3.2	Hierarchy of social infrastructure provision	18
3.3	Changes to social infrastructure provision over time	19
3.4	Social infrastructure access for Yarralumla residents	19
3.5	Social infrastructure benchmarks	20
3.6	Social infrastructure provision in comparable suburbs	20
3.7	Retail and associated facilities in and near Yarralumla	21
3.8	Community services and youth facilities	24
3.9	Recreation facilities	26
3.10	Health facilities and services	28
3.11	Aged care services	30
3.12	Schools	32
3.13	Child care and children's services	34
3.14	Places of worship	36
3.15	Emergency services	38
4	**KEY FINDINGS AND RECOMMENDATIONS**	**40**
4.1	Retail and community facilities	40
4.2	Timing of Provision	42
APPENDIX A		**43**
ACT Planning System and Policies		43
APPENDIX B		**47**
Population		47
Dwellings and employment		49
Population projections		52

APPENDIX C **57**
Stakeholder Engagement 57

APPENDIX D **59**
Social Infrastructure benchmarks in other jurisdictions 59
Social Infrastructure provision in comparable suburbs in the ACT 62

LIST OF FIGURES

FIGURE 1. CANBERRA BRICKWORKS AND ENVIRONS PRECINCT 10
FIGURE 2. TERRITORY MAP PLANS AND OVERLAYS 13
FIGURE 3. RETAIL FACILITIES 21
FIGURE 4. COMMUNITY AND YOUTH FACILITIES 24
FIGURE 5. RECREATION FACILITIES 26
FIGURE 6. HEALTH FACILITIES 28
FIGURE 7. AGED CARE SERVICES 30
FIGURE 8. SCHOOLS 32
FIGURE 9. CHILD CARE AND CHILDREN'S SERVICES 34
FIGURE 10. PLACES OF WORSHIP 36
FIGURE 11. EMERGENCY SERVICES 38
FIGURE 12. NATIONAL CAPITAL PLAN: DESIGNATED AREAS 44
FIGURE 13. POPULATION BY AGE - YARRALUMLA, DEAKIN AND ACT 47
FIGURE 14. RELIGIOUS AFFILIATIONS 48
FIGURE 15. HOUSEHOLD COMPOSITION – YARRALUMLA, DEAKIN AND ACT 49
FIGURE 16. DWELLING TYPE – YARRALUMLA, DEAKIN AND ACT 50
FIGURE 17. HOUSING TENURE 50
FIGURE 18. LABOUR FORCE STATUS – YARRALUMLA, DEAKIN AND ACT 51
FIGURE 19. WEEKLY HOUSEHOLD INCOME – YARRALUMLA, DEAKIN AND ACT 52
FIGURE 20. YARRALUMLA POPULATION, 2001 TO 2021 53
FIGURE 21. PROJECTED AGE PROFILE, SOUTH CANBERRA 53
FIGURE 22. PROJECTED AGE PROFILE, WODEN VALLEY 54
FIGURE 23. PROJECTED AGE PROFILE, ACT 54
FIGURE 24. PERCENTAGE OF DWELLINGS BY TYPE AND STRUCTURE AND HOUSEHOLD COMPOSITION - ACT 2011 56

LIST OF TABLES

TABLE 1. POPULATION TRENDS AND PROJECTIONS 16
TABLE 2. STAGES OF DEVELOPMENT (ASSUMING POPULATION TO REACH 3,200) 17
TABLE 3. ESTIMATED POPULATION BY DWELLING TYPE 17
TABLE 4. PROJECTED POPULATION FOR CB + E PRECINCT 18
TABLE 5. TYPES OF COMMUNITY FACILITIES 19
TABLE 6. PLACE OF BIRTH 48
TABLE 7. POPULATION AND DWELLINGS BY AREA 49
TABLE 8. EMPLOYMENT BY INDUSTRY - YARRALUMLA, DEAKIN AND ACT 51
TABLE 9. PROPORTIONS OF PERSONS BY DWELLING STRUCTURE AND AGE, ACT 2011 55
TABLE 10. STAKEHOLDER ENGAGEMENT UNDERTAKEN AS PART OF CB+E COMMUNITY NEEDS ASSESSMENT 57
TABLE 11. COMMUNITY FACILITY GUIDELINES 60
TABLE 12. HEALTH AND AGED CARE GUIDELINES 60

TABLE 13. EDUCATION AND CHILD CARE GUIDELINES 61
TABLE 14. EMERGENCY SERVICES AND PUBLIC SAFETY GUIDELINES 61

EXECUTIVE SUMMARY

Context

The Canberra Brickworks and Environs (CB + E) precinct is located in the suburb of Yarralumla, South Canberra, within 10 kilometres from the Canberra city centre. It also includes a portion of land on the southern side of Adelaide Avenue that is currently part of Deakin.

The proposed CB + E precinct can accommodate 1,800 dwellings and a population of around 3,100 persons. The development will also include a commercial areas distributed across the site which will include some local retail and services for residents.

The scope of this community needs assessment includes an analysis of the following:

- existing community facilities and services;
- the accessibility to current facilities and services within a reasonable distance from the suburb of Yarralumla;
- what community facilities and services (including retail) a future Yarralumla suburb of approximately 6,000 persons would require; and
- what new facilities and services required for the Yarralumla community of 6,000 persons would best be located within the new CB + E development.

Current and Future Population

Current demographic profile and projections for Yarralumla indicate that:

- the population of the existing suburb of Yarralumla reached a recent peak of around 3,300 residents, but is expected to fall to around 3,100 persons by 2021;
- 30% of the Yarralumla population is currently aged over 60 years;
- in comparison with the rest of the ACT, a smaller proportion of current Yarralumla residents are aged between 30 and 44 years; and
- in line with current projections for South Canberra, the population of the existing suburb of Yarralumla is expected to see significant growth in the proportion of residents aged between 65 and 79 years.

A projected demographic profile of people living in the CB +E precinct has been prepared, using information on occupants of different dwelling types from the 2011 Census. A majority of the new residents in the new CB + E precinct are expected to be aged between 20 to 59 years.

As well as doubling the current population of Yarralumla, the new development is thus likely to significantly change the demographic profile of the suburb, with a substantial increase in the number of younger adult residents.

Community Facility Needs and Provision

Different community facilities and services are required to service local, district and regional populations. Larger facilities address demand at district and regional levels, including more specialised facilities.

While some social infrastructure facilities and services are already established in Yarralumla, many facilities and services accessible to current Yarralumla residents (and likely to be accessible to new residents of the CB + E precinct) are also available in Deakin, Hughes, Curtin, Woden, Manuka, Parkes, Barton and Civic.

Local and District Shops

There is an existing local shopping centre in Yarralumla that includes a range of facilities and services including a supermarket, a newsagent, bakery, chemist, gift shop, dry cleaner, restaurants, cafes and professional offices. There are similar local shopping centres in Deakin and Hughes.

The shopping centre at Curtin is a larger Group Centre designed to serve a district catchment. It includes a larger supermarket, a post office agency, a newsagent, chemist, baker, gym, community bank, medical and dental services, a chiropractic centre, an optical centre, a real estate agent, a vet and a TAB outlet as well as cafes and restaurants.

The Westfield Woden Shopping Centre is the closest major shopping facility to the proposed new development at Yarralumla.

Community Facilities

This report identifies a wide range of community facilities and services generally provided at the local or district level, and assesses the need for additional services to meet the needs of the increased population associated with the CB + E precinct. The facilities and services include:

- community halls and youth facilities;
- health facilities and services;
- aged care services;
- schools;
- child care and children's services;
- places of worship; and
- emergency services.

Findings and Recommendations

The findings and recommendations in the report are summarised as follows:

Retail and commercial facilities

– Provision should be made for new small-scale local shops (around 650 sq metres GFA) in the CB + E precinct on the northern side of Cotter Road as part of a commercial mixed use facility. This should ideally be located close to the main access point off Cotter Road.

- Provision could also be made for a coffee shop/mini mart located in the south-eastern corner of the new development closest to the Adelaide Avenue bus interchange, on the Yarralumla or Deakin side of Adelaide Avenue.

- Additional space for medical and allied health services could be provided as part of the commercial development proposed on the Deakin side of Adelaide Avenue. Timing of provision would need to take into account the extent of office vacancies in the adjacent professional office and peak association precinct.

- As part of the refurbishment of the Canberra Brickworks Complex, there is also likely to be scope for adjunct facilities such as a coffee shop, bar, entertainment venue or small-scale conference venue.

Community meeting spaces and youth facilities

- For an additional population of around 3,100 associated with the CB + E precinct, the specific provision of an additional community hall or youth facility is not considered to be justified.

Clubs and recreation facilities

- The inclusion of privately-owned gym (and possibly also swimming pool) facilities as part of mixed use commercial and residential sites within the CB + E precinct is likely to be financially viable. There may also be potential to include additional recreation facilities as part of the redevelopment of the Canberra Brickworks Complex. Given that the population profile of the new development area is likely to include a relatively high proportion of young adults, the attractiveness of the area for potential new residents could be improved by the addition of outdoor exercise equipment in public spaces, such as the proposed Denman Street Park.

Health facilities and services

- Existing GP and allied health services in Yarralumla and Deakin could provide services to the additional population generated by the CB + E precinct.

- There is likely to be scope for additional services to be provided in mixed use or commercial precincts on both sides of Adelaide Avenue. These additional facilities could also provide services to residents of areas outside of Yarralumla and Deakin.

Aged care facilities and services

- The suburb of Yarralumla could generate a need for around 44 residential aged care places by 2027. This demand could potentially be accommodated in one of the existing residential aged care facilities in Deakin, Hughes or Curtin.

Education facilities

- The provision of an additional Government school in the new CB + E precinct is not recommended, as current schools in Yarralumla and surrounding suburbs should be able to cater for the increased number of students generated by the new development.

Child care facilities

- The population of the CB + E precinct is not itself likely to generate enough demand for a new child care facility.

- An additional childcare centre in the CB + E precinct could be attractive for parents from surrounding areas, including the new development at Molonglo.

Places of Worship and religious-associated use.

- The provision of sites for additional facilities as part of the CB + E precinct is not considered necessary.

Emergency Services

- The current ACT Emergency Services Upgrade and Relocations Strategy has taken into account the general increase in population proposed for areas within 10 km of the Canberra City Centre, which would include areas such as the new CB + E precinct. Provision for additional facilities is therefore not considered necessary.

Timing of Provision

- It would be desirable to provide some convenience retail facilities as soon as the population is large enough to make the facilities viable. This is likely to be associated with Stage 2 of the development. The viability of a small scale convenience shop at this time is also likely to be improved by patronage from construction workers.

- Other community facilities, such as medical services and child care, would be subject to the interest of service providers and could be included when the other elements of associated mixed use developments are constructed. This may not be until the late in the development timeframe. The provision of child care services in the midst of construction activities, however, would not generally be desirable.

1 INTRODUCTION

1.1. Project objective

This report has been prepared for the Land Development Agency (LDA). The LDA is seeking an assessment of the impact of the proposed Canberra Brickworks and Environs (CB +E) precinct on local community facilities and services, and an assessment of what new facilities and services would best be located within the proposed CB + E precinct.

1.2. Canberra Brickworks and Environs site

The CB + E precinct is located in the suburb of Yarralumla, South Canberra, within 10 kilometres from the Canberra city centre. Yarralumla covers an area of around nine square kilometres and accommodates a large proportion of open space, including Weston and Stirling Parks and the Royal Canberra Golf Club, as well as Government House and a number of international embassies.

The CB + E precinct is bounded by the suburban edge of Yarralumla to the east, Deakin to the southeast, Cotter Road to the south and the Royal Canberra Golf Club to the north and west (see Figure 1).

The CB + E precinct incorporates a portion of land on the southern side of Adelaide Avenue that is currently part of Deakin. Most of the land is on the northern side of Adelaide Avenue in Yarralumla and includes the heritage-listed Yarralumla Brickworks, located in the north-western corner of the site, and the land situated between Denman Street, Dudley Street, Dunrossil Drive and Cotter Road.

The development of the CB + E precinct will be guided by the revised *Canberra Brickworks and Environs Planning and Development Strategy* (the Strategy) of 2015.

1.3 The Canberra Brickworks and Environs Planning and Development Strategy

The LDA has advised that the proposed redevelopment of the CB + E precinct can accommodate 1,800 dwellings and a population of around 3,100. The redevelopment will also include commercial areas which will provide some local retail and services for residents.

Key principles of the *Strategy* include:

- an inclusive community;
- transit oriented design;
- walkable streets and a well-connected pedestrian network;
- sustainability;
- a variety of housing types, scales and forms to suit the diverse demographic of inner Canberra;
- heritage conservation; and
- the provision of a high-quality public domain, including a mix of urban and natural landscapes.

FIGURE 1. CANBERRA BRICKWORKS AND ENVIRONS PRECINCT

1.4 Community Needs Assessment scope

The scope of this community needs assessment includes an analysis of the following:

- existing community facilities and services;
- the accessibility to current facilities and services within a reasonable distance from the suburb of Yarralumla;
- what community facilities and services (including retail) a future Yarralumla suburb of approximately 6,000 persons would require; and
- what new facilities and services required for the Yarralumla community of approx. 6,000 persons would best be located within the new CB + E precinct.

2 BACKGROUND

2.1 Planning context

The Territory Plan

The Territory Plan is the key statutory planning document in the ACT providing the policy framework for the administration of planning. The purpose of the Territory Plan is to manage land use change and development in a manner consistent with strategic directions set by the ACT Government. The Territory Plan includes broad principles and policies that guide development, through specific land use objectives and policies.

The current planning framework for the ACT includes a hierarchy of centres with each town having a centre as a focal point for higher order retail functions, commercial services, offices and community facilities. The hierarchy of centres can be described as a 'nested hierarchy', and includes:

- Civic/Canberra CBD;
- Town Centres;
- Group Centres; and
- Local Centres.

Within the ACT there are currently established Town Centres at Woden, Belconnen and Tuggeranong, as well as the Gungahlin Town Centre which is still growing as its population catchment increases. The Town Centres of Tuggeranong and Belconnen both provided for populations of around 90,000 in 2011. The combined populations of Woden Valley, Weston Creek and South Canberra were also in the order of 90,000 in 2011, providing a similar population catchment for the Woden Town Centre.

Town Centres provide the main focus for the district population for shopping, community and cultural facilities, entertainment and recreation. The nearest Town Centre to the CB + E precinct is the Woden Town Centre. Many residents of Yarralumla are also likely to access the Canberra CBD for facilities otherwise provided in Town Centres.

Group Centres in the ACT provide a wide range of retail, business, community, and recreation services. The dominant role of Group Centres is the provision of major food retailing serving nearby suburbs. The population catchment for Group Centres would generally be in the order of 15,000 – 25,000 people. The nearest Group Centre to the CB + E precinct is the Curtin Group Centre. Many current Yarralumla residents may also choose to access Group Centre facilities at Manuka.

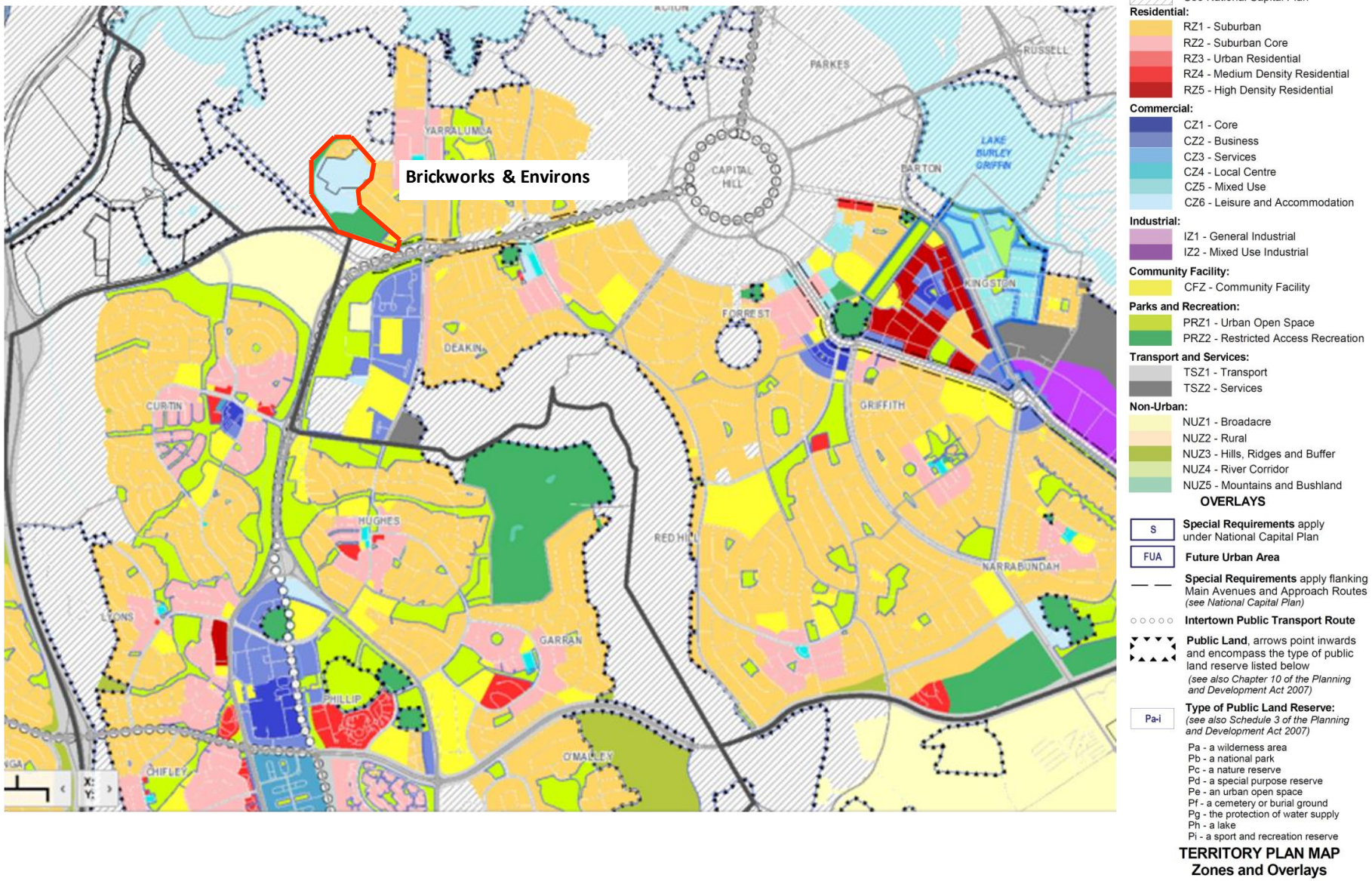
Local Centres provide for convenience shopping, community and business services to meet the daily needs of the local population. Unless otherwise specified, the ACT Territory Plan provides for a maximum height of 2 storeys for development in local centres.[1] The population catchments for Local Centres would generally be in the order of 3,000 – 10,000 people. The nearest Local Centre to the CB+ E precinct is the Yarralumla Local Shops.

The Territory Plan includes a description of the different land use zones and provides for the inclusion of different activities and structures in different zones. Current zoning for the CB + E site includes RZ1 Suburban; CZ6 Leisure and Accommodation; PRZ1 Urban Open Space and PRZ2 Restricted Access Recreation Zone.

Figure 2 shows the Territory Plan for the area around Yarralumla, including land use zones and overlays.

[1] ACT Territory Plan Part B2D.

FIGURE 2. TERRITORY MAP PLANS AND OVERLAYS



Community facilities provide spaces for residents, local workers and students to meet, participate in activities and programs, and for community services provision. Community services include schools, libraries, emergency services, police, health care, cultural activities and religious services. The benefits of public open space and community facilities can include economic benefits such as investment attraction and an increase in property prices due to improved amenity.

While many community facilities are provided by governments some will also be provided by the private or not-for-profit sectors. These may include schools, churches, health services and gymnasiums. In planning for new development, there will be a need to allow for land or buildings that can accommodate these services.

As shown in Figure 2, some land is specifically set aside for community facilities and is designated as **CFZ Community Facility Zone land**. Community Facility Zone objectives are as follows:

- To facilitate social sustainability and inclusion through providing accessible sites for key government and non-government facilities and services for individuals, families and communities.
- To provide accessible sites for civic life and allow community organisations to meet the needs of the Territory's various forms of community.
- To protect these social and community uses from competition from other uses.
- To enable the efficient use of land through facilitating the co-location, and multi-use of community facilities, generally near public transport routes and convenience services appropriate to the use.
- To encourage adaptable and affordable housing for persons in need of residential support or care.
- To safeguard the amenity of surrounding residential areas against unacceptable adverse impacts including from traffic, parking, noise or loss of privacy.

Across all of the developed area of the ACT, an average of around 2.22% of all land is currently zoned as CFZ Community Facility Land. This varies by District with around 2.87% in Canberra Central and 2.91% in Woden Valley.[2]

The Community Facility Development Code provides planning guidance for the provision of community facilities. The objectives of this Code are:

- To protect and enhance social amenity for all ACT residents and visitors. Social amenity includes access to services, safety and equity in the distribution of facilities.
- To maximise efficient land use, accessibility and convenience for uses through clustering related facilities and encouraging shared use.
- To protect and enhance residential amenity for ACT residents whilst meeting the need to provide access to facilities best located in the residential area.

Many community facilities, however, can also be located in other land use zones such as Residential Zones and Commercial Zones. Under the *Strategy* it is currently proposed to incorporate community facilities as part of mixed-use developments within the CB + E precinct.

ACT Planning Strategy (2012)

The ACT Planning Strategy (2012) provides long-term planning policy and goals to promote orderly and sustainable development, consistent with the social, environmental and economic aspirations of the people. The ACT Planning Strategy recognises the value of the metropolitan structure and seeks to build on this foundation by establishing a more compact, sustainable city that uses its resources and infrastructure more efficiently.

The ACT Planning Strategy proposes development and urban intensification around Civic, Town and Group Centres as well as inter-town rapid transit corridors. The CB + E precinct incorporates the inter-town rapid transit corridor of Adelaide Avenue.

[2] ESDD, April 2012.

The ACT Planning Strategy emphasises the importance of access to a range of community, sport and recreation facilities and services for all Canberra residents. It identifies the need to ensure everyone has access to a range of community facilities, services and opportunities for social interaction by reinforcing the role of group and local centres as community hubs. Specific actions include addressing the needs of people in greenfields estates and urban intensification areas, and identifying opportunities for mixed use developments to incorporate community facilities.

Additional information on other legislation and policies relevant to this community needs assessment can be found in **Appendix A**.

3 SOCIAL INFRASTRUCTURE DEMAND AND SUPPLY

3.1 Factors impacting on demand for social infrastructure

Current demographic profile and projections

Table 1 shows recent population growth and projections for Yarralumla, South Canberra, Woden Valley and for the ACT as a whole. Between 2001 and 2011 Yarralumla grew by an additional 250 residents, equating to an average annual growth rate of 0.8 per cent. This was higher than the growth experienced in Woden Valley, but about half the rate of growth for South Canberra and the ACT as a whole.

Future population growth across all areas is projected to be slower than in previous years. Yarralumla and Woden Valley are both projected to experience a decrease in population, while South Canberra and the ACT will experience 1.1 per cent and 1.3 per cent annual growth respectively.

TABLE 1. POPULATION TRENDS AND PROJECTIONS

	2001	2006	2011	2016	2021	AAGR 2001-11	AAGR 2011-21
Yarralumla	3,000	3,000	3,250	3,200	3,100	0.8%	-0.5%
South Canberra	23,300	24,700	27,450	29,200	30,600	1.7%	1.1%
Woden Valley	32,500	33,100	34,200	33,650	33,650	0.5%	-0.2%
ACT	319,350	334,100	363,850	390,600	414,400	1.3%	1.3%

Source: ACT Population Projections by Suburb and Districts: 2009 to 2021 and SGS calculations.

A detailed analysis of the current demographic profile and projections for Yarralumla is included in **Appendix B**. Key points are:

- The population of Yarralumla has reached peak levels of around 3,300 residents, and the population of the existing Yarralumla suburb is expected to decline gradually to reach around 3,100 persons by 2021;
- 30% of the Yarralumla population is currently aged over 60 years;
- In comparison with the rest of the ACT, a smaller proportion of Yarralumla residents are aged between 30 and 44 years; and
- In line with current projections for South Canberra, the population of the existing suburb of Yarralumla is expected to see significant growth in the proportion of residents aged between 65 and 79 years.

The changing age profile of the suburb will impact on demand for different types of facilities and services.

Profile for the Canberra Brickworks and Environs Precinct

As noted elsewhere in this report, the CB +E precinct is expected to include 1,800 dwellings and a population of around 3,100 persons.

To assess the potential needs for the CB + E precinct, SGS has prepared a demographic profile of people living in medium and higher density housing using information from the 2011 Census. We have then used this analysis to identify the likely characteristics of the future population of the CB +E precinct.

Advice from LDA is that these dwellings are likely to be provided in three stages. SGS has estimated the likely impact of 1,880 dwellings and an overall population increase of 3,100, using information provided by the LDA on proposed development stages. The impact is shown in Table 2.

TABLE 2. STAGES OF DEVELOPMENT (ASSUMING POPULATION TO REACH 3,100)

Stage	Dwellings	Increase in Population	Cumulative increase in Population
1	419	734	734
2	1022	1673	2407
3	439	693	3100
Total	**1,880**	**3100**	

Table 3 provides information on the average number of people per household for different dwelling types. The information in this table is consistent with the information used for the planning of a similar large-scale urban intensification project at East Lake. The breakdown of dwellings by different dwelling types is indicative only, but illustrates a potential dwelling mix that would deliver 1,880 dwellings and a population of 3,100.

TABLE 3. ESTIMATED POPULATION BY DWELLING TYPE

Type of Dwelling	Bedrooms	Occupancy	Dwellings	Population
Apartment	1	1.4	800	1120
Apartment	2	1.7	500	850
Apartment	3	2.2	138	304
Apartment	4	3	62	186
Mews/Terrace/TH	2	2	100	200
Mews/Terrace/TH	3	2.2	200	440
Total			**1800**	**3100**

Source: ABS Census of Population and Dwellings 2011, and SGS Economics and Planning calculations (consistent with information in report prepared for development of East Lake).

Using information from Table 3 and from the 2011 Census on the age profile of people in different dwelling types, SGS has prepared the following age profile of the likely future population of the CB + E precinct.

TABLE 4. PROJECTED POPULATION FOR CB + E PRECINCT

Population	Pop in terrace houses/mews	Pop in 4+ storey flats	Tot pop by age
0-4 years	43	67	110
5-9 years	31	28	58
10-14 years	25	22	47
15-19 years	31	52	83
20-24 years	79	383	462
25-29 years	94	634	728
30-34 years	73	371	444
35-39 years	54	201	255
40-44 years	45	125	170
45-49 years	38	110	149
50-54 years	35	120	155
55-59 years	29	109	137
60-64 years	27	91	118
65-69 years	16	44	59
70-74 years	9	31	40
75-79 years	6	25	31
80-84 years	4	29	33
85-89 years	3	14	17
90-94 years	1	4	5
95-99 years	0	1	1
100 years+	0	0	0
Total	**640**	**2460**	**3100**

As can be seen in Table 4, a majority of the new residents are expected to be aged between 20 to 59 years.

The new CB + E precinct will therefore double the current population of around 3,300 Yarralumla residents as well as potentially introduce a younger demographic living in the suburb.

More detailed information explaining how these figures have been derived is included in **Appendix B**.

3.2 Hierarchy of social infrastructure provision

Provision of social infrastructure is generally determined via a broad hierarchy, with different facilities required to service local, district and regional populations. The different levels of community facility provision ensure that local needs will be met, while larger facilities address demand at district and regional levels, including more specialised facilities (i.e. a range of library services, or complete theatre requirements). For residents living nearby, most district and regional facilities can also serve a local function. There can also be advantages in co-locating or coordinating the location of facilities and services. These co-location and coordination arrangements such as recreation, retail and commercial services need to take into account population catchments and hierarchies.

The catchments from which users of different community facilities are drawn vary. The size and shape of catchments are influenced by a number of factors including:

- the frequency of visits that users make to the facility;
- the number of users in the geographic catchment;
- urban form and transport systems in the region and catchment (and the ability of users to travel);
- the provision of similar and competing facilities in the region;
- provision policies of government agencies; and
- economies of scale – the differential costs of providing fully equipped smaller facilities compared with one or few fully equipped larger facilities.

The following table lists the types of community facilities included in this assessment and the catchment for each.

TABLE 5. TYPES OF COMMUNITY FACILITIES

Facility Type	Catchment
Retail	
Retail Services	Local, District
Community meeting spaces	
Community Halls	Local
Health Facilities	
GP Clinics	Local, District
Dentists	Local, District
Allied Health Services	Local, District
Residential Aged Care facilities	District
Education Facilities	
Primary Schools	Local
Secondary Schools	District
Child care facilities	Local, District
Religious facilities	
Places of Worship	Local, District
Emergency Services	
Ambulance	District
Fire	District
Police	District

Source: SGS Economics and Planning

3.3 Changes to social infrastructure provision over time

Most Canberra suburbs developed as part of greenfield estates have included a local centre, often adjacent to a public primary school and playing fields. In Belconnen and Tuggeranong a public high school, a Group Centre and District Playing Fields would often have been provided for each four to six suburbs. Over time, however, the populations of some suburbs and districts declined with some schools closing and some shops in local centres no longer viable. Some of the newer suburbs in these districts, such as Bruce and McKellar, were developed without public primary schools. Some local shopping centres, such as Latham, were also redeveloped for residential use.

The development of higher density housing in some areas has also been accompanied by planning requirements for non-residential use in ground floor units. This has meant that small scale commercial offices, community services and convenience food outlets, which may previously have been located in low-rise local centres, are now located on the ground floor of medium or high rise residential and commercial developments.

3.4 Social infrastructure access for Yarralumla residents

While some social infrastructure facilities and services are already established in Yarralumla, many facilities and services accessible to current Yarralumla residents are in Deakin, Hughes, Curtin, Woden, Manuka, Parkes, Barton and Civic. These existing facilities include:

- Aged persons accommodation;
- Arts and culture facilities;
- Libraries;
- Community activity centres and halls;
- Child care services including long day care and before/after school care;
- Schools;
- Institute of Technology;

- Other Adult and community education services;
- Health and medical services;
- Social and welfare assistance services;
- Hospitality clubs;
- Churches and other religious facilities;
- Emergency service facilities;
- Sports and other outdoor recreation facilities; and
- Parks and gardens.

In assessing the need for additional facilities in the CB + E precinct, there is a need to take into account the potential for residents to access existing facilities in Yarralumla and in surrounding areas.

The study areas for the facilities and services covered in this report therefore include the suburbs of Deakin, Hughes and Curtin, and the Statistical Subdivisions of South Canberra and Woden Valley.

Appendix C includes information collected through stakeholder engagement on use of current facilities.

3.5 Social infrastructure benchmarks

At present there are no specific benchmarks for the provision of community, sport and recreation facilities in the ACT. Findings in this report have drawn on benchmarks set in New South Wales, Queensland and Victoria and on provision elsewhere in the ACT. Details are provided in **Appendix D**.

Most established benchmarks, including those in **Appendix D**, relate to development in new greenfield areas rather than infill developments, such as the CB + E precinct. Infill developments generally have a different mix of dwelling types, household composition and age profiles from those in greenfield estates. Residents in infill developments are often able to access existing services in surrounding areas, some of which may be underutilised as a result of demographic changes over time.

3.6 Social infrastructure provision in comparable suburbs

Along with benchmarks adopted for the provision of social infrastructure in other jurisdictions, a comparison with other ACT suburbs with a similar population is also useful to determine what community facilities and services (including retail services) an expanded suburb of Yarralumla with a population of around 6,000 is likely to require.

The suburbs of Bruce, Watson and Lyneham have been chosen for comparison purposes. These suburbs all include elements of infill development, and are similar distances to Yarralumla from the Canberra City Centre. Their populations are around 8,000, 7,000 and 5,000 respectively. Information on the community and retail facilities in these suburbs is included in **Appendix D**.

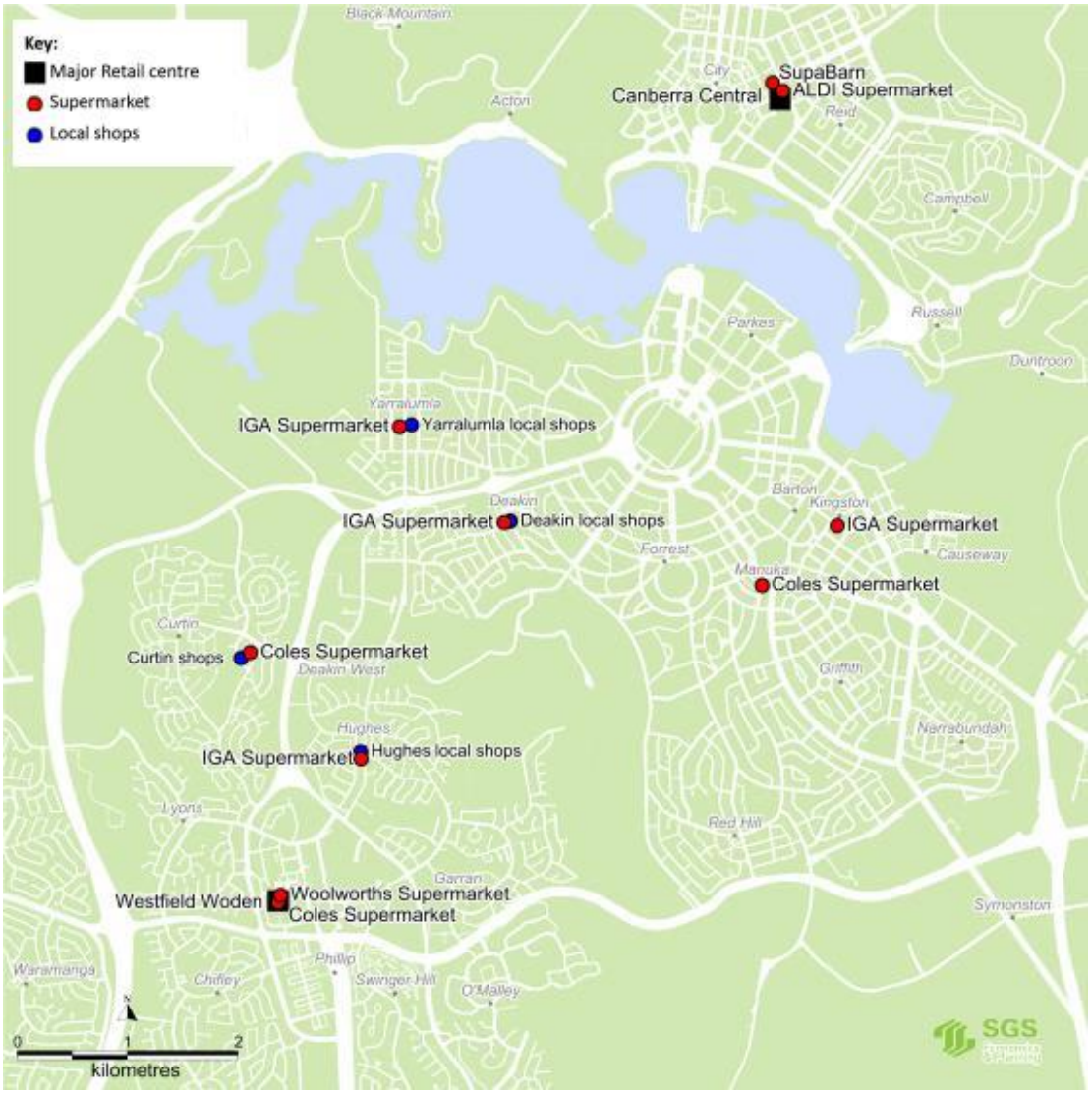
3.7 Retail and associated facilities in and near Yarralumla

Current supply and demand

As shown in Figure 3, there is an existing local shopping centre in Yarralumla on the corner of Bentham and Novar Streets. This local shopping centre includes a range of facilities and services including an IGA supermarket, a newsagent, bakery, chemist, gift shop, dry cleaner, restaurants, cafes and professional offices. The shops are generally fully tenanted, and vacant parking spaces adjacent to the shops are limited at peak times. A café and plant nursery are also located in Weston Park, Yarralumla. Current retail floorspace (GFA) at the local shops in Yarralumla is around 1,430 sq metres.

Local shopping centres in the suburbs of Deakin and Hughes provide a range of similar services and facilities to those provided at the Yarralumla shops, and also appear to be well patronised and to have minimal vacant tenancies. There is also a café and hairdresser at Geils Court in Deakin, and a café and bar on Kent Street close to the John James Hospital. The retail floorspace (GFA) at the Deakin local shops is around 1,550 sq metres, and at the Hughes local shops is around 1,400 sq metres.

FIGURE 3. RETAIL FACILITIES



The shopping centre at Curtin is a larger group centre designed to serve a district catchment. It includes a Coles Supermarket, a post office agency, a newsagent, chemist, baker, gym, community bank, medical

and dental services, a chiropractic centre, an optical centre, a real estate agent, a vet and a TAB outlet as well as cafes and restaurants. There are some vacant shops at this centre, so there would be some capacity to accommodate increased demand. Parking is generally available in a number of car parks adjacent to the shops. The retail floorspace (GFA) at the Curtin Group Centre is around 4,000 sq metres.

The Westfield Woden Shopping Centre is the closest major shopping facility to the proposed new development at Yarralumla. This shopping centre would generally expect to serve the whole of the Woden Valley and would also provide some services to the residents of Weston Creek and Tuggeranong and to suburbs such as Yarralumla. There is scope for this Centre to expand to serve an increased population if required. Some Yarralumla residents may also choose to shop at Manuka or in the Canberra City Centre (Civic).

Future demand

Local shopping centres in the ACT have generally been designed to provide for convenience shopping, community and business services to meet the daily needs of the local population. Local centres were previously planned to serve population catchments in the order of 5,000 to 10,000 people. Over time, however, demographic and social changes have impacted on the viability of some local shopping centres. The population of many of the suburbs built in the 1960s, 1970s and 1980s has declined as children have grown up and left home, and the average number of people per household in these suburbs has also declined.

The hierarchy of shopping centres has also been undermined by changing shopping patterns. For all practical purposes, local shopping centres no longer operate in the suburbs of Latham (population 3,602) or Macgregor (population 5,506). In the suburbs of Aranda (population 2483), McKellar (population 2,798), Macquarie (population 2,556), Weetangera (population 2,608), Higgins (population 3,090) and Page (population 2,880) the local shops no longer include a supermarket.[3]

The viability of local shops is not just dependent upon the population of the suburb where the shops are located. Other key issues include proximity to other shopping centres, the socio-demographic profile (including income) of local residents, and the extent to which the shops can capture "passing trade" from residents of other areas.

The local shops in Yarralumla, Deakin (population 2,783) and Hughes (population 2,956), all appear to be well-patronised and commercially sustainable. All of these shops are located in a way that assists them to capture "passing trade" from people who are not local residents. They all also include an IGA supermarket. Cutting off current access to Yarralumla via Dudley Street may reduce "passing trade". Unless a supermarket the size of the current Yarralumla IGA or larger is included as part of the new development, however, any reduction in "passing trade" is likely to be offset by an increase in demand from new residents.[4]

An issue to be considered in assessing the desirability of including additional local shopping facilities in the new CB + E precinct on the northern side of Adelaide Avenue, is the extent to which CB + E residents would use these local facilities, as there is likely to be minimal through traffic to add to the resident customer base. Even when the Brickworks Complex is open for public access, the additional traffic may not be enough to make a supermarket financially viable. Positioning new local shops in the part of the CB + E precinct close to the main traffic access point from Cotter Road would provide the best option in terms of financial viability. However, it is unlikely that there would be sufficient patronage to justify a supermarket the size of current IGA supermarkets in Yarralumla, Deakin and Hughes. A more viable option would be to include a local shopping centre as part of a commercial mixed use facility of similar size to the small local shopping centre near the intersection of Thynne Street and Eardley Street in Bruce. The retail floorspace (GFA) at this Bruce local centre is around 650 sq metres and includes a small convenience supermarket, a café and hairdresser.

[3] Canberra Times, 13 January 2014 and ABS 2011 Census of Population and Dwellings.
[4] See Appendix D for additional information.

There may also be scope to provide a coffee shop/mini mart located in the south-eastern corner of the new development closest to the Adelaide Avenue bus interchange, or on the Deakin side of Adelaide Avenue. This would be convenient for people using the interchange as well as people from the established part of Yarralumla.

There is likely to be additional scope for commercial development (including space for medical and allied health services) on the Deakin side of Adelaide Avenue. Timing of provision would need to take into account the extent of office vacancies in the adjacent professional office and peak association precinct, as the proposed total increase of over 8,000 sq metres of commercial space is substantial.

As part of the refurbishment of the Canberra Brickworks Complex, there is also likely to be scope for adjunct facilities such as a coffee shop, bar, entertainment venue or small-scale conference venue.

As indicated above, there are currently some vacant shops at the Curtin Group Centre, so there would be some capacity to accommodate increased demand for the district-level retail services provided at this Centre. Adequate parking is also generally available in a number of car parks adjacent to the Curtin shops.

Recommendations

- Provision should be made for new small-scale local shops (around 650 sq metres GFA) in the CB + E precinct on the northern side of Cotter Road as part of a commercial mixed use facility. This should ideally be located close to the main access point off Cotter Road.

- Provision could also be made for a coffee shop/mini mart located in the south-eastern corner of the new development closest to the Adelaide Avenue bus stop, on the Yarralumla or Deakin side of Adelaide Avenue.

- Additional commercial development (including space for medical and allied health services) could be provided on the Deakin side of Adelaide Avenue. Timing of provision would need to take into account the extent of office vacancies in the adjacent professional office and peak association precinct.

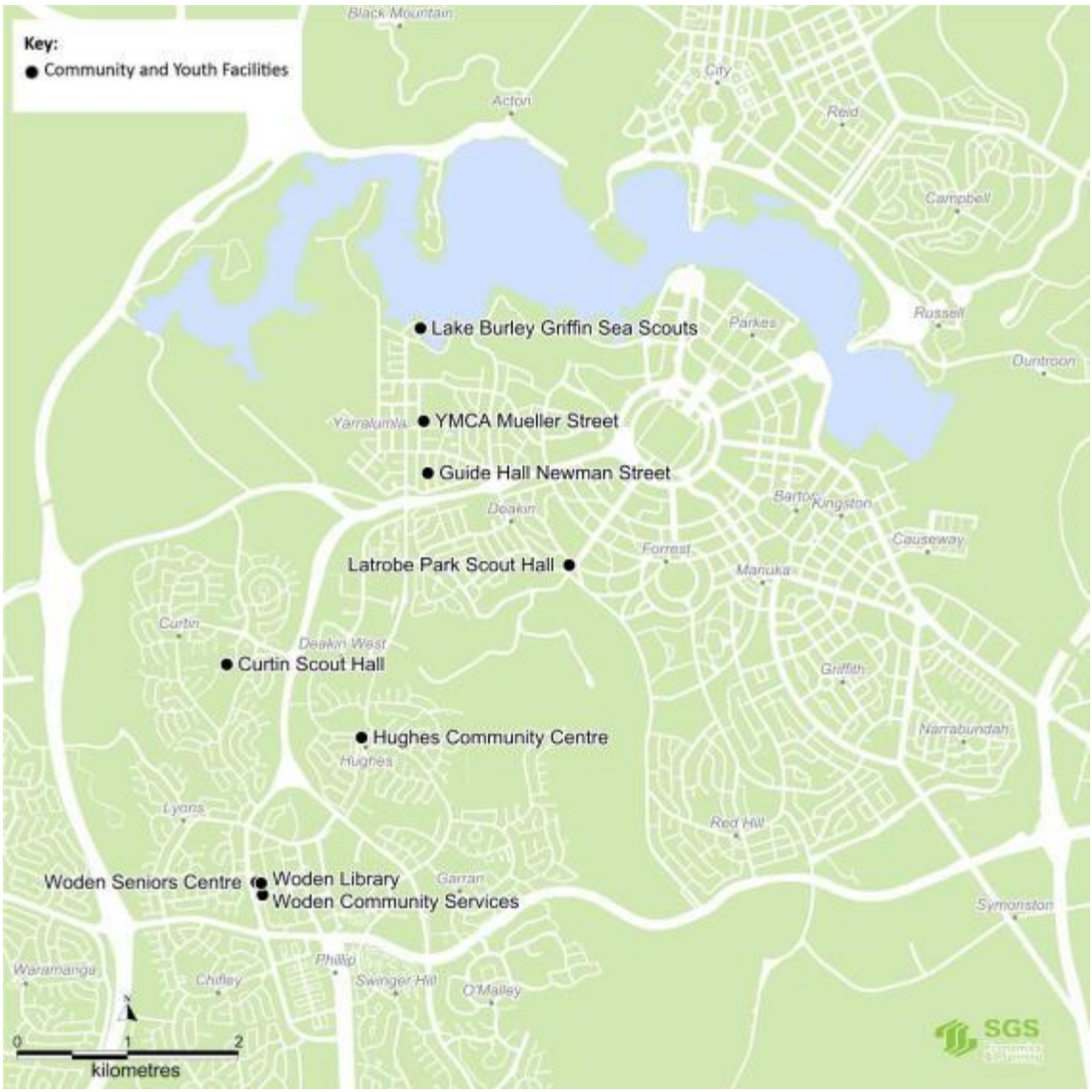
- As part of the refurbishment of the Brickworks and quarry site, there is also likely to be scope for adjunct facilities such as a coffee shop, bar, entertainment venue or small-scale conference venue.

3.8 Community services and youth facilities

Current supply and demand

Yarralumla and surrounding areas have a range of community services, meeting facilities and youth facilities. There is a community hall that is currently leased to the YMCA. There is also a guide hall and a sea scouts hall. The community hall adjacent to the Hughes local shops is managed by the Council on the Ageing, but is used for a range of community activities. Facilities at the Woden Town Centre include a library, Woden Community Services and the Woden Senior Citizens Centre.

FIGURE 4. COMMUNITY AND YOUTH FACILITIES



Future demand

As noted earlier, various benchmarks are used for the provision of community meeting spaces and youth facilities in different jurisdictions. For NSW growth areas and in Greater Geelong, the benchmarks suggest that one community hall or centre be provided for a population of 6,000 and one youth centre be provided for a population of 20,000. The benchmarks for these facilities in SE Queensland are for a slightly higher level of provision.

For a population of 6,000 in Yarralumla there are already a number of meeting places and youth service facilities. These include the community hall currently leased to the YMCA, a Sea Scout hall and a Guide

hall. There are also a number of religious facilities and schools with facilities that may be accessible as general community meeting places.

For the additional population of 3,000 - 3200 associated with the CB + E precinct, the specific provision of an additional community hall or youth facility is therefore not considered to be justified.

Additional facilities to serve district populations are also likely to have capacity to serve the expanded population generated by the new development. These facilities include a branch of the ACT Library at the Woden Town Centre, a community hub in Chifley and the Council of the Ageing meeting rooms at Hughes. Planning is currently underway to improve facilities for the Woden Seniors Centre to cater for an increase in the population of older people in the Woden, Weston Creek and Inner South areas.

Recommendation

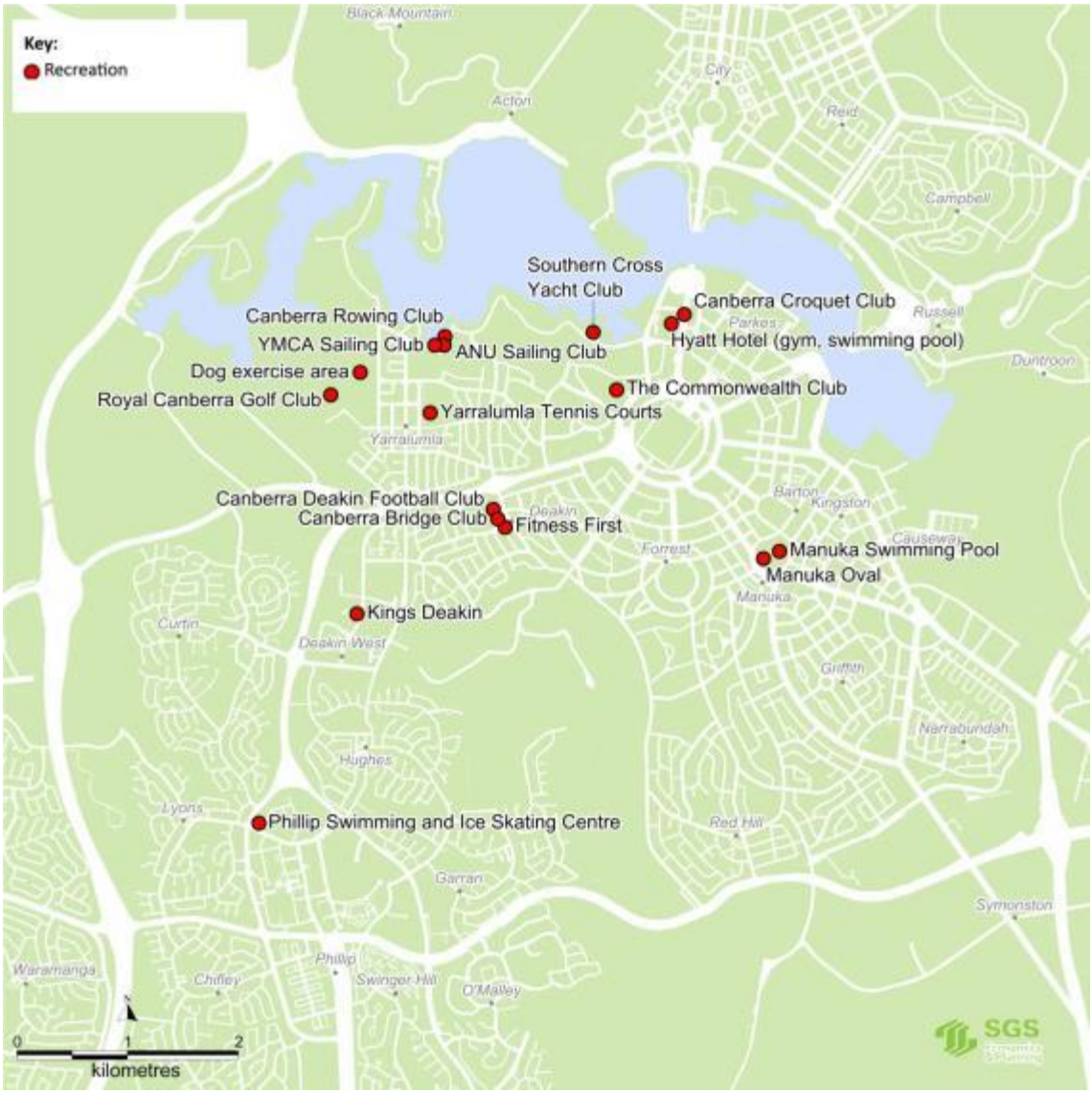
- For the additional population of 3,000 – 3,200 associated with the CB + E precinct, the specific provision of an additional community hall or youth facility is not considered to be justified.

3.9 Recreation facilities

Current supply and demand

There are a range of clubs and recreation facilities in the Yarralumla area, including golf and sailing clubs and gyms. There is a privately owned pool at Deakin (Kings Deakin), and a public pool adjacent to an ice skating rink at Woden. The location of these facilities and services are shown below.

FIGURE 5. RECREATION FACILITIES



Future demand

Residents of Yarralumla and surrounding areas generally have access to a range of clubs and recreation activities, although membership of some of these clubs and facilities may be restricted.

At the district level, the Woden and Inner South areas of the ACT do not have the same access as some other parts of Canberra to year around public-access swimming facilities such as the swimming pool complexes at Belconnen, Tuggeranong, Gungahlin and in Civic. Residents of the CB + E precinct may also be able to access the new swimming pool and gym facility proposed for Molonglo.

The inclusion of privately-owned gym (and possibly also swimming pool) facilities as part of mixed use commercial and residential sites within the CB + E precinct is likely to be financially viable. There may also be potential to include additional recreation facilities as part of the redevelopment of the Canberra Brickworks Complex. Given that the population profile of the new development area is likely to include a relatively high proportion of young adults, the attractiveness of the area for potential new residents could be improved by the addition of outdoor exercise equipment in public spaces, such as in the proposed Denman Street Park.

Recommendations

- The inclusion of privately-owned gym (and possibly also swimming pool) facilities as part of mixed use commercial and residential sites within the CB + E precinct is likely to be financially viable.

- There may also be potential to include additional recreation facilities as part of the redevelopment of the brickworks and quarry sites.

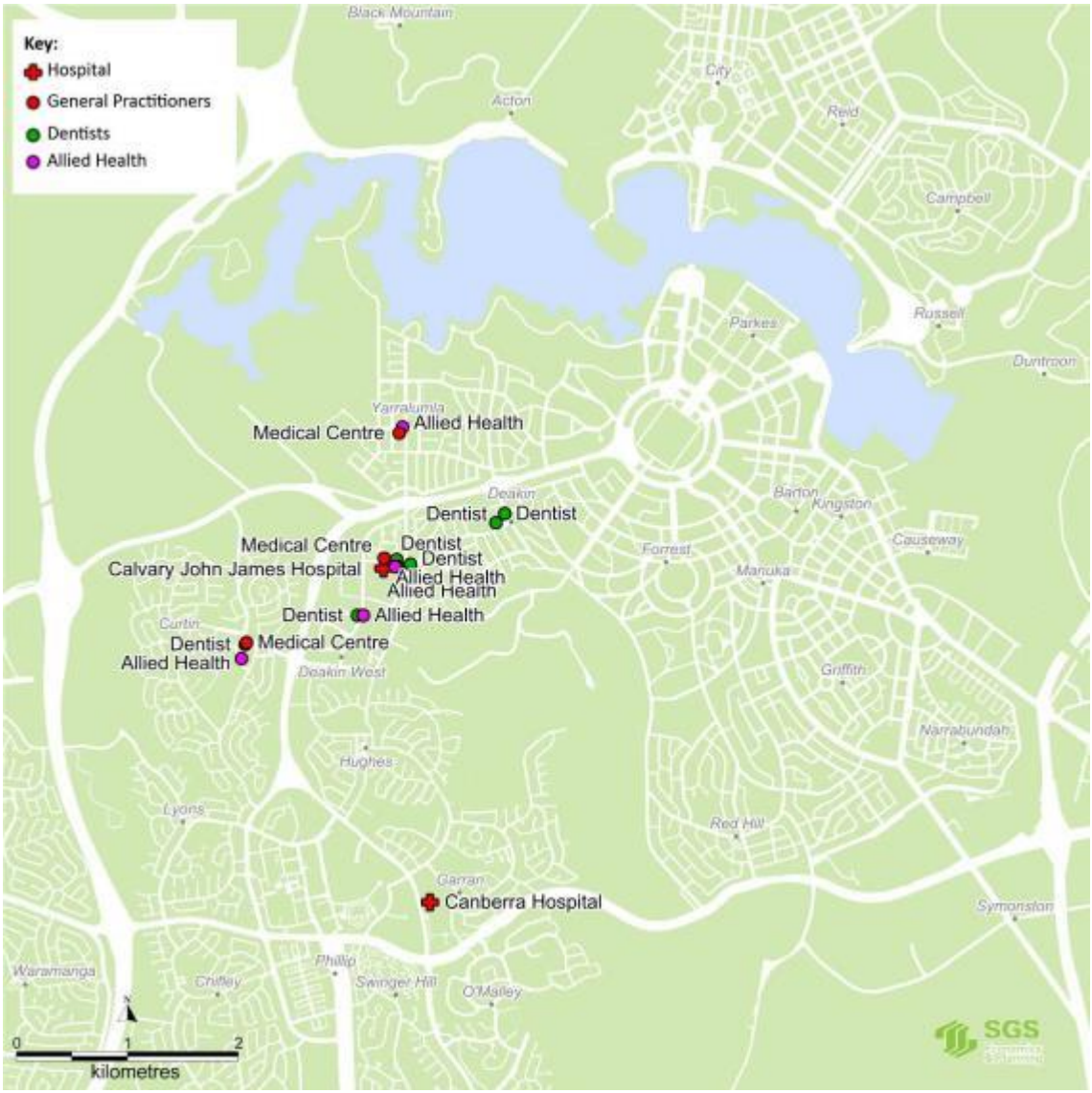
- The attractiveness of the area for potential new residents could be improved by the addition of outdoor exercise equipment in public spaces.

3.10 Health facilities and services

Current supply and demand

There is a medical centre adjacent to the Yarralumla shops, and an allied health service is also included in the Yarralumla local shop precinct. There are also many health services in Deakin, including the Calvary John James Hospital and a cluster of associated medical practitioners , specialists and allied health providers . There are additional medical and allied health services in Curtin. The Canberra Hospital in Garran serves a regional catchment.

FIGURE 6. HEALTH FACILITIES



Future demand

The information in Section 3.5 includes benchmarks for the provision of health facilities and services. These benchmarks generally suggest a need for one community health centre for each population of 20,000 people. The increased population of 3,000 – 3,200 attributable to the CB + E precinct does not of itself justify the addition of another community health centre.

Benchmarks for provision of GPs and GP Medical Centres vary. Using the Australian Government guide of 1 GP for each 1,500 people, for example, would suggest a need for two additional GPs to serve the needs of the additional population in Yarralumla. The additional population is also likely to generate a similar increase in demand for allied health services.

As shown in Figure 6, there is an existing cluster of health services and facilities around the Calvary John James Private Hospital in Deakin. There is also an existing medical centre and an allied health service provider located at the Yarralumla shops.

While it is likely that existing GP and allied health services in Yarralumla and Deakin could provide services to the additional population generated by the CB + E precinct, there is also likely to be scope for additional services to be provided in mixed use or commercial sites on both sides of Adelaide Avenue. These additional facilities could also provide services to residents of areas outside of Yarralumla and Deakin.

The ACT's *Community and Recreation Facilities Locational Guidelines* suggest that Medical Centres be located close to residential areas, and in or within 200 metres of retail centres, with provision for emergency vehicle access.

In some of Canberra's established suburbs, GP services are provided through home-based businesses in residential areas, rather than in community or commercial land use areas. However, current trends are towards larger GP centres located in community facility or commercial land use areas.

Integrated Primary and Community Care Development Plans for the NSW South West Growth Centre suggest that 330 square metres of gross floor area (GFA) be allowed for a GP clinic with 10 consultation rooms.[5]

Examples of current suburban GP medical centres in the ACT include the Kaleen Medical Centre which is located on a block with an area of 502 square metres at 149 Maribyrnong St, and the Lyneham Medical Centre, which is located on a block with an area of 505 square metres at 62 Brigalow Street, Lyneham. Both of these centres take advantage of adjacent off-site parking.

If there was a demonstrated demand for an additional stand-alone medical centre, this could possibly be provided as part of the new precinct.

Recommendations

- Existing GP and allied health services in Yarralumla and Deakin could provide services to the additional population generated by the CB + E precinct.

- There is likely to be scope for additional services to be provided in mixed use or commercial sites on both sides of Adelaide Avenue. These additional facilities could also provide services to residents of areas outside of Yarralumla and Deakin.

[5] Integrated Primary and Community Care Development Plans for the South West Growth Centre, 2012, page 91.

3.11 Aged care services

Current supply and demand

There are a range of residential and non-residential aged care services in the Yarralumla area. The location of these facilities and services are shown below.

FIGURE 7. AGED CARE SERVICES

Future demand

There are a number of aged persons accommodation facilities and services in Yarralumla, Deakin, Curtin and Hughes. As indicated in Table 5, provision for these facilities and services is generally considered from a district perspective. As the population ages, however, there is also likely to be an increasing demand for both supported and independent living units suitable for older people. As discussed in Section 3.1, the proportion of the population in all age groups over 50 is already higher in Yarralumla and Deakin than it is for the ACT as a whole. The population of older people in South Canberra, Woden and for all of the ACT is also projected to continue to increase.

Much of the funding for residential aged care and support services for older people is provided by the Federal Government. Until recently, recurrent funding for high care (nursing home) and low care (hostel) supported residential accommodation was allocated by the Federal Government in response to

applications received from service provider organisations. The general basis for allocations of funding was for 88 beds per 1,000 persons aged 70 + for this supported accommodation. Under changes applying from 1 July 2014, there will be a greater priority given to funding for Home Care Packages, and more flexible service delivery arrangements. From 1 July 2014 the distinction between funding for high care and low care residential accommodation places will also be removed.

At the time of the 2011 Census there were 376 people aged 70+ living in the suburb of Yarralumla. The information in Table 4 suggests that the new development will add an estimated 127 additional people aged 70+ to the suburb, giving a total of around 500 people aged 70+. Using the previous benchmark of 88 residential aged care places for each 1,000 people aged 70+, indicates that the suburb of Yarralumla could generate a need for around 44 residential aged care places by 2027. This demand could potentially be accommodated in one of the existing residential aged care facilities in Deakin, Hughes or Curtin.

Around 5.3% of Australians over the age of 65 years currently live in retirement villages. By 2027 when the CB + E precinct is complete, there are likely to be around 760 people aged 65+ living in Yarralumla. If 5.3% of these people are seeking retirement village accommodation, there will be a demand for around 40 retirement village places, some of which may be units shared by couples.

The most recent population projections for the ACT indicate that by 2062 around 22.5% of the ACT population is likely to be aged 65 years and over, and that 18% will be aged 70 years and over. Applying these percentages to the projected population of 6,000 for Yarralumla, suggests that there could be as many as 1,350 people aged 65 and over, and 1,080 people aged 70 years and over by 2062. This would indicate a need for around 90 supported residential aged care places (based on guidelines discussed above). Of the population aged 65+ in Yarralumla, around 150 may also seek to live in a retirement village.

In the longer term the need for additional nursing homes and retirement villages will partly depend on the needs and preferences of older people, including their preference for outreach support rather than specific older persons accommodation.

Given the relatively high value of land in Yarralumla, any aged persons accommodation is likely to be through a higher density development than is the case for many of the existing retirement villages and residential accommodation facilities in other parts of the ACT. The Goodwin Homes development at Crace could provide a model for consideration. The Crace development is in a commercial mixed use zone.

Recommendations

- The suburb of Yarralumla could generate a need for around 44 residential aged care places by 2027. This demand could potentially be accommodated in one of the existing residential aged care facilities in Deakin, Hughes or Curtin.

3.12 Schools

Current supply and demand

Access to places in Government schools is generally subject to the Priority Enrolment Area (PEA) for that school. Children residing in the PEA for a school must be accepted into that school, although special arrangements apply for some shared PEAs. Some specialist schools do not have PEAs, but have other placement criteria. As shown in Figure 8, there are a number of schools in Yarralumla and surrounding suburbs.

The PEA for the Yarralumla Primary School currently includes all of Yarralumla and part of Deakin.

High school students living in Yarralumla are currently within the PEA for the Alfred Deakin High School in Deakin. The PEA for the Alfred Deakin High School also includes Curtin, Deakin (Part of Deakin also has a shard PEA with Telopea Park High School), Garran, Hughes, Lyons and Part of Phillip.

College students (Yr 11-12) living in Yarralumla are currently within the PEA for Narrabundah College. The PEA for Narrabundah College also includes Barton, Deakin, Forrest, Fyshwick, Griffith, Harman, Kingston, Narrabundah, Oaks Estate, Parkes, Red Hill and Symonston

FIGURE 8. SCHOOLS

Future demand

Primary schools

The Yarralumla Primary School had an enrolment of 241 pupils at the end of 2014.[6] Census information suggests that there were 237 students of primary school age living in Yarralumla in 2011. However, only around 60% of these students (145 students) are likely to be attending a Government School.[7] The Priority Enrolment Area for the Yarralumla Primary School currently includes part of Deakin. Information from the 2011 Census indicated that there were around 270 students of primary school age living in Deakin. Adding 60% of these students (160) gave a potential enrolment of 305 students if all of Deakin was included in the Yarralumla Primary School Priority Enrolment Area.

The information in Table 4 indicates that there could be an additional 82 children of primary school age in the new CB + E precinct. If 60% of these students sought to attend Yarralumla Primary School, the current school enrolment could be increased by around 50 students to give a total enrolment of around 300 students. These additional students could be accommodated at the Yarralumla Primary School, with a reduction in the enrolment of children living outside the Yarralumla area if necessary. The Government Primary Schools in close-by suburbs of Hughes and Garran had 321 students and 525 students respectively in 2014.[8]

High schools and secondary colleges

Students living in Yarralumla currently have priority access to the Alfred Deakin High School in Deakin for Years 7-10 education and to Narrabundah College for Years 11 -12 education. As well as Yarralumla, the Priority Enrolment Area (PEA) for Alfred Deakin High School includes the suburbs of Curtin, Deakin (Part of Deakin has a shared PEA with Telopea Park High School), Garran, Hughes, Lyons, Yarralumla and Part of Phillip.

Alfred Deakin High School had an enrolment of 783 students in 2014.[9] As indicated in Table 4, the new CB + E precinct is likely to generate around 65 additional students of high school age, around 40 of whom are likely to seek to attend a Government high school. These additional students could be accommodated at Alfred Deakin High School, with amendments to the PEA boundaries if necessary.

Narrabundah College has an enrolment of 928 students in 2014[10]. Table 4 shows that the new CB + E precinct is likely to generate around 42 additional students of Yr 11-12 school age, around 25 of whom are likely to seek to attend a Government secondary college. These students could be accommodated at either Narrabundah College or at the Canberra College (Woden Campus).

Recommendation

- The provision of an additional Government school in the new CB + E precinct is not recommended, as current schools in Yarralumla and surrounding suburbs should be able to cater for the increased number of students generated by the new development.

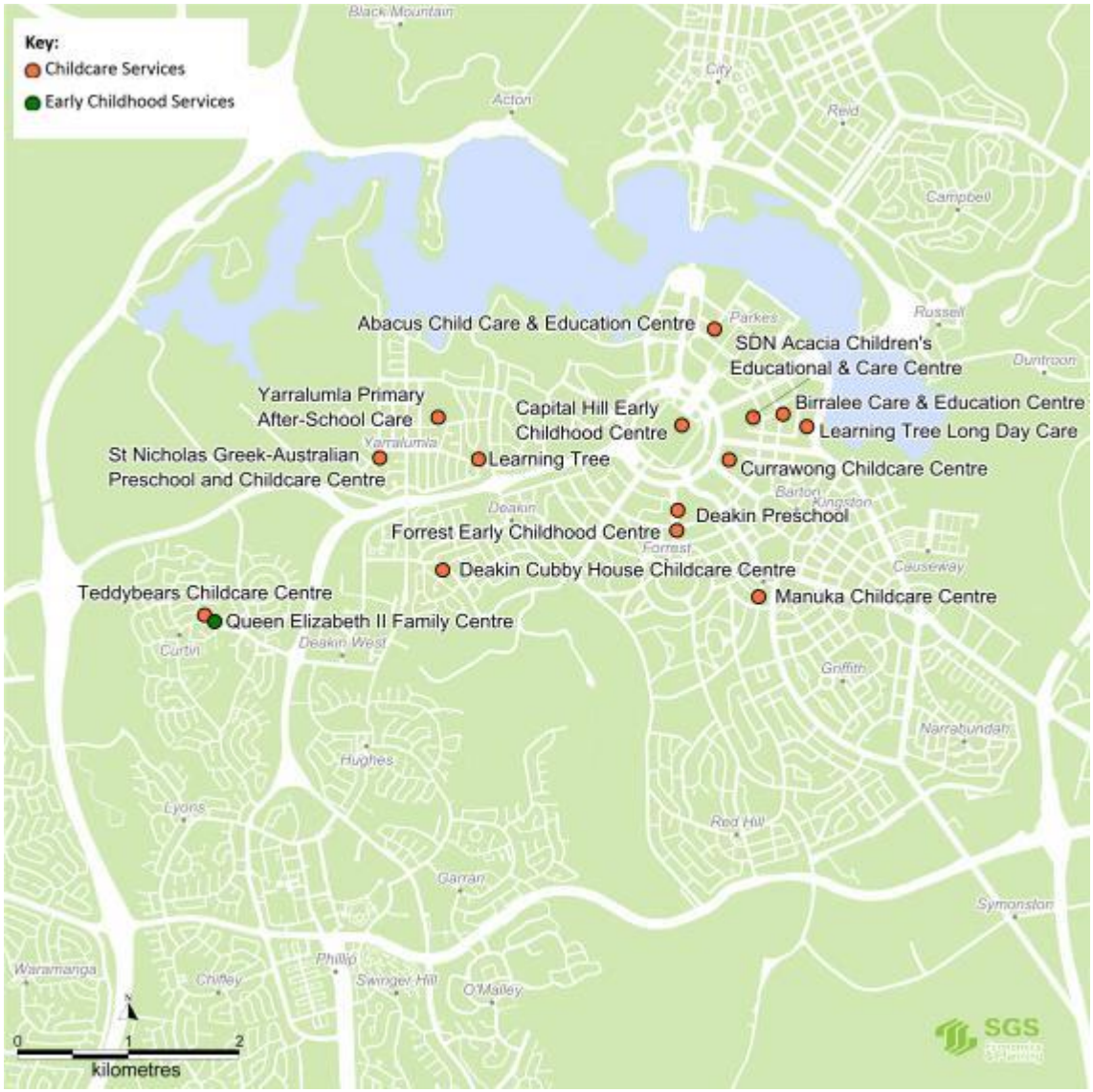
[6] Myschool website., 2014
[7] In 2013, 57% of all full time school students in the ACT attended a Government school. Source: ABS Cat. No 4221.0, page 18.
[8] Myschool website, 2014
[9] Myschoolwebsite , 2014
[10] Myschoolwebsite, 2014.

3.13 Child care and children's services

Current supply and demand

There are a range of child care services in the Yarralumla area, including several services in the suburb of Yarralumla. The Queen Elizabeth II Family Centre, located in the adjacent suburb of Curtin, also provides support services for mothers and babies. The location of these facilities and services are shown below.

FIGURE 9. CHILD CARE AND CHILDREN'S SERVICES



Future demand

At the time of the 2011 Census there were 123 children aged 0-4 years old living in Yarralumla. The information in Table 4 indicates that there could be an additional 110 children in the 0-4 age group in the new CB + E precinct. If the benchmark used for NSW Growth Centres (1 long day care place for each 5 children) is applied, then the CB + E precinct is likely to generate a need for around 22 additional long day care places. However, given the relatively high female participation rate in the ACT, the need for additional child care places is likely to exceed this.

Many of the more recently developed long day care centres in the ACT can accommodate 100-120 children at one time, while some of the older centres accommodate less than 50 children.

While the population of the CB + E precinct may not itself likely generate enough demand for a new child care facility, the location of the CB + E precinct between where people live and where they work is likely to mean that an additional childcare centre in this location would be attractive for parents from surrounding areas, including the new development at Molonglo. As indicated in **Appendix C**, most long day care facilities in the Yarralumla and Deakin areas are currently full.

Provision of a site for an additional long day care centre where there is good access to the intertown public transport network could also encourage use of public transport for at least part of the journey to work for some parents.

The ACT's Community and Recreation Facilities Locational Guidelines suggest that long day care facilities:

- be located on major journey to work routes, or have easy vehicle access near major work places;
- be separated from correctional facilities, industrial areas, roads with high traffic volumes and safety hazards such as bodies of water; and
- be co-located with pre-schools or primary schools or with occasional care services if practical.

The size of the parcel of land needed for a long day child care facility will depend to some extent on the number of child care places to be included and the potential for sharing of land for parking, etc. The Harrison Early Childhood Centre, for example, is located on a block of land with an area of 2,400 square metres.

In addition to long day care for children under school age, there is also a need for occasional day care services for children, before and after school child care services and children's holiday programs.

Occasional care child care services in the ACT are generally provided in town centres, or in locations that enable parents to use other co-located or nearby facilities such as health services. Occasional care is sometimes provided in facilities that also offer long day care services.

In the ACT the provision of before and after school care is often provided on site at primary schools, or on sites adjacent to primary schools.

Recommendations

- The population of the CB + E precinct may not itself generate enough demand for a new child care facility.

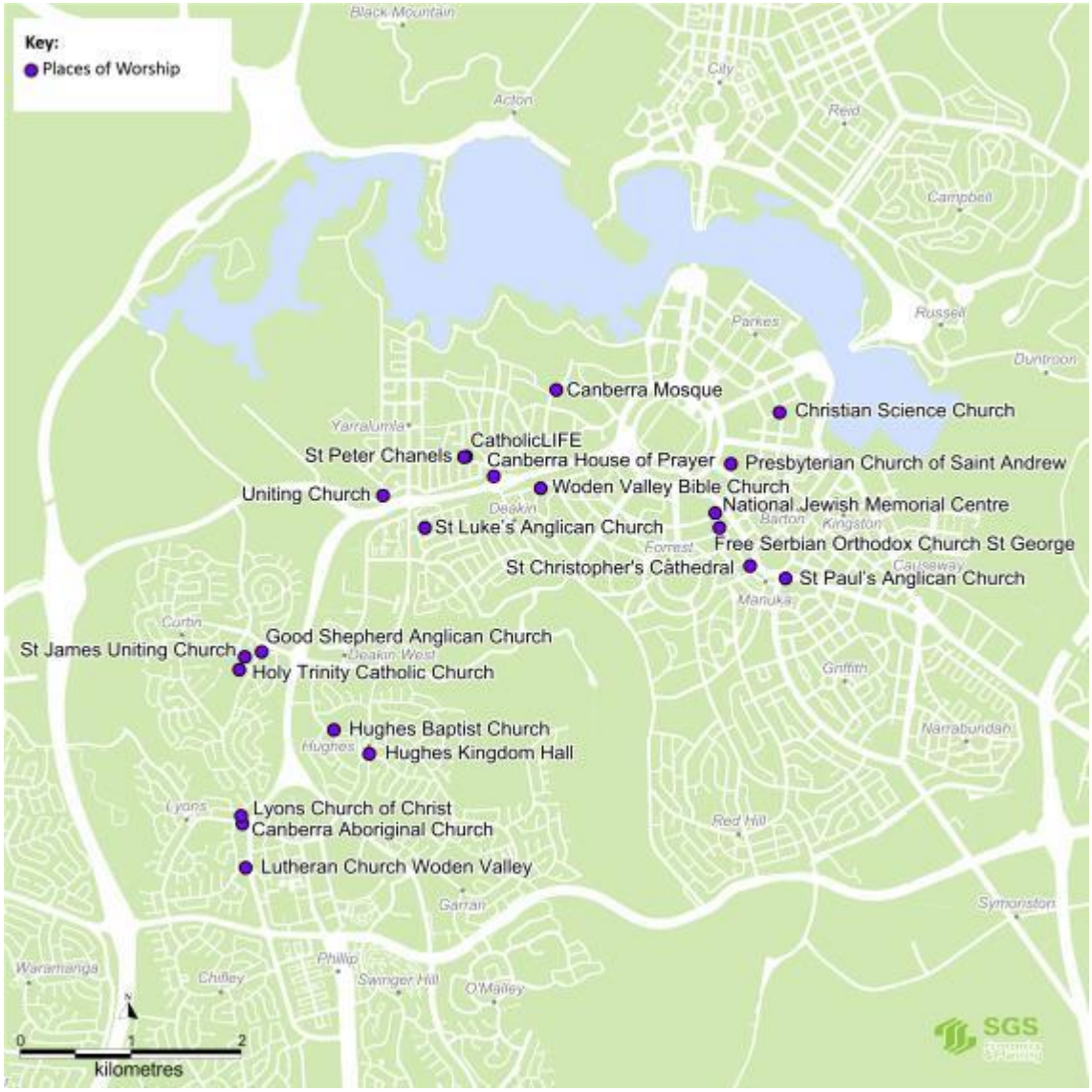
- An additional childcare centre in the CB + E precinct would be attractive for parents from surrounding areas, including the new development at Molonglo.

3.14 Places of worship

Current supply and demand

Figure 10 below, shows the location of churches and other places of worship in Yarralumla and surrounding suburbs.

FIGURE 10. PLACES OF WORSHIP



Future demand

As shown in Figure 10, there are a number of places of worship and places for religious-associated use in Yarralumla and surrounding suburbs. To some extent this is likely to reflect the generally higher church attendance of the population when these suburbs were first developed.

The ACT's *Community and Recreation Facilities Locational Guidelines* suggest that a Place of Worship should be located close to residential areas, and near major car parking areas if parking demand is not met on site. Noise separation or adequate noise buffering from residential areas is also required. Co-location with related non-government schools should be considered.

A 2009 Research Paper *Future planning for religious community in the ACT*, prepared for the ACT Planning and Land Authority, identified key trends and issues including:

- a significant increase in the proportion of the population who do not identify with any religion;
- a significant decrease in identification with many traditional Christian denominations, particularly the larger Protestant Churches;
- low and declining rates of attendance at weekly church services for many who identify with Christian denominations, including Catholic (15% attendance), Anglican (5% attendance), Uniting (10% attendance) and Presbyterian or Reformed churches (7% attendance);
- the emergence and growth of 'mega churches' which are generally evangelical and linked to the Pentecostal or Baptist movements; and
- recent patterns of immigration into Australia have led to notable increases in identification with non-Christian religious groupings, including Buddhism, Islam and Hinduism.

A general finding in this Research Paper was that planning in the ACT will need to accommodate a trend away from worship at the neighbourhood parish level in favour of 'mega' places of worship.

Pentecostal and evangelical groups in the ACT and elsewhere have generally sought to establish places of worship much larger than the more traditional neighbourhood churches, and also seek to draw their congregations from much larger catchments. This is in contrast to the general preference of tradition Christian denominations for smaller places of worship in local areas such as parishes. However, the ability of these traditional denominations to continue to fund local facilities and services is also likely to be constrained in the future if participation continues to decline.

Many non-government schools include places of worship on site, which should also be taken into account when assessing the need for additional facilities.

The Research Paper *Future planning for religious community in the ACT*, also mentioned that:

- many local churches have a role in the provision of community programs, or provide venues for other community activities; and
- some religious groups do not have dedicated premises but meet in local halls or other facilities.

Given the number of churches and other places of worship already established in Yarralumla and surrounding suburbs, the provision of sites for additional facilities as part of the CB + E precinct is not considered necessary.

Recommendation

- The provision of sites for additional facilities as part of the CB + E precinct is not considered necessary

3.15 Emergency services

Current supply and demand

Figure 11, below, shows the location of emergency service facilities that currently provide services to the suburb of Yarralumla.

FIGURE 11. EMERGENCY SERVICES

Future demand

The ACT Emergency Service Agency has recently prepared an Upgrade and Relocations Strategy to identify where emergency services would be best located to provide optimal coverage for the ACT community into the future.

Ambulance and fire services are required to meet prescribed response time targets, and assessment of locations for emergency services are done at the 'whole of ACT' level.

The current Upgrade and Relocations Strategy is already taking into account the general increase in population proposed for areas within 10 k of the Canberra City Centre, which would include areas such as the new CB + E precinct.

Recommendation

- The current ACT Emergency Services Upgrade and Relocations Strategy has taken into account the general increase in population proposed for areas within 10 kilometres of the Canberra City Centre, which would include areas such as the new CB + E precinct. Provision for additional facilities is therefore not considered necessary.

4 KEY FINDINGS AND RECOMMENDATIONS

Yarralumla is one of Canberra's oldest and most conveniently located suburbs. It is within 10 kilometres of the City Centre which, as part of the ACT Government's plan to make the City more sustainable, is the catchment area targeted for an increase in housing and population density.

Yarralumla was first developed at a time when land was relatively cheap. When compared to the suburbs currently being developed in areas such as Gungahlin and Molonglo, Yarralumla residents have relatively good access to community and recreation facilities.

The development of the CB + E precinct will include up to 3,000 – 3,200 additional residents and will require the provision of some new retail and community facilities.

The most pressing need for additional community facilities and services generated by the new CB + E precinct will be at the neighbourhood/local level. The population catchments used for planning local centres are generally in the order of 5,000 to 10,000 people, although some local centres serve suburbs with current populations lower than 5,000. The additional population generated by the CB + E precinct would generally be expected to be part of the catchment that could be served by the existing Yarralumla local shopping centre, although parking provisions at the Yarralumla local shops may need to be augmented.

4.1 Retail and community facilities

Recommendations for specific facilities are summarised below.

Retail and commercial facilities

- Provision should be made for new small-scale local shops (around 650 sq metres GFA) in the CB + E precinct on the northern side of Cotter Road as part of a commercial mixed use facility. This should ideally be located close to the main access point off Cotter Road.
- Provision could also be made for a coffee shop/mini mart located in the south-eastern corner of the new development closest to the Adelaide Avenue bus interchange, on the Yarralumla or Deakin side of Adelaide Avenue.
- Additional space for medical and allied health services could be provided as part of the commercial development proposed on the Deakin side of Adelaide Avenue. Timing of provision would need to take into account the extent of office vacancies in the adjacent professional office and peak association precinct.
- As part of the refurbishment of the Canberra Brickworks Complex, there is also likely to be scope for adjunct facilities such as a coffee shop, bar, entertainment venue or small-scale conference venue.

Community meeting spaces and youth facilities

- For the additional population of 3,000 – 3,200 associated with the CB + E precinct, the specific provision of an additional community hall or youth facility is not considered to be justified.

Clubs and recreation facilities

- The inclusion of privately-owned gym (and possibly also swimming pool) facilities as part of mixed use commercial and residential sites within the CB + E precinct is likely to be financially viable.

- There may also be potential to include additional recreation facilities as part of the redevelopment of the brickworks and quarry sites.

- The attractiveness of the area for potential new residents could be improved by the addition of outdoor exercise equipment in public spaces.

Health facilities and services

- Existing GP and allied health services in Yarralumla and Deakin could provide services to the additional population generated by the CB + E precinct.

- There is likely to be scope for additional services to be provided in mixed use or commercial sites on both sides of Adelaide Avenue. These additional facilities could also provide services to residents of areas outside of Yarralumla and Deakin.

Aged care facilities and services

- The suburb of Yarralumla could generate a need for around 44 residential aged care places by 2027. This demand could potentially be accommodated in one of the existing residential aged care facilities in Deakin, Hughes or Curtin.

Education facilities

- The provision of an additional Government school in the new CB + E precinct is not recommended, as current schools in Yarralumla and surrounding suburbs should be able to cater for the increased number of students generated by the new development.

Child care facilities

- The population of the CB + E precinct may not itself generate enough demand for a new child care facility.

- An additional childcare centre in the CB + E precinct would be attractive for parents from surrounding areas, including the new development at Molonglo.

Places of Worship and religious-associated use.

- The provision of sites for additional facilities as part of the CB + E precinct is not considered necessary.

Emergency Services

- The current ACT Emergency Services Upgrade and Relocations Strategy has taken into account the general increase in population proposed for areas within 10 km of the Canberra City Centre, which would include areas such as the new CB + E precinct. Provision for additional facilities is therefore not considered necessary.

4.2 Timing of Provision

It would be desirable to provide some convenience retail facilities as soon as the population is large enough to make the facilities viable. This is likely to be associated with Stage 2 of the development. The viability of a small scale convenience shop at this time is also likely to be improved by patronage from construction workers.

Other community facilities, such as medical services and child care, would be subject to the interest of service providers and could be included when the other elements of associated mixed use developments are constructed. This may not be until the late in the development timeframe. The provision of child care services in the midst of construction activities, however, would not generally be desirable.

APPENDIX A

ACT Planning System and Policies

This Appendix provides additional information about the ACT Planning system and planning policies relevant to the development of the C B + E precinct.

The Australian Capital Territory (Planning and Land Management) Act 1988 (Cth)

The *Australian Capital Territory (Planning and Land Management) Act 1988* (Cth) (the PALM Act) identifies the National Capital Authority as an Australian Government agency with a number of responsibilities, including the preparation and review of the National Capital Plan (NCP). In addition to the NCP, the PALM Act also requires the ACT Government to prepare and administer a Territory Plan. The PALM Act makes it clear that the Territory Plan must be consistent with the NCP and that if there is any inconsistency between the two plans, the NCP prevails over the Territory Plan.

The key objective of the NCP is to ensure that Canberra and the ACT are planned and developed in accordance with their national significance. The NCP also includes several key objectives that apply throughout the ACT and several elements that apply in specific locations. For example, S.10(1) of the PALM Act provides that the NCP may specify areas of land that have the special characteristics of the National Capital to be 'Designated Areas' and sets out the detailed conditions of planning, design and development in those 'Designated Areas' and the priorities to be addressed in carrying out such planning, design and development.

The NCP identifies that three primary factors are relevant in deciding the extent of the Designated Areas. The three primary factors are:

1. Canberra hosts a wide range of National Capital functions – activities which occur in Canberra because it is the National Capital and which give Canberra a unique function within Australia;
2. Griffin's strong symbolic design for Canberra Central has given the National Capital a unique and memorable character; and
3. Canberra's landscape setting and layout within the Territory have given the Capital a garden city image of national and international significance.

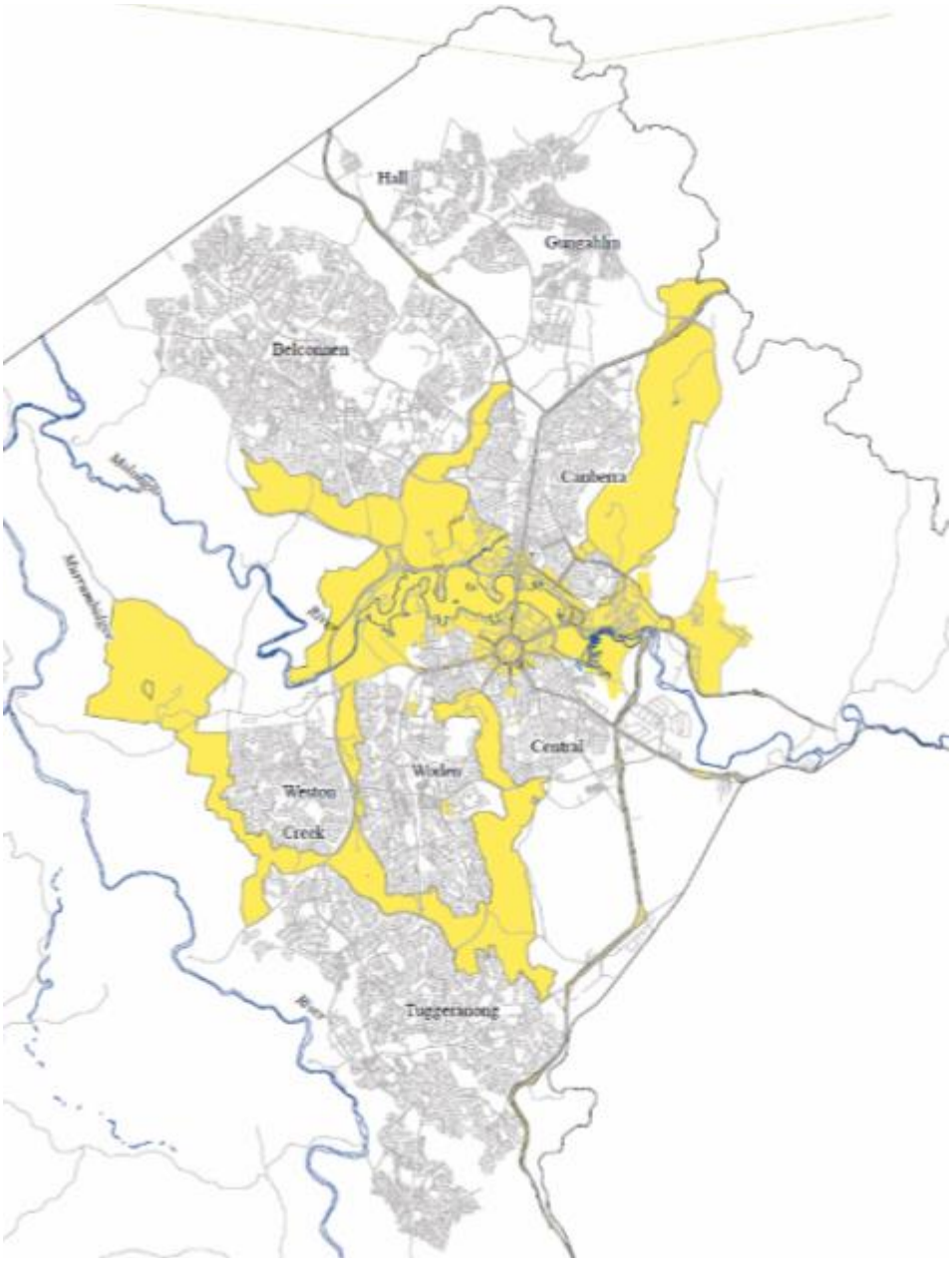
The National Capital functions include:

- Parliamentary uses
- Key Australian Government policy departments which have a close association with Parliament
- Official residences of the Prime Minister and the Governor-General
- Diplomatic Missions of foreign countries
- Major national institutions such as the High Court, Australian National Gallery, the National Library of Australia, and
- Major national associations.

The Designated Areas are shown in , and comprise the following areas:

- Lake Burley Griffin and its foreshores
- the Parliamentary Zone
- the balance of the Central National Area (CNA) adjoining the Lake and the Parliamentary Zone, and extending from the foot of Black Mountain to the airport
- the Inner Hills which form the setting for the CNA, and
- the Main Avenues and Approach Routes between the ACT Border and the CNA.

FIGURE 12. NATIONAL CAPITAL PLAN: DESIGNATED AREAS



Source: National Capital Authority

Within the Designated Areas, the NCA has the sole responsibility for determining the detailed conditions of planning, design and development, and for Works Approval. Designated Areas are excluded from the provisions of the Territory Plan and are controlled by the provisions of the NCP (s.25 (1)(b)(i) and s.25(6) of the PALM Act

Section 27(1) of the PALM Act enables the relevant Minister to declare specified areas in the ACT to be National Land if the land is, or is intended to be, used by or on behalf of the Commonwealth.

Currently, the Diplomatic estates at Yarralumla, Deakin and O'Malley are within Designated Areas, and have been declared National Land.

Transport for Canberra (2012)

The ACT Government released a new transport policy, Transport for Canberra in March 2012, which updates and replaces the 2004 Sustainable Transport Plan and compliments the ACT Planning Strategy.

The focus is on creating a transport system that:

- is integrated with land use planning
- makes active travel like walking and cycling the easy way to get around
- provides sustainable travel options and reduces transport emissions
- is safe for moving people however they get around
- is accessible for everybody whatever their level of mobility at any time or place, and
- is efficient and cost effective, providing value for money for the government, business and the community by managing travel demand across the whole transport system.

Transport for Canberra also identifies Journey to Work Targets, which includes a target of 23 per cent of all trips to be via walking, cycling or public transport by 2016. In order to achieve this target increased development within Town Centres and along major transport routes will be essential.

Canberra Social Plan (2011)

The *Canberra Social Plan* 2011 is a high-level policy framework for the ACT Government's ongoing investment in the people of Canberra. It has built on the foundation of the 2004 Plan, and renewed the ACT Government's commitment to building a strong, vibrant and inclusive community.

The 2011 Plan:

- articulates the Government's commitment to collaboration and strengthening partnerships as the cornerstone of an inclusive community
- provides direction for planning and service delivery
- guides new Government initiatives, and
- maintains the commitment to reporting against the 2004 *Canberra Social Plan* targets.

Commitments by the ACT Government in the *Canberra Social Plan* include:

- Better co-ordination and planning of infrastructure and services (through the ACT Infrastructure Plan and Strategic Asset Management Plans) to meet the diverse needs of Canberrans and maximise the liveability and sustainability of the city.
- Systematically addressing barriers to participation through legislation, policy development, information, and implementation of services.
- Delivery of programs that enable people of diverse backgrounds and abilities to share community benefits.
- Strengthening the Territory's commitment to active and sustainable transport by linking cycling, walking and public transport with supportive land use around public transport corridors. Flexible transport options that address transport disadvantage and more frequent public transport in suburban areas will form part of building a comprehensive and sustainable transport system. The

transport system will also be supported by a safe and connected road network and smart parking policies aimed at managing congestion and private travel demand.
- Investing in community infrastructure that promotes connection and allows for diverse activities. For example, new Regional Community Centres are providing long term tenancies for over 40 community organisations across Canberra and new neighbourhood halls provide meeting and recreational space for the benefit of local communities.
- More flexible use of schools, libraries and civic places through co-location and provision of common facilities for art, sport, recreation, gardening, bringing together communities of interest and supporting everyday social interaction.

The *Canberra Social Plan* also identified the need for a liveable community to give highest priority to the principles of access, equity and participation.

ACT Strategic Plan for Positive Ageing 2010 – 2014 and Action Plan

The ACT Strategic Plan for Positive Ageing 2010-2014 provides a blueprint for a coordinated approach across Government and the community to support positive ageing and an age-friendly city where older people are respected, valued and supported to actively participate. It was developed in 2009 by the ACT Office for Ageing in partnership with the ACT Ministerial Advisory Council on Ageing, and guided by an Interdepartmental Committee.

The Plan includes seven strategic priorities that closely align with the World Health Organisation's Checklist of Essential Features of Age-Friendly Cities. The priorities and goals include:

- **Information and Communication** - People in the ACT easily access information about healthy living, retirement planning, support services and products, entitlements, and community groups and clubs.
- **Health and Wellbeing** - People in the ACT maintain their health and wellbeing across their lifespan to allow them to age positively and to actively participate in their community as they get older.
- **Respect, Valuing and Safety** - Seniors feel respected and valued and experience the ACT as a safe place to live and visit.
- **Housing and Accommodation** - ACT seniors access appropriate and affordable housing.
- **Support Services** - Seniors use appropriate, timely and accessible support services to assist them to maintain active and relatively independent lives.
- **Transport and Mobility** - Seniors easily move around in their community through personal, community and public transport, and walkways.
- **Work and Retirement** - People plan for their retirement and, once retired, continue to actively participate in our community through paid and unpaid work, and through educational and recreational activities.

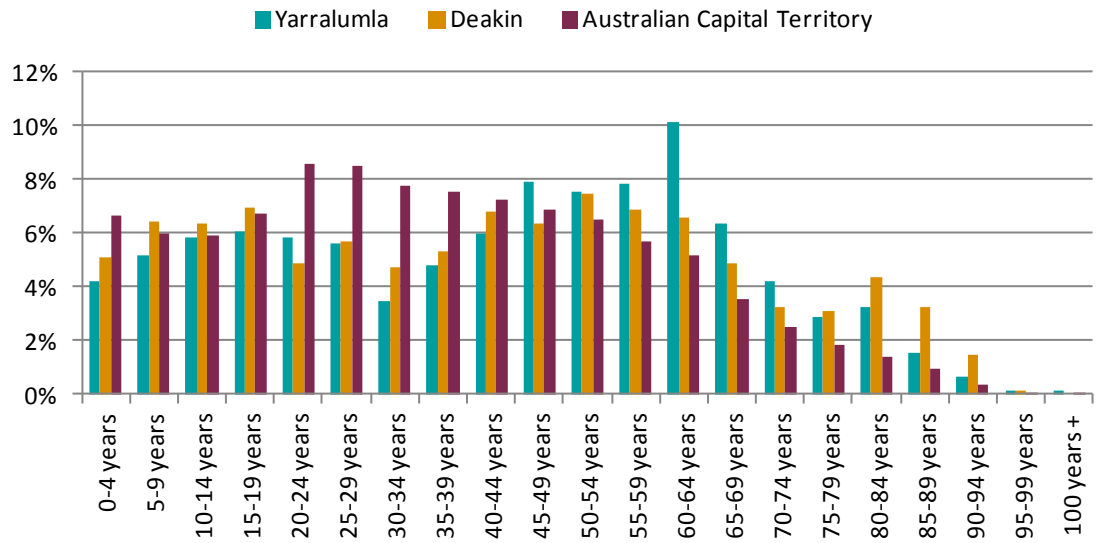
APPENDIX B

This appendix provides additional information on the demographic profile and population projections relevant to Yarralumla and the development of the C B + E precinct, as well as information and assumptions on dwelling structures and tenure.

Population

Figure 13 illustrates the age profile of Yarralumla, Deakin and the ACT. It shows that around 30 per cent of the Yarralumla population is aged over 60 years (compared to 27 per cent of Deakin residents and 15 per cent of the wider ACT population). Conversely, a smaller proportion of Yarralumla residents are aged between 30 and 44 years. The continued ageing of the population will have implications on demand for services, particularly health services.

FIGURE 13. POPULATION BY AGE - YARRALUMLA, DEAKIN AND ACT



Source: ABS Census: Counting Persons, Place of Usual Residence (2011)

Place of birth

Table 6 shows place of birth for residents of Yarralumla, Deakin and the ACT. Australia is the most common birthplace for residents of all three locations. A relatively high proportion of residents were born in other English speaking countries, including England, New Zealand and the USA. Compared to the other locations Yarralumla has a slightly higher proportion of residents born in England.

TABLE 6. PLACE OF BIRTH

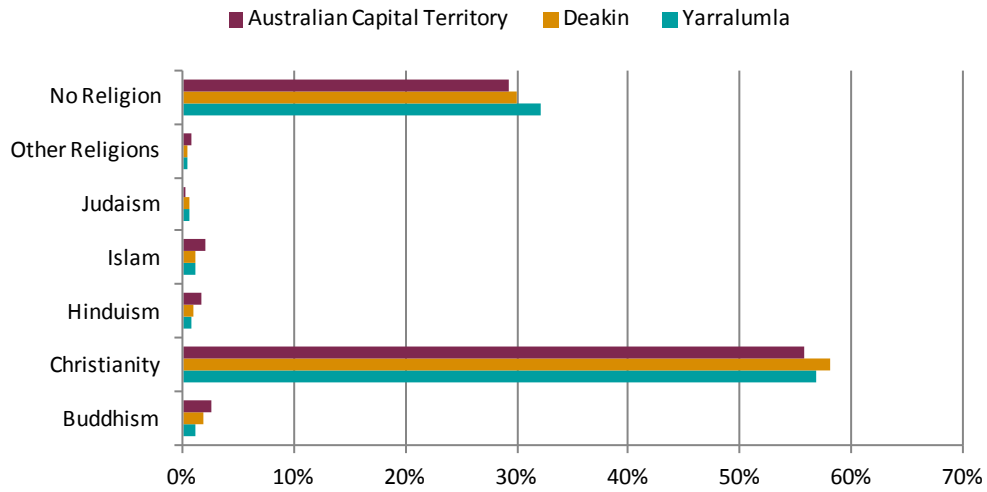
Yarralumla			Deakin			ACT		
Place of birth	**#**	**%**	**Place of birth**	**#**	**%**	**Place of birth**	**#**	**%**
Australia	2,111	72%	Australia	2,005	72%	Australia	255,052	71%
England	191	7%	England	157	6%	England	13,049	4%
New Zealand	47	2%	New Zealand	55	2%	China	6,591	2%
India	42	1%	India	32	1%	India	5,887	2%
USA	36	1%	USA	30	1%	New Zealand	4,387	1%
South Africa	34	1%	Germany	26	1%	Vietnam	2,956	1%
Italy	23	1%	Italy	26	1%	Philippines	2,422	1%
China	22	1%	Malaysia	26	1%	USA	2,417	1%
Germany	21	1%	China	25	1%	Germany	2,332	1%
Scotland	20	1%	South Africa	19	1%	Sri Lanka	2,268	1%
Other	371	13%	Other	379	14%	Other	59,857	17%

Source: ABS Census (2011)

Religion

Christianity is the most common religious affiliation in Yarralumla, Deakin and the ACT. Around a third of the population of all areas do not identify a religious affiliation.

FIGURE 14. RELIGIOUS AFFILIATIONS

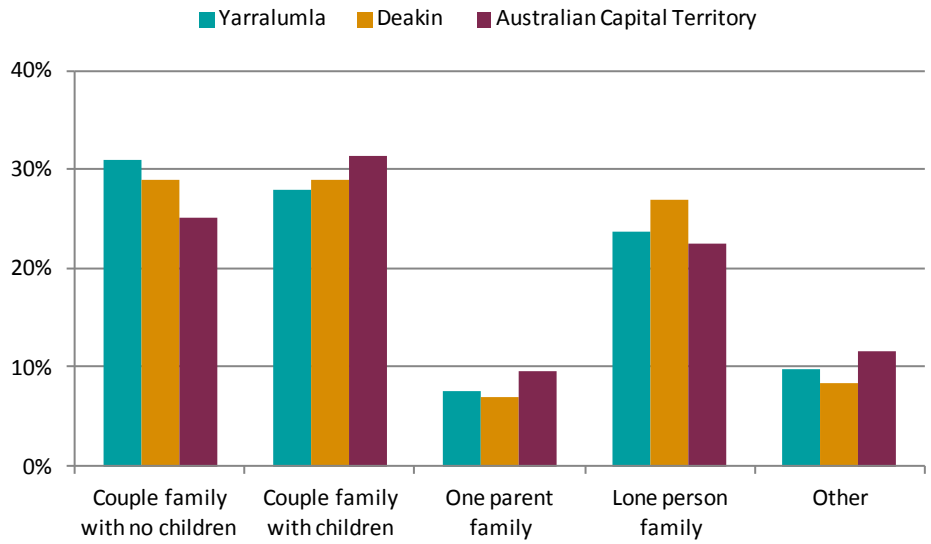


Source: ABS Census (2011)

Household composition

Figure 15 shows household composition for Yarralumla, Deakin and the ACT. Compared to other locations, Yarralumla has a slightly higher proportion of couple families with no children, and a slightly smaller proportion of couple families with children. Yarralumla has a higher proportion of one parent and lone person households than Deakin, however these are lower than for the ACT. The high proportion of couple families with no children and lone person households within Yarralumla contributes to the relatively older population within the area.

FIGURE 15. HOUSEHOLD COMPOSITION – YARRALUMLA, DEAKIN AND ACT



Source: ABS Census (2011)

Dwellings and employment

Population and dwelling ratios

Table 7 shows number of dwellings, population and population per dwelling ratio in 2011. The average number of people per dwelling in Yarralumla was 2.1, smaller than that of both Deakin (2.3) and the ACT (2.5).

TABLE 7. POPULATION AND DWELLINGS BY AREA

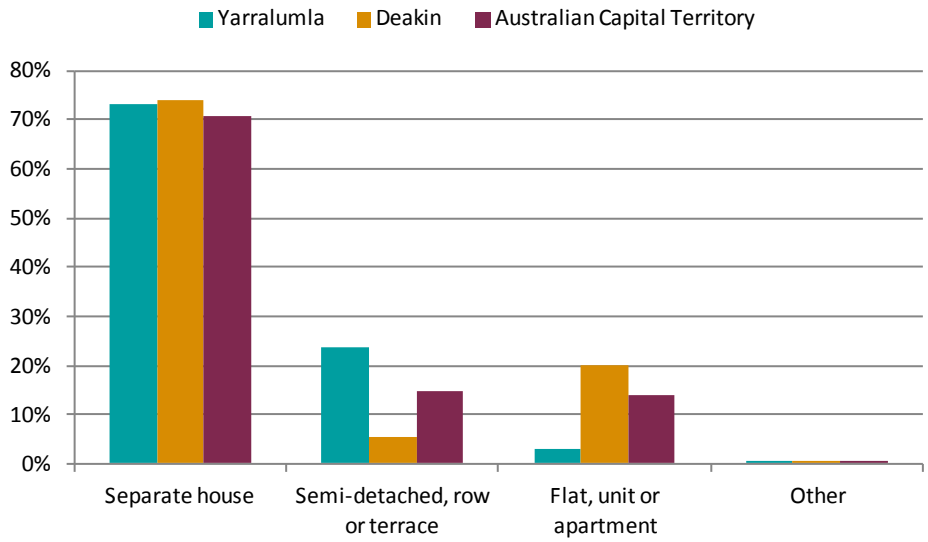
Area	Persons (place of usual residence)	Dwellings	No. of people per dwelling
Yarralumla	2,780	1,310	2.1
Deakin	2,918	1,293	2.3
ACT	356,586	145,473	2.5

Source: ABS Census (2011); SGS calculations

Dwelling structure

Figure 16 shows the share of different dwelling types for Yarralumla, Deakin and the ACT for 2011. All three locations have a similar proportion of separate houses (around 70 per cent). Yarralumla has a significantly higher proportion of semi-detached, row or terrace type houses (24 per cent), while Deakin has the highest proportion of flat, units or apartments (20 per cent).

FIGURE 16. DWELLING TYPE – YARRALUMLA, DEAKIN AND ACT

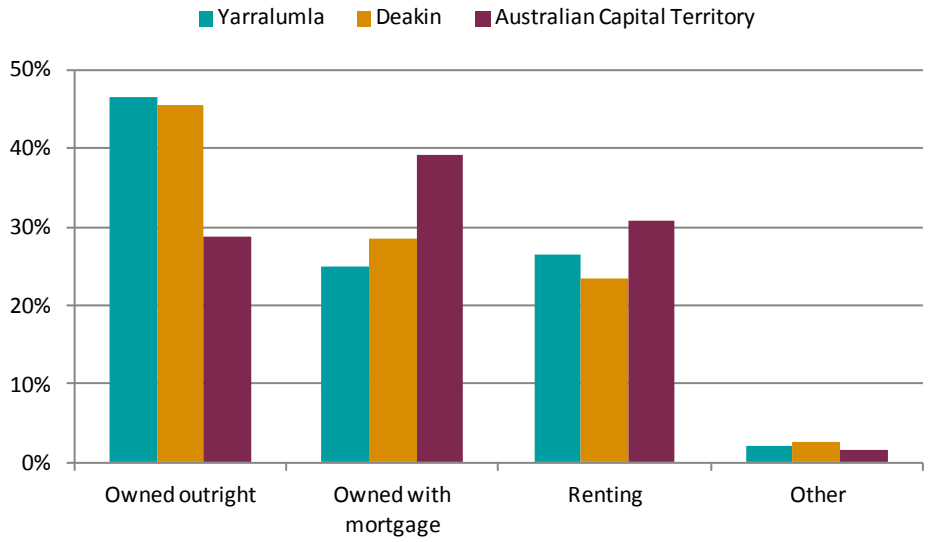


Source: ABS Census (2011)

Tenure

Figure 17 below shows housing tenure for Yarralumla, Deakin and ACT residents. Compared to the ACT (29 per cent), a higher proportion of Yarralumla (46 per cent) and Deakin (46 per cent) residents own their houses outright. This most likely reflects the age and relatively high level of income of the Yarralumla population.

FIGURE 17. HOUSING TENURE

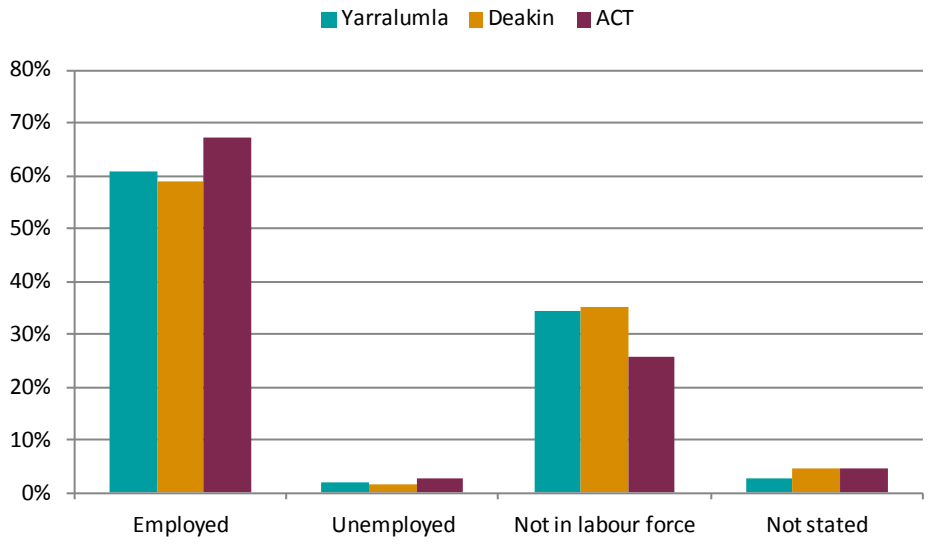


Source: ABS Census (2011)

Employment

Figure 18 shows the status of employment for Yarralumla, Deakin and ACT residents. Around 60 per cent of Yarralumla and Deakin residents are employed, slightly less than the ACT as a whole. Yarralumla and Deakin both have a higher proportion of residents not in the labour force, a reflection of the proportion of the population above retirement age.

FIGURE 18. LABOUR FORCE STATUS – YARRALUMLA, DEAKIN AND ACT



Source: ABS Census (2011)

Table 8 shows employment, by industry, for Yarralumla, Deakin and ACT residents. It highlights that the proportion of residents employed in each industry is broadly similar between all areas. For example, the highest employing industry for Yarralumla (28 per cent), Deakin (31 per cent) and ACT (33 per cent) residents is public administration and safety, followed by the professional, scientific and technical service industry. Compared to Deakin and the ACT, Yarralumla has a higher proportion of residents employed in health care and social services as well as in education and training.

TABLE 8. EMPLOYMENT BY INDUSTRY - YARRALUMLA, DEAKIN AND ACT

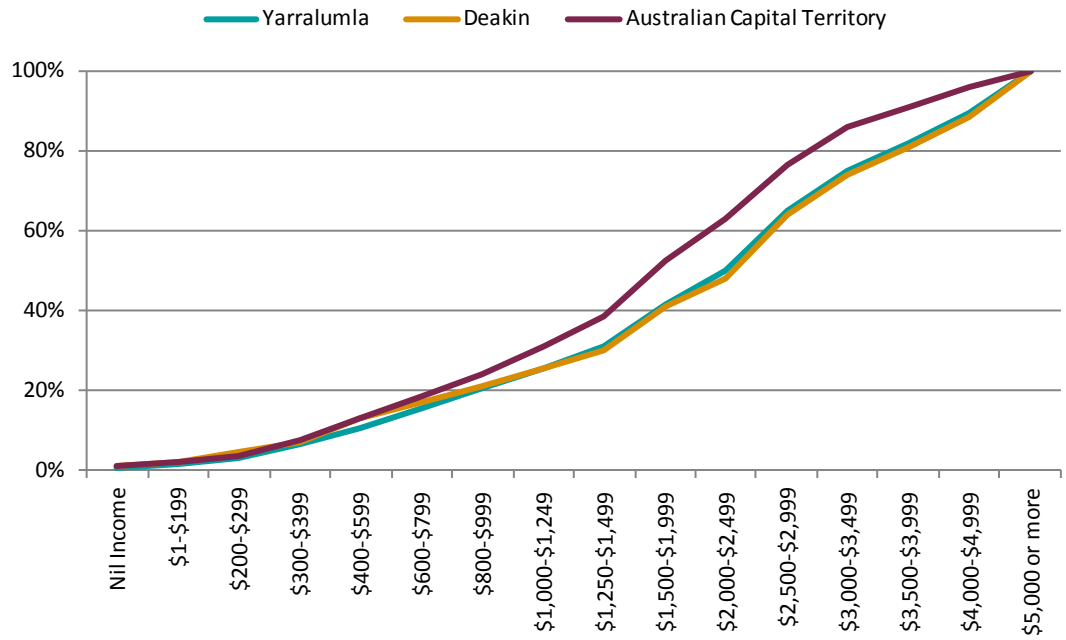
	Yarralumla		Deakin		ACT	
	#	%	#	%	#	%
Agriculture, Forestry and Fishing	5	0.3%	4	0.3%	355	0.2%
Mining	-	0.0%	-	0.0%	95	0.0%
Manufacturing	20	1.4%	22	1.7%	4,026	2.1%
Electricity, Gas, Water and Waste Services	6	0.4%	8	0.6%	1,490	0.8%
Construction	70	4.7%	49	3.7%	11,987	6.2%
Wholesale Trade	17	1.2%	11	0.8%	2,418	1.3%
Retail Trade	69	4.7%	69	5.2%	14,836	7.7%
Accommodation and Food Services	77	5.2%	72	5.4%	11,282	5.8%
Transport, Postal and Warehousing	21	1.4%	10	0.8%	4,404	2.3%
Information Media and Telecommunications	37	2.5%	26	2.0%	3,665	1.9%
Financial and Insurance Services	33	2.2%	41	3.1%	3,555	1.8%
Rental, Hiring and Real Estate Services	44	3.0%	19	1.4%	2,432	1.3%
Professional, Scientific and Technical Services	231	15.7%	226	17.0%	19,138	9.9%
Administrative and Support Services	40	2.7%	17	1.3%	4,613	2.4%
Public Administration and Safety	406	27.5%	410	30.8%	64,112	33.2%
Education and Training	158	10.7%	124	9.3%	17,144	8.9%
Health Care and Social Assistance	180	12.2%	152	11.4%	17,977	9.3%
Arts and Recreation Services	31	2.1%	26	2.0%	3,301	1.7%
Other Services	31	2.1%	45	3.4%	6,215	3.2%
Total	**1,476**	**100.0%**	**1,331**	**100.0%**	**193,045**	**100.0%**

Source: ABS Census: Persons, Place of Usual Residence (2011)

Income

Figure 19 shows the difference in weekly income between Yarralumla, Deakin and ACT residents. Weekly income for Yarralumla and Deakin residents is relatively similar with a higher proportion of residents in these locations earning higher incomes than residents of the ACT more broadly. The median weekly income for Yarralumla and Deakin residents is between $2,500 and $2,999. This compares to a median weekly income of between $1,500 and $1,999 for ACT residents.

FIGURE 19. WEEKLY HOUSEHOLD INCOME – YARRALUMLA, DEAKIN AND ACT



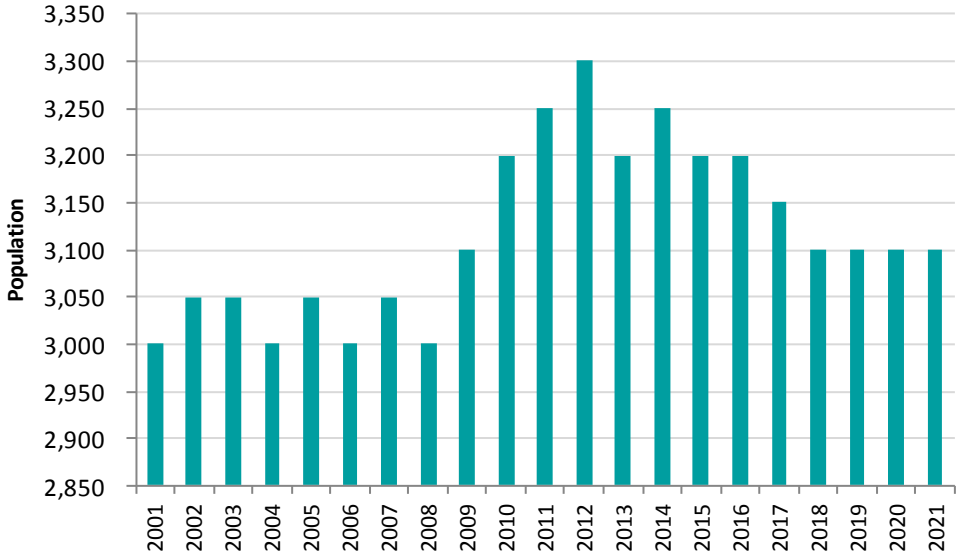
Source: ABS Census (2011)

Population projections

Figure 20 illustrates the recent past and projected population of Yarralumla to 2021, without taking into account the CB + E precinct. It shows that the population has already reached peak levels of around 3,300 residents, and that the population is expected to decline gradually to reach around 3,100 persons by 2021. This projected trend for the broader suburb will have implications for community facilities and services as data indicates that demand levels for some services in the future will be less than they currently are. However, the age profile of the future population is also projected to change,[11] impacting demand for different types of facilities and services.

[11] The population of Canberra is projected to continue to age, with the median age expected to rise from 34 years in 2012 to 39 years by 2042 (http://www.cmd.act.gov.au/policystrategic/actstats/projections/act/total)

FIGURE 20. YARRALUMLA POPULATION, 2001 TO 2021

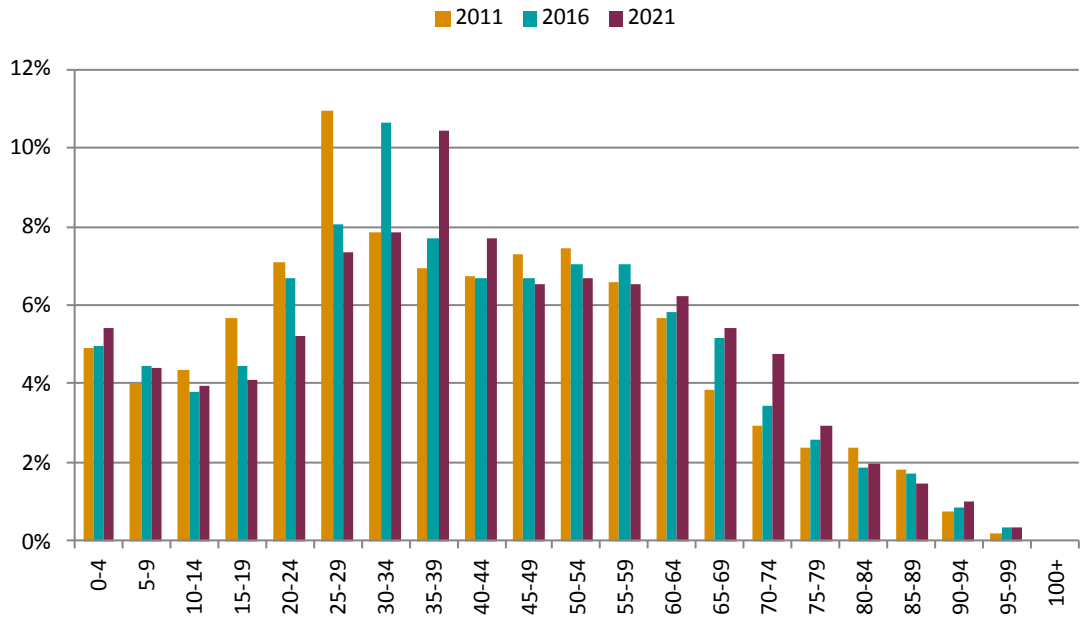


Source: ACT Population Projections by Suburb and Districts: 2009 to 2021

The following figures show the projected change in the age distribution of residents of South Canberra, Woden Valley and the ACT.

Figure 21 shows that the most significant changes within the age profile of South Canberra between 2011 and 2021 will occur with residents aged 25 to 40 years. There is also projected to be significant growth in the proportion of residents aged between 65 and 79 years.

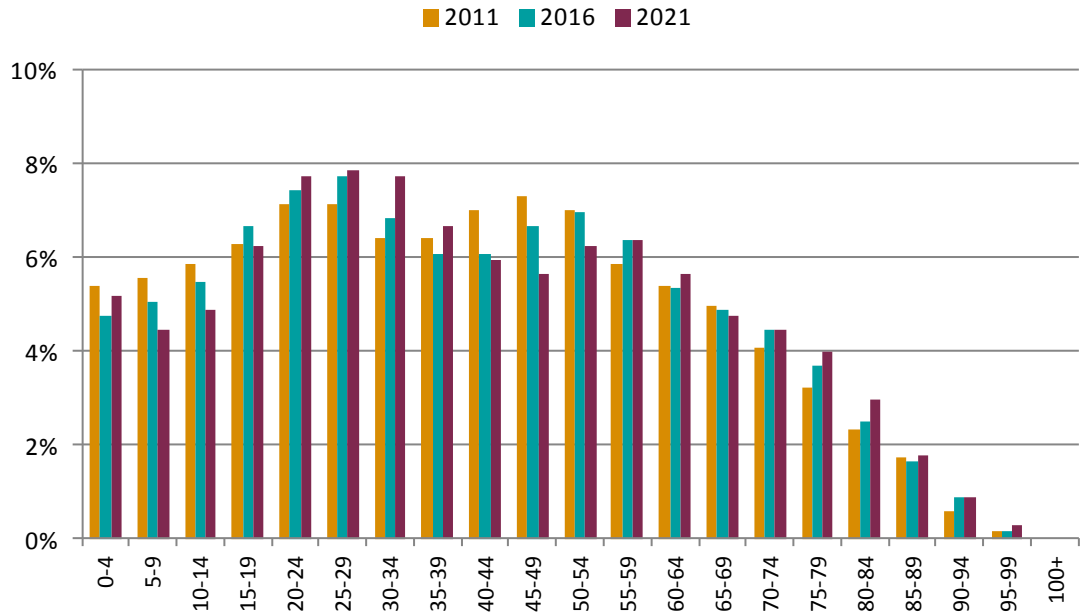
FIGURE 21. PROJECTED AGE PROFILE, SOUTH CANBERRA



Source: ACT Population Projections by Suburb and Districts: 2009 to 2021

Figure 22 shows the projected age distribution for Woden Valley residents to 2021. Compared to South Canberra, changes within the age profile of Woden Valley residents will be less. While the proportion of residents aged 20 to 39 years and 75 to 89 years is projected to grow to 2021, there is projected to be a decline in the proportion of residents aged between 0 and 19 years and 40 to 49 years. This will result in decreased demand for children's services and schools within the area.

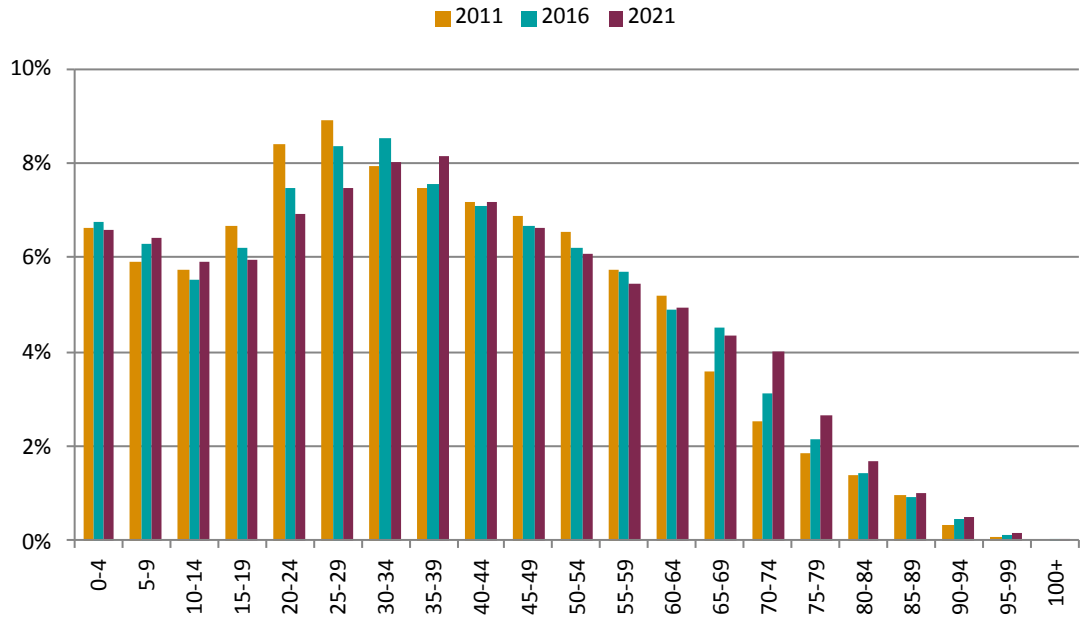
FIGURE 22. PROJECTED AGE PROFILE, WODEN VALLEY



Source: ACT Population Projections by Suburb and Districts: 2009 to 2021

Figure 23 shows the expected ageing of the ACT population to 2021 with residents aged 65 and above projected to increase as a proportion of total population.

FIGURE 23. PROJECTED AGE PROFILE, ACT



Source: ACT Population Projections by Suburb and Districts: 2009 to 2021

Table 9 provides a breakdown by age of people living in different types of dwellings in the ACT in 2011. This information has been used to assess the age profile of people likely to be living in the C B + E precinct (see Table 4).

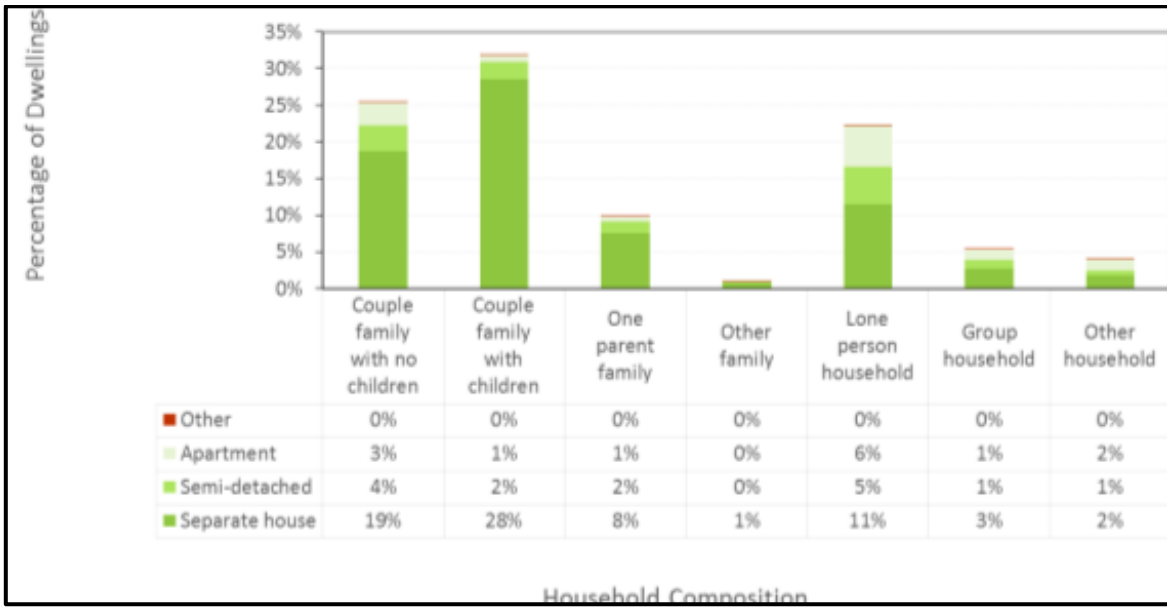
TABLE 9. PROPORTIONS OF PERSONS BY DWELLING STRUCTURE AND AGE, ACT 2011

Age	Separate house	Semi-detached, row or terrace house, townhouse etc with one storey	Semi-detached, row or terrace house, townhouse etc with two or more storeys	Flat, unit or apartment in a one or two storey block	Flat, unit or apartment in a three storey block	Flat, unit or apartment in a four or more storey block	Other/Not Stated	Total
0-4 years	7.26%	6.99%	6.76%	4.96%	3.94%	2.72%	1.18%	6.60%
5-9 years	7.02%	4.42%	4.78%	2.38%	1.83%	1.13%	0.57%	5.95%
10-14 years	7.07%	3.19%	3.86%	1.76%	1.13%	0.89%	5.58%	6.09%
15-19 years	7.17%	3.64%	4.85%	3.06%	2.54%	2.10%	13.54%	6.80%
20-24 years	6.81%	7.84%	12.38%	11.28%	14.48%	15.56%	25.84%	8.78%
25-29 years	6.35%	11.27%	14.61%	19.32%	24.57%	25.78%	7.63%	8.54%
30-34 years	6.67%	10.34%	11.37%	14.23%	15.42%	15.08%	5.27%	7.75%
35-39 years	7.56%	7.99%	8.39%	8.27%	8.61%	8.18%	5.03%	7.56%
40-44 years	7.77%	6.17%	6.97%	6.44%	5.43%	5.09%	4.95%	7.29%
45-49 years	7.51%	5.11%	6.00%	5.14%	4.90%	4.48%	5.09%	6.92%
50-54 years	7.12%	4.92%	5.43%	5.13%	4.76%	4.87%	4.63%	6.57%
55-59 years	6.16%	4.90%	4.48%	4.23%	3.58%	4.42%	4.03%	5.71%
60-64 years	5.50%	4.89%	4.19%	3.92%	2.62%	3.69%	3.00%	5.08%
65-69 years	3.69%	4.19%	2.45%	2.50%	2.00%	1.77%	1.82%	3.43%
70-74 years	2.52%	4.03%	1.38%	1.89%	1.36%	1.26%	1.52%	2.42%
75-79 years	1.74%	3.69%	0.87%	1.86%	1.11%	1.02%	1.64%	1.79%
80-84 years	1.19%	3.39%	0.69%	1.58%	0.88%	1.17%	2.54%	1.39%
85-89 years	0.66%	2.22%	0.42%	1.44%	0.61%	0.57%	3.36%	0.92%
90-94 years	0.18%	0.68%	0.11%	0.52%	0.21%	0.18%	2.04%	0.33%
95-99 years	0.03%	0.11%	0.02%	0.06%	0.03%	0.03%	0.70%	0.07%
100 years+	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.10%	0.01%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

The ABS may have adjusted small values to avoid release of confidential data; therefore, aggregated figures may be also adjusted.
Source: Australian Bureau of Statistics (2013) Census of Population and Housing 2011, Table Builder; and SGS Economics and Planning calculation

Figure 24 shows the household composition by different dwelling types for the ACT as a whole in 2011.

FIGURE 24. PERCENTAGE OF DWELLINGS BY TYPE AND STRUCTURE AND HOUSEHOLD COMPOSITION - ACT 2011



	Couple family with no children	Couple family with children	One parent family	Other family	Lone person household	Group household	Other household
Other	0%	0%	0%	0%	0%	0%	0%
Apartment	3%	1%	1%	0%	6%	1%	2%
Semi-detached	4%	2%	2%	0%	5%	1%	1%
Separate house	19%	28%	8%	1%	11%	3%	2%

The ABS may have adjusted small values to avoid release of confidential data; therefore, aggregated figures may be also adjusted.
Source: Australian Bureau of Statistics (2013) Census of Population and Housing 2011, Data-Packs: Statistical Areas 2; and SGS Economics and Planning calculation

Changes in dwelling occupancy rates over time

In accordance with general practice, the ACT's population projections take into account the overall ageing of the population and the tendency for occupancy rates in new dwellings in green field suburbs to increase in the first few years as the number of children in family households increases.

The population estimates for the CB + E precinct in this report have been based on the average occupancy of dwellings being stable over time. This reflects both the relatively low proportion of couple households or sole parent households with children living in higher density housing (see Figure 24), and the relatively high proportion of renters living in higher density housing.

Information from the 2011 Census indicates that in the ACT the proportion of dwellings owned outright or being purchased varies between different dwelling types as follows:

Separate house	78.6%
Attached house/townhouse, etc	51.2%
Unit, apartment, etc	29.2%
All dwelling types	**68.4%**

As shown in Table 3, the assessment undertaken in this report is based on the assumption that the CB + E precinct will include 300 townhouses or attached dwellings and 1500 units or apartments. Using the above information from the 2011 Census indicates that around 1208 or 67% of these dwellings are likely to be occupied by renters. In general, it is assumed that renters would be less likely than home owners to choose a dwelling that has capacity beyond current household needs.

APPENDIX C

Stakeholder Engagement

This Appendix provides information collected through stakeholder engagement undertaken for this project in late 2014.

TABLE 10. STAKEHOLDER ENGAGEMENT UNDERTAKEN AS PART OF CB+E COMMUNITY NEEDS ASSESSMENT

Stakeholder	Comments /Information
Education & Training Directorate, Schools Planning Section	"We believe that there is capacity in our system to cater for the development".
Yarralumla Primary School, Administration Office.	Current enrolment is 349, including 40 pre-school children and 46 at the Montessori School. (This leaves 263, which is close to the number of 241 on the myschool website). Yarralumla Primary School offers an English-Italian bi-language program. This attracts students from some families outside the Priority Catchment Area.
Greek Australia Preschool and child care	Offers child care and pre-school for ages 2 years to pre-school. Currently has some capacity for extra students.
Child Care Services	Information on the website www.careforkids.com.au/child-care/yarralumla/2600 indicates that there is some spare capacity at the Greek Australia Preschool and Child care Centre, at YWCA Yarralumla After School Care and Canberra Girls Grammar School Outside School Hours Care. Services currently provided at The Learning Tree, Deakin School for Early Learning, Deakin Early Education Centre and Canberra Girls Grammar Early Learning Centre have no vacancies.
Southside Community Services, Community Development Officer.	Southside Community Services provides a range of services including child, youth and family support services. Home and Community Care is currently provided to some clients living in Yarralumla. This program provides outreach support to older people and people with disabilities. All services are currently near capacity. Changed funding arrangements currently being implemented will enable clients to choose a service provider. People living in Yarralumla will generally have access to services provided by Southside Community Services, Woden Community Services or Communities@work.

Council on the Ageing, Hughes Community Hall	COTA provides advocacy and information to assist older people in areas such as housing. The Hughes Community Hall is used by a range of organisations, and is heavily used during the day by the University of the Third Age (U3A).
Uniting Church Hall at Yarralumla, hall bookings officer.	As well as church-related activities, the hall is also used regularly by dance groups and choirs. There are also larger events such as an Art Show and Garage Sale. The hall has also been used for community meetings and consultations. The Uniting Church facilities are also used for regular weekly services by a Samoan Church group. The Uniting Church has capacity to accommodate, and would welcome new members from the CB & E development.
Yarralumla Residents Association	Have prepared a substantial submission identifying a range of issues including: • more information sought on public transport options, community facilities and planned new amenities; • detailed plans for restoration & adaptive reuse of the Brickworks site needed; • more green space as part of the development, retention of trees and existing walking trails; and • increased parking at local shops, medical centres & other facilities in Yarralumla & Deakin.
Yarralumla Local Shops , IGA supermarket owner	Concern that many of the current customers of the Yarralumla supermarket use Dudley Street to enter or leave Yarralumla, and will no longer be able to do so. This will impact the viability of the Yarralumla IGA. Concern that the proposed additional sq metres of commercial space could include a Woolworths supermarket. This would not be appropriate in a site that is not a Group Centre or Town Centre, and would jeopardise the viability of local shops at Yarralumla, Deakin and Hughes. Parking at the Yarralumla local shops is a current concern that is being discussed with TAMS. An increase in cafes at the Yarralumla local shops has meant that there is a need for more short term parking for people who just want to go to the supermarket or chemist.
Territory and Municipal Services (TAMS)	Initiatives are being pursued to address parking near the Yarralumla shops.

APPENDIX D

This appendix provides additional information on social infrastructure benchmarks and social infrastructure provision elsewhere.

Social Infrastructure benchmarks in other jurisdictions

Table 11 to Table 14 show the various benchmarks for the provision of community and recreation facilities in New South Wales, Queensland and Victoria. The comparison of benchmarks shows that recommended benchmarks vary as some include a provision ratio, others specify catchment areas, and others nominate age cohorts. There are also differences between jurisdictions in the way that terminology is used.

TABLE 11. COMMUNITY FACILITY GUIDELINES

Facility type	NSW	Qld UDLA	Greater Geelong
Community hall/centre	1:6,000 people	Neighbourhood centre 1:2,000-3,000 people	1: 6,000-10,000 people
Arts facilities, theatres, performance space	1:30,000 people	1:30,000-150,000 people	1: 50,000-200,000 people
Libraries	1:33,000-40,000 people	1:15,000-30,000 people	1: 6,000-15,000 people
Youth centres, including Scout/Guide halls	1:20,000 people	1:10,000-20,000 people	1: 20,000 people

Sources: NSW Dept of Planning and Infrastructure Growth Centres Development Code – Local and district community facility requirements for Austral- Leppington North, p 60.
NSW South West Growth Centre Development Code Precinct Development Parameters Oct 2006, page A11.
Queensland Community Facilities ULDA Guideline No 11, pages 6,7,9, www.dsdip.qld.gov.au/resources/quideline/pda/guideline-11-community-facilities.pdf.
Greater Geelong Sustainable Communities Infrastructure Development Guidelines, P 46

TABLE 12. HEALTH AND AGED CARE GUIDELINES

Facility type	NSW	Qld UDLA	Greater Geelong
Hospitals	2 beds:1,000 people	Likely to serve a catchment of over 100,000 people	Public 2.6 beds: 1,000 people Private 1.7 beds: 1,000 people
General practice and specialist medical services	1 integrated primary health GP:1,300 people – also identifies Australian Govt. preference for 1 GP: 1,500 people.	Included in community health centre provision	1.48 GP: 1,000 people
Community health centre	1:20,000 people	1:20,000-30,000 people	Early Childhood Centre 1: 4,000 – 6,000 people Community Health Centre 1: 20,000- 30,000 people
Aged persons accommodation and services	High care nursing home 40 beds: 1,000 people 70+ years Low care hostel 48 places: 1,000 people aged 70+ years	Aged care/respite facility 1:7,000-10,000 people	High care nursing home 40 beds: 1,000 people aged 70+ years Low care hostel 48 places: 1,000 people aged 70+ years

Sources: NSW Dept of Planning and Infrastructure Growth Centres Development Code – Precinct Development Parameters Oct 2006, page A11 and Social Infrastructure & Demographic Assessment – Catherine Fields (Part) Precinct, page 31.
Queensland Community Facilities ULDA Guideline No 11, page7, www.dsdip.qld.gov.au/resources/guideline/pda/guideline-11-community-facilities.pdf.
GREATER GEELONG SUSTAINABLE COMMUNITIES INFRASTRUCTURE DEVELOPMENT GUIDELINES, P 46

TABLE 13. EDUCATION AND CHILD CARE GUIDELINES

Facility type	NSW	Qld ULDA	Greater Geelong
Long day child care	1 place:5 children 0-4 years	NA	1: 4,000-8,000 or 1: 5-7 children aged 0-4 years
After school and holiday child care	1 place:25 children 5-12 years	Located with primary school	1: 12,00-15,000 people
Preschools	NA	1:7,500 – 10,000 population	Kindergarten for a population of 3,000 – 5,000
Government Primary school education	1:1,500 new dwellings	1:3,000 dwellings	NA
Government High school education	1:4,500 new dwellings	1:17,000 dwellings	1: 20,000 people
TAFE	NA	District 1: 50,000+ people Regional 1: 150,000+ people	District 1: 30,000 people Regional 1: 150,000 people
Universities/higher education	NA	1:250,000+ people	1: 150,000 – 200,000 people

Sources: NSW Dept of Planning and Infrastructure Growth Centres Development Code – Local and district community facility requirements for Austral- Leppington North, p 60,62,64 and NSW South West Growth Centre Development Code Precinct Development Parameters Oct 2006, page A11.

Queensland Community Facilities ULDA Guideline No 11, pages 7,8,9, www.dsdip.qld.gov.au/resources/guideline/pda/guideline-11-community-facilities.pdf

Greater Geelong Sustainable Communities Infrastructure Development Guidelines, P 46

TABLE 14. EMERGENCY SERVICES AND PUBLIC SAFETY GUIDELINES

Facility Type	NSW	Qld ULDA	Greater Geelong
Fire and rescue	NA	Over 25,000 people	1:25,000-30,000 people
Ambulance	NA	1:25,000 people	1:25,000-30,000 people
Police services	NA	1:20,000-30,000 people	1:25,000-30,000 people

Sources: Queensland Community Facilities ULDA Guideline No 11, pages 6,7,8,www.dsdip.qld.gov.au/resources/guideline/pda/guideline-11-community-facilities.pdf.
Greater Geelong Sustainable Communities Infrastructure Development Guidelines, P 46

Social Infrastructure provision in comparable suburbs in the ACT

Along with benchmarks adopted for the provision of social infrastructure in other jurisdictions, a comparison with other ACT suburbs with a similar population is also useful to determine what community facilities and services (including retail services) an expanded suburb of Yarralumla with a population of around 6,000 would require.

Bruce

The residential areas of the suburb of Bruce have been built in stages, with the first stage (often referred to as "South Bruce") developed over 20 years ago. Building of subsequent stages is continuing with new apartments and townhouses still coming on the market in the northern and north-western parts of the suburb.

Bruce had a population of 6,390 at the time of the 2011 Census. Retail and commercial facilities in Bruce are spread over several locations. There is a small local shopping centre near the intersection of Thynne Street and Eardley Street. This local centre includes a small convenience supermarket, a café and hairdresser. There are other commercial and professional service offices close by, and a separate cafe, restaurant and service precinct in Braybrooke Street. The University of Canberra campus also includes on-site retail and food service facilities.

Bruce includes a number of facilities that serve regional populations. These include the University of Canberra, the Bruce Campus of the Canberra Institute of Technology, Calvary Hospital, Radford College (a non-government co-ed school covering years K-12), Canberra Stadium, the CISAC pool and gym complex, older persons accommodation (including supported accommodation) facilities and child care services. Some health facilities, such as specialist doctors and allied health services, are provided on the Calvary Hospital site. Additional hospital and allied health services are also being built on the site of the University of Canberra. There are no Government schools located in Bruce, with students living in Bruce accessing Aranda and Kaleen Primary Schools, Canberra High School and Ginninderra College in adjacent suburbs. There are also no stand-alone places of worship, but there are some worship facilities on sites primarily used for other purposes such aged persons accommodation or non-government schools.

Watson

Watson had a population of 5,123 at the time of the 2011 Census. A large part of the suburb of Watson was developed in the 1960s, mainly as detached housing, but with some units also included. More recently, the northern part of the suburb has been developed with a much higher proportion of attached town houses and apartments.

The suburb of Watson includes a long-established local shopping centre with an IGA supermarket and a number of smaller shops and cafes. At the northern edge of the suburb is a mixed use precinct that includes a petrol station and motel. This precinct serves a broader client group, particularly people travelling on the Federal Highway between Canberra and Sydney. There is also a caravan park.

Watson includes a Government primary school, and the Rosary Catholic Primary School. It also includes Canberra Technology Park and a campus of the Australian Catholic University. The Canberra Potters Society is located in Watson. There are also a number of churches and child care facilities. There are no residential aged care facilities in Watson, but there is a nursing agency located in Mary Kitson Street, Watson.

Lyneham

Lyneham had a population of 4,484 at the time of the 2011 Census. Much of the older part of Lyneham was developed in the 1960s, although there has since been redevelopment of some of this lower density housing, particularly around the Lyneham local shops and along the Northbourne Avenue corridor.

The area north of Ginninderra Drive was developed in the late 1980s, much of it for medium density housing.

The Lyneham local shopping centre is a vibrant hub that includes an IGA supermarket, restaurants, cafes, a chemist, a newsagent, hairdresser, speciality shops and licensed premises. Adjacent to the Lyneham local shops is a medical centre, a dentist and other small scale professional offices. Other medical and allied health services are located nearby.

There is a separate but smaller local shopping centre at North Lyneham. This shopping centre includes a mini-mart, restaurant and take away food shop, medical and dental facilities, a hairdresser and other professional offices. On Mouat Street there is also a motel and an inn with a beer garden.

Access by car between the older part of Lyneham and the area north of Ginninderra Drive is via main arterial roads. There is a direct walking and bike path connection via an overpass over Ginninderra Drive.

Lyneham includes a Government primary school that serves a local population catchment, and a Government high school that serves a number of inner North suburbs as well as Lyneham. Within Lyneham there is also a non-government school, Brindabella Christian College. Brindabella Christian College is a co-ed school covering all years from preschool to Year 12. There is also an on-site child care centre on the Brindabella Christian College campus.

In addition to the child care facility at the Brindabella Christian College, there is another long day care centre in Wattle Street. Lyneham Primary School includes on-site after-school care. There are two residential aged care facilities on Archibald Street, Lyneham. There are also a number of places of worship and religious-associated use in Lyneham, including a Buddhist Centre and Monastery.

The suburb of Lyneham also includes a number of sporting and recreational facilities that serve a regional population. These are generally in the north to north east of the suburb and separate from the main residential areas. These facilities include tennis, hockey and netball centres and playing fields, a golf course, a race course for horses and Exhibition Park in Canberra (EPIC). There is also the Kamberra Wine and Function Centre and the Canberra Veterinary Hospital. The Yowani Country Club, which manages the golf course, also includes bowling greens, motel units, a restaurant and conference facilities.

Contact us

CANBERRA

Level 6, 39 London Circuit
Canberra City ACT 2601

+61 2 6263 5940
sgsact@sgsep.com.au

HOBART

Unit 2, 5 King Street
Bellerive TAS 7018

+61 (0)439 941 934
sgstas@sgsep.com.au

MELBOURNE

Level 5, 171 La Trobe Street
Melbourne VIC 3000

+61 3 8616 0331
sgsvic@sgsep.com.au

SYDNEY

209/50 Holt Street
Surry Hills NSW 2010

+61 2 8307 0121
sgsnsw@sgsep.com.au

SGS Economics & Planning

BLOC

Former Brickworks Redevelopment, Yarralumla

Climate Adaptation Plan

Report Ref

Rev 0 | 7 April 2021

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 276289

Arup Pty Ltd ABN 18 000 966 165

Arup
Level 5
151 Clarence Street
Sydney NSW 2000
Australia
www.arup.com

ARUP

Document verification

ARUP

Job title		Former Brickworks Redevelopment, Yarralumla			**Job number** 276289
Document title		Climate Adaptation Plan			**File reference**
Document ref		Report Ref			
Revision	**Date**	**Filename**	Draft CCRA Report.docx		
Draft 1	22 June 2020	**Description**	First draft		
			Prepared by	Checked by	Approved by
		Name	Linda Slechta	Roger Swinbourne	Roger Swinbourne
		Signature			
Rev 0	7 April 2021	**Filename**	CCRA Report_Final April21		
		Description	Final Report for Issue		
			Prepared by	Checked by	Approved by
		Name	Linda Slechta	Roger Swinbourne	Roger Swinbourne
		Signature			per
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
				Issue Document verification with document	✓

Contents

		Page
1	**Introduction**	**2**
1.1	Document purpose	2
1.2	Document approach	2
2	**Scope of Assessment**	**4**
2.1	Stakeholder Consultation	4
2.2	Key Stakeholders	4
2.3	Project description	5
3	**Context**	**7**
3.1	Project Context	7
3.2	Statutory Context	7
3.3	Standards and credit requirements	9
4	**Historic and existing climate context**	**10**
4.1	Mean temperature anomalies	11
4.2	Urban heat and mircoclimate	13
5	**Climate change projections**	**15**
5.1	Climate change scenarios	15
5.2	Time scales	16
5.3	Projections	16
6	**Impact Assessment**	**21**
7	**Risk Assessment**	**22**
7.1	Methodology	22
7.2	Risk analysis	25
8	**Adaptation responses**	**32**
8.1	Urban heat and microclimate	32
8.2	Climate change adaptation responses	34
9	**Next steps**	**39**
10	**Conclusions**	**40**
11	**References**	**41**

Appendices

Appendix A

Climate change risk assessment spreadsheet

1 Introduction

This chapter introduces the proposal and proponent while describing the purpose and structure of this report.

1.1 Document purpose

The purpose of this document is to assist the Project understand and assess the implications of projected climate change on the design, construction and operations of the proposed Brickworks masterplan development.

The Climate Adaptation Plan (CAP) delivered in this document also meet the requirements of the Green Building Council of Australia's (GBCA) Green Star Adaptation and Resilience credit.

It reports on the outcomes of the Climate Risk Assessment (CRA) workshop held in June 2020 and identifies climate-related risks, their impacts and ratings, as well as proposed mitigations and revised ratings. The intention of the CAP is to:

- Inform the process of integrating climate change adaptation measures throughout the design, construction and operation of the Project;
- Contribute to achieving the Project's environmental approvals requirements (within the EIS); and
- Contribute towards attainment of GBCA's Adaptation and resilience credit under the Green Star Communities v1.1 rating tool.

1.2 Document approach

The following outlines specific requirements as part of the projects Scoping Report which must be addressed within the Environmental Impact Statement (EIS) document. Some of these items are being addressed in separate technical reports as referenced.

Table 1: EIS requirements cross reference

EIS requirements	Where addressed
Information on how the proposal will reduce the risks from climate change impacts and include proposed adaptation measures to reduce vulnerability and increase resilience of the community and the Territory, particularly to the extreme events of heatwaves, droughts, storms with flash flooding and bushfires	Sections 6 and 8
Address impacts on the local microclimate and how it will avoid contribution to urban heat and positively contribute to urban cooling measures	Section 4.2

EIS requirements	Where addressed
Address the contribution the proposal will make to reducing greenhouse gas emissions and meeting the legislated target for a net zero emissions Territory (by 2045 at the latest)	GHG technical paper
Consider the risks of extreme climatic events upon future residents and how the precinct has been designed to deal with climatic extremes	Section 6
Consider the likely increase in heat retention as a result of increased concrete and hard, landscaped areas. Provide mitigation measures to minimise increases in temperature and promote cooling through design and landscaping	Section 8.1
Investigate the impact of increasing residential and vehicular activities upon greenhouse gas emissions	GHG technical paper
Describe the design and layout of the site and provide details of building orientation and materials to achieve solar passive design. Provide details of mitigation methods to reduce reliance on mechanical heating and cooling	GHG technical paper
Outline proposed climate change adaption measures to reduce vulnerability and increase resilience of the community	Section 8.2
Describe how the site design and landscaping will contribute to the 30% Urban Environment target for coverage, in accordance with Canberra's Living Infrastructure Plan: Cooling the City	Section 8.1

2 Scope of Assessment

In the development of the CAP for the proposed masterplan development, Arup undertook climate risk and adaptation assessment in three stages: determining relevant scenarios of present and future climate change for use in risk assessment; a preliminary risk assessment; and stakeholder consultation and risk validation.

2.1 Stakeholder Consultation

This Climate Adaptation Plan was developed in collaboration with project stakeholders and included the following activities:

- Identifying key stakeholders and creating opportunities for them to input appropriately to the risk assessment process;
- Explaining the climate change scenarios for two time periods (2030; 2070) relevant to the project life cycle, and associated climate projections to the stakeholders;
- Mapping, in collaboration with the design team, climate variables relevant to each aspect of the design;
- Workshop with key stakeholders to identify potential design or operational activities impacted or at risk against relevant climate variables, along with a preliminary review of potential risk;
- Identifying and evaluating potential adaptation actions with the design team to manage unacceptable risks to the project;
- Run climate hazard scenarios, and determine the likelihood and consequences of potential impacts;
- Agreeing on the likelihood and consequence estimates and descriptions to produce a climate change risk register for the project.

2.2 Key Stakeholders

The key stakeholders involved in consultation are listed below:

- Project and construction managers
- Landscape Architect
- Utilities, energy and civils
- Architect
- Environmental consultant
- WSUD specialist
- Climate Change and ESD consultants

A climate change risk assessment workshop was held in June 2020 and was attended by the key stakeholders as noted above. The objective of the workshop was to provide background information on climate adaptation planning, present expected climate variability and change for the site, complete climate change scenarios for the masterplan and assets and undertake impact assessment and adaptation action planning exercises.

2.3 Project description

The Brickworks is a proposed low to medium density, residential development project at the former Canberra Brickworks at Yarralumla. The project will provide a maximum of 380 residential dwellings and recreational parkland around the re-purposed Brickworks heritage buildings. Given the heritage value of the site, the residential development will focus on maintaining the urban parkland that fits in with the existing landscape and surround urban areas.

The project will be divided into four distinct precincts, including:

- Low density dwelling houses to the east of the gravel pit
- Southern precinct which will include residential buildings including mix of houses, townhouses and apartment buildings
- Higher density, more urban residential setting to the west of the brickworks
- Brickwork heritage precinct including the repurposed buildings to allow for retail and commercial spaces

The site location is provided in Figure 1.

Figure 1 Site location

3 Context

3.1 Project Context

Arup was commissioned by Bloc to provide a high-level assessment of the current Yarralumla Brickworks Masterplan to achieve a 5 stars rating under Green Star Communities v1.1 rating tool. The Green Star Communities tool assesses the Communities scale development based on four categories, namely Governance, Liveability, Economic Prosperity and Environment. It also recognises and encourages the adoption of innovative technologies and programs that foster market transformation towards a sustainable building.

3.2 Statutory Context

3.2.1 Commonwealth

National Climate Resilience and Adaptation Strategy (2015)

This strategy articulates how Australia is managing the risks of a variable and changing climate. It identifies a set of principles to guide adaptation practices and the role of State and Territory Governments in delivering adaption responses for transport infrastructure and services.

Critical Infrastructures Resilience Strategy (2010)

This strategy aims to allow continuous operation of critical infrastructure in the face of all hazards. This strategy defines critical infrastructure as the “facilities, supply chains, information technologies and communication networks which, if unavailable, would significantly impact the wellbeing of Australians or their national security”. Resilience refers to coordinated planning across sectors and networks including responsive, flexible and timely recovery measures and an organisational culture that can give a minimum level of service during interruptions while quickly returning to full operation.

Smart Cities Plan (2016)

This plan sets out the vision for maximising the potential of our cities. This includes making smarter: infrastructure investments in accessibility, jobs, housing and healthy environments; developing policies that unlock public and private investment in main economic centres; and embracing new technologies that help define how cities are planned, function, and how economies grow. The Plan makes clear the Australian Government’s drive to use energy efficient technologies focussed on “innovations in climate change”.

3.2.2 Territory

ACT Climate Change Strategy 2019-25

The strategy outlines many actions regarding climate change and infrastructure adaptation including:

- Monitor climate change projections and ensure infrastructure and services are resilient to climate change impacts.
- Plan for efficient and sustainable urban land use to reduce emissions and maintain and enhance living infrastructure and biodiversity.
- Apply Canberra's Living Infrastructure Plan to work towards 30% urban canopy cover and 30% surface permeability, account for the value of living infrastructure and assess local needs for managing heat.
- Develop more climate-ready infrastructure that would help protect against future environmental threats.

Canberra's Living Infrastructure Plan: Cooling the City

Canberra's *Living infrastructure plan: cooling the city*, provides strategic direction to help the city's expanding and densifying metropolitan areas become better prepared for and more resilient to climate change. It identified options and opportunities provided by living infrastructure measures to enable residents and visitors to enjoy the benefits of climate resilience, amenities of nature, economic prosperity and health and wellbeing.

The Plan recognises the balance needed between urban density, with a growing population, and the natural environment, green spaces and trees. The actions in the Plan are to ensure appropriate planning, design, construction and managing the city in a way that values, incorporates and protects natural assets to strategically reduce climate vulnerability and safeguard the liveability of Canberra.

The Plan's success will rely on developments and local community taking collective action to enhance the natural environment, hence the importance of appropriate design considerations for the Brickworks project to contribute to this action.

3.3 Standards and credit requirements

The following standards and credit requirements have informed the structure of the Climate Change Risk Assessment carried out for the proposal.

Standards and requirements

The risk assessment method has been developed consistent with the following standards:

- AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines and ISO/IEC 31010 Risk Management – Risk assessment techniques
- AS 5334-2013 Climate change adaptation for settlements and infrastructure − A risk-based approach, which follows ISO 31000:2009 Risk Management – Principles and guidelines
- Green Star Communities v1.1 Submission Guidelines

Green Star Communities – Adaptation and Resilience

There are four points available for adaptation and resilience under GS Communities v1.1. This report aims to address 4.1 Climate Adaptation under the credit.

Process	4.1	Climate Adaptation	**2 points** are available where: • a **project-specific** Climate Adaptation Plan (CAP) has been developed in accordance with a recognised standard; and • ‖Solutions have been included into the plan for development that specifically address the risk assessment component of the adaptation plan.‖R1.04.01
Process	4.2	Community Resilience	**2 points** are available where, prior to the occupation of any habitable building on the project site, a **project-specific** Community Resilience Plan (CRP) has been developed that addresses preparation, during- and post-disaster communication, safety, and response.

A Community Resilience Plan is being developed and will be informed by outcomes of this assessment.

4 Historic and existing climate context

Canberra has a warm and temperate climate with hot summers, dry autumns and cool winters (ACT Climate Change Strategy, 2019-25). The following figures 2 - 4 illustrate the climate statistics from the Bureau of Meteorology (BoM) between 1996 and 2020 for Tuggeranong weather station, the closest weather station with long term climate statistics and similar climate conditions to the subject site, located approximately 10 km to the south of the site. The key observations are:

- Annual mean maximum and minimum temperatures are 20.9ºC and 7.0ºC respectively; the mean number of days per year above 35ºC is 9.1 days.
- The total annual mean rainfall is 607 mm, with mean rainfall higher in November through to February; the mean number of days per year with rainfall above 10mm is 20 days.
- Relative humidity (RH) at 9am typically ranges between 59-83%, and RH is generally greater in the winter months.

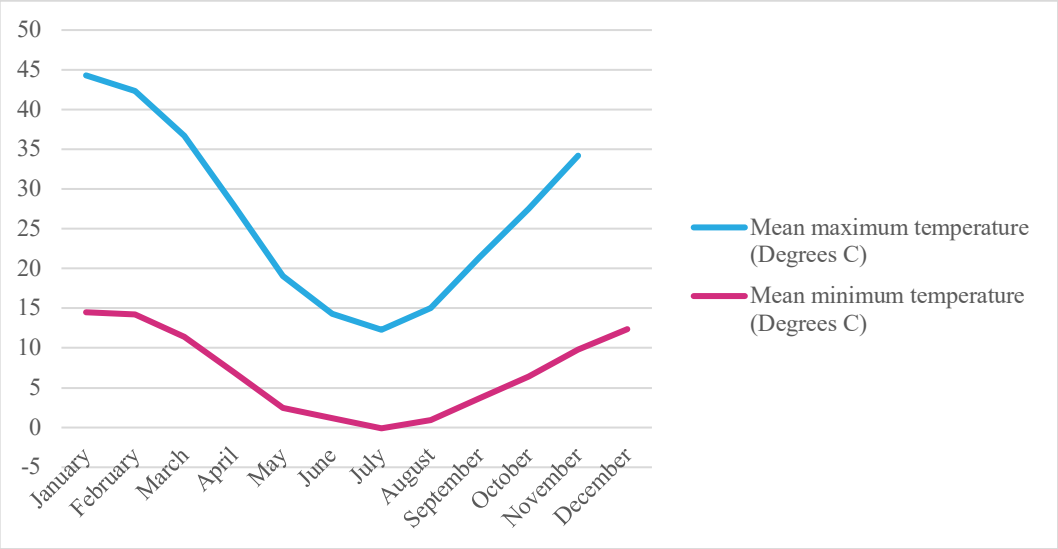


Figure 2 Historic annual mean maximum and minimum temperatures (1996 – 2020)

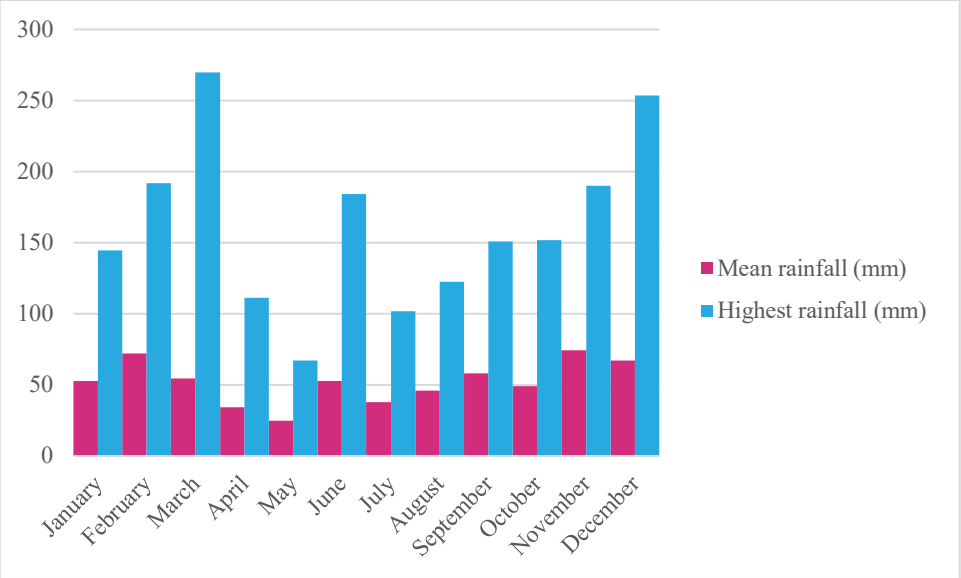


Figure 3 Historic annual mean rainfall (1996 – 2020)

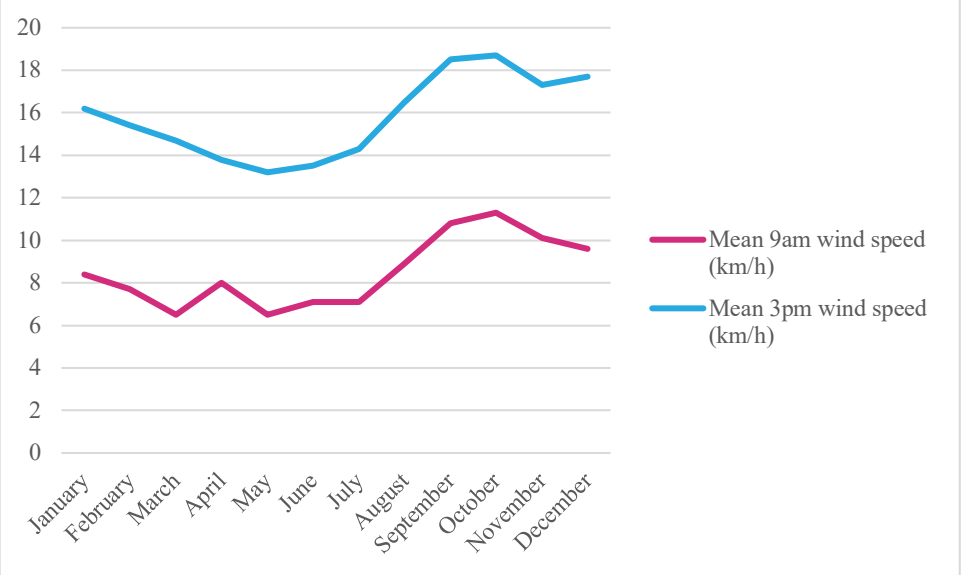


Figure 4 Historic mean wind speed (1996 – 2020)

4.1 Mean temperature anomalies

Australia's warmest year on record; 2019 had an annual national mean temperature 1.52 °C above average, surpassing the previous record of +1.33 °C in 2013. Warmth was widespread and persistent throughout 2019 — January, February, March, April, July, October, November, and December were all amongst the ten warmest on record for Australian mean temperature for their respective months. January, March, and December were the warmest on record, with January and December exceeding their previous records by a substantial 0.98 °C and 1.08 °C respectively.

The following charts are from global and national data which demonstrate mean temperature anomalies year on year.

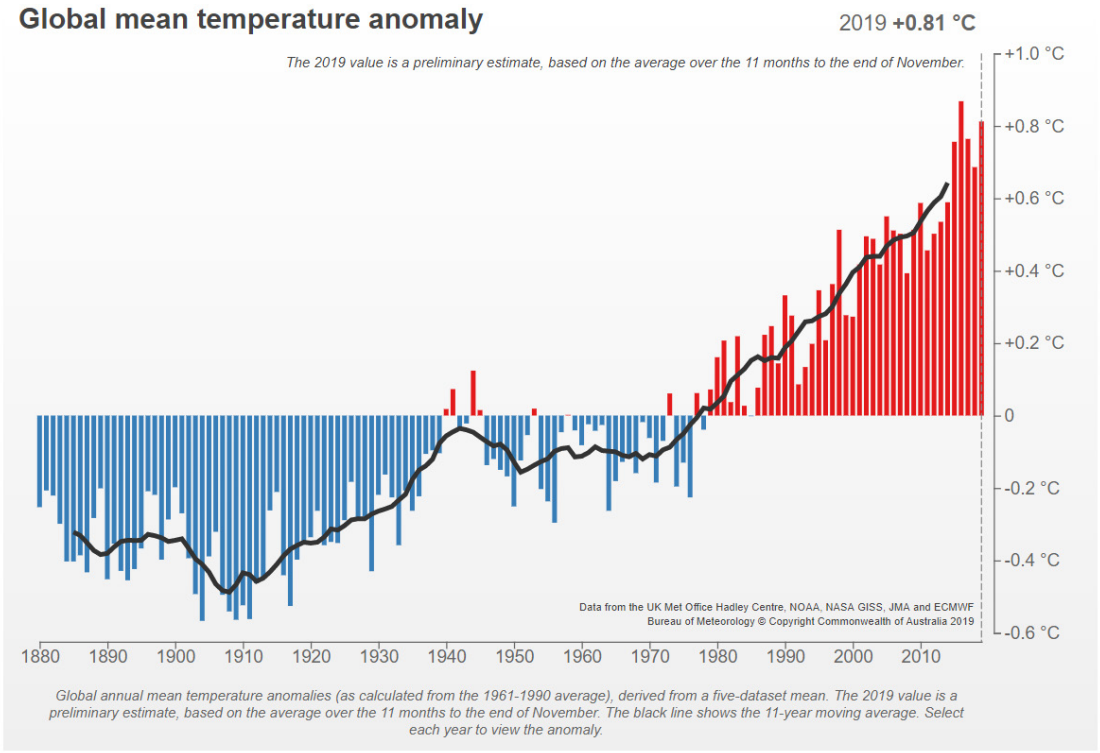


Figure 5: Global mean temperature anomalies (1880 – 2010) (BOM, 2019)

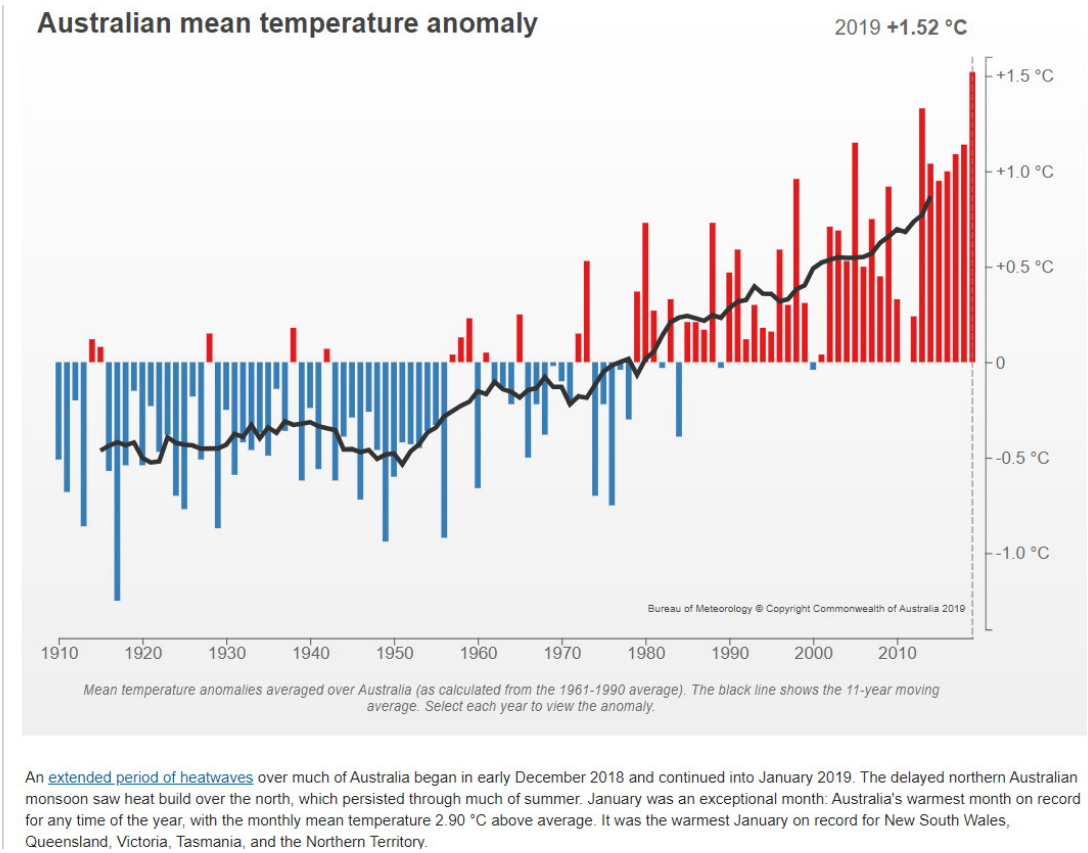


Figure 6: Australian mean temperature anomalies (1910 – 2010) (BOM, 2019)

The ACT Government has recognised that the climate of Canberra is already changing and that extreme weather events will occur more frequently and with more intensity, particularly heatwaves, droughts, storms and bushfires.

Impacts of climate change are already being observed in the ACT. The ACT Climate Change Strategy 2019-25 outlines that more hot days (above 35 degrees Celsius) and fewer cold nights in the ACT region are already observed, with the hottest day recorded in history observed in January 2020 with 44 degrees Celsius recorded in the Canberra CBD

Since the 1950s, average temperatures in the ACT have increased by about 1° C and in the last 55 years, increases to all heatwave characteristics have been observed.

4.1.1 Precipitation

Rainfall is highly variable. Drier conditions were experienced in the first half of the 1900s, with more variability in rainfall then seen between 1950 and 2000. The Millennium Drought characterised the early part of the 21st century through below average rainfall (NSW OEH, ACT Gov, 2014).

The Murray Basin cluster within which the Canberra region is located, has experienced differing rainfall variability in the past 15 years, including the record-breaking Millennium drought, affecting the Murray Basin cluster region. This ended with two of the wettest years on record for Australia (2010-2011 – BOM, 2012)

4.2 Urban heat and mircoclimate

The urban heat island (UHI) effect is the elevated temperature experienced in urban areas compared to surrounding areas given the dynamic interplay between the urban fabric (urban materials and geometry, orientation and configuration), urban land cover (the ratio of natural and built environments) and the urban metabolism (anthropogenic effects). Each of these factors can shape the temperature of the urban environment and can lead to greater absorption of solar radiation, reduced convective cooling and lower water evaporation rates as shown in Figure 7.

Microclimate is the climate effects at the local precinct or street scale and can relate to the landscape and urban design that has a direct impact at the local scale on human and environmental comfort.

In Canberra's Living Infrastructure Plan, the urban heat island effect showed up to a 10°C or more temperature difference between different parts of Canberra on a hot day. Other studies have shown that on average in different parts of Australia the difference in urban daytime temperatures can be 10-15°C greater than rural areas, with it being a 5-10°C temperature difference at night-time (EPSDD, 2019). The magnitude of these temperature differences varies with seasons, location and the layout of the urban environment.

Factors that influence the UHI effect need to be well understood to ensure appropriate and effective mitigation strategies are implemented. As population growth and urban expansion drive new infrastructure during a time of predicted extreme weather events, mitigating the effects of UHI is critical to human health and the functioning and productivity of a city.

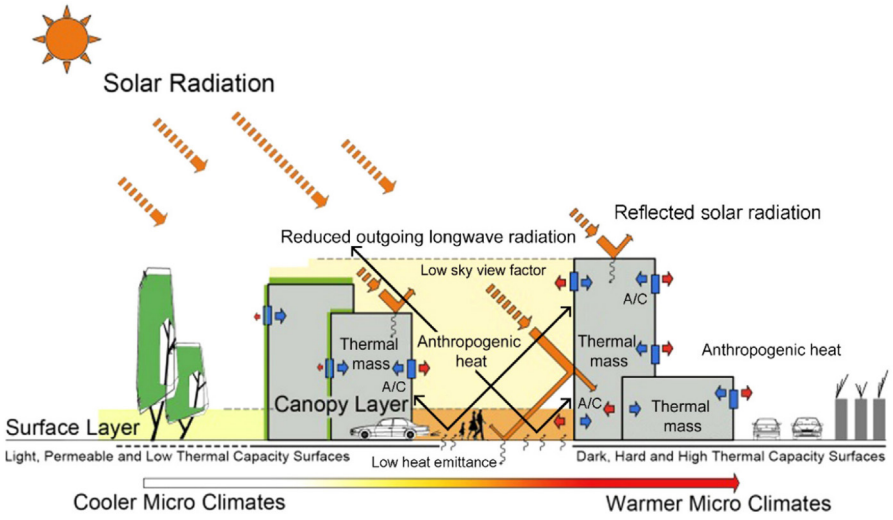


Figure 7- Urban Landscape and the UHI effect

Issues such as heat retention as a result of increased hardstand areas and materials with high thermal mass, such as concrete, bricks and tiles, act as a thermal battery. During summer they absorb heat during the day, and release heat during the evenings and nights, providing thermal comfort. In winter, the same mass can store heat from heaters or the sun, releasing it at night when temperatures are at their lowest.

The thermal comfort levels of an urban landscape are ultimately shaped by five fundamental processes; radiant heat from the sun, radiant heat reradiated from surfaces, air temperature and humidity, windspeed, direction and frequency, and anthropogenic effects (HVAC, transport, industry). Implementing proper design and integrating a variety of UHI mitigation strategies that deal with these factors can help cool the urban landscape, temper climate variances and improve thermal comfort levels. In turn, this can increase the value and productivity of the area, reduce incidents of heat stress and reduce energy consumption. Some of these design and mitigation strategies also offer additional benefits such as improving air quality, reducing stormwater runoff, reducing glare, dust mitigation, providing an acoustic barrier and improving the aesthetics of the space, which in turn improve the social and health outcomes for the region.

5 Climate change projections

5.1 Climate change scenarios

Climate projection data was sourced from the CSIRO's Australian Climate Futures (Climate Futures). Climate Futures is an interactive tool which references a range of global and regional climate models as well as statistically downscaled results to determine projection data for a range of climate variables as guided by the user.

Climate Futures uses the four Representative Concentration Pathways (RCPs) adopted in AR5 based on different greenhouse gas (GHG) scenarios. When applied, the RCPs describe four plausible climate futures for the project corridor, changing the levels of greenhouse gasses emissions that could be expected.

The RCPs are:

- RCP 2.6 – assumes global annual GHG emissions (measured in CO2-equivalents) peak between 2010-2020, and the decline substantially thereafter
- RCP 4.5 – assumes global annual GHG emissions peak around 2040, and then decline
- RCP 6 – assumes global annual GHG emissions peak around 2080, and then decline
- RCP 8.5 – assumes global annual GHG emissions continue to rise throughout the 21st century

Climate models suggest that global surface temperature change for the end of the 21st century is likely to exceed 1.5 degrees Celsius relative to 1850 to 1900 for all RCP scenarios except RCP2.6. Figure 8 displays the RCPs and corresponding carbon dioxide concentrations over time.

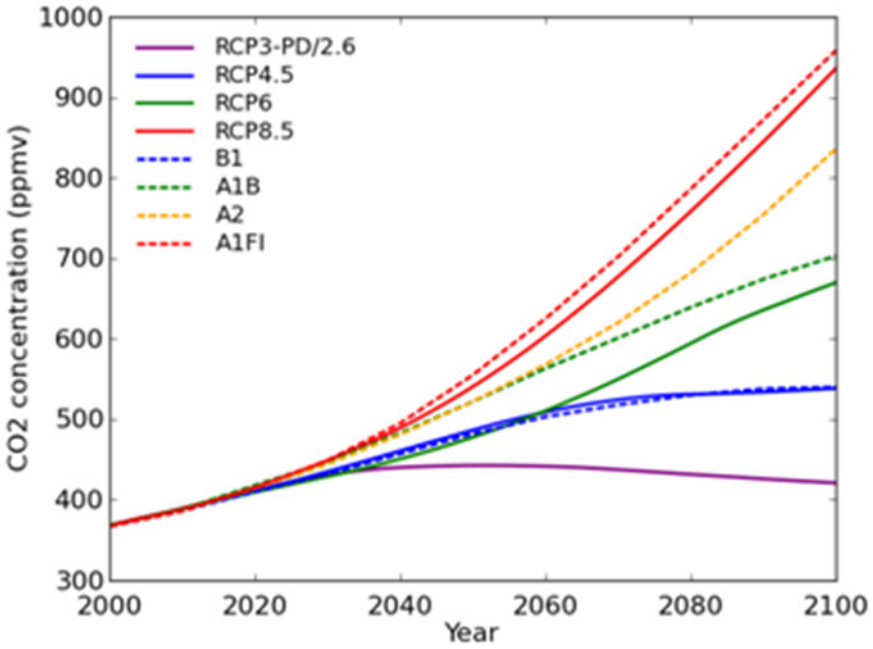


Figure 8: Comparison of Carbon dioxide concentrations for RCP scenarios (CSIRO and BOM, 2015)

For this project, RCP 8.5 has been considered in the climate projections. RCP8.5 corresponds to the pathway with modest rates of technological change and energy intensity improvements, leading in the long term to high energy demand and GHG emissions with weak climate policy commitments in Australia (business as usual). RCP 8.5 is considered a worst case scenario, and has therefore been used to derive the corresponding climate projections.

5.2 Time scales

Two time periods, 2030 and 2070 were selected to establish climate scenarios that represent the near-term and long-term design life of the masterplan development and associated infrastructure components.

5.3 Projections

Across Australia, there has been almost a one degree increase (0.9°C) in the average surface temperature since 1910 (CSIRO & BoM, 2014). Based on long term observations (1910 – 2013), mean surface air temperatures has increased by 0.80C, with a substantial increase in the number and frequency of hot days. The region has experienced prolonged periods of extensive dry periods, with less rainfall particularly in the cooler seasons (Murray Basin Cluster Report, 2014).

Projected changes for each of the climate variables relevant for the Canberra region are presented in Table 2 below.

Future projections provided further below are soured from the Murray Basin cluster report (CSIRO, 2014) under which the Canberra region is located.

Table 2: Climate projections - Brickworks

Climate variable	Specific climate variables for ACT	Current observations[1]	Main climate change impacts for ACT	
			By 2030	By 2070
Rainfall	Mean rainfall	607 mm	> Spring = decrease (-18% to -4%) > Summer = increase (-19% to +28%) > Autumn = increase (-12% to +48%) > Winter = decrease (-17% to +12%)	> Spring = decrease (-6% to -19%) > Summer = increase (-7% to +28%) > Autumn = increase (-9% to +54%) > Winter = decrease (-23% to +13%)
	Extreme rainfall	Not available	10% increase in rainfall intensity for every 1.0ºC increase	10% increase in rainfall intensity for every 1.0ºC increase
Temperature	Average daily maximum temperatures	20.9 ^{0}C	Increase by 0.6 – 0.9ºC	Increase by 1.4 – 2.3ºC
	Average daily minimum temperatures	7 ºC in winter	Increase by 0.6ºC	Increase by 2.0ºC
	Temperature (heatwaves, for example the average number of days over 35ºC)	9.1	Increase in number of hot days (1-5 extra days per year for Canberra)	Increase in number of hot days (10-20 extra days per year for Canberra)
	Cold nights	Not available	Decrease in number of cold nights (10-17 per cold nights year)	Decrease in number of cold nights (32-53 fewer cold nights per year)

[1] Based on data sourced from BOM Tuggeranong AWS weather station #070339 based on average for years 1996 – 2020 http://www.bom.gov.au/climate/averages/tables/cw_070339_All.shtml

Climate variable	Specific climate variables for ACT	Current observations[1]	Main climate change impacts for ACT	
			By 2030	By 2070
Bushfire	Bushfire Risk – average FFDI	Annual Average FFDI = 6.9	Increase in average Forest Fire Danger Index (FFDI)* during spring and summer	Increase in average and severe Forest Fire Danger Index (FFDI)* during spring and summer
	Bushfire Risk – severe FFDI days	Severe FFDI days per year = 1.1 (for example FFDI>50)	Increase in severe Forest Fire Danger Index (FFDI)* during spring and summer	Increase in severe Forest Fire Danger Index (FFDI)* during spring and summer

5.3.1 Temperature

Under the RCP 8.5, daily temperature maximums in Canberra indicate projections of a marked increase by 2090, with predicted increase in warm spells of 75 days compared to 1986 – 2005 time period (CSIRO, 2014). The number of days above 35^0C is expected to more than double under the RCP 4.5 scenario by 2090, with number of days over 40^0C more than tripling in occurrence.

5.3.2 Precipitation

In the near future (2030), year to year changes in rainfall will dominate trends caused by greenhouse gases. By the middle of the century, and under high emissions, winter and spring rainfall reductions will become evident against natural variability. Projections indicate while mean rainfall is tending towards a decrease, the extremes are projected to increase.

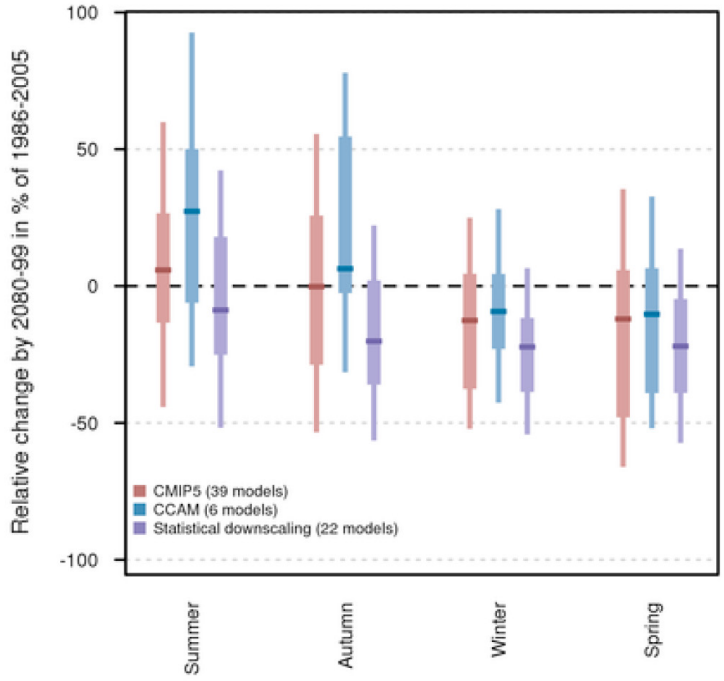


Figure 9 Projected near surface wind speed change between baseline period (19686-2005) and changes for 2090

5.3.3 Drought

In recent history, the Murray Basin cluster has been affected by three prolonged droughts. Projections indicate an increase in the percentage of time spent in drought and the frequency of extreme drought up to year 2090.

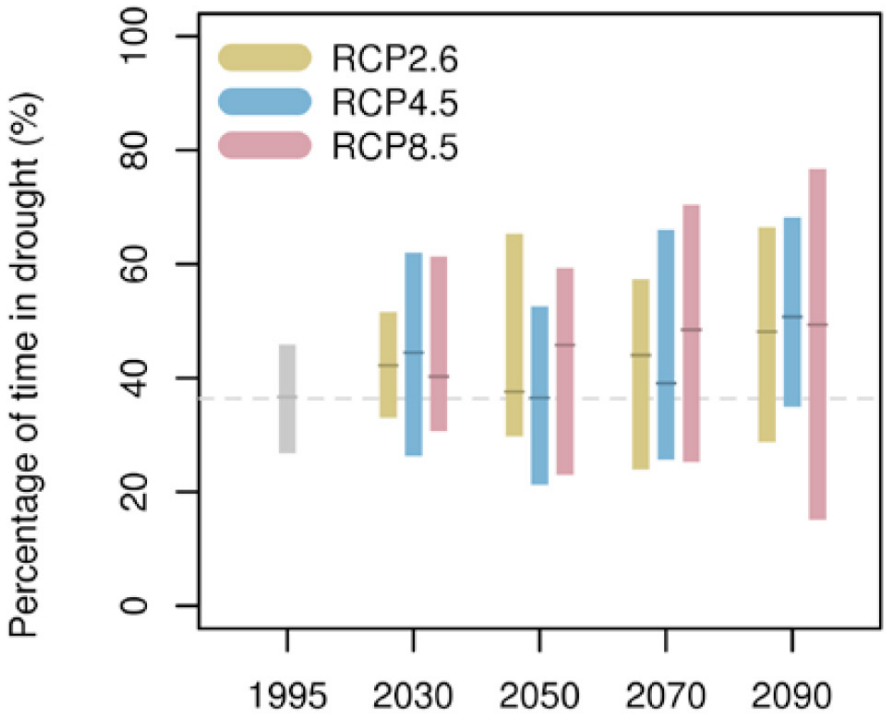


Figure 10 Projections of time spent in drought for Murray Basin region

5.3.4 Wind

Any notable projections changes to surface wind speed are expected during winter months, with indications that decreasing in wind speed will by more apparent during winter by 2090.

5.3.5 Fire weather

Fire weather is a measure of fuel dryness and abundance, as well a weather conditions i.e. hot, dry, and windy. CSIRO has estimated fire risk into the future based on the McArthur Forest Fire Danger Index (FFDI). This index uses 'drought factor' to estimate fuel dryness and inputs meteorological conditions. Modelling of climate change impacts on the fire regimes of the ACT landscapes predicts that a 20C increase in mean annual temperature would increase fire intensity by 25% and halve the mean interval between fires in the ACT (Department of Climate Change, 2009).

Focusing on the 2030 and 2090 timescales, the results indicate increased fire weather risk in the future, resulting from increased temperature combined with lower annual average rainfall.

6 Impact Assessment

Potential design or operational activities relevant to the Project and associated ancillary asset at risk or likely to be impacted were identified in a workshop with stakeholders. Impacts considered against respective climate variables identified in the workshop are outlined in Table 3.

Table 3: Potential climate impacts

Climate Variable	Direct/ Indirect impact	2030 – 2070 Potential Impact
Temperature	Direct	WSUD treatments more susceptible to extreme conditions Vegetation affected by temperature extremes leading to loss of trees/plants Health and safety of occupants, workers and visitors affected
Increase in extreme weather events – increased days >350C	Direct	Heat retention as a result of increased concrete, hard and landscaped areas Exposure of equipment/switchboards etc and potential for overheating Increased speed in degradation of building materials/facades or hardstand areas Heat retention in exposed metal contacts (handrails, children's playground etc) Increased temperatures affecting heat loads of buildings and occupants in particular on west facing facades
Bushfires	Indirect	Poor visibility, air quality and increased smoke resulting from nearby bushfires Bushfire risk and damage to infrastructure and utilities Restricted access to site due to bushfire threat
Increased precipitation	Direct	Flooding and subsequent damage to infrastructure and services Flow paths through the heritage areas resulting from increased wet weather Excess water loosening soils, in particular around heritage chimney Essential parts of site inundated Increased stormwater runoff from site Potential flooding of low level carparks
Drought	Direct	Reduction in water availability for irrigation
Wind	Direct	Increased structural load on buildings and infrastructure

7 Risk Assessment

Stakeholder engagement has been carried out to identify the potential impacts from the climate projections for 2030 and 2070. A risk assessment was then undertaken to assess the potential impacts identified for the development. The methodology and results of risk assessment are presented in this section.

7.1 Methodology

To evaluate the risks associated with impacts as a result of the projected climate change for 2030 and 2070 timescales, a qualitative risk assessment framework in line with the AS 5334 was undertaken. The risk management process is illustrated in Figure 11.

Risk is defined as the combination of consequences and likelihood. For each potential climate impact, the consequences and likelihood of occurrence were determined in accordance with Table 4 and Table 5. The risk rating for each combination of consequences and likelihood was outlined in Table 6.

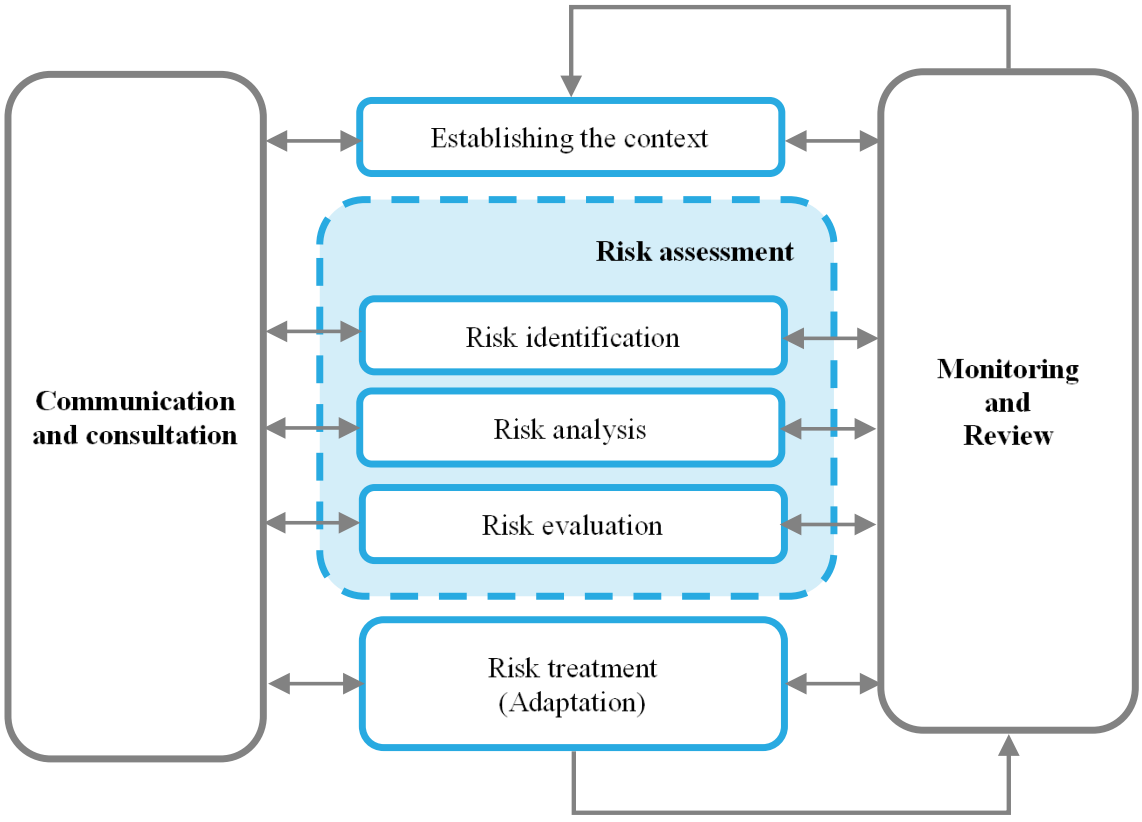


Figure 11: Risk management process (adapted from AS 5334-2013)

Table 4: Consequence scale

Level	Descriptor	Consequence	Environmental	Social	Financial
1	Insignificant	No change, limited impacts	No adverse effect on natural environment	No adverse human health effects or complaints.	Insignificant financial loss
2	Minor	Localised service disruption. No permanent damage. Some minor restoration work required. Lifespan reduced by 10-20%	Minimal effects on the natural environment.	Short-term disruption to employees, residents or businesses. Slight adverse human health effects or general amenity issues. Negative reports in local media.	Additional operational costs. Minor financial loss
3	Moderate	Widespread damage. Damage recoverable by maintenance and minor repair. Partial loss of local infrastructure. Lifespan reduced by 20-50%.	Some damage to the environment, including local ecosystems. Some remedial action may be required	Frequent disruptions to employees, residents or businesses. Adverse human health effects. Negative reports in state media.	Moderate financial loss
4	Major	Extensive damage requiring extensive repair. Lifespan reduced by >50%.	Significant effect on the environmental and local ecosystems. Remedial action likely to be required.	Permanent physical injuries and fatalities may occur from an individual event. Negative reports in national media. Public debate about performance.	Major financial loss
5	Catastrophic	Permanent damage and/or loss of service Retreat and translocation of development.	Very significant loss to the environment. May include localised loss of species, habitats or ecosystems. Extensive remedial action essential to prevent further degradation. Restoration likely to be requirement.	Severe adverse human health effects – leading to multiple events of total disability or fatalities. Emergency response. Negative reports in international media.	Significantly high financial loss

Table 5: Likelihood scale

Level	Descriptor	Description	Recurrent risk
A	**Almost Certain**	Event is almost certain to occur (90% probability) within the next 12 months or is imminent.	May occur several times per year
B	**Likely**	Event is likely to occur within the next 12 months (greater than 60% probability).	May arise about once per year
C	**Possible**	Event is possible within the next 12 months (30% probability) OR, has a reasonable chance (more than 50% probability) of occurring in next 3 years.	May arise once in 10 years
D	**Unlikely**	Event is not likely to occur in a given year (less than 30% probability).	May arise once in 10 to 25 years
E	**Very Unlikely**	The event may occur in exceptional circumstances (less than 1% probability) within the next 3 years).	Unlikely during the next 25 years

Table 6: Risk matrix.

			Consequence				
			1	**2**	**3**	**4**	**5**
			Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Likelihood	**A**	**Almost Certain**	Low	Medium	High	Extreme	Extreme
	B	**Likely**	Low	Medium	Medium	High	Extreme
	C	**Possible**	Low	Low	Medium	High	High
	D	**Unlikely**	Low	Low	Medium	Medium	High
	E	**Very Unlikely**	Low	Low	Low	Medium	Medium
			Recurrent risk				

7.2 Risk analysis

Following the stakeholder workshop, climate risks were identified for associated impacts. This was undertaken as a first pass and discussed and agreed with the relevant technical leads to support the identification of relevant adaptation measures.

The following table presents the likelihood, consequences and resulting risks for the three timescales considered by the project team. The likelihood was largely determined by the climate data whilst the consequences were indicated by the project team. A full copy of the risk spreadsheet as informed by the workshop and subsequent outcomes is provided in Appendix A.

Risk Number	Details of risk event	Impact of risk event	Present Risk			2030			2070		
			Likelihood	Consequence	Level or risk	Likelihood	Consequence	Level or risk	Likelihood	Consequence	Level or risk
Change in average air temperature											
1	Prolonged periods of heat or drought	Death of fringing vegetation in wetland treatment system	Likely	Minor	Medium	Almost certain	Minor	Medium	Almost certain	Minor	Medium
2	Extreme temperatures affecting vegetation	Leading to potential loss of trees/plants which aren't designed to withstand conditions	Likely	Minor	Medium	Likely	Minor	Medium	Likely	Minor	Medium
3	Extreme temperatures affecting occupant and visitor comfort	Health and safety of occupants, workers and visitors - in particular pedestrian traffic to and from outdoor parking areas	Likely	Minor	Medium	Almost certain	Minor	Medium	Almost certain	Minor	Medium
Increase in extreme weather events – increased days >35^{0}C											
4	Microclimate impacts	Heat retention as a result of increased concrete and hard, landscaped areas	Likely	Minor	Medium	Likely	Minor	Medium	Likely	Minor	Medium

Risk Number	Details of risk event	Impact of risk event	Present Risk			2030			2070		
			Likelihood	Consequence	Level or risk	Likelihood	Consequence	Level or risk	Likelihood	Consequence	Level or risk
5	Occupant comfort	Pedestrian comfort during extreme heat (Safety of users)	Possible	Moderate	Medium	Almost certain	Moderate	High	Almost certain	Moderate	High
6	Equipment design temperatures	Technology exposure / switchboards / cooling, equipment overheating	Possible	Moderate	Medium	Possible	Moderate	Medium	Possible	Moderate	Medium
7	Exposure of building and facades to extreme heat conditions	Increased speed degradation of building materials/ facades/hardscaped areas	Possible	Minor	Low	Possible	Minor	Low	Likley	Minor	Medium
8	User safety	Heat retention in exposed metal contact (handrails, Kids playgrounds etc), exposed railroad tracks	Likely	Minor	Medium	Almost certain	Minor	Medium	Almost certain	Minor	Medium
9	Increased temperatures affecting heat loads and resident comfort	West facing facades (considered in design), limited opportunity for heritage assets	Almost certain	Minor	Medium	Almost certain	Minor	Medium	Almost certain	Minor	Medium

Risk Number	Details of risk event	Impact of risk event	Present Risk			2030			2070		
			Likelihood	Consequence	Level or risk	Likelihood	Consequence	Level or risk	Likelihood	Consequence	Level or risk
10	Worker safety	construction delays due to prolonged periods of extreme temperature events	Possible	Minor	Low	Possible	Minor	Low	Possible	Minor	Low
Bushfires											
11	Smoke and visibility resulting from nearby bushfires	Bushfires within the proximity of the development may lead to smoke and limited visibility/poor air quality for occupants and residents.	Likely	Moderate	Medium	Likely	Moderate	Medium	Almost certain	Moderate	Medium
12	Bushfire threat to infrastructure	bushfire risk - damage to infrastructure (inner asset and outer asset protection zones)	Possible	Moderate	Medium	Possible	Moderate	Medium	Possible	Moderate	Medium
13	Accessibility for emergency services	Restricted access during bushfire events for emergency services	Possible	Moderate	Medium	Possible	Moderate	Medium	Possible	Moderate	Medium

Risk Number	Details of risk event	Impact of risk event	Present Risk			2030			2070		
			Likelihood	Consequence	Level or risk	Likelihood	Consequence	Level or risk	Likelihood	Consequence	Level or risk
Increased precipitation											
14	Increase extreme wet weather	Flooding and subsequent damage to infrastructure and services	Possible	Moderate	Medium	Possible	Moderate	Medium	Possible	Moderate	Medium
15	Increased extreme wet weather	Resulting in flow paths through the heritage area - challenges of managing heritage levels due to restrictions on development	Possible	Minor	Low	Possible	Minor	Low	Likely	Minor	Medium
16	Excess water from flooding	Excess water ingress leading to loosening of soils and potentially affecting stability of heritage chimney	Possible	Moderate	Medium	Possible	Major	High	Possible	Major	High

Risk Number	Details of risk event	Impact of risk event	Present Risk			2030			2070		
			Likelihood	Consequence	Level or risk	Likelihood	Consequence	Level or risk	Likelihood	Consequence	Level or risk
17	Flooding risk	Increased stormwater runoff from the site – stormwater facilities not built for more frequent more intense storm events	Possible	Moderate	Medium	Possible	Moderate	Medium	Possible	Moderate	Medium
18	Flooding risk	Essential parts of site inundated for the future scenario. Increase in frequency of damaging storms,	Possible	Moderate	Medium	Possible	Moderate	Medium	Possible	Moderate	Medium
19	Water ingress due to excess precipitation	potential flooding of low level carparks	Likely	Moderate	Medium	Likely	Moderate	Medium	Likely	Moderate	Medium
20	Increased severity of hail storms	Causing damage to property and personal injury	Possible	Moderate	Medium	Possible	Moderate	Medium	Possible	Moderate	Medium

Risk Number	Details of risk event	Impact of risk event	Present Risk			2030			2070		
			Likelihood	Consequence	Level or risk	Likelihood	Consequence	Level or risk	Likelihood	Consequence	Level or risk
Drought											
21	Reduced average rainfall events	Reduction in water supply to the wetland / pond treatment systems results in too little turnover and subsequent stagnation	Possible	Minor	Low	Possible	Minor	Low	Possible	Minor	Low
22	Prolonged dry periods	Reduction in water availability for irrigation	Possible	Minor	Low	Possible	Minor	Low	Likley	Minor	Medium
23	Increased wind loads	Increased structural load on buildings and infrastructure	Unlikely	Minor	Low	Unlikely	Minor	Low	Unlikely	Minor	Low

8 Adaptation responses

8.1 Urban heat and microclimate

There are a variety of ways UHI mitigation strategies can be incorporated into the urban landscape. Some methods involve new innovations and technology surrounding different compositions, types and colour of materials, while others use landscape design techniques to maximise the urban cooling effect.

The effectiveness of urban cooling strategies is heavily dependent on the local climate conditions and seasonal variabilities. Canberra experiences the range of seasons and is hot and dry in summer and cold in winter. Green infrastructure and shading can be used to combat high solar radiation intensity on hot summer days and choosing to use deciduous species on orientations that can help warm particular areas in the cold winter months. strategies in the Canberra's dry heat while high levels of annual rainfall means permeable paving can be utilised for additional cooling effects and stormwater management. The use of cool paving and structures to reflect away the urban heat can be effective, but the resulting glare that this can cause may limit its use in built up, high-traffic areas.

Integrating some of these design strategies and technologies can help reduce the UHI effect in Canberra and improve comfort levels immediately surrounding the Brickworks development. Combining a number of these strategies can have a cumulative effect and can often work better when employed together (e.g. canopy coverage, shading structures, high albedo surfaces). A summary of urban heat island mitigation strategies which have been considered in design of the masterplan development are presented in Table 7.

Table 7: UHI adaptation responses considered in design

UHI mitigation strategy	Design response	Design consideration
Urban green infrastructure	Tree canopy/planting – maximising canopy coverage where appropriate	Significant increase of tree canopy from exiting conditions and mature size on day of planting for immediate effect. New trees, including street trees and understory planting layer to be chosen from an appropriate species selection that are resilient to droughts and currently performing adequately within the local context
	Green roofs/green walls	To be further explored and implemented where possible

UHI mitigation strategy	Design response	Design consideration
Urban water	Active water features – old conveyor water feature	Water is an important element in the design and is the story telling element of the site past use A large water body located at Pittman Park collects all the water from site where is treated and then distributed to the site for many purposes such as irrigation or part of the design features.
	Permeable surfaces	To be further explored and implemented where possible
Materials	Solar reflective or light coloured paints/coatings and pavements	The paving and materials palette will take into account the heat mitigation by using light colours paving and implement permeable materials where possible
Shading structures	Solar radiation and reflection	Trees and vegetation will provide solar protection to the main gathering areas. The incorporation of shade structures and vegetated pergolas will be explored and implemented where possible

Implementation of the garden city design principles - to increase green space and canopy cover of the area, helps attribute to the cooling effects. Removal of the existing poor quality trees and vegetation, and replacement with higher quality vegetation which provides canopy cover and shading of exposed spaces. Establishment of green spaces, particularly at Pittman Park, where irrigated lawns and an ornamental lake will feature will help reduce temperature increases associated with the built surrounds. Extensive street planting along Quarry Drive will further provide shading and cooling effects along the site entrance.

The historic industrial nature of the site will also be maintained by retaining and reusing the concrete and other finish materials in the public domain areas. A water feature that brings water from the lake up via the historic conveyor belt to the old kiln site and public areas will also contribute cooling within the urban areas. The combination of the evaporation from the water feature and the shade from the tree canopy will assist in reducing the surface and air temperature providing a comfortable micro climate within the public domain area.

While the homage to the historic industrial nature of the site will retain concrete within some of the public domain areas, the water element which brings water from the lake up via the historic conveyor belt to the old kiln site and public areas will also allow cooling within the urban areas. Both the water feature and tree canopy from planted trees will assist in providing a comfortable micro climate within the public domain area.

The residential zones will sit amongst garden settings in contrast to the dominantly brick material used in construction, providing cooling and further minimising increases in temperature around the built up areas.

8.2 Climate change adaptation responses

As a result of the risk assessment and stakeholder consultation, the following adaptation options has been considered and included in the design and operational intent of the Project to improve the climate resilience – noting adaptation responses are not proposed for items identified as ‘low’ risk.

Where risks have been highlighted as 'high', mitigation measures have been implemented to reduce these risks to medium or lower. Intervention measures which are subsequently incorporated within design have also been considered for at least two of risks identified, in line with GS Communities requirements.

Table 8: Project Mitigation responses

Risk ID	Description of Impact	Initial Risk rating			Measures implemented	Residual risk rating		
		Present	2030	2070		Likelihood	Consequence	Risk
1	Prolonged periods of heat or drought	Medium	Medium	Medium	Wetland water levels monitored during heatwaves and adjusted as required to keep plants alive. Replanting program for any plants lost during extreme events	Likely	Minor	Medium
2	Extreme temperatures affecting vegetation	Medium	Medium	Medium	Planting of native species that are resilient to droughts - minimising erosion and degradation of soil	Possible	Minor	Low
3	Extreme temperatures affecting occupant and visitor comfort	Medium	Medium	Medium	Consideration of covered walkways, design considers wayfinding through site links and shared paths to minimise walking distances	Possible	Moderate	Medium
4	Microclimate impacts	Medium	Medium	Medium	No further mitigation measures proposed as impact not considered high risk	Likely	Minor	Medium

Risk ID	Description of Impact	Initial Risk rating			Measures implemented	Residual risk rating		
		Present	2030	2070		Likelihood	Consequence	Risk
5	Occupant comfort	Medium	High	High	Outdoor parking under cover or underground Appropriate design of wayfinding to minimise pedestrian exposure Implementation of garden city design principle to increase green space and canopy cover of the area through removal of existing poor quality trees and replacement with better quality vegetation Provision of water drinking fountains in public areas	Possible	Moderate	Medium
6	Equipment design temperatures	Medium	Medium	Medium	Locate systems appropriately. Providing shelter for equipment will reduce the impact of UV radiation and weather and increased temperature.	Unlikely	Minor	Low
8	User safety – heat retention on exposed metal	Medium	Medium	Medium	Consideration of shade structures for playgrounds Canopy coverage from replacement trees and vegetation to provide shading Use of alternative materials for playground equipment to be investigated to minimise heat retention	Likely	Minor	Medium

Risk ID	Description of Impact	Initial Risk rating			Measures implemented	Residual risk rating		
		Present	2030	2070		Likelihood	Consequence	Risk
9	Increased temperatures affecting heat loads and resident comfort	Medium	Medium	Medium	Deeper balconies proposed for western facing apartments, consideration of shading structures for afternoon sun, appropriate glazing selection to reduce solar heat penetration Look at maximising passive shading for residential buildings	Likely	Minor	Medium
11	Smoke and visibility resulting from nearby bushfires	Medium	Medium	Medium	100% recycled air in majority of apartments	Possible	Moderate	Medium
12	Bushfire threat to infrastructure	Medium	Medium	Medium	power and comms infrastructure u/ground Bushfire report been completed - inner and outer impact - existing APZ and possible amplification, lower fire potential plantings, maintained trees in park like fashion (reducing fuel loading)	Possible	Minor	Low
13	Accessibility for emergency services	Medium	Medium	Medium	Use of designated access/street for emergency service vehicles	Possible	Moderate	Medium
14	Increase extreme wet weather leading to flooding	Medium	Medium	Medium	No further mitigation measures proposed as impact not considered high risk	Medium	Medium	Medium

Risk ID	Description of Impact	Initial Risk rating			Measures implemented	Residual risk rating		
		Present	2030	2070		Likelihood	Consequence	Risk
16	Excess water from flooding loosening soil around heritage chimney	High	High	High	Chimney stacks currently structurally sound - continue to monitor as part of ongoing mgt, monitor structural performance. Assumed level of degradation within design, with structures to be retained water proofed etc	Possible	Moderate	Medium
17	Flooding risk affecting stormwater infrastructure ability to cope	Medium	Medium	Medium	No further mitigation measures proposed as impact not considered high risk	Medium	Medium	Medium
18	Flooding risk – inundation of site access	Medium	Medium	Medium	No further mitigation measures proposed as impact not considered high risk	Medium	Medium	Medium
19	Water ingress due to excess precipitation – flooding risk to lower carparks	Medium	Medium	Medium	Assess parking access road levels to minimise water ingress and provide strategies to manage excess water flow	Possible	Minor	Low
20	Increased severity of hail storms	Medium	Medium	Medium	Specify impact resistant building materials as required	Possible	Moderate	Medium

9 Next steps

This climate change risk assessment has been developed for the proposed Brickworks masterplan development, and the following actions would be undertaken as design progresses to ensure that relevant climate risks are considered at each stage of design. This will ensure the project has considered the future occupied environment along with relevant climate factors or variables which may impact the asset.

The following items are noted as the next steps following design progression and detailed design:

- Further develop and consider the work undertaken to date, in conjunction with relevant literature and data to identify and prioritise the key climate impacts and potential urban heat impacts likely to impact the functionality of the masterplan development and its impact on both the local and wider regional community
- Work with relevant stakeholders, including external stakeholder organisations to enable aligned approach to adaptation and response to climate change impacts and urban heat impacts across the broader region
- Collaborate with relevant stakeholders to develop and implement site specific Community Resilience Plan (CRP).

10 Conclusions

This report summarises the outcomes of potential climate change and urban heat impacts on the Brickworks masterplan development through completion of a climate change risk assessment. The report demonstrates a rise in climate uncertainty, affecting the future masterplan whereby considerations to be made through the design stage need to take into account rise in temperatures, the increase in the number of heatwaves per year and the potential for flooding.

Both direct climate change impacts (such as change in average temperatures) and indirect climate change impacts (such as reduced bushfires resulting in flow on impacts to service requirements) need to be taken into consideration when carrying out future climate change risk assessments.

Current weather conditions that lead to flooding and heatwaves, are predicted to increase in intensity over the coming years within the region due to an increase in temperatures and the number and intensity of storms. Through appropriate design and construction, future climate change assessments will assist in protecting the masterplan development from future extreme weather conditions.

11 References

ACT Government (2019). Canberra Living Infrastructure Plan: Cooling the City.

Australian Standard (2013) AS5334, Climate change adaptation for settlements and infrastructure – a risk based approach

Argüeso, D., Di Luca, A., Evans, J.P., Parry, M., Gross, M., Alexander, L., Green, D., Perkins, S. (2015) Heatwaves affecting NSW and the ACT: recent trends, future projections and associated impacts on human health. NARCliM Technical Note 5. Report to the NSW Office of Environment and Heritage. Sydney.

BoM (2020), Climate Statistics summary for Tuggeranong station, [online] available at:
http://www.bom.gov.au/climate/averages/tables/cw_070339_All.shtml

Canberra Times, 2020, available from
https://www.canberratimes.com.au/story/6566060/canberra-experiences-hottest-temperature-on-record/ accessed 15 June 2020

CSIRO. 2017. Climate Change in Australia: Projects for Australia's NRM Regions. Canberra: CSRIO, [online] available at:
https://www.climatechangeinaustralia.gov.au/en/support-and-guidance/contact/

CSIRO and Australian Bureau of Meteorology (2007), Climate Change in Australia – Technical Report, Commonwealth of Australia [Canberra].

CSIRO and Bureau of Meteorology (2015), Climate Change in Australia Information for Australia's Natural Resource Management Regions: Technical Report, CSIRO and Bureau of Meteorology [Canberra].

CSIRO (2016) Murray Basin Cluster Report, [online] available at:
https://www.climatechangeinaustralia.gov.au/media/ccia/2.1.6/cms_page_media/172/MURRAY_BASIN_CLUSTER_REPORT_1.pdf

Department of Climate Change, 2009 *Interactions between climate change, fire regimes and biodiversity in Australia*

Environment Planning and Sustainable Development Directorate (EPSDD) – ACT Government, 2019, ACT Climate Change Strategy 2019-25.

NSW Office of Environment and Heritage, ACT Government (2014), ACT Climate Change Snapshot.
Sides, Keirnan, Alexander, Mozqueira (2018), Creating Resilience to Risk in the ACT.
United States Environmental Protection Agency (2019). Reducing Urban Heat Islands: Compendium of Strategies. Washington, USA

Appendix A

Climate change risk assessment spreadsheet

Climate Change Risk Workshop				9/6/2020	Brickworks Masterplan												
					Present Risk			2030			2070						
								RCP 8.5 (2030)			RCP 8.5 (2070)				Residual Risk		
Item Number	Climate Variable	Direct / Indirect	Details of Risk Event	Impact of the risk event	Likelihood	Consequence	Level of Risk	Likelihood	Consequence	Level of Risk	Likelihood	Consequence	Level of Risk	Adaptation/Mitigation Strategy	Likelihood	Consequence	Level of Risk
1	Change in average air temperature	Direct	Prolonged periods of heat or drought	WSUD treatments more susceptible to extreme conditions	Likely	Minor	Medium	Almost certain	Minor	Medium	Almost certain	Minor	Medium	Wetland water levels monitored during heatwaves and adjusted as required to keep plants alive. Replanting program for any plants lost during extreme events	Likely	Minor	Medium
2	Change in average air temperature	Direct	Extreme temperatures affecting vegetation	Leading to potoential loss of trees/plants which aren't designed to withstand conditions	Likely	Minor	Medium	Likely	Minor	Medium	Likely	Minor	Medium	Planting of native species that are resilient to droughts - minimising erosion and degradation of soil	Possible	Minor	Low
3	Change in average air temperature	Direct	Extreme temperatures affecting occupant and visitor comfort	Health and safety of occupants, workers and visitors - in particular pedestrian traffic to and from outdoor parking areas	Likely	Minor	Medium	Almost certain	Minor	Medium	Almost certain	Minor	Medium	Consideration of covered walkways, design considers wayfinding through site links and shared paths to minimise walking distances	Possible	Moderate	Medium
4	Increase in extreme weather events – increased days >350C	Direct	Microclimate impacts	Heat retention as a result of increased concrete and hard, landscaped areas	Likely	Minor	Medium	Likely	Minor	Medium	Likely	Minor	Medium	Use of light coloured surfaces for light reflection and reducing heat retention Implementation of garden city design principles to increase green space and canopy cover	Likely	Minor	Medium
5	Increase in extreme weather events – increased days >35^0C	Direct	Occupant comfort	Pedestrian comfort during extreme heat (Safety of users)	Possible	Moderate	Medium	Almost certain	Moderate	High	Almost certain	Moderate	High	Outdoor parking under cover or underground Appropriate design of wayfinding to minimise pedestrian exposure Implementation of garden city design principle to increase green space and canopy cover of the area through removal of existing poor quality trees and replacement with better quatity vegetation Provision of water drinking fountains in public areas	Possible	Moderate	Medium
6	Increase in extreme weather events – increased days >35^0C	Direct	Equipment design temperatures	Technology exposure / switchboards / cooling, equipment overheating	Possible	Moderate	Medium	Possible	Moderate	Medium	Possible	Moderate	Medium	Locate systems appropriately. Providing shelter for equipment will reduce the impact of UV radiation and weather and increased temperature.	Unlikely	Minor	Low
7	Increase in extreme weather events – increased days >35^0C	Direct	Exposure of building and facades to extreme heat conditions	Increased speed degradation of building materials/ facades/hardscaped areas	Possible	Minor	Low	Possible	Minor	Low	Possible	Minor	Low	Specificiation of durable materials to maximise lifespan of building components			
8	Increase in extreme weather events – increased days >35^0C	Direct	User safety	Heat retention in exposed metal contact (handrails, Kids playgrounds etc), exposed railroad tracks	Likely	Minor	Medium	Almost certain	Minor	Medium	Almost certain	Minor	Medium	Consideration of shade structures for playgrounds Canopy coverage from replacement trees and vegetation to provide shading Use of alternative materials for playground equipment to be investigated to minimise heat retention	Likely	Minor	Medium
9	Increase in extreme weather events – increased days >35^0C	Direct	Increased temperatures affecting heat loads and resident comfort	West facing facades (considered in design), limited opportunity for heritage assets,	Almost certain	Minor	Medium	Almost certain	Minor	Medium	Almost certain	Minor	Medium	Deeper balconies proposed for western facing apartments, consideration of shading structures for afternoon sun, appropriate glazing selection to reduce solar heat penetration	Likely	Minor	Medium

Item Number	Climate Variable	Direct / Indirect	Details of Risk Event	Impact of the risk event	Present Risk			2030 RCP 8.5 (2030)			2070 RCP 8.5 (2070)			Adaptation/Mitigation Strategy	Residual Risk		
					Likelihood	Consequence	Level of Risk	Likelihood	Consequence	Level of Risk	Likelihood	Consequence	Level of Risk		Likelihood	Consequence	Level of Risk
10	Increase in extreme weather events – increased days >35^{0}C	Indirect	Worker safety	construction delays due to prolonged periods of extreme temperature events	Possible	Minor	Low	Possible	Minor	Low	Possible	Minor	Low	Appropriate health and safety management plans and adherence to industry regulations around work conditions			
11	Bushfires	Indirect	Smoke and visbility resulting from nearby bushfires	Bushfires within the proximity of the development may lead to smoke and limited visibility/poor air quality for occupants and residents.	Likely	Moderate	Medium	Likely	Moderate	Medium	Almost certain	Moderate	High	100% recycled air in majority of apartments	Possible	Moderate	Medium
12	Bushfires	Direct	Bushfire threat to infrastructure	bushfire risk - damage to infrastructure (inner asset and outer asset protection zones)	Possible	Moderate	Medium	Likely	Moderate	Medium	Likely	Moderate	Medium	power and comms infrastructure u/ground Bushfire report been completed - inner and outer impact - existing APZ and possible amplifcation, lower fire potential plantings, maintained trees in park like fashion (reducing fuel loading)	Possible	Minor	Low
13	Bushfires	Direct	Accessibility for emergency services	Restricted access during bushfire events for emergency services	Possible	Moderate	Medium	Possible	Moderate	Medium	Possible	Moderate	Medium	Use of designated access/street for emergency service vehicles	Possible	Moderate	Medium
14	Increased precipitation	Direct	Increase extreme wet weather	Flooding and subsequent damage to infrastructure and services	Possible	Moderate	Medium	Likely	Moderate	Medium	Likely	Moderate	Medium				
15	Increased precipitation	Direct	Increased extreme wet weather	Resulting in flow paths through the heritage area - challenges of managing heritage levels due to restrictions on development	Possible	Minor	Low	Possible	Minor	Low	Possible	Minor	Low				
16	Increased precipitation	Direct	Excess water from flooding	Excess water ingress leading to loosening of soils and potentially affecting stability of heritage chimney	Possible	Major	High	Possible	Major	High	Possible	Major	High	Chimney stacks currently structurally sound - continue to monitor as part of ongoing mgt, monitor structural performance. Assumed level of degredation within design, with structures to be retained water proofed etc	Possible	Moderate	Medium
17	Increased precipitation	Direct	Flooding risk	Increased stormwater runoff from the site – stormwater facilities not built for more frequent more intense storm events	Possible	Moderate	Medium	Possible	Moderate	Medium	Possible	Moderate	Medium				
18	Increased precipitation	Direct	Flooding risk	Essential parts of site inundated for the future scenario. Increase in frequency of damaging storms,	Possible	Moderate	Medium	Possible	Moderate	Medium	Possible	Moderate	Medium				
19	Increased precipitation	Direct	Water ingress due to excess precipitation	potential flooding of low level carparks	Likely	Moderate	Medium	Likely	Moderate	Medium	Likely	Moderate	Medium	Assess parking access road levels to minimise water ingress and provide strategies to manage excess water flow	Possible	Minor	Low
20	Increased precipitation	Direct	Increased severity of hail storms	Causing damage to property and personal injury	Possible	Moderate	Medium	Possible	Moderate	Medium	Possible	Moderate	Medium	Specify impact resistant building materials as required	Possible	Moderate	Medium
21	Drought	Indirect	Reduced rainfall events	Reduction in water supply to the wetland / pond treatment systems results in too little turnover and subsequent stagnation	Possible	Minor	Low	Possible	Minor	Low	Possible	Minor	Low	Water availability in a drying climate for wetland/pond could be enhanced by connecting to the stormwater system in the surrounding suburban areas. Could also be enhanced by connecting into the potable mains system.			
22	Drought	Direct	Prolonged dry periods	Reduction in water availability for irrigation	Possible	Minor	Low	Possible	Minor	Low	Possible	Minor	Low	70% irrigation demand - design looking at ability to expand tanks to store more water for contingency?			
23	Wind	Direct	Increased wind loads	Increased structural load on buildings and infrastructure	Unlikely	Minor	Low	Unlikely	Minor	Low	Unlikely	Minor	Low	structure of bldg designed to meet current codes			

Memorandum

ARUP

To	EIS Input - Umwelt	Date	7 April 2021
Copies	Bloc, Doma	Reference number	Click here to enter text.
From	Arup	File reference	276789-00
Subject	Brickworks Redevelopment, Yarralumla - GHG technical input for EIS		

1 Introduction

This technical memo outlines specific requirements relating to greenhouse gas and carbon mitigation required as part of the projects Scoping Report which must be addressed within the Environmental Impact Statement (EIS) document. This memo just includes those that relate to greenhouse gas contribution and response.

Table 1 EIS requirements cross reference

EIS requirements	Where addressed
Address the contribution the proposal will make to reducing greenhouse gas emissions and meeting the legislated target for a net zero emissions Territory (by 2045 at the latest)	*GHG technical memo section 1.1*
Investigate the impact of increasing residential and vehicular activities upon greenhouse gas emissions	*GHG technical memo section 2.5*
Describe the design and layout of the site and provide details of building orientation and materials to achieve solar passive design. Provide details of mitigation methods to reduce reliance on mechanical heating and cooling	*GHG technical memo sections 2.2 and 2.3*

1.1 Approach

Overall, the design principles guiding the development for Brickworks precinct considers strategies which aim to reduce reliance on mechanical heating and cooling, using the existing building design and orientation to achieve solar passive design.

The Project is also undertaking a climate risk assessment process that examines impacts of a changing climate in terms of microclimate and urban heat. Building resilient communities which take into consideration construction and design impacts and how these can reduce the carbon foot will also assist in reducing greenhouse gas emissions and contribute towards meeting the legislated target for a net zero emissions Territory.

The general approach is to prioritise initiatives which sit higher in the energy hierarchy Figure 2, where:

- Load reduction – means limiting the amount of energy used, while maintaining amenity
- Passive systems – uses systems driven by natural means to achieve outcomes that would otherwise have used energy e.g. orientation
- Active systems- where energy is used, providing systems that utilise energy more efficiently e.g LED lighting that gives the same amount of light for less input energy
- Energy recovery – where energy has been spent, recovering it before it is released into the environment
- Renewable energy – application of renewable energy close to the use of energy e.g. solar PV panels for core heritage precinct
- Offsets – where the above cannot be achieved, the final step is to offset the energy impact by the purchase or development of off-site, carbon-free energy generation.

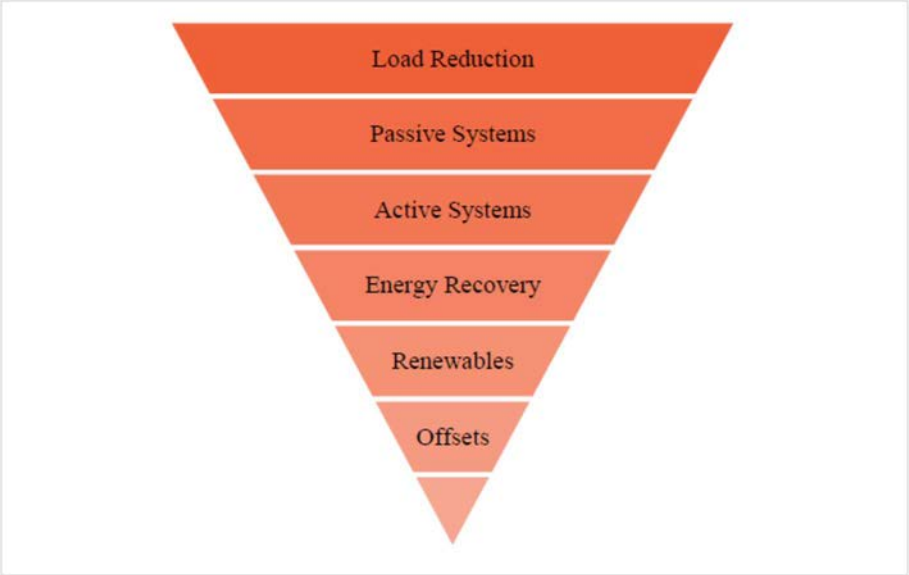


Figure 1 Energy approach hierarchy

The overall strategy for operational emissions reduction is to follow a 'Lean, Clean, Green' approach, balancing immediate environmental and economic performance with longer term reduction in GHG emissions. This approach delivers opportunities to maximise development opportunity while minimising the carbon footprint of the precinct:

- Lean – prioritising passive design to mitigate the demand for resources through design of natural and passive lighting and ventilation. The design concept follows the energy hierarchy by utilising world class passive design principles to reduce the energy demand in the first instance
- Clean – selection of efficient equipment to deliver further improvements – in the form of highly efficient mechanical and lighting design to further reduce energy consumption
- Green – selection of green technology to reduce remaining carbon emissions where possible. For example, the roofs of the kiln building within the heritage core provides an excellent opportunity for onsite renewable energy generation using solar panels.

1.2 Impact

According to Architecture Australia (2019), approximately 25% of greenhouse gas emissions in Australia is produced by the construction, operation and maintenance of buildings[1]. Hence, it is important to consider the whole of lifecycle of planning, design, construction and operations of buildings, to produce structures that are less resource intensive with less carbon emissions throughout the process.

[1] https://architectureau.com/articles/buildings-produce-25-of-australias-emissions-what-will-it-take-to-make-them-green-and-wholl-pay/

Reducing greenhouse gas emissions on the project and hence contributing towards the Territory's ultimate net zero target, will result from reducing consumption through energy efficient passive design. Passive design involves the designing of a building or structure and surrounds which requires little heating and cooling requirements. Apartments and dwellings which are appropriately passively designed will take advantage of the natural climate to maintain and improve thermal comfort.

2 GHG actions

2.1 NatHERS

The majority of GHG emissions are attributed to the operational phase, specifically the Heating Ventilation and Cooling (HVAC). The design aims to optimise orientation, materials and passive design features to increase the energy efficiency of the buildings and minimise the heating and cooling demand. The resultant building performance will be measurable, and it is anticipated that the National House Energy Rating Scheme (NatHERS) will be used to target a high level of building performance. Through the targeted NatHERS rating and on-site generation of green power, GHG savings of 68.4-84% compared to a BAU reference development will be targeted. The details of this will be outlined in the Green Star Communities Submission, credit 25A.

2.2 Orientation

The proposed Brickworks development layout consists of a mixture of apartment and terrace building typologies, as well as single dwelling lots and the existing heritage precinct. All buildings are accessible by public roads and footpaths with green space concentrated within the north west region of the site. Optimum solar orientation of the apartment buildings and townhomes in response to both the site topography and north orientation will allow passive heating and cooling – see site layout in **Error! Reference source not found.**.

Memorandum

Figure 2 Site layout plan

North facing units will be maximised with appropriate cross ventilation, optimisting the orientation to catch the sun and breezes consitent with improved solar passive design. Responding to the solar orientation of the site also ensures adequate sunlight is provided to the public open space areas as well as to the café and restaurant spaces. The use of deciduous trees to provide appropriate shading through varied seasons is considered within the public realms and parkland areas, providing further cooling effects to mitigate urban heating.

Limiting the level of sun exposure directly or indirectly into a buildings core structure is a logical way of mitigating and reducing heat generation particularly during summer months. Utilising window shading structures or eaves will be considered to reduce mean radiant heat temperature (heat gain) within apartments and dwellings, improving the overall thermal comfort levels within the building interior. In Canberra, north orientation is desirable as it's a region which requires winter heating and summer cooling. By utilising the seasonal variation of the angle of the sun and incorporating simple design features such as shading, the dwellings and apartment buildings can be protected from the summer sun while providing full penetration during winter months.

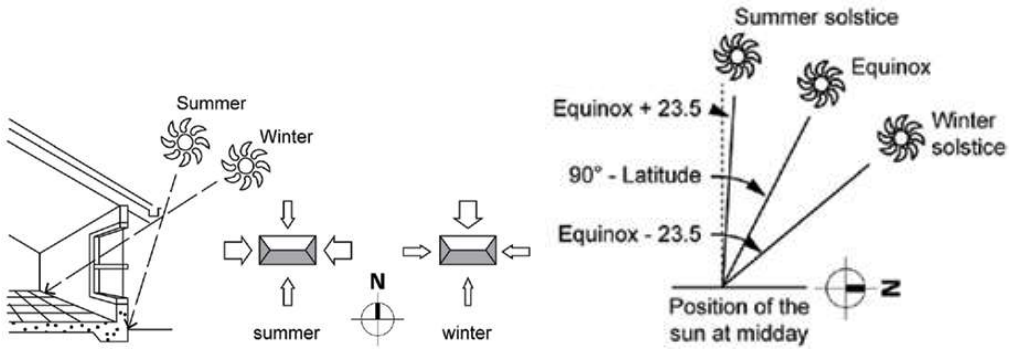


Figure 3 Solar solstice angles and example of standard eaves shading[2]

Incorporation of extensive shading in the form of balconies in addition to eaves and window overhangs for apartment buildings will also be considered, allowing low-angle winter sun into the interiors while reducing high angle summer sun and maintaining ample daylight. This will act to reduce the need and reliance on mechanical heating during the cooler seasons.

Cool breezes are a cost free and effective means of cooling where the climate provides it. Buildings can utilise these breezes by adopting a narrow or open plan layout. Cross ventilation within apartments and dwellings will allow for breezes, with the proposed building design providing opportunities for natural ventilation and/or mixed mode in certain buildings to reduce reliance on mechanical ventilation.

As outlined in the Climate Adaptation Plan, urban cooling strategies have the potential to be effective in the outdoor spaces, which can lead to flow on positive effects to the common accessible areas and cafés and indoor/outdoor spaces. Evaporative cooling strategies, in particular with the importance of water in the design and the presence of large water body at Pittman Park conveying water up to the public spaces, helps reduce excessive heat in the hotter months within the shared spaces, leading to potentially cooler indoor spaces. Green infrastructure and appropriately designed shading will be considered to combat high solar radiation intensity on hot summer days, with selection of deciduous tree species, particularly on orientations that can help warm areas in the cold months and provide shading in the warmer months. These passive design features help to reduce the heating effect around the urban areas and improve comfort levels within the indoor spaces.

2.3 Building materials

As is the case with any development, there is an inevitable impact on GHG emissions. Embodied emissions in materials, transportation and construction account for approximately 11% of the total GHG emissions across the whole life cycle of a development[3]. Recent advances in technology now enable engineers and architects to quickly assess how their design decisions impact on the total embodied carbon of the development. These carbon tools can be used to aid the option appraisal and design iterations as the development progresses to realise reductions in embodied carbon. This has the potential to save thousands of tonnes of carbon at little to no cost.

[2] https://www.yourhome.gov.au/passive-design/orientation
[3] https://architecture2030.org/new-buildings-embodied/

The manufacture of materials commonly used in building construction, such as steel, concrete, aluminium and glass, accounts for 11% of global carbon dioxide emissions[4]. Specification of the use of sustainable natural materials in construction thereby provides opportunities for reduction in embodied energy of a structure and subsequent GHG emissions.

Design opportunities being considered in material choice include low embodied energy and low life cycle impact such as timber, recycled steel, aluminium and glass products which will be considered across the design.

Materials with high thermal mass, such as concrete, bricks and tiles, act as a thermal battery. During summer they absorb heat during the day, and release heat during the evenings and nights, providing thermal comfort. In winter, the same mass can store heat from heaters or the sun, releasing it at night when temperatures are at their lowest. Thermal mass is most effective where diurnal ranges (difference between day and night temperature) exceed 10 degrees. Canberra has a high seasonal diurnal temperature range with a mean high of 27.7 degrees in January and a mean low of 11.1 in July. It is therefore an optimum climate for the use of thermal mass to aide comfort and reduce reliance on mechanical heating and cooling.

The use of brick as a dominant material in building structure for the new terraces, apartments and houses will increase the thermal value, contributing towards energy efficiency and lower heating and cooling demand. High performance facades combined with high levels of insulation to external walls, floors and roofs will also enhance thermal mass to minimise impacts of external temperature fluctuations.

Low emissivity, high albedo materials will be considered in particular for the open space areas where appropriate, to increase albedo and solar reflectance.

2.4 Reducing Building Green House Gas (GHG) emissions

The two most common sources of greenhouse gas emissions for buildings are purchased electricity and direct consumption of natural gas for heating and cooking.

The design is currently exploring options of introducing a rooftop photovoltaic system integrated with battery storage to the core heritage buildings, the aim being for a central heritage precinct that is ‘net electricity neutral’. This initiative would provide the precincts energy usage, thereby contributing to overall reduction in GHG emissions.

In common areas where energy is used, systems which utilise energy more efficiently, such as LED lighting (common areas, street lighting and public areas) will be mandated where possible. Low energy lighting in the car park would also be considered, with variable speed drives linked to CO sensors for occupant detection and subsequent energy saving benefits. Energy efficient lift systems would also be considered, along with provision of a staircase to access floors as an alternative to using the lifts. In private dwellings where active systems can not be directly controlled, consideration of incentives for the purchase of more energy efficient appliances, in the form of residential incentive discounts may be applied, reducing overall site energy consumption and associated GHG emissions.

[4] UIN Environment Program, 2018 *Global Alliance for Buildings and Construction*

Highly efficient mechanical ventilation systems with variable speed drives responsive to occupation through CO2 or CO sensors will be considered, along with high efficiency chillers and plant systems.

2.5 Increased vehicular Activity

As with residential activity, there will be an increase in GHG emissions during the construction phase, however most vehicular emissions will occur during the operational phase from the use of private vehicles. This impact is difficult to quantify as the majority of new residents may already have private vehicles. From a local perspective, it is true that an increased number of vehicles will be detrimental to air quality. However, for GHG emissions the point of source is largely irrelevant; CO_{2e} that is released in north west Canberra has the same global warming potential than CO_{2e} that's released in south east Canberra. Therefore, the question that remains is how many additional vehicles on the road will occur as a result of the development.

Since this cannot be estimated with any real certainty, a series of scenarios have been modelled to assist in determining the plausible range of impact. Firstly, the total CO_{2e} released from the expected number of cars was calculated, which equates to approximately 666,000 $kgCO_{2e}$ assuming that each of the 200 carpark lots is occupied, and each car travels the average number of kms per year. Secondly, by assuming a range of scenarios for the % of cars that are new to the road, the impact of the development was estimated. Three scenarios in total were modelled; 5, 10 & 15%, resulting in additional emissions of approximately 33,000, 67,000 & 100,000 $kgCO_{2e}$ per year. It is expected that the actual figure will be towards the lower range of this estimate. The calculation methodology and assumptions can be found in Attachment A.

However, given the proximity to public transport, and the emerging market for Electric Vehicles there is the opportunity to encourage a transition away from Internal Combustion private vehicle use and enabling a transition towards public transport or electric vehicle choice. The design facilitates easy and direct access to public transport and light rail and will provide conduits throughout the carpark to enable owners to fit EV charging stations in bays to enable EV choice.

ARUP

Vehicle Use Inputs

Brickworks

Methodology

The total distance travelled by all vehicles within the development was based on expected number of cars and the average distance travelled per car per year.

Scenarios 1-3 represent the plausible range of the % of total cars that are new to the road, and therefore result in a net increase in CO2e emissions.

Distance travelled and scenario inputs

Total distance travelled

	Value	Unit	Source	Comment
Average distance per car	13400	km/year	https://www.abs.gov.au/ausstats/ab	Based on length of journey to and from work for ACT (14.4 km x2)
Number of cars	200		Site masterplan	Assumed that each parking lot contains a car
Total km	2,680,000	km/year		

New cars on the road

Scenario 1	5.0%	%	Assumed value	% of cars that were not on the road prior to the development
Scenario 2	10.0%	%	Assumed value	% of cars that were not on the road prior to the development
Scenario 3	15.0%	%	Assumed value	% of cars that were not on the road prior to the development

ARUP

Carbon Intesity Inputs

Brickworks

Methodology

The split of petrol and diesel vehicles was based on 2016 data, assuming a worst case scenario with no electric vehicles.

Fuel efficiency was also found for 2016 as this was the most recent and robust data source.

Emissions factors were taken from the National Greenhouse Accounts

Carbon intensity inputs

Vehicle fleet split

	Value	Units	Source	Comment
% of cars that are Petrol	87%	%	https://www.bitre.gov.au/sites/defa	
% of cars that are Diesel	13%	%	https://www.bitre.gov.au/sites/defa	Assuming no LPG/CNG/dual fuel/hybrid and other

Fuel efficiency

	Value	Units	Source	Comment
Passenger Vehicle (Petrol)	0.11	l/km	https://www.bitre.gov.au/sites/defa	Based on 2016 car fleet as most recent data available
Passenger Vehicle (Diesel)	0.10	l/km	https://www.bitre.gov.au/sites/defa	Based on 2016 car fleet as most recent data available

Energy content factor

	Value	Units	Source	Comment
Petrol	34.20	GJ/kL	https://www.environment.gov.au/sy	
Diesel	38.60	GJ/kL	https://www.environment.gov.au/sy	

Emission factors

		Value	Units	Source	Comment
Petrol	CO_2	67.40	kgCO2e/GJ	https://www.environment.gov.au/sy	
	CH_4	0.02	kgCO2e/GJ	https://www.environment.gov.au/sy	
	N_2O	0.20	kgCO2e/GJ	https://www.environment.gov.au/sy	
Diesel	CO_2	69.90	kgCO2e/GJ	https://www.environment.gov.au/sy	
	CH_4	0.01	kgCO2e/GJ	https://www.environment.gov.au/sy	
	N_2O	0.60	kgCO2e/GJ	https://www.environment.gov.au/sy	

ARUP

Emission Calculations

Brickworks

Methodology

Based on the total number of km travelled per year, the fleet split and the fuel efficiency for petrol and diesel cars, the fuel consumption per year was estimated in Litres.

Litres were then converted to GJ using the energy content values from the National Greenhouse Accounts Factors.

Similarly, GJ was converted to kgCO2e using the emissions factors for petrol and diesel.

The additional kgCO2e was then calculated for scenarios 1 - 3.

CO2e Calculations

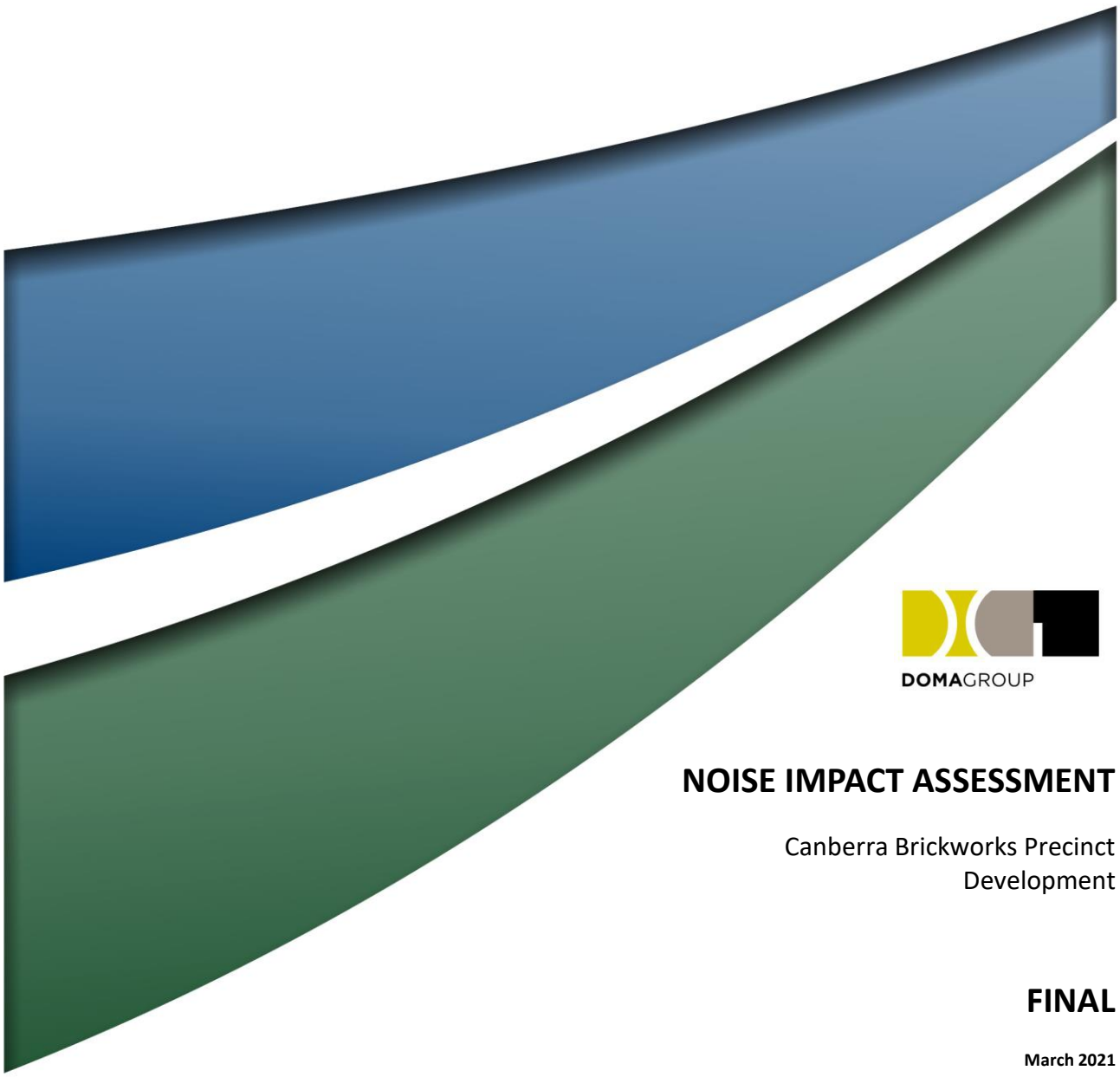
Emissions

		Value	Units	Source	Comment
Fuel consumption	Petrol	247,150	L/year		
	Diesel	34,840	L/year		
Energy content	Petrol	8,453	GJ/year		
	Diesel	1,345	GJ/year		
Emission factors	**Petrol**				
	CO_2	569,700	kgCO2e/year		
	CH_4	169	kgCO2e/year		
	N_2O	1,691	kgCO2e/year		
	Diesel				
	CO_2	94,003	kgCO2e/year		
	CH_4	13	kgCO2e/year		
	N_2O	807	kgCO2e/year		
	Total	666,383	kgCO2e/year		

Additional Emissions

		Value	Units	Source	Comment
Scenario 1	5% new cars	33,319	kgCO2e/year		
Scenario 2	10% new cars	66,638	kgCO2e/year		
Scenario 3	15% new cars	99,957	kgCO2e/year		

umwelt
Environmental & Social Consultants



DOMAGROUP

NOISE IMPACT ASSESSMENT

Canberra Brickworks Precinct Development

FINAL

March 2021

NOISE IMPACT ASSESSMENT

Canberra Brickworks Precinct Development

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Doma Group

Project Director:	Peter Cowper
Project Manager:	Caitlin Adcock
Technical Director:	Tim Proctor
Technical Manager:	Dave Davis
Report No.	8137_R05_V2
Date:	March 2021

Newcastle

75 York Street
Teralba NSW 2284

T| 1300 793 267
E| info@umwelt.com.au

www.umwelt.com.au

This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

Disclaimer
This document has been prepared for the sole use of the authorised recipient and this document may not be used, copied or reproduced in whole or part for any purpose other than that for which it was supplied by Umwelt (Australia) Pty Ltd (Umwelt). No other party should rely on this document without the prior written consent of Umwelt.

Umwelt undertakes no duty, nor accepts any responsibility, to any third party who may rely upon or use this document. Umwelt assumes no liability to a third party for any inaccuracies in or omissions to that information. Where this document indicates that information has been provided by third parties, Umwelt has made no independent verification of this information except as expressly stated.

©Umwelt (Australia) Pty Ltd

Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
1	Tim Procter	17/06/2020	Dave Davis	17/06/2020
2	Tim Proctor	01/03/2021	Dave Davis	01/03/2021

Table of Contents

1.0 Introduction 1

2.0 Noise Assessment Framework 2

2.1 Construction noise impact assessment 2

2.1.1 Environmental Protection Guidelines for Construction and Land Development in the ACT 2

2.1.2 Australian Standard 2436 – 2010 (R2016) 3

2.2 Construction vibration assessment 3

2.2.1 Criteria for vibration effects on non-heritage structures 3

2.2.2 Criteria for vibration effects on heritage structures 4

2.2.3 Criteria for vibration effect on human occupants within buildings 4

2.3 Operation noise impact assessment 5

2.3.1 Requirement for a Noise Management Plan 6

2.4 Road traffic noise assessment 6

2.4.1 Road traffic noise received within the precinct 6

2.4.2 Road traffic noise generated from within the precinct 6

2.5 Commercial Zones Development Code 6

2.6 Other ACT Government publications 7

3.0 Construction Noise 8

3.1 Prediction methodology 8

3.2 Construction activities 8

3.3 Construction noise sources 8

3.3.1 Variation in noise emissions from construction activities 8

3.3.2 Noise emissions of construction equipment 9

3.4 Construction noise levels 15

3.5 Construction noise mitigation 15

3.5.1 High noise-generating activities 25

3.5.2 Noise Management Plan – management of construction noise 28

4.0 Construction Vibration 29

5.0 Operational Noise 31

5.1 Operational noise sources 31

5.1.1 Garden or grounds maintenance noise 31

6.0 Road Traffic Noise 32

7.0 Noise Management Plan 33

7.1 Guidelines for the preparation of Noise Management Plans for development applications 33

7.2 Australian Standard 2436-2010(R2016) 35

8.0 Future Developments within the Brickworks Precinct 39
8.1 Contamination remediation and encapsulation 39
8.2 Road traffic noise levels 39
8.2.1 Road traffic noise level criteria 39
8.2.2 Predicted road traffic noise levels 40
8.3 Building construction acoustic design requirements 44
8.3.1 Building Code of Australia (National Construction Code Volumes 1 and 2) 44
8.3.2 Internal noise levels from road traffic 44
8.3.3 Australian Standard/New Zealand Standard 2107-2016 44
8.3.4 Australian Standard 3671-1989 45
8.4 Noise assessment and management requirements 45
8.4.1 Residential developments within the Brickworks Precinct 46
8.4.2 Commercial developments within the Brickworks Precinct 47
9.0 Conclusions and Recommendations 50
9.1 Construction noise 50
9.2 Road traffic noise 50
9.3 Preparation of noise management plan 50
9.4 Recommended assumptions for future development applications 51
9.4.1 Developments outside the Brickworks Precinct 51
9.4.2 Developments within the Brickworks Precinct 51
10.0 References 52

Figures

Figure 3.1 Locations of modelled construction noise sources 14
Figure 3.2 Predicted noise levels Construction Scenario 1 Single Residences Area - Clearing 16
Figure 3.3 Predicted noise levels Construction Scenario 2 Heritage Area - Clearing 17
Figure 3.4 Predicted noise levels Construction Scenario 3 Water Feature and Park – Bulk Earthworks 18
Figure 3.5 Predicted noise levels Construction Scenario 4 Stage 1 Residential – Bulk Earthworks 19
Figure 3.6 Predicted noise levels Construction Scenario 5 Stage 1 Residential – Drainage Infrastructure 20
Figure 3.7 Predicted noise levels Construction Scenario 6 Stage 2 Residential – Bulk Earthworks 21
Figure 3.8 Predicted noise levels Construction Scenario 7 Stage 2 Residential – Drainage Infrastructure 22
Figure 3.9 Predicted noise levels Construction Scenario 8 Roads – Bulk Earthworks 23
Figure 3.10 Predicted noise levels Construction Scenario 9 Roads – Local Road Works 24
Figure 3.11 Example of noise reduction treatment on a rock-breaking head fitted to an excavator 26
Figure 3.12 Example of a temporary noise barrier 27
Figure 8.1 Predicted free-field road traffic noise levels at ground level Day-time period 7 AM to 10 PM LAeq(15 hour) 42

Figure 8.2 Predicted free-field road traffic noise levels at ground level Night-time period 10 PM to 7 AM LAeq(9 hour) 43

Tables

Table 2.1 Time restrictions for building work to manage noise impacts 2
Table 2.2 Noise Standard at the boundary of the development for construction noise impacts (for works longer than 2 weeks) 2
Table 2.3 Recommended vibration criteria for cosmetic damage to structures 3
Table 2.4 Recommended criteria for continuous and impulsive vibration for human comfort (weighted vibration acceleration m/s ^{2}) 1-80 Hz 4
Table 2.5 Recommended vibration criteria for intermittent vibration (VDV m/s$^{1.75}$) 5
Table 2.6 Noise standards at the boundary of the development 5
Table 3.1 Australian Standard 2436-2010(R2016) Table A1 10
Table 3.2 Modelled construction activities – locations 12
Table 3.3 Modelled construction activities – component noise sources 12
Table 4.1 Recommended minimum working distances for vibration generating plant from residential sensitive receivers 29
Table 5.1 EP Reg Schedule 2 Noise Sources and Operating Limits 31
Table 8.1 *Roads ACT Noise Management Guidelines* Section 4 Schedule 1 Guidelines for new developments on existing roads 39
Table 8.2 *Roads ACT Noise Management Guidelines* Section 4 Table 1.1: Noise Sensitive Land Uses 40
Table 8.3 *Roads ACT Noise Management Guidelines* Section 4 Table 1.2: Maximum external traffic noise level (Target level) at the development, expressed as LAeq dB(A) 40
Table 8.4 Traffic data used in road traffic noise modelling 41
Table 8.5 Recommended AS/NZS 2107 design sound levels in residential buildings in the Brickworks Precinct 45
Table 8.6 Time restrictions for building work to manage noise impacts 47
Table 8.7 Noise Standard at the boundary of the development for construction noise impacts 47
Table 8.8 Territory Plan 2008 – Commercial Zones Development Code, Element 6: Noise – Rules 48
Table 8.9 Noise standards at the boundary of the development 48
Table 8.10 Noise restrictions for building work - EP Reg (2005) for the Brickworks Precinct 49

1.0 Introduction

The Canberra Brickworks Precinct (CBP) is located in south-west Yarralumla, Canberra, in the Australian Capital Territory (ACT). It is surrounded by residential development to the north and east; open landscape to the south; and a landscape buffer to the Royal Canberra Golf Club to the west. The Canberra Brickworks is of heritage significance within the ACT, as one of only three examples of industrial heritage in Canberra. The CBP is approximately 7 kilometres (km) from the Canberra Central Business District and 2 km south of Lake Burley Griffin. It is adjacent to Government House, the official residence of the Governor-General of Australia.

Based on the concept masterplan submitted during the tender process in 2017, the proposed redevelopment would include a maximum of 380 residential dwellings, surrounding re-purposed Canberra Brickworks buildings and recreational parkland. The entire development footprint would cover approximately 16.09 hectares (ha). The re-purposed heritage buildings would include limited retail and commercial space, including cafes, health and wellness facilities, and interpretive features focused on the history of the Canberra Brickworks.

This Noise Impact Assessment (NIA) describes the noise and vibration impacts associated with the construction and operation of the Brickworks Precinct in accordance with the requirements of the Environmental Protection Act 1997, the Environment Protection Regulation 2005, and other relevant guidelines and documents published by the Environment Protection Authority.

The NIA provides details of the potential noise emissions from the major construction activities during the development of the Precinct and the corresponding noise levels received in the surrounding areas. The NIA also includes details of the minimum noise mitigation and management strategies required by the ACT environment protection legislation, as well as additional noise controls that should be implemented if required and if reasonable and feasible.

The NIA also provides a prediction of road traffic noise levels received within the Precinct from traffic on nearby roads, and an assessment of current road traffic noise impacts against the ACT road traffic noise criteria.

A Noise Management Plan will also be required for the Precinct development. Recommendations are provided in this NIA for information that should be included in the Noise Management Plan.

Additionally, the NIA also provides relevant information and recommendations regarding the assessment of future developments within the Brickworks Precinct.

2.0 Noise Assessment Framework

2.1 Construction noise impact assessment

2.1.1 Environmental Protection Guidelines for Construction and Land Development in the ACT

The objective of the *Environmental Protection Guidelines for Construction and Land Development in the ACT*, 2011 is to ensure all building work that generates noise is conducted within the time periods detailed in Schedule 2 of the *Environment Protection Regulation* (EP Reg), 2005. The time periods presented in the guidelines from Table 2.3 Item 6 of the EP Reg are shown in **Table 2.1**.

Table 2.1 Time restrictions for building work to manage noise impacts

Building Work Details	Monday to Saturday	Sunday and Public Holidays
Industrial, city and town centre areas	6am to 8pm	6am to 8pm
Any other area when work completed within 2weeks	7am to 8pm	8am to 8pm
Any other area when work not completed within 2 weeks	7am to 6pm	Building work must not exceed Noise Standard

Source: EP Reg Table 2.3 Item 6 (2005)

The adjoining land uses on all boundaries of the Brickworks Precinct are classified as noise Zone G in EP Reg Schedule 2 Part 2.1 Table 2.1. The Noise Standard for receivers on land adjoining the Brickworks Precinct is shown in **Table 2.2.** The Noise Standard applies at the shared boundary of the precinct and the adjoining land containing the receiver. The time restrictions in **Table 2.2** are based on the construction works' duration being longer than 2 weeks.

Table 2.2 Noise Standard at the boundary of the development for construction noise impacts (for works longer than 2 weeks)

Noise Zone	Noise Standard, $L_{A10(10\ minutes\ [1])}$ dB(A)	
	Monday to Saturday (6pm to 10pm) Sunday / Public Holiday (8 am to 10 pm)	**'Any other time'** Monday to Saturday (10pm to 7am) Sunday / Public Holiday (10pm to 8am)
G	45	35

Source: EP Reg (2005) Table 2.2

Note: 1. The ACT *Noise Measurement Manual*, 2009 recommends a period between 5 to 15 minutes where the measurement period for a time-varying sound source of 10 minutes would be more appropriate.

In addition to the restrictions outlined in **Table 2.1**:

- All relevant noise reduction measures mentioned in AS 2436 (see **Section 2.1.2)**, as in force from time to time, must be implemented
- schedule noisy activities for the least sensitive times of the day such as mid-morning and mid-afternoon
- select machinery that produce less noise
- ensure machinery is well maintained.

2.1.2 Australian Standard 2436 – 2010 (R2016)

Australian Standard 2436-2010 (Reconfirmed 2016) *Guide to noise and vibration control on construction, demolition and maintenance sites* provides many recommendations for managing noise and vibration impacts from construction sites. Some of the standard noise control strategies from AS 2436 that are commonly employed on typical construction sites are described in **Section 7.0.**

2.2 Construction vibration assessment

There are no specific state-based legislation or guidelines regarding the assessment of ground vibration impacts in the ACT. It is therefore recommended that for this project, ground vibration impacts are assessed and managed based on the approach that is typically followed in NSW.

Vibration from construction activities has the potential to affect structures such as buildings and the human occupants within the buildings. Vibration affects structures and humans differently, consequently, there are distinct criteria applicable to these two types of receivers as described below.

2.2.1 Criteria for vibration effects on non-heritage structures

Criteria that are commonly used in NSW for the assessment of vibration effects on non-heritage building structures are given in British Standard 7385 (BS 7385) Part 2 *Evaluation and measurement of vibration in buildings* (1993). The criteria in BS 7385 are given in terms of peak component (x-, y- or z-axes separately) vibration velocity values from transient (impulsive) vibration events. The criteria for continuous vibration are recommended to be 50% lower than for impulsive vibration. It is considered that these criteria that are commonly used in NSW are suitable for use for the Brickworks Precinct development. The vibration criteria for the protection of structures and buildings from cosmetic damage (e.g., hairline cracks in drywalls, etc.) are given in **Table 2.3.**

Table 2.3 Recommended vibration criteria for cosmetic damage to structures

Type of structure	Peak Component Particle Velocity (mm/s)		
	4 Hz - 15 Hz	15 Hz - 40 Hz	40 Hz and above
• Un-reinforced or light framed structures • Residential or light commercial type buildings	15 - 20 (transient (impulsive) vibration) 7.5 - 10 (continuous vibration)	20 - 50 (transient (impulsive) vibration) 10 - 25 (continuous vibration)	50 (transient (impulsive) vibration) 25 (continuous vibration)
• Reinforced or framed structures • Industrial and heavy commercial buildings	50 (transient (impulsive) vibration) 25 (continuous vibration)		

2.2.2 Criteria for vibration effects on heritage structures

It is recognised that heritage structures may have special requirements to protect the structures from damage due to vibration. There are no criteria provided in ACT legislation or guidelines regarding the protection of heritage structures from vibration due to construction and/or operation of nearby developments. In New South Wales, the criteria given in the German Standard DIN 4150-3 is commonly used for protection of heritage structures. However, the criteria given in DIN 4150-3 is primarily intended for assessment of heritage residential buildings in European countries, which may be significantly more sensitive to damage from vibration than the former industrial buildings in the heritage area within the Brickworks Precinct.

Therefore, it is recommended that a site-specific set of vibration criteria be developed for the heritage structures in the Brickworks Precinct. These site-specific vibration criteria should be derived and recommended by a suitably qualified Structural Engineer and/or Heritage Consultant.

2.2.3 Criteria for vibration effect on human occupants within buildings

Human perception of vibration

Criteria for the human perception of vibration from construction activities are given in *Assessing Vibration: A Technical Guideline*, NSW Department of Environment and Conservation (2006) (AVATG). The criteria in AVATG are given for continuous vibration, impulsive vibration and intermittent vibration. For continuous and impulsive vibration, the criteria are given in terms of root-mean-square (*rms*) vibration acceleration (m/s^2) in the frequency range 1 - 80 Hertz (Hz). For intermittent vibration, the criteria are given in terms of vibration dose value (VDV), which is a parameter used for assessing the combined magnitude and the total duration of vibration impacts. It is recommended that the criteria for human perception of vibration given in the NSW Guideline are suitable for the assessment of the construction of the Brickworks Precinct.

The criteria given in AVATG for continuous or impulsive vibration relevant to the receivers in land use zones adjoining the Brickworks Precinct are given in **Table 2.4**. The frequency weightings are given in AVATG Appendix B3.

Table 2.4 Recommended criteria for continuous and impulsive vibration for human comfort (weighted vibration acceleration m/s^2) 1-80 Hz

Location	Assessment period [1]	Preferred values		Maximum values	
		z-axis	x- and y-axes	z-axis	x- and y-axes
Continuous vibration					
Residences	Day	0.010	0.0071	0.020	0.014
	Night	0.007	0.005	0.014	0.010
Impulsive vibration					
Residences	Day	0.30	0.21	0.60	0.42
	Night	0.10	0.071	0.20	0.14

Note: 1 Day-time period is 7am - 10pm. Night time period is 10pm - 7am.

The criteria for intermittent vibration given in AVATG for the relevant receivers in the area are shown in **Table 2.5**. The vibration dose value (VDV) is calculated using the frequency-weighted *rms* acceleration as described in AVATG.

Table 2.5 Recommended vibration criteria for intermittent vibration (VDV m/s$^{1.75}$)

Location	Day-time period [1]		Night-time period [1]	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical Areas[2]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Note: 1. Day-time period is 7am - 10pm. Night time period is 10pm - 7am.
2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas. Source: BS 6472–1992

2.3 Operation noise impact assessment

The Brickworks Precinct is classified in the *Territory Plan* 2008 as a Commercial Zone, Class CZ6 – Leisure and Accommodation Zone. The *Territory Plan* Section 4.1: CZ6 - Leisure and Accommodation Zone Objectives and Development Table specifies that development proposals must comply with the Commercial Zones Development Code, which in turn requires that potentially noisy land uses to comply with the Noise Zone Standards as detailed in the EP Reg. The noise zones, noise standards and conditions are given in the EP Reg Schedule 2, Part 2.1 and Part 2.2. Table 2.1 in the EP Reg Schedule 2 Part 2.1 states that the noise zone for a leisure and accommodation zone is classified as Zone F. Table 2.2 in the EP Reg Schedule 2 Part 2.2 states that the noise standards for developments within Noise Zone F zones are the *"same as the noise standard for the adjoining noise zone with the loudest noise standard for the time period"*.

The adjoining land uses on all boundaries of the Brickworks Precinct are classified as noise Zone G in EP Reg Schedule 2 Part 2.1 Table 2.1. The noise standards for developments within Noise Zone G from the EP Reg Schedule 2 Part 2.2 Table 2.2 are shown in **Table 2.6**. As per EP Reg Schedule 2 Part 2.2 Table 2.2, these noise standards also apply to all developments within the Brickworks Precinct. The noise standards apply at the boundary of each development that emits noise.

Table 2.6 Noise standards at the boundary of the development

Noise Zone	Noise Standard, $L_{A10(10\ minutes\ [1])}$ dB(A)	
	Monday to Saturday (7am to 10pm) Sunday / Public Holiday (8 am to 10 pm)	**'Any other time'** Monday to Saturday (10pm to 7am) Sunday / Public Holiday (10pm to 8am)
G	45	35

Source: EP Reg (2005) Table 2.2

Note: 1. The ACT *Environment Protection (Noise Measurement Manual)*, 2009 recommends a period between 5 to 15 minutes where the measurement period for a time-varying sound source of 10 minutes would be more appropriate.

2.3.1 Requirement for a Noise Management Plan

A Noise Management Plan (NMP) will need to be developed for the Brickworks Precinct.

Following is an extract from *Guidelines for the preparation of Noise Management Plans for development applications*

> ***When is a NMP required for development applications?***
>
> *NMPs may be required under the Territory Plan, the key statutory planning document in the ACT, which is directed by the Planning and Development Act 2007. Certain land uses in local, group, town and city centres and other areas specified in the Territory Plan will trigger a NMP under the development and precinct codes. Mixed use developments, multi -unit housing and single residential housing may also trigger a NMP under the development codes. Australian Standard/New Zealand Standard 2107:2016 Acoustics - Recommended levels and reverberation times for building interiors (AS/NZS 2107) establishes 'satisfactory' recommended design sound levels. A NMP must demonstrate that acoustic levels meet the relevant satisfactory standard for: multi-unit residential developments located within a commercial zone or adjacent to a commercial or industrial zone and multi-unit or single residential developments identified in a precinct code as being potentially affected by noise from external sources. Where development applications, including lease variations, propose commercial accommodation located in or adjacent to areas subjected to higher noise levels, the EPA will require NMPs to demonstrate that the acoustic levels within commercial accommodation sleeping areas meet AS/NZS 2107.The EPA may also require a NMP where the noise generated by a proposal may exceed the zone noise standards set in the Regulation at the boundary of the lease, or when the noise generated by a proposal may exceed the noise standards within other leases in the same complex.*

2.4 Road traffic noise assessment

2.4.1 Road traffic noise received within the precinct

There are no legislative requirements or guidelines for the undeveloped precinct to manage the received levels of road traffic noise within the precinct. However, as described in **Section 6.0**, development applications for future developments within the precinct may need to demonstrate that the external and/or internal road traffic noise within the future developments will be controlled to achieve the noise level criteria in the *Roads ACT Noise Management Guideline*, 2018).

2.4.2 Road traffic noise generated from within the precinct

The paved surfaces within the precinct will not be classified as Public Roads. Consequently, noise from vehicle movements within the precinct will not be assessable under the ACT road traffic noise legislation or guidelines.

2.5 Commercial Zones Development Code

The Commercial Zones Development Code includes a mandatory requirement that all potentially noisy uses listed must have a NMP prepared for that land use. The NMP must include details of the land use's construction, layout and siting that together will achieve adequate acoustic containment to ensure that the noise zone standards in the EP Reg are met. If the land use is a building, the construction details will be required to demonstrate that the proposed building construction materials will be able to achieve an

adequate level of acoustic isolation performance. In this case, the acoustic isolation performance that the building construction materials are required to achieve will depend not only on the building design itself but also on the presence and acoustic shielding benefit of any intervening structures between the noise source and the noise receiver(s).

This requirement of the Commercial Zones Development Code presents a unique challenge to the various commercial premises and outdoor recreation spaces in the Brickworks Precinct as a Development Application may be prepared for an individual development when other areas within the Brickworks Precinct may or may not yet have been developed. It is noted that some of the future buildings may have already been constructed, while others may not yet have been constructed or been approved for construction, in which case they would not be able to provide a physical obstruction to the propagation of noise from a venue which is producing amplified sound.

In the case of the Brickworks Precinct, it is considered that the acoustic designs of all proposed land uses should be permitted to assume that all other elements of the Brickworks Precinct have been developed to the full extent of the Master Plan. That is, while preparing a NMP for an individual Development Application for any type of proposed land use within the Brickworks Precinct, the acoustic designer should be permitted to assume that the acoustic shielding to be provided by all existing and future buildings, structures and terrain features in the Brickworks Precinct Master Plan can be included in the relevant acoustic calculations and/or modelling.

2.6 Other ACT Government publications

The ACT Government has published several other guidance documents that provide relevant information for noise assessment and acoustic design within the Brickworks Precinct. These include:

- Noise pollution law – Fact Sheet # 11, Environmental Defender's Office (ACT), March 2010
- Snapshot: Noise in residential areas, ACT Government, December 2019
- Snapshot: Installation of air conditioners and evaporative coolers, August 2018
- Snapshot: Building and construction noise in the ACT, February 2019

A number of publications and resources available from
https://www.accesscanberra.act.gov.au/app/home/cityservices/noiseportal

3.0 Construction Noise

3.1 Prediction methodology

Indicative noise levels from the construction of the precinct have been predicted using computer noise modelling. The noise modelling software used was Cadna/A and the model prediction methodology was CONCAWE. The assumed meteorological conditions were: atmospheric stability class 'D', wind speed 3 m/s, downwind (i.e., noise-enhancing) in all directions.

3.2 Construction activities

Construction activities associated with the development of the precinct, but excluding the development of any individual developments within the precinct, are expected to consist of the following major noise-generating activities:

- Bulk Earthworks
- Rock breaking
- Landscaping
- Road construction
- Water Feature and Park construction.

3.3 Construction noise sources

A variety of different noise-producing plant and equipment will be utilised at different areas of the project site during different phases of construction. Each area and each phase of demolition and construction will require a different sequence of activities, each of which will have an appropriate inventory of plant and equipment.

3.3.1 Variation in noise emissions from construction activities

Construction noise levels received at nearby receivers from large construction sites are highly variable and are dependent on many factors.

Typically, construction noise impacts are estimated based on conservative assumptions such as:

- All noise sources operating continuously, or
- All construction noise sources operating simultaneously, or
- All noise sources operating in close proximity to each other, or
- All noise sources operating in close proximity to the nearest noise sensitive receiver(s), or
- Any combination of some or all of the above.

In reality, none of the above circumstances will ever occur simultaneously in the worst possible combination, however, there will be times (possibly brief) when a combination of factors occur together to

create short-term high noise emissions from the site which will likely cause short-term high noise levels at the nearby receivers. Such coincidental noise events are unavoidable on large complex construction sites, however, they are typically rare and usually brief in duration.

For instance, there will be times when there are a large number of noise sources in close proximity to a particular nearby receiver, and there will be other times when most of those same noise sources are located at very large distances away from that same receiver. If all of those noise sources were operating at full power in both of those circumstances, that receiver would experience two very different noise levels on those two occasions.

It is considered that the prediction of noise levels from construction sites is more correctly demonstrated by presenting a realistic range of noise levels that will very likely occur at various stages of the construction program.

3.3.2 Noise emissions of construction equipment

The actual sound power levels of noise sources to be used on site is unknown and will depend on the individual plant to be used. However, an estimate of noise emissions from construction equipment can be obtained from Australian Standard AS 2436-2010 (2016) as shown in **Table 3.1.**

Table 3.1 Australian Standard 2436-2010(R2016) Table A1

TABLE A1

TYPICAL SOUND LEVELS OF CONSTRUCTION PLANT AND EQUIPMENT*

Plant description	A-weighted sound power levels L_{wA} dB ref: 10^{-12} W		A-weighted sound pressure levels L_{pA} (mid-point) dB at 10 m
	Typical or Range	Typical (mid-point)	
Asphalt paver	103-112	108	80
Asphalt rotomill	111	111	83
Backhoe	100-108	104	76
Backhoe with auger	100-111	106	78
Bulldozer	102-114	108	80
Cherry picker	105	105	77
Compactor	110-115	113	85
Compressor (silenced)	93-110	101	73
Concrete agitator truck	107-111	109	76
Concrete pencil vibrator	101-105	103	75
Concrete pump truck	103-113	108	80
Concrete saw	112-122	117	89
Concrete vibratory screed	115	115	87
Crane (mobile)	95-113	104	76
Crane (tower)	105	105	77
Excavator	97-117	107	79
Filtration unit (40 000 cfm)	109	109	81
Forklift	106	106	78
Front end loader	110-115	113	85
Generator (diesel)	84-113	99	71
Grader	105-115	110	82
Gritblaster (grit & nozzle air noise)	129	129	101
Hand tools (electric)	95-110	102	74
Hand tools (pneumatic)	114-117	116	88

(*continued*)

TABLE A1 (*continued*)

Plant description	A-weighted sound power levels L_{wA} dB ref: 10^{-12} W		A-weighted sound pressure levels L_{pA} (mid-point) dB at 10 m
	Typical or Range	Typical (mid-point)	
Jack hammers	121	121	93
Loader (wheeled)	99-111	105	77
Machine mounted hydraulic drill	110-115	113	85
Machine mounted percussive drill	116	116	88
Machine mounted pneumatic drill	110-121	116	88
Piling (bored)	111	111	83
Piling (impact sheet) (L_{max})	126-147	137	109
Piling (vibratory)	116-133	125	97
Rock breaker	118	118	90
Roller (vibratory)	103-112	108	80
Scraper	116	116	88
Spreader	95	95	67
Truck (>20 tonne)	107	107	79
Truck (dump)	117	117	89
Truck (water cart)	106-108	107	79
Vehicle (light commercial e.g. 4WD)	100-111	106	78
Welder	100-110	105	77

* Information in Table A1 has been derived from a combination of the following sources and further information can be obtained from them:

(a) AS 2436—1981 *Guide to noise control on construction, maintenance and demolition sites*.

(b) BS 5228-1, *Code of practice for noise and vibration control on construction and open sites. Noise*.

(c) DEFRA—Department for Environment Food and Rural Affairs (United Kingdom), Update of noise database for prediction of noise on construction and open sites-Phase 3: Noise measurement data for construction plant used on quarries, July 2006.

NOTE: The sound power data within the column marked 'Typical (mid-point)' can be used to calculate typical noise levels at the nominated assessment locations.

However, for this NIA, rather than predicting noise impacts from individual noise sources, it is considered that it would be more appropriate to predict noise emissions from a fleet of combined plant and equipment which would typically be working together in close proximity while developing specific elements or Stages of the precinct.

For this NIA it was considered appropriate to undertake the noise impact predictions using the typical construction fleets that are commonly used for the assessment of road construction projects in New South Wales. The Construction Noise and Vibration Guideline (CNVG) published by Transport for New South Wales (TfNSW) contains information that may be used to provide assessment recommendations for the Brickworks Precinct. The CNVG and its companion software, the Construction and Maintenance Noise and Estimator Tool (CMNET) (version 21/03/2017) provide typical sound power levels of construction fleets undertaking common construction activities. It is considered that these typical sound power levels of construction equipment commonly used in New South Wales are suitable for the purposes of providing indicative noise level predictions for this NIA.

Several construction activities have been modelled in several locations based on the expected construction works that will be required in different areas of the Brickworks Precinct, shown in **Table 3.2**.

The locations where noise-generating activities have been assumed in the modelling are shown in **Table 3.3** and Error! Reference source not found.. The component noise sources in each of the construction activities are shown in **Table 3.3.**

Table 3.2 Modelled construction activities – locations

Area	Construction Activities - Noise Modelled [Scenario No.]
Detached Single Residence (Blocks)	Clearing [1]
Heritage Area	Clearing [2]
Water Feature and Park	Bulk Earthworks [3]
Stage 1	Bulk Earthworks [4]; Drainage Infrastructure [5]
Stage 2	Bulk Earthworks [6]; Drainage Infrastructure [7]
Onsite Roads	Bulk Earthworks [8]; Local Road Works [9]

Table 3.3 Modelled construction activities – component noise sources

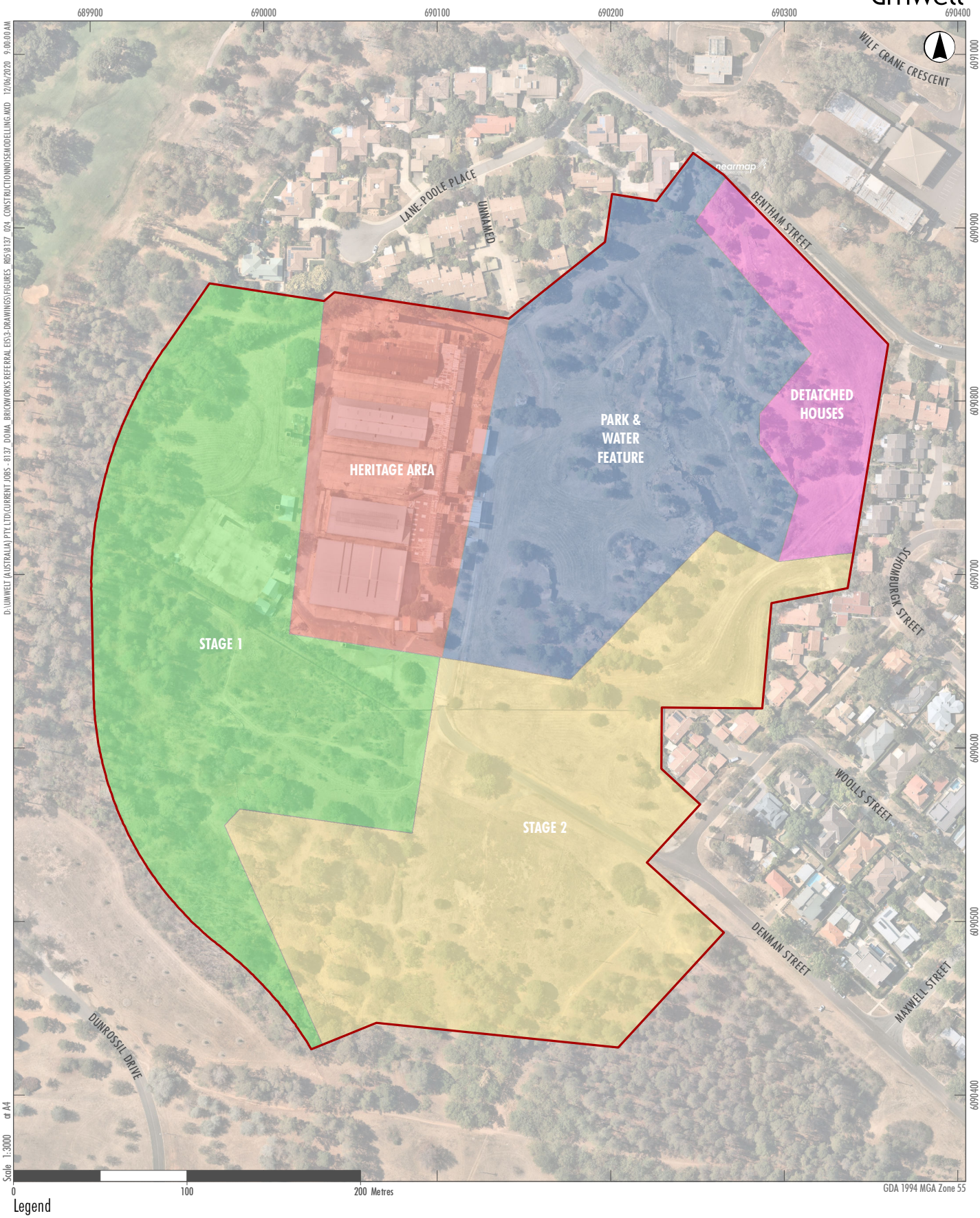
Construction activity and associated plant and equipment	Sound Power Level, dB(A) ref: 10^{-12}W	
	Typical or Range	Typical (mid-point)
Site Clearing		
Bulldozer	102-114	108
Excavator	97-117	107
Chainsaw	114	114
Tub grinder/ mulcher 40-50hp	116	116
Dump truck	110-117	114
TOTAL (Estimated Range)	**97 to 123**	**120**

Table 3.3 Continued

Construction activity and associated plant and equipment	Sound Power Level, dB(A) ref: 10^{-12}W	
	Typical or Range	Typical (mid-point)
Drainage Infrastructure		
Backhoe	100-111	105
Mobile crane	95-103	104
Excavator	97-117	107
Concrete truck	107-111	109
Truck compressor	75	75
Vibratory roller	103-112	108
Road truck	107-108	107
TOTAL (Estimated Range)	**75 to 120**	**115**
Bulk Earthworks		
Bulldozer	102-114	108
Scraper	110-116	113
Excavator	97-117	107
Hydraulic hammer (rock breaker)	118-122	120
Grader	105-115	110
Dump truck	110-117	114
Compactor	106-115	110
Roller (large pad foot)	109	109
Water cart	106-108	107
TOTAL (Estimated Range)	**97 to 126**	**124**
Local Road Works		
Bulldozer	102-114	108
Excavator	97-117	107
Front end loader	110-115	113
Scraper	110-116	113
Backhoe	100-111	105
Compactor	106-115	110
Dump truck	110-117	114
Road truck	107-108	107
Water cart	106-108	107
TOTAL (Estimated Range)	**97 to 124**	**121**

Sources: NSW TfNSW Construction Noise and Vibration Guideline; Australian Standard 2436-2010(R2016) *Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites.*

To estimate the approximate range of noise emissions from each construction activity, each noise source has been assumed to be operating for 80% utilisation in any time period.



Legend

Proposal Area

Modelled Construction Noise Sources

- Stage 1
- Stage 2
- Detatched Houses
- Heritage Area
- Park & water Feature

FIGURE 3.1

Locations of Modelled Construction Noise Sources

Image Source: Nearmap (Jan 2020) Data source: Geoscience Australia; www.ACTmapi.act.gov.au ©Australian Capital Territory;

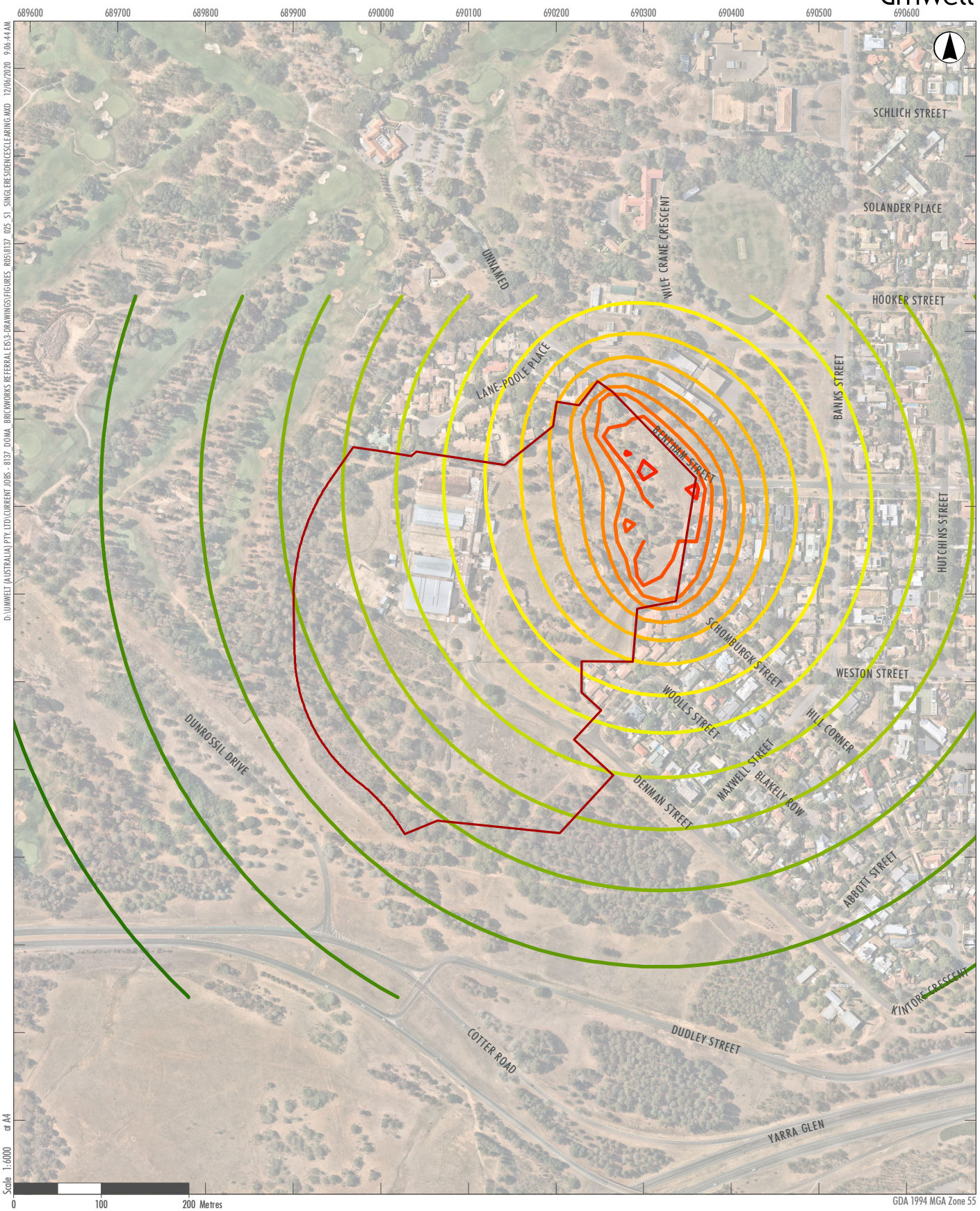
3.4 Construction noise levels

Construction noise level contours have been predicted for the nine (9) scenarios listed in the right column of **Table 3.3.** The predicted noise levels are the average of the noise impacts from construction works in the main areas of the precinct shown in the left column of **Table 3.3**, based on the total typical (mid-point) sound power level of the construction fleet. The actual noise impacts will vary continuously throughout the construction of each area, due to the changes in activity and the changes in locations of the various mobile construction noise sources. The construction noise contours presented in **Figures 3.2** to **3.10** have been predicted assuming a flat ground terrain model, and no acoustic shielding or reflections from structures such as buildings. The model, therefore, presents a conservative over-estimate of the noise propagation from the construction sites. However, the model's accuracy is more reliable in closer proximity to the construction areas where the closer receivers are usually the most relevant in regard to the assessment of noise impact.

Figures 3.2 to **3.10** indicate the construction noise levels associated with the Brickworks Precinct development could exceed the objectives of the ACT Environmental Protection Guidelines for Construction and Land Development the EP Reg outlined in **Table 2.1** and **Table 2.2** subject to the methods of construction. However, the ACT *Environmental Protection Guidelines for Construction and Land Development* does not provide guidance on additional mitigation measures that could be implemented to manage both the short-term and long-term noise impacts from the construction activities. Therefore, recommendations to manage/mitigate the noise impacts from construction activities are provided in **Section 3.5**.

3.5 Construction noise mitigation

The EP Reg requires that the noise mitigation recommendations of AS 2436 be implemented for all construction sites. Adoption of all noise mitigation recommendations in AS 2436 can achieve a substantial reduction in noise impact at receivers from the construction of the Brickworks Precinct. The noise mitigation strategies described in AS 2436 should be considered by the Project as the minimum noise mitigation that should be implemented on site. Additional noise mitigation and management measures can and should be considered for high noise generating equipment or activities and if such additional noise controls are reasonable and feasible to implement, they should also be included in the NMP. For example, it is understood that rock breaking will likely be required during some construction activities. Rock breaking is typically a high noise generating activity. If additional noise controls for rock-breaking can be reasonably and feasibly implemented, the additional controls should be included in the Project NMP.



Legend

- Proposal Area

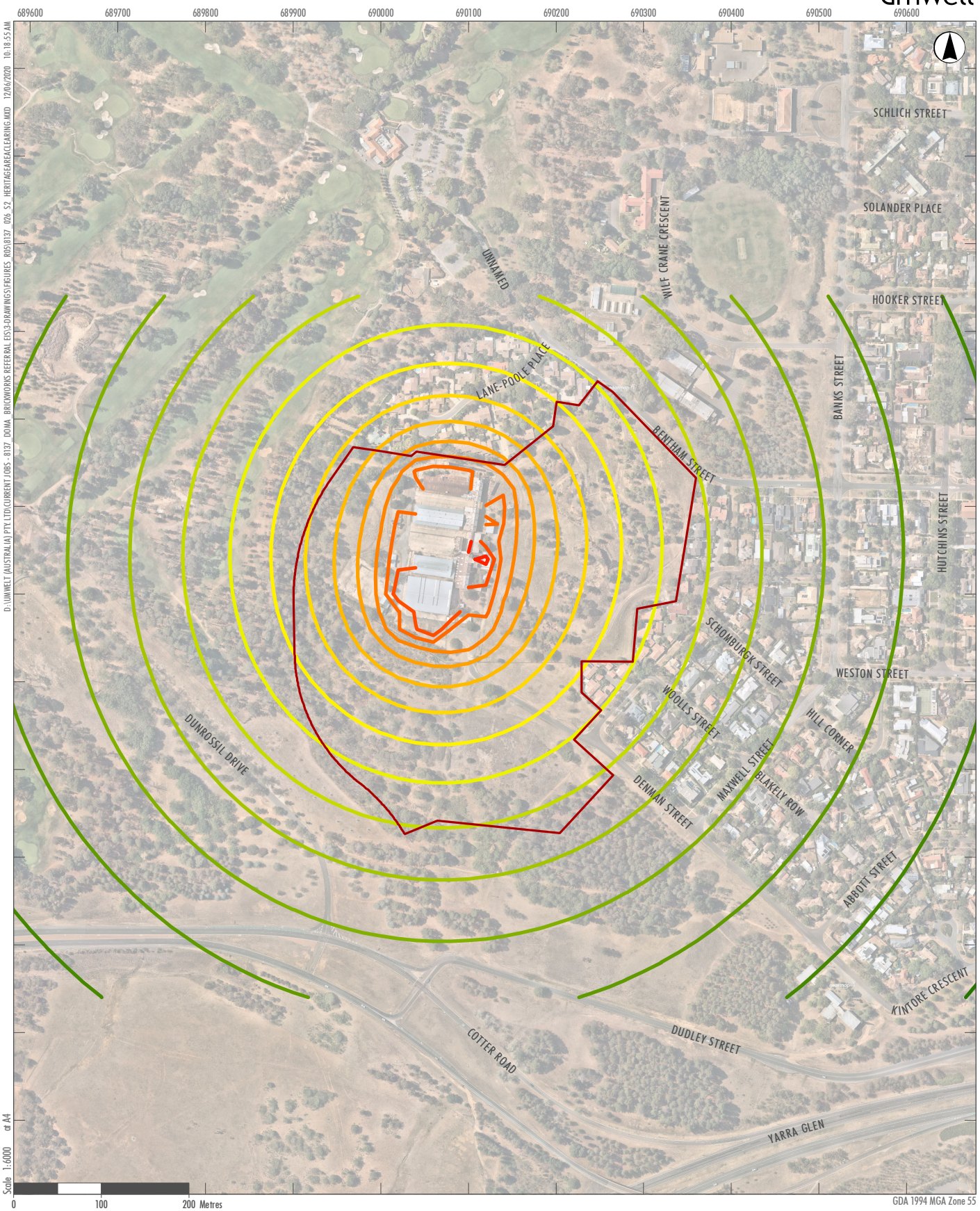
Predicted Noise Levels (dBA)

- 40
- 42.5
- 45
- 47.5
- 50
- 52.5
- 55
- 57.5
- 60
- 62.5
- 65
- 67.5
- 70
- 72.5
- 75
- 77.5

FIGURE 3.2

Predicted Noise Levels Construction Scenario 1 Single Residences - Clearing

Image Source: Nearmap (Jan 2020) Data source: Geoscience Australia; www.ACTmapi.act.gov.au ©Australian Capital Territory;



Legend

- Proposal Area

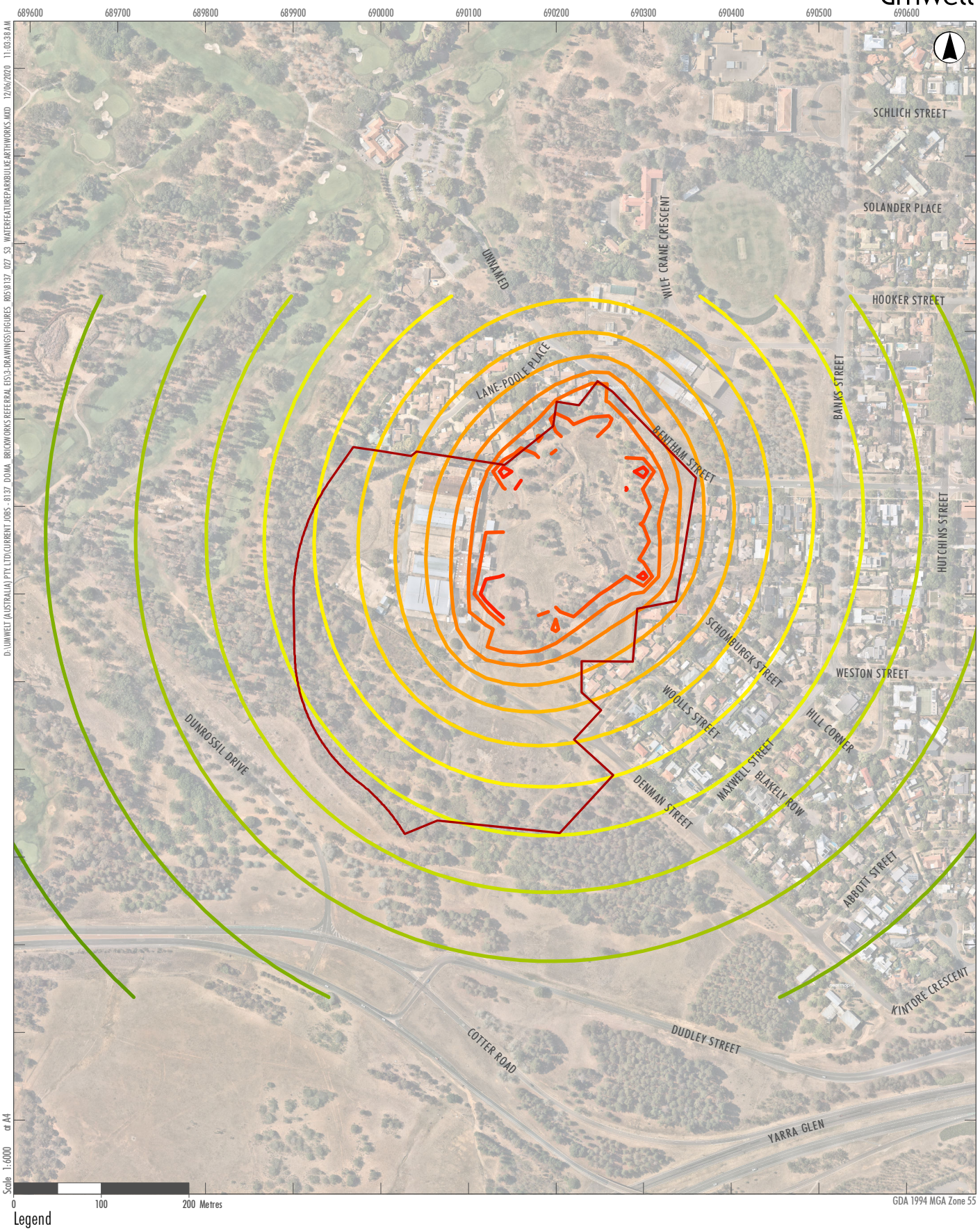
Predicted Noise Levels (dBA)

- 42.5
- 45
- 47.5
- 50
- 52.5
- 55
- 57.5
- 60
- 62.5
- 65
- 67.5
- 70
- 72.5
- 75
- 77.5

FIGURE 3.3

Predicted Noise Levels Construction Scenario 2 Heritage Area - Clearing

Image Source: Nearmap (Jan 2020) Data source: Geoscience Australia; www.ACTmapi.act.gov.au ©Australian Capital Territory;



Legend

- Proposal Area

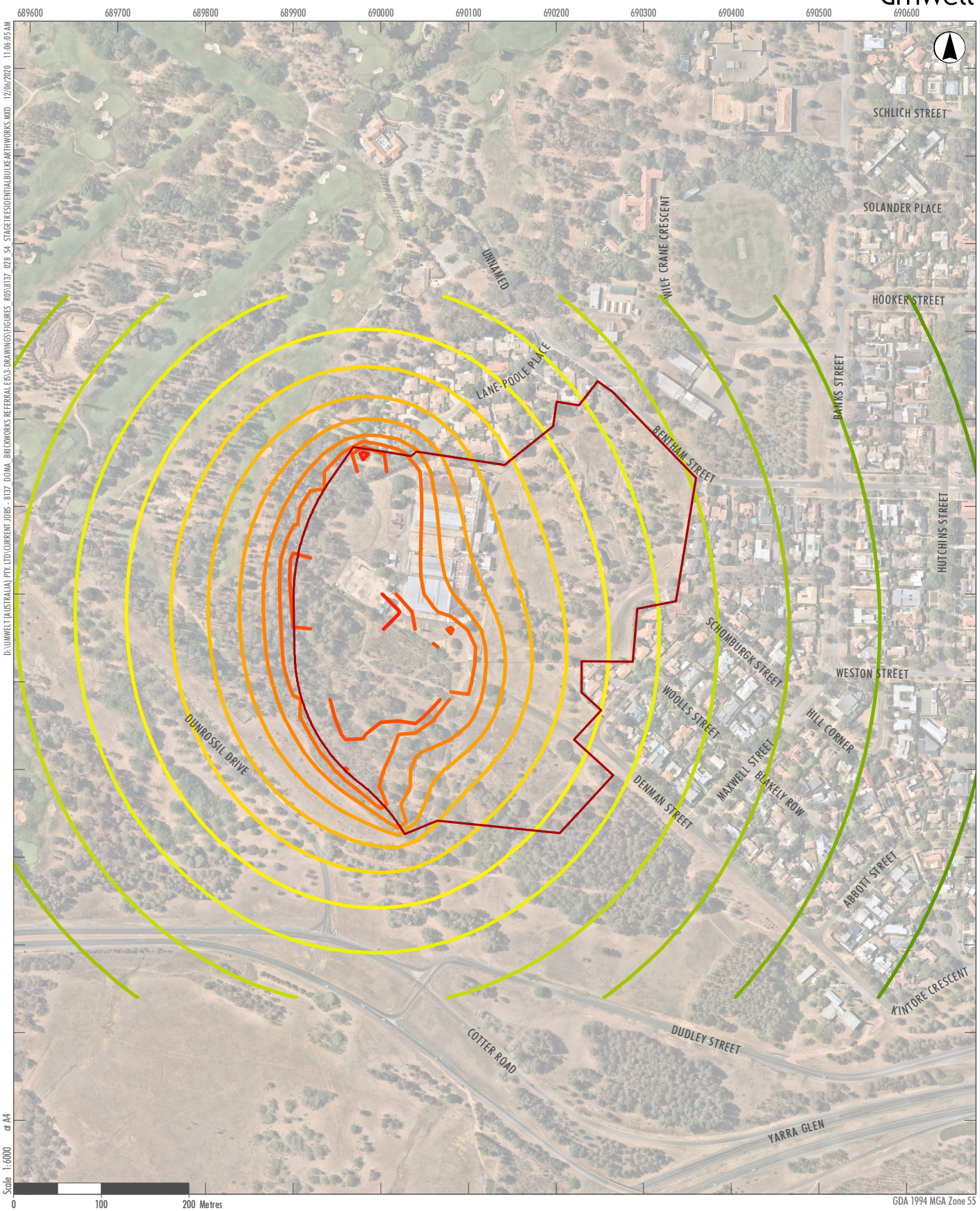
Predicted Noise Levels (dBA)

- 47.5
- 50
- 52.5
- 55
- 57.5
- 60
- 62.5
- 65
- 67.5
- 70
- 72.5
- 75
- 77.5

FIGURE 3.4

Predicted Noise Levels Construction Scenario 3 Water Feature and Park – Bulk Earthworks

Image Source: Nearmap (Jan 2020) Data source: Geoscience Australia; www.ACTmapi.act.gov.au ©Australian Capital Territory;



Legend

- Proposal Area

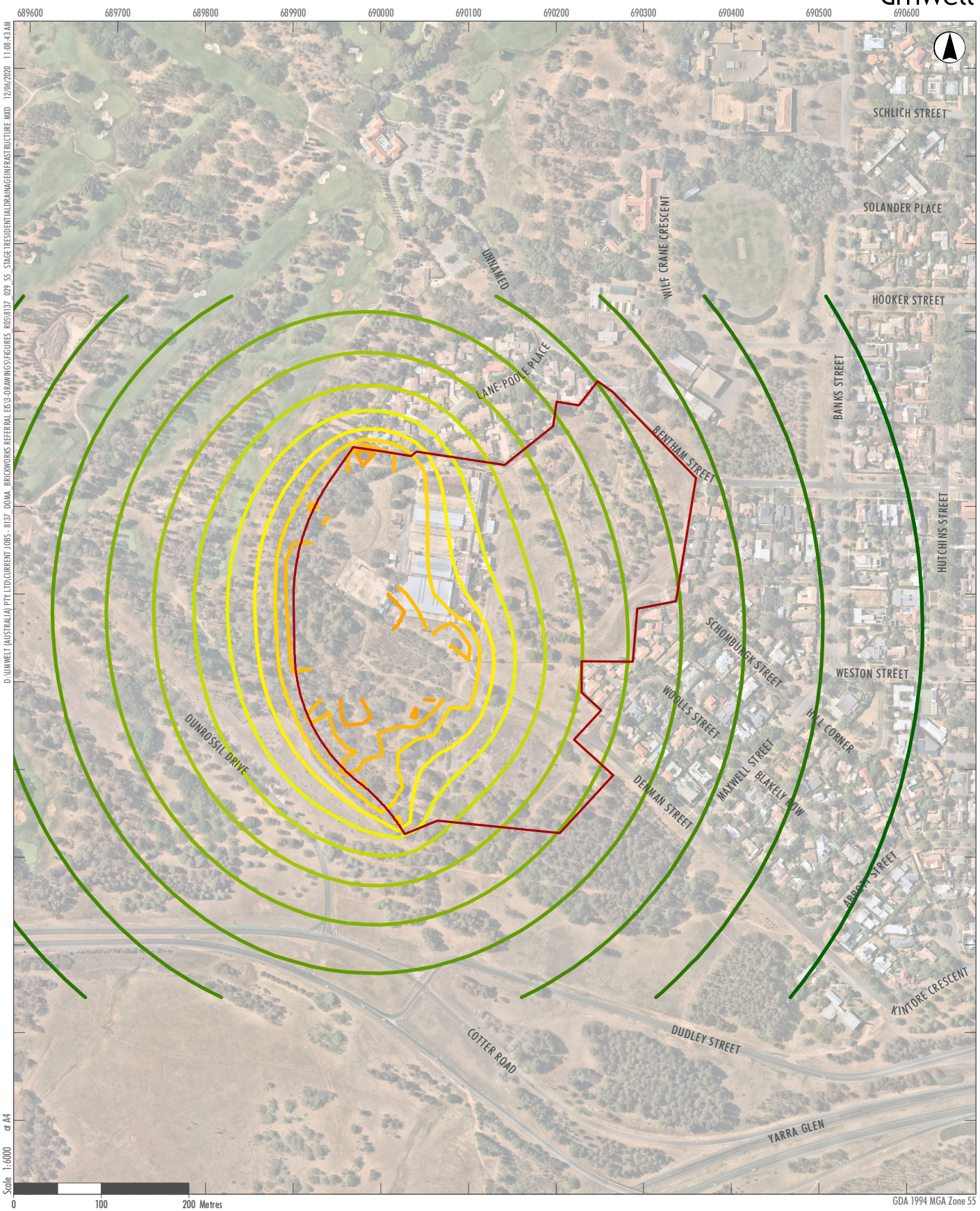
Predicted Noise Levels (dBA)

- 47.5
- 50
- 52.5
- 55
- 57.5
- 60
- 62.5
- 65
- 67.5
- 70
- 72.5
- 75
- 77.5

FIGURE 3.5

Predicted Noise Levels
Construction Scenario 4
Stage 1 Residential – Bulk Earthworks

Image Source: Nearmap (Jan 2020) Data source: Geoscience Australia; www.ACTmapi.act.gov.au ©Australian Capital Territory;



Legend

- Proposal Area

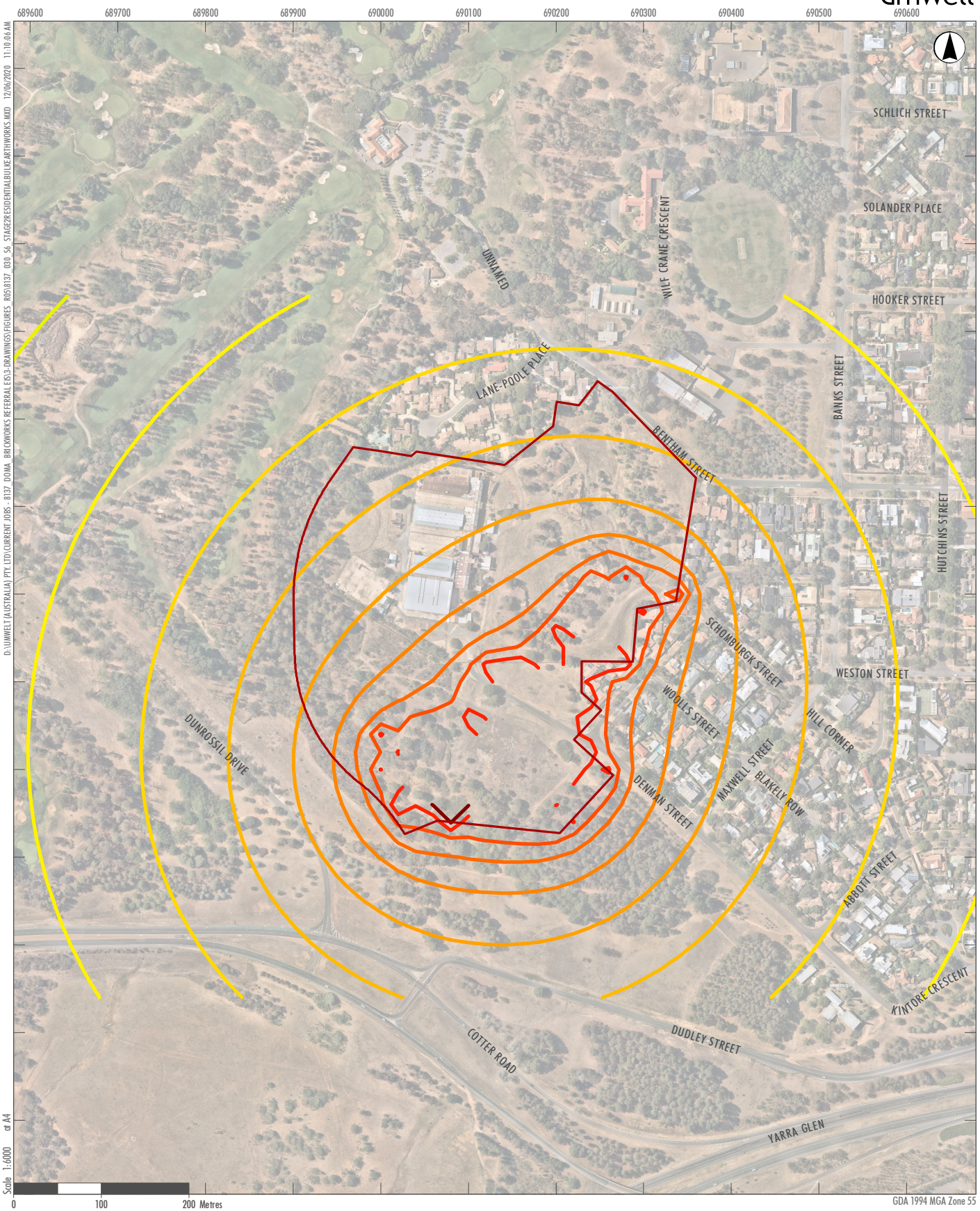
Predicted Noise Levels (dBA)

- 40
- 42.5
- 45
- 47.5
- 50
- 52.5
- 55
- 57.5
- 60
- 62.5
- 65
- 67.5

FIGURE 3.6

Predicted Noise Levels Construction Scenario 5 Stage 1 Residential – Drainage Infrastructure

Image Source: Nearmap (Jan 2020) Data source: Geoscience Australia; www.ACTmapi.act.gov.au ©Australian Capital Territory;



Legend

- Proposal Area

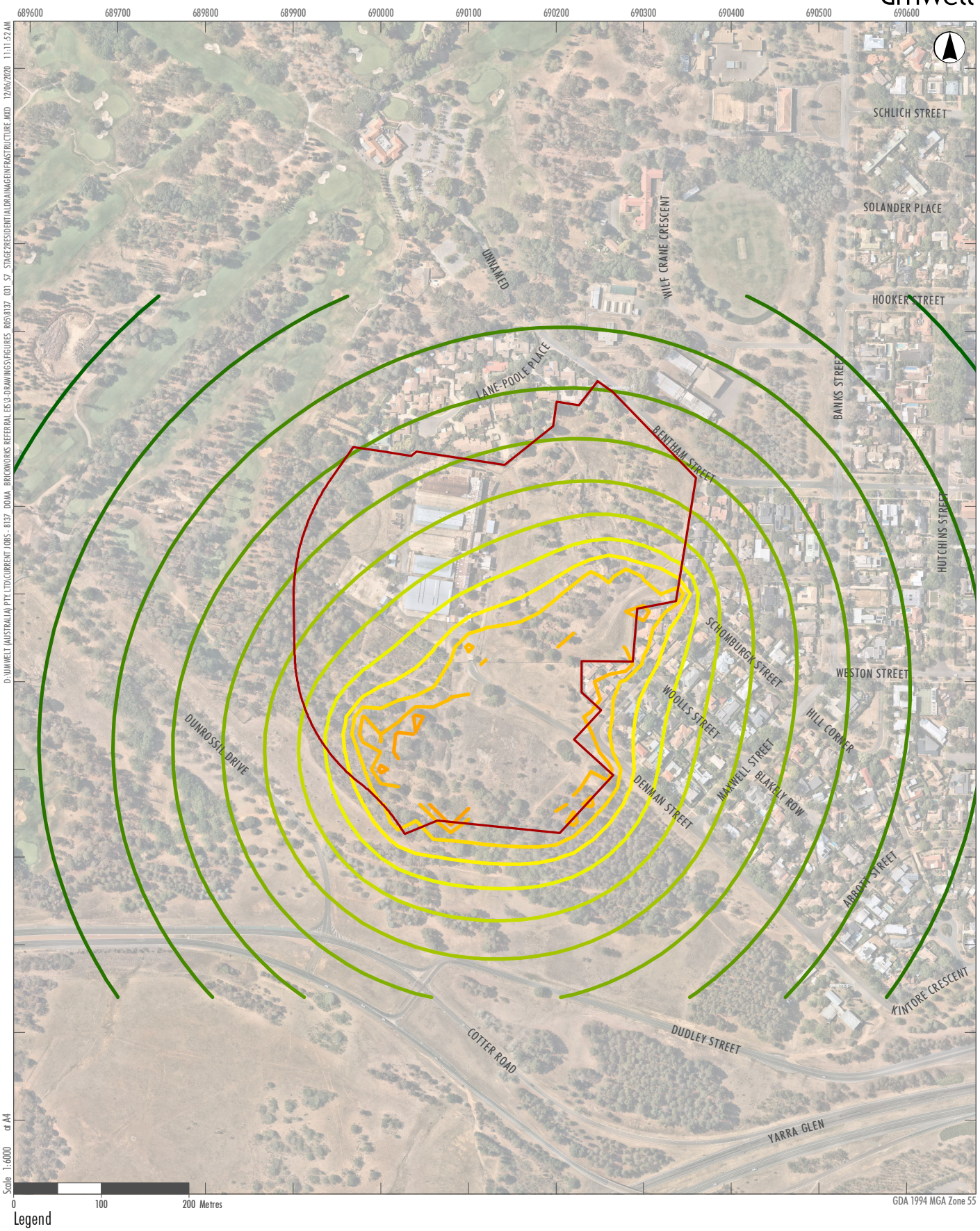
Predicted Noise Levels (dBA)

- 57.5
- 60
- 62.5
- 65
- 67.5
- 70
- 72.5
- 75
- 77.5
- 80

FIGURE 3.7

Predicted Noise Levels
Construction Scenario 6
Stage 2 Residential – Bulk Earthworks

Image Source: Nearmap (Jan 2020) Data source: Geoscience Australia; www.ACTmapi.act.gov.au ©Australian Capital Territory;



Legend

- Proposal Area

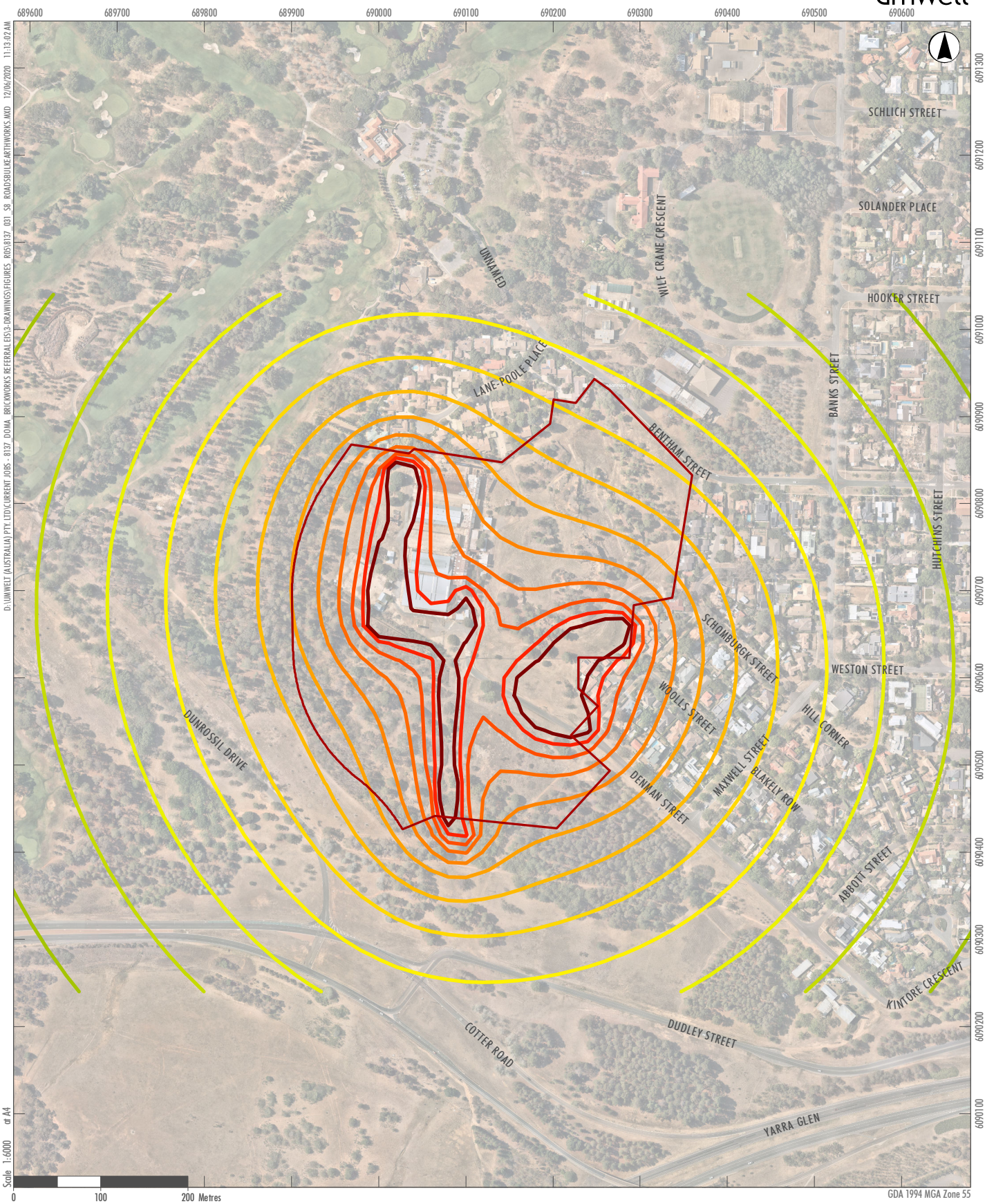
Predicted Noise Levels (dBA)

- 40
- 42.5
- 45
- 47.5
- 50
- 52.5
- 55
- 57.5
- 60
- 62.5
- 65
- 67.5

FIGURE 3.8

Predicted Noise Levels
Construction Scenario 7
Stage 2 Residential – Drainage Infrastructure

Image Source: Nearmap (Jan 2020) Data source: Geoscience Australia; www.ACTmapi.act.gov.au ©Australian Capital Territory;



Legend

- Proposal Area

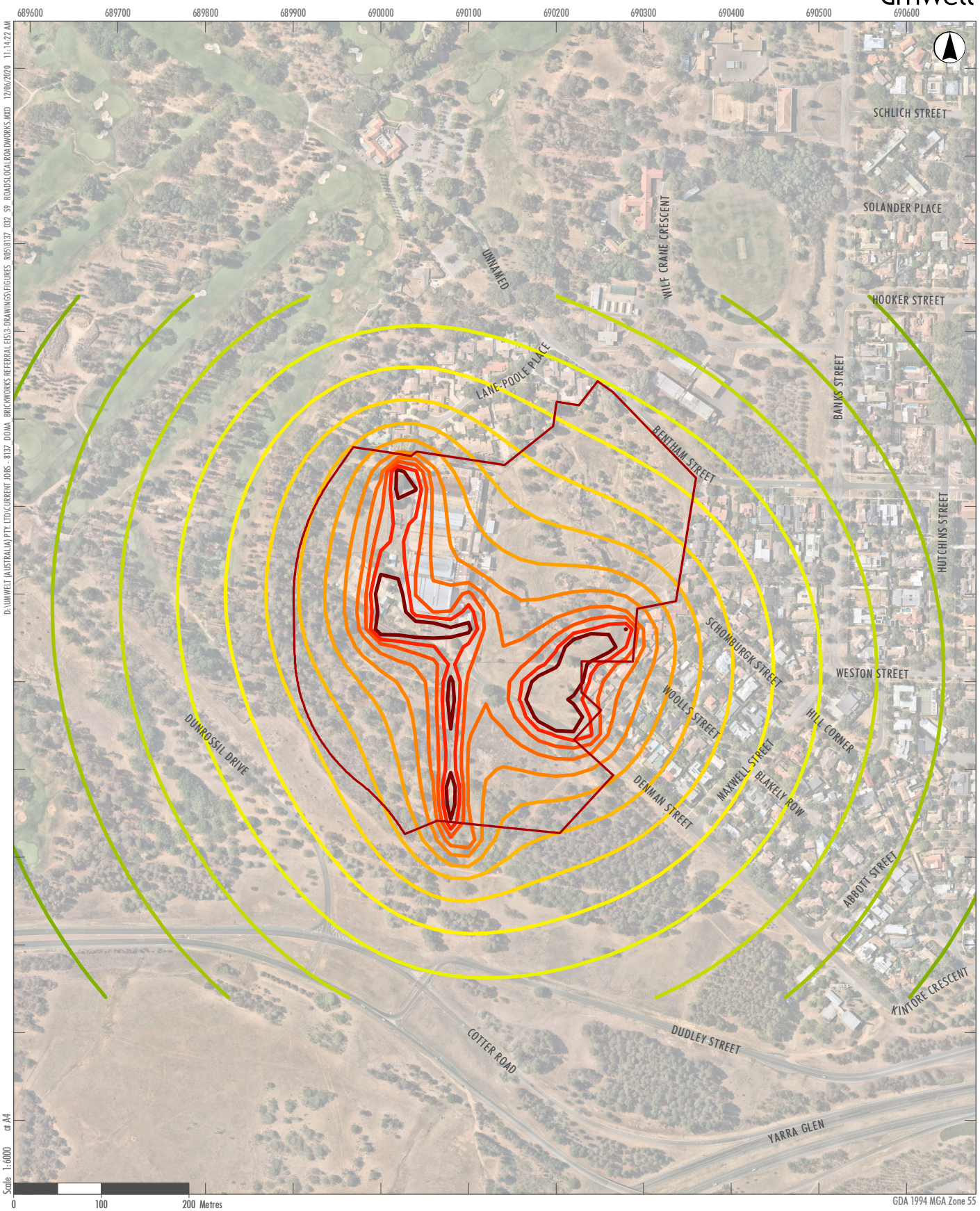
Predicted Noise Levels (dBA)

- 52.5
- 55
- 57.5
- 60
- 62.5
- 65
- 67.5
- 70
- 72.5
- 75
- 77.5
- 80

FIGURE 3.9

Predicted Noise Levels Construction Scenario 8 Roads - Bulk Earthworks

Image Source: Nearmap (Jan 2020) Data source: Geoscience Australia; www.ACTmapi.act.gov.au ©Australian Capital Territory;



Legend

- Proposal Area

Predicted Noise Levels (dBA)

- 50
- 52.5
- 55
- 57.5
- 60
- 62.5
- 65
- 67.5
- 70
- 72.5
- 75
- 77.5
- 80

FIGURE 3.10

Predicted Noise Levels
Construction Scenario 9
Roads - Local Roadworks

Image Source: Nearmap (Jan 2020) Data source: Geoscience Australia; www.ACTmapi.act.gov.au ©Australian Capital Territory;

3.5.1 High noise-generating activities

The construction plan includes the need for high noise-generating construction activities such as rock-breaking. Rock-breaking and similar high energy activities are typically high noise level producing activity. Noise impacts from high noise-generating activities on site can be managed in two ways:

1. Noise mitigation at the point of noise generation
2. Mitigation of noise propagation to receivers by locating the point of noise generation at a position which will provide high noise attenuation to receivers

Mitigation of high noise-generating activities such as rock breaking at the point of noise generation can be achieved using:

- Dampening or baffling of the hammer (see Error! Reference source not found.), and/or
- Partially enclosing the site with temporary noise barriers (see Error! Reference source not found.)

Figure 3.11 Example of noise reduction treatment on a rock-breaking head fitted to an excavator

Source: https://www.safesmartaccess.com.au//media/catalog/product/h/u/hushtec_rock_breaker_noise_redcuer_1.jpg (accessed May 2020)

Figure 3.12 Example of a temporary noise barrier

Source: noisebarriers.com.au (accessed May 2020)

3.5.2 Noise Management Plan – management of construction noise

The Noise Management Plan (NMP) to be prepared for the development of the Brickworks Precinct will need to address the requirement for mitigating high noise-generating activities, implementing additional airborne noise management measures and implementing the noise mitigation recommendations of AS 2436. The preparation of the NMP is discussed in **Section 7**.

4.0 Construction Vibration

Vibration impact at receivers from construction activities depend on many factors including:

- The size and power rating of the equipment causing the vibration
- The type of activity and utilisation of the equipment causing the vibration
- The distance between the source of vibration and the receiver
- The geology of the soil/rock through which the vibration is transmitted.

Due to the inherent variability of the above factors and other influences, it is generally not possible to accurately predict construction-based vibration levels for inclusion in a NIA prepared in support of a Development Application. However, the *Construction Noise and Vibration Guideline* (CNVG) *2016* published by TfNSW contains information that may be used to provide assessment recommendations for the Brickworks Precinct. The CNVG and provide recommended minimum working distances from vibration generating plant and residential receivers. The TfNSW recommendations are reproduced in **Table 4.1.**

Table 4.1 Recommended minimum working distances for vibration generating plant from residential sensitive receivers

Plant Item	Rating/Description	Minimum Working Distance	
		Cosmetic Damage (Residential Building)	Human Response
Vibratory Roller	< 50 kN (Typically 1-2 tonnes)	5 m	15 m to 20 m
	< 100 kN (Typically 2-4 tonnes)	6 m	20 m
	< 200 kN (Typically 4-6 tonnes)	12 m	40 m
	< 300 kN (Typically 7-13 tonnes)	15 m	100 m
	> 300 kN (Typically 13-18 tonnes)	20 m	100 m
	> 300 kN (> 18 tonnes)	25 m	100 m
Small Hydraulic Hammer	(300 kg - 5 to 12t excavator)	2 m	7 m
Medium Hydraulic Hammer	(900 kg – 12 to 18t excavator)	7 m	23 m
Large Hydraulic Hammer	(1600 kg – 18 to 34t excavator)	22 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	20 m
Pile Boring	≤ 800 mm	2 m (nominal)	4 m
Jackhammer	Handheld	1 m (nominal)	2 m

Table 4.1 Continued

Plant Item	Rating/Description	Minimum Working Distance	
		Cosmetic Damage (Residential Building)	Human Response
Profiler	Wirtgen W210	4 m	
Asphalt Paver	Vogele Super 1800-3	1 m	
Steel Drum Roller	Hamm HD70 (Oscillating Mode)	2 m	
Steel Drum Roller	Hamm HD70 (Static Mode)	1 m	

Source: CNVG Table 2 and CMNET 21/03/2017 version

The CNVG companion software, the *Construction and Maintenance Noise and Estimator Tool* (CMNET) (version 21/03/2017) can be used to provide recommended minimum working distances from vibration generating plant and residential receivers. It is recommended the noise management plan for the development of the Brickworks Precinct includes the regular review of activities that generate ground vibration and assess the potential for adverse impacts using CMNET.

5.0 Operational Noise

Noise from the operation of the Brickworks Precinct is assessable under the EP Reg. The receivers on land adjoining the Brickworks Precinct are classified as zone G in the EP Reg Schedule 2. Noise from the operation of the precinct that is not otherwise permitted by the EP Reg would be required to comply with the Noise Standards shown in **Table 2.6**.

5.1 Operational noise sources

The Brickworks Precinct by itself would normally generate little to no noise operational noise. Noise sources that may fall within the category of operation noise could include:

- Water pumping noise associated with the Water Feature
- Water falling noise from a fountain (if any) operating within the Water Feature
- Garden or grounds maintenance activities

5.1.1 Garden or grounds maintenance noise

Noise from maintaining a garden or grounds on residential land, or on land other than residential land is listed in the EP Reg Schedule 2, Table 2.3, Column 2. Under the EP Reg Part 3, Division 3.2, Section 29, noise from garden or grounds maintenance is not taken to cause environmental harm if it complies with the conditions mentioned in the EP Reg Schedule 2, Table 2.3, Column 3 as shown in **Table 5.1.**

Table 5.1 EP Reg Schedule 2 Noise Sources and Operating Limits

Column 1 Item	Column 2 Noise	Columns 3 Conditions
3	noise emitted in the course of maintaining a garden or grounds on residential land	(a) the noise is emitted- i) between 7 am and 8 pm on Monday to Saturday; or ii) between 8 am and 8 pm on Sunday or a public holiday; and (b) the equipment used is maintained and operated in accordance with the manufacturer's instructions
4	noise emitted in the course of maintaining a garden or grounds on land other than residential land	(a) the noise is emitted- i) between 7 am and 10 pm on Monday to Saturday; or ii) between 8 am and 10 pm on Sunday or a public holiday; and (b) the equipment used is maintained and operated in accordance with the manufacturer's instructions

Source: Extract from EP Reg Schedule 2, Table 2.3

6.0 Road Traffic Noise

There are no requirements to manage road traffic noise levels within the Brickworks Precinct for the protection of the undeveloped precinct, because an undeveloped parcel of land is not classified as a sensitive receiver according to the *Roads ACT Noise Management Guideline* (Section 4 Table 1.1).

The future individual developments and the future occupants of the existing buildings will be responsible for providing acceptable external and/or internal noise levels for Brickworks Precinct and adjoining areas in accordance with the requirements of the *Roads ACT Noise Management Guideline*. Future individual developments will require approval, and a Noise Impact Assessment (NIA) and/or a NMP will be prepared for each development application if required. Where applicable, the NIA and NMP of each future individual developments would need to address the potential for and the generation of road traffic noise.

Indicative road traffic noise level information that can be used as a guide for future development applications within the precinct is presented in **Section 8.2**.

7.0 Noise Management Plan

An underlying commitment for the preparation of the Brickworks Precinct development, as documented in the DOMA Request for Tender for the Sale & Development of the Canberra Brickworks Precinct (Returnable Schedule 05) is the preparation of a Noise Management Plan (NMP) for the development of the Brickworks Precinct. The information that will need to be included in the NMP for the development of the Brickworks Precinct is described below. It is noted that the NMP for the Brickworks Precinct will not need to address the noise assessment and management requirements for each of the future developments within the estate. However, the following information provides a guideline on the potential requirements of the NMPs that could be required for each future development within the Brickworks Precinct. Additional details on the requirements that could apply to each of the future developments within the Brickworks Precinct is provided in **Section 8**.

7.1 Guidelines for the preparation of Noise Management Plans for development applications

The *Guidelines for the preparation of Noise Management Plans for development applications* (EPA,2014) provides the following recommendations for the information to be provided in an NMP:

> ***What should a NMP consider?***
>
> *The EPA expects developers to introduce measures to attenuate (reduce) the noisiest use permitted by the lease, regardless of whether or not the proponent intends to use it. Many factors need to be considered when preparing a NMP, with these factors differing with each proposal. It is necessary to consider the following when preparing a NMP:*
>
> - *The permitted noise standard under the Regulation for the site – all noise emitted from the site must comply with the noise standard at any point within the vertical plane of the site boundary. Where a residential development is proposed in an area with a noise standard higher than zone G, the development must meet the 'satisfactory' recommended design sound levels for residential buildings of AS/NZS 2107. Commercial accommodation developments should meet AS/NZS 2107 for sleeping areas.*
> - *The activities currently carried out within the area – this is particularly relevant when considering a residential development in an area other than zone G (as defined in the Regulation).*
> - *The permitted uses under the lease for the site – the NMP must address noise from all permitted uses identified as being noisy, regardless of whether the noisy permitted use is utilised. If a noisy use is permitted the noise must be attenuated.*
> - *Noise sources – the NMP must include all sources of noise which may have an impact on the development and/or adjoining sites. The EPA has found noise from the following sources to be the subject of complaints: exhaust fans including both kitchen and underground car parks; garage roller doors; mechanical plant; and garbage collection among others. There are also noise sources associated with many proposals which, due to their occasional nature, are not normally included in acoustic modelling, such as public address systems, emergency warning systems, reversing beepers. These noise sources should be identified in the NMP, their likely impacts discussed, and comment provided on the potential use of alternative systems that can minimise their impact. The NMP should also identify and discuss low frequency (particularly where amplified music is identified as a noise source), tonal, impulsive and intermittent noise sources and their associated mitigation measures. The NMP should discuss both the protection of*

noise receivers from noise sources and the minimisation of noise generated at the noise source and outline appropriate noise reduction measures. Where the proposal includes a mixed-use site (i.e., residential and commercial), the NMP must address the impact of noise sources on other leaseholders within the same lease boundary, particularly residential dwellings. Note: The ACT is divided into noise zones. Noise Standards for these zones are set in the Environment Protection Regulation 2005. All noise emissions from a parcel of land must comply with the noise standards at any point within the vertical plane of the boundary. It can therefore be assumed that noise sources external to the parcel of land should not exceed the noise standards that apply to that land. The noise standards for the purposes of this document are taken to be expressed as $L_{A10,T}$ where T is 10 minutes (i.e., for a multi-unit dwelling located within the city centre, the maximum noise source external to the dwelling should be 60 dB(A) $L_{A10,10\ minutes}$).

What should a NMP contain?

At a minimum a NMP should contain:

- *the name, qualification/experience of the person who prepared the report*
- *an adequate description of the project, including background history or relevant previous studies, scope of work, noise/vibration issues addressed, hours of operation*
- *a detailed site map that identified location of the noise sources, noise receiver locations (including existing and proposed residential areas), topographical data which may affect noise propagation, measurement or prediction locations and north point and scale*
- *relevant noise guidelines, policies or standards that have been applied, for example:*
    - *Environment Protection Regulation 2005*
    - *Noise Environment Protection Policy, Environment Protection Authority*
    - *Noise Measurement Manual, Environment Protection Authority*
    - *AS 2436-2010(R2016) Guide to noise control on construction, demolition and maintenance sites*
    - *AS/NZS 2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors*
    - *AS 2670.2 Evaluation of human exposure to whole-body vibration - Continuous and shock-induced vibration in buildings (1 - 80Hz).* [Note: This Standard has now been replaced by AS ISO 2631-2:2014]
- *details of any noise monitoring undertaken*
- *noise predictions for the proposed activity including:–how noise levels for each activity or permitted use were determined – type of computer noise modelling software used – noise source locations and source heights – topography settings – meteorological conditions used – receiver locations–operating conditions of the building when predicting internal noise levels including a justification for those conditions (i.e., windows and doors open or closed).*
- *a comparison of noise predictions against noise criteria*
- *a discussion of proposed mitigation measures, the noise reduction likely and the feasibility and reasonableness of these measures*
- *how compliance can be determined practically.*

7.2 Australian Standard 2436-2010(R2016)

AS 2436-2010(R2016) provides the following recommendations regarding noise management plans (Section 3.4)

> *Noise and vibration management plans should describe the approaches that will be applied in consulting with, and notifying, the community. Noise and vibration management plans should also show a commitment to work practices, such as scheduling of activities and selection of equipment and procedures that will be implemented to minimize impacts and manage complaints.*
>
> *A range of media should be used to notify the community before and during construction, including use of community meetings, individual contact and letterbox drops. Contact details for complaints and further information, including emergency phone numbers, should be readily available to the community.*
>
> *In large projects, a community relations plan should be developed and implemented. Complaints should be recorded and managed in conformity with the plan to ensure prompt and fair response.*

Some of the standard noise control strategies commonly employed on typical construction sites described in AS 2436 are:

> ***4.4.2 Adoption of universal work practices***
>
> *Many noise and vibration complaints are due to preventable day-to-day activities that may be addressed by:*
>
> *(a) Regular reinforcement (such as at toolbox talks) of the need to minimize noise and vibration.*
>
> *(b) Regular identification of noisy activities and adoption of improvement techniques.*
>
> *(c) Avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby residents.*
>
> *(d) Developing routes for the delivery of materials and parking of vehicles to minimize noise.*
>
> *(e) Where possible avoiding the use of equipment that generates impulsive noise.*
>
> *(f) Minimizing the need for vehicle reversing (see Clause 3.5) for example, by arranging for one-way site traffic routes.*
>
> *(g) Use of broadband audible alarms on vehicles and elevating work platforms used on site (see Clause 3.5).*
>
> *(h) Minimizing the movement of materials and plant and unnecessary metal-on-metal contact.*
>
> *(i) Minimizing truck movements.*
>
> *(j) Scheduling respite periods.*
>
> ***4.4.3 Community Consultation/Notification***

Noise and vibration management plans should describe the approaches that will be applied in consulting with, and notifying, the community.

4.4.4 Plant and equipment

In terms of both cost and results, controlling noise and vibration at the source is one of the most effective methods of minimizing the impacts from any work site activities. Work practices that will reduce noise or vibration at the source include:

(a) Employing quieter techniques for all high noise activities such as rockbreaking, concrete sawing, and using power and pneumatic tools.

(b) Choosing quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks.

(c) Selecting plant and equipment with low vibration generation characteristics.

(d) Operating plant and equipment in the quietest and most efficient manner.

(e) Regularly inspecting and maintaining plant and equipment to minimise noise and vibration level increases, to ensure that all noise and vibration reduction devices are operating effectively.

4.4.5 On site noise mitigation

Practices that will reduce noise from the site include:

(a) Maximizing the distance between noise activities and noise sensitive land uses.

(b) Undertaking noisy fabrication work off-site where possible, e.g., with enclosed factory premises, where noise can be controlled.

(c) Adopting alternatives to beeper reversing alarms (see Clause 3.5).

(d) Maintaining any pre-existing barriers or walls on a demolition or excavation site as long as possible to provide optimum sound propagation control.

(e) Constructing barriers that are part of the project design early in the project to afford mitigation against site noise.

(f) Using temporary site building and material stockpiles as noise barriers. These can often be created using site earthworks and may be included as a part of final landscape design.

(g) Installing purpose-built noise barriers, acoustic sheds and enclosures.

4.4.6 Work scheduling

Scheduling work during periods when people are least affected is an important way of reducing adverse impacts. The following scheduling aspects may reduce impacts:

(a) Providing respite periods, including restricting very noisy activities such as rock hammering or piling to daytime, restricting the number of nights that after-hours work is conducted near residences, or by determining any specific requirements, particularly those needed for noise sensitive receivers such as schools and hospitals.

(b) Scheduling activities to minimize impacts by undertaking all possible work during hours that will least adversely affect sensitive receivers (e.g., outside normal working hours for nearby workplaces; within normal working hours for nearby residences) and by avoiding conflicts with other scheduled events.

(c) Scheduling work to coincide with non-sensitive periods (i.e., work near schools during weekends or in school holidays).

(d) Scheduling noisy activities to coincide with high levels of neighbourhood noise so that noise from the activities is partially masked and not as intrusive.

(e) For specific works, such as tunnelling, stockpiling excavated tunnel material overnight and scheduling its removal during day-time hours or night-time where receivers are commercial, or it is more appropriate.

(f) Planning deliveries and access to the site to occur quietly and efficiently and organising parking only within designated areas located away from the sensitive receivers.

(g) Optimizing the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours.

(h) Designating, designing and maintaining access routes to the site to minimize impacts.

(i) Including contract conditions that include penalties for non-compliance with reasonable instructions by the principal to minimise noise or arrange suitable scheduling.

4.5 Control of Noise at Source

Some ways of controlling noise at source are—

(a) substitution (See AS 2436 Appendix C for examples);

(b) modification of existing equipment;

E.g., an acoustic shroud around the hammer head of excavator-mounted hydraulic rock breakers

(c) use and siting of equipment;

E.g., shut down equipment when not in use;

(d) regular and effective maintenance of equipment.

4.6 Controlling the Spread of Noise

If noisy processes cannot be avoided, then the amount of noise reaching the receiver should be minimized. Two ways of doing this are either to increase the distance between the noise source and the receiver or to introduce noise reduction measures such as screens. Physical methods to reduce the transmission of noise between the site works and residences, or other sensitive land uses, are generally suited to works where there is longer-term exposure to the noise. Practices that will reduce noise from the site include:

(a) Increasing the distance between noise sources and sensitive receivers.

(b) Reducing the line-of-sight noise transmission to residences or other sensitive land uses using temporary barriers (stockpiles, shipping containers and site office transportables can be effective barriers).

(c) Constructing barriers that are part of the project design early in the project to afford mitigation against site noise.

(d) Installing purpose-built noise barriers, acoustic sheds and enclosures.

8.0 Future Developments within the Brickworks Precinct

8.1 Contamination remediation and encapsulation

It is understood that the primary means of disposal of contaminated material within the precinct is intended to be encapsulation in an as yet undetermined location in the eastern section of the Site. The works to provide this contamination remediation would be considered as 'Building Work' and would be assessable under the EP Reg Schedule 2, as shown in **Table 2.1** and **Table 2.2.** It is therefore anticipated the contamination remediation and encapsulation project would require its own Approval, and consequently, it would require its own Noise Impact Assessment and NMP.

8.2 Road traffic noise levels

8.2.1 Road traffic noise level criteria

Future developments within the Brickworks Precinct will need to consider the potential requirement to provide acoustic controls for road traffic noise levels received at the proposed developments from nearby roads. The noise level targets and options to provide noise control are described in *Roads ACT Noise Management Guidelines, 2018* Section 4 as follows:

> ***4. New Developments on Existing Roads***
>
> *Proposed noise sensitive developments (refer to Table 1.1) located adjacent to arterial or major collector roads are to be planned, designed and constructed to standards that provide: external noise levels based on the existing conditions at the receiver below the maximum levels set out in Table 1.2, or; internal noise levels that meet the Australian Standard AS 2107.*
>
> *Proposals for development of potentially noise sensitive land uses (refer to Table 1.1) adjacent to any existing arterial or major collector road will require an assessment against Table 1.2, guidelines contained in the table Schedule 1 provide guidance on achieving this.*

The above statement is summarised in Schedule 1 of the guideline, reproduced in **Table 8.1**, **Table 8.2** and **Table 8.3**.

Table 8.1 *Roads ACT Noise Management Guidelines* Section 4 Schedule 1 Guidelines for new developments on existing roads

Objective	Technique	Criteria
To protect occupants of developments from excessive levels of traffic noise	set-back of the building from the road AND/OR acoustic barrier between the building and the road (within the lessee land)	Maximum external traffic noise level at the development, as set out in Table 1.2
	OR building design measures to provide acoustic insulation	OR Internal noise levels as set out in AS/NZS 2107 and AS 3671

Table 8.2 *Roads ACT Noise Management Guidelines* Section 4 Table 1.1: Noise Sensitive Land Uses

Development Type	
Residential	**Community**
apartment attached house boarding house caravan park/camping ground detached house guest house retirement complex special care establishment special care hostel	childcare centre community activity centre (except community halls) educational establishment health facility/ hospital special dwelling

As stated in the *Roads ACT Noise Management Guidelines, 2018*, the noise-sensitive developments may be planned, designed and constructed to achieve target noise levels either external to the building or internally within the building. In either case, the proposal for a noise-sensitive development will require an assessment against the target external noise levels in the *Roads ACT Noise Management Guideline, 2018* as shown in **Table 8.3.**

Table 8.3 *Roads ACT Noise Management Guidelines* Section 4 Table 1.2: Maximum external traffic noise level (Target level) at the development, expressed as L_{Aeq} dB(A)

Land uses	Target noise level dB(A) (inc. façade reflection)
Residential and community facilities day-time $L_{Aeq(15\ hour)}$	60
Residential night-time $L_{Aeq(9\ hour)}$	55
Commercial facilities	72

8.2.2 Predicted road traffic noise levels

Road traffic noise levels have been predicted as noise level contour maps throughout the Brickworks Precinct. The road traffic noise levels were calculated using the 3-dimensional environmental noise prediction software Cadna/A, using the modelling method *Calculation of Road Traffic Noise* (CoRTN) as modified for use in Australia. Road traffic noise levels were predicted as equivalent-continuous sound levels (L_{Aeq}) for the Day (7 AM to 10 PM) and Night (10 PM to 7 AM) time periods as defined in the *Roads ACT Noise Management Guidelines, 2018* to enable assessment against the target noise levels in **Table 8.3.**

The traffic noise model was constructed using road and traffic volume data provided by the traffic consultant AECOM, shown in **Table 8.4.**

Table 8.4 Traffic data used in road traffic noise modelling

Road	Number of Lanes	Speeds	7am – 10pm	10 pm – 7 am	HV %
Adelaide Avenue	Two each way	80 km/h	29566	2237	5.3%
Cotter Road	Two each way	80 km/h	20240	1405	5.3%
Dunrossil Drive[1]	One each way	60 km/h	< 935	< 65	1%
Dudley Street	One each way	60 km/h	9104	421	5.3%

Note: 1. Estimated data

Legend

- Proposal Area

Predicted Road Traffic Noise

Day time LA_{eq}(15 hour)

- < 40
- 40 - 42
- 42 - 44
- 44 - 46
- 46 - 48
- 48 - 50
- 50 - 52
- 52 - 54
- 54 - 56
- 56 - 58
- 58 - 60
- > 60

FIGURE 8.1

Predicted Road Traffic Noise Levels – Day time period 7 AM to 10 PM LAeq(15 hour)

Image Source: Nearmap (Jan 2020) Data source: Geoscience Australia; www.ACTmapi.act.gov.au ©Australian Capital Territory;

Legend

- Proposal Area

Predicted Road Traffic Noise

Night time LA_{eq}(9 hour)

- < 30
- 30 - 32
- 32 - 34
- 34 - 36
- 36 - 38
- 38 - 40
- 40 - 42
- 42 - 44
- 44 - 46
- 46 - 48
- 48 - 50
- > 50

FIGURE 8.2

Predicted Road Traffic Noise Levels – Night time period 10 PM to 7 AM LAeq(9 hour)

Image Source: Nearmap (Jan 2020) Data source: Geoscience Australia; www.ACTmapi.act.gov.au ©Australian Capital Territory;

Figure 8.1 indicates the road traffic noise levels at the nearest residential buildings from the arterial and collector roads identified in **Table 8.4** are predicted to marginally exceed the day-time $L_{Aeq(15\ hour)}$ criterion of 60 dB(A) (inc. façade reflection). The maximum predicted day-time $L_{Aeq(15\ hour)}$ noise level at the nearest receiver building is within the 58 to 60 dB(A) (free-field) band in **Figure 8.1**.

Figure 8.2 indicates the road traffic noise levels at the nearest residential buildings from the arterial and collector roads identified in **Table 8.4** are predicted to be less than the night-time $L_{Aeq(9\ hour)}$ criterion of 55 dB(A) (inc. façade reflection). The maximum predicted night-time $L_{Aeq(9\ hour)}$ noise level at the nearest receiver building is within the 48 to 50 dB(A) (free-field) band in **Figure 8.2**.

The results of the road traffic noise assessment indicate that, with current traffic volumes and road configurations, noise mitigation such as noise barrier(s) and architectural acoustic treatments may be required to be implemented by the development for the residential buildings to control the external noise level generated by road traffic. The external road traffic noise levels may also be higher at higher floors within the proposed residential buildings.

8.3 Building construction acoustic design requirements

All proposed future developments within the Brickworks Precinct will be required to be designed and constructed in compliance with the acoustic performance requirements detailed in the BCA and the *Roads ACT Noise Management Guidelines*, Transport Canberra and City Services, 2018.

8.3.1 Building Code of Australia (National Construction Code Volumes 1 and 2)

The Australian Building Codes Board has published a Handbook of Sound Transmission and Insulation in Buildings. The Handbook provides non-mandatory advice for the design and construction of buildings regarding internal acoustics performance in relation to the *Building Code of Australia* (BCA). The Handbook states that the BCA does not address the issues such as noise entering the building from outside from any source for example from industrial processes, vehicle traffic, trains, aircraft or animals; or environmental noise emission from the building to surrounding areas.

8.3.2 Internal noise levels from road traffic

In accordance with the *Roads ACT Noise Management Guidelines*, a proposal for a noise-sensitive development [building] adjacent an arterial or major collector road may comply with the Guidelines by demonstrating that the building will be designed and constructed to achieve satisfactory levels of road traffic noise internally within the building. As discussed in Section 8.2, the traffic noise levels have been predicted to marginally exceed the external noise criteria at the nearest buildings therefore further assessment of the traffic noise is required during each phase. The satisfactory internal road traffic noise levels for different types of building occupancy are given in Australian/New Zealand Standard AS/NZS 2107-2016 *Acoustics – Recommended design sound levels and reverberation times for building interiors* (AS/NZS 2107) described in Section **8.3.3** below.

8.3.3 Australian Standard/New Zealand Standard 2107-2016

AS/NZS 2107 nominates a range of design internal sound levels within occupied spaces for various types of buildings. AS/NZS 2107 does not specify which types of noise sources that the internal design sound levels apply to.

8.3.3.1 Design sound levels within commercial occupancies in the precinct Heritage Area

As the future commercial uses within the precinct's Heritage Area are currently unknown, the recommended internal design sound levels for individual occupancies within the precinct's Heritage Area will need to refer to the appropriate guidance in Table 1 of AS/NZS 2107.

8.3.3.2 Design sound levels within residential buildings

AS/NZS 2107 provides recommended internal design sound levels for different types of residential accommodation buildings. For houses and apartments, AS/NZS 2107 provides guidance for buildings in areas with elevated ambient noise levels such as inner-city areas, entertainment districts or near major roads, and it also provides guidance for buildings in areas with lower ambient noise levels such as suburbs or near minor roads.

In the Brickworks estate Master Plan, the detached single-occupancy residential buildings are proposed to be located in areas that would be classified in AS/NZS 2107 as suburbs or near minor roads. The multi-unit apartment buildings are located relatively near Adelaide Avenue and Cotter Road, which are both major roads.

On this basis, the design sound levels for different types of occupied spaces within the different types of residential buildings in the Brickworks Precinct are shown in **Table 8.5.**

Table 8.5 Recommended AS/NZS 2107 design sound levels in residential buildings in the Brickworks Precinct

Type of occupancy/activity	Design sound level ($L_{Aeq,t}$) range, dB(A)	
	Single-occupancy detached houses	Multi-unit apartments
Apartment common areas (e.g., foyer, lift lobby)	n/a	45 to 50
Living areas	30 to 40	35 to 45
Sleeping areas (night-time)	30 to 35	35 to 40
Work areas	35 to 40	35 to 45

8.3.4 Australian Standard 3671-1989

AS 3671-1989 *Acoustics - Road traffic noise intrusion - Building siting and construction* (AS 3671) provides advice on the location and construction of buildings near major roads to provide adequate acoustic isolation performance of the external building envelope to achieve target noise levels within the building. The construction materials and designs of building elements recommended within AS 3671 the industry standard best practice at the time of publication of the Standard. Contemporary building construction materials and designs are now available that can achieve similar or better acoustic performance. AS 3671 allows buildings to be constructed with bespoke acoustic designs to achieve the recommended design noise levels.

8.4 Noise assessment and management requirements

A NIA and/or NMP may be required to be developed in support of a development application for future individual developments within the Brickworks Precinct. If a NIA and/or an NMP is requested by the Approval Authority to support the development application, it may need to address the noise impacts and management from the construction as well as the operational phases of the development. If an NMP is

required to support a development application, it should be prepared following the guidance given in *Guidelines for the Preparation of Noise Management Plans for Development Applications*, Environment Protection Authority, 2014. Some of the requirements of the Guidelines are reproduced in **Section 7.1** above.

8.4.1 Residential developments within the Brickworks Precinct

8.4.1.1 Operational noise from residential developments

The noise standards defined in the EP Reg apply to residential land uses, with some limitations. The noise standards do not apply to human sounds or typical domestic sounds. The noise standards would typically apply only to mechanical and/or electrical noise from sources such as:

- Air-conditioners or ventilation fans
- Pool pumps
- Garage roller doors
- Garbage collection

For these types of noise sources, the noise standards shown in **Table 2.6** would usually apply. However, for multi-unit developments, as stated in the EP Reg Part 3 Division 3.1 Section 24 (2) (a), *if the compliance point for noise emitted from a unit is a point in any of the other units in the units plan, the noise standard for the unit is 5 dB(A) below the noise standard that would otherwise apply*.

8.4.1.2 Noise received at residential developments

As described in **Section 2.3.1**, a NMP may be required under the development and precinct codes for multi-unit housing and single residential housing within the Brickworks Precinct. For residential developments within the Brickworks Precinct that are potentially affected by noise from external sources (for example, commercial noise) the NMP would need to demonstrate that the acoustic design of occupied dwellings would meet the 'satisfactory' design sound levels in Australian Standard/New Zealand Standard 2107:2016 *Acoustics - Recommended level sand reverberation times for building interiors* internally within dwellings.

In the case of road traffic noise received at proposed developments, as described in the *Roads ACT Noise Management Guidelines* Section 4 Schedule 1, the developer may choose whether to control the road traffic noise to achieve the target external road traffic noise level (for example, by the construction of noise barriers) or to achieve the AS/NZS 2107 target internal noise levels using architectural acoustic treatments to the receiver building(s)' external envelope, or by a combination of both types of treatments.

8.4.1.3 Construction noise from construction of residential developments

The restrictions for noise from building work during construction of future developments within the precinct are detailed in Schedule 2 of the EP Reg, as shown in **Table 8.6**.

Table 8.6 Time restrictions for building work to manage noise impacts

Building Work Details	Monday to Saturday	Sunday and public holidays
Industrial, city and town centre areas	6am to 8pm	6am to 8pm
Any other area when work completed within 2weeks	7am to 8pm	8am to 8pm
Any other area when work not completed within 2 weeks	7am to 6pm	Building work must not exceed Noise Standard

Source: EP Reg (2005)

The Noise Standard for receivers on land adjoining the Brickworks Precinct are shown in **Table 8.7.** The Noise Standard applies at the shared boundary of the precinct and the adjoining land containing the receiver. The time restrictions in **Table 8.7** are based on the construction works' duration being longer than 2 weeks.

Table 8.7 Noise Standard at the boundary of the development for construction noise impacts

Noise Zone	Noise Standard, $L_{A10(10\ minutes\ ^{1})}$ dB(A)	
	Monday to Saturday (6pm to 10pm) Sunday / Public Holiday (8 am to 10 pm)	**'Any other time'** Monday to Saturday (10pm to 7am) Sunday / Public Holiday (10pm to 8am)
G	45	35

Source: EP Reg (2005) Table 2.2

In addition to the restrictions outlined in **Table 8.6**:

- All relevant noise reduction measures mentioned in Australian Standard 2436-2010 (Reconfirmed 2016) *Guide to noise and vibration control on construction, demolition and maintenance sites* (AS 2436), as in force from time to time, must be implemented
- schedule noisy activities for the least sensitive times of the day such as mid-morning and mid-afternoon
- select machinery that produce less noise, and
- ensure machinery is well maintained.

Australian Standard 2436 -2010(R2016)

AS 2436 provides many recommendations for managing noise and vibration impacts from construction sites. Some of the standard noise control strategies commonly employed on typical construction sites are described in **Section 7.2.**

8.4.2 Commercial developments within the Brickworks Precinct

Potentially noisy land uses within the precinct will be required to comply with the applicable Rules (R23) in the Territory Plan 2008 – Commercial Zones Development Code, Element 6: Noise, as shown in **Table 8.8.**

Table 8.8 Territory Plan 2008 – Commercial Zones Development Code, Element 6: Noise – Rules

Rules
6.1 Potentially noisy uses
R23 This rule applies to any of the following: a) club b) drink establishment c) emergency services facility d) hotel e) indoor recreation facility f) industry (except light industry) g) indoor entertainment facility h) outdoor recreation facility i) restaurant. Development complies with a noise management plan prepared by a suitably qualified person and endorsed by the Environment Protection Authority (EPA). The noise management plan will detail the proposed design, siting and construction methods that will be employed to ensure compliance with the Noise Zone Standard as detailed in the Environment Protection Regulation 2005, based on the estimated noise levels when the facility is in use. Note: A condition of development approval may be imposed to ensure compliance with the endorsed noise management plan.

The Commercial Zones Development Code imposes the rule that any potentially noisy development within the precinct of the types a) to i) listed in **Table 8.8** will require a noise management plan which will demonstrate how the development will achieve compliance with the Noise Zone Standard. As the Brickworks Precinct land is zoned as Commercial Zone CZ6, the entire precinct is classified as Noise Zone F in the EP Reg Schedule 2, Parts 2.1 and 2.2. Table 2.2 in the EP Reg Schedule 2 Part 2.2 states that the noise standards for developments within Noise Zone F zones are the *"same as the noise standard for the adjoining noise zone with the loudest noise standard for the time period"*.

The adjoining land uses on all boundaries of the Brickworks Precinct are classified as noise Zone G in EP Reg Schedule 2 Part 2.1 Table 2.1. As per EP Reg Schedule 2 Part 2.2 Table 2.2, these noise standards also apply to all developments within the Brickworks Precinct. The noise standards applicable to all potentially noisy developments within the precinct will be as shown in **Table 8.9.** The noise standards apply at the boundary of the development that emits the noise.

Table 8.9 Noise standards at the boundary of the development

Noise Zone	Noise Standard, LA10(10 minutes [1]) dB(A)	
	Monday to Saturday (7am to 10pm) Sunday / Public Holiday (8 am to 10 pm)	**'Any other time'** Monday to Saturday (10pm to 7am) Sunday / Public Holiday (10pm to 8am)
G	45	35

Source: EP Reg (2005) Table 2.2

It is important to note that the Noise Zone Standards will apply to noisy individual developments within the Brickworks Precinct only during operation of the individual development.

Noise emissions during the construction of the development are not required to comply with the noise standards in the EP Reg Table 2.2 provided the noise occurs within the time restrictions shown in **Table 8.10** (from **Table 2.1**).

Table 8.10 Noise restrictions for building work - EP Reg (2005) for the Brickworks Precinct

Monday to Saturday	Sunday and public holidays
7am to 6pm	Building work must not exceed Noise Standard

9.0 Conclusions and Recommendations

9.1 Construction noise

The predicted construction noise levels indicate that construction noise during development of the precinct will be audible in the surrounding areas. It is recommended that all construction activities with the potential to create noise be restricted to within the hours 7 am to 6 pm Monday to Saturday, except public holidays. It is anticipated that some construction activity may be required from time to time outside of standard construction hours, these works will require approval from the regulatory authorities.
Construction Vibration

For the assessment of vibration at residential buildings for potential structural damage, it is recommended that the criteria that are commonly used in New South Wales (NSW) be adopted for all developments within the Brickworks Precinct. The relevant criteria are given in British Standard 7385 Part 2 – *Evaluation and measurement of vibration in buildings*, 1993.

For the assessment of human perception of vibration within buildings, it is recommended that the criteria that are commonly used in NSW be adopted for all developments within the Brickworks Precinct. The relevant criteria are given in the NSW *Assessing vibration: a technical guideline*, NSW Department of Environment and Conservation, 2006.

It is recommended that a site-specific set of vibration criteria be developed for the heritage structures in the Brickworks Precinct. These site-specific vibration criteria should be derived and recommended by a suitably qualified Structural Engineer.

9.2 Road traffic noise

The predicted road traffic noise levels within the precinct due to traffic on nearby roads, based on current traffic volumes and road configurations, are expected to marginally exceed the target external road traffic noise levels at the nearest buildings to the road.

When development applications are prepared for the future development stages within the Precinct, if an assessment of road traffic noise impacts is required for an application, it is recommended that contemporary road traffic noise modelling be undertaken at the time to confirm the predicted noise levels with updated traffic volumes and road configurations.

9.3 Preparation of noise management plan

It is recommended that the NMP for development of the Brickworks Precinct be prepared in accordance with the *Guidelines for the preparation of Noise Management Plans for development applications (EPA, 2014).*

The NMP should address the mitigation and management of noise during the construction phase and the operation of the Precinct. The NMP should clearly specify that “operation” of the Precinct excludes noise from any construction or operation of the future developments within the Precinct.

9.4 Recommended assumptions for future development applications

9.4.1 Developments outside the Brickworks Precinct

Regarding the assessment of operational noise impacts for proposed developments outside the Brickworks Precinct, it is considered and recommended that all future noise impact assessments and noise management plans to be prepared should be undertaken assuming that all buildings in the Brickworks Precinct Master Plan have been completed and are fully occupied with residential and/or commercial occupants as per the Master Plan. For acoustics impact assessment purposes, this should include consideration of:

- The sensitive receivers located within land uses adjoining the Brickworks Precinct.
- The sensitive receivers in all existing (at the time of the future DA) and expected future buildings within the precinct as proposed in the Master Plan.
- The sound propagation acoustic shielding and reflections caused by the physical structures of the expected future buildings within the Brickworks Precinct as proposed in the Master Plan.

9.4.2 Developments within the Brickworks Precinct

In the case of the future development stages within the Brickworks Precinct, it is considered that the acoustic designs of all proposed land uses should be permitted to assume that all other elements of the Brickworks Precinct have been developed to the full extent of the Master Plan. That is, while preparing a Noise Management Plan for an individual Development Application for any type of proposed land use within the Brickworks Precinct, the acoustic designer should be permitted to assume that the acoustic shielding to be provided by all existing and future buildings, structures and terrain features in the Brickworks Precinct Master Plan can be included in the relevant acoustic calculations and/or modelling. The road traffic noise modelling that has been provided in this NIA for the Brickworks Precinct has been undertaken assuming that all buildings shown in the Master Plan have been constructed and are thereby providing acoustic shielding and reflections that should be taken into account when designing the acoustic isolation performance of the external facades of all of the buildings in the Brickworks Precinct.

10.0 References

A Resident's Guide to Sound in Mixed Use Areas
https://www.accesscanberra.act.gov.au/app/home/cityservices/noiseportal (accessed 28 May 2020)

Access Canberra Publication: Snapshot: Noise in Residential Areas, December 2019

Assessing Vibration: A Technical Guideline, NSW Department of Environment and Conservation, 2006

Australian Capital Territory Environment Protection (Noise Measurement Manual) Approval 2009 (No 1)

Australian Standard 1055-2018 – Description and Measurement of Environmental Noise, Standards Australia, 2018

Australian Standard/New Zealand Standard 2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors, Standards Australia/Standards New Zealand, 2016

Australian Standard 2436-2010(R2016) Guide to noise and vibration control on construction, demolition and maintenance sites, Standards Australia, 2016

Australian Standard 3671-1989 – Acoustics – Road Traffic noise intrusion- Building siting and construction, Standards Australia, 1989

British Standard 7385 Part 2 Evaluation and measurement of vibration in buildings, 1993

Calculation of Road Traffic Noise (CoRTN), UK Department of Transport (Welsh Office), 1988

Construction Noise and Vibration Guideline, Transport for New South Wales (Roads and Maritime Services), April 2016

DIN 4150-3 – 1999:02. German Standard – Structural vibration – Part 3: Effects of vibration on structures, Deutsche Norm, 1999

Environmental Protection Act 1997

Environmental Protection Regulation 2005

Guidelines for the Preparation of Noise Management Plans for Development Applications, Environment Protection Authority, February 2014

ISO 2631-2:2003 Mechanical vibration and shock – Evaluation of human exposure to whole-body vibration – Part 2: Vibration in buildings (1 Hz to 80 Hz), International Organization for Standardization, 2003

National Construction Code Volumes 1 and 2 / Building Code of Australia

Noise pollution law – Fact Sheet # 11, Environmental Defender's Office (ACT), March 2010

Preliminary (Geotechnical) Site Investigation for the Canberra Brickworks, SMEC Ref: 3002369, 8 November 2013

Territory Plan 2008, version R234, Published 28 February 2020, Effective 28 February 2020

- 4.1 CZ6 – Leisure and Accommodation Zone Objectives, Effective 19 August 2016
- 4.2 Commercial Zones Development Code, Effective 21 February 2020
- 10.1 Suburb Precinct Maps and Codes - Yarralumla Precinct Map and Code, Effective 14 December 2012

umwelt
Environmental & Social Consultants

Newcastle | Perth | Canberra | Brisbane | Sydney | Orange

T| 1300 793 267 E| info@umwelt.com.au www.umwelt.com.au

BUSHFIRE RISK ASSESSMENT REPORT

YARRALUMLA BRICKWORKS PRECINCT

BLOCK 1, BLOCK 7 & BLOCK 764, SECTION 102

YARRALUMLA,

AUSTRALIAN CAPITAL TERRITORY

Australian Bushfire Protection Planners Pty Limited.
ACN 083 085 474
32 Old Dog Trap Road
SOMERSBY 2250 NSW
Phone: (02) 43622112
Email: abpp@bigpond.net.au

ABPP
Australian Bushfire Protection Planners Pty Ltd
ABN 48 935534 462
Bushfire Mitigation Consultants

BUSHFIRE RISK ASSESSMENT REPORT

YARRALUMLA BRICKWORKS PRECINCT

BLOCK 1, BLOCK 7 & BLOCK 764, SECTION 102

YARRALUMLA,

AUSTRALIAN CAPITAL TERRITORY

Assessment Number	Document	Preparation Date	Issue Date	Directors Approval
B203479	Final	17.04.2020	20.04.2020	*G.L.Swain*

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

EXECUTIVE SUMMARY

Australian Bushfire Protection Planners Pty Limited has been commissioned by BLOC to prepare a Bushfire Risk Assessment that determines the level of bushfire risk, and the protection measures required to mitigate the risk to the future residential development within the Yarralumla Brickworks precinct, Block 1, Block 7 and Block 764, Section 102 Yarralumla, ACT.

The site has an area of 16 hectares and is zoned CZ6 – Leisure and Accommodation, RZI Suburban Zone and PRZ2 Restricted Access Recreation Zone.

The Yarralumla Precinct Code allows residential landuse [up to three storeys] on the CZ6 & RZ1 zoned land and Rule 3 states that 'The minimum setback to the northern and eastern boundary is 20 metres' [against the existing residential development].

The ACT Government will be responsible for the design and construction of a new access road from the southern interface of the site connecting into Dudley Street.

BLOC seeks to ascertain the bushfire risk and mitigation measures which should be included in the Concept Estate Development Plan – Concept Master Plan for the site.

Section 1 of this report outlines the background to the assessment and describes the site and details the site inspection carried out on the 12th November 2015 and the desk-top review of this information undertaken for the preparation of this assessment.

Section 2 of the report provides a description of the site and the precinct [bushfire study area] it is contained within. It examines the topography as well as the vegetation both within and external to the site.

Section 3 determines the bushfire risk to the site by examining background information on the:

- Fire history of the area;
- Ignition and fire sources;
- Climate and weather;
- Wind and fire paths;
- Slope;
- Bushfire fuels;
- Assessment of the fuel hazard;
- Likelihood of each fire scenario;
- Description of the Asset Interface Classification;
- Risk statement; and
- Summary of the bushfire risk.

Section 3 examines the context of bushfire risk within the ACT.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Section 4 outlines a range of factors influencing bushfire risk and identifies the broad strategies to manage the risk and examines the two elements of risk – ***likelihood*** which is described as the chances of a bushfire occurring, and ***consequence***, the impact of the bushfire when it occurs.

Section 4 also undertakes an assessment of the potential bushfire risk to the site and determines the level of risk to future development on the site.

The details of the bushfire protection measures required to be put in place and fully implemented to reduce the level of risk to the assets are provided in **Section 5**.

This Section describes the measures for:

- Bushfire fuel reduction;
- Provision of Asset Protection Zones for future development;
- Construction standards to the buildings;
- Water supply provisions for fire-fighting;
- Access for fire-fighting;
- Evacuation planning; and
- Standards for fire protection zones.

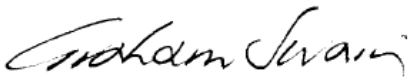
Section 6 examines the residual risk once the bushfire protection measures recommended are implemented.

The conclusions to the assessment are outlined in **Section 7** of the report. These include:

- The assessment undertaken in this report has found that the bushfire risk to the Yarralumla Brickworks precinct may occur as a result of a fire in the vegetation within the North Curtin Horse Paddock, located to the southwest of Cotter Road and the woodland vegetation in the PRZ2 Zoned land to the south/southeast and that, prior to the implementation of bushfire protection measures, the risk is high/low;

  and

- If the protection measures recommended in this report are fully implemented, the level of risk will be reduced from high to moderate/low.



Graham Swain,
Managing Director
Australian Bushfire Protection Planners Pty Limited.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

TABLE OF CONTENTS

EXECUTIVE SUMMARY..... 3

TABLE OF CONTENTS 5

SECTION 1 – INTRODUCTION
1.1 Background 6
1.2 Aim of this Report 6
1.3 Objectives of this Report..... 7
1.4 Scope of Work..... 7
1.5 Site Inspection 7

SECTION 2 – DESCRIPTION OF STUDY AREA
2.1 Study Area 8
2.2 Existing Land Use..... 8
2.3 Adjoining Land Use..... 10
2.4 Topography 12
2.5 Vegetation 14
2.6 Site Photographs..... 19
2.7 Ecological constraints within the Development Precinct..... 23
2.8 Ecological constraints on land beyond the Development Precinct... 24

SECTION 3 – CONTEXT OF BUSHFIRE RISK ASSESSMENT..... 27

SECTION 4 – BUSHFIRE RISK ASSESSMENT
4.1 Introduction..... 28
4.2 Management Strategies..... 29
4.3 Risk Assessment..... 29
4.4 Fire History..... 30
4.5 Ignition/Fire Sources 31
4.6 Climate and Weather 31
4.7 Slope & Fire Paths..... 33
4.8 Bushfire Fuels 34
4.9 Assessment of Fuel Hazard..... 36
4.10 Asset Interface Classification [AIC]..... 37
4.11 Potential Fire Scenarios..... 38
4.12 Risk Statement 39
4.13 Summary of Bushfire Risk 40

SECTION 5 – BUSHFIRE PROTECTION MEASURES
5.1 Introduction..... 41
5.2 Asset Protection Zones..... 41
5.3 Construction Standards to Buildings..... 43
5.4 Access for Fire-fighting Operations..... 44
5.5 Water Supplies for Fire-fighting Operations..... 44
5.6 Management of Pocket Parks and Open Space..... 44

SECTION 6 – RESIDUAL RISK
6.1 Introduction..... 45
6.2 Summary of Residual Bushfire Risk..... 45

SECTION 7 – CONCLUSION..... 46

REFERENCES 48

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

SECTION 1

INTRODUCTION

1.1 Background.

Australian Bushfire Protection Planners Pty Limited was commissioned by the *Land Development Agency [LDA]* in 2014 to prepare a Bushfire Risk Assessment that determined the level of bushfire risk, and the protection measures required to mitigate the risk to the proposed development within the Yarralumla Brickworks, Block 1, Block 7 and Block 764 Section 102 Yarralumla, ACT.

The final ABPP report (Reference B142415 dated 29.01.2016) found that the bushfire risk to the Yarralumla Brickworks precinct may occur as a result of a fire in the Pinus Radiata vegetation on the land to the west; the vegetation within the North Curtin Horse Paddock, located to the southwest of Cotter Road and the woodland vegetation in the PRZ2 Zoned land to the southeast and that, prior to the implementation of bushfire protection measures, the risk is high.

The report provided recommendations on the provision of measures required to be implemented to mitigate the potential bushfire risk to future residential development on the site. These measures included:

- The management of the vegetation within Block 1, Section 127 to the west of the development precinct;

- The provision of a 10 and 30 metre wide Inner Asset Protection Zone (IAPZ) against the retained vegetation on Block 3 Section 94 to the southeast of the development precinct; and

- The provision of a 30 metre wide Inner Asset Protection Zone to the southwest of the development precinct – unless the adjacent land outside the Lease Boundary was managed as an Outer Asset Protection Zone (OAPZ).

1.2 Aim of this Report.

The aim of this report is to review the Concept Estate Development Plan – Concept Masterplan against the recommendations of the Bushfire Risk Assessment prepared by ABPP – Reference B142415 – Dated 29.01.2016 and prepare an updated bushfire risk assessment that provides recommendations on measures required to be implemented to comply with the *Strategic Bushfire Management Plan for the ACT (2014).*

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

1.3 Objectives of the Report.

The objectives of the updated report are to:

- Identify the level of risk to the future development within the site in accordance with best practice bushfire risk management, the requirements of any relevant Australian Standards and the Emergency Services Agency's *Strategic Bushfire Management Plan – 2014 – Version 3* and any recommendations of the Emergency Services Agency;

- Identify how levels of risk can be mitigated.

1.4 Scope of Work.

The following is an outline of the scope of work undertaken in the assessment of bushfire risk to the future development within the Yarralumla Brickworks within Block 1, Block 7 and Block 764 Section 102 Yarralumla, ACT.

- Identify and describe the study area environment;

- Establish the context of the bushfire risk to the proposed landuse;

- Identify measures that might assist to reduce bushfire risk;

- Identify the location of any bushfire protection measures required to protect the future landuse.

1.5 Site Inspection.

Graham Swain undertook an inspection of the study area on the 12th November 2015 to assess the topography of the land and the classification of the vegetation within and external to the site.

This inspection reviewed the general topography and gradients of the land and vegetation classification.

Adjoining land was also inspected to determine the surrounding landuse / type and adequacy of land management, vegetation communities, topography and whether the land contained vegetation which has the potential to support fire.

Prior to the preparation of this report a desk-top assessment was undertaken using the latest aerial photography and ACTMAPi information, the latter being used to confirm the Bushfire Prone Land Mapping and Bushfire Operations Plan details.

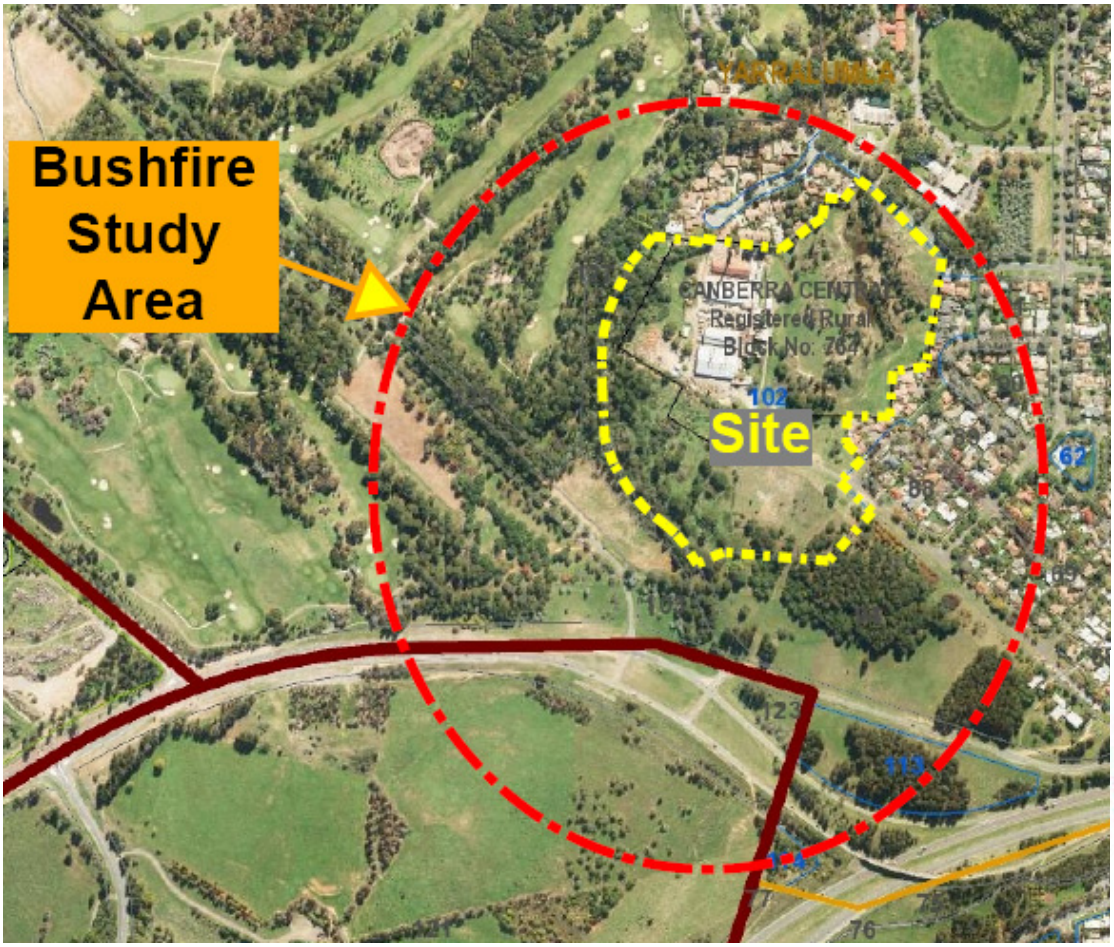
© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

SECTION 2
DESCRIPTION OF STUDY AREA

2.1 The Study Area.

For the purpose of examining the potential bushfire risk to the Yarralumla Brickworks precinct the study area consists of land within Section 102, 103 & 113 Yarralumla; Sections 123 Curtin; Section 125 & 127 Yarralumla; Section 94 and the North Curtin Horse Paddocks within Section 121 Curtin – refer to Figure 1 below.

Figure 2 – Bushfire Risk Assessment Study Area.



2.2 Existing Land Use.

Except for the former Yarralumla Brickworks complex on Block 764 Section 102 Yarralumla, the development precinct contains vacant land – refer to Figure 2 - Aerial Photograph of the Yarralumla Brickworks Precinct and the surrounding landuse on Page 9.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 2 – Aerial Photograph of the Yarralumla Brickworks Precinct and the surrounding landuse.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

2.3 Adjoining Land Use.

The land to the north, northeast and east of the development precinct contains existing residential development.

The land to the immediate west of the development precinct is vacant land zoned PRZ2 – Restricted Access Recreation. The land further to the west contains the Royal Canberra Golf Club.

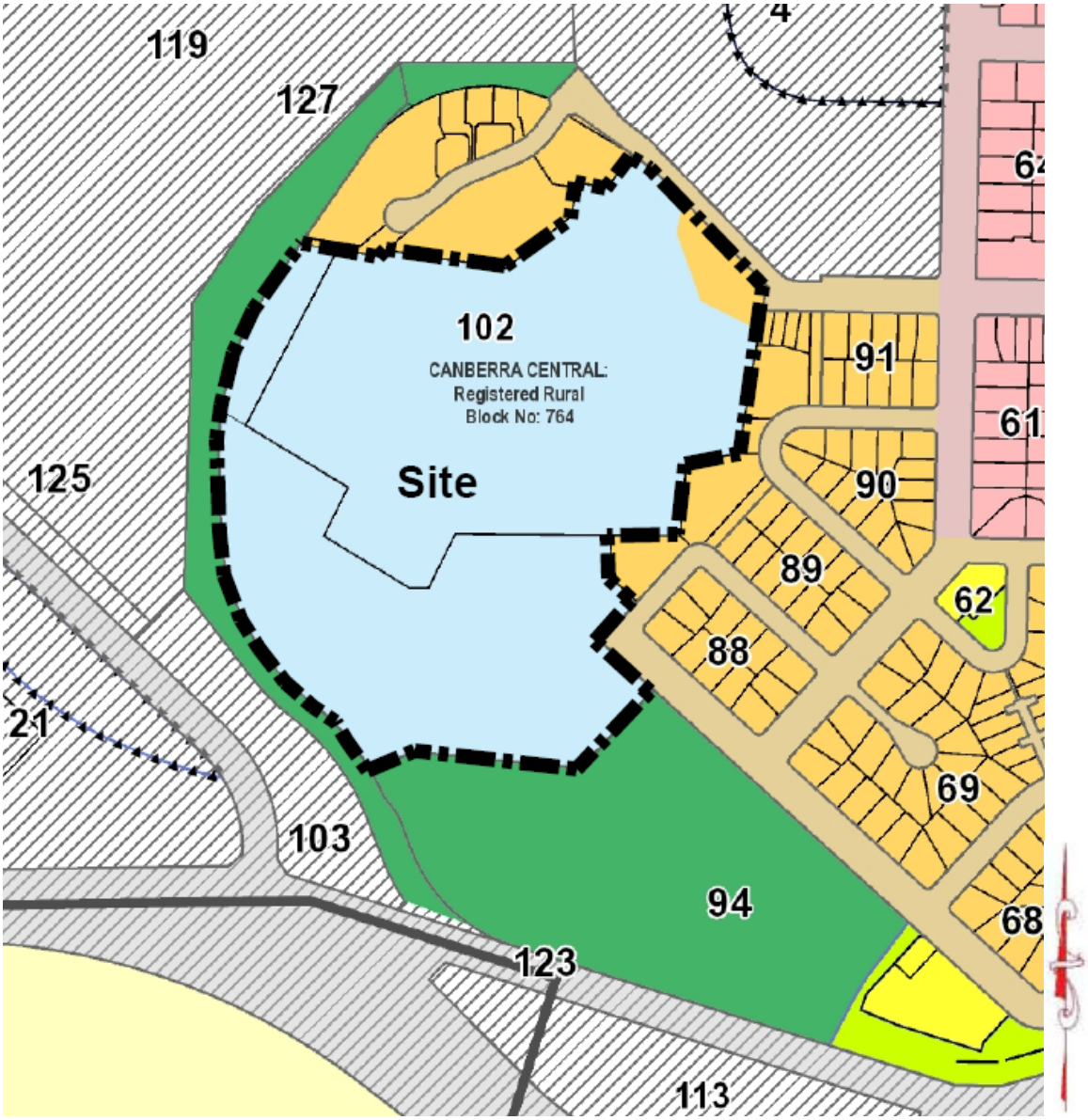
The land to the southwest is vacant land zoned PRZ2 – Restricted Access Recreation. The Dunrossil Drive corridor, which leads to Government House, is located beyond the PRZ2 zoned land and is identified as a Designated Area on the ACT Territory Plan.

The land to the southeast and south of the development precinct is vacant land zoned PRZ2 – Restricted Access Recreation – refer to Figure 3 – Territory Plan on Page 11 and Figure 4 – Aerial Photograph on Page 12.

The Legend to the landuse on the Territory Plan is provided below:

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 3 – Territory Plan.



© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 4 – Aerial Photograph.

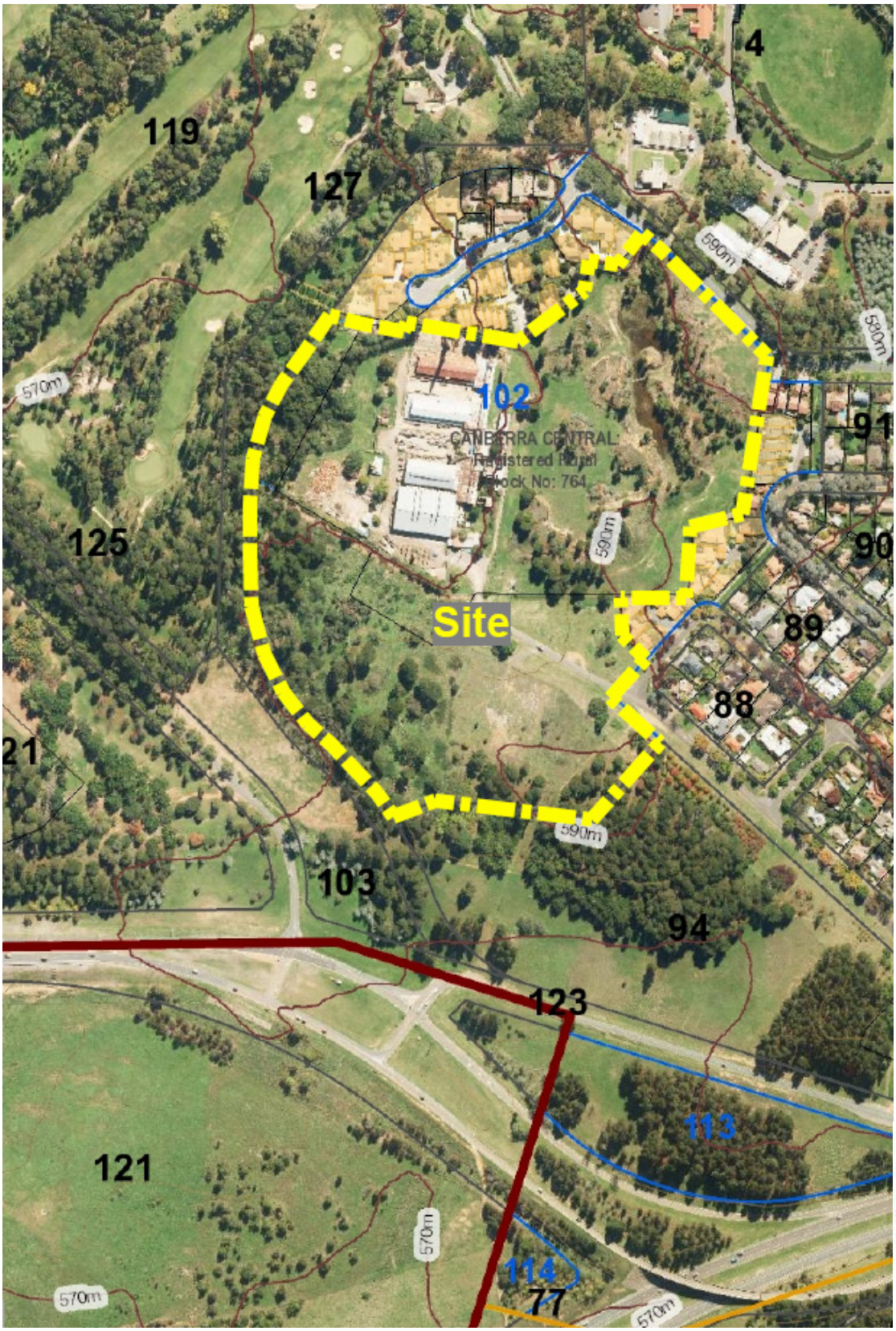
2.5 Topography.

The landform within the Yarralumla Brickworks precinct is gently undulating with a fall to the west and southwest of less than 10%.

The land beyond the precinct falls to the northwest at less than 10% across the Royal Canberra Golf Club and the Dunrossil Drive corridor, rising to the west beyond the Dunrossil Drive corridor. The land within the North Curtin Horse Paddock to the southwest of Cotter Road falls to the south and southwest at less than 10% into Yarralumla Creek – refer to Figure 5 – Contour Plan on Page 13.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 5 – Contour Plan.



© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

2.6 Vegetation.

The vegetation within the Yarralumla Brickworks precinct was assessed by DSB Architects [refer to Yarralumla Brickworks Precinct Tree Assessment – 25th November 2015]. The report identifies that the predominant specie within the precinct is Pinus Radiata, Pinus ponderosa and Pinus silvestris and Ulmus procera and various tree and weed species.

Within Block 7 the Pines generally are of low quality and the isolated elm trees are subject to elm leaf beetle. Adjacent to Dunrossil Drive, on the south-western edge of Block 7 the vegetation consists of an 8 metre high unmanaged dense thicket of urban weed tree species and other weed species.

Along the western edge of the precinct the Pines are at, or approaching, the end of their useful life. This vegetation will be cleared as part of the development proposal.

The vegetation within the adjoining residential development to the north, northeast and east of the precinct consists of managed landscaped gardens which do not constitute bushfire prone vegetation.

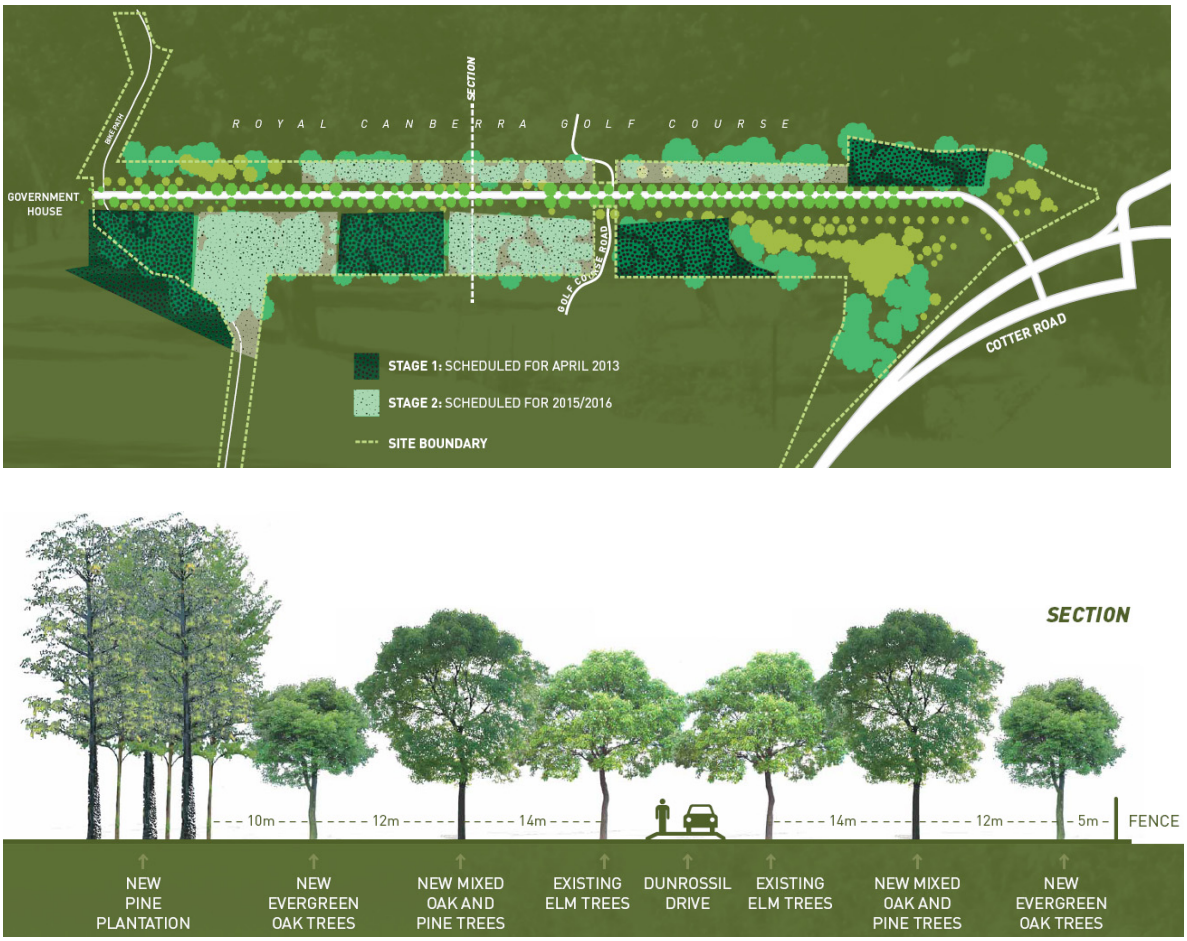
To the southeast of the Yarralumla Brickworks precinct, within Block 3, Section 94, [between Cotter Road and Denman Street] the vegetation consists of large copses of planted woodland separated by managed [mown] grassland. This vegetation type also occupies the land between the east and west bound lanes of Cotter Road – within Section 113.

The PRZ2 zoned land to the west and southwest of the development precinct [within Block 1, Section 127] contains mature Pinus Radiata with a dense weed infested understorey. The Royal Canberra Golf Club, to the west and northwest of the Brickworks precinct, contains mown lawns and managed grass [which is irrigated] beneath a canopy of Pinus Radiata trees. This vegetation is not currently deemed to be bushfire prone vegetation.

The mature Pinus Radiata trees in the Dunrossil Drive corridor have been removed and tree replanting has commenced with the retention of the existing central avenue of Elm trees, surrounded by a second avenue of mixed trees [Pine & Oak], with an evergreen tree backdrop formed by creating a third outer avenue using an evergreen species of Oak and then replanting the Pine plantation on the outside of the avenue – refer to Figure 6 – Plan and Section of the Dunrossil Drive planting on Page 15.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 6 – Plan and Section of the Dunrossil Drive planting

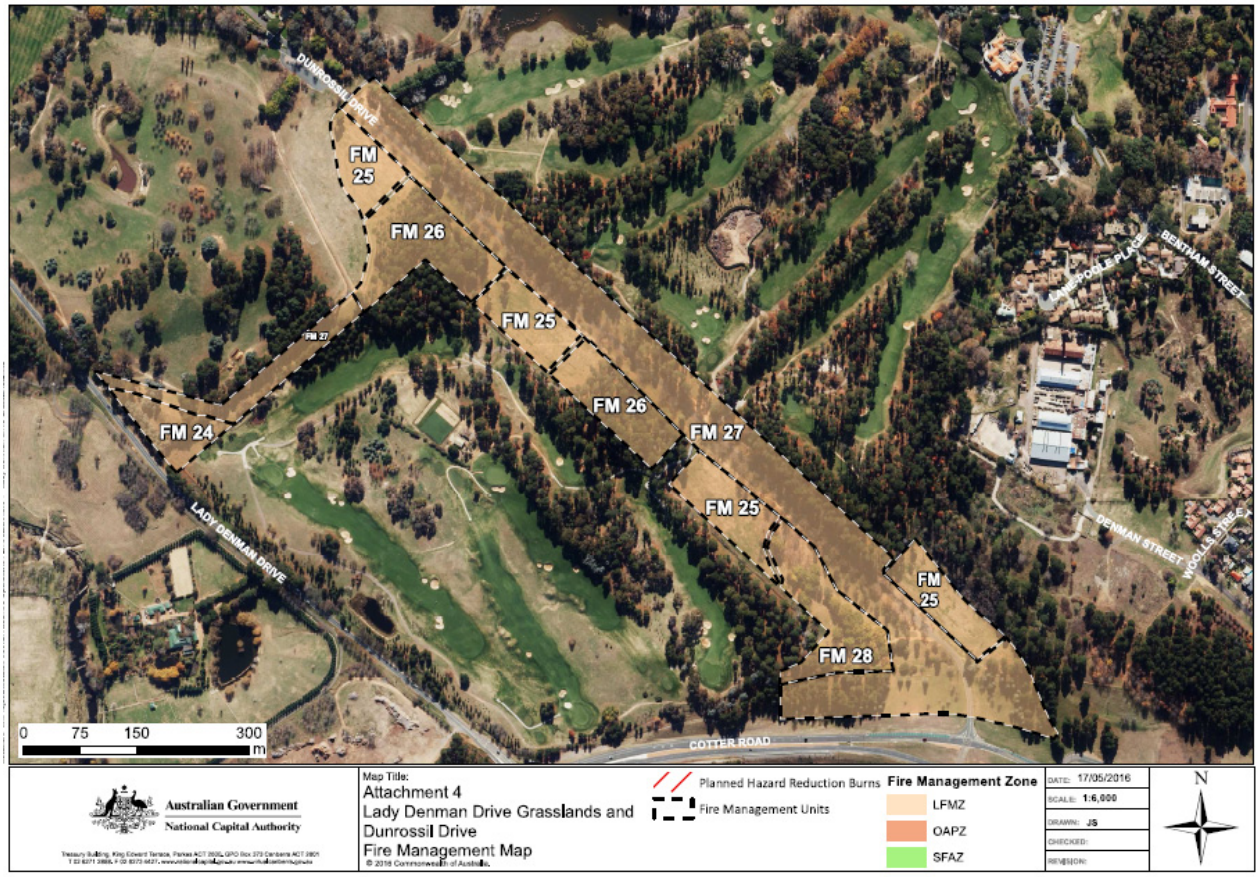


The latest version of the National Capital Bushfire Operations Plan [June 2018] identifies that the vegetation within the Dunrossil Drive corridor will continue to be regularly managed (slashed) and the Royal Canberra Golf Club Fairways, located to the southwest of the Dunrossil Drive corridor, also contains managed vegetation.

The vegetation within the Dunrossil Drive corridor and the Royal Golf Club Fairways is therefore not deemed to be bushfire prone – refer to Figure 7 - Lady Denman Drive Grasslands and Dunrossil Drive Fire Management Map and Management Program on Page 16.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 7 – Lady Denman Drive Grasslands and Dunrossil Drive Fire Management Map and Management Program – Source National Capital Authority.



Fire Mgt Area	Fire Mgt Unit	Fire Mgt Zone	Winter 2016	Spring 2016	Summer 2016-17	Autumn 2017	Winter 2017	Spring 2017	Summer 2017-18	Autumn 2018	Notes
Lady Denman/ Dunrossil	FM24 Lady Denman Grassland (0.7Ha)	Landscape Fire Management Zone									Last burnt in Spring 2015. Planned burn again in Spring 2019
Lady Denman/ Dunrossil	FM25 Original Westborne Woods (2.6Ha)	Landscape Fire Management Zone	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Pine Plantation harvested in Summer 2013
Lady Denman/ Dunrossil	FM26 Original Westborne Woods (3.0Ha)	Landscape Fire Management Zone	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Pine Plantation harvested in Summer 2016
Lady Denman/ Dunrossil	FM27 Cycle path link (1.0Ha)	Landscape Fire Management Zone	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	
Lady Denman/ Dunrossil	FM28 Oak tree area (1.6Ha)	Landscape Fire Management Zone	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	Slashing every 6-8 weeks	

The North Curtin Horse Paddock, located to the southwest of Cotter Road, contains grazed grassland with scattered woodland shade trees. Figure 9 on Page 18 provides a copy of the TaMS Bushfire Operations Plan for the fuel management of the vegetation within the North Curtin Horse Paddocks and within Block 3 Section 94, to the southeast of the Brickworks precinct, and the vegetation on the land within the Cotter Road reserve.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 8 – The ESA Bushfire Operations Plan [BOP] for the North Curtin Horse Paddocks and the vegetation within Section 94, Section 113 and Section 127 [Cotter Road reserve].

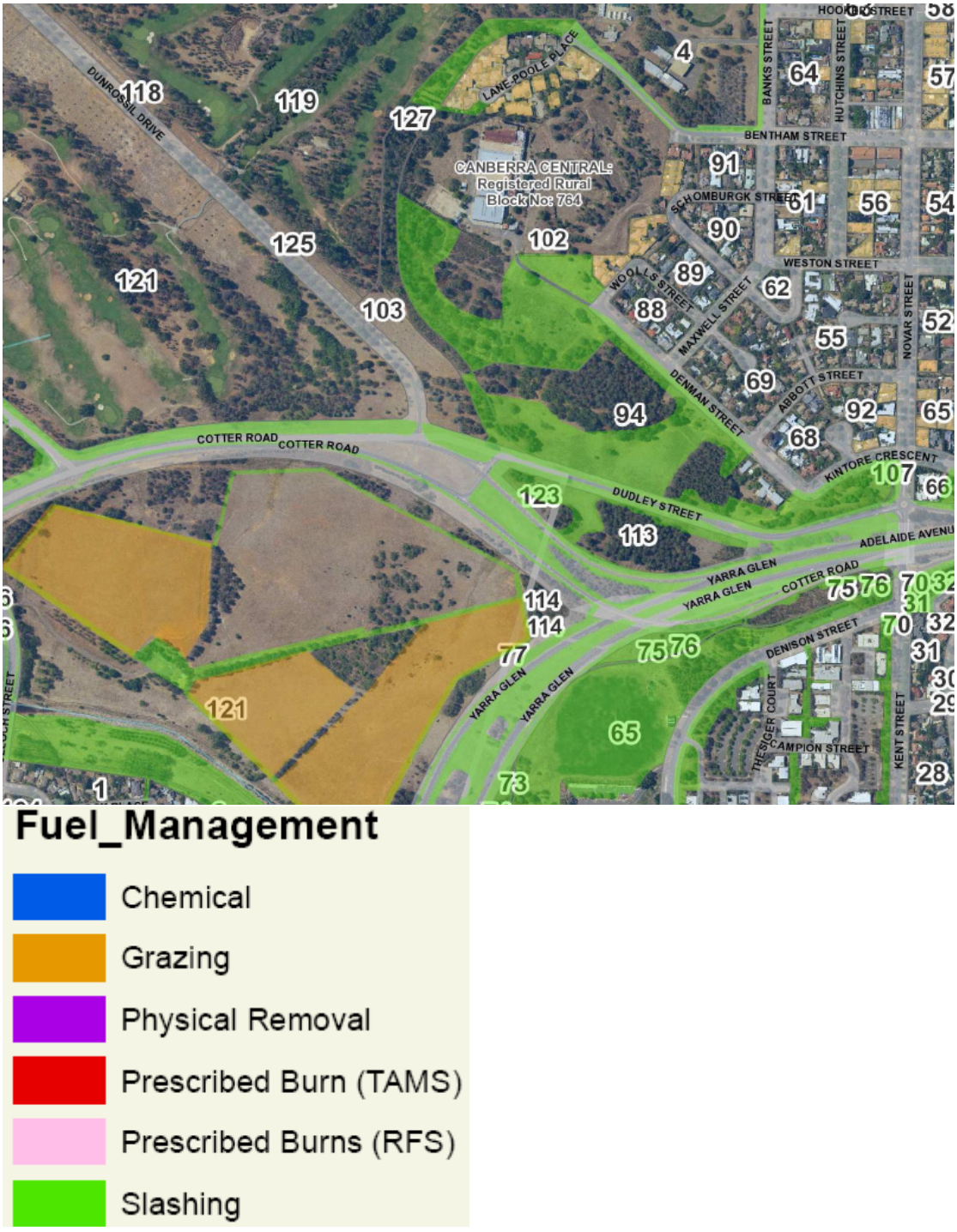


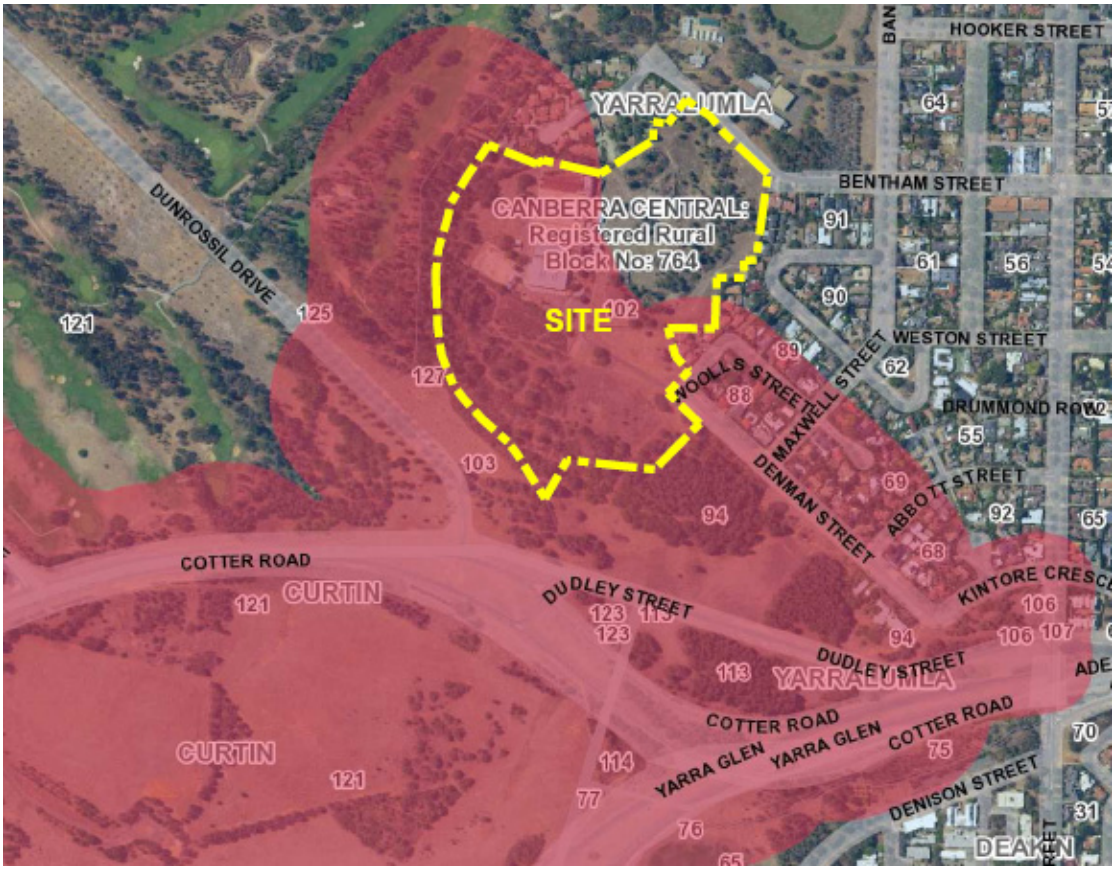
Figure 8 identifies that the management of the vegetation within the North Curtin Horse Paddocks relies on grazing of a portion of the Horse Paddock.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 8 also identifies that the grassland vegetation within the Cotter Road reserve and on Section 94, to the south and southeast of the Brickworks precinct is managed by slashing. The ESA Bushfire Operations Plan also shows that slashing also extends into the southern portion of the Brickworks precinct.

The review of the ESA Bushfire Prone Land Map – refer to Figure 9 below – has identified that the only vegetation which is deemed to present a direct bushfire hazard to the development precinct is the weed infested Pinus Radiata vegetation within the PRZ2 zoned land to the west and southwest and the retained vegetation in the narrow corridor of PRZ2 land to the south [within Block 1, Section 127] and the copses of retained vegetation within Block 3, Section 94, to the southeast of the Brickworks precinct.

Figure 9 – ESA Bushfire Prone Land Map.



Based on the current management practices within the Canberra Golf Club, the Dunrossil Avenue corridor, including Block 2 Section 103, this report examines the bushfire risk to the development precinct created by the vegetation within Block 1 Section 127 and Block 3 Section 94 and the grassy woodland within the Horse Paddock precinct - refer to Site Photographs below.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

2.7 Site Photographs.

Photograph No. 1 – Taken from Cotter Road looking to the south - across to the Mint Oval and the commercial development within West Deakin.

Photograph No. 2 – Taken from Cotter Road looking to the southwest across the North Curtin Horse Paddock.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Photograph No. 3 – Taken from the Cotter Road/Dunrossil Drive intersection looking to the southwest – Horse Paddock on the left, vegetation within the Dunrossil Drive corridor on the right.

Photograph No. 4 – Taken looking to the southeast from Dunrossil Drive showing managed vegetation.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Photograph No. 5 – Taken looking to the north from Block 1, Section 127 showing the managed, irrigated land within the Royal Canberra Golf Club.

Photograph No. 6 – Taken looking to the southwest from Block 1, Section 127 showing the managed, irrigated land within the Royal Canberra Golf Club.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Photograph No. 7 – Taken from Block 1 Section 127 looking southwest to Dunrossil Drive showing the managed, irrigated land within the Royal Canberra Golf Club.

Photograph No. 8 – Taken from Block 1 Section 127 looking to the west showing the managed, irrigated land within the Royal Canberra Golf Club.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

2.8 Ecological Constraints.

An ecological assessment was undertaken in late 2014 within the PRZ2 Area and adjoining land. Figure 10, below, provides the results of this study and identifies that the areas of grassland between the east and west bound lanes of Cotter Road and an area to the southwest and south of Denman Street contains Natural Temperate Grassland.

Figure 10 – Ecological Constraints Plan – Natural Temperate Grassland.

Figure 11 on Page 24 provides the results of an ecological assessment to determine the extent of habitat for Golden Sun Moth in the grassland vegetation between the east and west bound lanes of Cotter Road, the area to the southwest and south of Denman Street and in the vegetation to the south of the west bound lane of Cotter Road [within the road verge and adjacent Horse Paddocks].

Figure 8 on Page 17 provides an extract from the ESA Bushfire Operations Plan which shows the fuel management works within the Yarralumla Brickworks precinct and within the North Curtin Horse Paddocks.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 11 – Ecological Constraints Plan – Golden Sun Moth Habitat.

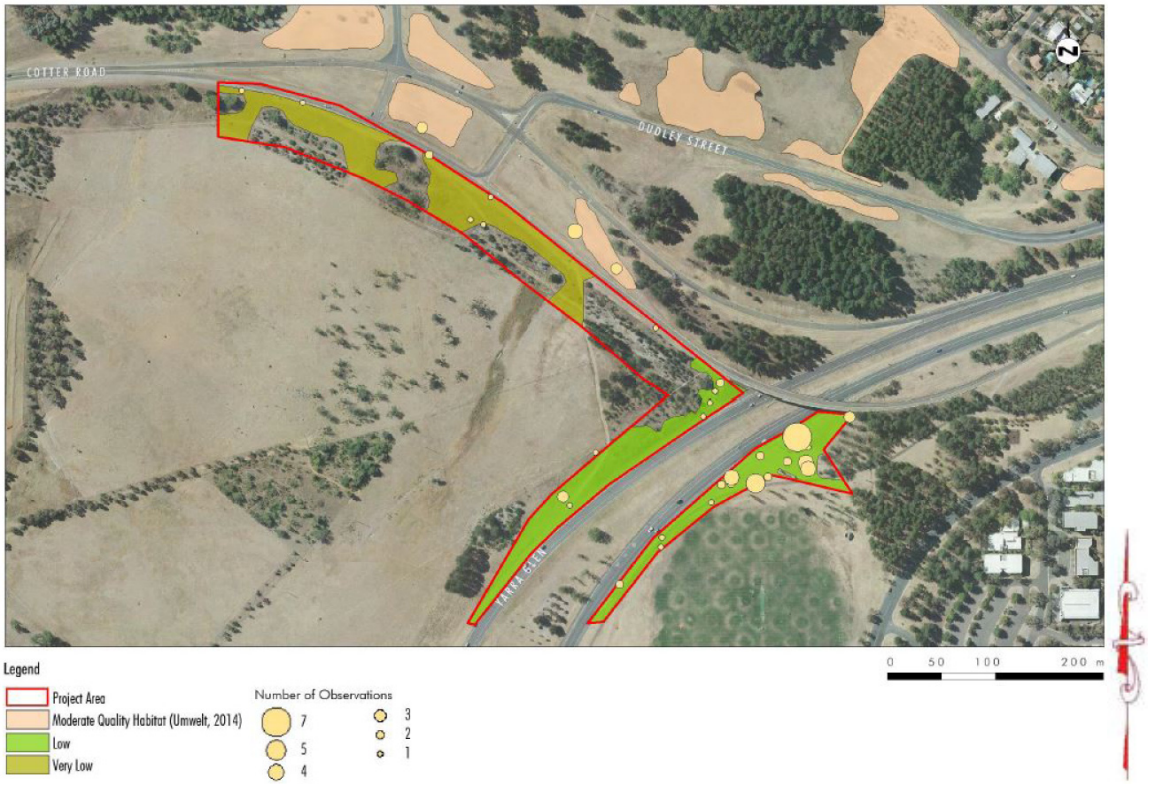


Figure 8 – ESA Bushfire Operations Plan [BOP] for the North Curtin Horse Paddocks and the vegetation within Section 94, Section 113 and Section 127 [Cotter Road reserve] on Page 17 identifies that most of the area nominated on Figure 11 [above] as containing potential Sun Moth Habitat and Natural Temperate grassland is maintained by slashing for Amenity & Urban Roads and Fire & Rural fuel management purposes.

Figure 8 also identifies the area of the Curtin Horse Paddock which is managed by grazing to reduce the bushfire fuels. This area does not constitute the entire Horse Paddock precinct with the central and north-eastern portion not managed by grazing or by slashing.

2.9 Ecological Constraints found on the land beyond the Canberra Brickworks precinct.

The northern portion of the North Curtin Horse Paddock was not studied as part of the most recent ecological surveys.

However, the presence of potential Sun Moth habitat within the Horse Paddock is shown on the ACTmap Significant Plants Map – refer to Figure 12 on Page 25.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 12 – ACTmap Significant Plants Map.

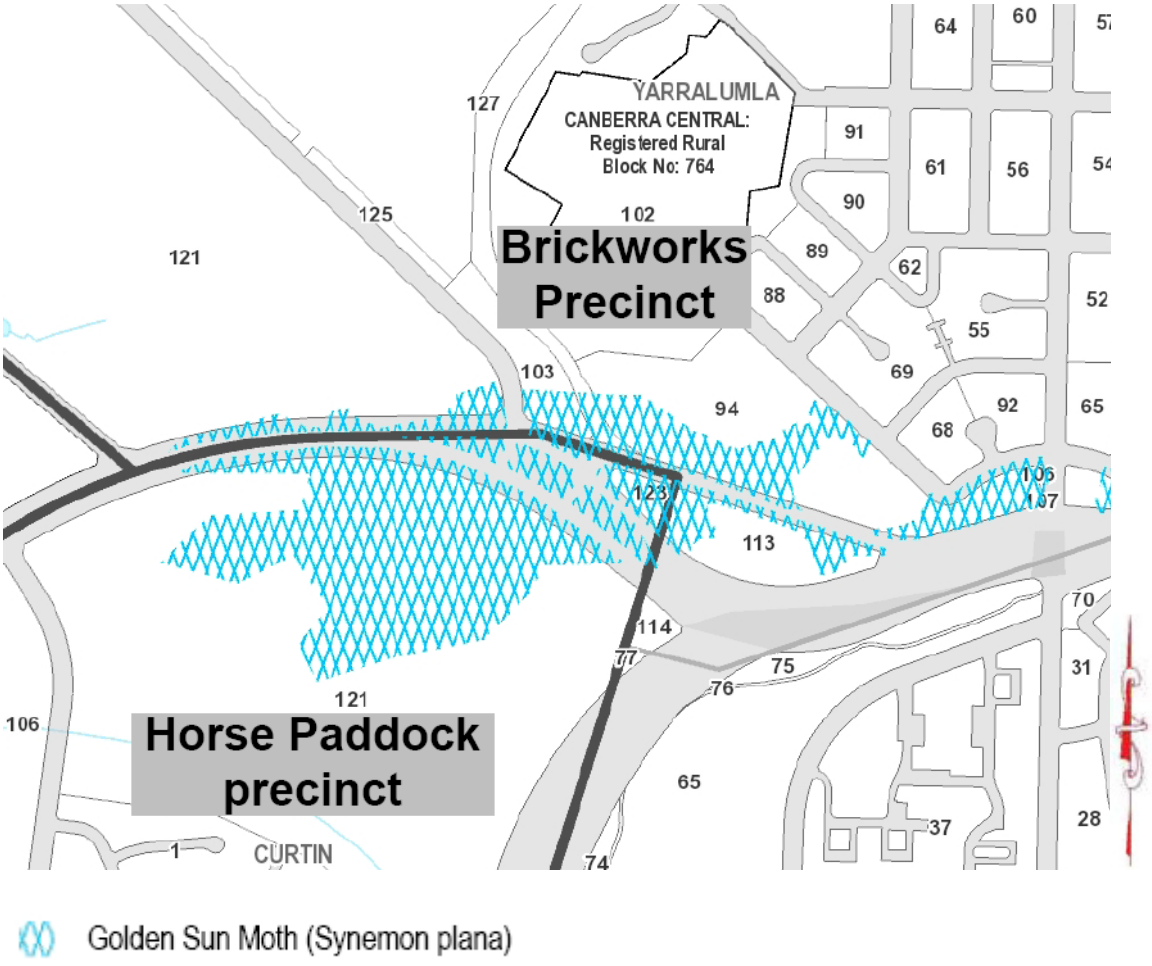
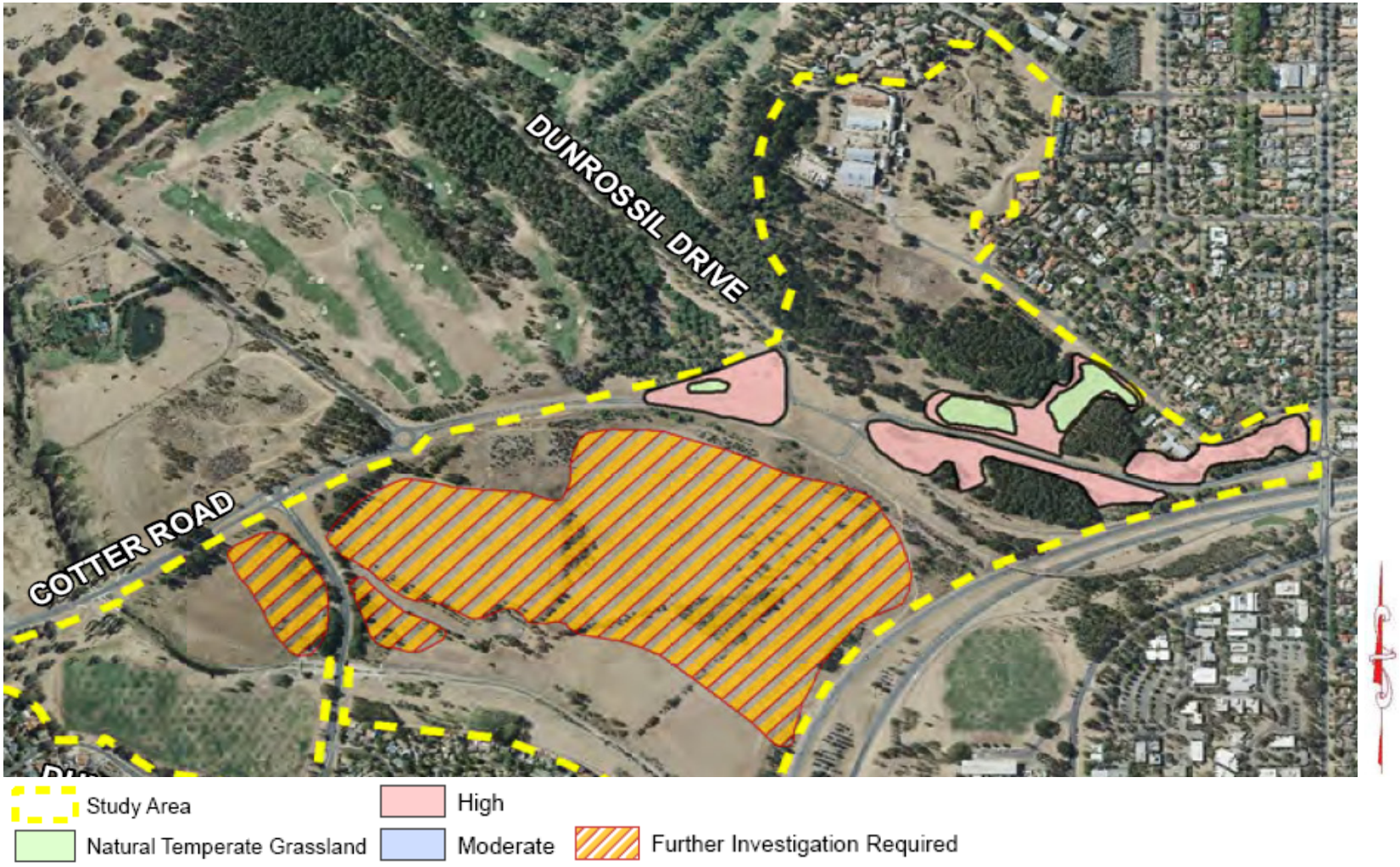


Figure 13 on Page 27 is an extract from the National Capital Authority Yarralumla and North Curtin Study Area Environmental Constraints plan, dated 8.2.2010.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 13 – Ecological Constraints Plan – National Capital Authority Yarralumla & North Curtin Study Area.



© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

SECTION 3.

CONTEXT OF THE BUSHFIRE RISK ASSESSMENT

The ACT Government enacted the *Emergencies Act 2004,* as part of its response to the needs identified by the McLeod Inquiry to replace the *Bushfire Act 1936* and sets the legislative basis for bushfire related planning.

Resulting from the changes in legislation, the ACT Planning & Land Authority prepared *"Planning for Bushfire Risk Mitigation",* a guideline adopted under the Territory Plan, that provides guidance to mitigate adverse impacts from bushfires in the ACT.

The Guideline is one of many documents that informs planning and development in the ACT and is taken into account by the ACT Planning & Land Authority when determining development applications and is complementary to the ACT Emergency Services Authority's *Strategic Bushfire Management Plan 2014,* a strategic document outlining measures for the Prevention, Preparedness, Response and Recovery from bushfire in the ACT.

A *Bushfire Prone Area* for the ACT was declared through the *Building Regulations* and came into effect on the 1st September 2004. Under the declaration, all parts of the ACT outside the defined urban area have been designated bushfire prone and the Authority, under Part A (Consideration of Land Use and Development Proposals) of the Territory Plan, can require a site specific bushfire risk assessment to be undertaken during the planning/design process.

This Bushfire Risk Assessment addresses this requirement and has been undertaken using the *Australian Standard for Risk Management* AS/NZS ISO 31000:2009 and AS 3959 - 2009.

This assessment determines the level of bushfire risk on the proposed development within the Yarralumla Brickworks precinct from a fire which may occur in the vegetation on the North Curtin Horse Paddock to the southwest, a fire in the retained vegetation on Block 1, Section 127 and a fire in the unmanaged vegetation on Block 3, Section 94 and provides recommendations on measures required to mitigate the effects of such fire events.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

SECTION 4

BUSHFIRE RISK ASSESSMENT – YARRALUMLA BRICKWORKS PRECINCT

4.1 Introduction.

The Australian Standard AS/NZS ISO 31000:2009, the ACT Government Enterprise-wide risk management framework and the Emergency Management Australia (EMA) emergency risk management process provide the framework for establishing the context, analysis, evaluation, treatment, monitoring and communication of risk.

Risk has two elements: likelihood, the chances of a bushfire occurring and consequence, the impact of a bushfire when it occurs.

Bushfire risk is defined as the chance of a bushfire occurring that will have harmful consequences to human communities and the environment. Bushfire risk is usually assessed through consideration of the likelihood of ignition and consequences of a bushfire occurring. Risk reduction can be achieved by reducing the likelihood of a bushfire, the opportunity for a bushfire to spread or the consequence of a bushfire (on natural and built assets).

Bushfire management should have a clear objective to reduce both the likelihood of bushfires and reduce the negative impacts of bushfires. It should also consider the costs, inconvenience and dangers of measures taken to reduce the risk of bushfires.

The consequences of bushfire management activities and the failure to implement programs also need to be considered. A range of factors influence bushfire risk – these include:

- The likelihood of human and natural fire ignitions, as influenced by time, space and demographics;
- The potential spread and severity of a bushfire, as determined by fuel, topography and weather conditions;
- The proximity of assets vulnerable to bushfire fuels, and likely bushfire paths; and
- The vulnerability of assets including natural assets, or their capacity to cope with, and recover from bushfire.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

4.2 Management Strategies.

Broad strategies to manage bushfire risk include:

- Eliminate the bushfire risk (make the land-use decision first by asking the question about whether development should or should not proceed in a given area);

- Design or substitution (review boundary locations and shape, change the types of land-use policy);

- Engineering controls (infrastructure, building standards and landscaping) and

- Administration and organisation; (community preparedness measures).

4.3 Risk Assessment.

An assessment of bushfire risk must firstly define the problem. This involves the identification of the nature and scope of issues to be addressed and defining the possible boundaries for the assessment *(Emergency Risk Management – Applications Guide. (EMA Echo Press, 2000).*

For the purpose of analysing fire risks that might emerge in the ACT, a dangerous and damaging fire has the potential to occur when the following conditions prevail:

- Continuous available fuel – fuel at moisture content sufficiently low to enable rapid combustion, arising from drought effects or the maturing and drying, of grasslands;

- Exposure of vulnerable assets. The 'catchment' for such fires may be within several hundred metres or many (60-70) kilometres from the asset/s;

- A combination of weather conditions that generate a forest or grass fire danger index of Very High (24) or greater. Typically in the ACT, prevailing adverse fire weather will have a strong northerly, through to south-westerly wind influence;

- A fire in the landscape which is not effectively suppressed.

The preliminary assessment of the risk to the Yarralumla Brickworks precinct was undertaken during the site inspection and identified that the retained vegetation within the PRZ2 zoned land to the west, southwest and south, within Block 1 Section 127 and to the southeast presented a moderate risk to the future development within the Yarralumla Brickworks precinct, if it remained unmanaged.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Advice from Doma confirms that the vegetation within Block 1 Section 127, to the west, southwest and south will be removed and this land managed, extending the existing management protocols to the west of the residential development along the western, south-western and southern edge of the Yarralumla Brickworks precinct.

The continued management of the vegetation within the Canberra Golf Club land, the Dunrossil Avenue corridor and the land within Block 1 Section 127 removes the risk of bushfire to the Brickworks precinct from the northwest, west and southwest directions.

The vegetation within Block 3 Section 94, to the southeast of the Brickworks precinct will remain and therefore present a risk to the development precinct.

At a broader scale unmanaged grassland vegetation within the North Curtin Horse Paddock, located to the southwest of Cotter Road (beyond the Canberra Golf Club), presents an indirect risk to the development precinct from ember attack.

The following Risk Assessment and resultant recommendations seek to address the protection of the Yarralumla Brickworks precinct from the impact of unplanned fire events in the North Curtin Horse Paddock and Block 3 Section 94 by examining:

- Fire History;
- Exposure to possible ignition / fire sources;
- Vegetation type and likely fuel loads and fire hazards arising using the "Overall Fuel Hazard Guide" – Fourth edition (DSE July 2010);
- The impact of climate and likely fire runs during severe fire danger periods;
- Wind effects; and
- The impact of surrounding land uses and fuel loads.

4.4 Fire History.

The Strategic Bushfire Management Plan for the ACT [version two] states: "*The ACT has a history of severe damaging bushfires with large areas burnt in the bushfire seasons of 1919/20; 1925/26; 1938/39; 1951/52; 1978/79; 1982/83; 1984/85; 2000/01 and in 2002/03".*

"Intervals between recorded severe fire seasons range from two years to twenty seven years".

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

"Planning to reduce the likelihood and consequence of bushfires in the ACT must take into account the full range from small grass fires to landscape-wide severe fires".

Figure 1 of the *Strategic Bushfire Management Plan for the ACT - 2009* identifies the approximate location of major fires and shows that the Brickworks precinct and the North Curtin Horse Paddock have not been impacted directly by large scale fires, however the 2001 & 2003 bushfires came within 1klm of the precinct.

4.5 Ignition / Fire Sources.

Causes of bushfires, including those in the ACT, are natural or human caused. Fires caused by humans can be categorised as:

- Malicious – including arson;

- Careless – such as escaped campfires, children and burning off without a permit; and
- Accidental – uncommon but includes motor vehicle and industrial accidents.

The only common natural cause of bushfires in the ACT is lightning. The majority of fire ignitions in the ACT are arson, and arson ignitions are correlated to the demographics of the ACT. People are the major source of bushfire ignitions and where people concentrate, bushfires occur most frequently. Most bushfires occur in or near the built-up areas of Canberra.

The largest areas burnt are attributed to lightning ignitions, which are dispersed across the landscape.

The likely cause of a bushfire which may occur within study area to the Yarralumla Brickworks precinct is varied. Accidental or malicious ignition of the vegetation within the Molonglo River corridor, to the west, is a potential source and ignition of the vegetation within the Equestrian Park, spreading to the east under westerly winds, turning upslope out of the Yarralumla Creek corridor towards the south-western edge of the Cotter Road corridor.

Arson may result in the ignition of the vegetation within Block 3, Section 94.

4.6 Climate and Weather.

The ACT has a relatively dry, continental climate with warm to hot summers and cool to cold winters. The climate of Canberra is strongly influenced by a band of high pressure systems located around the globe at about 30 – 40S, known as the sub-tropical ridge.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

During summer, the sub-tropical ridge is located over southern Australia resulting in warm to hot conditions with winds generally from the east through to northwest.

The average annual rainfall is 629 mm with an average of 108 rain days per year with rainfall reasonably evenly distributed throughout the year with the wettest month being October and the driest being June.

Rainfall tends to be influenced by cold fronts during the winter 6 months and thunderstorm activity during the summer 6 months. While rainfall in most years is reasonably reliable, drier than average years are closely related to ENSO events in the Pacific Ocean and all significant droughts have occurred in El Nino years and these years tend to be significant bushfire seasons as well.

Rainfall across the ACT varies considerably, with much higher rainfall occurring in the ranges to the west and less rainfall to the east.

January is the hottest month with a mean daily maximum temperature of 27^{o}C and an average of 10 days of 30^{o}C or more with 2 days of 35^{o}C or more.
Canberra tends to get cooler easterly winds penetrating from the coast during many summer evenings which can sometimes bring cloud in with the moister air.

The highest recorded maximum temperature was 42.2^{o}C on February 1st 1968 followed closely by 41.4^{o}C on the previous day [31st January 1968]. Relative humidity in Canberra is around 37 – 40% at 3pm in summer.

The fire season in the ACT corresponds with the summer months' high temperatures and low rainfall, and can occur from September to April with a proclaimed bushfire danger period from October to March. There is significant variability from year to year. Fire seasons may be serious in three out of every 15 years, but this can vary considerably.

Extreme and uncontrollable bushfires typically occur when the fire danger rating is over 50, a rating of Extreme. Many of the major house loss events have occurred at fire danger ratings over 70, on a scale of 0 to 100. Analysis of 1951 – 2004 meteorological records identified 105 days of Extreme fire danger from the Forest Fire Danger Index (FFDI) at Canberra airport.

These were broken down into the following FFDI ratings:

- 61 days 50 – 59 FFDI;
- 25 days 60 – 69 FFDI;
- 9 days 70 – 79 FFDI;

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

- 4 days 80 – 89 FFDI; and
- 6 days 90 – 100.

Eighteen percent [18%] of January days had Very High FFDI and 2% of January days had Extreme FFDI.

The Very High and Extreme Forest Fire Danger conditions mainly occur between November and March.
[Source SBMP for the ACT].

[The (McArthur) Forest Fire Danger Index (FFDI) was developed in the 1960s by CSIRO scientist A.G. McArthur to measure the degree of danger of fire in Australian forests. The index combines a record of dryness, based on rainfall and evaporation, with daily meteorological variables for wind-speed, temperature and humidity.

A fire danger rating of between 12 and 25 on the index is considered a "high" degree of danger, while a day having a danger rating of over 50 is considered an "Extreme" fire danger day. McArthur used the conditions of the Black Friday fires of 1939 as his example of a 100 rating.

The FFDI on Black Saturday, 7th of February, 2009, reached as high as 180, the worst fire conditions ever recorded].

Canberra generally is not very windy with, on average, 25 days of strong winds a year. Late Winter/Spring tends to be the windiest time with just over half of these days [13 days] occurring in the four [4] months between August and November.

Wind is an important factor in bushfire behaviour as it influences the rate of spread of the fire front and spreads burning embers / sparks, providing ignition sources for spot fires ahead of the main fire front.

The Yarralumla Brickworks precinct has an exposure to hot and dry south-westerly wind influences. These winds can spread burning embers from both small and large fires over long distances and ignite cured fuels ahead of the main fire front.

Fires that occur in the unmanaged vegetation within Block 3 Section 94 have the potential to spread towards the site under the influence of south-easterly winds.

4.7 Slope & Fire Paths.

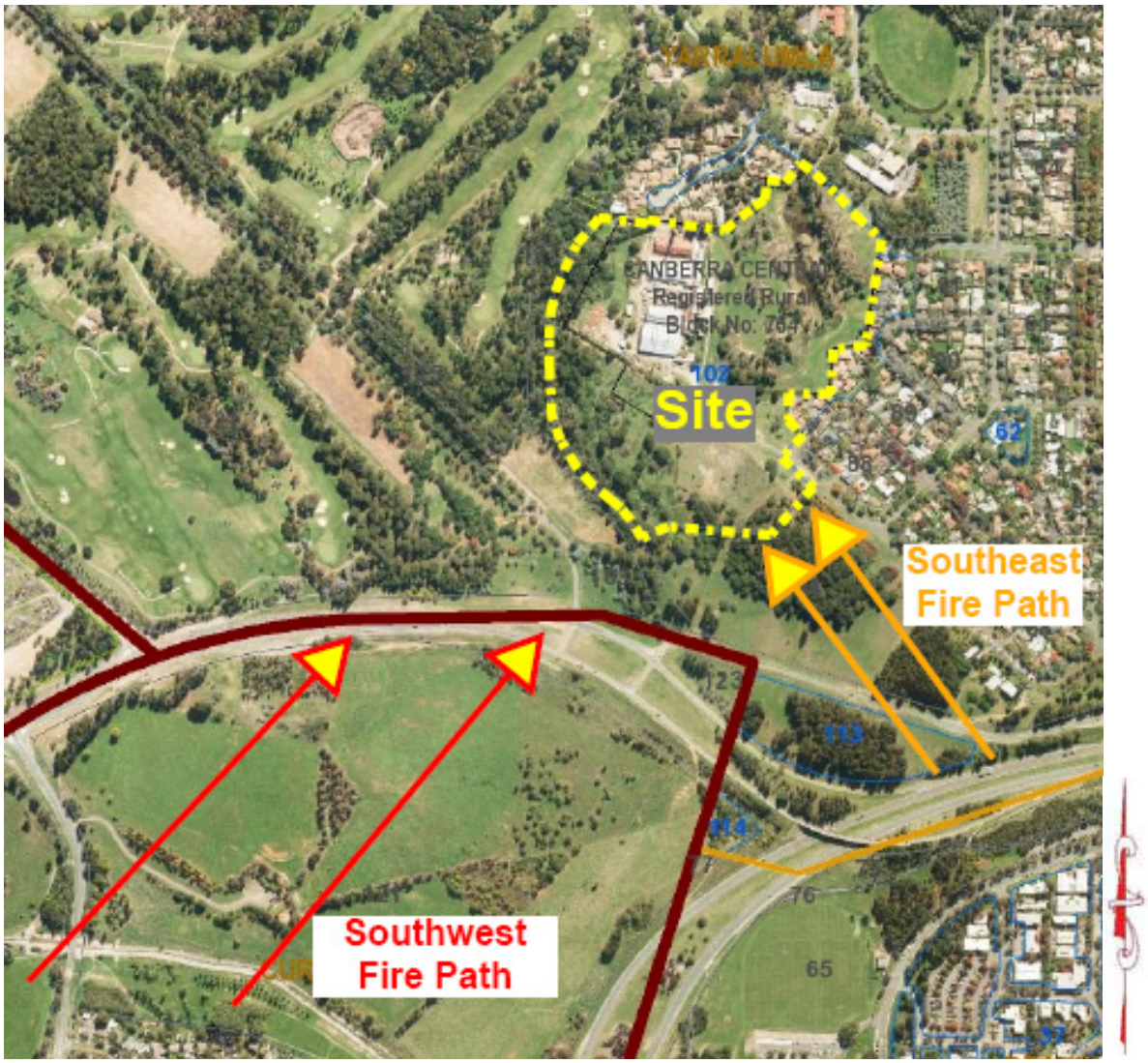
Slope is a critically important factor when assessing fire risk and likely behaviour. The rate of fire propagation doubles up a slope of 10 degrees (18%) and increases almost fourfold up a slope of 20 degrees (40%). The rate of progress downslope tends to slow at a corresponding rate however wind direction in the lee of hills/ridgelines can cause fires to change direction unpredictably.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

The land within the North Curtin Horse Paddock falls to the southwest into the Yarralumla Creek corridor, providing an upslope fire path from the southwest – Refer to Figure 14 below.

The PRZ2 – Restricted Access zoned land, within Block 3, Section 94, to the southeast of the southern portion of the development precinct provides a larger area of vegetation which may be subject to bushfire – refer to the fire path diagram shown on Figure 14, below.

Figure 14 – Potential Fire Paths



4.8 Bushfire Fuels.

Fuel is a critical element in bushfire risk management, as it is the one factor relating to fire behaviour that can be managed.

The precinct is exposed to the direct risk of a fire occurring in the unmanaged woodland vegetation within the PRZ2 zoned land to the southeast, within Block 3, Section 94.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

The precinct is also exposed to the indirect risk from a fire that occurs in the grassy woodland vegetation on the North Curtin Horse Paddock, located to the south and southwest of the Cotter Road corridor.

The Bushfire Operations Plan [BOP] for the North Curtin Horse Paddocks identifies that fuel management by grazing will only occur within the southern portion of the Horse Paddock precinct, leaving the remainder of the precinct unmanaged for fuel reduction, during the period 2015/2018.

Figure 12 on Page 25 identifies the possibility that the northern portion of the Horse Paddock precinct and the land to the south and east of the development precinct may contain suitable Sun Moth habitat.

Whilst the presence of potential or actual Sun Moth Habitat does not exclude management of the grassland vegetation to reduce the fuel hazard, it does restrict the potential for management of the vegetation to provide a low level of bushfire hazard.

In addition, there always remains the likelihood that circumstances may prevail when the grassy woodland vegetation within the Horse Paddocks has not or cannot be managed to mitigate the bushfire risk. This section therefore examines the Overall Fuel Hazard for the grassy woodland on the Horse Paddock land to the south and southwest of the Cotter Road corridor and the PRZ2 zoned land, within Block 3, Section 94, to the southeast of the development precinct.

There are four 'types' of fuel that contribute to bushfire hazard. They relate to the distribution and nature of combustible material within a vegetated environment and are defined by the Overall Fuel Hazard Guide – Fourth Edition (DSE July 2010), as:

- Bark;
- Elevated fuel load;
- Near Surface fuels; and
- Surface fine fuels.

The level of bushfire hazard depends on fuel continuity, height, amount of dead material, foliage thickness and flammability of live foliage.

Flammability of vegetation is at the highest when composition is fine, it contains a lot of dead material, is dense vertically and horizontally and has low moisture content.

Bark has the potential to travel significant distances in a fire situation (spotting) and act as a ladder between surface fuels and the forest crown.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Bark contributes to fire hazard when it is loose and fibrous, present in large quantities and in long loose ribbon forms.

Elevated fuels are defined as shrubs, heath and suspended material greater than 0.5 metres above ground. Elevated fuels Influences the flame height and rate of spread of a fire.

Near Surface Fuels are defined as live and dead fuels effectively in touch with the ground but not lying on it. Near surface fuels influence the rate of spread and flame height of a fire.

Surface fine fuels are defined as the litter bed including leaves, twigs, bark and other fine fuel lying on the ground. Surface fine fuel influences the rate of spread of a fire.

4.9 Assessment of Bushfire Fuel Hazard.

An overall Fuel Hazard for vegetation which presents a hazard to the development precinct can be determined using the DSE Overall Fuel Hazard Guide. The predominant vegetation groups are the grassy woodland within the Horse Paddock and the woodland within the PRZ2 zoned land within Block 3, Section 94 to the southeast development precinct.

1. Grassy woodland vegetation within the Horse Paddock.

Whilst the vegetation within the Horse Paddock has some level of management implemented by grazing, the success of this management practice can vary depending on the amount of rainfall in the spring period, producing abundant growth of grasses, the stock loading and their ability to crop the grasses to levels which will mitigate the intensity of fires that may occur in the cured grass.

Therefore, the assessment of fuel hazard will be determined for unmanaged grassy woodland vegetation to the southwest of the development precinct.

Using the methodology provided within the DSE Overall Fuel Hazard Guide - 2010, the following Fuel Hazard observation was determined.

(a) Bark Hazard: ***High.***

(b) Elevated Fuel Hazard: ***High – Very High.***

(c) Near Surface Fine Fuel Hazard: ***High***

(d) Surface Fine Fuel Hazard: ***High***

The Overall Fuel Hazard for unmanaged grassy woodland vegetation within the North Curtin Horse Paddock has been assessed as being is **Very High**.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

2. <u>Woodland vegetation within the PRZ2 zoned land within Block 3, Section 94 to the southeast.</u>

(a) Bark Hazard: ***High.***

(b) Elevated Fuel Hazard: ***High.***

*(*c) Near Surface Fine Fuel Hazard: ***Very High***

(d) Surface Fine Fuel Hazard: ***Very High***

The Overall Fuel Hazard for unmanaged woodland vegetation within the PRZ2 zoned land within Block 3, Section 94 has been assessed as being is **Very High**.

4.10 Asset Interface Classification [AIC].

The ACT ESA & Rural Fire Service have developed a methodology for determining the classification of potential exposure [risk] of an asset to severe bushfires and introduces Asset Interface Classification [AIC], which is defined as the boundary between an asset and the bushfire paths that approach it. It is determined by an assessment of:

- The maximum fire size an asset may be subject to;
- The part of the fire [head, flank, back] an asset may be subject to, recognizing the major fire threat from the north and west;
- The fire run length criteria and the length of fire run.

The following table provides an Asset Interface Classification [AIC], at a broader scale, for assets exposed to a bushfire threat. The classification system does not identify bushfire mitigating factors such as topography, vegetation types and vegetation management and assumes the 'worst case' for bushfire attack on an asset.

Table 1: Asset Interface Classification

	Length of Fire Run to Asset Interface (through unmanaged vegetation)		
Aspect of Fire Run	<100	100 – 350	>350
N	**Secondary**	**Primary**	**Primary**
NW	**Secondary**	**Primary**	**Primary**
W	**Secondary**	**Primary**	**Primary**
SW	**Lee**	**Secondary**	**Primary**
S	**Lee**	**Secondary**	**Secondary**
SE	**Lee**	**Lee**	**Lee**
E	**Lee**	**Lee**	**Secondary**
NE	**Lee**	**Lee**	**Secondary**

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Table 2 examinations the Asset Interface Classification at a precinct level.

Table 2: Asset Interface Classification – Yarralumla Brickworks Precinct.

	Length of Fire Run to Asset Interface (through unmanaged vegetation)		
Aspect of Fire Run	<100m	100 – 350m	>350m
Southwest – Grassy Woodland within Horse Paddock			**Primary**
South – Southeast – Woodland vegetation		**Lee**	

4.11 Potential Fire Scenarios.

An assessment of the fire scenarios that may impact on the Yarralumla Brickworks precinct has been undertaken, based on the potential fire paths identified in Figure 14 on Page 34.

Scenario 1:

A fire event that occurs in unmanaged grassy woodland on the North Curtin Horse Paddock to the southwest of the Cotter Road corridor, spreading embers across the road corridor, with a resultant impact on the southern edge of the Yarralumla Brickworks development precinct.

This fire event may occur during fire seasons when conditions are such that the grassland vegetation has cured to > 70% and has not been managed to remove the fuel hazard, the Fire Danger Index is Extreme (FDI > 50) and the prevailing wind is from the west/southwest and an ignition occurs either within the North Curtin Horse Paddock or within the Equestrian Park located to the west of Cotter Road.

Scenario 3:

A fire event that occurs in the unmanaged woodland vegetation on the PRZ2 zoned land within Block 3, Section 94, to the south/southeast of the Yarralumla Brickworks precinct, spreading under south-easterly winds toward the south-eastern edge of the Yarralumla Brickworks development precinct.

However, the level of risk is mitigated due to the limited length of fire run through unmanaged woodland vegetation and the current land management measures – refer to Figure 8 – Bushfire Operations Plan on Page 17.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

4.12 Risk Statement.

Table 6 provides a statement of risk for the potential fire scenario that may impact the Yarralumla Brickworks precinct [prior to mitigation measures being adopted / implemented] and assigns risk levels reflecting identified levels of likelihood and consequences for a 'catastrophic' fire occurrence which may occur if the vegetation is not managed to reduce the combustible fuels available to burn during severe fire weather conditions.

Table 3 provides a list of qualitative measures of consequence [or impact] whilst Table 4 provides a list of qualitative measures of likelihood – used to determine the level of risk in Table 6. Table 5 provides a qualitative risk analysis matrix – used to determine the level of risk in Table 6.

Table 3 – Qualitative Measures of Consequence [or Impact]

Level	Descriptor	Detail Description
1	Insignificant	No public safety injuries, low financial loss
2	Minor	No public safety injuries – minor impact to buildings
3	Moderate	Burns and Respiratory problems – moderate damage to buildings
4	Major	Death of people exposed to radiant heat & major property damage
5	Catastrophic	Death of people exposed to radiant heat and total destruction of buildings

Table 4 – Qualitative Measures of Likelihood

Level	Descriptor	Detail Description
A	Almost Certain	Is expected to occur during high, extreme & catastrophic fire danger periods
B	Likely	Will probably occur during high, extreme & catastrophic fire danger periods
C	Possible	May occur during high, extreme & catastrophic fire danger periods
D	Unlikely	Unlikely to occur during high, extreme & catastrophic fire danger periods
E	Rare	Will rarely occur during high, extreme & catastrophic fire danger periods

Table 5 – Qualitative risk analysis matrix – used to determine the level of risk in Table 6

Likelihood	Risk Rating				
	Consequences				
	Insignificant 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
A – almost certain	High	High	Extreme	Extreme	Extreme
B – likely	Moderate	High	High	Extreme	Extreme
C – possible	Low	Moderate	High	Extreme	Extreme
D – unlikely	Low	Low	Moderate	High	Extreme
E – rare	Low	Low	Moderate	High	High

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Table 6 – Bushfire Risk Register – Severe Bushfire Event – if high levels of combustible fuels / unmanaged vegetation exist in the landscape within the Yarralumla Brickworks Study Area.

The Risk What can happen?	The consequences & likelihood of an event happening Consequences	Likelihood	Consequence Rating	Likelihood Rating	Level of Risk	Risk Priority
Fire burning in the grassy woodland vegetation on the North Curtin Horse Paddocks to the southwest of the Cotter Road corridor, spreading under southwest winds	Moderate	Possible - May occur during severe fire danger periods	3	C	High	1
Fire burning in the grassland/woodland vegetation to the south/southeast of the development precinct, spreading under southeast winds	Minor	Unlikely to occur during severe fire danger periods	2	D	Low	2

4.13 Summary of Bushfire Risk.

The last major bushfire which came close to impacting the Yarralumla Brickworks precinct occurred in 2001 and again in 2003, during the bushfires that burnt through the pine forests in the Molonglo Valley. These fires did not directly impact on the precinct, however smoke and ember impact occurred.

A similar large scale fire event is not likely to occur due to the development of the Molonglo urban release area. However, a severe local fire may still occur if the prevailing weather conditions are such to support ignition of the vegetation within the North Curtin Horse Paddock.

An example of this event would be ember ignition of the vegetation in the Tuggeranong Parkway corridor, from remote fires located to the west and northwest of the Molonglo urban release area, with the fire extending into the Horse Paddock / Equestrian / Riding School precincts located between the Tuggeranong Parkway corridor and Cotter Road thence into the North Curtin Horse Paddock, spreading upslope across the landscape towards the south-western edge of the Cotter Road corridor, creating ember attack on the development precinct.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

SECTION 5

PROTECTION MEASURES TO BE IMPLEMENTED TO REDUCE THE BUSHFIRE RISK TO THE PROPOSED DEVELOPMENT.

5.1 Introduction.

The following sections of this report provide recommendations on the measures required to address the bushfire risk and the requirements of the *Strategic Bushfire Management Plan for the ACT – 2014.*

5.2 Asset Protection Zones.

The *Strategic Bushfire Management Plan for the ACT 2014* provides recommendations on the provision of Asset Protection Zones to development located in a bushfire prone area and which is likely to be subject to bushfire attack. These provisions are detailed below:

Outer Asset Protection Zone:

Vegetation Type	AIC	OAPZ Width
Southwest Unmanaged open grassy woodland vegetation within the North Curtin Horse Paddock > 350m wide fire spread	**Primary**	**Minimum 100 metres** **Refer to Note 2**
Southeast Unmanaged woodland vegetation within the PRZ2 zoned land [Block 3, Section 94] to the southeast of the development precinct: < 100 metre fire spread	**Lee**	**Nil**

Inner Asset Protection Zone:

Vegetation Type	AIC	IAPZ Width
Southwest Unmanaged grassy woodland vegetation within the North Curtin Horse Paddock > 350m wide fire spread	**Primary**	**30 metres** **Refer to Note 3**
Southeast Unmanaged woodland vegetation within the PRZ2 zoned land [Block 3, Section 94] to the southeast of the development precinct: < 100 metre fire spread	**Lee**	**10 metres**

Note 1:

The vegetation to the west and southwest of the development precinct, within Block 1, Section 127 consists of a narrow band [20 – 45 metres wide] of poor quality Pinus Radiata trees which will be removed and the area managed as 'parkland', removing the current bushfire risk from this vegetation.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Note 2:
The management of the Cotter Road and Dunrossil Drive corridors, as described in the National Capital Bushfire Operations Plan [BOP] for the Dunrossil Avenue corridor and the ESA Bushfire Operations Plan [BOP] for the Cotter Road corridor, provides a managed Outer Asset Protection Zone to the south and southwest of Block 1, Section 127 and the Brickworks precinct.

The National Capital Bushfire Operations Plan [BOP] identifies that the Dunrossil Avenue corridor, including the replanted Pines within Block 2, Section 103, will be slashed at 6 – 8 week intervals – satisfying the prescriptions of an Outer Asset Protection Zone.

The ESA Bushfire Operations Plan [BOP] identifies the grassland vegetation within the Cotter Road corridor, including the grassland vegetation within Block 3, Section 94 is slashed. The site inspection confirmed that the current management practices maintain this area to the standards of an Outer Asset Protection Zone – i.e. maintain a Grassland fire hazard rating of < 35 when grassland curing reaches > 70%.

Note 3:
The provision of the 30 metre wide Inner Asset Protection Zone to the south-western aspect of the development precinct is a mandatory requirement of the *Strategic Bushfire Management Plan for the ACT 2014* and is provided by the managed Cotter Road and Dunrossil Drive corridors.

Foot Note:

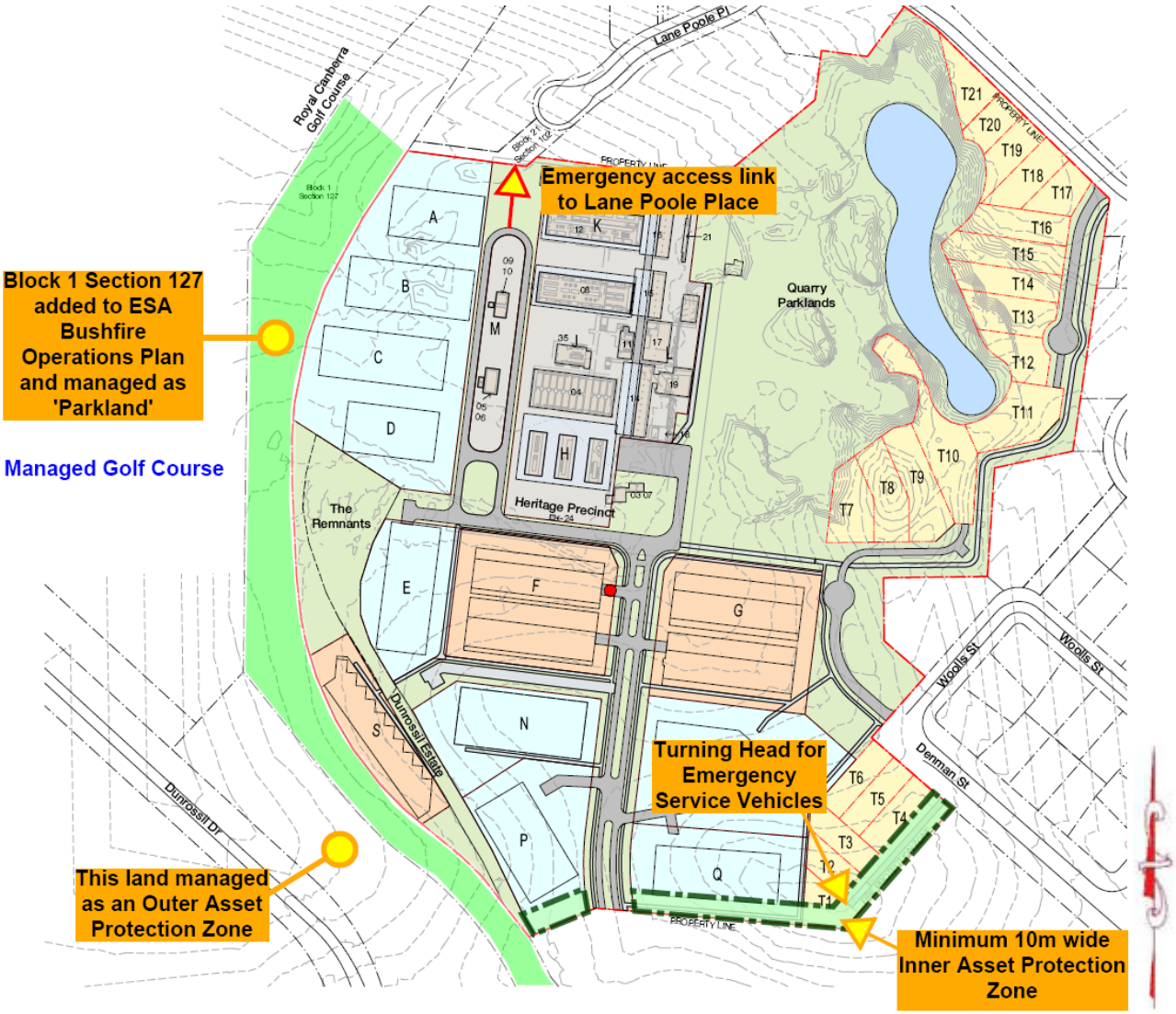
1. The recommended widths of Asset Protection Zones are based on the assumption that the vegetation within the Canberra Golf Club, the Dunrossil Avenue/Cotter Road corridors and Block 1 Section 127 is maintained to mitigate the bushfire risk to the Brickworks precinct.

2. The current management of the land adjoining the south-western boundary of the Brickworks precinct, in accordance with the National Capital and ESA Bushfire Operations Plans [BOPs], may satisfy the prescriptions of an Inner Asset Protection Zone [IAPZ].

   The Developer shall satisfy itself that the provision and management of the Inner Asset Protection Zone, in perpetuity, can be achieved on land beyond the Lease Boundary.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 15 – Plan of indicative widths of Asset Protection Zones to the Yarralumla Brickworks precinct.



5.3 Construction Standards to Buildings.

The *Strategic Bushfire Risk Management Plan for the ACT 2014* requires an assessment to be undertaken using the criteria within Australian Standard A.S. 3959 – 2009.

An examination of A.S. 3959 – 2009 requires that all buildings located within 100 metres of the outer edge of the Inner Asset Protection Zone shall be constructed to comply with BAL 12.5, pursuant to A.S. 3959 – 2009 – *'Construction of Buildings in Bushfire Prone Areas'.*

This requirement applies to future buildings erected on Blocks T1 – T6 and Buildings N, P, Q. R and S.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

5.4 Access for Fire-fighting Operations.

The internal road network shall be designed and constructed to ACT Fire Brigade [Fire & Rescue ACT] standards so as to allow heavy emergency service vehicles to manoeuvre quickly and efficiently in both response and normal operating modes.

An emergency access link shall be provided from the internal road network to Lane Poole Place.

A turning head (or through access) shall be provided to Blocks T1, T2, T3 & T4.

5.5 Water Supplies for Fire Fighting Operations.

Hydrants for fire-fighting operations are to be provided along the perimeter road to the satisfaction of the ACT Fire Brigade [Fire & Rescue ACT]".

The hydrant supply shall be installed to comply with the agreed standards for water supply and require type F5 standard 45 l/s single standard hydrants at 60 metre intervals to the hazard interface.

5.6 Management of Pocket Parks and Open Space Areas.

The pocket parks within the development precinct shall be maintained to the prescriptions of an Inner Asset Protection Zone as defined by the *ACT Strategic Bushfire Management Plan - 2014*.

Management shall also comply with the 'Low Threat Vegetation' as defined by Section 2.2.3.2 of Australian Standard A.S. 3959 – 2009 – *'Construction of Buildings in Bushfire Prone Areas'.*

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

SECTION 6

RESIDUAL RISK.

6.1 Introduction.

Table 7 evaluates the residual bushfire risk to the proposed development following the implementation of the recommended bushfire protection measures, and determines the vulnerability of the proposed development, the possible consequences and residual bushfire risk during extreme to catastrophic fire danger periods.

Table 7 – Bushfire Risk Register & Action Treatment Plan – catastrophic bushfire events, post implementation of the recommended protection measures.

The Risk What can happen?	The consequences and likelihood of an event happening Consequences	Likelihood	Risk before mitigation	Strategy to reduce the risk	Consequences & Likelihood after mitigation	Residual Level of Risk	Risk Priority
Fire burning in the grassy woodland vegetation on the North Curtin Horse Paddocks to the southwest of the Cotter Road corridor, spreading under southwest winds	Moderate	Possible - May occur during severe fire danger periods	High	Provision of Asset Protection Zones & construction standards to buildings	Minor/Possible	Moderate	1
Fire burning in the grassland/wood land vegetation to the south/southeast of the development precinct, spreading under southeast winds	Minor	Unlikely to occur during severe fire danger periods	Low	Provision of Asset Protection Zones & construction standards to buildings	Minor/Unlikely	Low	2

6.2 Summary of Residual Bushfire Risk.

Table 7 provides a review of the residual level of risk to the assets within the Yarralumla Brickworks precinct and has been determined on the basis that the recommended bushfire mitigation measures are implemented and maintained over the life of the development.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

SECTION 7

CONCLUSION

This assessment examines the potential bushfire risk to the proposed Yarralumla Brickworks precinct within Block 1, Block 7 and Block 764, Section 102 Yarralumla, ACT.

The report has examined the topography and vegetation on the land adjoining the development precinct, identified the fire-paths which may present a threat to the future development, determined the level of risk prior to and the residual risk after the implementation of the recommended bushfire protection measures.

The examination of the potential risk has identified that the grassy open woodland on the North Curtin Horse Paddocks to the southwest and the woodland vegetation on Block 3, Section 94, to the south and southeast of the development precinct, may present a hazard to the proposed development.

The removal and management of the vegetation within Block 1, Section 127 to the west and southwest of the development precinct is a mandatory requirement as part of the ESA Bushfire Operations Plan in order to remove, in perpetuity, the hazard adjoining the western and south-western edges of the development precinct.

The *ACT Strategic Bushfire Management Plan 2014* requires the provision of an Outer and Inner Asset Protection Zone to the south-western edge of the Brickworks precinct. The management of the Dunrossil Avenue and Cotter Road corridors plus provides a satisfy Outer Asset Protection Zone – provided that the current management practices remain in place.

The provision of the Inner Asset Protection Zone, inside the Lease Boundary, is a mandatory requirement of the *ACT Strategic Bushfire Management Plan 2014.* However some scope may exist for part of the Inner Asset Protection Zone to be located within Section 103, to the southwest of the development precinct.

DOMA shall satisfy its-self of the practicality of the placement of the IAPZ within Section 103.

The *ACT Strategic Bushfire Management Plan 2014* requires the establishment of a 10 metre wide Inner Asset Protection Zone to the southern and south-eastern aspect of the Brickworks precinct, located inside the Lease Boundary.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Irrespective of the location of the IAPZ, the construction of buildings located within the 100 metre wide setback to unmanaged bushfire prone vegetation shall comply with BAL 12.5 standards, pursuant to A.S.3959 – 2009. This applies to the future buildings erected on Blocks T1, T2, T3 & T4; Buildings N, P, Q, R & S.

It is concluded that the provision and maintenance of the recommended fire protection measures reduces the potential bushfire risk to the proposed development from high, prior to implementation of the protection measures, to moderate/low after the implementation of those measures.

Graham Swain
Managing Director - ***Australian Bushfire Protection Planners Pty Limited***

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

REFERENCES:

- Strategic Bushfire Management Plan for the ACT – Version 1 – January 2005; Version 2 – October 2009 and Version 3 – 2014;
- ACT Planning Strategy – 2012;
- Australian Standard AS/NZS ISO 31000:2009 Risk Management;
- Emergency Risk Management – Applications Guide. (EMA) 2000);
- Overall Fuel Hazard Guide – Department of Sustainability & Energy [DSE] Victoria; July 2010;
- Planning for Bushfire Risk Mitigation 2006 & update 2009;
- National Capital Bushfire Operations Plan [BOP] - June 2004;
- TaMS Bushfire Operations Plan [BOP] – North Curtin Horse Paddocks and Brickworks Precinct;
- Emergency Services Agency (ESA) Bushfire Operations Plan [BOP];
- Yarralumla & North Curtin Environmental Constraints Mapping;
- ACTmap – Significant Plants, Animals & Registered Trees Map - Yarralumla & North Curtin;
- ACTmap – Natural Temperate Woodland Mapping – Yarralumla & North Curtin; and
- ACTmap – Sun Moth Habitat Mapping – Yarralumla & North Curtin;
- DSB Tree Assessment;
- Umwelt Ecological Assessment – 2004.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au