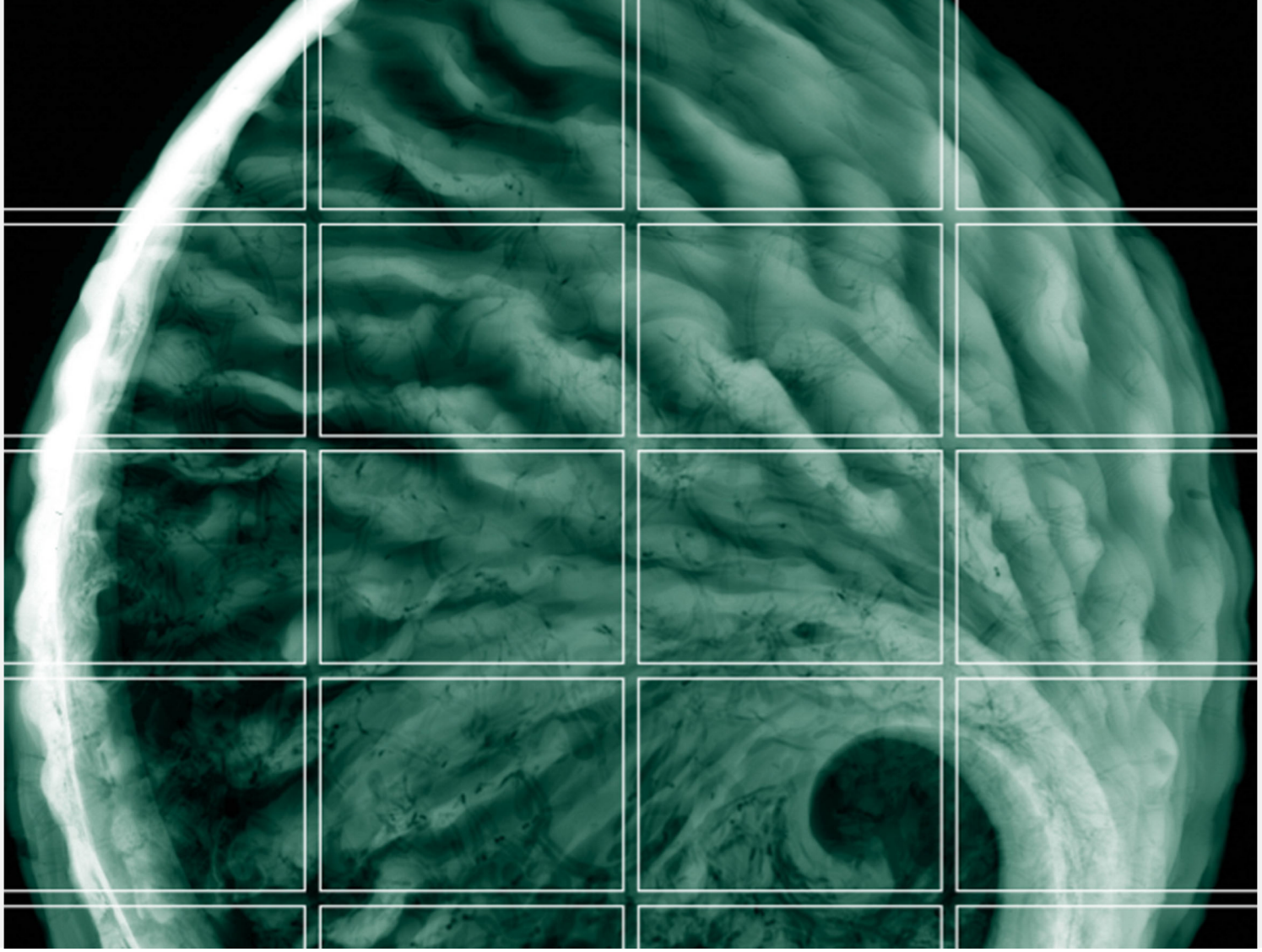

Raising London Circuit

Environmental Assessment – Contamination

29th September 2021

Project No.: 0527116

The business of sustainability

ERM

Document details	The details entered below are automatically shown on the cover and the main page footer. PLEASE NOTE: This table must NOT be removed from this document.
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Signature Page

29th September 2021

Raising London Circuit

Environmental Assessment – Contamination

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CONTENTS

List of Tables

Acronyms and Abbreviations

Name	Description
ACM	Asbestos Containing Material
ACT EPA	Australian Capital Territory (ACT) Environment Protection Authority
AHD	Australian Height Datum
AMG	Australian Map Grid
ASC NEPM	National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013)
ASS	Acid Sulfate Soils
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CoPC	Contaminant of Potential Concern
CSM	Conceptual Site Model
DP	Deposited Plan
DPI	Department of Primary Industries
DSI	Detailed Site Investigation
EPA	Environment Protection Authorisation
EPP	ACT EPA (2017) *Contaminated Sites Environment Protection Policy* (December 2017)
ESA	Environmental Site Assessment
m	Metre
m AHD	Metres Above Australian Height Datum
m bgl	Metres Below Ground Level
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NPI	National Pollutant Inventory
OCP	Organochlorine Pesticides
OPP	Organophosphorus Pesticides
PAH	Polycyclic Aromatic Hydrocarbons
PFAS	Per and Polyfluoroalkyl Substances
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulphonate
PSI	Preliminary Site Investigation
RAP	Remedial Action Plan
RCIP	Regional Contamination Investigation Program
SAQP	Sampling and Analysis Quality Plan
TRH	Total Recoverable Hydrocarbons

INTRODUCTION

Environmental Resources Management Australia Pty Ltd (ERM) was engaged by Major Projects Canberra (MPC) to undertake an assessment of potential contamination issues that may require consideration during completion of the project identified as Raising London Circuit (RLC) Canberra, ACT (the Site).

The RLC project would involve raising London Circuit between Edinburgh Avenue and Constitution Avenue on a gradual filled embankment to meet the current height of Commonwealth Avenue, and provision of a new signalised intersection between London Circuit and Commonwealth Avenue.

- The site location is illustrated on Figure 1 and the current layout is illustrated on Figure 2.

Objective

The objective of these works was to undertake review of site conditions to inform the Environmental Assessment being prepared by AECOM Australia Pty Ltd (AECOM) and ensure that contamination is appropriately considered and managed during future stages of the approvals and development process.

Scope of Works

To meet the project objectives, ERM completed the following scope of works:

- Review of background information relating to the site, including:
  - Previous investigations relating to site contamination.
  - The ACT EPA contaminated land database.
  - Historical aerial photographs.
  - Groundwater bore information.
  - Relevant government databases.
  - Published soil, geology and topographic maps.
- Development of a preliminary Conceptual Site Model;
- Assessment of potential risks to construction in consideration of proposed construction works; and
- Preparation of this report.

This report was developed with consideration of the relevant parts of the following guidelines:

- *National Environment Protection (Assessment of Site Contamination) Measure 1999* (ASC NEPM (1999)) *(*as amended May 2013) - herein referred to as the ASC NEPM (2013).
- Australian Capital Territory (1997) *Environment Protection Act 1997* – herein referred to as the Act.
- ACT EPA (2017) *Contaminated Sites Environment Protection Policy (December 2017)* – herein referred to as the Contaminated Sites EPP.

PROJECT DESCRIPTION

Initial project planning indicates that the construction of RLC will be undertaken over the following 5 phases. ERM notes that potential risks to the project from potential contamination have been assessed in consideration of the project specific development requirements.

Table 1: Project Description

Phase	Detail
Phase 1 – Enabling Works Utilities	■ Utility enabling works involves relocating services from London Circuit into a new network installed around Vernon Circle south, Constitution Avenue, and Edinburgh Avenue
Phase 2 – Enabling Works RLC	■ Decommissioning of existing services within RLC corridor ■ Constructing a mass fill embankment along London Circuit together with civil construction activities to achieve an on grade intersection. ■ Removal of trees and stripping of topsoil and installation of stormwater drainage including attenuation works. ■ Structural works including constructing retaining walls to support the new fill embankment, installation of new utilities, road pavements, kerb & gutter, hard landscaping, soft landscaping, traffic signals, signs and lines and finishing works. ■ North West Clover Leaf: demolishing the Commonwealth Avenue to London Circuit Eastbound Loop road and reinstating the area to match existing landscaping ■ South West Clover Leaf: demolishing the Commonwealth Avenue to Parkes way eastbound loop road, as well as the Commonwealth Avenue to London Circuit west loop road, and reinstating the area to match existing landscaping ■ South East Clover Leaf: demolishing the London Circuit westbound off ramp to commonwealth Avenue and reinstating to match existing landscaping. The Parkes way off ramp onto Commonwealth Avenue southbound will be maintained with the addition of kerb and gutter upgrades and re-sheeting the road. ■ Some temporary works will also be required and include: construction of side track, temporary pavements in Commonwealth Avenue median, and temporary water basins for water management.
Phase 3	■ Involves the removal of Commonwealth Avenue southbound bridge which will be the first activity undertaken in this phase. ■ Other activities include; removal of side track, bulk fill installation, installation of stormwater drainage, installation of new utilities, road pavements, kerb & gutter, hard landscaping, soft landscaping, traffic signals, signs and lines and finishing works. ■ New road works shall be tied into existing pavements at locations determined by constructability and temporary works assessments undertaken by accredited design consultants
Phase 4	■ Involves the removal of Commonwealth Avenue northbound bridge which will be the first activity undertaken in this phase. ■ Other activities include: bulk fill installation, installation of stormwater drainage, installation of new utilities, road pavements, kerb & gutter, hard landscaping, soft landscaping, traffic signals, signs and lines and finishing works. ■ New road works shall be tied into existing pavements at locations determined by constructability and temporary works assessments undertaken by accredited consultants.
Phase 5	■ Finalisation and completion works to be undertaken prior to achieving practical completion. ■ Such completion works include finalisation of soft landscaping, line marking, and final clean.

SITE IDENTIFICATION AND SETTING

The site identification information is presented within the table below:

Table 2: Site Identification and Setting

Item	Description
Site Identification	Raising London Circuit - Canberra ACT
Site Location and Site Layout	Figure 1 and Figure 2
Surrounding Land Use	The land uses surrounding the site include: ■ **North:** Vernon Circle, commercial properties then Northbourne Avenue (vehicle and light rail transport corridor) and a range of commercial buildings (offices, restaurants, hotels etc.) and high density residential dwellings. ■ **South:** Parkes Way and a range of commercial buildings (offices, restaurants, hotels etc.) followed by recreational open space then Lake Burley Griffin ■ **East:** Constitution Avenue followed by range of commercial buildings (offices, restaurants, hotels etc.). ■ **West:** Canberra Law Courts, public parking areas followed by and a range of commercial buildings (university buildings, offices, restaurants, hotels etc.) and high density residential dwellings.
Site Elevation	■ The site elevation ranges between 560 m AHD in the southern portion of the Site to approximately 570 m AHD in the north eastern portion of the Site with a slight slope towards the south east.
Topography	■ Regional topography is generally flat with a slight slope to the southeast ■ The site is also primarily flat with a slight slope towards the south east in the direction of Lake Burley Griffin
Hydrology	No surface water was observed on the site surface within the proposed RLC site area. ■ During periods of rainfall surface waters are likely to be directed to stormwater infrastructure located onsite and within adjacent roadways. ■ The nearest surface water body is Lake Burley Griffin located on the southern boundary of the Site.
Geology and Acid Sulfate Soils	■ Geology mapping indicates the site is underlain by the Canberra formation comprising Palaeozoic aged mudstone, siltstone dacitic ignimbrite and volcaniclastic sediments. ■ Soils were described as moderately deep, moderately well-drained Yellow Chromosols (Yellow Podzolic Soils) on Red and Brown Kandosols (Red and Yellow Earths) on upper rises and fan elements. Moderately to very deep, poorly to imperfectly drained Sodosols (Solodic Soils and Solodized Solonetz Soils) on lower rises and fan elements. ■ Mapping within the Atlas of Australian Acid Sulfate Soil and Salinity indicates the both the 0-1 km and 1- 2 km portion of the proposed alignment have an “Extremely low probability” of the occurrence of acid sulfate soils.
Hydrogeology	A search of registered groundwater bores within the vicinity of the Site indicated the following: ■ One groundwater bore (bore ID 473) was located within the search buffer approximately 100 m north west of the RLC site. Results of the search indicated the bore was drilled to a final depth of 15.1 m bgl. ERM notes that the authorised purpose for the bore was not recorded. ■ Drillers logs indicate that moderately – highly weather mudstone and shales were present from 1.8 m bgl to the maximum depth of drilling. ■ It is considered that groundwater is likely to be present within shallow perched aquifers, at the clay / bedrock interface or within deeper aquifers located within underlying fractured bedrock.


SITE
O'Connor
Ainslie
North Canberra
Turner
Braddon
Little Black Mountain
Acton
City
City Hill
Reid
Parkes
Canberra
Russell
Barton
Capital Hill
South Canberra
Kingston
KINGSLEY PLACE
ALLSOP STREET
UNIVERSITY AVENUE
WEST ROW
EAST ROW
THEATRE LANE
AINSLIE PLACE
HILL STREET
IDE LANE
KNOWLES PLACE
VERNON CIRCLE
LIVERSIDGE STREET
THE MEWS
MCCOY CIRCUIT
EDINBURGH AVENUE
PHILLIP STREET
LONDON CIRCUIT
PARKES WAY
LAWSON CRESCENT
REGATTA PLACE
BARRINE DRIVE
LENNOX CROSSING
Legend
RLC Boundary
Cadastre (Block)
Data Source:
ACTMapi (c) ACT Government 2019
Nearmap Imagery May 2021
Inset: Esri OpenStreetMap 2019
Privileged and Confidential
Site Location
F1
Drawing No: 0527116s_RLC_G001_R0.mxd
Date: 01/09/2021
Drawing Size: A4
Drawn By: GC
Reviewed By: IB
Coordinate System: GDA 1994 MGA Zone 55
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N
Raising London Circuit - Contamination Assessment
Canberra Light Rail – Stage 2A
Client: Light Rail – Major Project Canberra
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

Data Source:
ACTMapi (c) ACT Government 2019
Nearmap Imagery May 2021

Privileged and Confidential

Site Layout

F2

Drawing No:	0527116s_RLC_G002_R1.mxd	
Date:	01/09/2021	Drawing Size: A4
Drawn By:	GC	Reviewed By: IB

Coordinate System: GDA 1994 MGA Zone 55

0 50 100 150m

N

Raising London Circuit - Contamination Assessment
Canberra Light Rail – Stage 2A

Client: Light Rail – Major Project Canberra

ERM

SITE HISTORY

Aerial Photographs

Historical aerial photographs (Appendix A) were reviewed to assess potential historical land use practices undertaken within the Site and surrounding area. A summary of information obtained from the review is presented within the table below.

Table 3: Summary of Aerial Photography

Year	Description
1951 – Black and White	■ **Site Area:** London Circuit is present within its current alignment. Two commercial / office buildings are present on the southern boundary of London Circuit at the commencement of Commonwealth Avenue within the current south eastern and south western "clover leaf" portions of the Site. Commonwealth Avenue is present in its current alignment with ornamental garden beds located within the centre of the road. ■ **Surrounding Area:** The surrounding area is comprised of undeveloped / cleared land with several unsealed tracks and scattered vegetation. Roadways within the surrounding area indicate the surrounding area has been subdivided for future development to occur. Unsealed roads in the current alignment of University Avenue located approximaterly 100m to the north west of the RLC site extend northwest from London Circuit. Low density residential buildings are located to the west and southwest of Commonwealth Avenue and several commercial buildings are located to the east. A military barracks is located to the east of the site within the vicinity of Parkes Way.
1955 – Black and White	■ **Site Area:** The northern portion of London Circuit appears to have been cleared**.** An unsealed road intersects the Site in the northern portion of Commonwealth Avenue. A bridge has been constructed on Commonwealth Avenue at the southernmost extent of the Site. ■ **Surrounding Area:** The majority of buildings on either side of Commonwealth Avenue have been demolished with the exception of the Archbishop's Residence which comprises a large rectangular shaped building. The construction of Parkes Way appears to have commenced to the east of Commonwealth Avenue. Commercial development is observed to the north east and west of London Circuit. Unsealed roads along the current alignments of Gordon Street and Edinburgh Avenue have been constructed. Additional roadways have also been developed to the northeast of the site.
1961 – Black and White	■ **Site Area:** The Site appears generally consistent with previous aerial photography with the exception of the construction of an unsealed road bisecting Commonwealth Avenue in the current alignment of Parkes Way. ■ **Surrounding Area:** Canberra Hospital is visible to the south west of the Site. Roadways in the current alignment of Vernon Circle and Northbourne Avenue have been constructed with Commonwealth Avenue extended to the north to join Vernon Circle. Commercial development has occurred in a small portion southwest of the site. The remaining surrounding area is still generally comprised of commercial development to the north, northeast and northwest as well as vacant/cleared land to the south of the site. Land clearing / construction works appear to be occurring under the bridge in the southern portion of Commonwealth Avenue.
1968- Black and White	■ **Site Area:** The site appears generally consistent with previous aerial photography with the exception of London Circuit and Commonwealth Avenue which appear to have been re-sealed. ■ **Surrounding Area:** Lake Burley Griffin has been created to the south and southwest of the site. Car parking areas appear to have been constructed on the northern portion of London Circuit consistent with their current alignment. Commercial development has continued to occur to the north, east and west of the Site. Additional roadways have also been constructed to the east and south (beneath the Commonwealth Avenue Bridge) of the Site. The Barracks located to the east of the Site has been demolished and replaced with the eastern portion of Parkes Way.

Year	Description
1975 – Colour	■ **Site Area:** The central portion of Commonwealth Avenue has been elevated with the construction of a bridge over Parkes Way. The "clover leaf" on / off ramps have been constructed within the central portion of Commonwealth Avenue to enable access to Parkes Way. The remainder of the site appears consistent with previous aerial imagery. ■ **Surrounding Area:** Parkes Way been expanded and includes an underpass beneath Commonwealth Avenue. Recreational areas within West Basin and the adjacent parklands to the west of the site have been developed. Additional commercial development has occurred to the west of London Circuit and expansion of the university to the east of the Site has also occurred.
1978 – Colour	■ **Site Area:** No significant changes observable since previous aerial photography ■ **Surrounding Area:** The area to the west of the Site has been cleared for construction of the current Parkes Way alignment. The area to the east and west of Commonwealth Avenue (within the location of the current Commonwealth Park and Henry Rolland Park) appears to have been cleared.
1980 – Colour	■ **Site Area** No significant changes observable since previous aerial photography ■ **Surrounding Area:** The construction of Parkes Way has been completed and is consistent with its current alignment.
1986 – Colour	■ **Site Area:** No significant changes observable since previous aerial photography ■ **Surrounding Area:** The area surrounding London Circuit has been developed for primarily car parking purposes. The remainder of the surrounding areas appear generally consistent with previous aerial photography.
1993 – Colour	■ **Site Area:** No significant changes observable since previous aerial photography ■ **Surrounding Area:** Commercial construction has occurred to the south west of the Site and within the area surrounding City Hill. Construction of a high-rise building immediately west of the site can also be observed. Commonwealth Park appears to be consistent with the current layout including a car park to the north of Henry Rolland Park.
1998 – Colour	■ **Site Area:** No significant changes observable since previous aerial photography ■ **Surrounding Area:** Additional commercial development to the west and north east of the Site. Regatta Point and Nerang Pool now appear to have been constructed consistent with their current layout.
2008 – Colour	■ **Site Area:** No significant changes observable since previous aerial photography ■ **Surrounding Area:** Additional commercial development to the north east (Canberra Centre) and west of the Site. A large car park area has been constructed to the immediate west of Commonwealth Avenue.
2010 - Colour	■ **Site Area:** No significant changes observable since previous aerial photography ■ **Surrounding Area:** No significant changes since previous aerial photography
2013 – Colour	■ **Site Area:** No significant changes observable since previous aerial photography ■ **Surrounding Area:** No significant changes observable since previous aerial photography
2016 – Colour	■ **Site Area:** No significant changes observable since previous aerial photography ■ **Surrounding Area:** Constitution Avenue, located to the west of the Site has been upgraded. Anecdotal evidence provided to ERM indicates that ACM was identified within fill materials excavated as part of these development works.
2019- Colour	■ **Site Area:** No significant changes observable since previous aerial photography ■ **Surrounding Area:** No significant changes observable since previous aerial photography aside from the construction of a jetty west of the Site.

DESKTOP SEARCH RESULTS

The sections summarise the results of desktop searches relevant to potential contamination within the Site.

PFAS Investigations

A search for PFAS Investigations undertaken on behalf of the Department of Defence, Airservices Australia and ACT EPA within the search area indicated that no sites within the report 1 km buffer area have undertaken a PFAS Investigation.

ACT EPA Register of Notified Contaminated Sites

A search of the EPA register of contaminated sites undertaken for the site and a 1 km buffer area identified the following:

Table 4: ACT EPA Register of Notified Contaminated Sites

District	Location	Notified Under Section	Description	Distance from site	Direction
Canberra Central	-	76A(1)	Capital Metro audit area - Northbourne Ave within the District of Canberra Central	Not mapped	-

While the results of database searches did not identify the nature / extent of contamination, it is considered that as the registered site is the Capital Metro Audit Area, primary CoPCs would include asbestos and are unlikely to pose a significant risk of migration into the RLC site area.

ACT EPA Contaminated Sites Register

A search of records held by the ACT EPA contaminated sites unit indicated the following sites were located within the search buffer area:

Table 5: ACT EPA Contaminated Sites Register

ID Number	Block / Section	Address	Details
HCP393	Block 12 Section 3 Canberra Central	Tamar House London Circuit	Potential hydrocarbon contamination associated with fuel storage
HCP88	Block 1 Section 18 Canberra Central	20- 22 London Circuit (Reserve Bank)	Potential hydrocarbon contamination associated with fuel storage
OTP226	Block 1 Section 5 Canberra Central	Unit 3 University Avenue	Dry cleaning chemicals TCE, PCE etc.

EPA Public Register – EPA Authorisations

The following EPA Authorisations were recorded within the EPA public register within the 200 m search buffer for both sections of the site.

Table 6: ACT EPA – EPA Authorisations

ID Number	Business Name	Suburb	Location	Activity	Status	Distance (m)	Direction
1128	Director General, ACT Government	Canberra City ACT	Various locations within Australian Capital Territory	Commercial use of chemicals (Activity 29)	Current	Not mapped	-
1165	City Pest Control Service Pty Ltd	Canberra City ACT	Various locations within Australian Capital Territory	Commercial use of chemicals (Activity 29)	Current	Not mapped	-

ACT Asbestos Response Taskforce List

A search of the ACT Asbestos Response taskforce List within the site indicated that there were no recorded asbestos responses within the site or surrounding 200 m buffer area.

NPI Industrial Facilities

A search for National Pollutant Inventory (NPI) Industrial facilities within the Site and a 2 km buffer area indicated that no NPI industrial facilities were located within the search area.

Other Contamination Issues - Defence Sites

A search for other contamination issues identified within the Department of Defence Regional Contamination Investigation program (RCIP) undertaken for the search area identified the following:

Table 7: Defence Facilities

Site Name	Address	Description	RCIP Code	Distance (m)	Direction
Werriwa Depot	Civic, Australian Capital Territory	■ There are no known contamination issues at the depot. ■ A disused underground fuel storage tank (associated with heating oil) was removed from the site in 2006, with no contamination evident in surrounding soils.	0250	150	Southeast

Other Current Potentially Contaminating Activities

A search for other current potentially contaminating activities undertaken for the search area identified the following:

Table 8: Other Potentially Contaminating Activities

Site Name	Category	Location	Status	Distance (m)	Direction
Canberra City Police Station	Police Station	16-18 London Cct, Canberra ACT 2601	Operating	27	East

PREVIOUS INVESTIGATIONS

In undertaking this assessment, ERM undertook a review of the following previous reports relevant to the Site:

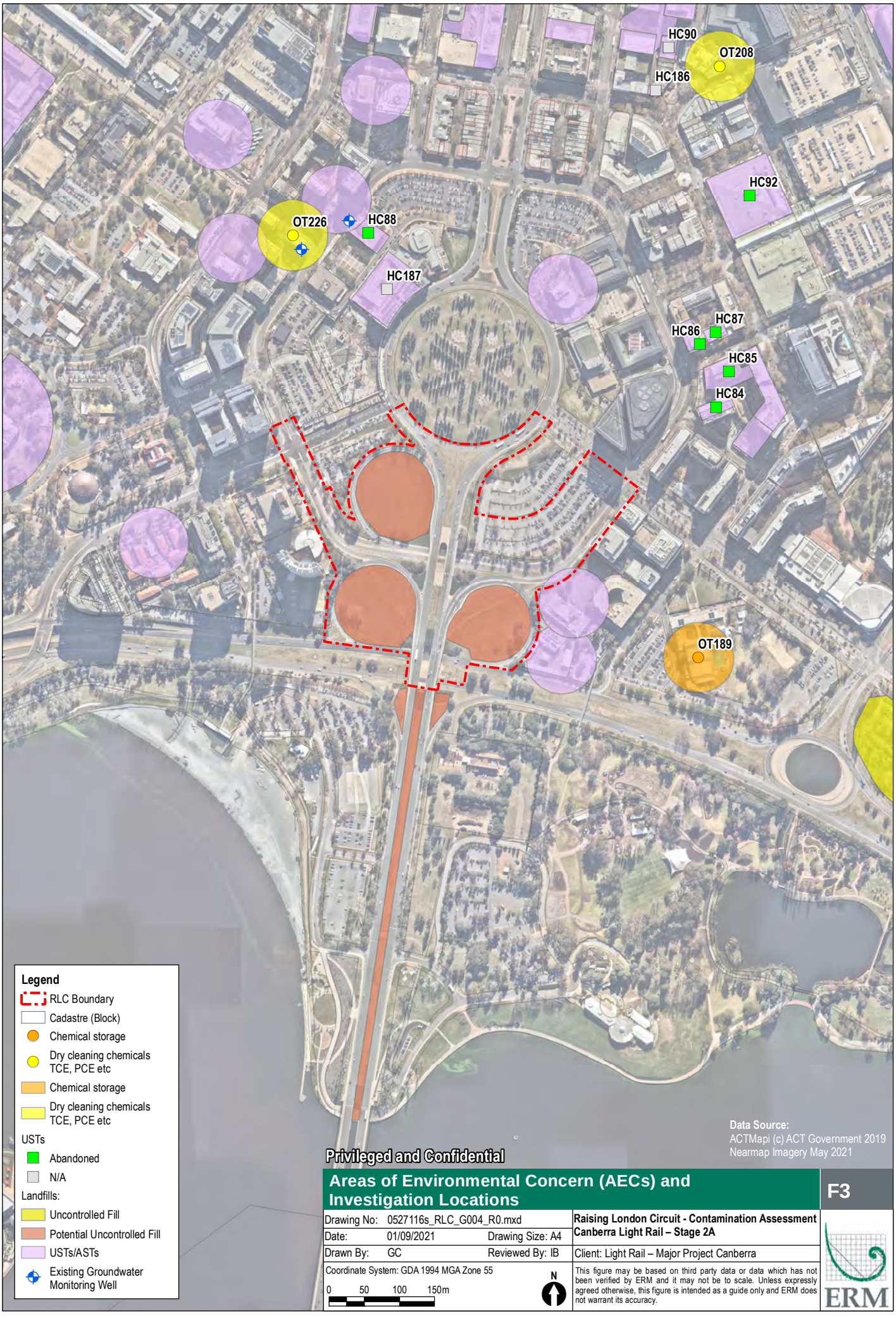
- RPS Australia West Pty Ltd (2017): *Limited Phase 2 Contaminated Site Assessment Report, Canberra Light Rail Stage 2.* Report number: EWS72591, 1 December 2017 (RPS 2017);
- Environmental Resources Management (2019) Preliminary Site Investigation, Canberra Light Rail Stage 2A, 19th December 2019 Ref No 0527116 (ERM 2019); and
- AECOM Australia Pty Ltd (2020) S200-ASJ-LTR-ENV-VN-0001 – Contaminated Soil Classification Letter for an Augmented Proposal 21st May 2020 (AECOM 2020)

A summary of the above reports is provided below.

Table 9: Summary of Previous Investigations

Previous Report	Detail
RPS 2017	RPS undertook a Limited Phase 2 Contaminated Site Assessment to assess the potential for contamination associated with past and present land uses and to assess the potential for contamination to impact human health and / or the environment during or after development. The assessment was undertaken across 6 various proposed stages / options of the Canberra Light Rail including the proposed Stage 2A alignment and included a site visit, observation of test pits and/or boreholes and the collection / analysis of soil samples for relevant Contaminants of Potential Concern (CoPCs). ■ ERM notes that based on a review of information presented within RPS 2017 no sample locations were within the proposed RLC footprint. Desktop information presented within RPS 2017 indicated that the following 3 sites located within the PSI investigation area (but outside the RLD footprint) were recorded within the ACT EPA contaminated land database: ■ Acton Section 22/23 - Authorisation Agreement for acceptance of soil on land associated with construction of a boardwalk. The volume of material imported is noted as being greater than 100 m^3. The source of this material is unknown. ■ 20-22 London Circuit - Contaminated Sites Database suggests history of hydrocarbon storage. ■ 25 London Circuit - Contaminated Sites Database suggests history of hydrocarbon storage. While ERM notes that no samples were collected from the RLC footrprint, results of the limited field investigation indicated that all areas with exception of TP63 (located on a triangular mound between Capital and State Circuits bounded by the on and off ramps for Canberra Avenue) were suitable for use as part of the proposed alignment of Stage 2 of the Canberra Light Rail. Testpit TP63 contained small fragments of asbestos containing material in surface soil. RPS advised that interim waste classification of soils from in the vicinity of these sampling locations indicated that excavated soils would be classified as solid or industrial waste.

ERM 2019	ERM was engaged by MPC to undertake a PSI at the site identified as proposed Canberra Light Rail Stage 2A alignment (including RLC), Canberra, ACT (the Site). The objective of these works was to undertake a PSI that refined the understanding of the site and to aid MPC in assessing potential liabilities associated with site contamination that may require consideration during future development works. Based on information reviewed as part of the PSI, ERM noted that there may be a potential risk to human health / ecological receptors during construction due to the following potentially complete pollutant linkages identified at the site: ■ Disturbance of potential uncontrolled fill materials associated with historical land uses or construction of the existing road ways; and ■ Disturbance of potential contamination associated with former building structures located within the “clover leaf” portion of the Site. The PSI concluded that whilst the risk of harm to human health / ecological receptors was generally low, the completion of a targeted Detailed Site Investigation (DSI) would quantitatively assess the potential for soil contamination to be present that may require management / remediation to facilitate development of the Stage 2A Light Rail alignment.
AECOM 2020	AECOM was engaged by Canberra Metro Construction (CMC) to undertake a Targeted Detailed Site Investigation (T-DSI) of the proposed southern extension of the stage 2A portion of the Canberra Light Rail project. The T-DSI was undertaken to assess potential CoPCs within soil samples and assess the suitability of soils for onsite re-use or offsite disposal. A review of information within the AECOM report indicated that a total of approximately 24 samples locations were within the RLC footprint Laboratory analysis of collected samples indicated that: ■ All samples met the NEPM HIL-D criteria with the exception of one sample within the RLC footprint which exceeded the adopted criteria for benzo[a]pyrene toxicity equivalent quotient (B[a]P TEQ); ■ A total of five samples located within the RLC footprint exceeded the solid waste criteria and 4 exceeded industrial waste criteria due to elevated polycyclic aromatic hydrocarbons (PAHs). ERM notes that no leachate analysis (ASLP / TCLP) appears to have been undertaken.. ■ Three samples within the RLC footprint exceeded the beneficial re-use criteria due to elevated Total Recoverable Hydrocarbons (TRH) in the C10 – C36 fraction; and ■ Three samples exceeded the ACT Beneficial Reuse criteria due to elevated chromium and two samples due to elevated Nickel.


HC90
OT208
HC186
HC92
OT226
HC88
HC187
HC87
HC86
HC85
HC84
OT189
Legend
RLC Boundary
Cadastre (Block)
Chemical storage
Dry cleaning chemicals TCE, PCE etc
Chemical storage
Dry cleaning chemicals TCE, PCE etc
USTs
Abandoned
N/A
Landfills:
Uncontrolled Fill
Potential Uncontrolled Fill
USTs/ASTs
Existing Groundwater Monitoring Well
Data Source:
ACTMapi (c) ACT Government 2019
Nearmap Imagery May 2021
Privileged and Confidential
Areas of Environmental Concern (AECs) and Investigation Locations
F3
Drawing No: 0527116s_RLC_G004_R0.mxd
Date: 01/09/2021
Drawing Size: A4
Drawn By: GC
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0 50 100 150m
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CONCEPTUAL SITE MODEL

Potential Sources of Contamination

Based on the site history and background data reviewed and ERMs professional experience, the Contaminants of Potential Concern (CoPC) associated with current and historical land uses undertaken in the general area are considered to include the following:

Table 10: Potential Sources of Contamination

Potential Source	CoPC	Comment
Uncontrolled fill	■ Asbestos, total recoverable hydrocarbons (TRH); benzene, toluene, ethylbenzene and xylenes (BTEX); semi-volatile organic compounds (SVOCs), Volatile Organic Compounds (VOCs), heavy metals, polycyclic aromatic hydrocarbons (PAHs), phenols, OCP / OPP	■ Potential for uncontrolled fill materials to have been imported to the site for raising various portions of the Site such as the “Clover Leaves” and Commonwealth Avenue.
Current and historical onsite and surrounding land uses	■ Trichloroethylene (TCE), tetrachloroethene (PCE), Asbestos, total recoverable hydrocarbons (TRH); benzene, toluene, ethylbenzene and xylenes (BTEX); semi-volatile organic compounds (SVOCs), Volatile Organic Compounds (VOCs), heavy metals, polycyclic aromatic hydrocarbons (PAHs), phenols, OCP / OPP	■ Fuel / chemical storage infrastructure located within adjacent building structures within London Circuit. ■ Dry cleaning chemicals used within adjacent sites located within University Avenue. ■ Leaks and spills from vehicles on roadways and adjacent car parking areas. ■ Pesticides / herbicides and other products used within adjacent recreational parklands and former agricultural land-uses. ■ Potential building waste from demolition of former building structures located within the Site and adjacent area. ■ Potential for asbestos / hazardous materials within onsite service pits / conduits

Potential Pathways

The primary potential exposure pathways of concern at the site are:

- Inhalation of vapour (from soil and/or groundwater) and contaminated dust (from soils);
- Dermal contact and / or incidental ingestion with contaminated surface water and soils / sediments;
- Transport of contamination through surface water flows;
- Transport of contamination to underlying groundwater aquifers; and
- Transport of contaminants via mechanical transport / windblown dust.

Potential Receptors

Key receptors have been identified as:

- Current site users (commercial / industrial);
- Future site users (commercial / industrial);
- Potential future users of groundwater;
- Workers carrying out installation or maintenance works within the site;
- Groundwater beneath the site; and
- Adjacent sensitive receptors e.g. adjacent residents, sensitive ecological receptors (e.g. Golden Sun Moth (GSM) habitat) and surface water bodies.

Preliminary Conceptual Site Model

Based on the results of the desktop assessment and review of previous investigations and the potential sources, pathways and receptors identified above ERM developed the below Preliminary Conceptual Site Model (CSM).

Table 11: Preliminary Conceptual Site Model

Potential Sources	Pathways	Potential Receptors	Comment
Uncontrolled fill	Dermal contact and / or incidental ingestion with contaminated surface waters / soils.	■ Current and future site users; and ■ Workers carrying out development, installation or maintenance works within the site.	■ ERM notes that based on results of the desktop review, former building structures were identified within the Clover Leaf portion of the site. It is the opinion of ERM that fill materials within this portion of the Site may pose a risk to human health during construction of RLC if not appropriately managed. ■ PAH and heavy metals exceeding adopted ACT EPA beneficial reuse and inert waste criteria were located within the southern and western portion of the Site. ERM notes that further assessment of these areas may be required to assess the extent of potential exceedances that may require consideration during construction including further assessment of potential leachability of identified exceedances. ■ Based on a review of desktop information the Site has been present since at least the 1950's. In addition London Circuit is generally at the same level as the surrounding area indicating that it has not been subject to significant filling. It is therefore considered that the risk of contamination from significant uncontrolled fill materials underlying this portion of the site is low.
	Transport of contamination through surface water flows.	■ Adjacent sensitive receptors; ■ Current and future site users; and ■ Workers carrying out development, installation or maintenance works within the site.	■ Results of desktop searches and analysis of samples collected by AECOM during previous investigations indicate that Potential contamination within the Site is likely to be limited to imported fill materials. ■ While the site in its current form is likely to pose a low risk of harm to surrounding receptors from surface water flows, where construction works re undertaken, all works should be undertaken in accordance with an approved CEMP to mitigate the risk of potential surface water migration of impacted water/ sediment.
	Transport of contamination to underlying groundwater aquifers	■ Adjacent sensitive receptors; and ■ Future potential users of groundwater.	■ A review of potential CoPCs indicates a low risk of harm to underlying groundwater aquifers from potential contamination within the Site. ■ Contact with potentially contaminated groundwater is considered a low risk due to the depth to groundwater (i.e. low risk of contact during construction) and the low likelihood of groundwater being beneficially re-used.

Potential Sources	Pathways	Potential Receptors	Comment
	Transport of contaminants through mechanical transport	■ Workers carrying out development, installation or maintenance works within the site.	■ ERM notes that based on results of the desktop review, potential importation of uncontrolled fill for raising the site within the “Clover Leaves” and elevated portions of Commonwealth Avenue may have occurred. Fill materials located within this portion of the Site may pose a risk to human health if disturbed during construction and not appropriately managed. ■ Potential contamination within the Site is largely associated with potentially impacted fill materials. During all construction works within the Site a construction environmental management plan and unexpected finds plan will be required to manage the potential for contaminated fill.
Current and historical onsite and surrounding land uses	Dermal contact and / or incidental ingestion with contaminated surface waters / soils.	■ Current and future site users; and ■ Workers carrying out development, installation or maintenance works within the site.	■ ERM notes that based on results of the desktop review, former building structures were identified within the Clover Leaf portion of the site. It is considered that fill materials within this portion of the Site may pose a risk to human health during construction of RLC if not appropriately managed. ■ PAH and heavy metals exceeding adopted ACT EPA beneficial reuse and Inert Waste criteria were located within the southern and western portion of the Site. ERM notes that further assessment of these areas may be required to assess the extent of potential exceedances that may require consideration during construction including further assessment of potential leachability of identified exceedances. ■ Based on a review of desktop information the Site has been present since at least the 1950’s. In addition London Circuit is generally at the same level as the surrounding area indicating that it has not been subject to significant filling. It is therefore considered that the risk of contamination from significant uncontrolled fill materials underlying this portion of the site is low.
	Transport of contamination through surface water flows.	■ Adjacent sensitive receptors; ■ Current and future site users; and ■ Workers carrying out development, installation or maintenance works within the site.	■ ERM notes that based on results of the desktop review, potential importation of uncontrolled fill for raising the site within the “Clover Leaves” and elevated portions of Commonwealth Avenue may have occurred. Fill materials located within this portion of the Site may pose a risk to human health if disturbed during construction and not appropriately managed. ■ While the site in its current form is likely to pose a low risk of harm to surrounding receptors from surface water flows, where construction works re undertaken, all works should be undertaken in accordance with an approved CEMP to mitigate the risk of potential surface water migration of impacted water/ sediment.

Potential Sources	Pathways	Potential Receptors	Comment
	Transport of contamination to underlying groundwater aquifers	■ Adjacent sensitive receptors; and ■ Future potential on-site users of groundwater.	■ Potential contamination arising from identified fuel / chemical (dry cleaning) storage infrastructure located on adjacent sites within London Circuit and University Avenue is, if present, is likely to migrate via underlying groundwater aquifers. While ERM notes that no contamination has been identified from offsite sources, where present it is unlikely that construction would intercept groundwater and as such the risk to the project is considered to be low. ■ A review of potential CoPCs indicates a ow risk of harm to underlying groundwater aquifers from potential contamination within the Site. ■ Contact with potentially contaminated groundwater is considered low due to the depth of groundwater (i.e. low risk of contact during construction) and the low likelihood of groundwater being beneficially re-used. ■ Based on the depth to groundwater and the low likelihood of beneficial uses of groundwater during construction, it is considered that the risk of contamination from fuel storage infrastructure located on London Circuit is low. ■ The risk of groundwater contamination from other surrounding land uses is generally considered to be low. In addition, contact with potentially contaminated groundwater is considered low due to the low likelihood of groundwater being beneficially re-used and the depth of groundwater.
	Transport of contaminants through mechanical transport	■ Workers carrying out development, installation or maintenance works within the site.	■ ERM notes that based on results of the desktop review, potential importation of uncontrolled fill for raising the site within the “Clover Leaves” and elevated portions of Commonwealth Avenue may have occurred. Fill materials located within this portion of the Site may pose a risk to human health if disturbed during construction and not appropriately managed. ■ Potential contamination within the Site is largely associated with potentially impacted fill materials. During all construction works within the Site a construction environmental management plan and unexpected finds plan will be required to manage the potential for contaminated fill.

RISK FRAMEWORK

To assess the potential risk to construction from potential contamination within the Site, ERM utilised the risk framework adopted within the AECOM Environmental Assessment detailed below:

Table 12: Risk Likelihood Descriptors

Likelihood	Description
Remote	Extremely rare/unprecedented
Unlikely	Not expected to occur in most circumstances
Possible	Could occur
Likely	Probably would occur
Almost Certain	Expected to occur

Table 13: Risk Consequence Descriptors

Consequence	Environment	Economic	Social
Insignificant	■ No environmental damage.	■ Minimal losses	■ No noticeable change experienced by people in the locality
Minor	■ Minor instances of environmental damage that could be reversed. I.e. negative impact on a specific species.	■ Several thousand dollars lost revenue or remediation costs	■ Mild deterioration, for a reasonably short time, for a small number of people who are generally adaptable and not vulnerable
Moderate	■ Isolated but significant instances of environmental damage that might be reversed with intense efforts.	■ Half million dollars lost revenue or remediation costs	■ Noticeable deterioration to something that people value highly, either lasting for an extensive time, or affecting a group of people
Major	■ Severe loss of environmental amenities and a danger of continuing	■ One million dollars lost revenue or remediation costs	■ Substantial deterioration to something that people value highly, either lasting for an indefinite time, or affecting many people in a widespread area
Catastrophic	■ Major widespread loss of environmental amenity and progressive irrecoverable environmental damage.	■ Several million dollars in lost revenue or remediation costs	■ Substantial change experienced in community wellbeing, livelihood, amenity, infrastructure, services, health, and/or heritage values; permanent displacement or addition of at least 20% of a community

Table 14: Risk Matrix

Likelihood	Consequence				
	Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost Certain	**Medium**	**High**	**Very High**	**Significant**	**Significant**
Likely	**Low**	**Medium**	**High**	**Very High**	**Significant**
Possible	**Very Low**	**Low**	**Medium**	**High**	**Very High**
Unlikely	**Negligible**	**Very Low**	**Low**	**Medium**	**High**
Rare	**Negligible**	**Negligible**	**Very Low**	**Low**	**Medium**

Qualitative Evaluation of Environmental Risk – Pre Risk Mitigation

Based on information reviewed as part of this assessment, it is considered that the Site in its current form is unlikely to pose a significant risk of harm to human health or ecological receptors.

Specific risks relating to construction activities associated with the RLC project are detailed within the table below:

Table 15: Qualitative Evaluation of Environmental Risk (Pre Risk Mitigation)

Project Construction Phase	Construction Requirement	Potential Risk	Comment	Likelihood	Consequence	Risk Rating (Prior to Risk Mitigations)
Phase 1 – Enabling Works Utilities	Service Relocation	■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Low risk of encountering groundwater during works ■ Potential ACM service pits and conduits present within the Site. ■ ERM notes that the location of services and conduits is understood and relocation can be undertaken in a controlled manner minimising the risk to surrounding receptors and potential cross contamination of surrounding soil.	Almost Certain	Minor	High
Phase 2 – Enabling Works RLC-	Constructing a mass fill embankment along London Circuit together with civil construction activities to achieve an at-grade intersection	■ Risk of importing unsuitable fill materials ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Low risk of encountering groundwater during works ■ Potential for uncontrolled fill materials to be encountered during excavation works. ■ Imported fill materials will require strict controls to ensure suitability for use within the Site. This will also include Site Auditor and EPA approvals. Where materials are brought to site that have not been appropriately screened, materials may require assessment onsite or removal from site resulting in delays to project and potential limitations due to excess stockpiles of soils. ■ Bituminous subgrade may require assessment / disposal / treatment ■ Materials requiring offsite disposal may require further assessment for waste classification ■ Potential for asbestos to be present in fill that requires onsite management plans to be implemented including dust suppression / air monitoring.	Likely	Moderate	High
	Removal of trees and stripping of topsoil and installation of stormwater drainage	■ Potential contamination within surrounding fill materials	■ Potential for uncontrolled fill materials to be encountered during excavation works.	Possible	Moderate	Medium
	Structural works including constructing retaining walls to support the new fill embankment, installation of new utilities, road pavements, kerb & gutter, hard landscaping, soft landscaping, traffic signals, signs and lines and finishing works	■ Risk of hazardous materials within former structures ■ Risk of importing unsuitable fill materials ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Imported fill materials will require strict controls to ensure suitability for use within the Site. This will also include Site Auditor and EPA approvals. Where materials are brought to site that have not been appropriately screened, materials may require assessment onsite or removal from site resulting in delays to project and potential limitations due to excess stockpiles of soils.	Possible	Moderate	Medium

Project Construction Phase	Construction Requirement	Potential Risk	Comment	Likelihood	Consequence	Risk Rating (Prior to Risk Mitigations)
	North West Clover Leaf: demolishing the Commonwealth Avenue to London Circuit Eastbound Loop road and reinstating the area to match existing landscaping	■ Risk of importing unsuitable fill materials ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Low risk of encountering groundwater during works ■ Potential for hazardous materials in construction materials may require consideration during demolition of any existing structures to prevent cross contamination ■ Potential for uncontrolled fill materials to be encountered during excavation works. ■ Imported fill materials will require strict controls to ensure suitability for use within the Site. This will also include Site Auditor and EPA approvals. Where materials are brought to the Site that have not been appropriately screened, materials may require assessment onsite or removal from site resulting in delays to project and potential limitations due to excess stockpiles of soils. ■ Materials requiring offsite disposal may require further assessment for waste classification ■ Potential for asbestos to be present in fill that requires onsite management plans to be implemented including dust suppression / air monitoring	Likely	Moderate	High
	South West Clover Leaf: demolishing the Commonwealth Avenue to Parkes way eastbound loop road, as well as the Commonwealth Avenue to London Circuit west loop road, and reinstating the area to match existing landscaping	■ Risk of importing unsuitable fill materials ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Potential for uncontrolled fill materials to be encountered during excavation works. ■ Potential for hazardous materials in construction materials may require consideration during demolition of any existing structures to prevent cross contamination ■ Imported fill materials will require strict controls to ensure suitability for use within the Site. This will also include Site Auditor and EPA approvals. Where materials are brought to site that have not been appropriately screened, materials may require assessment onsite or removal from site resulting in delays to project and potential limitations due to excess stockpiles of soils. ■ Materials requiring offsite disposal may require further assessment for waste classification ■ Potential for asbestos to be present in fill that requires onsite management plans to be implemented including dust suppression / air monitoring	Likely	Moderate	High
	South East Clover Leaf: demolishing the London Circuit westbound off ramp to commonwealth Avenue and reinstating to match existing landscaping. The Parkes way off ramp onto Commonwealth Avenue southbound will be maintained with the addition of kerb and gutter upgrades and re-sheeting the road.	■ Risk of hazardous materials within former structures ■ Risk of importing unsuitable fill materials ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Potential for uncontrolled fill materials to be encountered during excavation works. ■ Potential for hazardous materials in construction materials may require consideration during demolition of any existing structures to prevent cross contamination ■ Imported fill materials will require strict controls to ensure suitability for use within the Site. This will also include Site Auditor and EPA approvals. Where materials are brought to site that have not been appropriately screened, materials may require assessment onsite or removal from site resulting in delays to project and potential limitations due to excess stockpiles of soils. ■ Materials requiring offsite disposal may require further assessment for waste classification and receipt at a suitably licensed receiving facility ■ Potential for asbestos to be present in fill that requires onsite management plans to be implemented including dust suppression / air monitoring.	Likely	Moderate	High
Phase 3	Involves the removal of Commonwealth Avenue southbound bridge which will be the first activity undertaken in this phase	■ Risk of hazardous materials within former structures ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Potential for hazardous materials including ACM in construction materials may require consideration during demolition of any existing structures to prevent cross contamination ■ Potential for uncontrolled fill materials to be encountered during excavation works of footings and soils materials associated with structure ■ Imported fill materials will require strict controls to ensure suitability for use within the Site. This will also include Site Auditor and EPA approvals. Where materials are brought to site that have not been appropriately screened, materials may require assessment onsite or removal from site resulting in delays to project and potential limitations due to excess stockpiles of soils.	Likely	Moderate	High

Project Construction Phase	Construction Requirement	Potential Risk	Comment	Likelihood	Consequence	Risk Rating (Prior to Risk Mitigations)
	Removal of side track, bulk fill installation, installation of stormwater drainage, installation of new utilities, road pavements, kerb & gutter, hard landscaping, soft landscaping, traffic signals, signs and lines and finishing works.	■ Risk of importing unsuitable fill materials ■ Risk of hazardous materials within former structures ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Potential for hazardous materials in construction materials may require consideration during demolition of any existing structures to prevent cross contamination ■ Potential for uncontrolled fill materials to be encountered during excavation works of footings and soils materials associated with structure ■ Materials requiring offsite disposal may require further assessment for waste classification ■ Imported fill materials will require strict controls to ensure suitability for use within the Site. This will also include Site Auditor and EPA approvals. Where materials are brought to site that have not been appropriately screened, materials may require assessment onsite or removal from site resulting in delays to project and potential limitations due to excess stockpiles of soils.	Likely	Moderate	High
Phase 4	Removal of Commonwealth Avenue northbound bridge	■ Risk of hazardous materials within former structures ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Potential for hazardous materials (asbestos conduits etc) in construction materials may require consideration during demolition of any existing structures to prevent cross contamination ■ Potential for uncontrolled fill materials to be encountered during excavation works of footings and soils materials associated with structure ■ ERM notes that the potential for encountering groundwater may require consideration during removal of certain deeper below ground structures. Such works will require management under a dewatering management plan or equivalent.	Likely	Moderate	High
	Bulk fill installation, installation of stormwater drainage, installation of new utilities, road pavements, kerb & gutter, hard landscaping, soft landscaping, traffic signals, signs and lines and finishing works	■ Risk of importing unsuitable fill materials	■ Imported fill materials will require strict controls to ensure suitability for use within the Site. This will also include Site Auditor and EPA approvals. Where materials are brought to site that have not been appropriately screened, materials may require assessment onsite or removal from site resulting in delays to project and potential limitations due to excess stockpiles of soils. ■ Potential for uncontrolled fill materials to be encountered during excavation works of footings and soils materials associated with structure ■ ERM notes that the potential for encountering groundwater may require consideration prior to installation of drainage structures. Such works will require management under a dewatering management plan or equivalent.	Likely	Moderate	High
Phase 5	Finalisation and completion works to be undertaken prior to achieving practical completion. Works include finalisation of soft landscaping, line marking, and final clean	■ Risk of importing unsuitable fill materials	■ Imported fill materials will require strict controls to ensure suitability for use within the Site. This will also include Site Auditor and EPA approvals. Where materials are brought to site that have not been appropriately screened, materials may require assessment onsite or removal from site resulting in delays to project and potential limitations due to excess stockpiles of soils.	Possible	Moderate	Medium

RISK MITIGATION APPROACH

Based on the risks identified within Section 8, ERM recommends the below risk mitigation measures be implemented prior to, during construction and post construction:

Table 16: Risk Mitigation Approach

Ref	Mitigation measure	Timing	Responsibility
C1	■ Development and implementation of sampling and analysis quality plan (SAQP) for further assessment of soils requiring offsite disposal including areas where temporary construction structures such as stormwater / sediment basis may require excavation	■ Pre-construction	■ MPC / ERM
C2	■ Development and implementation of sampling and analysis quality plan (SAQP) for further assessment of potential residual fill within the site that may require management post construction due to the presence of hazardous materials	■ Pre-construction	■ MPC / ERM
C3	■ Hazardous materials survey of bridge and other structures requiring demolition.	■ Pre-construction	■ MPC / ERM
C4	■ Where hazardous materials are identified, preparation of a hazardous materials management plan	■ Pre-construction	■ MPC / ERM
C5	■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. The document is to detail specific requirements for the importation of any material onto the site including environmental properties, tracking requirements, reporting / record keeping requirements. ■ It is noted that this document and the requirements detailed within, will form a key part of the final requirements for EPA and Auditor sign off of the site	■ Pre-construction	■ MPC / ERM
C6	■ Development of a materials tracking methodology for all offsite disposal and imported fill materials. It is noted that this document and the requirements detailed within, will form a key part of the final requirements for auditor sign off on the site	■ Pre-construction	■ MPC / ERM
C7	■ Development of a detailed Unexpected Finds Protocol that outlines the roles and responsibilities where unexpected finds of potential contamination are identified during any works within the Site	■ Pre-construction	■ MPC / ERM
C8	■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials, surface water management etc.	■ Pre-construction	■ MPC and Construction Company
C9	■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.)	■ Construction	■ MPC / ERM and Construction Company

C10	■ Where residual contamination is present following completion of works, preparation of a Long term EMP outlining roles / responsibilities for management of any residual contamination (ACM etc.)	■ Post-construction	■ MPC
C11	■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works. The validation report will form a key part of the final requirements for EPA and auditor sign off of the site	■ Post-construction	■ MPC / ERM
C11	■ Preparation of a Site Audit Statement / Site Audit Report and ACT EPA approval of all reports. ERM notes that this is required as the final stage in attaining project completion from EPA.	■ Post-construction	■ MPC / Site Auditor

QUALITATIVE EVALUATION OF ENVIRONMENTAL RISK – POST RISK MITIGATION (RESIDUAL RISK)

Table 17: Qualitative Evaluation of Environmental Risk (Residual Risk)

Project Construction Phase	Construction Requirement	Potential Risk	Implemented Risk Mitigation Approach	Likelihood	Consequence	Risk Rating (Post implementation of Risk Mitigations)
Phase 1 – Enabling Works Utilities	Service Relocation	■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ The location / extent of services and conduits is understood and relocation can be undertaken in a controlled manner minimising the risk to surrounding receptors and potential cross contamination of surrounding soil. ■ Preparation of a hazardous materials management plan. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low
Phase 2 – Enabling Works RLC-	Constructing a mass fill embankment along London Circuit together with civil construction activities to achieve an at-grade intersection	■ Risk of importing unsuitable fill materials ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Development and implementation of sampling and analysis quality plan (SAQP) for further assessment of potential residual fill within the site that may require management post construction due to the presence of hazardous materials ■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc. ■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.) ■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low
	Removal of trees and stripping of topsoil and installation of stormwater drainage	■ Potential contamination within surrounding fill materials	■ Development and implementation of sampling and analysis quality plan (SAQP) for further assessment of potential residual fill within the site that may require management post construction due to the presence of hazardous materials. ■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low
	Structural works including constructing retaining walls to support the new fill embankment, installation of new utilities, road pavements, kerb & gutter, hard landscaping, soft landscaping, traffic signals, signs and lines and finishing works	■ Risk of hazardous materials within former structures ■ Risk of importing unsuitable fill materials ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc. ■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.) ■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low

	North West Clover Leaf: demolishing the Commonwealth Avenue to London Circuit Eastbound Loop road and reinstating the area to match existing landscaping	■ Risk of importing unsuitable fill materials ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Development and implementation of sampling and analysis quality plan (SAQP) for further assessment of potential residual fill within the site that may require management post construction due to the presence of hazardous materials ■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc. ■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.) ■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low
	South West Clover Leaf: demolishing the Commonwealth Avenue to Parkes way eastbound loop road, as well as the Commonwealth Avenue to London Circuit west loop road, and reinstating the area to match existing landscaping	■ Risk of importing unsuitable fill materials ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Development and implementation of sampling and analysis quality plan (SAQP) for further assessment of potential residual fill within the site that may require management post construction due to the presence of hazardous materials ■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc. ■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.) ■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low
	South East Clover Leaf: demolishing the London Circuit westbound off ramp to commonwealth Avenue and reinstating to match existing landscaping. The Parkes way off ramp onto Commonwealth Avenue southbound will be maintained with the addition of kerb and gutter upgrades and re-sheeting the road.	■ Risk of hazardous materials within former structures ■ Risk of importing unsuitable fill materials ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Development and implementation of sampling and analysis quality plan (SAQP) for further assessment of potential residual fill within the site that may require management post construction due to the presence of hazardous materials ■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc. ■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.) ■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low

Phase 3	The removal of Commonwealth Avenue southbound bridge	■ Risk of hazardous materials within former structures ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Preparation of a hazardous materials management plan. ■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc. ■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.) ■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low
	Removal of side track, bulk fill installation, installation of stormwater drainage, installation of new utilities, road pavements, kerb & gutter, hard landscaping, soft landscaping, traffic signals, signs and lines and finishing works.	■ Risk of importing unsuitable fill materials ■ Risk of hazardous materials within former structures ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Preparation of a hazardous materials management plan. ■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc. ■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.) ■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low
Phase 4	Removal of Commonwealth Avenue northbound bridge	■ Risk of hazardous materials within former structures ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc. ■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.) ■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low
	Bulk fill installation, installation of stormwater drainage, installation of new utilities, road pavements, kerb & gutter, hard landscaping, soft landscaping, traffic signals, signs and lines and finishing works	■ Risk of importing unsuitable fill materials	■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc. ■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.) ■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low

Phase 5	Finalisation and completion works to be undertaken prior to achieving practical completion. Works include finalisation of soft landscaping, line marking, and final clean	■ Risk of importing unsuitable fill materials	■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc. ■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.) ■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low

Project Construction Phase	Construction Requirement	Potential Risk	Implemented Risk Mitigation Approach	Likelihood	Consequence	Risk Rating (Post implementation of Risk Mitigations)
Phase 1 – Enabling Works Utilities	Service Relocation	■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ The location / extent of services and conduits is understood and relocation can be undertaken in a controlled manner minimising the risk to surrounding receptors and potential cross contamination of surrounding soil. ■ Preparation of a hazardous materials management plan. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low
Phase 2 – Enabling Works RLC-	Constructing a mass fill embankment along London Circuit together with civil construction activities to achieve an at-grade intersection	■ Risk of importing unsuitable fill materials ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Development and implementation of sampling and analysis quality plan (SAQP) for further assessment of potential residual fill within the site that may require management post construction due to the presence of hazardous materials ■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc. ■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.) ■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low
	Removal of trees and stripping of topsoil and installation of stormwater drainage	■ Potential contamination within surrounding fill materials	■ Development and implementation of sampling and analysis quality plan (SAQP) for further assessment of potential residual fill within the site that may require management post construction due to the presence of hazardous materials. ■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low
	Structural works including constructing retaining walls to support the new fill embankment, installation of new utilities, road pavements, kerb & gutter, hard landscaping, soft landscaping, traffic signals, signs and lines and finishing works	■ Risk of hazardous materials within former structures ■ Risk of importing unsuitable fill materials ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc. ■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.) ■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low
	North West Clover Leaf: demolishing the Commonwealth Avenue to London Circuit Eastbound Loop road and reinstating the area to match existing landscaping	■ Risk of importing unsuitable fill materials	■ Development and implementation of sampling and analysis quality plan (SAQP) for further assessment of potential residual fill within the site that may require management post construction due to the presence of hazardous materials	Unlikely	Minor	Very Low

		■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc. ■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.) ■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.			
	South West Clover Leaf: demolishing the Commonwealth Avenue to Parkes way eastbound loop road, as well as the Commonwealth Avenue to London Circuit west loop road, and reinstating the area to match existing landscaping	■ Risk of importing unsuitable fill materials ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Development and implementation of sampling and analysis quality plan (SAQP) for further assessment of potential residual fill within the site that may require management post construction due to the presence of hazardous materials ■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc. ■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.) ■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low
	South East Clover Leaf: demolishing the London Circuit westbound off ramp to commonwealth Avenue and reinstating to match existing landscaping. The Parkes way off ramp onto Commonwealth Avenue southbound will be maintained with the addition of kerb and gutter upgrades and re-sheeting the road.	■ Risk of hazardous materials within former structures ■ Risk of importing unsuitable fill materials ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Development and implementation of sampling and analysis quality plan (SAQP) for further assessment of potential residual fill within the site that may require management post construction due to the presence of hazardous materials ■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc. ■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.) ■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low

Phase 3	The removal of Commonwealth Avenue southbound bridge	■ Risk of hazardous materials within former structures ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Preparation of a hazardous materials management plan. ■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc. ■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.) ■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low
	Removal of side track, bulk fill installation, installation of stormwater drainage, installation of new utilities, road pavements, kerb & gutter, hard landscaping, soft landscaping, traffic signals, signs and lines and finishing works.	■ Risk of importing unsuitable fill materials ■ Risk of hazardous materials within former structures ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Preparation of a hazardous materials management plan. ■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc. ■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.) ■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low
Phase 4	Removal of Commonwealth Avenue northbound bridge	■ Risk of hazardous materials within former structures ■ Potential ACM service pits and conduits present within the Site. ■ Potential contamination within surrounding fill materials	■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc. ■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.) ■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low
	Bulk fill installation, installation of stormwater drainage, installation of new utilities, road pavements, kerb & gutter, hard landscaping, soft landscaping, traffic signals, signs and lines and finishing works	■ Risk of importing unsuitable fill materials	■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc. ■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.) ■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low

Phase 5	Finalisation and completion works to be undertaken prior to achieving practical completion. Works include finalisation of soft landscaping, line marking, and final clean	■ Risk of importing unsuitable fill materials	■ Development of a Construction Environmental Management Plan (CEMP) detailing requirements and responsibilities to mitigate potential risks of contamination arising during works from leaks / spills of construction equipment, cross contamination from materials etc. ■ Ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.) ■ Development of an imported fill material standard including requirements for re-use of onsite construction materials such as asphalt millings. ■ Post construction validation report detailing compliance with all approved plans / procedures implemented during works.	Unlikely	Minor	Very Low

CONCLUSIONS

A review of historical information indicates the potential for contamination to be present at the Site primarily associated with historical / uncontrolled filling (ACM) and potential residual soil contamination identified during previous waste classification assessment (heavy metals, PAH, TRH).

- While records indicate the potential for offsite sources of contamination that may have the potential to impact groundwater based on the nature of construction activities within the Site it is considered that there is a low potential for contaminated groundwater to pose a risk to current / future receptors during construction and ongoing use of the site.
- Where groundwater is to be utilised for beneficial re-use purposes or extracted and disposed during construction of RLC, assessment of groundwater conditions may be required to inform specific re-use / offsite disposal requirements.

Based on information reviewed as part of this assessment, ERM identified a number of potential risks to construction associated with potential contamination located within the Site. Identified risks are primarily associated with

- Hazardous materials within existing building structures / underground services; and
- Uncontrolled fill material containing elevated concentrations of various Contaminants of Potential Concern.

The site in its current / undisturbed form is unlikely to pose a risk of harm to identified human health and sensitive ecological receptors. ERM notes however, that where construction activities are undertaken within the Site that disturb sub-surface structures and / or on-site fill materials, the potential for risk to human health and sensitive ecological receptors will require consideration due to potential exposure to hazardous materials and potentially contaminated fill materials.

ERM considers that the identified potential risks from onsite contamination can be effectively managed prior to and during construction through the implementation of the following risk mitigations including:

- Development and Site Auditor / EPA endorsement of sampling plans for further assessment of soil conditions within the Site;
- undertaking additional investigations to assess the vertical / lateral extent of contamination within soils and the preparation and Site Auditor / EPA endorsement of investigation reports;
- the preparation, Site Auditor / EPA endorsement and implementation of unexpected finds / materials tracking plans; and
- the preparation Site Auditor / EPA endorsement and implementation of various environmental / construction management plans for implementation; and
- ongoing / routine compliance inspections and record keeping to be undertaken during construction works to assess compliance with CEMP and other approved plans (imported fill, unexpected finds etc.).

Following completion of construction activities, a validation report will be prepared documenting the successful completion of contamination management works undertaken during construction works and the suitability of the Site for the proposed land use.

The report will be reviewed / endorsed by the Site Auditor with subsequent site audit report / statements demonstrating completion of works and compliance with relevant environmental management requirements to be reviewed / endorsed by the ACT EPA.

Based on the information reviewed in relation to contamination as part of this EA, it is considered that the identified potential contamination within the RLC site can be effectively managed to mitigate the risk to potential receptors and enable the site to be suitable for the proposed ongoing land uses. It is therefore considered that pending implementation of the above risk mitigation approach, contamination poses a low risk to the overall RLC project.

APPENDIX A HISTORICAL AERIAL PHOTOGRAPHY

ATTACHMENT B

Historical Imagery

LIR-00892 Historical Aerial Photograph - 1951 08 10 2019. Data source: Please refer to 'Digital Data Sources' in the Product Guide

HISTORICAL AERIAL PHOTOGRAPH - 1951

LAND INSIGHT & RESOURCES

MAP 11

LIR-00892 Historical Aerial Photograph - 1955 08 10 2019. Data source: Please refer to 'Digital Data Sources' in the Product Guide

HISTORICAL AERIAL PHOTOGRAPH - 1955

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MAP 12

LIR-00892 Historical Aerial Photograph - 1961 08 10 2019. Data source: Please refer to 'Digital Data Sources' in the Product Guide

HISTORICAL AERIAL PHOTOGRAPH - 1961

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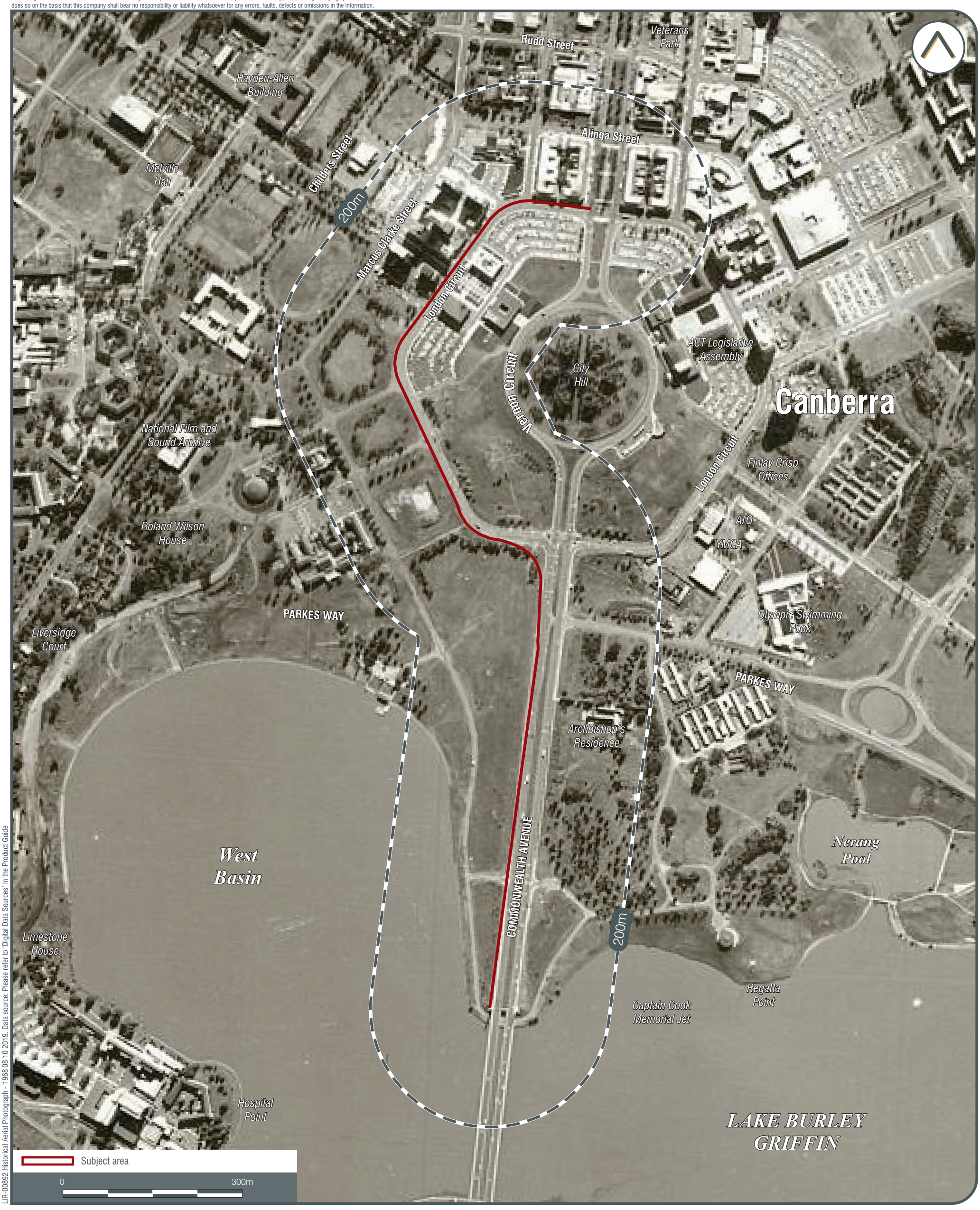
MAP 13



LIR-00892 Historical Aerial Photograph - 1968 08 10 2019. Data source: Please refer to 'Digital Data Sources' in the Product Guide

HISTORICAL AERIAL PHOTOGRAPH - 1968

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MAP 14

LIR-00892 Historical Aerial Photograph - 1975 08 10 2019. Data source: Please refer to 'Digital Data Sources' in the Product Guide

HISTORICAL AERIAL PHOTOGRAPH - 1975

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MAP 15

LIR-00892 Historical Aerial Photograph - 1978 08 10 2019. Data source: Please refer to 'Digital Data Sources' in the Product Guide

HISTORICAL AERIAL PHOTOGRAPH - 1978

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MAP 16

LIR-00892 Historical Aerial Photograph - 1980 08 10 2019. Data source: Please refer to 'Digital Data Sources' in the Product Guide

HISTORICAL AERIAL PHOTOGRAPH - 1980

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MAP 17

LIR-00892 Historical Aerial Photograph - 1986 08 10 2019. Data source: Please refer to 'Digital Data Sources' in the Product Guide

HISTORICAL AERIAL PHOTOGRAPH - 1986

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MAP 18

LIR-00892 Historical Aerial Photograph - 1993 08 10 2019. Data source: Please refer to 'Digital Data Sources' in the Product Guide

HISTORICAL AERIAL PHOTOGRAPH - 1993

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MAP 19

LIR-00892 Historical Aerial Photograph - 1998 08 10 2019. Data source: Please refer to 'Digital Data Sources' in the Product Guide

HISTORICAL AERIAL PHOTOGRAPH - 1998

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MAP 20

LIR-00892 Historical Aerial Photograph - 2008 08 10 2019. Data source: Please refer to 'Digital Data Sources' in the Product Guide

HISTORICAL AERIAL PHOTOGRAPH - 2008

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MAP 21

LIR-00892 Historical Aerial Photograph - 2010 08 10 2019. Data source: Please refer to 'Digital Data Sources' in the Product Guide

HISTORICAL AERIAL PHOTOGRAPH - 2010

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MAP 22

LIR-00892 Historical Aerial Photograph - 2013 08 10 2019. Data source: Please refer to 'Digital Data Sources' in the Product Guide

HISTORICAL AERIAL PHOTOGRAPH - 2013

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MAP 23

LIR-00892 Historical Aerial Photograph - 2016 08 10 2019. Data source: Please refer to 'Digital Data Sources' in the Product Guide

HISTORICAL AERIAL PHOTOGRAPH - 2016

LAND INSIGHT & RESOURCES

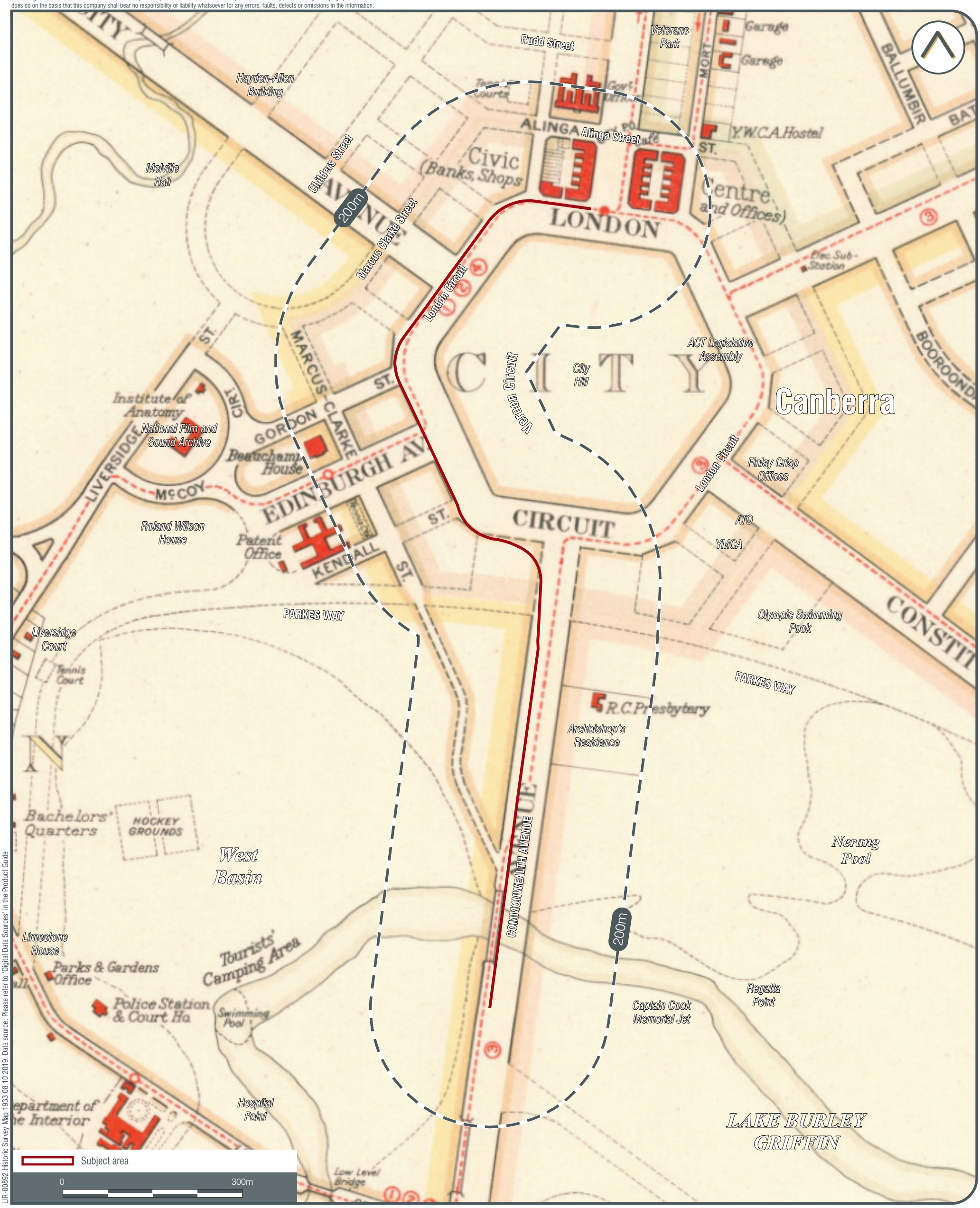
MAP 24

LIR-00892 Historical Aerial Photograph - 2019 08 10 2019, Data source: Please refer to 'Digital Data Sources' in the Product Guide

HISTORICAL AERIAL PHOTOGRAPH - 2019

LAND INSIGHT & RESOURCES

MAP 25



LIR-00892 Historic Survey Map 1933 08 10 2019. Data source: Please refer to 'Digital Data Sources' in the Product Guide

HISTORIC SURVEY MAP - 1933

LAND INSIGHT & RESOURCES

MAP 26

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