PARSONS BRINCKERHOFF

CAPITAL METRO
CANBERRA'S LIGHT RAIL PROJECT

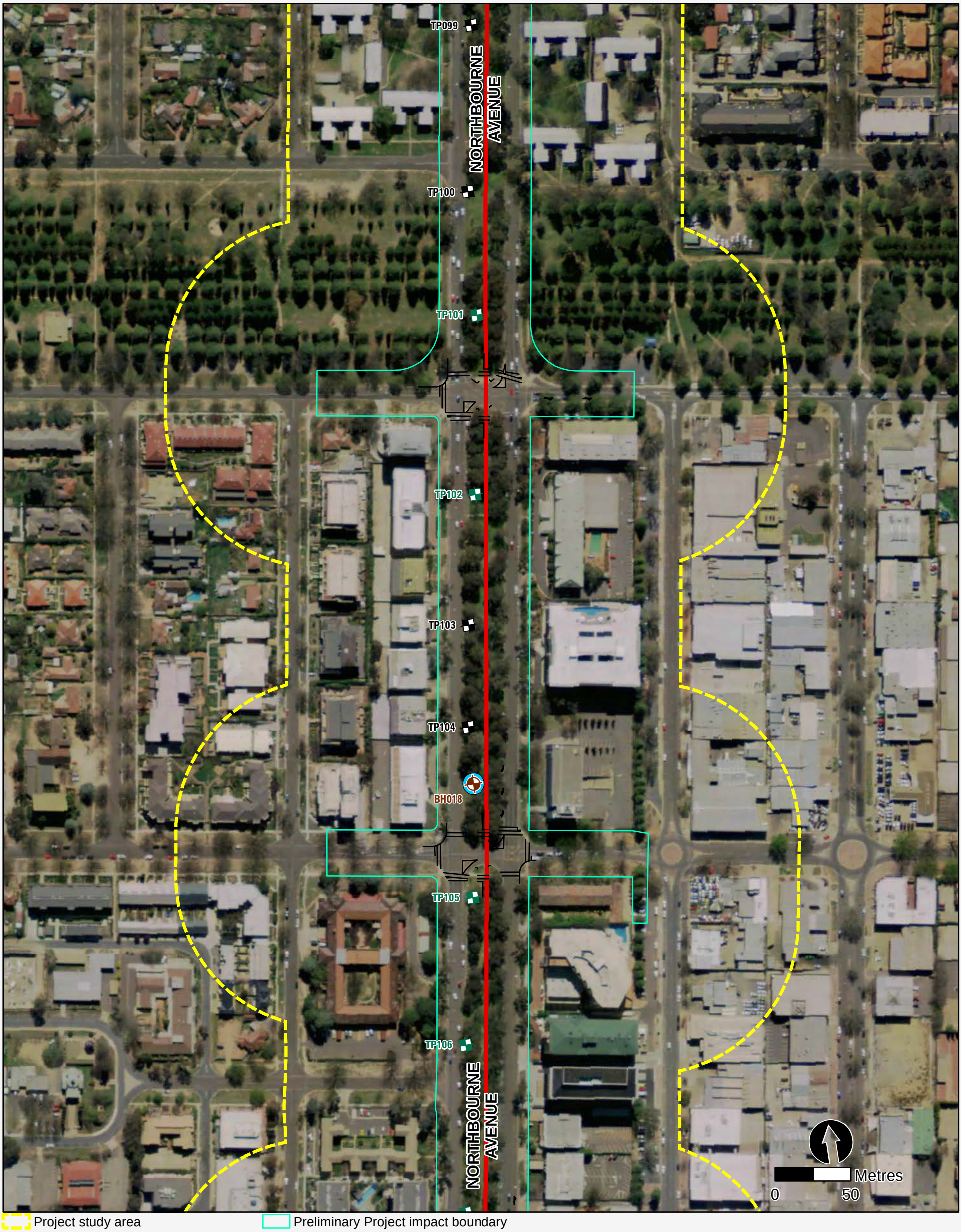
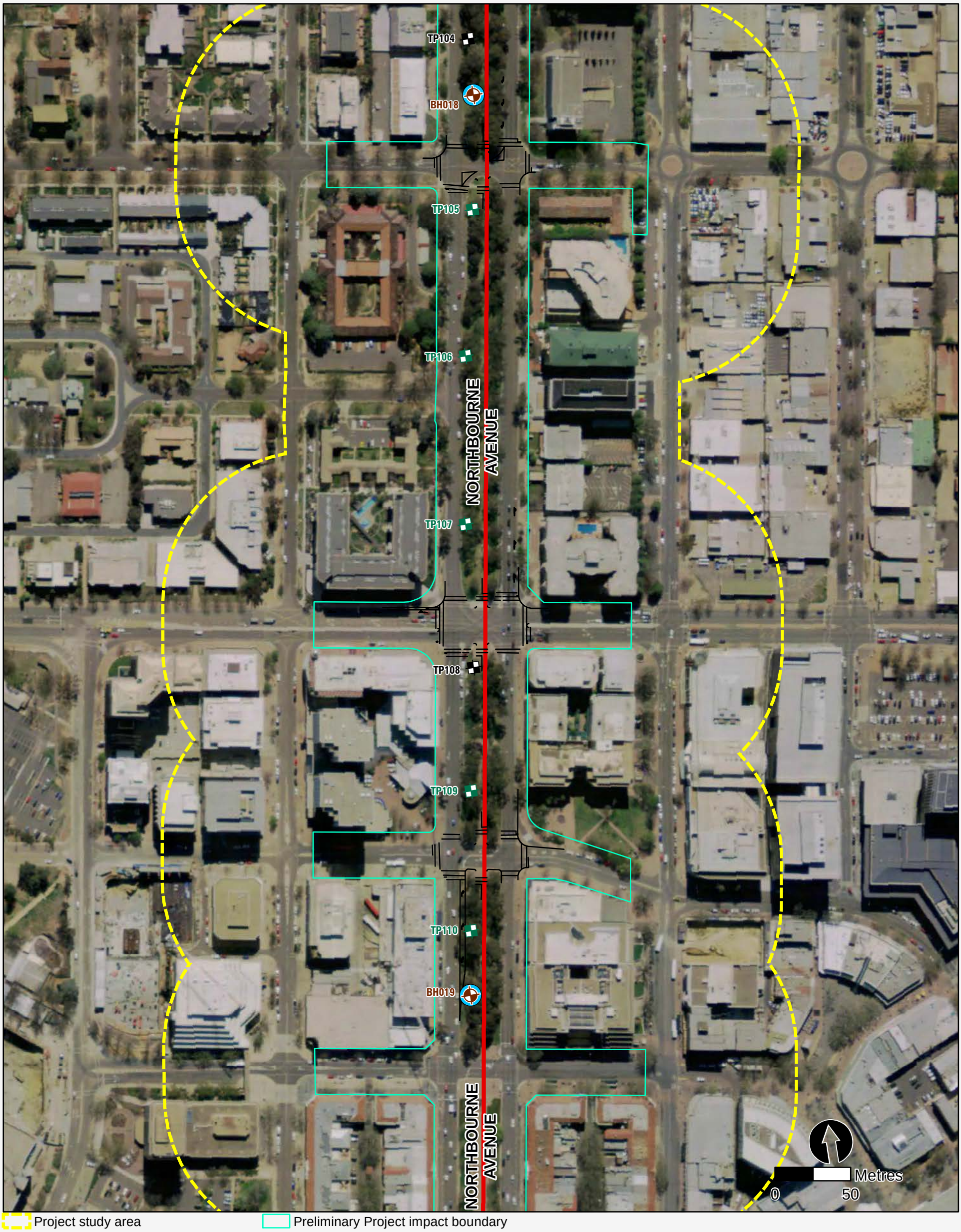


Figure 2 Sampling locations including test pit, borehole and piezometer locations
Map 25 of 27

\\Apsydfil03\proj\A\Arup\2207509A_Canberra_Light_Rail_TA\10_GIS\Projects\Maps\2207509A_GIS_025_A4.mxd // SafianK // 17/09/2014

PARSONS BRINCKERHOFF

CAPITAL METRO
CANBERRA'S LIGHT RAIL PROJECT



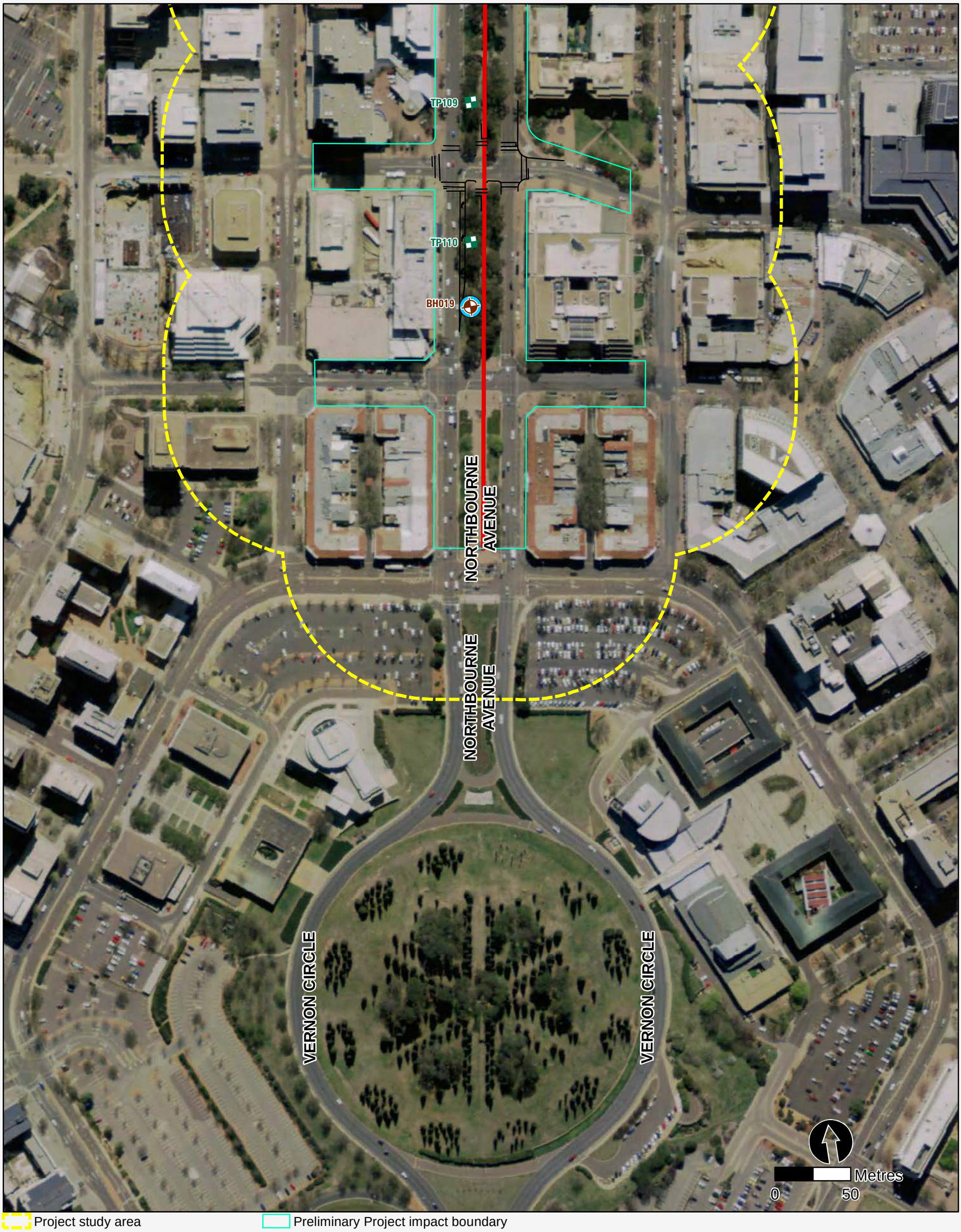
Project study area
Borehole
Borehole with environmental sampling
Piezometer location
Test pit
Test pit with environmental sampling
Preliminary Project impact boundary
Maintenance depot layout
Proposed road construction works
Existing transport corridor

Figure 2 Sampling locations including test pit, borehole and piezometer locations
Map 26 of 27

\\Apsydfil03\pro\AArup\2207509A_Canberra_Light_Rail_TA\10_GIS\Projects\Maps\2207509A_GIS_025_A4.mxd // SafliankK // 17/09/2014

PARSONS BRINCKERHOFF

CAPITAL METRO
CANBERRA'S LIGHT RAIL PROJECT



Project study area
Borehole
Borehole with environmental sampling
Piezometer location
Test pit
Test pit with environmental sampling
Preliminary Project impact boundary
Maintenance depot layout
Proposed road construction works
Existing transport corridor

Figure 2 Sampling locations including test pit, borehole and piezometer locations
Map 27 of 27

\\Apsydfil03\proj\A\Arup\2207509A_Canberra_Light_Rail_TA\10_GIS\Projects\Maps\2207509A_GIS_025_A4.mxd // SafliankK //17/09/2014

Capital Metro Agency

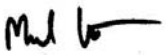
Capital Metro – Contamination Management Plan

27 March 2015

PARSONS BRINCKERHOFF

Document information
Client: Capital Metro Agency Title: Capital Metro – Contamination Management Plan Document No: 2207526A-CLM-RPT-001 RevC Date: 27 March 2015

Rev	Date	Details
A	03/03/2015	Final
B	03/03/2015	Final
C	27/03/2015	Final

Author, Reviewer and Approver details			
Prepared by:	Beejal Patel	Date: 27/03/2015	Signature: 
Reviewed by:	Michael Watson	Date: 27/03/2015	Signature:  pp
Approved by:	Alex McDonald	Date: 27/03/2015	Signature: 

Distribution
Capital Metro Agency, Parsons Brinckerhoff file, Parsons Brinckerhoff Library

Document owner
Parsons Brinckerhoff Australia Pty Limited *ABN 80 078 004 798* Level 27 Ernst & Young Centre 680 George Street Sydney NSW 2000 GPO Box 5394 Sydney NSW 2001 Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 www.pbworld.com *Certified to ISO 9001, ISO 14001, OHSAS 18001*

Contents

List of tables

List of appendices

Abbreviations

ACM	Asbestos-containing materials
ACT EPA	Australian Capital Territory Environment Protection Authority
ACS	Asbestos cement sheeting
ASS	Acid sulfate soils
AASS	Actual acid sulfate soils
BTEX	Benzene, toluene, ethylbenzene and xylene
CMP	Contamination management plan
ESA	Environmental site assessment
LOR	Laboratory limit of reporting
mBGL	Metres below ground level
OCPs	Organochlorine pesticides
OPPs	Organophosphate pesticides
PASS	Potential acid sulfate soils
ProjectCo	The entity who will be contracted by the Act Government to deliver the Project.
RAP	Remedial action plan
TRH	Total recoverable hydrocarbons
WHS	Work Health and Safety

1. Introduction

Parsons Brinckerhoff Australia Pty Ltd (Parsons Brinckerhoff) has been commissioned by the Capital Metro Authority (Capital Metro) to prepare a contamination management plan (CMP) for the proposed route of the ACT Light Rail Stage 1 – Civic to Gungahlin (the Project). The project footprint in presented in Figure 1 in Appendix A.

1.1 The project

The Project is anticipated to include the following key features:

- the construction of approximately 12 km of light rail track primarily within existing road corridors, with some land-take into adjacent properties possible
- approximately 13 stops including major transport interchanges at Gungahlin, Dickson and Civic
- a pedestrianised zone in Hibberson Street, Gungahlin
- overhead line equipment providing traction power and electrical substation facilities for the provision of power along the route
- potential impacts to existing bridge structures and construction of a new bridge
- a series of crossovers and turnback facilities
- the provision of new signals at existing unsignalised intersections
- passenger information systems at stops and on light rail vehicles (LRVs)
- a depot (stabling and maintenance) facility in Mitchell incorporating the control centre and the operator's management and administrative teams as well as operations and maintenance staff, the LRV maintenance building and stabling for the fleet of LRVs
- potential changes to existing utilities and new drainage infrastructure
- changes to some parking conditions along the route
- urban design and landscaping.

The location of the proposed light rail route is shown on Figure 1.

1.2 Area of assessment

The area of the assessment includes the section of Northbourne Avenue from London Circuit to the Federal Highway, a section of the Federal Highway to Flemington Road, Flemington Road to Hibberson Street and a section of Hibberson Street to the corner of Gungahlin Place West (the light rail route). The area of assessment also includes a portion of land to the north west of Flemington Road in Mitchell where the depot (stabling and maintenance) facilities are proposed to be developed.

1.3 The objectives

The objective of the CMP is to detail the measures required to manage potential contamination impacts identified in subsurface materials along the route, in a manner which protects human health and the local environment. The objective will be achieved by applying the identified controls for any work requiring disturbance of subsurface materials along the route or to ensure that these are undertaken in an environmentally responsible manner that protects the health of the workers and other users of the light rail. The Department of Infrastructure, Planning and Natural Resources, 2004, *Guideline for the Preparation of Environment Management Plans* was used as a base reference for this CMP.

1.4 Legislative requirements

Key legislation relevant to contaminated soil management is listed in Table 1.1 below. Legislation outlined below should be updated when changes occur.

Table 1.1 Key legislation and guidelines

Relevant key legislation and guidelines	Applicable to project
Environment Protection Act 1997 (republication date 12 November 2014)	Establishes a process for prevention of environmental degradation and risk of harm to human health and the management of contaminated land. Offences exist in relation to activities that cause water, soil and air pollution. This ACT also provides limitations associated with waste removal and reuse and the order to assess and remediate land.
Environmental Protection Regulation 2005	Provides an assessment of contaminants, likely to cause harm, sources and application, movement in the environment, risks associated with the affect contamination has on the environment and human health. This regulation also details the procedures and protocols required to sample waste and erosion and sediment control measures for development sites. Soil, water and air pollution associated with generation, handling and disposal of waste are controlled through this CMP.
Environment ACT 2000, *ACT's Environmental Standards: Assessment & Classification of Liquid and Non-liquid Wastes*	Defines types of wastes, procedures for assessing waste, waste storage and disposal requirements, record keeping and licence requirements. Applies to the handling, storage and disposal of contaminated materials, if uncovered during construction works.
Work Health and Safety Regulation 2011 (republication date 2 January 2015)	Provides for guidance for the application of the assessment of risks associated with health and safety associated with a hazard, task, thing, or circumstance. This regulation also provides risks associated with the disturbance of asbestos.
National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPM; amended 2013)	Provides adequate protection of human health and the environment, where site contamination has occurred, through the development of an efficient and effective approach to the assessment of site contamination.
Work Health and Safety (Asbestos) Amendment Regulation 2014	Delivers regulations applying to the removal of asbestos from premises and the controls applicable during the time of removal.
Dangerous Substances (Asbestos Safety Reform) Amendment Bill 2014	Applies to the handling of asbestos, only if the handling is not commercial handling.

Relevant key legislation and guidelines	Applicable to project
National Occupational Health and Safety Commission (NOHSC) 2005, *Code of Practise for the Safe Removal of Asbestos 2nd Edition*	Provides a framework for the safe removal of asbestos and asbestos contaminating materials (ACM) from buildings and structures, plant and equipment and vehicles.
Western Australian (WA) Department of Health (DOH) 2009, *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia*	Provides guidance for assessing and remediating asbestos impacted sites in order to minimise the risk to public health from the future use of the site.
Safe Work Australia 2011, *How to Safely Remove Asbestos: Code of Practice*	Provides guidance for the safe removal of ACM.
Acid Sulfate Soils Management Advisory Committee 1998, *Acid Sulfate Soils Assessment Guidelines*	Provides guidelines for the application of management practises in the planning, design and undertaking of activities that disturb acid sulfate soils.

1.5 Context of the CMP

The CMP has been prepared for application during the construction phase of the project and will be updated as necessary. The CMP has been prepared as a result of the environmental investigation previously conducted at the site, outlined in section 2.4. The CMP will serve under the larger Construction Environmental and Safety Management Plan (CEMP).

2. Site background

2.1 Site location and description

The proposed route passes through the Canberra central business district (CBD), past Braddon, Turner, Dickson, Lyneham, Downer, Mitchell, Franklin, Harrison and Gungahlin to the north. The total length of the route is approximately 12 kilometres (km).

The Northbourne Avenue and Federal Highway portion of the site is identified as a busy main road located at the centre of the Canberra CBD, comprising three southbound lanes and two northbound lanes and separated by a vegetated traffic island varying in width from 10 metres (m) to 30 m. The total width of Northbourne Avenue and the Federal Highway generally varied from 30 m to 40 m, with narrower sections at the northern portion of the Federal Highway.

The Flemington Road portion of the site was observed to be a main road travelling through northern Canberra suburbs including Lyneham, Mitchell, Franklin, Harrison and Gungahlin. Traffic flows in both directions and varies from one lane to two lanes either side. The road is separated by a traffic island in parts, varying in width from 5 m to 20 m. The total width of Flemington Road varies from 10 m to 30 m.

Hibberson Street is identified to be a main road travelling through the commercial district of Gungahlin. The road has a single lane in either direction and has a width of approximately 8 m.

2.2 Physical setting

A review of the geological sheet (reference: Canberra 1:100,000 Geological Series, Sheet 8727, 1992) indicates that the portions of the route along Northbourne Avenue south of Morphett Street, the Federal Highway north of Swinden Street and south of Flemington Road and Flemington Road north of Sandford Street are underlain by the Canberra Formation, comprising mudstone, siltstone, minor sandstone, limestone, and volcanic sediments.

The portion of the route along Northbourne Avenue north of Morphett Street and south of Swinden Street and north of Flemington Road and south of Sandford Street is indicated by the referenced plan to be underlain by alluvium soils comprising gravel, sand, silty clay and black organic clay.

Based on the findings of the route inspection, the topography is a generally flat with slight rise in elevation towards the northern portion of the route. Slight rises in elevation are noted at Gould Street and Macarthur Avenue along Northbourne Avenue. A larger rise in elevation was noted directly south of Sandford Road along Flemington Road.

2.3 Acid sulfate soils

Acid sulfate soils (ASS) are acidic soil horizons or layers resulting from the aeration of soil materials that are rich in iron sulfides, primarily pyrite (FeS_2). They are generally likely to be present in:

- marine and estuarine sediments of the recent (Holocene) geological age
- soils usually not more than 5 m above mean sea level
- marine or estuarine settings.

Based on the Australian Soil Resource Information System (http://www.asris.csiro.au/index_ie.html#) the portion of the site south of the corner of the Federal Highway and Phillip Avenue is identified as a *'Class C4 Extremely low probability/very low acid sulfate soil area'*, the portion of the site north of the corner of the Federal Highway and Phillip Avenue is classified as a *'Class B4 Low probability/very low confidence acid sulfate soil area'*. ASS identified in class 4 areas are considered probable to be found beyond 2 m below the natural ground surface.

2.4 Previous investigations

2.4.1 Phase 1 environmental site assessment

Parsons Brinckerhoff undertook a Phase 1 environmental site assessment (ESA) at the site in April 2014 with a purpose to provide baseline data with which to evaluate the potential for contamination to have impact on the development or future use of the site.

The scope comprised a detailed desktop review of information including the physical site setting including regional and local geology, hydrology and hydrogeology, a search of the ACT Environment Protection Authority (EPA) contaminated land record and historical aerial photographs. A site inspection was conducted and observations were made regarding areas of potential or actual (visible) contamination and surrounding land uses, including their potential to impact the site.

The Phase 1 ESA identified a number of areas across the proposed alignment that has the potential to have caused historical contamination. Areas were identified across the entire route and included the following sources of contamination:

- potentially contaminated heterogeneous fill material in the subsurface
- potentially dumped contaminated waste on the route or adjacent sites
- petroleum hydrocarbons from the use of adjacent car dealerships and car parks
- chemical residues associated with vehicle storage at the car dealerships and a repair shop where cleaning agents and solvents are stored and an oil water interceptor is present
- pesticides associated with the maintenance of open space public and private land
- bitumen, road base and vehicle emissions from the highway and adjacent roads
- asbestos associated with historically operated landfill sites
- hydrocarbon, landfill and unknown contamination identified as a part of the EPA contaminated land record search at a number of sites adjacent to the route.

Furthermore, a summary of the review of information allowed the following conclusions to be made:

- the regional geology generally comprises the Canberra Formation, comprising mudstone, siltstone, minor sandstone, limestone, and volcanic sediments and alluvium soils comprising gravel, sand, silty clay and black organic clay
- the topography is relatively flat with a slight increase in elevation towards the northern portion of the site
- sensitive receptors in the vicinity of the site include Sullivans Creek, Gungaderra Creek, Yerrabi Pond, Lake Burley Griffin, Mulanggari Grasslands Nature Reserve, Goorooyarroo Nature Reserve, drainage lines and minor waterways, underlying groundwater at and surrounding the site and surrounding residential occupants
- the majority of properties bordering the site were commercial properties.

2.4.2 Phase 2 environmental site assessment

Following the Phase 1, Parsons Brinckerhoff undertook a Phase 2 ESA completed in January 2014. The objectives of the assessment were to assess the current extent of soil and groundwater contamination and the implications it may have to the development of the Project and assess the potential for soil and groundwater contamination, if present at the route, to impact human health and the environment during development and/or during operation of the light rail. Sampling locations are presented on Figure 4, Appendix A.

The scope of work for the investigation included:

- the excavation of and soil sampling from 44 test pits using an excavator to a maximum depth of 3.1 mBGL
- the drilling of and soil sampling from 11 boreholes using a track mounted drill rig to a maximum depth of approximately 15 mBGL
- conversion of six boreholes to a groundwater monitoring wells and subsequent sampling.

Subsurface conditions varied across the route. Fill, where present, was generally described as clayey sand, sandy clay/silty clay or sand, and generally extended to between 0.2 m and 1 m depth, although localised areas of deeper fill, up to 1.6 m depth, were identified. Natural material varied from clayey sand/sandy clay, sand and clay to claystone. Alluvium soils were observed at a number of locations. No visual signs of contamination were observed in soil across the site.

Groundwater was identified at depths greater than 8 mBGL at the Northbound Avenue portion of the site and depths greater than 1.8 mBGL at the proposed depot. Groundwater parameter readings generally indicated the conditions were aerobic, freshwater and of neutral pH conditions.

The Phase 2 ESA identified the following results:

- concentrations of the contaminants of concern analysed in soils at the route were below the adopted human health criteria
- concentrations of copper, nickel and zinc were reported to exceed the adopted ecological criteria at some investigation locations
- concentrations of titratable actual acidity (TAA) and titratable peroxide acidity (TPA) in a sample collected from TP050_3.0-3.1 and TAA in a sample collected from TP090_3.0-3.1 analysed to detect ASS were identified to be above the reporting limits but below the action criteria for ASS
- concentrations of the majority of the contaminants of concern in the groundwater samples collected were below laboratory limits of reporting, with the exception of some heavy fraction total recoverable hydrocarbons (TRH) concentrations (TRH >C_{10}-C_{40}) which was reported above laboratory reporting limits in the samples collected from BH018 and BH019, for which there was no applicable adopted assessment criteria
- concentrations of heavy metals (cadmium, copper, chromium, nickel and zinc) were reported above the groundwater assessment criteria in a number of monitoring wells.

With regard to soil, the Phase 2 ESA concluded the following:

- Statistical analysis was conducted on affected heavy metals concentrations indicating that exceedances reported were acceptable and were considered unlikely to pose a significant risk to on-site ecological receptors.
- The concentration of zinc detected in BH022_0.2–0.3, which exceeded 250% of the ecological criteria, was not considered appropriate to consider as a ‘hot spot’ due to variable concentrations of heavy metals within the fill materials present at the depot. It is also noted that concentrations above the

ecological criteria would not likely pose a risk to human health during development and/or during operation of the light rail. Parsons Brinckerhoff concluded that remediation would not be required to address these ecological criteria/EIL exceedances.

With regard to groundwater, the Phase 2 ESA concluded the following:

- The detections of heavier fraction TRH in groundwater sampled from BH018 and BH019 were considered unlikely to pose a risk to human health during the development of the route or during operation of the light rail due to the depth of groundwater at both locations (deeper that 8 mBGL) and the absence of detections of TRH in soil samples analysed.
- The heavy metal concentrations in groundwater across the route were also considered unlikely to pose a risk to human health during the development of the route or during operation of the light rail project due to the depth of groundwater and the absence of heavy metals concentrations in soil above the relevant criteria.

The Phase 2 ESA required that a CMP, this document, be prepared to outline management objectives required during the development of the Project.

2.5 Areas previously identified as data gap concerns

During the delivery of Phase 2 ESA field works and in review of the EPA provided contaminated sites register, the following areas were identified as areas of potential data gaps due to the absence of available sampling locations to target each area:

- Land approximately 250 m south-west of the corner of Flemington Road and Well Station Drive was identified to be historically used for uncontrolled dumping. A site walkover was conducted of the area and ground cover was identified to be visibly uneven and grassed. Two spoil stockpiles were observed approximately 15 m west of the route and no other visible signs of contamination were identified.
- Land on the north-west corner of Lysaght Street and Flemington Road which extends approximately 200 m north was identified to be historically contaminated with hydrocarbon contamination. The area comprises a large L-shaped warehouse, an open hardstand storage area and a small portion of grassed land identified as the Australian War Memorial Treloar Technology Centre.
- Land to the west of sampling location BH025 has been historically identified to contain hydrocarbon, heavy metal and polycyclic aromatic hydrocarbon (PAH) contamination. Results from samples collected within fill at TP115 targeting this area were below the adopted criteria. However, groundwater was not assessed at this location, and considering the shallow depth of groundwater (1.76 mBGL) identified at location BH021 in proximity to the area, groundwater may potentially be identified at shallow depths.
- Chlorinated hydrocarbons were identified as a contaminant of concern associated with car dealership facilities located on the central portion of Flemington Road. Chlorinated hydrocarbons were not assessed in soil or groundwater samples as a part of the Phase 2 investigation. No detections of TRH were reported in soil in the vicinity of the car dealerships, however some chlorinated hydrocarbons are above the TRH fraction range analysed and the criteria for chlorinated hydrocarbons are generally lower than most laboratory limits of reporting for TRH. Parsons Brinckerhoff observed no evidence indicating chlorinated hydrocarbons were present in soil; however the potential risks are considered in this CMP.
- Hydrocarbon contamination was identified in groundwater at the southern portion of Northbourne Avenue at BH019, located at the northern corner of Alinga Street, and BH018, located at the northern corner of Gould Street and Northbourne Avenue. The depth to groundwater was greater than 8 m BGL. Hydrocarbon contamination is likely to be present in groundwater beneath the route in the vicinity of these locations and between them.

2.6 Conceptual site model

The conceptual site model (CSM) was developed based on the available information from the Phase 1 and Phase 2 ESA works. The CSM outlines potential source, transport and receptor linkages, taking into account the site settings and surrounding land use. A source, a receptor (human or environmental) and pathway between the source and receptor must be present for a complete exposure pathway to exist. The CSM is summarised in Table 2.1.

Table 2.1 Conceptual site model

Potential sources	Potential sources include: ■ potentially contaminated fill material in the subsurface ■ petroleum hydrocarbons from the use of adjacent car dealerships and car parks ■ chemical residues associated with vehicle storage at the car dealerships and the repair shop where cleaning agents and solvents are stored and an oil water interceptor is present ■ pesticide contamination used to maintain private and public open space ■ coal tar, bitumen, road base and vehicle emissions from the route and adjacent roads ■ contaminated waste stored at the Mitchell Resource Management Centre ■ petroleum hydrocarbons from underground storage tanks located along the route ■ landfill contamination located along the route ■ petroleum hydrocarbons, polychlorinated biphenyls (PCBs), PAHs, phenols, pesticides, heavy metals and asbestos at a route at the north east of the corner of Mapleton Avenue and Flemington Road.
Contaminants of potential concern	Contaminants of potential concern include: ■ petroleum compounds including TRH ■ benzene, toluene, ethylbenzene and xylene (BTEX compounds) ■ PAHs and phenols ■ heavy metals ■ organochlorine and organophosphate pesticides (OCPs/OPPs) ■ chlorinated hydrocarbons ■ PCBs ■ asbestos.
Potential migration pathways	Potential migration pathways include: ■ leaching and migration of contaminants vertically into underlying groundwater ■ surface water flow and lateral migration of contaminated water through preferential pathways such as drainage lines, sewers and infrastructure trenches ■ atmospheric dispersion ■ vapour production and accumulation.

Potential receptors	Potential receptors include: ■ surface waters bodies including: ▸ Lake Burley Griffin located approximately 400 m south of the route ▸ Gungaderra Creek (intersects the route at Flemington Road) ▸ Sullivans Creek (intersects the route north of Clare Burton Circuit) ▸ Yerrabi Pond located approximately 1 km north-west of the route ■ underlying groundwater at and surrounding the route (see section 4.2.3 for details of the local groundwater bore search) ■ drainage lines and minor waterways ■ site infrastructure workers and utility/construction personnel undertaking works at the route ■ future users of the light rail system ■ recreational users of Lake Burley Griffin and Yerrabi Pond ■ nature reserves in proximity to the route, including: ▸ Mulanggari Grasslands Nature Reserve located approximately 300 m south-west of the route ▸ Goorooyarroo Nature Reserve located approximately 500 m north-east of the route ■ surrounding residential occupants or commercial site users.
Potential complete exposure pathways	Potential complete exposure pathways include: ■ inhalation of contaminated surface dust by workers at the site or users of the site ■ ingestion of contaminated soil or groundwater by excavation workers at the site ■ inhalation of accumulated vapour from soil or groundwater by workers at the site or users of the site. Further information is provided in section 2.7 below.

2.7 Potential contaminants of concern and exposure pathways

The following contaminants of concern may potentially be encountered during the construction of the light rail route:

- ASS may potentially be identified in natural alluvium soils across the route. Low levels of ASS were identified in natural soil at two locations below the action criteria, in the vicinity of the corner of Northbourne Avenue and Wakefield Drive and in the vicinity of the corner of Flemington Road and Randwick Road. Although results were below the criteria at both locations, the sampling density was limited and ASS may be potentially identified at further locations. Figure 3 presents areas where alluvium soils are identified along the route. Alluvium soils are generally identified as clay or silt or gravel carried by flood plains or in river beds.
- Asbestos may potentially be identified in fill across the route. Although ACM was not identified in samples collected in fill across the site, it has been determined that asbestos may potentially be identified in fill across the route.
- Chlorinated hydrocarbons may be identified in soil in the vicinity of car dealerships located at the central portion of Flemington Road. Chlorinated hydrocarbons were not assessed in soil samples or groundwater as a part of the Phase 2 investigation. No detections of TRH were reported in soil in the vicinity of the car dealerships, however some chlorinated hydrocarbons are above the TRH fraction range and the assessment criteria for chlorinated hydrocarbons are generally lower than most laboratory limits of reporting for TRH.

- TRH may be identified in groundwater at the southern portion of Northbourne Avenue. Detections of TRH were identified in groundwater sampled from BH018 and BH019. Groundwater is found at depth below 8 mBGL at the southern portion of Northbourne Avenue.
- Heavy metals concentrations marginally exceeding the ecological criteria at a number of locations along the route comprising elevated concentrations of copper, nickel and zinc. These concentrations were considered to be indicative of minor impacts in imported fill materials along the route. There is a potential for heavy metals to be present at varying concentrations in fill at other areas across the route.
- PAHs were detected in one sample located on Northbourne Avenue south of Mouat Street. Concentrations were below the criteria and not considered likely to affect human health or ecological indicators across the route. However, there is a potential for unidentified PAHs to exist in fill across the route.
- Pesticides were detected in one sample located on Northbourne Avenue south of Haig Park. Concentrations were below the criteria and not considered likely to affect human health or ecological indicators across the route. However, there is a potential for unidentified pesticides to exist in fill across the route.

Potential for unexpected finds may include the following contaminants:

- presence for underground storage tanks acting as sources of hydrocarbons
- presence of waste or rubbish above or below ground, containing metals, PAHs, asbestos or other contaminants.

A summary of identified contaminants of concern, including their potential effects and exposure pathways, is provided in Table 2.2.

Table 2.2 Contaminants of concern and exposure pathways

Contaminant of concern	Source	Effects	Exposure pathway	Risk
ASS	Any location showing the presence of alluvium soils ASS may be exposed during the excavation of natural alluvium soils along the route or through lowering of the water table.	Runoff of ASS creates water quality issues relating to acidity, soluble iron, heavy metals, and changes in bicarbonate, carbonate and dissolved oxygen levels. These changes in water chemistry can lead to the degradation to habitat. ASS soils may affect existing vegetated areas or the growth of vegetation and waterways.	Direct contact with or ingestion of acidic soil or leachate.	Moderate, ASS likely in estuarine areas.
Asbestos	Uncontrolled filling of the site historically. If asbestos in fill is exposed through excavation fibres may be generated at the surface.	Inhalation of asbestos fibres may cause asbestosis and possibly cancer of the respiratory system including mesothelioma.	Inhalation of free fibres or dust.	Moderate, asbestos has not been identified at the site, although it may be present in fill material.
TRH	Groundwater at the southern portion of Northbourne Avenue.	Ingestion, direct contact or inhalation of TRH may cause cancer.	Direct contact, ingestion or inhalation of volatile vapours.	Low, TRH present in groundwater in the southern portion of Northbourne Avenue although depth to groundwater makes exposure unlikely.
Chlorinated hydrocarbons	Car dealerships at the central portion of Flemington Road.	Leaching of chlorinated hydrocarbons into groundwater below the car dealership has the potential to migrate below the site. Ingestion of chlorinated hydrocarbons may cause cancer.	Ingestion of soil or groundwater, inhalation of vapours, or direct contact.	Low, may be present in proximity to car dealerships, although it has not been identified.
Heavy metals	Uncontrolled filling across the route historically. Heavy metals may be exposed in soil across the route potentially affecting existing vegetated areas or the growth of vegetation.	Exposure of elevated heavy metals in fill may affect the growth of vegetation or present human health risk.	Ingestion of soil or groundwater, or direct contact.	Moderate, metals have been identified along the route but not at concentrations likely to pose a risk to human health. Environmental effects considered low risk due to land use.

Contaminant of concern	Source	Effects	Exposure pathway	Risk
PAHs	Uncontrolled filling across the route historically.	Ingestion of or inhalation of some PAH compounds including benz[a]anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(j)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene may cause cancer.	Ingestion of soil or groundwater, or direct contact.	Moderate, PAHs have been identified along the route but not at concentrations likely to pose a risk to human health.
Pesticides	Historical pesticides use, particularly in areas where maintained open space, parks are located e.g. Yowani Country Club, Canberra Racecourse. Uncontrolled filling across the route historically.	Ingestion or inhalation of pesticides may cause a number of human health issues such as birth defects, cancer and liver disease.	Direct contact or ingestion of soil or groundwater.	Low, pesticides have not been identified along the route.

3. Application of the CMP

3.1 Reference to the CMP

The CMP should guide the construction methodology planning and also be referred to under the following specific circumstances:

- prior to commencing works, including both ‘minor works’ and ‘major works’ (as defined in Table 3.1) that involve the disturbance of soils
- during work in any location where fill material is encountered across the route and especially, areas identified in section 2.5
- if soil is penetrated below a depth of 8 mBGL across the Northbourne Avenue portion of the site or where groundwater is encountered, in particular at the portion of Northbourne Avenue south of Haig Park
- when the potential exists for ASS material to become exposed in natural soils identified as alluvium soils, particularly in proximity to locations TP050_3.0–3.1, located at the corner of Flemington Road and Randwick Road. and TP090_3.0–3.1 located on Northbourne Avenue, directly north of Wakefield Avenue
- when the potential exists for asbestos material to become exposed, in fill material across the entire route
- in the event that any unexpected contamination or potential contamination is encountered.

This CMP has been prepared to be applied during the construction of the light rail; it is not applicable to the operational phase of the light rail.

3.2 Responsibilities

ProjectCo (the entity who will be contracted by the Act Government to deliver the Project is responsible for the overall implementation and maintenance of this CMP. ProjectCo are to ensure that all occupants of their respective sites and contractors working in these specified defined areas of the site have been informed of the requirements of the CMP prior to commencement of any works. A copy of this plan is to be kept on site at all times during any intrusive works in these areas.

The supervisor or person-in-charge of works is responsible for implementing the requirements of the CMP during the course of the works and at the completion of the works.

The specific responsibilities of ProjectCo and the supervisor or person-in-charge of the works are outlined in Table 3.1.

Table 3.1 Specific responsibilities of Capital Metro and the site supervisor/person-in-charge of any future works

Position and Company	Responsibilities
ProjectCo	*General:* ■ approve the CMP ■ advise persons working or operating on the site of the requirements of the CMP ■ ensure ProjectCo staff and any contractors comply with the requirements of the CMP ■ ensure ProjectCo staff and contractors clearly understand the requirements of the CMP and ensure that compliance with the CMP is a condition of any agreement with these parties ■ ensure the conditions of the CMP are implemented and supplemented, if necessary, by any conditions of development or works approvals ■ commission a suitably qualified environmental consultant to update the CMP if the condition of the site is changed, and, if necessary, inform other parties of the changes ■ if necessary, commission a suitably qualified environmental consultant to undertake any necessary assessment, remediation, and/or validation of contamination identified during construction ■ if necessary, engage suitably experienced contractors (licensed asbestos assessor and/or removalist) to undertake assessment and/or removal of asbestos containing materials ■ ensure the site is maintained in accordance with the CMP ■ provide the CMP for inclusion on the relevant records maintained by the ACT Government ■ ensure all non-conformance and/or complaints are recorded in Appendix D of the CMP ■ ensure appropriate consents and licences (as required) are obtained for the works ■ provide training and induction of employees and contractors before and during the works, as appropriate (Appendix B) ■ maintain a log of Project Personnel (Appendix B) ■ provide a copy of the CMP to the supervisor or person-in-charge of the works being undertaken ■ ensure implementation of the CMP.
Supervisor or person-in-charge of any major works to be undertaken on the site. (ProjectCo/Contractors/ Subcontractors).	*General:* ■ implement the CMP to ensure compliance ■ complete the registers, databases and records required by the CMP ■ conduct works in an environmentally responsible manner ■ meet relevant occupational health and safety regulatory requirements ■ implement the works in a safe and responsible manner ■ ensure that environmental protection measures are in place and are functioning correctly during the works and after completion of the works ■ conduct monitoring as required in the CMP ■ undertake audits of activities in accordance with the requirements of the CMP ■ ensure non-conformance and/or complaints are reported to the appropriate ProjectCo personnel ■ ensure all works comply with relevant regulatory requirements.

3.3 Document revision

This CMP is required to be reviewed annually and to be updated or amended when/where necessary. The CMP must be updated if there is significant change in scope of work and/or if a new source of contamination is identified. A table of revisions is included at the beginning of this document.

It is the responsibility of ProjectCo to ensure the CMP supplied to any person is the current updated or amended version. The up-to-date version of the CMP will be available from ProjectCo.

It is the responsibility of the supervisor or person-in-charge of works proposed to be undertaken to ensure they have the current version of the CMP.

3.4 Training

A safety and environmental induction will be developed prior to work commencing and will provide the required information, instruction and training for all personnel having business on the site to enable their duties to be performed in a manner that is safe and without risk to health and minimises damage to the environment. The managing contractor will induct all site workers prior to the commencement of work.

The induction should cover the environmental controls identified in this CMP and emergency response procedures in the event of an environmental incident such as a spill or release. If any additional training requirements are identified, during site works or review of the CMP, these will be undertaken.

ProjectCo and/or supervising contractor will be responsible for maintaining training records for the site, including who was trained, when they were trained, the name of the trainer and a general description of the training content.

3.5 Reporting

The following reports may be required during the work:

- waste classification letters, identifying any waste to be removed from site, discussing analytical results and waste classification, prepared by the environmental consultant
- Reporting requirements including a remedial action plan and/or a validation report for unexpected finds and will be endorsed by the auditor and ACT EPA
- Inspection reports provided in Appendix C.

3.6 Non-conformance preventative and corrective action

In the event of a non-conformance, the source and nature of the event will be investigated, the effectiveness of the existing controls reviewed and modified where practical, and necessary strategies will be implemented to minimise further impacts.

3.7 Emergency response

All unplanned events, irrespective of how minor the event, shall at the first opportunity be reported to the contractor's supervisor and then to ProjectCo and relevant stakeholders and/or government agencies as necessary. Additionally, should any other site personnel, company visitors or contractors experience an unplanned event they should also report the event through their own organisation's internal reporting mechanism. Employees and contractors directly or indirectly involved with an unplanned event are obliged to

assist with the investigation if requested to do so. All unplanned events shall be investigated. The degree and level of investigation shall depend on the outcome of the actual event, the outcome of a similar event if not controlled.

Discharge of water containing contamination, suspended matter, any oils or similar materials or any foaming or non-biodegradable detergents into the waterways on and adjacent to the work area is to be avoided using all proper precautions. Any release of water may be a breach of ACT EPA regulations and may be subject to action by the ACT EPA.

Any occurrence which may result in the contamination of the land, surface or groundwater or air should be immediately reported to the site supervisor and ProjectCo immediately. Any occurrence which does or may result in exposure of site workers or the public to contamination should be immediately reported to the site supervisor and ProjectCo immediately and to emergency services if necessary.

Where an occurrence is deemed to be reportable to the ACT EPA it should be reported at the earliest opportunity.

3.7.1 Spill management

In the event of a chemical spill, including of potentially contaminated groundwater, the following procedures will be implemented:

- Work will be immediately ceased and the spill will be contained and cleaned up using the spill kit.
- For large leaks, which cannot be contained using the spill kit, or leaks that leave the site, emergency services will be contacted for assistance (000).
- All leaks and spills to be reported as environmental incidents.

3.7.2 Emergency contacts

Emergency contacts for the parties are presented in Table 3.2.

Table 3.2 Emergency contacts

Contact	Office number	Mobile number
tbc		
tbc		
tbc		

3.8 Audit and review

The continued applicability of the CMP shall be reviewed and assessed every 12 months from the date of effect. The review shall include consideration of all implementation, investigation and monitoring data available from the preceding 12 months, and will be recorded in the inspection report in Appendix C. The inspection report must detail a record of inspections undertaken at the site during excavation works and to record the results of the inspections including a record of any corrective actions. Visible observation of the surface area, adequate drainage and potential signs of erosion should be recorded.

4. General site management

Information provided in this section will discussed in more detail in the construction management plan to be prepared by ProjectCo.

4.1 Work health and safety requirements

Prior to undertaking excavation works at the site, a site safety plan should be prepared to document occupational health and safety procedures on site. All personnel at the site should be required to read and understand the safety plan and sign on prior to commencing any work on site.

4.2 Excavation work

During excavation work the following procedures and controls should be in place:

- ensure erosion and sediment controls are in place prior to works commencing particularly on highly erodible soils
- erosion and sediment control will include (where necessary):
  - diversion banks/drains upslope of the work to divert water around the disturbed area. Drains must discharge onto stable, preferably vegetated surfaces or through sediment controls such as silt fences
  - level spreaders or straw bales at the end of diversion banks of any overland flow paths leading from the disturbed area, to dissipate flows and trap sediments
  - geotextile filter fabric fences down slope of the work areas
  - straw bales or filter fabric socks at the entrance to any drains, gutters or watercourses
- maintain all sediment controls as necessary until the site is stable. Once the project site has been stabilised, temporary sediment controls will be removed
- any permanent water-retaining structures or other erosion and water management controls will be routinely maintained.

On completion of excavation works:

- any exposed areas are to be stabilised (that is, compacted, sealed or vegetated) as soon as practicable following completion of works
- erosion and sediment controls devices are to be removed once work areas have been rehabilitated.

4.3 Spoil management

Stockpiles should be placed to minimise environmental impact. The design of stockpile(s) should include:

- bunding
- an impervious pad on which to place stockpiles
- minimisation of the amount of water infiltration – consider using some form of cover or capping if soil is to be stockpiled for an extended period of time
- sediment control upslope to prevent run-on water.

To manage spoil effectively and meet the above requirements, excavated materials should be stored in a designated area at each site and re-used or disposed of off-site as soon as possible following excavation.

4.3.1 Contaminated spoil management

Spoil containing contaminated material will require additional management to minimise potential spread of contamination or leachate. This includes:

- stockpiles containing asbestos and/or other contamination should be placed on and covered with plastic sheeting
- stockpiles containing asbestos should be monitored for dust and if necessary should be kept moist to prevent dust production
- soil that has the potential to generate vapour or odour should be kept covered and monitored to prevent exposure.

ASS which is required to be excavated should be stockpiled in accordance with the measures detailed in section 5.5.

4.3.2 Material tracking

Stockpile tracking should include the following:

- the location, dimensions, volume, source and contamination status, on-site and off-site, if removed for disposal
- where stockpiles are moved on-site, the new location and any required validation of the area where the stockpile was removed should be recorded.

4.4 Waste disposal

4.4.1 Waste classification for off-site disposal of soil or fill

Waste classifications are required for any excavated soil or fill material which is to be disposed of off-site. Soil or fill material to be taken off-site for disposal shall be assessed in accordance with the Environment ACT 2000, *ACT's Environmental Standards: Assessment & Classification of Liquid and Non-liquid Wastes.* Waste classification letters reporting details of material disposed off-site should be provided to the ACT EPA for approval prior to removing material offsite in accordance with the ACT EPA 2014, *Information sheet 4 – Requirements for the reuse and disposal of contaminated soil in the ACT*.

Material for off-site disposal may also be assessed for suitability for beneficial reuse. Where material is intended for beneficial reuse, a beneficial reuse assessment (BRA) is required to be undertaken in accordance with the ACT EPA 2014, *Information Sheet 4 – Requirements for the reuse and disposal of contaminated soil in the ACT*. Criteria used for the BRA must meet the proposed land uses of the intended placement location.

Materials excavated from the site should be tracked from 'cradle to grave', in order to provide detailed and accurate information about the location and quantity of all materials both on and off-site from the time of their excavation until their disposal. All waste disposal documentation should be retained for inclusion in validation reporting.

For any truck or bin leaving the site, the following information would be recorded:

- origin of material
- material type
- approximate volume
- truck and/or bin registration number.

4.4.1.1 Waste classification for spoil or fill containing asbestos

Although asbestos has not been previously identified in the project area it is possible that ACM will be encountered during the work. In addition to the general waste classification requirements, for soil which contains asbestos:

- Environment ACT 2000, *ACT's Environmental Standards: Assessment & Classification of Liquid and Non-liquid Wastes* provides a system for the classification of asbestos
- The *Work Health and Safety (Asbestos) Amendment Regulation 2014* provides certain requirements for the management and monitoring of asbestos
- The Safe Work Australia 2011, *How to manage and Control Asbestos in the Workplace* provides management risks related to asbestos and the controls applied to the associated risks
- All asbestos contaminated soil or fill leaving site must be transported in a leak proof covered vehicle and disposed of at a licensed facility in accordance with NOHSC, 2005, Code of Practise for the Safe Removal of Asbestos 2nd Edition.

4.4.1.2 Waste classification for off-site disposal of soil or fill containing ASS

ASS requiring treatment (above the action criteria) has not been identified. However, there is potential for localised areas of ASS to be present. The potential for ASS can be visually identified by the following observations:

- soil colours – look out for green/grey colours, presence of jarosite, a distinct buttery yellow coloured iron mineral.
- peaty soils
- 'scalding' – barren patches of soil
- dead/dying/stunted vegetation
- salt/acid tolerant vegetation such as marshes, melaleucas (paperbark), water lilies in nearby water courses
- red/brown or blue/green coloured water in nearby water courses
- corroded infrastructure, particularly around footings
- distinctive 'rotten egg' smell indicates the presence of hydrogen sulfide.

In addition to the general waste classification requirements, for ASS**:**

- for virgin excavated natural material (VENM) containing potential ASS (PASS; pH of 5.5 or more):
  - the materials must be kept wet at all times during excavation and subsequent handling, transport and storage
  - if sending material to a landfill, the receiving landfill must be licensed by the ACT EPA to dispose of PASS below the water table in accordance with the licence requirements

- material can be reused on-site if it has been appropriately treated and validated.

For actual ASS (AASS; pH of 5.5 or less) or potential ASS that has dried out, undergone any oxidation of its sulfidic minerals or is not VENM:

- The materials must be treated (neutralised) on-site through liming, mixing and testing to ensure that the mixing of lime materials is successful. Monitoring of pH should be carried out regularly during and after the neutralisation procedure to establish the effectiveness of the treatment.
- Where excavated PASS materials cannot be re-used on-site they must be disposed of to a suitably licensed off-site waste facility.
- The receiving landfill must be licensed by the EPA to accept the class of waste as per the classification. The landfill must be informed prior to receiving the waste that the material contained actual ASS and was treated in accordance with the neutralising techniques outlined in ASSMAC (1998).
- Soil should be sampled for classification in accordance with the ACT EPA 2014, *Information sheet 4 – Requirements for the reuse and disposal of contaminated soil in the ACT* and Environment ACT 2000, *ACT's Environmental Standards: Assessment & Classification of Liquid & Non-liquid Wastes*.

4.4.2 Waste classification for off-site disposal of groundwater

In the event that any dewatering or collection of groundwater from excavations is required, the following procedures must be followed:

- Any water pumped from the excavations or runoff collected is to be stored in retention basins or fully contained tanks on-site in preparation for disposal to an EPA licenced facility.
- Water samples is to be collected that are representative of the stored water; this may require sampling from different depths by a suitably qualified environmental consultant, particularly if the water has been stored long enough to allow it to settle. Samples should be analysed for contaminants of concern; i.e. TRH, BTEX, PAHs, metals, PCBs, chlorinated hydrocarbons and/or pesticides, where appropriate. A sufficient quantity of sample, pre-filtered and/or preserved (if required) should be placed in appropriate sample containers and stored so as to allow a range of chemical analyses to be performed.
- Liquid waste will be disposed of in accordance with waste classification guidelines (Environment ACT, 2000).

4.4.3 Classification of material for reuse on-site or off-site

If material is intended to be beneficially reused it should be stockpiled separately to waste materials after excavation. Material should be tracked from the time of excavation to the location of reuse. Details of the material should be reported and a BRA should be prepared and submitted to the ACT EPA for approval. If material is planned for beneficial reuse off-site, approval from the receiving site should be obtained. The ACT EPA 2014, *Information sheet 4 – Requirements for the reuse and disposal of contaminated soil in the ACT* should be referred to for requirements regarding reporting and reuse of material. Criteria used for the BRA must meet the proposed land uses of the intended placement location.

4.5 Importation of materials

All materials imported for use at the site should be sampled to confirm that they are suitable for use at the site. Imported fill materials to the site can comprise VENM, ACT EPA approved beneficial reuse material, or other approved material. For beneficial reuse material imported to site, a BRA assessment of the material endorsed by the ACT EPA is required. For imported VENM, a VENM certificate is required. Where other material is to be used (e.g. material for road construction), approval from ACT EPA may be required.

Assuming material is accompanied by appropriate documentation, samples will be collected and analysed at a rate of approximately 1 sample per 100 m^3 for the first 1,000 m^3 of imported fill materials and then 1 sample per 500 m^3 thereafter (assuming the same source). Imported fill samples would be submitted for analysis of TRH, BTEX compounds, PAHs, pesticides, PCBs, asbestos and heavy metals. Samples should not contain any evidence of contamination (by visual, olfactory, or laboratory analysis). Should documentation not be considered sufficient, additional sampling may be required to further assess the material.

The results of validation sampling should be compared to the NEPM (2013) criteria.

4.6 Control measures

This section outlines general requirements for works that could significantly disturb potentially contaminated material at the site; more detailed information regarding control measure will be provided in the planned construction environmental management plan. The safeguards outlined in this section will require review depending on the activity proposed. The induction requirements for maintenance workers are outlined in Appendix F.

4.6.1 Major works

Major works proposed for the project area include:

- excavation of soils for the construction of light rail key features outlined in section 4.2
- construction/maintenance works on the depot, stops and transport interchanges, road/pathway areas or any other areas which involve soil disturbance
- construction and maintenance of subsurface services, such as gas, electricity, stormwater, surface drainage, telephone cabling and water supply
- installation of equipment (e.g. additional building foundations, extensions etc.) that require excavation of soils for placement of footings
- potential vegetation clearing (>50 m^2) within the area of the proposed depot or any other area where soil is likely to disturb significant areas of vegetation and soil.

For any major works, determine if specific controls are required. General controls measures for major works comprise:

- All site workers and subcontractors should complete a site induction prior to commencing any maintenance or construction works at the site (Appendix E). The induction must cover the contingency plan and unexpected findings protocols in sections 5 and 6 of this document.
- A work health and safety (WHS) plan should be prepared by the contractor which will include safe work method statements (SWMS). This should recognise this CMP.
- Throughout the duration of any excavation or site works as part of the construction of the light rail, site personnel should ensure a suitably competent supervisor is present at all times to observe excavations.
- Appropriate personal protective equipment (PPE) should be worn. Based upon the contaminants of concern at the site, long sleeved shirt, long pants and protective gloves (preferably nitrile gloves, below leather gloves) should be worn when undertaking any intrusive works. Where dusty conditions prevail, a fine water mist should be applied during excavation. A disposable P2 dust mask should also be utilised.
- Good personal hygiene must be implemented by maintenance workers at the site, including:
  - no eating, drinking or smoking during works
  - avoid contact with soil (wear gloves)

- wash hands and clothes after work
- wash hands before eating, drinking or smoking.

- Dust prevention measures must be put into place – if the conditions are windy, this may include dampening of fill materials prior to and during excavation works.
- The surface capping material must be reinstated following removal and disposal of all excavated potentially contaminated fill materials.

4.6.2 Minor works

Minor works for the project are those which have only limited potential for exposure, including cleaning, weeding or gardening and general maintenance activities.

No specific controls are required for minor works, although all site workers and subcontractors should complete a site induction prior to commencing any maintenance or construction works at the site (Appendix E) and site workers are required to be aware of the contingency plan and unexpected findings protocols in sections 5 and 6 of this document.

4.7 Achievement and management of objectives

4.7.1 Induction

All personnel, including subcontractors, undertaking major works on the site will be made aware of the requirements of this CMP and will receive an environmental induction (Appendix F) prior to commencing work. These inductions shall be recorded in Appendix B.

4.7.2 Duration

The CMP shall remain applicable to the site until such time as the conditions are deemed to no longer apply.

4.7.3 Monitoring and reporting requirements

Monitoring of any site maintenance/excavation works may be undertaken to check whether the CMP is being effectively implemented by the maintenance workers/site users/subcontractors and whether any corrective actions are required. The inspection and monitoring activities that could be undertaken are outlined in Table 4.1.

Table 4.1 Monitoring and measurement for works

Action	Responsibility	Frequency
Develop a WHS plan	ProjectCo	As required for major and minor works
Monitor site maintenance works and effectiveness of risk mitigation measures	ProjectCo	As required for major works
Monitor dust generation and implement mitigation measures	ProjectCo	As required for major works
Disturbed areas to be reinstated and revegetated on completion of site maintenance works	ProjectCo	As required for major works
Monitor effectiveness and control of waste management of contaminated soils and appropriate disposal	ProjectCo	As required for major works

5. Contingency management plan

5.1 Overview

This contingency plan is aimed at ensuring the health and safety of staff, contractors and visitors with regard to potential ACM or ASS in the soil and TRH, chlorinated hydrocarbons in groundwater and pesticides, heavy metals and PAHs in fill. The plan is to be implemented during excavation works within areas where there is the potential to identify contaminants of concern (areas marked on Figure 2 and Figure 3 in Appendix A) and potential areas where ACT EPA identified contaminated sites are located (areas marked on Figure 4 in Appendix A) . Other potential areas of concern where data gaps are present are discussed in section 2.5.

The objective of the contingency plan is to describe procedures minimising exposure of all site workers or users to possible contaminants of concern, which may potentially found within through the development and implementation of the management systems outlined herein.

It is the responsibility of ProjectCo (as appropriate) to ensure that each time excavation works in the specified areas is undertaken, that the action is recorded and signed off. A form recording any potential unexpected finds should be completed as provided in Appendix F.

5.2 Excavation works within areas of fill where asbestos may be identified

The presence of asbestos and/or the extent of asbestos contamination in fill subsurface material are unknown due to the variable nature of subsurface material identified through the Phase 2 ESA and the undefined likely extent of depth of the excavation during work along the route. It is considered that there is a possibility that asbestos will be uncovered during the planned light rail development, especially in areas where construction waste in identified in fill material, especially but not limited to the area directly north of the corner of Northbourne Avenue and Antill Street. It should be noted that asbestos has not been identified in the investigations undertaken to date.

Worksafe ACT must be notified and provide a permit for any disturbance of asbestos contaminated soil, removal of ACM or any other works which require a licensed asbestos contractor.

All work should be undertaken in compliance with the Work Health and Safety (Asbestos) Regulation 2014 and any applicable future guidance released by WorkSafe ACT.

The following measures should be put in place to reduce the risk of potential exposure:

- Prior to excavation works all relevant site personnel will undertake a toolbox session to ensure that staff and contractors are adequately trained to recognise and identify asbestos fragments and discuss WHS issues associated with asbestos in accordance with Work Health and Safety (Asbestos) Amendment Regulation 2014. The toolbox talk will incorporate the activities required to manage contamination issues as detailed in this plan.
- If ACM is identified, a licenced asbestos removalist from the contracting company will collect the fragment and place it in a 200 mm polythene bag for later disposal at an appropriate waste facility. A detailed visual inspection of the area will be carried out by the licenced asbestos removalist. If no further fragments are identified, works can continue.

- If several fragments of ACM are identified, the licenced asbestos removalist from the contracting company is to direct the collection of the fragments and place them in a 200 mm polythene bag for later disposal at an appropriate waste facility. This person will also contact ProjectCo and advise them of the occurrence. A detailed visual inspection of the area will be carried out by the licenced asbestos removalist who will involve wet raking of the areas to a depth of 100 mm for any further fragments. If no further fragments are identified, works can continue.
- If suspected ACMs continue to be identified during excavation works or a large amount of fragments are identified in a localised area (i.e. above 10 fragments per square metre) and/or if it is thought that any uncovered material might be considered asbestos containing and friable, works will cease and a licenced asbestos assessor will be engaged to assess the situation and determine an appropriate course of action.
- The licenced asbestos assessor must determine and report:
  - if the asbestos is non-friable or friable
  - the extent of the contamination
  - options for the appropriate remediation of the area on site.
- If friable asbestos is identified the preparation of a risk assessment is required to identify the following:
  - condition of the friable asbestos
  - the likelihood of any person being exposed to it,
  - whether the nature of the work is likely to disturb the friable asbestos
  - the result of any air monitoring conducted at the workplace
  - a set of measures designed to control risks associated with the friable asbestos.

The licenced asbestos assessor, may recommend that as a precaution during asbestos removal works, continuous asbestos fibre monitoring should be carried out at the perimeter of the area and if deemed necessary by the licenced asbestos assessor, personal exposure asbestos fibre air monitoring for workers in area. The monitoring must be carried out immediately before the licenced asbestos removal work commences and whilst the removal work is carried out in accordance with Work Health and Safety (Asbestos) Amendment Regulation 2014.

5.3 Excavation works where contamination is encountered

The presence of heavy metals, PAHs, TRHs, chlorinated hydrocarbons and pesticides in soil across the route and the likelihood for them to be exposed is unknown due to the undefined nature and extent of contamination across the route. It is understood, fill will be exposed across the route at varying depth during excavation. The following measures should be put in place to reduce the risk of potential exposure:

- Prior to excavation works all relevant site personnel will undertake a toolbox session to ensure that staff and contractors are adequately trained to recognise contamination in soil and WHS issues associated with contamination in soil. The toolbox talk will incorporate the activities required to manage contamination issues as detailed in this plan.
- All personnel must where the appropriate PPE at all times.
- Fill removed and stockpiled during excavation activities should be kept secured in accordance with the procedure outlined in section 4.

- All personnel must wear disposable nitrile gloves when in contact with material identified as contaminated, personnel must also decontaminate any equipment that has come into contact with contaminated material. Decontamination of equipment/tools should be completed by:
  - rinsing in a large container with fresh water to remove any accumulated soil
  - washing in a second container containing a 5% Decon 90 solution, using scrubbing brush
  - rinsing with fresh water and allowing to dry prior to use.
- The decontamination rinse container and Decon 90 solution container should be emptied regularly. Used decontamination liquid should be stored in appropriate containers and sampled for classification in accordance with Environment ACT 2000, ACT's Environmental Standards: Assessment & Classification of Liquid and Non-liquid Wastes. Waste water should be collected by a licensed waste removal company as needed or upon completion of site works following approval from ACT EPA.

5.4 Excavation works where groundwater is encountered

The presence of identified heavy metals, PAHs, TRH, chlorinated hydrocarbons and pesticide contamination in groundwater and the likelihood for exposure to occur is unknown due to the undefined extent of depth of the excavation during work along the route. It is understood that it is unlikely groundwater will be exposed as a part of excavation during the planned light rail development. However, the following measures should be put in place to reduce the risk of potential exposure in areas identified in Figure 2 and Figure 4:

- Prior to excavation works all relevant site personnel will undertake a toolbox session to ensure that staff and contractors are adequately trained to recognise contamination in groundwater and WHS issues associated with contamination in groundwater. The toolbox talk will incorporate the activities required to manage contamination issues as detailed in this plan.
- If groundwater is exposed, dewatering activities may be required due to excavation occurring above the standing water level of the groundwater. Pumped water should be stored in retention basins or fully contained tanks on-site. An environmental scientist from a contracting company will collect a sample to assess the contaminant concentration of the groundwater. If the water is found to be suitable for reuse at the site for dust suppression or other appropriate uses it may be retained and used. This would be appropriate only where no detectable concentrations of concern are identified. For disposal of water not considered suitable or not required it should be classified in accordance with Environment ACT, (2000) *ACT's Environmental Standards: Assessment & Classification of Liquid and Non-liquid Wastes* for later disposal at an appropriate waste facility.
- All personnel must where the appropriate PPE at all times.
- All personnel must wear disposable nitrile gloves when in contact with material identified as contaminated, personnel must also decontaminate any equipment that has come into contact with contaminated material. Decontamination of equipment/tools should be completed by:
  - rinsing in a large container with fresh water to remove any accumulated soil
  - washing in a second container containing a 5% Decon 90 solution, using scrubbing brush
  - rinsing with fresh water and allowing to dry prior to use.
- The decontamination rinse container and Decon 90 solution container should be emptied regularly. Used decontamination liquid should be stored in appropriate containers and sampled for classification in accordance with Environment ACT 2000, ACT's Environmental Standards: Assessment & Classification of Liquid and Non-liquid Wastes. Waste water should be collected by a licensed waste removal company as needed or upon completion of site works following approval from ACT EPA.

5.5 ASS management

Due to the low probability of encountering ASS for the proposed site works, avoidance of ASS materials is considered the most suitable strategy. However, should ASS be encountered and be required to be disturbed the most feasible management strategy for the works would be oxidation prevention.

The potential for ASS can be visually identified by field observations, as discussed in section 4.4.1.2. Where ASS is suspected, field screening for pH and pH_{FOX} should be undertaken to determine whether material is actual or potential ASS. Laboratory analysis may be required to determine treatment requirements (e.g. liming rates).

Field pH measurements of all materials excavated should be taken and logged to provide broad coverage of the excavated material types encountered. One sample should be collected per 25 m^3 of excavated natural soil materials for on-site pH testing. Field pH readings of 4 or less will indicate that ASS are present with oxidising sulfides, readings of greater than 4 but less than 5.5 indicate that the soils are acidic and may be the result of limited oxidation of sulfides.

Selected field samples should be tested for the presence of ASS using the suspension peroxide oxidation combined acidity and sulfate (SPOCAS) method. These materials will require treatment/neutralisation prior to re-use or disposal. Laboratory results should be compared to the action criteria provided in Table 4.4 of the Acid Sulfate Soils Management Advisory Committee 1998, *Acid Sulfate Soils Assessment Guidelines*. These have been provided in Table 5.1 for reference.

Table 5.1 ASS action criteria (as per Acid Sulfate Soils Management Advisory Committee, 1998)

Type of material		Action Criteria 1-1,000 tonnes disturbed		Action Criteria 1,000 tonnes disturbed	
Texture range	**Approx. clay content** (%<0.002 mm)	**Sulfur trail** %S oxidisable	**Acid trail** mol H^+/tonne	**Sulfur trail** %S oxidisable	**Acid trail** mol H^+/tonne
Coarse texture (Sands to loamy sands)	≤5	0.03	18	0.03	18
Medium texture (Sandy loams to light clays)	5-40	0.06	36	0.03	18
Fine texture (Medium to heavy clays and silty clays)	≥40	0.1	62	0.03	18

5.5.1 Excavation

The following management considerations should be taken into account when excavating PASS or AASS (ASSMAC, 1998):

- where the sulfidic layer is <0.5 m deep, these areas should ideally be left undrained with minimal disturbance (i.e. generally these areas are best left waterlogged)
- where the sulfidic layer is between 0.5 and 2.0 m deep, drainage and excavation should only be attempted in accordance with a properly designed management plan
- where areas are 'scalded' or degraded and devoid of vegetation, no further drainage or excavation should be undertaken. Remediation strategies should be developed.

Should PASS be encountered, the overall remedial strategy to be adopted should include:

- burial of excavated PASS materials below the water table where possible
- neutralisation of PASS materials where re-use on site above the water table is required
- disposal of excess PASS material to an appropriate off-site facility where it cannot be reused on-site.

5.5.2 Spoil management

Where ASS materials are excavated, short and long term management of the material is required. If the excavated material is to be stockpiled prior to treatment and/or disposal, provisions should be made for safe storage.

The time between excavation and acid generation depends on a range of variables including, though not limited to, the texture, mineralogy, temperature and bacterial activity of the excavated material. Particular care is required when dealing with sandy sediments, which oxidise and leach more rapidly than clays. Oxidation in clays is often slower than sands due to diffusive oxygen considerations.

Erosion control measures should be applied to excavations including the following:

- include temporary bunding, covers, silt fences/socks and hay bales around excavations
- cell areas should be excavated separately to minimise oxidation of in situ materials and to allow for immediate capping where required.

Erosion control measures should be applied to stockpiles including the following:

- all stockpiles to be bunded
- establish leachate collection and treatment systems including an impervious pad on which to place the stockpile
- if an impervious pad has not been established under the stockpile, as a precautionary measure, an apron of fine lime should be applied below the stockpile when stockpiling materials for any length of time
- minimise the surface area exposed to oxidation – consider using some form of artificial capping if storage is for longer than a few weeks
- minimise the amount of water infiltration – consider using some form of artificial capping
- establish diversion banks upslope to prevent run-on water
- establish sediment control structures to ensure sulfidic material is not eroded – consider using some form of capping.

Works that involve short term disturbance of ASS should be staged to minimise the costs associated with mitigation measures and the risk posed to the environment. In some circumstances, the sulfidic material can be reburied into anaerobic conditions as quickly as possible prior to acid generation. As a general guide, sandy soils should be reburied into anaerobic conditions within one day while clay soils should be reburied within a couple of days. Neutralising agents should be incorporated with the excavated material prior to reburial to neutralise any acid that may have been or will be produced through oxidation by excavation and reburial.

Guidelines detailing the amount of lime required to treat specific volumes of disturbed ASS are presented in ASSMAC (1998). When estimating lime requirements in accordance with ASSMAC (1998) guidelines, a safety factor of at least 1.5–2 times the weight/volume should be applied to allow for inefficient mixing of the lime and its low reactivity. In addition, the purity and effective neutralising values also needs to be included in the estimation of lime requirement, as specified in ASSMAC (1998).

5.5.3 Treatment measures

Where visual assessment, pH testing, and/or laboratory analysis of excavated soil indicates that it is acid generating, treatment will be required prior to reburial or disposal of the material.

The most common ASS treatment measure relies on blending the soil with sufficient neutralising agent. Most treatment measures will result in a partial oxidation of ASS either deliberately or inadvertently. In most cases, the natural buffering capacity of the soils will initially contribute to the neutralisation of acid produced, however, depending on the sulfide content, additional neutralising material is typically needed.

Oxidation of sulfide and neutralisation using lime or similar agents – fine agricultural lime with a pH of approximately 8.2 is the lowest cost, most widely used, and the safest neutralising material. When estimating lime requirements in accordance with ASSMAC (1998) guidelines, a safety factor of at least 1.5 to 2 times the weight/volume should be applied to allow for inefficient mixing of the lime and its low reactivity. In addition, the purity and effective neutralising values also needs to be included in the estimation of lime requirement, as specified in ASSMAC (1998).

Other more caustic neutralising agents such as magnesium hydroxide (pH 12) or slaked lime (pH 12) pose an environmental risk to estuarine ecosystems from overdosing. In addition, workplace health and safety issues need to be considered when dealing with strongly alkaline neutralising agents such as magnesium hydroxide and slaked lime.

Works that involve the treatment of large quantities of ASS should be undertaken in stages for effective neutralisation management. Where there is a level of uncertainty with the method of lime application, field trials and/or further investigations may be required.

Neutralisation success relies on effective mixing of the neutralising agents and soil. Over the longer term iron, aluminium and gypsum precipitates may coat the neutralising agents, thereby reducing their effectiveness.

Full lime treatment and gradual oxidation of ASS involves the quantity of lime required to neutralise all of the sulfidic material present (based on soil analysis results) plus a safety factor of 1.5 (refer to ASSMAC, 1998). This involves spreading out ASS in thin layers (0.15–0.3 m) over a thin bed of lime, air drying and mechanically breaking up clods as drying proceeds. When the soil is sufficiently dry, lime is applied and thoroughly mixed. The material is then monitored to confirm that treatment has been effective (in accordance with the monitoring requirements outlined in Section 5.5.4) and compacted prior to the treatment of the next layer. Effective drying and mixing of lime with clay is often very difficult. In addition the sulfide distribution in some soils can be highly variable.

Records of the volume of material and treatment measures must be recorded for the purposes of disposal. Disposal of treated potential or actual ASS is to be undertaken in accordance with the NSW EPA (2014)

Waste Classification Guidelines Part 4: Acid Sulfate Soils. Material must be disposed of at an ACT EPA licenced facility and tracked according to the procedure outlined in Section 4.3.2.

There is a potential for incidents and emergency response requirements relating to ASS issues, particularly pollution/contamination of surrounding areas and waterways from acid contamination. The emergency response procedures will include:

- immediate containment of acid runoff from stockpiles or areas of excavation by bunding
- communication between the project manager, site managers, supervisors and contractors detailing the pollution incident requiring response/action
- site inspection to assess extent of severity of the emergency/incident
- based on the assessed severity of the incident by ProjectCo, the project manager will determine the need to notify regulators potentially including the ACT EPA; notifications should detail the type and extent of potential impacts and remediation requirements
- monitoring and/or management of incidents which may include soil or groundwater sampling by a suitably qualified environmental consultant and analysis by NATA accredited laboratory, spill clean-up, investigation materials, correction of erosion control measures and remediation of affected area (if required)
- incident reporting detailing all investigation and remediation actions taken and remediation results carried out
- environmental incidents will be reported immediately to the site supervisor who will contact the project manager. All incidences will be investigated and the appropriate course of action will be taken to address the issues. Serious environmental incidents will be reported to the ACT EPA.

5.5.4 Monitoring of effectiveness of treatment

Where soils are required to be limed, materials should be tested to monitor the effectiveness of the neutralisation process. Field testing should be undertaken at a rate of one per 50 m^3, if changes in liming rates or material are observed additional samples should be collected. Laboratory testing (SPOCAS) should be undertaken at a rate of 25% of field samples (i.e. one sample per 200 m^3) to confirm the results. Results should be assessed against the criteria provided in Table 5.1.

Further assessment is necessary if any of the above have not been met.

6. Unexpected finds protocol

Contamination that may not have been detected during previous investigation works may be discovered during the course of excavation works. Such contamination may be discovered due to observations such as:

- odour
- discolouration or staining of soil or rock
- seepage of unusual liquids from soil or rock
- unusual odours or sheens on groundwater
- unusual metal objects
- presence of underground storage tanks
- presence of oil
- presence of waste or rubbish above or below ground
- potential asbestos containing material
- unusual colour in soil
- unusual colour in groundwater.

If such contamination is discovered, the following procedure will be implemented:

- excavation will cease in the vicinity of the discovery
- the ProjectCo authorised person will be informed immediately of the event
- excavation should stop and a suitably experienced environmental consultant should undertake an assessment of any unexpected finds and determine any further actions required e.g. sampling and/or validation of material, potential for remediation and/or management
- a form recording the unexpected find/s should be completed and the register updated and signed off as appropriate (see Appendix F)
- excavation will not recommence until the extent of the contamination has been assessed and, if necessary, a remedial action plan (RAP) has been prepared
- the material will be separated from other materials and stockpiled for assessment
- sampling of the materials will be undertaken in accordance with the relevant guidelines
- samples will be analysed for a range of analytes as required
- laboratory results will be assessed to determine the appropriate waste classification of the material in accordance with the Environment ACT, 2000, *ACT's Environmental Standards: Assessment & Classification of Liquid and Non-liquid Wastes*
- depending on the classification, material already excavated and stockpiled will be transported to an appropriate waste facility that is licensed to accept waste of the relevant classification or beneficially reused if appropriate
- depending on the classification, vehicles transporting the waste may need to be licensed in accordance with ACT EPA requirements. Prior to works commencing appropriate instruction shall be obtained from ACT EPA
- a waste tracking system recording the volume of material, waste classification status, removal documentation and truck and receiving landfill facility details must be recorded to ensure all waste is accounted for and disposed of appropriately in accordance with ACT EPA requirements.

Any unexpected finds should be documented in the validation report to be prepared at the completion of the work.

Unexpected finds that may include the dumping of unidentified spoil material may be identified during or after the completion of the light rail development works. If dumping of material is discovered, material must be contained and ProjectCo must be informed immediately.

7. References

Acid Sulfate Soils Management Advisory Council (1998), *Acid Sulfate Soils Assessment Guidelines*

ACT EPA (2014) *Information Sheet 4 - Requirements for the Reuse and Disposal of Contaminated Soil*

ACT Government (2014) *Dangerous Substances (Asbestos Safety Reform) Amendment Bill 2014*

ACT Government (2014) *Work Health and Safety (Asbestos) Amendment Regulation 2014*

ACT Parliamentary Counsel (1997) *Environment Protection Act*

ACT Parliamentary Counsel (2005) *Environment Protection Regulation*

ACT Government (2011) Work Health and Safety Regulation

Environment ACT (2000) ACT's Environmental Standards: Assessment & Classification of Liquid and Non-liquid Wastes

National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013

National Occupational Health and Safety Commission (NOHSC) (2005) *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres* [NOHSC:3003(2005)], NOHSC, Canberra, Australia.

Parsons Brinckerhoff (2014a), *Phase 1 Environmental Assessment – Contamination*

Parsons Brinckerhoff (2014b), *Sampling, Analysis and Quality Plan, Canberra Light Rail – Civic to Gungahlin*

Parsons Brinckerhoff (2014d) *Addenda to Phase 1 Environmental Assessment – Contamination – Cabinet in Confidence*

Safe Work Australia (2011) *How to Safely Remove Asbestos: Code of Practice*

Safe Work Australia (2011) *How to Manage Asbestos in the Workplace*

Western Australian Department of Health (2009) *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia.*

8. Limitations

8.1 Scope of services

This Contamination Management Plan (the report) has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between ProjectCo (the client) and Parsons Brinckerhoff (scope of services). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

8.2 Reliance on data

In preparing the report, Parsons Brinckerhoff has relied upon data, surveys, analyses, designs, plans and other information provided by the client and other individuals and organisations, most of which are referred to in the report (the data). Except as otherwise stated in the report, Parsons Brinckerhoff has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report (conclusions) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Parsons Brinckerhoff will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Parsons Brinckerhoff.

8.3 Environmental conclusions

In accordance with the scope of services, Parsons Brinckerhoff has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

On all sites, varying degrees of non-uniformity of the vertical and horizontal soil or groundwater conditions are encountered. Hence no monitoring, common testing or sampling technique can eliminate the possibility that monitoring or testing results/samples are not totally representative of soil and/or groundwater conditions encountered. The conclusions are based upon the data and the environmental field monitoring and/or testing and are therefore merely indicative of the environmental condition of the site at the time of preparing the report, including the presence or otherwise of contaminants or emissions.

Also, it should be recognised that site conditions, including the extent and concentration of contaminants, can change with time.

Within the limitations imposed by the scope of services, the monitoring, testing, sampling and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

8.4 Report for benefit of client

The report has been prepared for the benefit of the client and no other party. Parsons Brinckerhoff assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of Parsons Brinckerhoff or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

8.5 Other limitations

Parsons Brinckerhoff will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

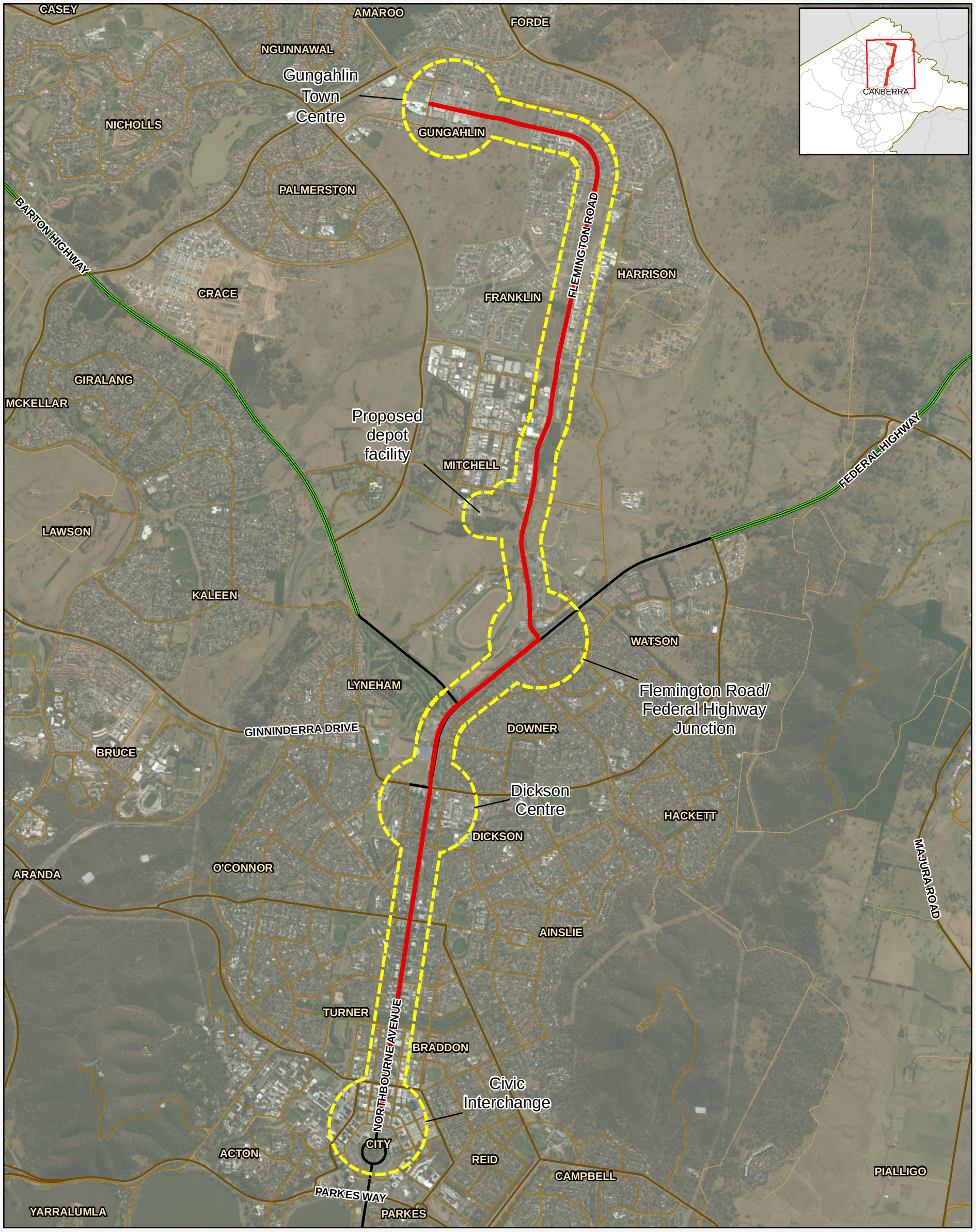
The scope of services did not include any assessment of the title to or ownership of the properties, buildings and structures referred to in the report nor the application or interpretation of laws in the jurisdiction in which those properties, buildings and structures are located.

Appendix A

Figures

PARSONS BRINCKERHOFF

CAPITAL METRO
CANBERRA'S LIGHT RAIL PROJECT



Legend
- Existing transport corridor
- Project study area

Imagery: Esri DigitalGlobe

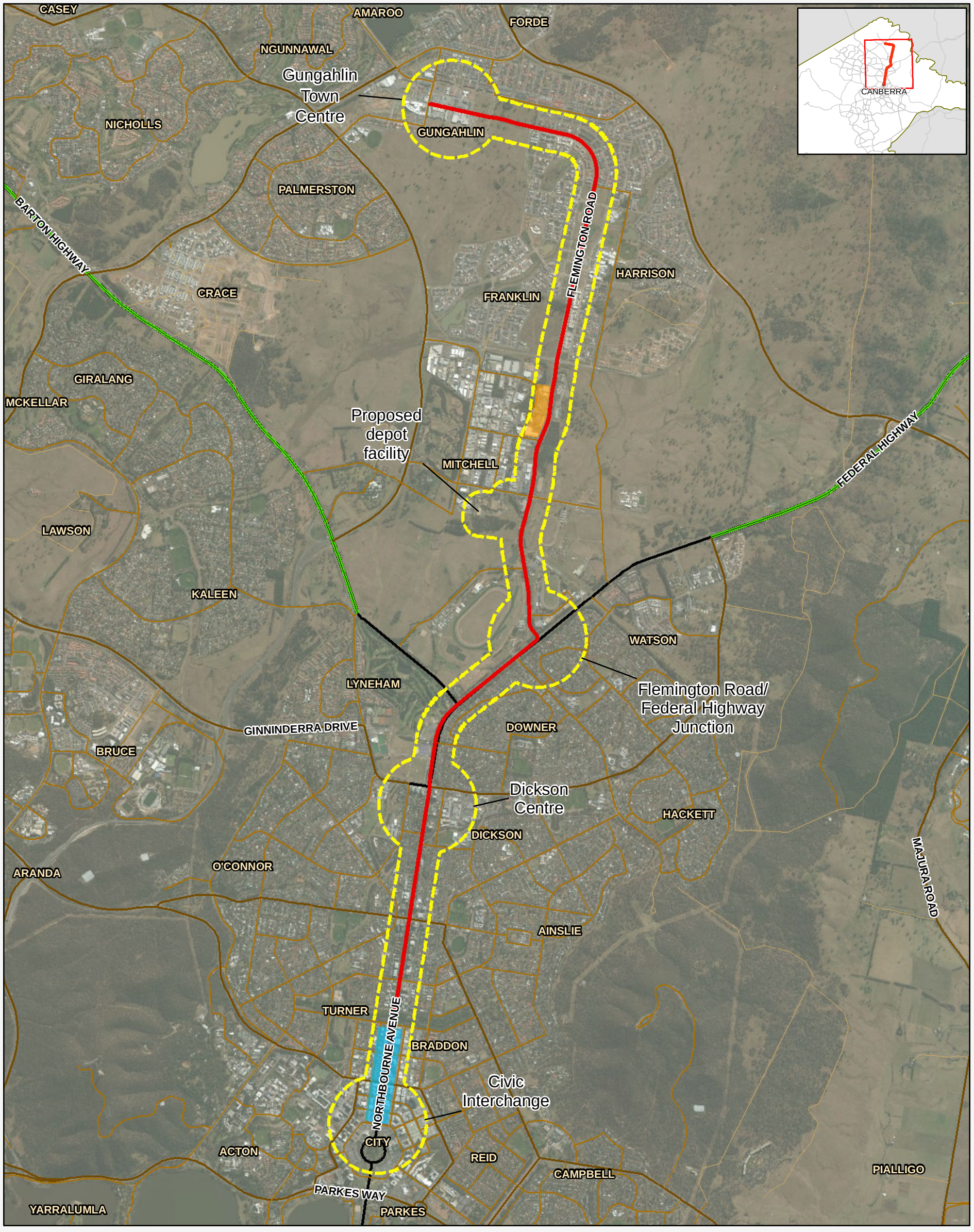
Figure 1: Route location plan

0 1 Kilometres

\\Apsydfil03\proj\AArup\2207509A_Canberra_Light_Rail_TA\10_GIS\Projects\Maps\2207509A_GIS_001_A5.mxd // SafilanK // 30/01/2015

PARSONS BRINCKERHOFF

CAPITAL METRO
CANBERRA'S LIGHT RAIL PROJECT



Legend

- Existing transport corridor
- Project study area
- Area of potential TRH in groundwater
- Area of potential chlorinated hydrocarbons

Figure 2: Areas of potential concern

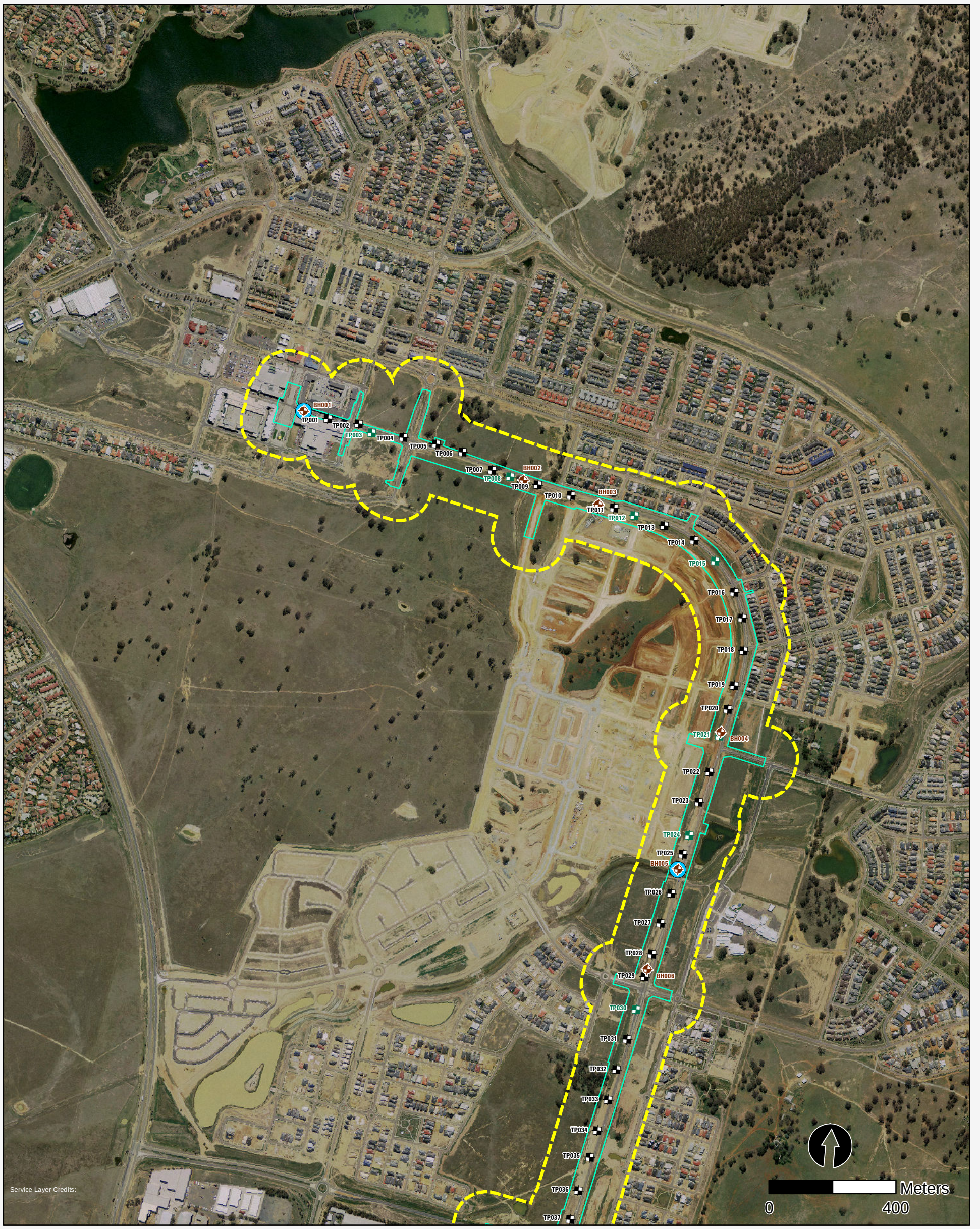
0 1 Kilometres

Imagery: Esri DigitalGlobe

\\APSYDFIL03\proj\AUArup\2207509A_Canberra_Light_Rail_TA\10_GIS\Projects\Maps\2207509A_GIS_047_A1.mxd // SafiiankK // 30/01/2015

PARSONS BRINCKERHOFF

CAPITAL METRO
CANBERRA'S LIGHT RAIL PROJECT



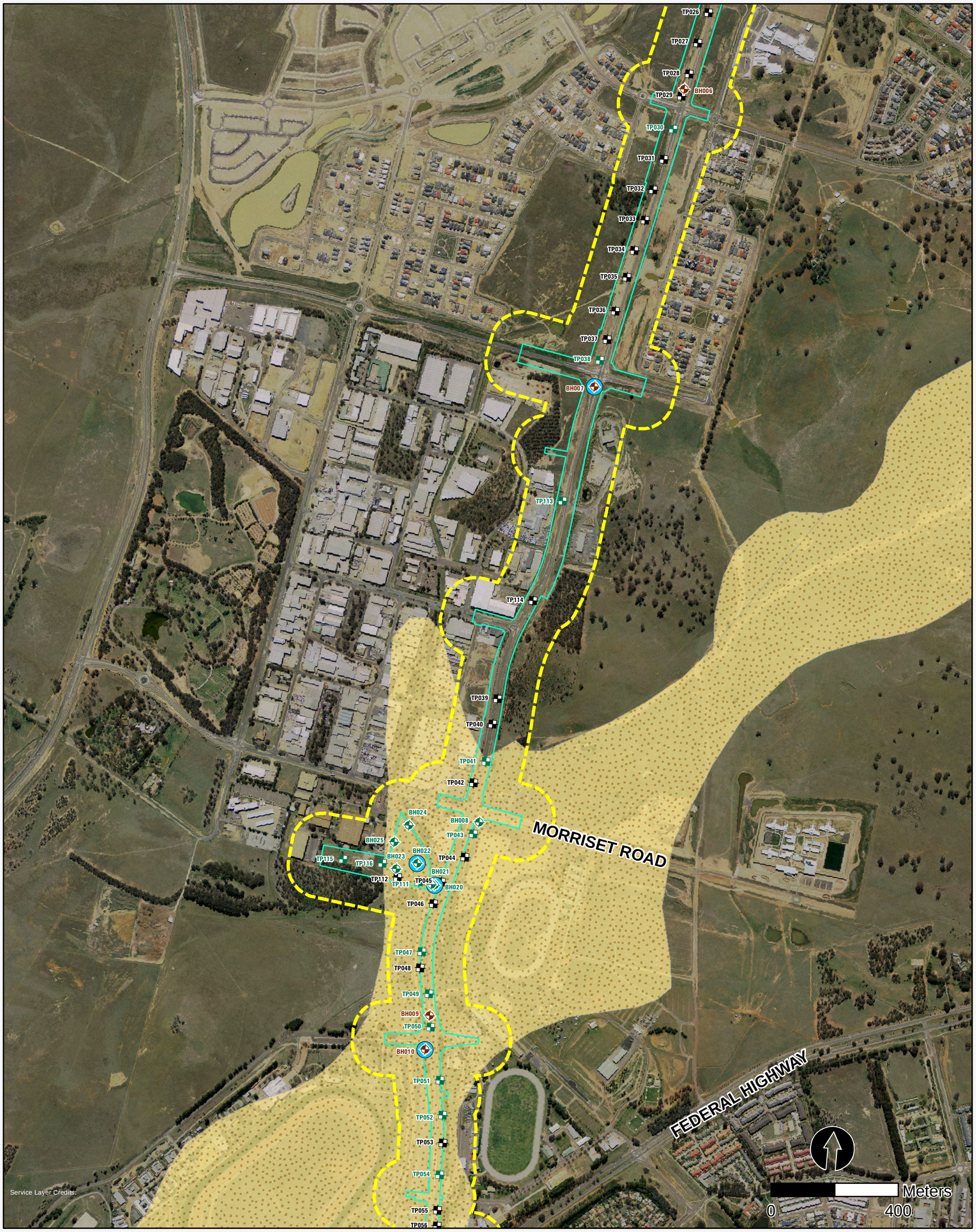
Borehole
Borehole with environmental sampling
Piezometer location
Test pit
Test pit with environmental sampling
Project study area
Preliminary Project impact boundary
Alluvium Present

Figure 3 Extent of Alluvium

Alluvium source: Abel RS, 1992, Canberra (1:100,000 Geological map)

PARSONS BRINCKERHOFF

CAPITAL METRO
CANBERRA'S LIGHT RAIL PROJECT



\\Apsydfil03\proj\A\Arup\2207509A_Canberra_Light_Rail_TA\10_GIS\Projects\Maps\2207509A_GIS_046_A2.mxd // SafiianK // 30/01/2015

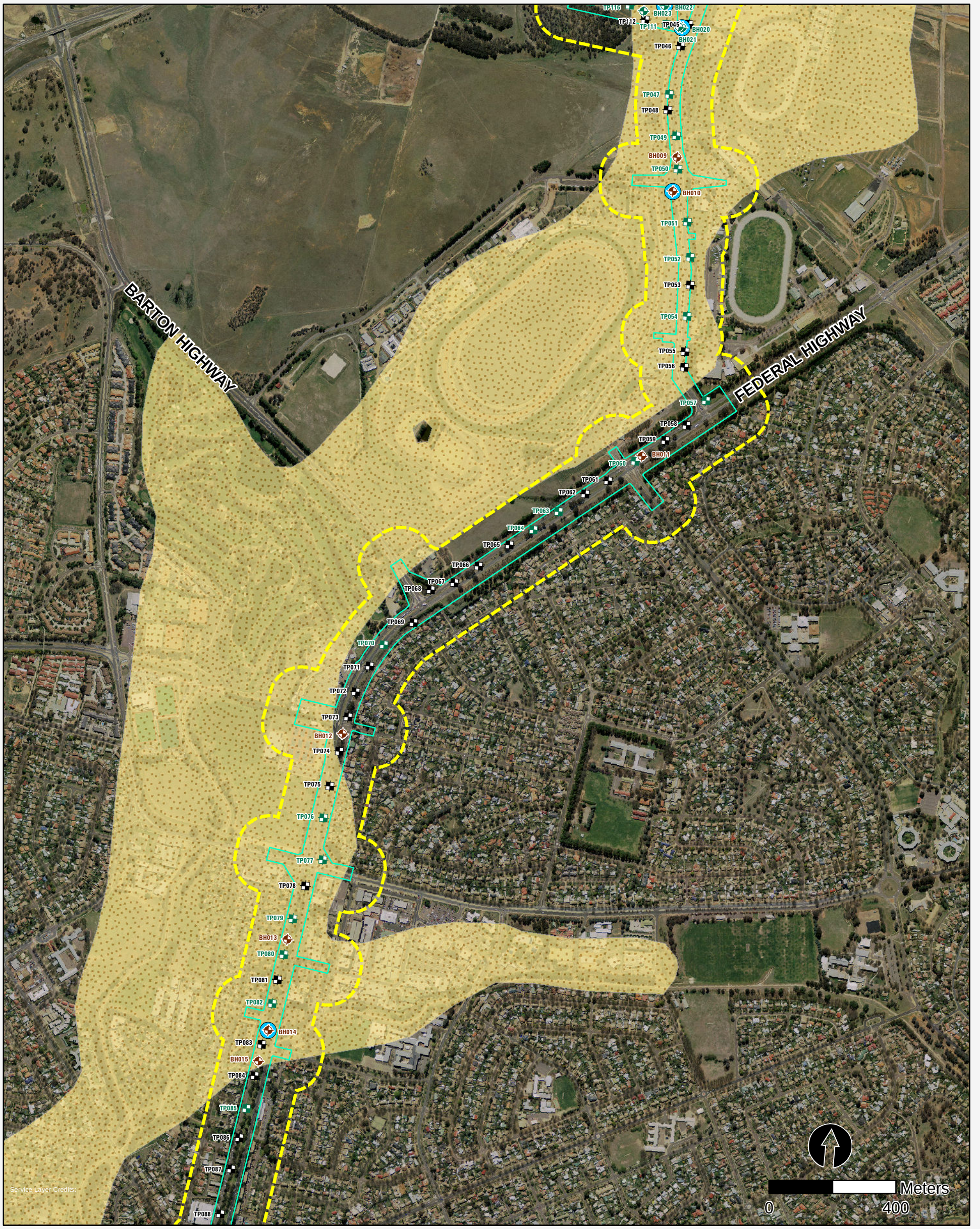
- Borehole
- Borehole with environmental sampling
- Piezometer location
- Test pit
- Test pit with environmental sampling
- Project study area
- Preliminary Project impact boundary
- Alluvium Present

Figure 3 Extent of Alluvium

Alluvium source: Abel RS, 1992, Canberra (1:100,000 Geological map)

PARSONS BRINCKERHOFF

CAPITAL METRO
CANBERRA'S LIGHT RAIL PROJECT



- Borehole
- Borehole with environmental sampling
- Piezometer location
- Test pit
- Test pit with environmental sampling
- Project study area
- Preliminary Project impact boundary
- Alluvium Present

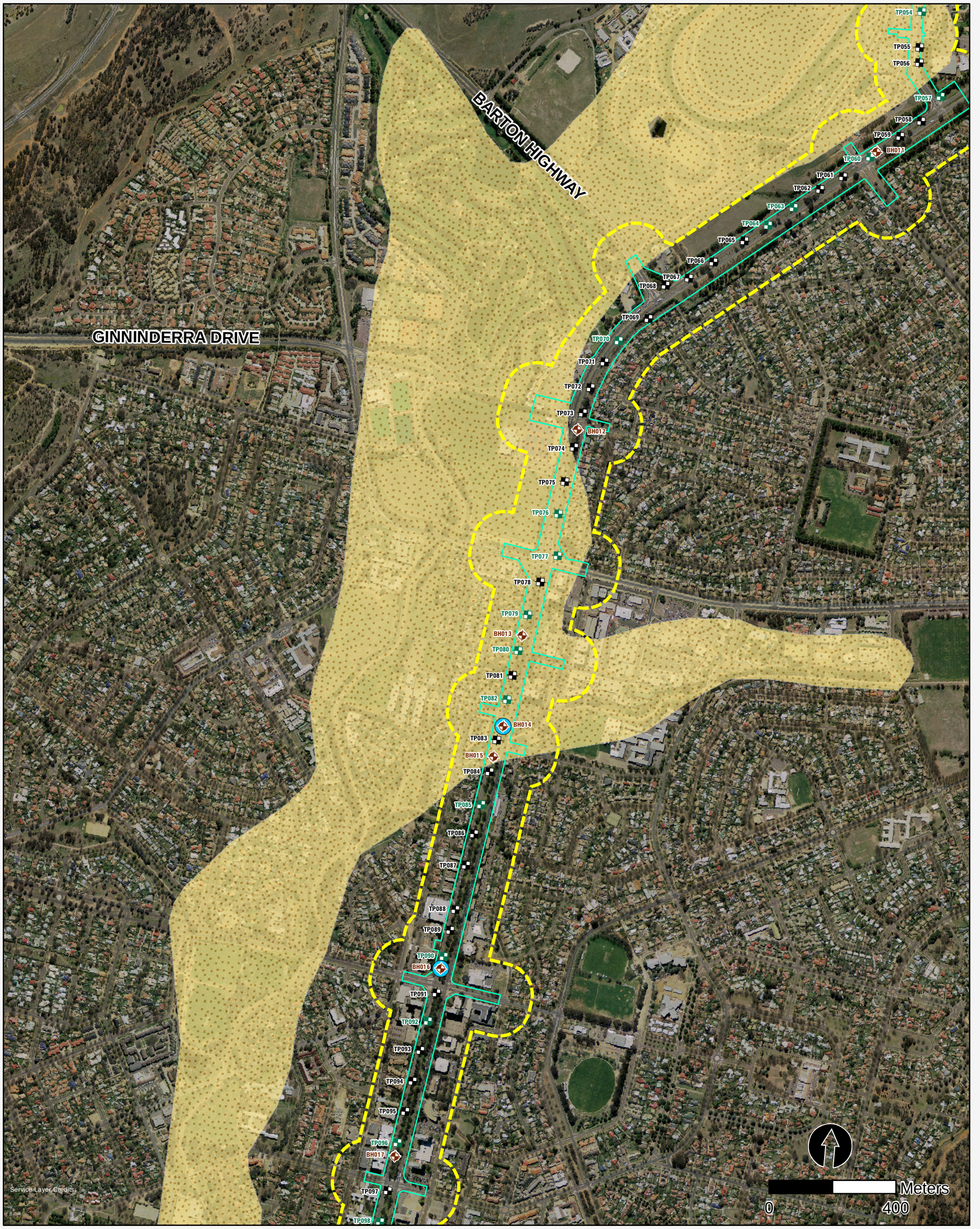
Figure 3 Extent of Alluvium

Alluvium source: Abel RS, 1992, Canberra (1:100,000 Geological map)

\\Apsydfil03\proj\A\Arup\2207509A_Canberra_Light_Rail_TA\10_GIS\Projects\Maps\2207509A_GIS_046_A2.mxd // SafiankK // 30/01/2015

PARSONS BRINCKERHOFF

CAPITAL METRO
CANBERRA'S LIGHT RAIL PROJECT



- Borehole
- Borehole with environmental sampling
- Piezometer location
- Test pit
- Test pit with environmental sampling
- Project study area
- Preliminary Project impact boundary
- Alluvium Present

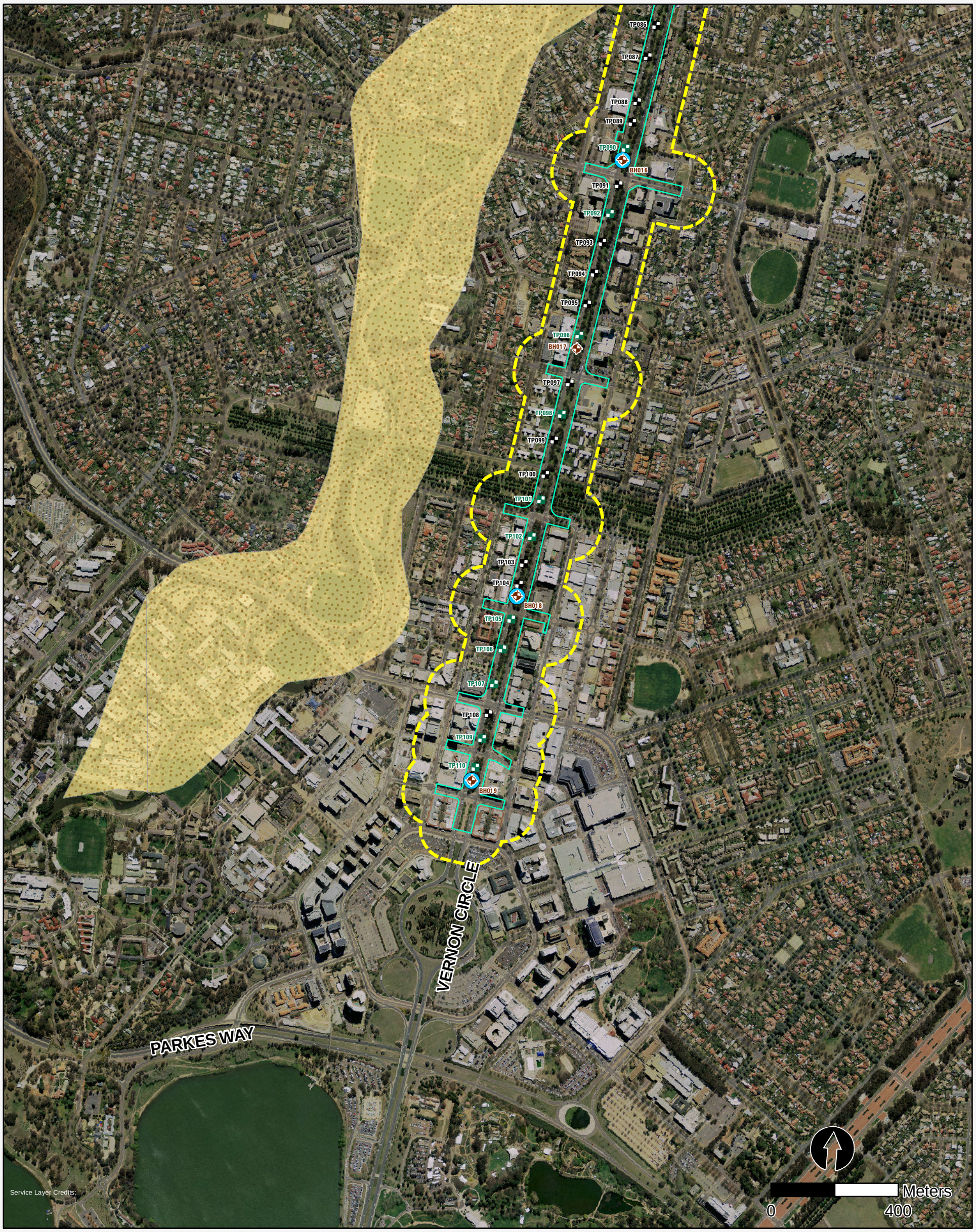
Figure 3 Extent of Alluvium

Alluvium source: Abel RS, 1992, Canberra (1:100,000 Geological map)

\\Apsydfil03\proj\A\Arup\2207509A_Canberra_Light_Rail_TA\10_GIS\Projects\Maps\2207509A_GIS_046_A2.mxd // SafiankK // 30/01/2015

PARSONS BRINCKERHOFF

CAPITAL METRO
CANBERRA'S LIGHT RAIL PROJECT



Borehole
Borehole with environmental sampling
Piezometer location
Test pit
Test pit with environmental sampling
Project study area
Preliminary Project impact boundary
Alluvium Present

Figure 3 Extent of Alluvium

Alluvium source: Abel RS, 1992, Canberra (1:100,000 Geological map)

\\Apsydfil03\proj\A\Arup\2207509A_Canberra_Light_Rail_TA\10_GIS\Projects\Maps\2207509A_GIS_046_A2.mxd // SafiankK // 30/01/2015