PURDON PLANNING

Appendix G:

Remedial Action Plan

WSP

CAPITAL RECYCLING SOLUTIONS

REMEDIAL ACTION PLAN

16 IPSWICH STREET, FYSHWICK

DECEMBER 2017

Question today
Imagine tomorrow
Create for the future

Remedial Action Plan
16 Ipswich Street, Fyshwick

Capital Recycling Solutions

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EXECUTIVE SUMMARY

Capital Recycling Solutions Pty Ltd (CRS) commissioned WSP Australia Pty Ltd (WSP) to prepare a remedial action plan (RAP) for the site located at 16 Ipswich Street, Fyshwick, Australian Capital Territory (ACT). This RAP has been developed to outline the remediation and validation strategy in relation to soil, groundwater and vapour risk to human health and the environment associated with residual on-site petroleum hydrocarbon contamination to ensure that the site is suitable for the proposed future development at the site.

The previous approval by the Site Auditor to allow ongoing commercial/industrial land use on the Site was contingent on the existing configuration of Site infrastructure being maintained and no new enclosed spaces or buildings being constructed.

Information provided by Capital Recycling on the proposed Site development indicates that they intend on utilising the Site as a rail freight terminal and materials recovery facility (MRF), which incorporates receiving and sorting of waste for recycling. This conversion of the existing commercial/industrial land use would require demolition of most of the Site structures including tanks, pipework, buildings and the rail siding, with the only infrastructure to remain on site includes the office on the west of the Site and the existing car parking in the west of the Site. A number of new enclosed spaces (e.g. offices, sheds, processing plant, storage facility, power plant) are proposed to be installed at the site as part of the MRF development.

This RAP details the methodology for removing and validating existing aboveground and underground petroleum storage systems and other relevant infrastructure to an extent suitable to facilitate the proposed land use as well as protection of proposed enclosed spaces from vapour intrusion. The RAP also assessed different options for management of groundwater and light non-aqueous phase liquid (LNAPL) migrating off-Site. details of implementation are to be incorporated into a Post-Remediation Environmental Management Plan

Based on these considerations, the preferred remedial strategy to render the Site suitable for the proposed use as a commercial/industrial facility includes the following steps:

— Ex-situ decommissioning of identified hydrocarbon contamination source infrastructure;

— Installation of suitable hydrocarbon vapour controls beneath buildings; and

— Implementation of a Post-Remediation Environmental Management Plan that includes a plan for long term protection of the vapour barrier systems, mitigation of exposure risks to workers accessing excavations and a protocol for long term monitoring of natural attenuation of the off-site groundwater plume along with contingencies.

1 INTRODUCTION

Capital Recycling Solutions Pty Ltd (CRS) commissioned WSP Australia Pty Ltd (WSP) to prepare a remedial action plan (RAP) for the site located at 16 Ipswich Street, Fyshwick, Australian Capital Territory (ACT) (refer to Table 2.1 for Site details).

This RAP has been developed to outline the remediation and validation strategy in relation to soil, groundwater and vapour risk to human health and the environment associated with residual on-site petroleum hydrocarbon contamination to ensure that the site is suitable for the proposed future development at the site.

Plans showing the location and existing layout of the whole Site are included as Figure 1 in **Appendix A-1**. The plan detailing the proposed development (i.e. an alternative waste treatment facility) is indicated on the Visual Amenity Impact document presented in **Appendix A-2** of this report.

2 SITE DETAILS

2.1 PROPOSAL SITE IDENTIFICATION

The available Site identification details are provided in Table 2.1.

Table 2.1 Site identification

ADDRESS	16 Ipswich Street, Fyshwick ACT
TITLE IDENTIFICATION	Block 9 and Block 11, Section 8, Division of Fyshwick in DP 5469 Vol: 832 Folio: 21
AREA	Approximately 3.26 hectares
LOCAL GOVERNMENT AREA	Fyshwick, ACT
ZONING	ICZ2 – Industrial Mixed Use Zone
CURRENT SITE USE	Not in use (former petroleum bulk storage depot)
PROPOSED SITE USE	Waste oil generation and /or metal recycling

2.2 SITE DESCRIPTION

The Site was the former (Shell Company of Australia (Shell)) petroleum, bulk storage depot. Based on a review of the previous investigations conducted by ENSR AECOM (2008) and AECOM (2011), the identified major features included:

- concrete/bitumen surface covering for the majority of the Site, except the rail siding area;
- a rail siding linked to the Canberra-Queanbeyan rail way in the north portion of the Site;
- a number of above ground storage tanks (ASTs) and one underground storage tank (UST);
  - to the south of the rail siding, three ASTs – one diesel (T11), one unleaded petrol (ULP) (T21) and one lead replacement petrol (LRP) (T15);
  - west of the rail siding, three ASTs – one diesel (T7), and two heating oil tanks (T12, T13);
  - further west of the rail siding – one slops recovery AST, one oil recovery UST; and
  - Two potential USTs (located with ground penetrating radar) in the south-western portion of the Site.
- a tanker filling gantry and aboveground fuel lines in the west portion of the Site;
- a fire water tank and foam plant in the south west portion of the Site, with associated above ground fire hydrant lines located across the Site;
- a garage and truck wash in the south portion of the Site;
- a Site office and interceptor in the southwest corner of the Site, next to the entrance off Ipswich Street. A network of bunding and underground drains lead to the interceptor; and
- storerooms in the south east and south west of the Site.

A review of records relating to historic and current fuel infrastructure is presented in Table 4.1.

2.3 SURROUNDING LAND USE

The surrounding land uses identified from the previous investigation conducted by ENSR AECOM (2008) includes:

Northern land use:

— Open vegetated land associated with the rail corridor (immediately adjacent to the Site boundary).

— Small waterway approximately 10 to 20 metres to the north-west of the Site

— Canberra-Queanbeyan Railway (approximately 30 m from the Site boundary).

— Retail properties, Harvey Norman Carpark (approximately 70 m from the Site boundary).

— Jerrabomberra Wetlands (approximately 550 m from the Site).

Southern land use:

— Commercial properties: an appliance retail shop, engineering workshop, Horseland.

Eastern land use:

— Scrap metal yard (observed car bodies and possible old USTs/ASTs adjacent to Site boundary).

Western land use:

— Ipswich Street.

— Undeveloped land.

— Jerrabomberra Creek (approximately 550 m from the Site).

2.4 PHYSICAL SETTING

2.4.1 TOPOGRAPHY AND GEOLOGY

Regional and local geology reported by ENSR AECOM (2008) suggests that the area of Fyshwick can be characterised by the following underlying units of geology:

— Permian aged 'Fyshwick Gravel' consisting of quartz pebble gravel and coarse sandstone.

— Middle Silurian aged calcareous shale, limestone, sandstone, tuff, porphyry and altered acid lavas.

— Quaternary sediments consisting of soil, clay, silt, sand and gravel.

Interpretation of the Canberra 1:250 000 Geological Series Sheet (1964) suggests the Site is underlain by the Permian-aged sandstone and is in close proximity to a south-east to north-west running fault, as well as the mid-Silurian aged sedimentary and volcanic formations and Quaternary sediments.

The substrata generally encountered beneath the Site in previous investigations (AECOM 2009, ENSR AECOM 2008 and as reported by URS, 2007) is comprised of shallow clay soil (ranging from 0.20-2.5m BGL) on top of weathered siltstone.

The Site slopes gently downward to the north. Directly outside the northern Site boundary is a stormwater channel/creek. An additional channel was identified on the western side of Ipswich Street, which flows across the dirt access road and into a pond. It is believed that this waterway is part of the Jerrabomberra Creek catchment.

2.4.2 HYDROGEOLOGY AND HYDROLOGY

Regional and Site-specific observations of the localised groundwater system and potential discharge zones is summarised in Table 2.2.

Table 2.2 Site-specific hydrogeology/hydrology

PARAMETER	COMMENT
Depth to groundwater	In previous investigations (ENSR 2008, AECOM 2009) groundwater has been encountered between 2.3 mBTOC (MW125S) and 9.1 mBTOC (MW134D).
Flow direction	Groundwater beneath the Site was inferred to be to the north (AECOM, 2011).
Water bearing unit	As reported by AECOM (2011) based on past investigations it appears that an aquifer exists in the weathered bedrock profile at the Site and is confined by an overlaying clay layer. Perched shallow groundwater appears to occur in the clay and clayey gravel layers in the up-gradient area of the Site. Inferred groundwater flow direction was generally north.
Potential groundwater discharge	A small waterway/stormwater drain discharging to the Jerrabomberra Creek was identified as the nearest surface water environmental receptor down hydraulic gradient of the Site. The ephemeral creek is approximately 20 m north of the Site boundary, and Jerrabomberra Creek is approximately 500 m north west of the Site. AECOM (2011) considered it unlikely that dissolved phase contaminants will migrate to this receptor.
Registered groundwater bore information	A groundwater bore search conducted by AECOM (2011) indicated that there are no registered private water extraction bores within a 500m radius of the Site.

3 RAP BACKGROUND AND CONTEXT

3.1 DATA QUALITY OBJECTIVES

Data quality objectives as outlined in the NSW EPA (2017) *Guidelines for the NSW Site Auditor Scheme* (3rd edition) and US EPA (2000) *Guidance for the Data Quality Objective Process* are required for all remediation programs. The Data Quality Objective (DQO) process should be applied to the validation programme, as described below, to ensure that data collection activities are appropriate and achieve the project objectives. The DQO process involves seven steps as follows:

— Step 1: Identify the problem.

— Step 2: Identify the decision.

— Step 3: Identify inputs to the decision.

— Step 4: Define the study boundaries.

— Step 5: Develop a decision rule.

— Step 6: Specify limits on decision errors.

— Step 7: Optimise the design for obtaining data.

The seven DQO steps for this project are defined in Sections 3.1.1 to 3.1.7.

3.1.1 STEP 1 – STATE THE PROBLEM

The Site has been planned to be re-developed into a material recycling facility (MRF) and rail freight terminal. Previous investigations have identified contaminated soil and groundwater that requires remediation and / or management.

The problem is how the Site will be remediated / managed to address the identified potential health and environmental risks in relation to the identified contamination, and if the remediation / management measures can be integrated into the proposed re-development works and construction methodologies to avoid large scale earth disturbance or generation of significant quantities of waste requiring off-Site disposal.

The matters considered within the validation strategy are:

— How many soil, groundwater and vapour validation samples should be collected to validate the Site?

— What sampling design (i.e. locations, layout, frequency) should be used to achieve the DQOs?

— How is performance of engineering protection of potential receptors going to be validated?

— What other validation is required (i.e. survey data, visual assessment) to validate the remediation strategy)?

3.1.2 STEP 2 – IDENTIFY THE DECISION

The aim of the validation program is to collect sufficient data to verify that the remediation has been carried out satisfactorily.

The decision to be made is whether the remediation has made the Site suitable for its intended uses. Questions to be answered include:

— Have all potentially fuel contaminating Site infrastructure present on the Site been removed?

— Have sensitive receptors (e.g. occupants of enclosed Site structures) been adequately protected from hydrocarbon vapours?

- Has the vapour protection barrier been demonstrably installed correctly?
- Is imported material acceptable for use on the Site?
- Is the spoil material to be disposed off-Site classified in accordance with waste classification guidelines?
- Are ground gas mitigation measures adequate?
- Have all materials disposed off-Site gone to an appropriately licensed facility under correct Waste Classification documentation?
- Is a plan in place for ongoing management of impacted groundwater migrating off-Site?

3.1.3 STEP 3 – IDENTIFY INPUTS TO THE DECISION

The validation program should be designed to provide sufficient information to allow a sound scientific and statistical evaluation of the questions set out in Section 3.1.2. This will be achieved by:

- exploratory excavation in the area of potential USTs.
- collation of survey data to confirm capping extent and thickness.
- sampling and analysis program for validation or waste classification purposes.
- visual inspection of Site areas, soils, and ground works on a regular basis.
- Implementing gas protection validation procedures and preparation of a verification report.
- post-construction ground gas and vapour monitoring.

In addition, where spoil material validation/classification and VENM/ENM validation are required:

- collection of soil samples to provide statistically valid data sets upon which to base subsequent decisions.
- comparison of the soil analytical data to applicable guidelines (as defined in Section 3) to evaluate the potential for contamination to adversely impact upon human health and/or environmental receptors.

3.1.4 STEP 4 – DEFINE THE SITE BOUNDARIES

The lateral boundaries of the remediation area are the boundaries of Block 9 and Block 11, Section 8 – Division of Fyshwick in DP 5469 Vol: 832 Folio: 21, as shown Figure 1, **Appendix A-1**. The vertical study boundary is nominated to extend to the required depth for the redevelopment, including service trenches. Material generated during piling works (depth to be decided) will require assessment for either on-Site re-use or off-Site disposal.

The ongoing delineation of the lateral extent of the off-Site migration of identified hydrocarbon plumes will be the subject of the Post-Remediation Environmental Management Plan and not this RAP (refer to Section 9 for further details).

3.1.5 STEP 5 – DEVELOP A DECISION RULE

The decisions associated with accepting data in relation to soil sampling will be assessed with reference to the chosen Site investigation levels, which were established within the framework of guidelines made or approved by the ACT EPA.

- Should unforeseen contamination be identified in the fill material which cannot be managed by the preferred capping strategy, then the proposed remedial strategy (capping) will require re-evaluation in the context of these findings and in compliance with the Unexpected Finds Protocol presented in Section 8.13.
- If the answers to the all the questions in Section 3.1.2 are yes, then the remediation will be considered successful and the partial Site will be considered suitable for the proposed commercial use.

3.1.6 STEP 6 – SPECIFY ACCEPTABLE LIMITS ON DECISION ERRORS

In general, a probability that 95% of data will satisfy the data quality indicators (DQIs) is considered acceptable for sample analytical testing, therefore a limit on the decision error will be 5% that a conclusive statement may be incorrect. The potential for significant decision errors are to be minimised by completing a robust QA/QC program and by completing a validation program that has an appropriate sampling and analytical density for the purposes of the assessment and that representative sampling is undertaken.

Proposed acceptable limits on decision errors associated with vapour barrier construction prior to final construction of the slab are that the barriers have been installed as per the requirements of this RAP (including using proprietary materials and specially trained contractors), the post installation verification inspections have not identified any tears in the barriers, all joins tested are appropriately sealed and leak testing undertaken by the contractor have either identified leaks for repair of no leaks.

3.1.7 STEP 7 – OPTIMISE THE DESIGN FOR OBTAINING DATA

DQIs for completeness, comparability, representativeness, precision and accuracy should be used to optimise the design for obtaining data. The DQIs for sampling techniques and laboratory analysis of collected samples identifies the acceptable level of error for the validation. For inorganic analytes, a nominal acceptance criterion of +/- 30% relative per cent difference (RPD) for field duplicates and splits is selected. For organic analytes, a nominal acceptance criterion of +/- 50% RPD for field duplicates and splits is selected. However, it is noted that this may not always be achieved, particularly in heterogeneous soil or fill materials, or at low analyte concentrations.

3.2 SUMMARY OF PREVIOUS SITE INVESTIGATIONS AND REMEDIATION WORK

WSP have undertaken a detailed review of historic contamination assessment and remediation works completed in relation to the Site. The discussion below is based upon review of the following reports (listed in chronological order):

- PPK Environment & Infrastructure (PPK) 1999, *Phase II Environmental Site Assessment, Canberra Railway Station and Rail Corridor – Shell Extract*
- Woodward Clyde 1999, *Preliminary Investigation of Shell Canberra Depot, 16 Ipswich Street, Fyshwick, ACT*
- IT Environmental (IT) 2004, *Canberra Depot – Stockpile Sampling Letter Report*
- IT Environmental 2005, *Environmental Site Assessment Report, Shell Canberra Depot (ACM107C) 16 Ipswich Street, Fyshwick ACT*
- IT Environmental 2006, *Environmental Site Assessment Report, Shell Canberra Depot (ACM107C) 16 Ipswich Street, Fyshwick ACT*
- Coffey Environments (Coffey) 2006, *Factual Groundwater Monitoring Event, Shell Canberra Depot (ACM107C) 16 Ipswich Street, Fyshwick ACT 2609*
- Coffey Environments 2007, *Factual Groundwater Monitoring Event, Shell Canberra Depot (ACM107C) 16 Ipswich Street, Fyshwick ACT 2609*
- URS 2007, *Human Health and Environmental Risk Assessment, Shell Canberra Depot, 16 Ipswich Street, Fyshwick, ACT*
- ENSR AECOM 2008, *Comprehensive Environmental Site Assessment, Shell Canberra Depot, 16 Ipswich Street, Fyshwick, ACT.*
- AECOM 2010, *Delineation Environmental Assessment, Shell Canberra Depot, 16 Ipswich Street, Fyshwick, ACT.*

- AECOM 2011, *Human Health and Environmental Risk Assessment, Shell Canberra Depot, 16 Ipswich Street, Fyshwick, ACT.*
- Environmental Consulting Services 2017, *Environmental Management Plan, 16 Ipswich Road, Fyshwick ACT.*
- GHD 2017, *Site Audit Report and Site Audit Statement, 16 Ipswich Street, Fyshwick, ACT*

3.2.1 PPK ENVIRONMENT AND INFRASTRUCTURE (1999)

In 1999 PPK was commissioned by INDEC Consulting to carry out a soil and groundwater contamination investigation at the Canberra Railway Station and a stretch of rail corridor spanning the suburbs of Fyshwick and Kingston. The investigation covered the rail corridor only and did not specifically target the Shell Site. The scope of works comprised desktop assessment, a Site walkover, drilling of soil boreholes and installation and sampling of groundwater monitoring wells.

The investigation identified localised soil and groundwater hydrocarbon contamination along the eastern portion of the rail corridor which was attributed to migration onto the corridor from the Shell Site. The contaminants identified in the investigation included high concentrations of benzene, toluene, ethylbenzene and xylenes (BTEX), total petroleum hydrocarbons (TPH) and some lead and polycyclic aromatic hydrocarbons (PAH).

3.2.2 WOODWARD CLYDE (1999)

Following this off-Site investigation, Woodward Clyde was engaged in 1999 by Shell Services International (Shell) to undertake a Preliminary Investigation of the Shell Site. The investigation was predominantly a desktop assessment which utilised Site records, aerial photographs, historic title searches and other documentary sources to detail the Site history from 1955 when the Site was largely vacant pastureland to 1965 when the aerial photographs indicate that the Site was under redevelopment for industrial purposes through to 1999. The Preliminary Investigation also discusses a groundwater monitoring event (GME) undertaken by Woodward Clyde in July 1999 on the off-Site wells previously installed by PPK. The key findings of this investigation relating to potential contamination sources (and excluding the findings of the PPK Investigation) were as follows:

- Product loss of between 80 and 100 litres was recorded by Shell between June and October 1993;
- Product loss of between 6 and 900 litres was recorded by Shell between June and August 1994;
- Evidence of general petroleum product spillage was noted on the Site during a property inspection by Judd Shutter Property Services in May 1994;
- Product loss of between 5 and 27.6 litres was recorded by Shell between April and July 1996;
- A 2.5 KL diesel tank was approved by ACT Government to be removed by Rainbow Environmental Services in January 1997;
- Product loss of 50 litres of Unleaded Petroleum was recorded by Shell in June 1997;
- Product loss of between 5 and 70 litres was recorded by Shell between March and September 1998; and
- In July 1999 Woodward Clyde undertook a GME in selected off-Site wells constructed during the PPK investigation. The GME confirmed the previous results presented by PPK that off-Site groundwater had been affected by hydrocarbon contamination.

The historical information presented in this report presents a recorded history of spills and housekeeping issues relating to product storage and use on-Site as well as an indication of off-Site impacts in the adjoining rail corridor.

3.2.3 IT ENVIRONMENTAL (2004)

IT were engaged in 2004 to undertake testing of soil samples in an on-Site stockpile for assessment of suitability either for reuse on-Site or off-Site disposal. The testing found elevated TPH and lead concentrations but found the material suitable for reuse on-Site or disposal off-Site as Inert Waste under the ACT Government Waste Classification Scheme.

3.2.4 IT ENVIRONMENTAL (2005)

Off-Site identification of soil and groundwater contamination and on-Site desktop and preliminary soil testing indicated the Shell Canberra Depot had the potential to act as a source of hydrocarbon contamination of soil and groundwater. Shell engaged IT in 2005 to undertake an Environmental Site Assessment (ESA). The objectives of the ESA were to investigate groundwater conditions at the Site and close out any risk off-Site (specifically with relation to the rail corridor to the north and north-west).

The investigation was targeted at delineating soil and groundwater contamination to facilitate a risk assessment. The scope comprised drilling of eight boreholes for collection of soil samples and installation of on-Site groundwater monitoring wells which were then sampled.

The laboratory testing indicated exceeding concentrations of light end hydrocarbons (C_6-C_9 fraction) and BTEX compounds were present in elevated concentrations within the vicinity of the rail sidings to depths potentially exceeding the depth of the boreholes (11 metres below ground level). Heavier end hydrocarbons (C_{10}-C_{36}) were identified proximal to several semi-buried tanks vertically delineated to a depth of 6.0 metres below ground level. Both light and heavy end hydrocarbons were identified around the fill gantry in the west of the Site. Exceeding concentrations of heavy end hydrocarbons were also identified downgradient from the heating oil ASTs (T12 and T13) in the west of the Site to a depth of 6.0 metres below ground level.

Elevated concentrations of both TPH and BTEX, and LNAPL were identified in the newly installed wells as well as the PPK off-Site monitoring wells. IT concluded that the majority of hydrocarbon impact to groundwater appears to be derived from a combination of diesel and petroleum fuel from the filling gantry and the rail siding. IT undertook fingerprinting of the LNAPL in MW3 (located in the centre of the Site between the rail sidings). The result indicated that the LNAPL comprised a mixture of degraded petroleum (90%) and diesel (10%) which had been in the environment for between 10 and 25 years.

3.2.5 IT ENVIRONMENTAL (2006)

Following the 2005 ESA, IT were engaged to undertake a further ESA (report date 2006). At the time of the report the Site was still being used for storage and bulk distribution of diesel, heating oil and petroleum products. The objective of this assessment was to further delineate the results of previous contamination assessments especially in relation to off-Site contamination risks to the north-east of the Site. The scope involved the drilling of a further 16 boreholes and conversion of all boreholes into groundwater monitoring wells. Soil samples were collected from all new boreholes and groundwater samples were collected from all new monitoring wells as well as historical wells GW2 and GW4. In addition to these samples, surface water samples were collected from the small waterway to the north-east of the Site.

The results of the soil and groundwater sample analysis found elevated contamination across a number of monitoring points. LNAPL Fingerprinting was undertaken in MW14 during the current round of investigation (situated to the north-east of the rail sidings). The LNAPL was found to comprise degraded petroleum (24%) and diesel (76%). The diesel component was found to have been in the environment for between 3 and 11 years and the petroleum component was aged at between 6 and 16 years.

The two surface water samples collected from the small waterway to the north-east were found to contain low levels of heavy end hydrocarbons and phenolic compounds. Due to the industrial nature of the surrounding area the exact source of this contamination could not be determined.

3.2.6 COFFEY ENVIRONMENTS (2006 AND 2007)

Coffey were engaged to undertake groundwater monitoring events in 2006 and 2007 by Shell. In 2006 this involved gauging of levels in 19 monitoring wells and sampling of twelve monitoring wells. LNAPL was identified in six monitoring wells (MW3, MW7, MW9, MW10, MW14 and GW4) ranging in thickness from 0.003m in GW4 to 5.249m in MW3. Additionally, TPH, BTEX, lead and some PAH compounds were detected in elevated concentrations dissolved in the groundwater in a number of monitoring wells.

During the 2007 monitoring round, Coffey undertook gauging in 19 monitoring wells and sampled 13 monitoring wells. LNAPL was identified in six monitoring wells (MW3, MW7, MW9, MW10, MW14 and GW4) ranging in thickness from 0.002m in MW9 to 2.541m thickness in MW3. Lead, benzene, ortho-xylene and naphthalene results were found to exceed the adopted criteria in a number of monitoring wells and elevated TPH was also identified across the well network.

3.2.7 URS (2007)

URS were engaged to undertake a Human Health and Environmental Risk Assessment (HERA) for the Site based upon the various environmental investigations and groundwater monitoring events carried out to date. The HERA involved quantification of human health risk of potential exposures to petroleum hydrocarbons that may be derived from operations at the Shell Canberra Depot, identified in soils and groundwater beneath the Site and off Site towards the Canberra Queanbeyan Railway. The ecological risk component was only undertaken in a qualitative manner.

Three key receptor groups were identified in the risk assessment: future on Site commercial workers, intrusive maintenance workers and off Site commercial workers. Receptor pathways evaluated included commercial worker inhalation of volatile COPC on-Site (from soil and groundwater) and off-Site (from groundwater) and maintenance worker inhalation of volatile COPC (from groundwater) off-Site. In all cases the main exposure route was deemed to be through inhalation of vapour.

For current on and off-Site commercial workers the assessment concluded that the risks associated with soil and groundwater were low and acceptable. However, it was noted, that for future on Site commercial workers, the risks would need to be reassessed in the event of any redevelopment including the construction of a building with a basement. It was also noted that exposure via inhalation of volatiles arising from contaminated soils was likely to be underestimated due to soils not being sampled from the tank farm, UST, transfer lines and AST areas. For intrusive workers the assessment concluded that the risks associated with groundwater were considered low and acceptable. For environmental risks the nearest surface water receptor identified was the stormwater channel/creek and Jerrabomberra Creek. Due to data gaps for off Site delineation and information availability for the stormwater channel/creek, the investigators concluded that they were unable to determine whether the hydrocarbon impacted groundwater could adversely affect the water quality

3.2.8 ENSR AECOM (2008)

Following the HERA, ENSR AECOM was engaged to undertake a further ESA in 2008. The aim of this ESA was to delineate the approximate extent of LNAPL and dissolved phased hydrocarbons previously identified at on-Site and off-Site locations and to fill the data gaps identified by URS in their HERA.

Impacted soil was identified on and off-Site in the fill, clay and weathered siltstone profile. LNAPL and dissolved phase hydrocarbons including TPH, BTEX and lead was detected in both on-Site and at off-Site monitoring well locations. Visual and olfactory observations made during the ESA confirmed the shallow soil profile is impacted across the Site (ranging between depths of 0.3 to 7 m below ground level).

Results of the sampling indicated that adopted soil assessment criteria were exceeded for both light end and heavy end TPH, benzene, total xylene and lead.

Dissolved phase hydrocarbon and phase separated hydrocarbon impacted groundwater was identified on and off-Site in shallow/perched groundwater and in deep groundwater. Groundwater impact was not identified west of Ipswich Street or north of the Canberra-Queanbeyan Railway Corridor.

Where groundwater assessment criteria exist, they were exceeded for benzene total xylene naphthalene and lead in shallow wells and total xylene in deep wells.

In addition to the analytical results described above LNAPL was observed in four monitoring wells on and off-Site, as summarised below:

— On-Site well MW126D, located within the rail siding in the northern portion of the Site; and

— Off-Site wells MW14, MW110 and MW117D, located to the north of the Site in the open land associated with the rail corridor.

The potential sources of contamination identified on-Site include five AST tanks, the filling gantry and associated fuel lines, the rail siding and associated pumping infrastructure, former semi buried tanks in the centre of the Site, possible former drum storage area (raised car park). Based on the observations during the drilling of BH123S, there is the potential for a further source of contamination to be present in this south-western portion of the Site.

3.2.9 AECOM (2010)

AECOM undertook further investigations in 2010. The specific objectives of the project were to complete an ESA to delineate previously identified off-Site groundwater contamination and LNAPL impacts to the north of the Site and to assess potential presence of current or former underground source in the car park area of the Site.

Results of the investigation indicate

— The GPR survey indicated the presence of two potential UST's beneath the on-Site car park located in the south-western portion of the Site;

— TPH (C_6-C_9) impact in shallow soil was detected in three locations (BH136, BH137 and BH138) in the on-Site carpark, however petroleum hydrocarbon impact to groundwater was not detected in the new monitoring wells;

— No petroleum hydrocarbon impact was detected in soil and groundwater samples from the locations within the Harvey Norman car park. Elevated dissolved phase petroleum hydrocarbon impact was detected in a number of existing wells and LNAPL was detected in three deep wells, with a thickness of approximately 8 m in MW126D (on-Site), 1.4 m in MW14 (off-Site) and 0.067 m in MW117D (off-Site); and

— Concentrations of TPH (C_6-C_9) and TPH (C_{10}-C_{36}) were detected in the surface water samples collected from the offSite waterway to the north-east.

3.2.10 AECOM (2011)

Following on from the additional monitoring and delineation assessment undertaken by AECOM, an updated HERA was prepared in 2011. The objective of the HERA was to assess whether hydrocarbon contamination detected at the Site and at off-Site locations may pose an unacceptable risk to human health or environmental receptors.

This assessment considered the risks to current and potential future on-Site commercial workers via exposure from incidental ingestion and/or dermal absorption of soil, inhalation of dust and inhalation of vapours derived from soil or groundwater following transport to indoor or outdoor air.

The assessment estimated that there were potentially unacceptable non-threshold risks to potential future Site users occupying buildings constructed over areas of the most significantly contaminated soil from inhalation of benzene (Hazard Index (HI) of 1.27) and toluene (HI of 1.14) vapours derived from soil contamination. Groundwater contamination was not estimated to give rise to unacceptable threshold risks.

Current Site users were not considered to be at unacceptable risk as the risk-driving pathway was via indoor inhalation of vapours derived from soil contamination, as soil contamination has not been observed above the Site Specific Target Levels (SSTLs) derived in this assessment, in the area sampled around the current buildings.

Fate and transport modelling indicated that after 100 years of steady state conditions that benzene would not be detectable at approximately 50 m from the source area. According to the HERA, LNAPL was not considered likely to pose an unacceptable vapour intrusion health risk at the Site.

3.2.11 GHD (2017) AND ENVIRONMENTAL CONSULTING SERVICES (2017)

A Site Audit Report (SAR) and Site Audit Statement (SAS) was prepared for the Site (ACT EPA Ref ACT02-2126014). The audit was non-statutory and was undertaken to demonstrate the Site is suitable for continued commercial industrial land use. The SAR was undertaken by Andrew Kohlrusch of GHD. The Site Auditor is accredited under the NSW *Contaminated Land Management Act 1997* and is thereby approved as an Environmental Auditor in the ACT under Section 75 of the *Environment Protection Act 1997*.

GHD undertook the Site Audit for Access Trading Company Limited who had acquired the Site from Shell for ongoing commercial/industrial land use. We note that GHD undertook a review of the AECOM 2010 and 2011 reports as well as a Site validation report and Environmental Management Plan (EMP) prepared by ECS in June 2017. The validation report was not available for review when preparing this RAP but the EMP was available. The main long term method of contamination risk mitigation put forward by the EMP for ongoing operation of the Site was as follows:

"*It is proposed that the construction of buildings or enclosed spaces be prohibited at the Site to mitigate the potential for vapour intrusion into buildings constructed over contamination which could result in a vapour inhalation risk to Site occupants.*"

The Site Auditor has based the sign-off the Site on the assumption that the above restriction on construction of buildings and enclosed spaces is upheld.

On the basis of the information reviewed as part of the audit the Site Auditor considered that the Site is suitable for commercial industrial land use provided the position of Site infrastructure does not change and there are no additional buildings constructed.

3.3 PROPOSED FUTURE SITE DEVELOPMENT

As indicated in Section 3.1.11 above, the approval by the Site Auditor to allow ongoing commercial/industrial land use on the Site was contingent on the existing orientation of Site infrastructure being maintained and no new enclosed spaces or buildings being constructed.

Information provided by Capital Recycling Solutions on the proposed Site development indicates that they intend on utilising the Site as an MRF and rail freight terminal which incorporates receiving of waste for the purpose of recycling. This conversion of the existing commercial/industrial land use would require demolition of the majority of Site structures including tanks, pipework, buildings and the rail siding. The only existing infrastructure proposed to be utilised by Capital Recycling Solutions includes a shed in the west of the Site and the existing car parking in the west of the Site.

A summary of new larger infrastructure items proposed as part of the works includes the following:

- Administration building: 303 m^2 area;
- Waste receival and MRF processing shed: 7,250 m^2 area;
- Educational/research centre: 180 m^2 area; and
- Two weighbridges and office location.

These structures comprise approximately 7,733m^2 of new Site structures. No basement levels are proposed as part of the works and the structures are proposed to be constructed on slab on grade.

With the exception of the existing vegetated area of the Site in the north-west corner and the unpaved area along the eastern roadway, the majority of the Site will be on hardstand.

Appendix A-2 presents a conceptual plan of the proposed future Site development.

4 CONCEPTUAL SITE MODEL

The conceptual Site model (CSM) was adapted from the HERA (AECOM, 2011). The CSM incorporates Site setting details, contamination concentrations, the geology, hydrogeology and surrounding land uses in order to identify potentially significant source-pathway-receptor (SPR) linkages in relation to potential risks to human health and the environment.

4.1 SUMMARY OF SITE CONTAMINATION STATUS

The contamination status of the Site is provided in the following sections.

4.1.1 SOIL

The following contamination summary was provided by AECOM (2011):

Soil results indicate exceedances of TPH (C_6-C_9), TPH (C_{10}-C_{36}), benzene, total xylenes and one sample with detection of lead. Samples exceeding guideline concentrations were predominantly located in the rail siding and main carpark areas.

4.1.2 GROUNDWATER

AECOM (2011) note where groundwater assessment criteria exist for petroleum hydrocarbons, they were exceeded for benzene, toluene, ethylbenzene, total xylene and naphthalene.

LNAPL was detected in four wells during June 2008 (MW110 and three wells during December 2009.

For heavy metals the ANZECC (2000) Fresh Water Guidelines for groundwater were exceeded for chromium, lead and zinc.

4.1.3 CONTAMINANTS OF POTENTIAL CONCERN

The COPCs identified on Site by AECOM (2011) were benzene, total xylene and TPH (C_6-C_9), TPH (C_{10}-C_{36}) in soil and TPH (C_{10}-C_{36}), benzene, toluene, ethylbenzene, total xylene, lead, naphthalene and LNAPL.

The presence of LNAPL in groundwater as well as TPH and monocyclic aromatic hydrocarbons in soil and groundwater indicate a potential vapour risk both on and off-Site.

It should be noted that surface water samples collected from the off-Site waterway to the north-west indicate impact from hydrocarbons and phenolic compounds. However, due to the heavy commercial and industrial land use of the surrounding area the source of this contamination cannot be properly defined.

LNAPL Fingerprinting analysis undertaken on two samples from separate monitoring wells indicate that the LNAPL in the groundwater is derived from both diesel and petroleum sources and that the age of both hydrocarbon types in the environment varies. This indicates that the contamination on the Site is the result of multiple releases from several sources over an extended time period.

As noted in Table 4.1 below, a firefighting foam plant has been noted at the Site, and thus per- and polyfluorinated alkyl substances (PFAS) are also considered to be a COPC. Based on the available reports, assessment of PFAS has not been conducted at the site, and therefore the assessment and management of PFAS is to be dealt with separately, and is beyond the scope of this RAP.

4.2 POTENTIAL SOURCES

The table below presents a list of potential on-Site sources of hydrocarbon impact to on-Site and off-Site soil and groundwater quality.

Table 4.1 Potential On-Site Contamination Sources

ITEM	DETAILS	LOCATION	STATUS	INFORMATION SOURCE
Tanks T1-T6 and T8-T10	Tanks installed pre-1985. 8 tanks contained leaded petrol, 1 contained kerosene, 1 contained diesel.	Inferred to be in central west of Site near truck wash	Removed in 1991. Nature of removal and validation unknown	Woodward Clyde 1999
Storage Tank	2.5KL diesel tank	Unknown	Approval for removal by Rainbow Environmental Services in 1997. Assumed removed	Woodward Clyde 1999
AST	700KL diesel tank (T11). Pre-1972 installation.	Central south of the Site	Still present on-Site based on reports	Woodward Clyde 1999, ENSR AECOM 2008
AST	900KL leaded petrol tank (T15). Pre-1976 installation.	Central south of the Site	Still present on-Site based on reports	Woodward Clyde 1999, ENSR AECOM 2008
AST	1,800KL unleaded petrol tank (T21). 1977 installation.	Central south of the Site	Still present on-Site based on reports	Woodward Clyde 1999, ENSR AECOM 2008
ASTs	50KL heating oil ASTs (T12 and T13). Pre-1977 installation.	West of the Site	Still present on-Site based on reports	Woodward Clyde 1999, ENSR AECOM 2008
AST	13.6KL diesel tank (T7). Unknown installation date.	West of the Site near T12 and T13	Still present on-Site based on reports	Woodward Clyde 1999, ENSR AECOM 2008
UST	Oil recovery from the interceptors and formerly used for diesel fuel storage	Unknown	Unknown	Woodward Clyde 1999
AST	Slop collection from the UST	Unknown	Unknown	Woodward Clyde 1999, ENSR AECOM 2008

ITEM	DETAILS	LOCATION	STATUS	INFORMATION SOURCE
Dispensers and associated pipes, pipe trenches and backfill	N/A	Site-wide	Still present on-Site based on reports	Woodward Clyde 1999, ENSR AECOM 2008
UST/AST Fill Points and Gantry	N/A	B.M.W Filling Gantry in West of Site	Still present on-Site based on reports	Woodward Clyde 1999, IT 2005, IT 2006, ENSR AECOM 2008
2xInterceptors	N/A	West of the Site near Ipswich Street	Still present on-Site based on reports	Woodward Clyde 1999
Recorded Incidences of Product Loss	Product losses identified in 1993, 1994, 1996, 1997 and 1998	Unknown	Unknown	Woodward Clyde 1999
Unrecorded Incidences of Product Loss	Unknown	Unknown	Unknown	N/A
General Housekeeping	Evidence of general product spillage recorded by Judd Shutter Property Services in 1994	Site-wide	Unknown	Woodward Clyde 1999
Rail Sidings	Soil contamination along the rail sidings from historic spills during on-offloading of product	Centre of the Site	Existing soil contamination	IT 2005, IT 2006, ENSR AECOM 2008
Foam plant and associated firefighting infrastructure	No available information other than location	South of the site next to fire water tanks	Unknown	IT 2005

In addition to the above identified potential sources, ground penetrating radar (GPR) results indicated the potential presence of up to two underground USTs, in the south-western portion of the Site. These possible USTs may also represent a potential source of contamination.

Secondary sources of contamination are those that have been potentially impacted by contamination from primary sources. The results of previous investigations and the identified primary sources of contamination above, indicate that potential secondary sources of contamination include:

— impacted surface soils;

— impacted subsurface soils;

— dissolved groundwater plume;

— free-phase liquid plume; and

— impacted surface water.

4.3 PATHWAYS

For an exposure to occur, a complete pathway must exist between the source of contamination and the receptor. Where the exposure pathway is incomplete, there is no exposure, and hence no risk.

An exposure pathway consists of the following elements:

— source (e.g. spills, leaks, etc.);

— release mechanism (e.g. leaching, volatilisation);

— transport media (e.g. soil, groundwater, sediment, surface water, air);

— exposure point, where the receptor comes in contact with the contamination (e.g. groundwater from an extraction bore, vapours inside a building or in ambient air); and

— exposure route (e.g. inhalation, ingestion, dermal contact).

Where the pathway for a chemical from the source to the receptor is incomplete, there is no incremental risk due to the presence of that contamination. A review of the possible exposure pathways has been undertaken based on the planned future use (residential including access to soil and recreational open space) as part of the CSM.

The primary pathways by which future Site users could be exposed to the sources of contamination on the Site are considered to be:

— direct contact (including accidental ingestion) with contaminated soil;

— inhalation of dust derived from contaminated soil outdoors and indoors; and

— volatilisation of hydrocarbons from soil to indoor and outdoor air and subsequent inhalation on-Site.

The potential pathway by which the environment could be exposed to contamination is via leaching of contaminants into groundwater, the lateral migration of dissolved contaminants in shallow groundwater and subsequent discharge to a surface water environment.

4.4 RECEPTORS

When evaluating potential adverse health effects to people or the environment from exposure to a contaminated Site, all potentially exposed populations should be considered.

Given the proposed end use, the populations or receptors of interest (on-Site) include:

— Future commercial workers;

— Site workers (during construction phase);

— intrusive maintenance (utility) workers (post-development); and

— off-Site ecological receptors (e.g. Jerrabomberra Creek approximately 550 m north-west of the Site and Jerrabomberra Wetlands approximately 2 km north of the Site).

Other nearby ecological receptors identified but not considered significant are the stormwater channel/creek (runs north to west, underground beneath the Site, underground beneath Ipswich Street and drains into Jerrabomberra Creek). Given the distance it is considered unlikely that hydrocarbon impacted groundwater will reach the Jerrabomberra Creek or wetlands and as such ecological receptors are not considered to be at significant risk from Site-based impacts.

5 LEGISLATIVE FRAMEWORK

The legislative framework for this RAP is based on guidelines that have been issued and/or endorsed by the ACT EPA under the following acts and regulations:

— *Environment Protection Act 1997* (establishment of ACT EPA responsibility and outlines environmental goals for the Territory);

— *Environment Protection Regulation 2005* (expansion of regulatory requirements under the Act predominantly in relation to pollution and waste);

— *Contaminated Sites Environment Protection Policy 2009* (demonstrates how the EPA Act and Regulation apply to contaminated land);

— *Public Health Act 1997* (protection of public health);

— *Occupational Health and Safety Act 1989* (working with hazardous materials);

— *Planning and Development Act 2007* (land use, design and siting);

— *Dangerous Substances Act 2004* (handling and storage of dangerous goods); and

— *Waste Minimisation Act 2001* (waste management).

The detailed RAP was prepared in accordance with the following ACT endorsed Guidance:

— *National Environment Protection (Assessment of Site Contamination) Measure 1999* (NEPM, as amended 2013 - Commonwealth);

— *Environmental Standards: Assessment and Classification of Liquid and Non-Liquid Wastes* (ACT 2011);

— *Information Sheet No. 1: Contaminated Sites – Decommissioning, Assessment and Audit of Sites Containing Above Ground or Underground Fuel Storage Tanks* (ACT 2009);

— *Information Sheet No. 2: Contaminated Sites – Requirements for the Assessment and Validation of Former Service Station Sites in the ACT* (ACT 2009);

— *Information Sheet No. 3: Contaminated Sites – Requirements for the Assessment and Validation of Sites Containing Above Ground or Underground Fuel Storage Tanks in the ACT* (ACT 2009);

— *Environmental Guidelines for Service Station Sites and Hydrocarbon Storage* (ACT 2009);

— *Guidelines for Consultants Reporting on Contaminated Sites* (NSW 2011);

— *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases* (NSW 2012); and

— *Vapour Intrusion: Technical Practice Note* (NSW 2010).

6 REMEDIATION PLANNING

6.1 RAP OBJECTIVES AND REMEDIATION GOALS

This RAP details the methodology for removing and validating existing aboveground and underground petroleum storage systems and other relevant infrastructure to an extent suitable to facilitate the proposed land use as well as protection of proposed infrastructure from vapour intrusion. The RAP also assessed different options for management of groundwater and LNAPL migrating off-Site. However, details of implementation are to be incorporated into a Post-Remediation Environmental Management Plan (refer to Section 9).

As noted in Section 4, due to the presence of a historic firefighting foam plant at the Site, PFAS is considered to be a COPC. However, the assessment and management of PFAS is to be dealt with separately, and is beyond the scope of this RAP.

In relation to compliance with ACT requirements (most notably compliance under the *Environment Protection Act 1997*) objectives are to:

- document the procedures and standards to be followed to manage any risk posed by contamination identified during previous investigations;
- outline a working plan for the remediation and validation strategy for the proposed long term vapour mitigation measures as well as other aspects of the works including bulk excavation, stockpiling, material re-use, management and disposal of excavated materials (where deemed not suitable for re-use) and controls, to ensure the Site is remediated to a suitable standard for the proposed commercial/industrial redevelopment;
- present a RAP with remediation solutions developed to a sufficient standard to be approved by the appointed Site Auditor;
- outline a contingency plan to address issues which may arise during the remediation, including handling and storage of materials which exceed landfill disposal guidelines, pending disposal; and
- where contamination not identified in the investigations discussed in Section 3.2 is identified, outline an unexpected finds protocol for management during the remediation and validation phase of works.

As indicated in the ECS Environmental Management Plan (EMP) and the Site Audit Report, the complete remediation of in-ground contamination of soil and groundwater is impractical on the Site. Additionally, both the URS and AECOM Human Health and Ecological Risk Assessments indicate a low risk to human health and the environment on the Site in its current orientation (for ongoing commercial/industrial land use). As a result, the intent of the remediation works presented in this RAP are to facilitate the redevelopment of the Site (including demolition of existing structures and erection of new infrastructure and enclosed spaces) while mitigating any risk to end users from petroleum hydrocarbon contamination while the bulk of the contaminated soil and groundwater remains *in-situ*.

We note that the remediation goal and subsequent remediation planning has been structured around the proposed development as presented in Section 3.3 of this report. The contaminants of concern which are being targeted by the remedial works presented in this RAP are those discussed in Section 4 (excluding PFAS).

6.2 REMEDIATION EXTENT

The remediation works required to achieve the goals presented in Section 6.1 will target three specific items on the Site:

— Removal of existing potentially contaminating Site infrastructure (e.g. ASTs and USTs) and subsequent validation;

— Protection of Site structures to be constructed as part of the proposed development on-Site; and

— Mitigation of off-site risk associated with existing groundwater contamination (to be managed under the Post Remediation Environmental Management Plan).

Apart from outlining means of source infrastructure removal, the remedial works are targeted at short-circuiting on-Site human health risk through tackling potential contaminant migration at the pathway – receptor interface. Therefore, on-Site remediation works will be focussed around the following Site locations:

— Identified current potentially contaminating infrastructure (primary source removal); and

— Proposed Site structures (e.g. the waste receival shed, fuel preparation plant, power plant, etc.).

Ongoing assessment and tracking of the existing groundwater contamination both on and off-Site will be required into the future as well. With regards to this item, the RAP outlines the preferred approach for long term management, but due to the time period during which this work will be required to take place (i.e. extending into the operational phase of the Site), the details of the approach along with monitoring, evaluation and contingency options will be detailed in full in the ongoing Environmental Management Plan.

6.3 REMEDIATION OPTIONS EVALUATION

The following options evaluation tables are based around the three-pronged approach of on-Site remediation presented in Section 6.2 (i.e. source infrastructure removal, protection of Site infrastructure and management of existing groundwater contamination).

The remedial options evaluation has been conducted in order to determine the most appropriate remedial strategy across the Site for the identified contaminated soils and groundwater, from a technical, environmental and legislative standpoint. With cognisance given to the identified COPCs, remediation options were evaluated for their appropriateness and application at the Site. The evaluation of soil and groundwater remediation options is presented in Tables 6.1, 6.2 and 6.3.

Table 6.1 Remediation Options & Feasibility Summary for Removal of Potentially Contaminating Infrastructure

REMEDIAL OPTIONS	BENEFITS	LIMITATIONS	ACCEPTABILITY
Do nothing	Nil cost No time requirement	Unlikely acceptable for proposed development Site may not be suitable for proposed development Source infrastructure remaining on-Site may allow further contamination	Does not meet the remediation objectives
In-situ Decommissioning	Reduced risk of continued contamination from source infrastructure Lower cost than ex-situ and mixed Can be factored into the existing demolition program	Some items of infrastructure may not be suited to in-situ decommissioning Residual issues in relation to orientation of infrastructure affecting proposed infrastructure development No validation of underlying of soil required	Does not meet the remediation objectives
Ex-situ Decommissioning	Completely compliant with ACT requirements Complete removal of primary contaminant source infrastructure No residual issues in relation to orientation of infrastructure affecting proposed infrastructure development Can be factored into the existing demolition program	Higher cost than other forms of remediation	Considered most acceptable for meeting remediation objectives
Mix of Ex and In-situ Decommissioning	Suited to different types of contaminating infrastructure Reduced risk of continued contamination from source infrastructure Can be factored into the existing demolition program	Some residual risk associated with potential source infrastructure remaining on-Site Less soil validation beneath infrastructure required than full ex-situ	Partially acceptable for meeting remediation objectives

Table 6.2 Remediation Options & Feasibility Summary for Vapour Protection of Proposed Infrastructure

REMEDIAL OPTIONS	BENEFITS	LIMITATIONS	ACCEPTABILITY
Do nothing	Nil cost No time requirement	Does not address vapour migration risk and not suitable for facilitating development	Does not meet the remediation objectives
Source Removal	If successful, substantially reduces long term risk associated with identified hydrocarbon contamination for both on-Site and off-Site human and ecological receptors	Full source removal not considered required to allow the proposed use of the land A previous product recovery trial indicated that active extraction of LNAPL was not viable Low permeability of the Site soils precludes effective vapour extraction or air sparging Soil contamination identified at depths greater than 11m below ground level. Excavation would result in significant disturbance of Site area and expenditure, and is not considered practicable.	Does not meet the remediation objectives
Vapour Dilution and Dispersion – Installed Within Buildings	Well understood technology with proven track record of success Able to be designed to suit both passive and active extraction systems as required	Generally set up as ventilation within basements and constructed voids but general construction on the Site is anticipated to be slab on grade with no basement or sub-floor voids Control may be excessive for managing vapour risk based on HERAs to date	Unlikely to be acceptable as doesn't fit proposed construction type
Vapour Dilution and Dispersion – Installed In-Ground	Well understood technology with proven track record of success Able to be designed to suit both passive and active extraction systems as required	Expensive initial outlay in installation (and possible ongoing cost for fans) Building slabs and piles need to be designed to accommodate the system Control may be excessive for managing vapour risk based on HERAs to date	Partially acceptable

REMEDIAL OPTIONS	**BENEFITS**	**LIMITATIONS**	**ACCEPTABILITY**
Vapour Barrier – In Building	Well understood and utilised technology with proven track record of success Contractors in Australia have active experience in applying this technology Generally cheaper than in-ground vapour dilution and vertical barriers Unless repairs required, only cost is at initial outlay Compliments well maintained concrete slabs as a protective barrier	The long-term effectiveness of many barrier materials are affected by direct contact with hydrocarbon impacted soils and water Needs to be appropriately installed and sealed by qualified geomembrane / vapour barrier installation contractors If punctured, repairs are required otherwise effectiveness is reduced	Considered most acceptable for meeting remediation objectives
Vapour Barrier – In Ground Vertical	Well understood technology with proven track record of success Able to be designed to suit both passive and active extraction systems as required	Detailed engineering design required Excavation and removal of contaminated material required for installation of barrier Expensive initial outlay in installation (and possible ongoing cost for fans) Due to spread of proposed buildings and distribution of soil and groundwater contamination it is unlikely that vertical barriers will protect buildings from all potentially vapour generating contamination	Unlikely to be acceptable as doesn't fit proposed construction type and contamination distribution

Table 6.3 Remediation Options & Feasibility Summary for Groundwater Contamination Management

REMEDIAL OPTIONS	BENEFITS	LIMITATIONS	ACCEPTABILITY
Do nothing	Nil cost No time requirement	Does not address risk of off-Site migration and potential impacts to off-Site receptors	Does not meet the remediation objectives
Active Source Removal (e.g. pump and treat, excavation)	If successful, substantially reduces long term risk associated with identified hydrocarbon contamination for both on-Site and off-Site human and ecological receptors	Full source removal not considered required to allow the proposed use of the land A previous product recovery trial indicated that active extraction of LNAPL was not viable Low permeability of the Site soils precludes effective vapour extraction or air sparging Soil contamination identified at depths greater than 11m below ground level. Excavation would result in significant disturbance of Site area and expenditure, and is not considered practicable Low probability of success	Not considered feasible and therefore does not meet remediation objectives
Passive Source Removal (e.g. passive skimmers)	Well understood technology with proven track record Skimmers highly mobile and can be moved between monitoring wells daily, weekly or fortnightly Method targeted at extracting LNAPL specifically and can contribute to groundwater and vapour contamination source removal	Focussed only on LNAPL entering groundwater monitoring wells. Has limited zone of influence around point of installation Due to complex hydrogeology, not guaranteed to be able to target all LNAPL in groundwater Effective on LNAPL only. Does not impact on dissolved phase hydrocarbon concentrations in groundwater other than indirectly through source removal	Partially acceptable. Can be used to compliment other remediation activities by targeting wells with known LNAPL

REMEDIAL OPTIONS	BENEFITS	LIMITATIONS	ACCEPTABILITY
Monitored Natural Attenuation	An approach regularly and successfully applied on Sites across Australia and internationally Identified contaminants of concern (i.e. petroleum hydrocarbons) are suited to natural attenuation Monitoring results to date indicate that the contaminant plumes are already attenuating Low energy approach to groundwater contamination management	Dependent on conditions within the groundwater system remaining consistent to allow long term degradation Natural attenuation is generally a slow process which means that ongoing monitoring will be required for a long period of time into the future until the results can demonstrate that the plumes have attenuated to acceptable levels	Considered most acceptable for meeting remediation objectives
Enhanced Natural Attenuation (e.g. chemical oxidant injection or air sparging)	Effective in homogeneous groundwater systems with moderate to high hydraulic conductivity Increased oxygenation of the groundwater system increases rates of volatilisation and microbial degradation of hydrocarbons	Not suited to confined, fracture-based aquifers where injection points would offer minimal zone of influence	Unlikely to be effective on its own based on known hydrogeological conditions. Partially acceptable if targeting specific parts of plumes
Pathway Intervention Methods (Permeable Reactive Barriers, bentonite slurry and sheet pile walls)	Suitable as a barrier system for complex hydrogeology Affords broad off-Site protection against a range of contaminants Has been applied in Australia and internationally effectively under the right conditions	Permeable reactive barriers most effective for dissolved phase hydrocarbon and less for LNAPL LNAPL and dissolved phase hydrocarbons already migrated off-Site. Barrier systems would only minimise future migration and not tackle existing contamination Depth of soil and groundwater contamination not fully delineated but existing information on depths indicates that pathway intervention would not be feasible Expensive option	Not considered feasible and therefore does not meet remediation objectives

6.3.1 OPTIONS SELECTION RATIONALE – POTENTIALLY CONTAMINATING INFRASTRUCTURE

A number of pieces of historic and current infrastructure located on-Site have been identified as having the potential to act as sources for hydrocarbon contamination (refer to Table 4.1). These infrastructure types include above ground and underground storage tanks, rail sidings, gantries, fuel dispensers and interceptors. In order to reduce the risk of ongoing or future contamination resulting from releases from these items they need to be remediated in an appropriate manner. Their removal and the remediation of impacted material immediately around them needs to be undertaken in a manner which is both compliant with ACT and Commonwealth standards and targeted to fit in with the orientation of future Site infrastructure and land use (refer to **Appendix A-2**).

Based upon this rationale, the "Do Nothing" approach neither meets regulatory obligations or the final land use objectives and is excluded as a potential option.

The in-situ remediation option is only partially compliant with regulations (for example underground storage tanks should only be decommissioned in-situ if there is no other alternative according to the Australian Standards). In addition to this, leaving sub-surface and surface structures in place would likely clash with the intended future design and land use of the Site.

Full ex-situ decommissioning of relevant Site infrastructure and sufficient remediation and validation of underlying and surrounding impacted soils is considered to meet both regulatory obligations and future land use plans and design. As such, this remediation method is considered the preferred option.

The mix of in-situ and ex-situ decommissioning is partially compliant and may be necessary due to planning and Site constraints as the works progresses. As a result, this option should be considered as the contingency if full ex-situ decommissioning is found to be unsuitable.

6.3.2 OPTIONS SELECTION RATIONALE – VAPOUR PROTECTION OF NEW INFRASTRUCTURE

As discussed elsewhere in this document, the full remediation of in-situ groundwater and soil contamination is not feasible on this Site. Therefore, remediation approaches focussed on ensuring the Site can be made suitable for the proposed future land use (as outlined in **Appendix A-2**) should target the breaking of the Source-Pathway-Receptor risk linkages at either the Pathway or Receptor links. Due to the nature of the proposed development on the Site there will be minimal potential of future Site workers to be exposed to contaminated soil and groundwater. Therefore the main exposure route and the target of this options selection will be through minimising risk of vapour inhalation. The remedial approaches presented above are designed to focus on protection of enclosed Site structures where vapours can accumulate. The information to date indicates that outdoor air flow will be sufficient to facilitate dilution and dispersion of vapours so that there is insignificant risk to on-Site workers in outdoor areas.

Because of the continued presence of hydrocarbon contaminated soil and groundwater as well as LNAPL beneath the Site the potential for generation of vapours which can accumulate within buildings is considered too high to "do nothing". As a result, this option has been excluded from the assessment.

The in-building vapour dilution remediation option is a viable option for buildings with constructed sub-floor voids such as basements and open voids below pre-cast suspended slabs. The void space allows adequate dilution of vapours and when fitted with an appropriate passive or active ventilation system, works well at venting vapour harmlessly to the atmosphere. However, due to the anticipated building design (warehouses on slab on grade with no sub-floor voids) this vapour mitigation method is unlikely to be suitable for the Site.

The construction of in-ground vertical barriers is considered unsuitable for this project as the contamination with the potential to cause vapour ingress into buildings is spread across the Site at varying depths and in different concentrations. As such the energy and expense of installing such a system will unlikely result in the level of protection afforded by less intrusive systems. Therefore, this approach is not considered suitable for this project.

The option of installing sub-slab vapour dilution systems with adequate venting is considered a partially compliant option for the management of vapour accumulation within Site structures. The system would entail the construction of specially designed voids and vapour drainage layers beneath Site structures which are linked up to appropriate venting points. This method has been found to be effective on a range of Sites where designs do not allow for sub-floor basements or similar structures. The disadvantages of this technique are that slabs and piling designs need to be configured to accommodate this system and systems can become clogged or impeded over time (thus reducing their long term effectiveness). In addition to these disadvantages, the HERAs prepared to date on the Site indicate that this remediation technique may be over-engineered for the level of risk (i.e. a less intrusive approach may be sufficient). However, if the preferred remedial approach is found to be ineffective beneath one or all of the Site structures, this option may be considered as a contingency.

The construction of an in-building vapour barrier in the form of a sealed geomembrane or spray-applied barrier system beneath individual building slabs is a technique which has been widely applied with consistent effectiveness for protection of structures from sub-surface vapour and gas both in Australia and internationally. The system rarely affects building design and is effective at improving on and complimenting the protection already afforded by a well constructed concrete slab. The key issue affecting the effectiveness of this technique is the incorrect application of the barriers by untrained or unqualified contractors, use of unsuitable materials and subsequent poor validation by the Site consultant. This issue can be avoided through use of proprietary materials, engagement of professional specialist contractors and a regimented system of validation by the project consultant. As such, this method is believed to be the most suitable option for vapour protection on the Site.

6.3.3 OPTIONS SELECTION RATIONALE – GROUNDWATER CONTAMINATION MANAGEMENT

Based upon the rationale presented in the Remediation Options and Feasibility Summary presented in Table 6.3 the preferred option for managing the off-Site groundwater contamination resulting from dissolved and phase separated hydrocarbons is through ongoing monitoring of natural attenuation. This option is preferred over other potential remediation strategies because there is existing evidence of natural attenuation taking place in the groundwater and variability in groundwater depth and complex hydrogeology limits the effectiveness of the majority of other options.

Given the long-term nature of the preferred remedial approach and the likelihood that the groundwater remediation goal will be achieved after the Site becomes operational, it is considered that this RAP is not the appropriate document for outlining the natural attenuation scope, monitoring/validation requirements, success indicators and potential contingency measures. As such the specific details of undertaking natural attenuation will be provided in the Post-Remediation Environmental Management Plan for the Site (refer to Sections 9 and 9.1 for more details).

7 IMPLEMENTATION OF THE RAP STRATEGY

7.1 KEY STAKEHOLDERS

The stakeholders involved in the remedial project are listed in Table 7.1.

Table 7.1 Key Stakeholders

ROLE	ORGANISATION	CONTACT
Property owner and project manager	Capital Recycling Solutions Pty Ltd	Adam Perry 15 Lithgow Street, Fyshwick ACT 2609 P: 1800 334 696 E: adam@capitalrecyclingsolutions.com.au
Environmental consultant (land quality and RAP)	WSP Australia Pty Ltd	Alex Moody, Jonathon Hilliard 121 Marcus Clarke Street, Canberra ACT 2601 M: 0459 843 003 / 0418 469 235 E: alex.moody@wsp.com / jon.hilliard@wsp.com
Remediation contractor	TBA	TBA
NSW EPA / VIC EPA Site Auditor – contaminated land	TBA	TBA
Approvals and Planning authority	ACT Environmental Protection Authority	ACT EPA 16 Challis Street Dickson ACT 2602 T: (02) 6207 1923 E: environment@act.gov.au

7.2 PROJECT PRELIMINARIES

Prior to commencement of remedial works at the Site, the following activities would need to be completed:

— Provision of the RAP to the Site Auditor appointed to the project for review and comment prior to finalisation of the remediation scope;

— The Dangerous Substances and Workers Compensation unit of the Office of Regulatory Services (ORS) WorkSafe ACT should be contacted to notify them of the decommissioning of UPSS;

— The RAP and any Health & Safety Plans are to be reviewed and endorsed by an independent auditor with a copy of the RAP endorsement provided to the ACT EPA stating that the installation of new facilities will not impact on the ongoing assessment and remediation of the Site;

— Provision of the RAP to ACT PLA;

- Receipt of all relevant regulatory approvals (development application) for demolition, tank removal, vapour barrier installation and Site development;
- Preparation of a health, environmental and safety plan (HESP) or equivalent (i.e. safe work method statement or SWMS) prior to commencement of Site works;
- Induction of all Site personnel to ensure they are aware of the health, safety and environmental management requirements relating to the excavation of potentially contaminated soils; and
- Ensure that the contractor conducting the tank pit excavation has adequate safety equipment (for example, adequate fencing, barrier boards, barricades and warning signage) to secure the work area and minimise the danger to contractor personnel and the public for the duration of the excavation works.

7.3 FUEL SOURCE INFRASTRUCTURE REMEDIATION AND VALIDATION METHODOLOGY

All removal, demolition and excavation works should be undertaken by experienced licensed contractors, experienced in the decommissioning and removal of fuel infrastructure and the remediation of contaminated soils.

An environmental consultant should be present during the excavation works, particularly to assess the contamination status of the soil excavated from around the tanks, and to determine whether further excavation of excavation walls and floor is required to remove contaminated soil.

As a minimum, the following Codes of Practice are applicable to the work and a copy of each should be obtained by the contractor. Standards should be the most recent version available unless otherwise specified:

- AS 4976:200, *The removal of underground storage tanks*.
- AS 1940 Section 9, *The storage and handling of flammable and combustible liquids*.
- *Contaminated Sites Environment Protection Policy*.
- ACT EPA 2014, *Information Sheet 2 – Requirements for the assessment and validation of former service station Sites*.
- ACT EPA 2014, *Information sheet 3 – Requirements for the assessment and validation of Sites containing above ground or underground fuel storage tanks*.
- ACT EPA 2015, *Information sheet 4 – Requirements for the reuse and disposal of contaminated soil in the ACT*.
- ORS WorkCover requirements.

7.3.1 PETROLEUM STORAGE SYSTEM REMOVAL

Aboveground and underground storage tanks and associated infrastructure (e.g. bowsers, fill points and pipework) must be cleared prior to excavation and/or destruction by draining all products, vapour venting and de-gassing. Once tanks are ‘cleared’ they will be gas tested for vapours and then deemed safe by an appropriately qualified person. The tank atmosphere and the excavation/demolition area shall be checked regularly for presence of vapour with an appropriately calibrated photoionisation detector (PID) until the tank is removed from the Site. Following removal, tanks must be properly labelled and disposed of.

All applicable permits must be obtained prior to the beginning of any work associated with tank clearance. All product liquid and residue removed from the tank shall be handled in accordance with appropriate standards and local regulations associated with environmentally hazardous materials and dangerous goods. The contractor shall submit written procedures to complete the following activities outlined below.

- Draining pipes and pumping out tanks.
- Removal of pipework.
- Removal of tank from ground.
- Lowering of tanks to the ground.
- Labelling of tanks.
- Transporting of tanks.
- Tank destruction.

The specific areas to be targeted for remediation as outlined in the conceptual Site model include the following:

- Oil recovery UST (status unknown);
- Two potential USTs picked up by GPR scan in south-west of the Site;
- ASTs – T7, T11, T12, T13, T15, T21; and
- Slop collection AST (status unknown).

7.3.2 PETROLEUM STORAGE SYSTEM REMOVAL VALIDATION

As already discussed, the remediation of the Site has been based upon soil and groundwater contamination remaining on-Site. As such traditional validation of walls and base of tank excavations is not required. However, in order to minimise risk of degradation of the vapour protection systems it will be a requirement of this RAP that the top 300mm of soil at the finished level of the Site within the footprint of Site structures be free of hydrocarbon contamination elevated above site criteria. As such, based on the final design levels (yet to be provided), validation testing of soil will be required for the walls and bases of excavations in the top 300mm of the Site soil.

Following the tank removal and subsequent excavation, soil samples will be collected from the walls and floor of the excavation. All soil samples will be screened in the field using a handheld photo ionisation detector (PID) to measure indicative concentrations of volatile organic compounds (VOC). Samples will be analysed for the contaminants of potential concern, i.e. TRH, BTEX, PAHs and lead.

Where facilities are to be removed, each location must be assessed and remediated, if necessary, in accordance with the following legislation and guidelines, which have been endorsed for use in the ACT by the Environment Protection Authority (EPA):

- Environment Protection Act 1997 and Environment Protection Regulation 2005
- ACT EPA 2009, *Contaminated Sites Environment Protection Policy*.
- ACT EPA 2011, *Environmental Guidelines for Service Station Sites and Hydrocarbon Storage.*
- NEPC 2013, *Assessment of Site Contamination, National Environment Protection Measure*.
- NSW EPA 2011, *Guidelines for Consultants Reporting on Contaminated Sites*.
- NSW EPA 2014, *Technical Note: Investigation of Service Station Sites.*

The tank pit characterisation will be undertaken in accordance with the NSW EPA (2014), *Technical Note: Investigation of Service Station Sites.* Section 2.6 of these guidelines state that:

> *'Where a UST is removed, as a guide sampling should be one sample from beneath the centre of the UST if tank length is less than 4 m and at least one sample from each of the four walls. If the tank is 4–10 m long, at least two samples from each of the four walls and under each end. If the tank is longer than 10 m,*

at least three samples from each of the four walls and under each end are taken. This applies to each tank in the same tank pit'

Note that if the final pit extends below 300mm in depth from the planned finished level, pit base samples will not be required. Quality assurance/quality control (QA/QC) samples would also have to be collected and analysed as described in Section 7.5. The excavations will be left open while waiting for laboratory results. If validation samples exceed the nominated assessment reference values, further excavation will be undertaken.

7.3.3 REMEDIAL METHODOLOGY (OTHER FUEL INFRASTRUCTURE)

For the non-storage tank areas, the remedial methodology may vary based on the extent and type of contamination identified; however it is anticipated that remedial works are likely to entail excavation. On this basis, the general remedial principals and methodology outlined for the removal of aboveground and underground petroleum storage systems will be applicable. The identified specific areas to be targeted for remediation as outlined in the conceptual Site model include the following:

— Fuel lines, dispensers, pumps and filling gantry;

— Two interceptors in west of Site; and

— Railway sliding.

Validation sampling, to demonstrate the successful removal of impacts, should be undertaken at a frequency of 1 sample per 25 m^2 wall/floor area. The QA/QC procedures required are outlined in Section 7.5. The methodology and results of remedial work should be presented in a report, which may form a part of an overall Site Validation Report including the tank removal works and installation of the vapour protection barrier.

The soil excavated from these areas will be managed in accordance with the methodology outlined in Section 8.3.6. Where contaminated soil is assessed as not suitable for on-Site reuse, it will be disposed off-Site to a licensed facility. If the soil cannot be removed from the Site, it may be treated on-Site by land farming or bioremediation or soil vapour extraction methods. The details of the remediation methodology will be provided to ACTPLA, if such remediation is required.

7.3.4 MANAGEMENT OF EXCAVATED SOILS

The excavated soils generated during the tank removal works or identified as unexpected finds, shall be segregated into separated stockpiles based on the field observations, such as soil type, field PID readings, olfactory evidence of contamination and depths (i.e. above or below the tanks) where the soils are excavated. The NEPM (2013) *Schedule B2, Guideline on Site Characterisation*, outlines the minimum number of samples for assessment of stockpiles. For stockpile volume less than 200 m^3, the recommended sampling frequency is 1 per 25 m^3. For stockpiles greater than 200 m^3, lower sampling rates should be suitable for calculating the 95% upper confidence level (UCL). All the stockpile soil samples shall be analysed for TRH, BTEX, PAH and lead.

Excavated soils may be suitable for re-use on-Site if the contaminant concentrations are less than the Site assessment criteria (see Section 7.3.8). If contaminant concentrations exceed these criteria, the following steps can be taken:

— Where possible, soils containing minimal impacts will be treated ex situ on-Site using landfarming techniques and coupled with treatment with solubilizing agents such as Biosolve (if required). This method will be effective if contamination in the stockpiles mainly comprises volatile hydrocarbons with minor semi-volatile hydrocarbons compounds. Any contaminated soil landfarmed on-Site must be approved by the Environment Protection Unit (EPU), Environment ACT prior to landfarming commencing and will be managed in accordance with the NSW EPA 2014, *Best Practice Note: Landfarming*. The strategy for landfarming will also be reviewed by the appointed Site Auditor.

- Soil containing moderate to high contamination levels will be disposed at an approved landfill facility. For disposal, the soils results will be compared guideline values in the *Waste Classification Guidelines* (ACT EPA, 2000; see Section 7.3.6). Any soil disposed of from the Site must be in accordance with the requirements of the EPU as set out in ACT EPA Information Sheet 4. Appropriately licensed ACT contractors must be engaged for the removal, transport and disposal of all contaminated soils from the Site. If the soils are disposed off-Site, disposal dockets for tracking of waste will be maintained by the contractor for inclusion in the validation report. If materials are to be disposed off-Site, additional analyses will be required to facilitate waste classification (i.e. heavy metals, organochlorine pesticides, polychlorinated biphenyls, asbestos (presence/absence) and selected samples for PFAS and PFAS leachability).

7.3.5 REINSTATEMENT OF THE EXCAVATIONS

Following excavation and validation of the tank pit, the voids between the tanks and the pit will be reinstated by using imported fill. The fill used for reinstatement should be certified suitable for the intended use using the following procedures.

7.3.5.1 REUSE OF EXCAVATED SOIL

Excavated soils with contaminant concentrations below the Site assessment criteria may be reused on-Site. The material should be assessed for its potential to pose risk to human and ecological receptors. The material will not be considered suitable for reuse if contaminant concentrations are shown to exceed assessment criteria or potential risks are identified.

7.3.5.2 VIRGIN EXCAVATED NATURAL MATERIAL (VENM)

The *Protection of the Environment Operations Act 1997* (POEO Act) and the ACT EPA defines VENM (e.g. clay, gravel, sand and rock) that is not mixed with any other waste and that:

- has been excavated from areas that are not contaminated, as a result of industrial, commercial, mining or agricultural activities, with manufactured chemicals and that does not contain sulphuric ores or soils, or
- consists of excavated natural materials that meet such criteria as may be approved by the Environment Protection Authority.

Under Schedule 1 of the Act, the acceptance of more than 100m^3 of fill by the lessee or occupier of the land in most areas of the ACT requires an Environmental Authorisation. Where VENM is required for backfilling, it should be certified suitable for the intended use in accordance with the ACT EPA Spoil management in the ACT 2015. This procedure would involve:

- ensuring that all the material is virgin excavated material (e.g. a mass of clay, gravel, sand, soil, or rock) that is not mixed with any other waste.
- reviewing the history of the source of the material including a request from the supplier to provide formal certification that the material is clean and information on what activities previously occurred on the source Site.
- checking the EPA records on the source Site.
- checking for signs of contamination such as odours (chemical/petrol), staining from chemicals, and rubbish such as bricks, timber, masonite, etc.
- supervision of the delivery of the material to ensure the material received is what was agreed upon.
- maintaining all documents and records.

All analytical results are required to be less than the soil validation criteria reported in Section 7.3.6.

7.3.5.3 EXCAVATED NATURAL MATERIAL (ENM)

Where ENM is to be imported to the Site for use as backfill, the material should be assessed in accordance with the Information Sheet 4 – ACT Government, contaminated Sites and NSW EPA (2014) *Excavated Natural Material Exemption* prior to being imported to the Site. For clarity, the most recent general exemption will be used during the remediation of the Site.

7.3.6 SOIL VALIDATION CRITERIA

For validating soils at the Site, based on the potential receptors identified and the exposure pathways, the chosen remediation criteria will be the soil health screening levels (HSLs) for vapour intrusion risks and soil health based investigation levels (HILs) for direct contact and ingestion risks. These criteria have been derived using a risk based model under various Site conditions and uses which thus applies to this Site. Furthermore, if concentrations in soil at the Site meet the HSL and HIL criteria then the Site can be determined to be suitable for the intended use. It is noted that these criteria are conservative and should concentrations at the Site exceed the nominated criteria, then further risk based assessment and derivation of Site specific remedial criteria may be required.

The HSLs and HILs for commercial users are provided in the NEPM (2013). For the intrusive maintenance workers, the recommended assessment criteria for vapour and direct contact pathways provided in the Cooperative Research Council for Contamination Assessment and Remediation for the Environment (CRC CARE) *Technical Report no. 10* (Friebel and Nadebaum, 2011) have been adopted.

In the absence of clay content data, the HSLs for ‘Sand’ and ‘Clay’ have been initially adopted as a conservative approach. Once intrusive works have been commenced and clay content analysis undertaken, this can be refined to reflect actual Site conditions and to ensure that remedial works are not undertaken unnecessarily.

The HSLs and HILs for the commercial Site users and the intrusive maintenance workers are summarised in Table 7.2 and Table 7.3 below.

Table 7.2 Soil health screening levels for vapour intrusion into buildings and health investigation levels for human contact with soil – commercial land use

CHEMICAL	HSLS(1) (MG/KG)								HILS(1) (MG/KG) – COMMERCIAL/ INDUSTRIAL (HIL-D)
	COMMERCIAL/INDUSTRIAL LAND USE (HSL-D) IN SAND				COMMERCIAL/INDUSTRIAL LAND USE (HSL-D) IN CLAY				
	0 TO <1 M	1 M TO <2 M	2 M TO <4 M	≥4 M	0 TO <1 M	1 M TO <2 M	2 M TO <4 M	≥4 M	
F1(2)	260	370	630	NL	310	480	NL	NL	–
F2(2)	NL	NL	NL	NL	NL	NL	NL	NL	–
Benzene	3	3	3	3	4	6	9	20	–
Toluene	NL	NL	NL	NL	NL	NL	NL	NL	–
Ethyl benzene	NL	NL	NL	NL	NL	NL	NL	NL	–
Xylene	230	NL	NL	NL	NL	NL	NL	NL	–
Naphthalene	NL	NL	NL	NL	NL	NL	NL	NL	–
Carcinogenic PAHs (BaP TEQ)4	–	–	–	–	–	–	–	–	40
Total PAHs	–	–	–	–	–	–	–	–	4,000
Lead	–	–	–	–	–	–	–	–	1,500

(1) **Schedule B1 Investigation levels for soil and groundwater** (NEPM, 2013)

(2) F1 = TRH C_6-C_{10} less BTEX, F2 = TRH >C_{10}-C_{16} less naphthalene.

(3) NL: not limiting; ‘-’: criteria are not available.

(4) Benzo(a)pyrene toxic equivalency quotient, a weighted sum of carcinogenic PAHs. Further detail provided in the NEPM Schedule B1.

Table 7.3 Soil health screening levels for vapour intrusion into trenches and direct contact – intrusive maintenance workers

CHEMICAL	HSL (MG/KG) FOR INTRUSIVE MAINTENANCE WORKER (SHALLOW TRENCH)(1)				COMMERCIAL/ INDUSTRIAL (2)
	VAPOUR INTRUSION			DIRECT CONTACT	DIRECT CONTACT
	0 TO <1 M	1 M TO <2 M	≥4 M		
F1 (C6–C10 less BTEX)	NL	NL	NL	82,000	26,000
TRH >C10–C16	NL	NL	NL	62,000	20,000
TRH >C16–C34	–	–	–	85,000	27,000
TRH >C34–C40	–	–	–	120,000	38,000
Benzene	77	160	NL	1,100	430
Toluene	NL	NL	NL	120,000	99,000
Ethyl benzene	NL	NL	NL	85,000	27,000
Xylene	NL	NL	NL	130,000	81,000
Naphthalene	NL	NL	NL	29,000	11,000

(1) *CRC CARE Technical Report no. 10* (Friebel and Nadebaum, 2011)

NL not limiting; '-': criteria are not available.

(2) Direct contact – commercial industrial

7.3.6.1 WASTE DISPOSAL CRITERIA

Prior to the transportation of soils off-Site for disposal, the excavated soils shall be tested then classified. The classification of excavated soils will be undertaken in accordance with ACT EPA 2000, *ACT's Environmental Standards: Assessment and Classification of Liquid and Non-liquid Wastes* and the ACT EPA 2015, *Information sheet 4 – Requirements for the reuse and disposal of contaminated soil in the ACT.* A summary of the waste acceptance criteria is included in Table 7.4 below.

Table 7.4 Waste classification guidelines

CHEMICALS	CT (WITHOUT TCLP)(1)			SCC (WITH TCLP)(2)					
	MAXIMUM VALUE FOR CLASSIFICATION WITHOUT TCLP			MAXIMUM VALUES FOR LEACHABLE CONCENTRATION AND SPECIFIC CONTAMINANT CONCENTRATIONS WHEN USED TOGETHER					
	INERT WASTE (CT1)	SOLID WASTE (CT2)	INDUSTRIAL WASTE (CT3)	INERT WASTE		SOLID WASTE		INDUSTRIAL WASTE	
				TCLP1	SCC1	TCLP2	SCC2	TCLP3	SCC3
	(MG/KG)	(MG/KG)	(MG/KG)	(MG/L)	(MG/KG)	(MG/L)	(MG/KG)	(MG/L)	(MG/KG)
TPH C6–C9	na	na	na	na	650	na	650	na	2,600
TPH C10–C36	na	na	na	na	5,000	na	10,000	na	40,000
Benzene	1	10	40	0.05	18	0.5	18	2	72
Toluene	28.8	288	1,152	1.44	518	14.4	518	57.6	2,073
Ethyl benzene	60	600	2,400	3	1,080	30	1,080	120	4,320
Total xylene	100	1,000	4,000	5	1,800	50	1,800	200	7,200
Benzo(a)pyrene	0.08	0.8	3.2	0.004	10	0.04	10	0.16	23
Total PAHs	20	200	800	na	200	na	200	na	800
Arsenic	10	100	400	0.5	500	5	500	20	2,000
Cadmium	2	20	80	0.1	100	1	100	4	400
Chromium (VI)	10	100	400	0.5	1,900	5	1,900	20	7,600
Lead	10	100	400	0.5	1,500	5	1,500	20	6,000
Mercury	0.4	4	16	0.02	50	0.2	50	0.8	200
Nickel	4	40	160	0.2	1,050	2	1,050	8	4,200

(1) Extracted from Table A3 in *ACT's Environmental Standards: Assessment and Classification of Liquid and Non-liquid Wastes*, Environment ACT, June 2000

(2) Extracted from Table A4 in *ACT's Environmental Standards: Assessment and Classification of Liquid and Non-liquid Wastes*, Environment ACT, June 2000

(3) Note that PFAS test results will be assessed against the NSW EPA Waste Classification Guidelines for selected PFAS

7.3.7 CONTINGENCY

As discussed in Section 6.3.1, if the ex-situ decommissioning of all site structures is not considered the most effective means of source removal the preferred remedial approach is to remove contamination risk of potential source infrastructure through a mix of ex-situ and in-situ decommissioning based on suitability in relation to the proposed development.

Any contingency measure should first get Site Auditor sign-off before being implemented.

For contingency related to unexpected finds and other issues identified during the remediation phase of works refer to Section 8.15 of this RAP.

7.4 VAPOUR PROTECTION SYSTEM INSTALLATION AND VALIDATION METHODOLOGY

It should be noted that at the time of preparing this RAP, the construction of building slab is unknown and therefore WSP is unable to make an assessment as to whether the vapour protection barrier will be installed underneath a slab directly on the soil surface, between multiple slabs or above the slab (beneath finished flooring). Section 7.4.1 has been prepared based on the assumption that the vapour protection barrier will be installed beneath the slab and directly contacting the underlying soil.

Prior to commencement of works, the engaged subcontractor who is familiar with the proprietary barrier material and its installation should provide a detailed specification for its installation to ensure that the most appropriate material specifications, installation and detailing techniques are adopted.

The technical specification should take into account aspects including floor slab design, penetrations into the slab such as service entry points and foundations and potential for differential movement between the slab and other building features such as walls.

7.4.1 SOIL PREPARATION – UNDER SLAB VAPOUR BARRIER

As discussed in Section 7.3.2, vapour resistant membranes need to be installed on relatively uncontaminated surfaces to protect them from increased rates of degradation over time. Soil and water contaminated with large concentrations of petroleum hydrocarbons have the potential to reduce the lifespan and thus the effectiveness of vapour barrier systems. As a result, soil within the footprint of the buildings (7,733m^2 area in total) is required to be validated for the presence of TRH and BTEX to a depth of 300mm of the final design level prior to commencement of installation.

The intent of this surface validation is to reduce the risk of future reduced effectiveness in vapour protection and thus the need for retrofitting other remedial systems to buildings.

In order to carry out this validation work, field screening of the top 300mm with an appropriately calibrated PID is required at a density of one sample per 50m^2 (178 locations). Of these locations a total of 60 will be further screened through collection of primary soil samples for analysis by a NATA accredited laboratory for TRH and BTEX (along with appropriate QA/QC samples).

Samples will be screened against the adopted criteria presented in Section 7.3.8. Where failures of the criteria are identified, these areas will be excavated and stockpiled for treatment or off-Site disposal and the excavated material replaced with clean fill as per the Sections 7.3.6 and 7.3.7.

Note that this RAP does not comment on or provide specifications with regards to the level of compaction or general geotechnical suitability of materials to be used on-Site. A geotechnical engineer should be engaged to make this assessment prior to commencement of construction.

7.4.2 VAPOUR BARRIER MATERIALS SELECTION AND INSTALLATION

The technical specification to be prepared by the installation contractor should detail the vapour resistant membranes that are to be employed as well as an assessment of their suitability with regards to the ground conditions and the types of contamination that they will be required to impeded. The materials to be used should meet the following minimum requirements:

- The materials should be proprietary and specifically designed and constructed for protection against vapour intrusion;
- Materials should be robust, potentially reinforced and have a thickness from 1,600g (0.4mm) upwards;
- The membrane should be specified on the basis of its resistance to puncture and tear and the joints (if not a spray on substance) should be in accordance with manufacturer's instructions;
- The critical properties that should be provided in the technical specification for the membrane for review include the following:
  - Tensile properties (kN/m);
  - CBR puncture resistance (N);
  - Resistance to tearing (nail shank or similar) (N);
  - Vapour permeability (ml/m^2/day);
  - Durability.

The installation contractor should ensure that sealing (through taping or welding) is done in accordance with manufacturer specifications. Detailing of joints around structural forms, service entry points and the like should be undertaken to ensure they are gas tight. Risk of differential movement (e.g. between slab and walls) should be accounted for in the design and installation of the barrier.

The technical specification should also indicate the contractor's method of verification of the completeness of the seal (e.g. air testing of welded joints or trace gas injection beneath the membrane followed by sweeping of the top surface with a gas detection device). The contractor should then have a plan in place for rectification of any identified breaches of the membrane.

7.4.3 VAPOUR BARRIER PROTECTION DURING SLAB CONSTRUCTION

In order to reduce the potential for damage to the vapour barrier before and during construction of the final slab, it is recommended that protective measures are employed. Some vapour barrier materials can be acquired with protective materials already attached as a layer overlying the membrane. However, the barrier system can also be protected using proprietary protection boards or thick geotextiles.

If any damage to the vapour barrier is identified prior to the laying of the slab, the damaged sections will need to be repaired to ensure an adequate seal is in place.

7.4.4 VALIDATION OF GAS PROTECTION MEMBRANES

In addition to the quality control measures to be implemented by the contractor, the appointed environmental consultant will undertake validation of the following:

- Membrane installation;
- Final leak testing;
- Membrane status immediately prior to construction of any overlying slab or flooring; and

— Floor slab construction.

Based on the findings and information provided by the contractor, the consultant will provide a verification report for each vapour protection system. The report will detail the following information:

— General condition of the membrane, identified punctures and tears and subsequent repairs undertaken;

— Confirmation of membrane product type and that the membrane is sufficient for the vapour resistance;

— Ensure overlap between rolls of membrane (if not sprayed membrane) are as recommended by the manufacture and have been joined either with manufacturer specified tapes or welding;

— Discussion of detailing points and level of join;

— Details of final leak testing; and

— Photographic evidence of final condition before laying of final slab or surface over the barrier.

7.4.5 CONTINGENCY

As discussed in Section 6.3.2, if the vapour barrier system is found to be ineffective at the design and construction phase, in-situ vapour dilution should be considered as a contingency. If the vapour barrier system is found to have not met the remediation objectives following completion of building construction the recommended contingency is to undertake a human health risk assessment on the subject building to assess likely level of risk before selecting a management approach.

Any contingency measure should first get Site Auditor sign-off before being implemented.

7.5 QUALITY ASSURANCE / QUALITY CONTROL

A summary of the QA/QC protocols to be followed during the remediation and validation works is presented in Table 7.7.

Table 7.5 Data quality indicators

Task	Description
General	Work will be undertaken in accordance with WSPs standard operating procedures, which are based on industry accepted standard practice.
Soil screening with PID	The PID will be serviced and calibrated as per the manufacturer requirements and the PID would be calibrated at the beginning and end of each day of fieldwork and records sheet maintained for inclusion in the validation report.
Equipment decontamination	Soil sampling equipment (not to be used for PFAS testing) will be decontaminated after the collection of each soil sample by washing with phosphate-free detergent (such as Decon 90) and potable water, followed by a final distilled water rinse. One rinsate blank will be collected per day and analysed for the contaminants of concern. All results should be non-detect.

Task	**Description**
Transport	Samples will be stored in an ice brick-cooled esky and transported to the laboratory. To ensure the integrity of the samples from collection to receipt by the analytical laboratory, soil samples will be sent by courier to the laboratories under 'chain of custody', describing sample preservation, and transport duration, for receipt at the laboratory within 24 hours of sampling or at minimum within holding times. One trip blank per sample batch will be sent to the laboratory. Results for trip blanks should all be non-detected.
QA samples	Field and laboratory QA samples will be analysed as follows: - intra-laboratory duplicate samples at a rate of 1 in 20 primary samples - inter-laboratory duplicate samples at a rate of 1 in 20 primary samples.
Soil QA sample relative per cent differences (RPDs)	The precision of the data is assessed by calculating the RPD of duplicate samples. As per the data acceptance criteria detailed in the NEPM 2013, RPD values of 50% will be adopted as acceptance criteria for analytes in soil. If a cause cannot be determined the data may require qualification.
Laboratory analysis	The laboratories selected will meet WSP in-house compliance requirements under the respective ISO 9001 QA programs. They will perform their own internal QA/QC programs, and will use appropriate detection limits for the analyses to be undertaken.
Holding Times	Holding times are the maximum permissible elapsed time in days from the collection of the sample to its extraction and/or analysis. All extraction and analyses will be completed within standard guidelines.
Rinsate blanks	While the number of equipment blanks varies between projects, a rate of one rinsate blank for each sampling day will be adopted.
Field/trip blanks	For soil sampling programmes, the field/trip blanks will consist of laboratory-supplied sand blank containing acid-washed quartz sand or deionised water. One field/trip blank will be analysed per sample batch. These samples will be analysed for the purpose monitoring for contamination that might be introduced during sampling or transit.
Trip spikes	Laboratory-prepared trip or VOC spikes consisting of distilled, de-ionised water or sand spiked with known concentrations of BTEX will be included at a rate of one per sample batch. These samples are to be submitted for BTEX analysis with results compared with the known additions. The purpose of these samples is to monitor VOC losses during transit.
Laboratory Duplicates	Laboratory duplicates are field samples that are split in the laboratory and subsequently analysed a number of times in the same batch. These sub-samples are selected by the laboratory to assess the accuracy and precision of the analytical method. The selected laboratories should undertake QA/QC procedures such as calibration standards, laboratory control samples, surrogates, reference materials, sample duplicates and matrix spikes. Intra-laboratory duplicates should be performed at a frequency of 1 per 10 samples.

Task	Description
Laboratory Control Standard	A laboratory control standard is a standard reference material used in preparing primary standards. The concentration should be equivalent to a mid-range standard to confirm the primary calibration. Laboratory control samples should be performed on a frequency of 1 per 20 samples or at least one per analytical run.
Matrix Spikes / Matrix Spike Duplicates (MS/MSD)	MS/MSDs are field samples to which a predetermined stock solution of known concentration has been added. The samples are then analysed for recovery of the known addition. Recoveries should be within the stated laboratory control limits of 70 to 130% and duplicates should have RPDs of less than 50%.
Surrogate Spikes	Surrogate spikes provide a means of checking, for every analysis that no gross errors have occurred at any stage of the procedure leading to significant analyte loss. Recoveries should be within the stated laboratory control limits of 70 to 130%.
QA/QC Conclusion	The QA/QC indicators should either all comply with the required standards or show no variations that would have a significant effect on the quality of the data.
Decontamination procedure	All non-disposable sampling equipment will be washed with Decon 90 and rinsed with clean water before and after each sample is collected. Disposable nitrile gloves were worn during sampling and were changed between samples to minimise the potential for cross contamination.
Sample handling	All soil samples will be stored in chilled eskies after collection and during transport by courier to the laboratory. Prior to delivery to the laboratory, a chain of custody form (COC) will be completed. The COC will be signed and accompany the samples. Upon receipt by the laboratory, COC and/or samples receipt notices will be returned to confirm the receipt, condition of samples and specified analysis

7.6 VALIDATION REPORTING

At the completion of the Site works, a Site validation report will be prepared in general accordance with Information Sheet 1 and 2 ACT Government Contaminated Sites and NEPM 2013 (Assessment of Site contamination). The validation report should detail the methodologies and results of the validation works and include the following sections:

— Introduction including objectives of the works and legislative requirements

— Site summary including location, identification, description, geological and hydrogeological details

— Historical report summary including a summary of the Sites contamination status, data gap analysis and a pre-remediation Site conceptual model

— Data quality objectives

— Demolition works summary including the methodology of hazardous materials removal, demolition and removal of aboveground infrastructure, UPSS removal, waste management information and the excavation, validation and backfilling process

— Investigation, remedial and validation works summary including the sampling design for the assessment of soil

- Site validation assessment criteria for soil and the results of the soil sampling program
- Details of the vapour barrier installation (including photographic evidence, inspection findings and comparison against RAP design criteria)
- A detailed Vapour Barrier Verification Report for each building vapour protection system
- A discussion of the post-remediation Site condition including a report on the condition of soil and a post-remediation Site conceptual model
- Conclusions on the Sites suitability and the need for any ongoing monitoring/management

A copy of the validation report must be reviewed and endorsed by an accredited Site Auditor and then forwarded to the ACT EPA for review and endorsement within 15 working days of the completion of the report.

8 REMEDIATION PHASE SITE MANAGEMENT

A Construction Environmental Management Plan (CEMP) should be developed for the Site remediation works to ensure that the on-Site and off-Site environment is not adversely impacted as a result of the works. The CEMP should address and consider the issues discussed in the following sections. The CEMP should be prepared by the contractor and submitted to the Site auditor for approval prior to the commencement of remediation works.

The following section presents an outline of the items which need to be addressed in the CEMP along with examples of control measures that can be incorporated.

Note that any issues and controls discussed in the CEMP which are relevant to workers of the Site should be incorporated into the Site induction which should be undertaken for all staff prior to being able to work on-Site.

8.1 MANAGEMENT OF CONTAMINATED SOIL AND WATER

Based upon plans provided to date, the majority of works on-Site will involve demolition of structures (both aboveground and underground) and construction of pavements and slab on grade buildings. With the exception of installation of underground services and piling to required depths there is understood to be minimal deep excavations required. However, the investigations to date indicate that uncontrolled losses of hydrocarbons from surface spills have occurred across the Site (likely centralised around the gantry and the rail siding). As a result there is a risk of Site construction workers coming into contact with hydrocarbon contaminated soils and groundwater during the project.

The following protocols are to be observed during this work and should be incorporated into the CEMP (to be developed):

- Site induction during which, workers are to be advised on the contamination status of the partial Site, including the location, nature, type, concentration and risk associated with the contaminants present.
- the location and the methods of field identification of contamination hotspots.
- the occupational health and safety monitoring to be undertaken (as required by Site conditions) in areas reported to contain contamination hotspots and areas outside contamination hotspots.
- the occupational health and safety controls to mitigate the risks (including personal protective equipment (PPE) and, as required, air monitoring) including work in and within 20 m of identified areas of exposed contamination or locations of deeper excavation.
- known contamination hotspots are to be clearly identified in the field.

Small scale earthmoving activities (for example, trenching) would not create a significant dust problem. However, dust levels must be kept to a minimum at all times and water carts should be available and used as appropriate.

All plant operators should:

- clean cabs daily to remove accumulated dust and dirt; and
- have appropriate PPE available within the cab at all times for use as required (refer to Section 8.8).

Work is to cease immediately when odours or unusual discolouration is found within the underlying soils. When odours or other indicators of environmental concern are noted, the Site Foreman must be informed immediately. The Site Foreman will assess the situation with reference to the Site Unexpected Finds Protocol and make a determination on the steps to be taken to make the situation safe and to resolve the issue. This would include seeking advice from an experienced environmental consultant or occupational hygienist as necessary.

8.2 VEHICLE AND TRAFFIC CONTROL

The Contractor will be responsible for ensuring adequate traffic control measures are in place to ensure Site safety. Appropriate records are to be kept, documenting all heavy vehicle entry and exit from the Site. Traffic control should also include consideration of pedestrian/cyclist traffic along the waterway which may be impacted by remedial works.

Vehicles shall also be maintained to prevent the transfer of mud or wastes onto adjacent streets or other areas. If wheel treads contain significant quantities of Site soils, the contractor will provide a wheel wash or manually remove and dispose in stockpiles.

8.3 ODOUR, GROUND GAS AND VAPOUR

The Site supervisor shall monitor all open excavations and remediated soils with a PID to ensure ambient air concentrations are within the acceptable work safe limits. Concentrations of PID monitoring shall be recorded by field staff and submitted for review on a daily basis. If ambient air concentrations of VOCs exceed 15 ppm for over 30 minutes based on short term exposure limit of 15 ppm for benzene (NOHSC, 1995), work should cease until levels drop.

Alternative control measures may be implemented as follows:

— Workers should be fitted with vapour masks or respirators for continuation of Site works in the area;

— Wetting down the excavated soil with the use of water sprays containing odour suppressant (e.g. Anotec); and/or

— All contaminated soil loaded onto trucks for off-Site disposal is to be securely covered.

8.4 DUST

If excessive dust is being generated, areas of earthworks should be sprayed with water to reduce dust levels. Soil to be stockpiled should be covered or wetted down to minimise dust generation.

During excavation and transport of any soil off-Site, truck wheels should be cleaned or driven through a constructed wash bay or similar control (e.g. rumble grid) to prevent potentially contaminated soil from being transported onto local roads.

In the event that excessive dust is generated during any operations on-Site, the works will cease and modifications to the process will be made before the operation is resumed. There must be no observable dust transport off-Site.

8.5 EXCAVATED SOIL AND STOCKPILE MANAGEMENT

The following procedures must be undertaken prior to, during and following any soil excavation works at the partial Site:

— Any excavations left open should be suitably barricaded to prevent access by Site workers and the general public.

— All potentially contaminated soil (at depths ranging from the surface to the base of proposed excavations must be stockpiled separately (where deemed unsuitable for reuse), from imported VENM in order to prevent cross contamination. Public access to any stockpiled soils needs to be restricted.

- Individual stockpiles that are formed for waste classification purposes should not exceed $300m^3$ in volume, to limit the amount of impacted material in the event that cross-contamination occurs.
- Excavated soils should be stockpiled on top of high-density polyethylene (HDPE) plastic lining (or equivalent) and covered with plastic sheeting in order to prevent the loss of soil from wind erosion (i.e. dust).
- Establish sediment controls around stockpiles via proposed sediments basins and/or hay bales and/or sandbags to prevent and control the loss of soils through water run-off, as well as protecting any nearby stormwater drains and waterways. Where possible, locate stockpiles away from drainage lines.
- Cover soil stockpiles during any heavy rainfall events. Place sediment control devices (as detailed above) around stormwater drains and stockpiles, as required.
- Where possible, keep topsoil separate from under burden when stockpiling soils.
- Construct the stockpile with no slope greater than 2:1 (horizontal to vertical). A less steep slope may be required, where the erosion risk is high.
- The source area of any soil excavated from the partial Site and the location of any stockpiled soil must be noted on a plan for reference, to ensure soil is accurately tracked on-Site (refer Appendix B for an example worksheet to record the movement and tracking of soil on-Site).
- Should stockpiles need to be removed and disposed off-Site then soil stockpiles need to be classified for off-Site disposal purposes in accordance with the ACT EPA (2011) *Environmental Standards: Assessment and Classification of Liquid and Non-liquid Wastes*.
- Following the completion of excavation works, resultant trenches should be reinstated either with the stockpiled materials removed (i.e. cut-to-fill or spoil), or with certified VENM material.
- Equipment used for soil excavations must be cleaned of loose soil prior to that equipment being used in another area/s.

8.6 PLANT AND MACHINERY

It is the responsibility of the remediation contractor to ensure that all plant and machinery used on the Site is properly maintained and in good working condition.

8.7 NOISE

Hours of operation will comply with the DA requirements to control noise from Site works. Increased noise levels may result from the use of on-Site and off-Site mechanical equipment during the course of the remediation works. To mitigate any noise which may arise as a result of Site works, all works should be carried out during normal working hours and in accordance with ACT regulations on this matter.

Noise control measures to be implemented during the remediation works may include:

- specified entry controls for construction vehicles entering and leaving the Site;
- suitable construction techniques and methodologies;
- use of quieter equipment; and

— restricted use of reversing alarms and all equipment should be fitted with alarm types that adjust output sound levels according to the prevailing ambient noise level.

All practical measures will be taken to minimise generation of noise, and contact information for enquires or complaints will be posted on the Site entrance gate.

8.8 WATER AND SEDIMENT MANAGEMENT

8.8.1 SURFACE WATER

Soil stockpiled during excavation works should be suitably contained to prevent run-off of any potentially contaminated water or soil to the surrounding environment, including the stormwater system. Control measures should be established to prevent surface water run-off entering and leaving excavation and stockpile areas. Control measures may include:

— limiting the extent of cleared areas;

— installation of well material as soon as practicable;

— temporary bunding or diversion drains;

— HDPE sheeting placed under stockpiles;

— silt fences/hay bales to surround stockpiles; and

— protection of existing drains with silt fencing/hay bales/sand bags.

These mitigation measures should be regularly inspected to ensure that they are in good condition and if necessary upgraded where their performance is deteriorating.

Stormwater runoff quality may be adversely affected in the event of rainfall. Hay bales should be placed near down-gradient stormwater entry points to prevent entry of contaminated sediment to stormwater, which may result from the project works.

8.8.2 SEDIMENT

Off-Site drains, gutters, roads and access ways shall be maintained free of sediment in accordance with regulatory requirements. Where required, gutters and roadways shall be swept regularly to keep them free from sediment. As per the infrastructure drawings, sediments basins are proposed to be constructed for the control of erosion and sediments, the details of which should be incorporated into the CEMP. As for surface water, control measures should be implemented as detailed in Section 9.7.1.

8.9 EQUIPMENT AND CLEANING OPERATIONS

Throughout the project, controls will be placed on the operation and movement of equipment. General procedures that will be implemented include:

— excavation/drilling equipment will be washed in an environmentally sound manner prior to leaving the Site;

— effective truck wheel-washing facilities will be provided to ensure that contaminated soil is not tracked off-Site; and

— no trucks or equipment carrying contaminated soils should be allowed to move across unsealed ground surfaces, except across designated transport corridors.

All contaminated soil/fill requiring off-Site disposal will be transported (subsequent to assigned classification) to an appropriate landfill facility. All transport trucks loaded with contaminated soil for off-Site disposal should be sealed and the load completely/securely covered to prevent wind-blown emissions or spillages and covers should be maintained until unloading. All truck tailgates should be securely fixed prior to loading and immediately after unloading soils and all vehicles are to be operated in a manner so as to prevent loss of soils during loading, transport and unloading activities. As part of the CEMP, a preferred transport route to the nominated facility is required to be identified.

8.9.1 GENERAL REFUSE DISPOSAL

All general Site refuse, including food, equipment wrappings, unused materials etc. shall be handled and disposed of appropriately into a skip.

8.10 HEALTH AND SAFETY PLAN

The Contractor should be responsible for preparing a health, environment and safety plan (HESP) which will be prepared prior to performing on-Site works associated with this detailed RAP. The HESP will address the health and safety of workers and receptors in the surrounding area. As a minimum the HESP should include:

— chemical hazard control (including procedures for exposure to unidentified chemicals)

— deep excavations

— heat stress, underground utilities and physical hazards encountered during excavation works

— ground gas/vapour monitoring requirements

— asbestos management plan

— regulatory requirements

— responsibilities

— sample and chemical handling procedures

— PPE

— work zones

— decontamination procedures

— emergency response plans

— contingency plans

— incident reporting.

8.11 SITE ACCESS AND SECURITY

During construction works, work areas will be barricaded or secured by a chain-wire fence, which will remain in place over the duration of the remediation works to exclude public visitors. Appropriate safety/warning signs will be posted in accordance with the WorkSafe ACT requirements. If an excavation and/or borehole is to be left open while the environmental project manager and contractor are not on-Site for a substantial period of time (such as overnight) a temporary fence will additionally be erected around the excavation/borehole.

Should any excavation be deeper than 1.5 m, the edges of the excavation should be battered to a 45 degree slope or benched into 1 m steps based on industry best practices.

8.12 WORKING HOURS

Working hours should be undertaken in accordance with the conditions of the DA. Any works to be conducted outside the normal working hours, needs to have Council's consent.

8.13 CONTACT INFORMATION AND SIGNAGE

As a minimum, security fencing and appropriate signage around all open excavations must be maintained at all times and the Contractor will be responsible for ensuring all persons on-Site are authorised personnel (i.e. persons not employed by the Principal Contractor, the environmental consultant, or their agents will not be permitted on-Site unless authorised by the Principal Contractor and/or environmental consultant).

A sign displaying the contact details of the Contractor (and Site facilitator if different to Contractor) shall be displayed on the Site adjacent to the Site access. This sign shall be displayed for the duration of the remediation works.

8.14 UNEXPECTED FINDS PROTOCOL

In the event that previously unidentified contamination that has not been included in this RAP is uncovered during the remediation works, the following procedures must be implemented:

- The workers that encounter the potential contamination must stop work immediately and notify their supervisor. The supervisor must then immediately notify the Site Foreman. Work must cease in this area until further assessed and advice by a suitably qualified person (e.g. Environmental Consultant or Occupational Hygienist).
- If the encountered contamination presents an immediate risk to human health or the environment (e.g. ruptured oil drum or friable asbestos), controls must be immediately implemented to isolate/barricade the area, contain and prevent further release of the contaminant. Workers initiating such controls must be suitably competent and wearing suitable personal protective equipment (PPE), which should be stored on-Site. Chemical spill kits should also be stored on-Site.
- The Site Foreman is to immediately notify an Environmental Consultant/Occupational Hygienist to undertake preliminary assessment of the potential contamination. Based on the findings of the preliminary assessment, further sampling and investigation may be required.
- Once confirmed that a contamination risk has been identified, the Site Foreman is to verbally advise the Client of the Unexpected Find. Written notification should follow, which will provide relevant information relating to any special recommendations to Site workers/employees, further sampling, investigation and remediation that may be required.
- If required, the Site Foreman must notify any relevant regulatory authorities (e.g. ACT EPA, WorkSafe ACT, etc.) of the contamination incident as soon as practicable.
- Based on the findings of the preliminary assessment and any further investigations undertaken, a remediation strategy or RAP may be required to be prepared by the Environmental Consultant.
- If remediation is required, the Client must notify relevant regulatory authorities (as required) of the planned commencement and completion dates and details of the remediation strategy to be adopted. Any information/reports

relating to assessment, investigation or remediation of the unexpected contamination must be included as part of this notification.

— The Client has a responsibility to keep regulatory authorities updated throughout the duration of any remedial works. If validation testing/validation programs are required on completion of the remediation works, a validation report will be prepared by the Environmental Consultant. Copies of the validation results and clearance reporting must be provided by the Client to all relevant parties.

8.15 CONTINGENCY MANAGEMENT

A contingency and emergency response plan should be prepared by the contractor. The purpose of the contingency plan is to identify situations that could occur during the remediation works that haven't been documented within this detailed RAP and to outline procedures to mitigate adverse impacts to the environment and human health, should they be encountered.

Contingency plans for anticipated environmental problems that may arise during the course of the remediation work are summarized in Table 9.1.

Table 8.1 Contingency management plan

Anticipated problem	Corrective actions
Unknown types of materials	In the event that greater volumes of potentially contaminated material are identified during the remedial works that exceed quantities estimated from the site investigations, specifically during the cut-to-fill program and/or spoil material generated through piling or trenching works, an assessment of the material should be conducted in accordance with Section 8.14.
Excessive dust	Use water sprays to suppress the dust or stop site activities generating the dust until it abates. Conduct dust monitoring as detailed within the CEMP.
Excessive noise	Identify the source, isolate the source if possible, and modify the actions of the source.
Excessive odours/vapours	If excessive organic odours/vapours are being generated, stop works and monitor ambient air across the site for organic vapours with a PID and odours at site boundaries. Implement control measures including respirators for site workers, use of odour suppressants, wetting down of excavated soil.
Excessive rainfall	Ensure sediment and surface water controls are operating correctly. If possible divert surface water away from active work areas or excavations.
Leaking machinery or equipment	Stop the identified leak (if possible). Clean up the spill with absorbent material. Stockpile the impacted soil in a secure location, sample and determine the appropriate disposal/treatment option.
Failure of erosion or sedimentation control measures	Stop work, repair the failed control measure.
Equipment failures	Ensure that spare equipment is on hand at the site, or ensure that the failed equipment can be serviced by site personnel or a local contractor.
Complaint management	All complaints should be dealt with immediately by the Contractor and should be directed to the Principal's nominated representative as required.
Asbestos	In the event that visible friable asbestos is identified during the remediation, stop work and the procedures documented within the AMP/CEMP (including an asbestos find protocol) should be followed.
Hazardous ground gases	In the event that hazardous ground gases/soil vapour concentrations are found to be unacceptable during remediation, stop work and follow the procedures documented in the CEMP.

Low environmental awareness of site workers may result in environmental impact including cross contamination of soil layers and off-site movement of contaminated soil. Accordingly, staff awareness training, inductions and daily tool box meetings should be conducted.

8.16 INCIDENT RESPONSE

Response to an incident occurring on-Site will be in accordance with the contractor's emergency and incident reporting procedures. A HESP and incident contact numbers are to be maintained in an on-Site register. All other relevant emergency contact numbers such as police, fire brigade and hospital will be listed in the Site health and safety plan and posted on-Site for easy access.

Local contractors (including a plumber and electrician) should be on call should an incident be reported by the Site workers or local residents.

9 POST-REMEDIATION SITE MANAGEMENT

Because hydrocarbon contaminated soil and groundwater is intended to remain in-situ underneath the Site, and the ongoing suitability of the Site for its proposed land use is contingent on the ongoing viability of the sub-slab vapour protection system, an Environmental Management Plan (EMP) will be required to be prepared for the ongoing day to day operation of the Site.

This EMP will be prepared specifically for the management of contamination and the protection system on the Site as well as associated monitoring requirements. It will not focus upon the environmental management of day to day Site operations other than how they relate to Site contamination.

Items to be covered in the EMP are anticipated to include the following:

— A detailed description of soil and groundwater hydrocarbon, PAH and lead contamination remaining on-Site based on investigations to date and any future rounds of monitoring;

— A detailed description of the vapour protection system installed on the Site including location, construction, materials and visual appearance;

— Requirements for training and notification of relevant Site staff with relation to management of in-situ contamination and protection of the vapour barrier;

— Procedure for reporting of impacts to the vapour barrier or exposure of contaminated soil or groundwater as well as rectification and repairs of any breaches of the vapour barrier;

— Procedures and worker health and safety controls for people excavating into contaminated soils;

— Requirements for ongoing monitoring of vapour risk within structures;

— An Unexpected Finds Protocol (UFP) for any discoveries of contamination not already identified through previous investigations on the Site to date; and

— Ongoing monitoring of natural attenuation of groundwater and LNAPL both on and off-Site.

9.1 MONITORED NATURAL ATTENUATION

The EMP shall provide a detailed procedure for undertaking a Monitored Natural Attenuation (MNA) program in on-Site and off-Site groundwater monitoring wells. As a guide, CRC CARE (2010), *Technical Report 15: A Technical Guide for Demonstrating Monitored Natural Attenuation of Petroleum Hydrocarbons in Groundwater* should be reviewed in developing the program.

The EMP should detail the regularity of monitoring, analytes required, monitoring criteria, data quality objectives as well as protocols for monitoring the effectiveness of natural attenuation (i.e. performance monitoring). In the event that the groundwater monitoring indicates that the groundwater contamination is not attenuating at the level required the EMP should also outline contingency approaches (e.g. chemical oxidant injection, passive skimmers, air sparging or other measures).

9.2 TRENCHING/EXCAVATION WORKS

Any excavation of service trenches or otherwise after the construction of the final Site slab and pavement would need to be conducted in accordance with established protocols detailed within the completed EMP. This should include:

- management of material that is excavated from below the cap so that it will not cross-contaminate the cap (i.e. any over excavation of the fill placed as part of the cut and fill works into the sub-surface);
- re-instatement of the marker layer at the appropriate position after completion of the works;
- placement of fill below the marker layer where required and/or waste classification and off-Site disposal of soil as necessary; and
- The installation of any services within the contaminated zone will require a marker layer lining the trench and a minimum of 300 mm of VENM or ENM surrounding the service. The marker layer is to be dovetailed into the marker layer underneath the capping layer and the trench is to be filled with VEMM or ENM to the finished ground level. Details of where this occurs must also be included in the survey plan.

10 CONCLUSIONS

WSP was commissioned to prepare this RAP to ensure that a remediation strategy is implemented to sufficiently mitigate on-Site vapour risk to future commercial/industrial development associated with the residual petroleum hydrocarbon contamination in soil and groundwater at the Site.

The remediation strategy detailed within the RAP assumes that the Site is to be redeveloped as per the summary presented in Section 3.3. The following remedial and management measures have been detailed:

— Removal of existing potentially contaminating Site infrastructure (e.g. ASTs and USTs) and subsequent validation; and

— Protection of Site structures to be constructed as part of the proposed development on-Site.

It is concluded that the implementation of this detailed RAP will render the Site suitable for the proposed use as an alternative waste treatment facility from the perspective of management of hydrocarbon contamination of soil and groundwater.

Prior to commencing the remediation works a CEMP needs to be prepared for the Site. A technical specification for the installation of vapour protection barriers on Site structures also need to be developed by the appointed installation contractor. The plans should be reviewed and approved by the Site Auditor before remediation begins.

A long-term EMP needs to be prepared prior to construction completion to detail the ongoing management requirements and maintenance of the vapour protection systems. The CEMP should also include monitoring of natural attenuation of contamination in groundwater and management of WHS risks to workers penetrating Site pavements and slabs and excavating into contaminated soils. The long term EMP/s must be reviewed and accepted by a Site Auditor prior to occupation of the Site.

Subsequent to the implementation of this RAP the following would be prepared:

— confirmation through preparation of a technical specification by the remediation contractors that all materials selected for installation of the vapour barriers meet the required specifications and were installed by appropriately experienced and qualified staff to specification requirements; and

— waste classification letters, as required for material being exported off-Site and appropriate VENM certification for any material to be imported.

11 LIMITATIONS

SCOPE OF SERVICES

This environmental due diligence assessment report (the report) has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the client and WSP (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.

RELIANCE ON DATA

In preparing the report, WSP 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, WSP 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. WSP 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 WSP.

ENVIRONMENTAL CONCLUSIONS

In accordance with the scope of services, WSP has relied upon the data and has not conducted any environmental field monitoring or testing in the preparation of the report. The conclusions are based upon the data and visual observations 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.

Within the limitations imposed by the scope of services, the assessment of the Site 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.

REPORT FOR BENEFIT OF CLIENT

The report has been prepared for the benefit of the client and no other party. WSP 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 WSP or for any loss or damage suffered by any other party in 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.

OTHER LIMITATIONS

WSP will not be liable to update or revise the report to take into account any events, 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 nor 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-1
SITE FIGURE

Map: 2271524A_GIS_F001_A2	Author: HartS
Date: 19/12/2017	Approved by: -

Data source: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community © Land and Property Information 2015

0 25 50 m

1:2,000

Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A3

Remedial Action Plan - 16 Ipswich Street, Fyshwick, ACT

Figure 1
Site layout and proposed development plan

wsp

APPENDIX A-2
PROPOSED SITE DEVELOPMENT

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Visual Impact Assessement

Canberra Materials Recovery Facility and Rail Freight Terminal

16 Ipswich Street, Fyshwick

November 2017

Capital
Recycling Solutions

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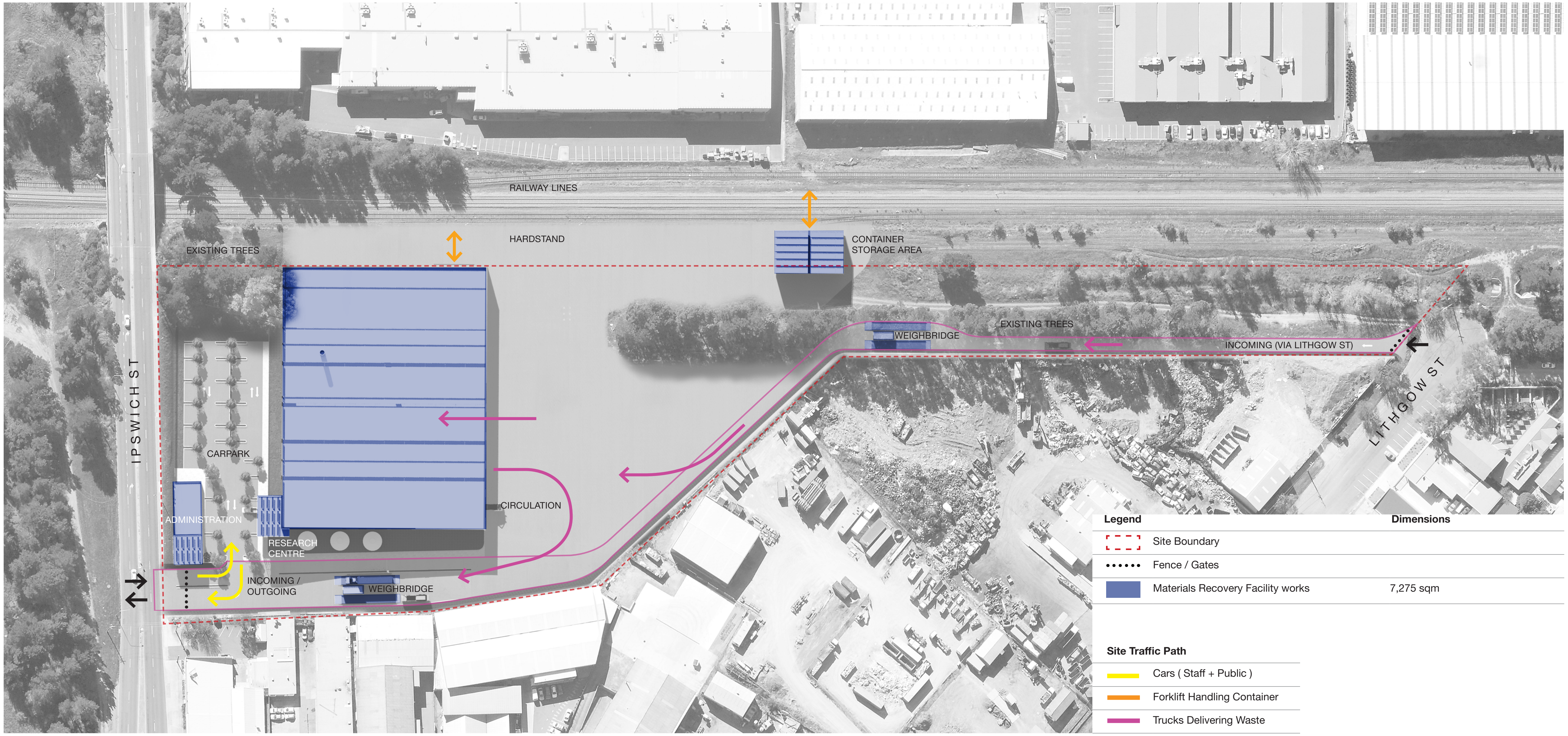
The Home of ACT's Renewable Energy

Advanced Waste Management
MATERIALS RECOVERY FACILITY



SCALE 1:1500 @ A3

0 15m 45m 90m

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Advanced Waste Management

Capital
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The Home of ACT's Renewable Energy

Advanced Waste Management

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Advanced Waste Management

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Recycling Solutions
The Home of ACT's Renewable Energy

PRELIMINARY

Revisions

DRAFT

22/11/2017 9:02:17 AM

Project: **Materials Recovery Facility**
Ipswich St, Fyshwick, ACT 2609

Drawing: **CONCEPT LAYOUT**

Project No: **216228**

Date: **11/20/17**

Author: **BW**

Scale: @ A1: **1 : 250**

Drawing No.: **SK01.01**

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PRELIMINARY

Revisions

DRAFT

22/11/2017 9:02:18 AM

Project	**Materials Recovery Facility** Ipswich St, Fyshwick, ACT 2609	Drawing	**ELEVATION - DIAGRAM**	Project No	**216228**	Date	**11/21/17**	Author	**BW**	Scale: @ A1	**1 : 250**	Drawing No.	**SK02.01**

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