STATE TRANSIT AUTHORITY

JULY 2020

ENVIRONMENTAL MANAGEMENT PLAN

MONA VALE BUS DEPOT - 58 DARLEY ST, MONA VALE NSW

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Environmental Management Plan
Mona Vale Bus Depot - 58 Darley St, Mona Vale NSW

State Transit Authority

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REV	DATE	DETAILS
A	31/3/2017	Draft for comments
B	05/06/2017	Final revision
C	19/06/2020	Update – inclusion of new remediation strategy
D	30/07/2020	Update – inclusion of auditor comments (IA 0301-1710)

	NAME	DATE	SIGNATURE
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1 PROJECT BACKGROUND

1.1 BACKGROUND AND EMP CONTEXT

WSP Australia Pty Ltd (WSP) was commissioned by State Transit Authority (STA), to prepare an Environmental Management Plan (EMP) for the Mona Vale Bus Depot located at 58 Darley Street, Mona Vale (the site). A site layout plan is included in Figure 1, Appendix A.

Previous site contamination investigations have identified a phase separated hydrocarbon (PSH) plume derived from a former leaking diesel fuel line located in the sites refuelling area, near the western boundary of the site which is inferred to be responsible for the light non-aqueous phase liquid (LNAPL) and dissolved phase hydrocarbons detected along the site boundary and in offsite wells to the northwest of the site. According to previous site investigations, underground storage infrastructure including USTs and associated fuel lines have been decommissioned and removed from the site.

Numerous contamination investigations have taken place to determine the risk to human and ecological receptors both onsite and offsite. Further details regarding these investigations is included in Appendix B. The PSH plume is known to have migrated offsite to adjoining properties to the west of the site.

The NSW EPA declared the site as significantly contaminated land on 11 November 2014 (Declaration Number 20141101). Since that time the site has been managed under various approved revisions to a voluntary management proposal VMP. The current VMP (approval number 20191731), presents the remediation program objectives as being to:

- Assess the extent of soil and groundwater contamination
- Assess the risks posed by the contamination; and
- Remove PSH from groundwater to the extent practicable.

The purpose of this EMP is, to summarise the current site condition, identify potential risks associated with residual hydrocarbon contamination at the site and on adjoining properties and to present procedures to mitigate these potential risks to human health and the environment. This EMP is designed to assist with relatively minor subsurface works that we describe herein as “routine works”: any maintenance or construction works involving removal of concrete slabs and penetration of the ground up to 1.5 metres below ground level (mbgl); and excavation or trenching associated with the general maintenance of the sub-surface fuel infrastructure, or underground services but not including the removal or replacement of underground storage tanks (USTs) (refer to Section 5.3).

The EMP has been prepared with reference to:

- Department of Infrastructure Planning and Natural Resources, 2004, G*uidelines for the Preparation of Environmental Management Plans* and
- NSW EPA 2017, *Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme, 3rd Edition*
- NSW EPA 2020 *Contaminated Lands Guidelines: Consultants Reporting on Contaminated Land*

1.2 OBJECTIVES

The objectives of the EMP are to:

- Outline the presence of known impacted materials remaining on the site and surrounds;
- Provide a framework for ongoing environmental management of the site and immediate surrounds;
- Document specific management requirements for any future subsurface works at the Site; and
- Provide recommendations for those responsible for surrounding properties or nearby service easements.

1.3 WHO DOES THE EMP APPLY TO?

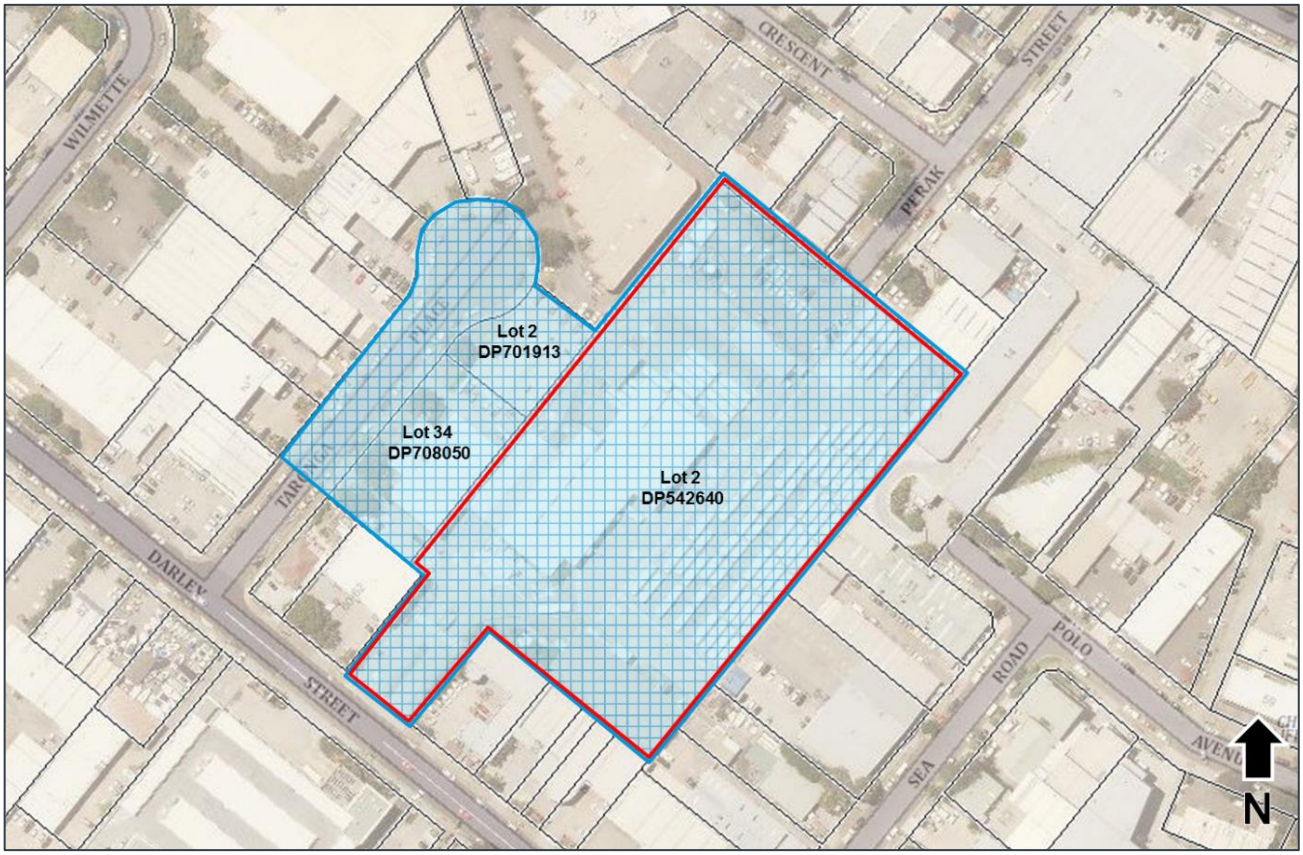
The EMP must be read, understood and implemented by those with a responsibility for management and upkeep of 58 Darley Street, Mona Vale (the Site).

As contamination issues extend beyond the boundaries of the site, the EMP also provides general advice for those with responsibility for surrounding sites to inform them of the potential risks on those sites so that they can manage future activities with due consideration to worker health and safety and to ensure their sites remain suitable for their land use.

Thus, the EMP provides:

- Mandatory requirements for management of the site itself (58 Darley Street, Lot 2 DP 542640); and
- General advice and recommendations for:
  - Those with responsibility on surrounding commercial properties including 9 and 10 Taronga Place (Lot 2 DP701913 and Lot 34 DP708050) should they be redeveloped or undergo change in land use; and
  - Those accessing utility trenches along Taronga Place, from the south western corner of Lot 34 to the cul-de-sac.

The area covered by this EMP is shown below and in Figure 4 (Appendix A).



1.4 TIMEFRAME/SUNSET

It is anticipated that an EMP will be required for the site at least until the NSW EPA no longer considers that the site warrants ongoing regulation. The form/content of the EMP is likely to change over time as the understanding of the contamination extent changes (both due to ongoing assessment and through positive remedial outcomes).

The current revision of the EMP is required to be prepared in June 2020 under the VMP, however, given the timing of the proposed remedial works, there will be a further amendment prepared once the remedial system is implemented.

Note: the planned remediation system implementation will be carried out under a contractor prepared Construction Environmental Management Plan that will reference this EMP.

1.5 EMP REVISIONS

STA are currently in the process of implementing an active remediation system that will include groundwater extraction and treatment in accordance with the current Remediation Action Plan (RAP) (WSP, 2020e). This current revision of the EMP (Rev D) relates to generic site management and will require an update once the new remediation system is installed to capture salient aspects of that system.

Active remediation is likely to be an ongoing activity for a period of time, but once the practicality of ongoing work has been reached it is likely that the system will be removed, and a period of passive monitoring may occur. These phases of the work will need to be captured in future revisions to ensure the EMP remains current.

Further details are provided in Section 6.

1.6 KEY MESSAGE OF THE EMP

The EMP has been prepared so that subsurface maintenance at the site and surrounds is carried out with appropriate consideration to health and safety of the workers.

This document sets out:

- The regulatory framework in which this EMP has been prepared – including enforceability, the roles and responsibilities relating to environmental management on the site and surrounds and reporting, training and emergency response procedures relating to the residual impact (Section 4);
- Current understanding of the nature and extent of contamination at the site and surrounds (Section 3);
- An analysis of the likely risks this residual contamination poses to future site users (Section 3), and key implementation strategies to control those risks (Section 5); and
- A recommended program for review of compliance, corrective actions and routine EMP revision in the future so that the EMP remains relevant and up to date (Section 6).

2 SITE CONDITION AND LANDUSE

2.1 SITE LOCATION AND DESCRIPTION

The subject site is located at 58 Darley Street, Mona Vale, NSW. The site is currently an active bus depot and comprises Lot 2 of DP 542640. Refer to Figure 1 and Figure 2, Appendix A for site location plans. A summary of site details are presented in Table 2.1 below.

Table 2.1 Site Identification Details

PARAMETER	SITE DETAILS
Street Address	58 Darley Street, Mona Vale, NSW
Lot / DP	Lot 2 DP 542640
Local Government Area	Northern Beaches Council
Land Zoning	4(b1) Light Industrial B1
Current Landuse	Bus Depot
Site Area	17,100 m^2 (approximately)
Geographical Coordinates Lat/Long	33º40’28.02”S 151º18’25.70”E

2.2 ADJACENT LAND USES AND SENSTITIVE RECEPTORS

The Site and immediate surrounds are shown in Figure 2, Appendix A. The site is positioned in a commercial and industrial precinct of Mona Vale. It is accessed via a driveway on Darley Street, to the south west and opens to a battle axe layout surrounded on all sides by other commercial enterprises.

The north eastern boundary at the rear of the site adjoins properties that front Perak Street and appear to be engineering workshops. The south eastern boundary is topographically up gradient of the site. Properties adjoining that boundary have frontage to By The Sea Road and Polo Road. These include a number of vehicle maintenance and smash repairers.

Neighbouring sites on Darley Street in the south west include general commercial shops including pet supplies, hardware store and a café.

The north west is downgradient of the site and includes commercial outlets and warehousing on Taronga Place. The adjoining sites include Pittwater Joinery and Reece Plumbing, separated from the site by a narrow walkway. Beyond Taronga Place are further mixed commercial and warehousing enterprises.

Potential human and environmental receptors located onsite and, in the surrounds, include:

- Workers and visitors on the site;
- Workers and visitors to the adjacent properties to the north and west;
- Residents in the surrounding suburb.
- Trees and shrubs in minor landscaped areas along the northern and southern site boundaries;
- Ecological receptors of Cahill Creek (which runs into Winnererremy Bay), north-west of the site;

The nearest identified sensitive environments are as follows:

- The nearest residential premises are located approximately 250 m to the west of the site (possibly downgradient) and 70 m to the south of the site, beyond Darley Street (likely cross gradient);
- The closest downgradient water body is an open stormwater channel located approximately 300 m north-west of the site (down hydraulic gradient). The channel flows into the estuarine environment of Cahill Creek and then Winnererremy Bay (part of Pittwater) approximately 1 km northwest of the site; and
- Bongin Bongin Bay is located approximately 750 m to the east of the site, but groundwater and surface water do not appear to migrate in this direction.

2.3 ENVIRONMENTAL SETTING

2.3.1 TOPOGRAPHY AND DRAINAGE

Based on the site survey and a review of available topographical maps for the region, the site is relatively flat with the ground surface sloping gently in a general north westerly direction. The site has an elevation of less than 10 mAHD.

Storm-water runoff generated on-site and from hardstands and roofs is likely to be directed to municipal stormwater networks likely discharging to the storm-water channel which crosses the site north of the plume and which discharges to Winnererremy Bay (part of Pittwater).

2.3.2 SOIL & GEOLOGY

Soils information was obtained from the 1:100,000 Sydney Soil Landscape Series Sheet 9130. The site is situated within the Warriewood Soil Landscape. The Warriewood Soil Landscape is described as level to gently undulating swales, depressions and in-filled lagoons on Quaternary sands. Deep soils (>150 cm) of well sorted sandy Humus Podzols and dark mottled Siliceous Sands overlie buried Acid Peats in depressions. Deep Podzols (>200 cm) and pail Siliceous Sands are typically found on sandy rises.

According to the 1:100,000 Sydney Geological Series Sheet 9130 (Edition 1), the area is underlain by Quaternary silty to peaty quartz sand, silt and clay. The lithology includes ferruginous and humic cementations in places and common shell layers. The Quaternary sediments are underlain by shale, sandstone and claystone of the Newport Formation.

WSP (2012) reported that observed subsurface conditions were in general accordance with regional soil and geology maps. Fill material was encountered to 1.4 m and was underlain by sand with variable quantities of clay and gravel.

2.3.3 HYDROGEOLOGY

To better understand the potential for local groundwater users to be impacted by the site, WSP have completed a groundwater bore search (Australian Government, Bureau of Meteorology *Australian Groundwater Explorer* (accessed on 23/7/2019). In summary 24 licensed bores were located within 1 km radius of the site. Of these only one was located downgradient, on parkland at the mouth of Cahill Creek where it discharges to Winnererremy Bay, approximately 975 m from the site. This bores purpose is listed as “other” indicating it is unlikely for potable supply.

Most bores are located east of Barrenjoey Road, which occupies a low ridge to the east of the site. These bores are likely to be up gradient of the site, or beyond a groundwater divide expected between the site and the Tasman Sea to the east, or otherwise are intercepting regional groundwater within underlying sandstone.

The shallow groundwater that is the subject of this EMP is unlikely to flow towards the east, or south east. The bores to the east and south east include a number of supply bores, most of which are installed to depth of greater than 50 m, likely in underlying sandstone. The nearest bore to the site is located approximately 60 m to the south south west of the Site entrance and is listed as being 93 m deep. Its purpose is shown as “Supply”. The groundwater flow direction of the regional aquifer in the sandstone is unknown as none of these wells are included in the monitoring program. It would be expected, based on regional topography that the regional groundwater flow system recharges west of the site and

discharges to the Tasman Sea. The uppermost aquifer at the site is located within the underlying sand and is unconfined. Groundwater is generally encountered at approximately 1.6 mbgl and reported to flow generally west with a potential north-westerly flow component.

Hydraulic conductivity (K) testing (documented in WSP 2020e) indicates a K of approximately 3.7 m/day and the local groundwater gradient is approximately 0.003. If the porosity of the sand was assumed to be 0.3 the groundwater seepage velocity would therefore be approximately 13.6 m/year.

3 SITE CONTAMINATION STATUS

The site has been the subject of a number of investigations and a series of targeted remedial activities. These are summarised in Appendix B. For a more comprehensive assessment of contamination status refer the remediation action plan (RAP) (WSP 2020e).

The more significant remediation/management works include:

- Removal of all underground fuel infrastructure including a former diesel spill sump pit, a former diesel pump house and a former diesel UST, and excavation and disposal of excavated hydrocarbon impacted soils;
- Installation of a PSH removal/skimmer system in six wells (MW05, MW13 and MW14 on the western boundary of the site, and MW09, MW19 and MW21 on properties to the west of the site).

In addition, STA have committed to implementing a more aggressive method of PSH removal, and at the time of this report the final design phase of this system is being completed. Therefore, a more effective PSH removal method will soon be implemented and this should reduce the head of PSH that is the primary driver for PSH migration.

3.1 SUMMARY OF RESIDUAL CONTAMINATION

Contamination on the site and surrounds comprises:

- Total recoverable hydrocarbons in soil were generally below the HSLs, except for samples in SB02, SB04 and SB12 which were inferred to marginally exceed the F1 criteria, refer to Figure 6, Appendix A for locations (WSP, 2012a). These locations were all in close proximity to the now abandoned former waste oil UST. These, and other locations, particularly around refuelling bay and along the former fuel line on the western boundary, also exhibited elevated hydrocarbons across the C_{10} to C_{28} range.
  - It is noted that across each soil bore locations tested the most elevated TRHs were detected at a depth of around 1.8 to 2.0 m consistent with the water table level. On only a few occasions (SB01, SB02 and MW05 – in proximity to the refuelling bay) were elevated hydrocarbons found at depths of less than or equal to 1 m depth. This finding indicates that the hydrocarbons in soils are predominantly associated with the PSH plume beneath the site and not with widespread surface spillage.
- In 2019, additional soil investigation was completed as part of a data gap assessment (WSP, 2020b) where additional monitoring wells were installed. Elevated hydrocarbons were reported in soils located within the water table level (approximately 2 mbgl) exceeding adopted assessment criteria. Results of soil samples collected from shallower soils were observed to not be impacted with hydrocarbons thus hydrocarbon impacts in soils are predominantly associated with the PSH plume beneath the site.
- Hydrocarbons, and in particular a PSH plume on the western boundary in the vicinity of the refuelling bay and associated infrastructure, which extends to the far side of Taronga Place west of the site.
  - The PSH is consistent with diesel and as such is predominantly hydrocarbon fraction F2 and F3, with minor F1, and virtually no F4. BTEX is low to non-detect, though naphthalene is elevated within the PSH affected areas.
  - A dissolved phase plume surrounds the PSH. Concentrations in the dissolved phase plume do not exceed available health or ecological criteria.
  - There is strong evidence for active biodegradation occurring with the plume and beneath the PSH. The rate of degradation is likely limited by availability of electron acceptors.
  - Primary sources are understood to have been removed or decommissioned.
- Inorganic dissolved heavy metals, and in particular arsenic as a widespread impact on the site and surrounds. The source is uncertain and unlikely to relate to the bus depot activities.

Identified risks relating to the contamination sources outlined above are generally acceptably low and manageable:

- The PSH is present at a depth that will not be intercepted during typical activities on the site and surrounds and there are no known nearby groundwater abstraction activities;
- Direct contact could occur during construction works or maintenance, however these activities should be carried out in accordance with this EMP and in accordance with project specific SWMS. The presence of the hydrocarbons has been notified to Dial Before you Dig and is shown of various utility plans for the local area.
- Vapour risk is acceptably low in the context of the commercial/ industrial land use of the site and surrounds.
- The plume is unlikely to migrate through sediments to more distant sensitive receptors including residential dwellings, recreational users of Cahill Creek or Winnererremy Bay, and ecosystems of these surface waters.
- The risks related to the arsenic plume are uncertain, as the extent of the plume is unknown. However, measures presented in this EMP for the protection of workers accessing the identified hydrocarbons contaminated groundwater should be sufficient to also mitigate risk to workers presented by the arsenic detected to date.

3.2 CONCEPTUAL SITE MODEL

The Conceptual Site Model for this site is included within the Remedial Action Plan (WSP 2020e). The CSM has been reproduced as Appendix C for reference purposes.

In the site's present condition, the identified contaminants present a low risk to human receptors. In the event of excavation or earthworks which expose impacted soils or groundwater, there is a moderate risk to human health via ingestion or dermal contact with contaminated soils or groundwater which would require management under a Construction Environmental Management Plan (CEMP) and site-specific safe work method statements (SWMS). This EMP has been prepared for the site and surrounds to assist in management of these risks.

4 ENVIRONMENTAL MANAGEMENT

This management plan has been prepared to ensure that the site remains safe through providing role responsibilities and control measures to ensure future construction works are carried out with due consideration to the risk of exposure to the chemicals of concern, and to ensure that upon redevelopment of the site or surrounds, that appropriate assessment is undertaken to ensure any local development is suitable for the intended land use. The EMP is not a construction environmental management plan (CEMP) – though it should be referred to in future CEMPs that may be prepared.

4.1 REGULATORY FRAMEWORK AND ENFORCEMENT

In order for an EMP to be effective it must be practical and enforceable. The NSW EPA 2017, *Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme, 3rd Edition*, in Section 3.4.6, makes allowance for EMPs in instances where:

- Complete clean-up of contamination affecting an area is not practicable;
- Contaminants are being capped or contained on-site; and
- Remediation is likely to cause a greater adverse impact than would occur if the site were left undisturbed.

In order for an EMP to be protective of health and the environment it must be:

- Made to be legally enforceable,
- Appropriately available and notified to the public so that that potential purchasers or other interested individuals are aware of the restrictions; and
- Able to demonstrate the site is free of off-site migration of contamination from the site or, where there is off-site migration or its potential, document management or monitoring requirements so that the contamination does not present an unacceptable risk to either the on-site or off-site environments.

4.1.1 THE EMP CAN REASONABLY BE MADE TO BE LEGALLY ENFORCEABLE

With respect to environmental management of the subject Site, the activities identified as needing to be controlled include:

- Assessment of risk in any future redevelopment of the site or surrounds to a more sensitive use; and
- Protection of the health of construction or maintenance workers accessing the subsurface on or offsite.

Of these identified aspects the former is an activity which would constitute development under the EP&A Act and require development consent, which provides an avenue for enforcement. Council may require adoption of this EMP as a condition of development consent.

The EMP will be provided to the NSW EPA as part of ongoing regulation of the property, which has been declared to be significantly contaminated land (declaration No. 20141101), under the current approved Voluntary management proposal (Notice No. 20191731). Therefore, EPA and Council will be in a position to require enforcement of the EMP during any onsite or offsite development works.

Risk related to, non-regulated sub surface maintenance activities can be managed by:

- The provision of this EMP to the Site management and management of neighbouring properties so that it can be referenced by contractors in work method statements prepared for planned activities;
- The provision of the EMP to Dial Before You Dig and the utility providers whose infrastructure is known to be in that location.

4.1.2 THERE WILL BE APPROPRIATE PUBLIC NOTIFICATION OF ANY RESTRICTIONS APPLYING TO THE LAND

As the land has been declared by the NSW EPA to be significantly contaminated land it is listed on the NSW EPA's public register of contaminated sites. The information provided by the EPA against this property can make mention of the EMPs existence.

Furthermore, notification of the EMP will be provided via Councils Section 149 certificate for the Site. This will advise that the Site (58 Darley Street, Mona Vale, NSW) is subject to a NSW EPA regulation and that an EMP has been prepared for the land.

In addition, as per Section 5.5.2, Dial Before You Dig and the utility providers whose infrastructure is known to be in the vicinity will be notified of the EMP so that where searches are conducted for utilities in Taronga Place the applicants will be made aware of the EMP's existence and can contact STA for a copy.

4.1.3 CONTAMINATION WITHIN THE SITE IS MANAGED OR MONITORED SO THAT IT DOES NOT PRESENT AN UNACCEPTABLE RISK TO EITHER THE ON-SITE OR OFF-SITE ENVIRONMENTS

The remediation on the site has been carried out to the extent practicable, given the operational constraints of the site. Though PSH is present onsite and on land to the west, the risk has been assessed to be acceptably low for ongoing current land uses.

Under the terms of the VMP, STA has an ongoing responsibility for monitoring of the groundwater conditions on and offsite, and this information is provided to the EPA, and a NSW EPA accredited auditor, for review on a periodic basis. In addition, STA have committed to implementing a much more aggressive method of PSH removal, and at the time of this report the final design phase of this system is being completed. Therefore, a more effective PSH removal method will soon be implemented and this should reduce the head of PSH that is the primary driver for PSH migration.

4.2 ENVIRONMENTAL MANAGEMENT STRUCTURE AND RESPONSIBILITY

This section summarises the various parties in Table 4.1 who have been allocated a responsibility under this EMP. The responsibilities have been allocated according to the party best placed to manage the requirements. The responsibilities may be delegated where appropriate, but this must be done in writing and notified to all affected parties.

Table 4.1: Responsibilities

PARTY	RESPONSIBILITY
Site owner (STA)	The key responsibility of the Site owner is to ensure the protection of the environment and site users. Specifically, the owner will: — Maintain ultimate responsibility for implementation of the EMP on the subject site. — Review the effectiveness of the EMP routinely (yearly in accordance with the VMP) and following any incident or other event that suggests the EMP is ineffective. — Implement and communicate improvements and amendments to the EMP as needed. — Provide sufficient resources, where needed, to comply with the requirements of this EMP; — Brief Contractors of the existence of this EMP, and their roles within it; — Maintain records of maintenance and/or reports related to the site.

PARTY	RESPONSIBILITY
Sub-Contractors	All subcontractors have an obligation to protect the environment and the health of their workers through carrying out their own work with due diligence. In particular, they must: — Prepare appropriate Work Method Statements with reference to this EMP; and — Comply with statutory requirements applicable to their work.
Off-site landholders	For properties subject to the EMP, it is the responsibility of the land holders to carry out the actions and controls presented and described in Section 4 of this EMP, to the extent that the requirements are applicable to those properties. This obligation to meet the requirements of the EMP also rests with Council with respect to the portion of Taronga Place covered by the EMP.

4.3 REPORTING

There is no particular reporting requirements under this EMP. Site management do have various monitoring and reporting obligations under the VMP.

4.4 INCIDENT REPORTING

Environmental incidents and emergencies will be reported verbally to STA as soon as practicable followed by a written report within 24 hours. Where appropriate the regulatory authority (EPA) will also be notified.

4.5 EMERGENCY MANAGEMENT

The following approach will be initiated in the event of an emergency:

- If required, emergency services will be notified to assist in mitigating the emergency;
- The Contractor will notify the Site Manager of the emergency immediately, who in turn will report to the STA Environmental Manager;
- The Contractor will identify the size and nature of the emergency;
- All work in the area will be stopped immediately and mitigation measures will be employed where safe to do so;
- The Contractor will notify the emergency to the EPA and other government agencies as required; and
- The Contractor will assist STA with the investigation of the cause of the emergency and implement procedures to prevent a repeat situation.

4.6 EMERGENCY CONTACTS AND RESPONSE

In the unlikely event of an emergency relating to the site following contacts are available:

Table 4.2 Contact details

NAME	ROLE	CONTACT
Emergency Response Contacts		
Fire and Rescue NSW	Emergency Response	000
NSW Police Force		
NSW Ambulance Service		
NSW Environment Protection Authority	Environmental hotline	131 555
WorkCover NSW	Incident Reporting	131 050
Poisons Information	Poisoning Information	131 126
Mona Vale Hospital (Emergency)	Local hospital	02 9998 0333
General Contacts		
Tarek Sabih	STA Mona Vale Depot Manager	02 9997 1258
David Gosling	STA Environmental Manager	02 9508 2911
WSP	Environmental Advice	02 8907 0900

5 EMP IMPLEMENTATION

This management plan has been prepared to ensure that the site remains safe for STA workers, and workers on adjacent commercial / industrial properties by providing role responsibilities and control measures that will continue to ensure the risk to occupants of the site and surrounding sites remains acceptably low.

This management plan is not designed to be a CEMP if future redevelopment works take place – though it may be referred to in future CEMPs that may be prepared.

5.1 RELEVANT LEGISLATION AND GUIDANCE

Any work that is carried out on the site should follow the current occupational health and safety regulations at the time (i.e. NSW Work Health and Safety Regulation, 2017).

A list of examples of work health and safety and environment protection documents relevant to the specific risks for onsite and offsite works, that should be consulted in preparation of intrusive works are included in Table 5.1. If at any time the advice in the codes of practice or legislation conflicts with advice in this EMP, then the advice / requirements of the code of practice or legislation prevails over this EMP.

Table 5.1: Relevant legislation and guidance

TYPE	REGULATOR	TITLE
Legislation	Work Cover NSW	*Work Health and Safety Act, 2011* *Work Health and Safety Regulation, 2017*
	NSW EPA	*Contaminated Land Management Act 1997* *Protection of the Environment Operations Act 1997*
Guidelines	NSW EPA	NSW EPA 2014 *Waste Classification Guidelines Part 1: Classifying Waste*. National Environment Protection Council, 2013 N*ational Environment Protection (Assessment of Site Contamination) Amendment Measure 2013*.
Codes of Practice	WorkCover	Safe Work Australia, 2019 *Code of Practice - How to Manager Work Health and Safety Risks* SafeWork Australia, 2019 *Code of Practice - Construction Work* SafeWork Australia, 2020 *Code of Practice - Excavation Work*

5.2 ENVIRONMENTAL TRAINING AND INDUCTION

Any contractors or maintenance personnel excavating into the Site or surrounds, within the areas shown in Figure 4, Appendix A, are to ensure that they:

- Carry out all works with due consideration of Work Health and Safety related to chemical exposure; and
- Ensure that the works reinstate the surface at completion.

To that end we recommend that the Site owner adopt an induction process that includes checking their contractors are qualified to carry out the required activities and that any personnel whose tasks involve penetrating the slab or other pavements on the site are briefed on specifics around:

- Depth and location of hydrocarbons;
- Pavement rectification requirements; and

- Health and environment protection controls associated with fuel impacted soil.

Before undertaking any work on the site, all subcontractors will be required to prepare their own Work Method Statements including an environmental risk assessment which will be reviewed by STA or their delegated project manager.

With respect to future works on adjoining land, we recommend that those with responsibility for the work also adopt an induction process that includes notification to all subcontractors of the risks of intercepting contaminated soil and / or groundwater below the site surface. In this way these risks can be assessed and managed by the contractors undertaking the works.

5.3 CONTROL OF FUTURE WORKS

Future maintenance or contract works onsite or offsite need to be assessed for the potential to expose *in situ* contaminants in soils or groundwater that remain on the site. This EMP is designed to assist with relatively minor subsurface works that we describe herein as "routine works".

5.3.1 DEFINITION OF ROUTINE WORKS

Routine works at the site are defined as:

- Any maintenance or construction works involving removal of concrete slabs and penetration of the ground up to 1.5 metres below ground level (mbgl); and
- Excavation or trenching associated with the general maintenance of the sub-surface fuel infrastructure, or underground services but not including the removal or replacement of underground storage tanks (USTs).

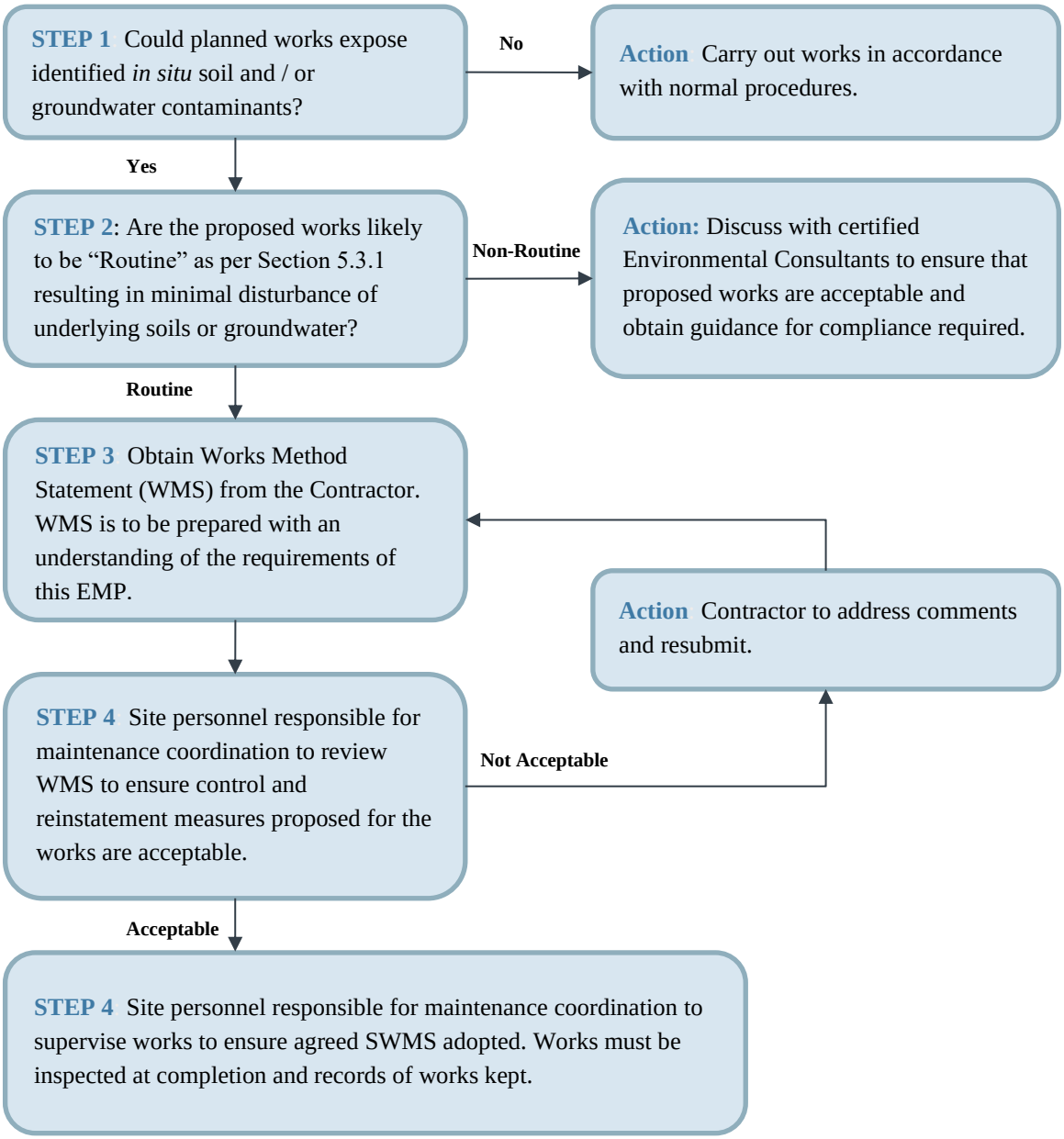
The EMP does not cover excavations greater than 1.5 m depth which would likely require notification to SafeWork NSW, an engineer's report and ground support systems such as shoring. It is anticipated that any such works will be undertaken in accordance with a specific construction EMP (if required).

If a CEMP is prepared it should reference this EMP and provide specific controls to minimise risk of exposure or environmental impact relating to the residual contamination described in this report.

5.3.2 DECISION SUPPORT FLOW CHART

Any proposed works should be assessed by the STA appointed Maintenance Manager for the site using the flow chart on the following page.

Diagram 5.1: Flow Chart of Control for Site Works



5.4 PROTECTION OF MAINTENANCE AND CONSTRUCTION PERSONNEL

5.4.1 SOURCES AND CONTAMINANTS OF CONCERN (COCS)

The contaminants of concern (COCs) as identified in WSP, 2020e are total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylenes and naphthalene (BTEXN), and polycyclic aromatic hydrocarbons (PAHs) associated with the LNAPL and dissolved hydrocarbons identified in groundwater beneath the site.

Sources of contamination at the site have been identified as:

— Impacted soils around refuelling bay and along the former fuel line on the western boundary;

- A former diesel spill sump located within the refuelling area near the western boundary of the site. The diesel spill sump is no longer present and was decommissioned and removed in 2013 along with hydrocarbon impacted soils in the vicinity of the sump pit;
- A former UST fuel line located in the vicinity of the refuelling area and inferred to be potentially responsible for the soil and groundwater contamination evident in this area. According to previous site investigations, underground storage infrastructure including USTs and associated lines have been decommissioned and removed from the site;
- Surface spills associated with bus refuelling in the refuelling area located to the west of the site;
- Two bus chassis wash bays to the west of the site and associated oil / water separators for bus cleaning; and
- A maintenance and workshop building to the west of the site for bus repairs, including waste oil disposal sinks and drums.

These features are shown on Figure 2 of Appendix A, while the location of the wells included in routine monitoring works are included in Figure 5.

5.4.2 SAFETY PLAN

A site-specific safety plan should be prepared for all routine works on the site. The safety plan will be prepared by the relevant person undertaking the works and will take into account the specific job tasks, the site employees and other workers involved in the works. Any additional workers at the site (i.e. subcontractors) are required to prepare their own safe work method statement prior to undertaking works onsite. Consideration of public health and safety is also required, particularly for works taking place on public roads or footpaths.

The safety plan must be prepared to comply with the New South Wales *Work Health and Safety Act 2011*. All workers involved in site works will be required to read and understand the safety plan prior to commencing any works on the site.

The safety plan should address the following issues:

- Relevant site contact details;
- Hazard identification and control;
- Chemical hazard control;
- Handling procedures;
- Personal protective equipment;
- Nearest route to medical facility; and
- Emergency muster point.

5.4.3 WORKER HEALTH AND SAFETY

Working with contaminated material may pose a risk to workers health and safety. These risks can be minimised by:

- Maintaining the sealed site surface in good condition where possible;
- Ensuring that appropriate waste management procedures are implemented to isolate or remove exposed contaminated material from site workers;
- Controlling dust generation;
- Limiting the inhalation of dust or vapours by wearing appropriate face masks or respirators where necessary. Specific protocols for the type of masks to be worn and when should be detailed within the CEMP.;
- Wearing appropriate PPE (long pants, long sleeved shirt, gloves and safety glasses) to minimise contact with exposed contaminated material;

- Establishment of appropriate exclusion zones e.g. barriers and signage to minimise contact with contaminated materials; and
- Maintaining a high level of personal hygiene – washing hands before eating, drinking and smoking and avoid eating, drinking or smoking in the vicinity of contaminated material.

5.4.4 PUBLIC HEALTH AND SAFETY

Construction involving intrusive works at the site or on adjoining commercial / industrial properties and roadways (e.g. Taronga Place) may pose a risk to public health and safety. These risks can be reduced by:

- Maintaining the sealed site surface in good condition;
- Confining works to an approved area and restricting access to the approved area via temporary fencing, barricades and / or bunting as appropriate;
- Maintaining construction site security outside of work hours;
- Placing safety signage such as "Construction Site No Entry", required PPE and any other signs as appropriate on the boundary fencing and access gate; and
- Minimising dust generation and stormwater / sediment runoff using dust suppression, minimising traffic movements, and appropriate tarping and bunding of exposed contaminated material.

5.4.5 ACCESS AND SECURITY

The STA bus depot site is fenced and public access is not permitted. However, should any intrusive works (i.e. removal of the sealed surface for excavations works) occur, the working area should have temporary fencing or barricading erected around it for the period of the works and until the site has been returned to its usual configuration for the safety of the site workers and visitors.

Works in offsite areas including Reece Plumbing, Pittwater Joinery and Taronga Place should require fencing around the works until the work area has been returned to its usual configuration and resealed appropriately. A traffic management should be implemented for any works taking place on the road or in carpark areas. Works taking place on public walkways should have appropriate measures to re-route pedestrian access away from the work area.

5.5 GENERAL ENVIRONMENTAL MANAGEMENT AND CONTROLS

Potential hazards associated with the works that require management may include but are not limited to:

- Materials releasing volatile compounds or odours;
- Liquid waste generation;
- Collapse of trenchwork;
- Uncontrolled ingress of water into excavated areas;
- Flooding of excavated pits; and
- Uncontrolled discharge of stormwater or spillages to groundwater.

These should be addressed in any safe work method statements prepared for the planned maintenance or construction works. Additional notes and recommended controls for subsurface works are described in the following subsections.

5.5.1 SITE BOUNDARY DEMARCATION

The work area must be defined / isolated by the erection of temporary fencing, cones, barricades and / or barriers, as appropriate to prevent access to the work area and/or exclusion zones around the work area. In particular, signage will be positioned to prevent the access of unauthorised / unprotected personnel and vehicles to the work area.

5.5.2 UNDERGROUND SERVICES

All plans documenting underground services on the site will be made available prior to commencing any excavation. Dial before you dig (DBYD) searches should be conducted prior to the commencement of any intrusive works onsite or offsite.

All excavation areas should be cleared for the presence of underground services and existing services marked up by a professional Service Locator prior to the commencement of any earthworks. If the exact location of the services cannot be determined or is found to encroach on the proposed excavation area, the service should be exposed for visual assessment using non-destructive drilling (NDD) techniques.

The contractor will not disrupt the supply of any services unless authorisation from the relevant local supply authority has been granted.

5.5.3 DUST

Generation of dust during construction works may pose risks to human health and the environment if not managed appropriately. During any works which have the potential to generate dust, visual monitoring will be undertaken to assess for excessive dust generation. Mitigation measures such as good housekeeping measures (e.g. the covering of stockpiles, maintenance of designated haul road(s) etc.), minimisation of vehicular traffic (volume and speed to less than10 km/hr) and dust suppression techniques such as water spraying will be employed to control dust on the site.

If excessive dust is being generated, areas of earthworks will be sprayed with additional water to reduce levels but not to the extent that uncontrolled runoff is created. Stockpiles will be limited to 1.5 m in height and should be covered to reduce potential for dust generation.

Appropriate PPE including P2 (asbestos / dust) face masks should be worn by workers in areas where dust is being generated as a result of site works or weather conditions (i.e. extreme heat or wind).

5.5.4 ODOUR AND CHEMICAL VAPOURS

During the excavation of shallow soils at the site, it is considered possible (based on the presence of PSH in the groundwater) that nuisance hydrocarbon odours may be generated. Based on the results of the vapour assessment (WSP, 2020c), the vapours generated are not expected to pose a risk to human health for short term shallow trenching works from 0 < 2 mbgl. It is recommended that a photo ionisation detector (PID) be used during excavation works to inform staff of the presence of volatile hydrocarbons with the alarm set at 25 ppm. If the alarms are exceeded in the breathing zone during the work then it is recommended that works cease and an occupational hygienist be engaged to advise on health and safety aspects.

Where any level of odours are present half face respirators should be kept on hand and used by any staff that are concerned or indicate the odours to be causing them headaches etc. respirators should be fitted with an A1P2 and/or E1 cartridge that filters both particulates and organics.

Mitigation measures to be employed to control odour and / or chemical vapours during any routine works may include the following:

— Site personnel will be supplied with and wear appropriate protective clothing including disposable overalls, gloves and face masks to prevent contact with volatile chemicals and their breakdown products;

— Application of odour suppressants such as ‘Biosolve’ on stockpiles and excavation faces to reduce odours;

— Periodic vapour monitoring during excavation works;

— Excavation activities are to be undertaken in favourable weather conditions (i.e. low wind and heat);

— Exposed surfaces covered overnight or during periods of low excavation activity;

— Plan excavation works so as to minimise off-site nuisance odours;

— Minimise exposed surface area of stockpiles and excavation cuts; and

— Dispose of any odorous material to a licenced landfill facility as soon as practicable.

5.5.5 NOISE

Increased noise levels may result from the use of machines on the site during the course of any maintenance or construction works. In addition, these works can cause vibration levels which can disturb residents.

To mitigate any noise which may arise as a result of site works, all works will be carried out during Council approved construction hours (Mon to Fri 7 am – 5 pm and Sat 8 am – 1 pm with no work permitted on Sundays or public holidays) and in accordance with all applicable state and local Council noise regulations.

During work breaks all machinery is to be switched off or throttled to a minimum to reduce noise output whenever possible. The location of stockpiles and entrance / exit routes for trucks should take into account the need to maximise distance to sensitive noise receptors.

5.5.6 SURFACE WATER

In order to mitigate the potential for the spread of contaminated soil, erosion and a degradation of water quality due to surface water run-off, the following management measures shall be employed:

- Stockpiles / bins stored on site will be covered to prevent water infiltration and then seepage through the stockpile. Containment around stockpiles should also be included to filter excessive sediment loads;
- Avoid unnecessary ground disturbances; and
- Vehicles, machinery or equipment are only to be washed in the bus chassis wash bay areas on the bus depot site which have suitable runoff collection sumps and oil / water separators.

Contractors undertaking subsurface works in off-site locations should plan for plant and equipment decontamination so that impacted soil is not tracked away from the worksite. Decontaminating activities should include collection and lawful disposal of all wash water.

5.5.7 GROUNDWATER / WASTEWATER MANAGEMENT

Given groundwater contamination exists at the site, any proposed excavation works should consider the potential for exposure to contaminated groundwater to occur and have control measures in place to protect construction / maintenance workers (Section 5.4).

If dewatering of shallow excavations is required, these works should be carried out by a licenced waste management contractor and pumped water should be collected in appropriate drums or tankers for offsite disposal with supporting waste transport documentation.

Waste groundwater could potentially be disposed of through the planned onsite water treatment system (which separates oil and water and discharges waste water under a trade waste agreement), provided the volumes do not impact the rate of groundwater remediation works. This should only occur with approval of the remediation contractor responsible for the design and maintenance of the system.

Small volumes of oily water (<50 L) may be disposed of in the bus depot's waste oil and oily water disposal collection points that are directed to the facilities waste oil store for offsite disposal. This should only occur with the approval of the site environmental manager.

5.5.8 FLORA AND FAUNA

Given the site is an active bus depot with a predominantly sealed surface, the occurrence of flora and fauna is minimal. There are some small, landscaped areas to the west of the main office building and a row of hedges along the eastern side of the driveway entrance from Darley Street. There are also some grassed / landscaped areas and mature trees on the median strip on the eastern side of Taronga Place which need to be considered for any works taking place on adjoining properties or on Taronga Place.

The risk of impacting flora and fauna can be minimised through implementation of the following:

- Avoid maintenance or construction works in the vicinity of landscaped or vegetated areas on the site;
- Report any injured or killed animals to WIRES; and
- Manage food waste using sealed bins to discourage foraging animals.

5.5.9 HAZARDOUS MATERIALS STORAGE AND HANDLING

Fuels and chemicals can contaminate soil, surface water and groundwater, as well as presenting a risk to human health. All chemical storage and handling activities must comply with relevant legislation and regulatory requirements. Minimise the risk of adverse environmental impacts associated with chemical/fuel storage and handling by undertaking the following mitigation measures:

- Ensure all chemicals stored onsite are appropriately labelled and stored, with supporting documentation in accordance with Safework NSW codes of practice;
- Do not undertake standard vehicle maintenance, except in appropriate areas of the vehicle maintenance workshop;
- Ensure machinery does not leak fuels, oils or any other chemicals;
- Have spill kits available and use when required;
- Clean up leaks immediately and fix or remove leaking / faulty machinery;
- Dispose of soils / materials contaminated during fuel, oil or chemical spills to a licensed waste facility;
- Have the relevant material safety data sheet (MSDS) available on site; and
- Store and handle chemicals appropriately.

5.5.10 WASTE MANAGEMENT

Uncontrolled waste and rubbish can affect the aesthetics of the site and surrounding properties, attract pest animals and can have adverse environmental impacts. These impacts can be reduced by:

- Minimising waste generation;
- Storing waste securely in appropriate bins or drums;
- Recover and recycle where possible;
- Clear the work site of rubbish at the completion of work each day;
- Maintain work areas in a neat and tidy condition; and
- All waste to be removed from the site and disposed of appropriately.

5.5.11 SOIL DISPOSAL

Any soil generated at site which requires disposal should be stockpiled and subsequently classified by an appropriately qualified environmental consultant for disposal. Samples should be collected at a rate of at least one sample per 25 m^3, with a minimum of three samples per waste stream.

A qualified consultant shall prepare a waste classification letter for the receiving waste facility as per the NSW EPA, 2014 *Waste Classification Guidelines Part 1: Classifying Waste*. Once classified, the material can be disposed of only by appropriately licensed transportation contractors to an appropriately licensed facility.

At all stages appropriate documentation should be maintained including but not limited to:

- Waste classification report;
- Waste consignment documentation; and
- Landfill disposal dockets

6 MONITORING AND REVIEW

6.1 ENVIRONMENTAL MONITORING

The site is currently regulated by the NSW EPA under an approved voluntary management proposal. The VMP requires STA to conduct ongoing monitoring of the groundwater surrounding the site. This work is ongoing and further details are available in the VMP and the RAP (WSP, 2020e).

In terms of monitoring of excavation works, that are the subject of this EMP, the following advice is provided. Whilst these requirements are for the subject Site (58 Darley Street, Mona Vale, NSW) we recommend that those with responsibly for adjacent sites also adopt the recommendations for future subsurface works on their land.

6.1.1 INSPECTIONS DURING INTRUSIVE SITE WORKS

During any planned excavation works on the site it is important that the planning documentation be reviewed, and the works be inspected by the site owner, or delegate (Site Manager). Where works will penetrate or affect the slab the Site Manager will inspect the progress and completion of the works. The inspections are to be carried out on a daily basis during works and at completion of works:

The inspector(s) shall note at least:

- Date and personnel onsite;
- Activities being undertaken;
- That works are being undertaken in accordance with an approved WMS;
- Level of compliance with the WMS;
- Condition of all environmental controls;

In the event of a non-conformance this information will be documented, and corrective actions implemented in a timely manner. Where no issues are identified the record should be kept for reference purposes.

6.1.2 ENVIRONMENTAL RECORDS

Environmental records, which will be collated by the Site owner shall include the following:

- EMP distribution records;
- Training and induction records;
- Environmental incident reports;
- Environmental complaint records;
- Non-conformances and corrective and preventative action reports;
- Routine and non-routine inspection checklists/reports and
- Environmental monitoring data and reports (e.g. any air monitoring results, waste classification reports etc that may be generated in the future).

6.1.3 SUMMARY OF ENVIRONMENTAL MONITORING

A summary of monitoring requirements for the project is provided in Table 6.1 (following page).

Table 6.1: Summary of monitoring requirements

ISSUE	LOCATION	MONITORING PARAMETER	MONITORING FREQUENCY	PERFORMANCE CRITERIA/ OBJECTIVE	DOCUMENTATION
Ongoing Monitoring					
Groundwater wells	As documented in the approved VMP and any subsequent approved variations, and the RAP (WSP, 2020e).				
Monitoring during future routine excavation works					
Contaminated soil and groundwater beneath the site and surrounding lands west of the site.	Excavations	Compliance with the EMP	Daily during any intrusive works	Works in accordance with agreed WMS	Performance checklist/report
	Stockpiles of waste spoil	Inspection of stockpiles for appropriate fencing to prevent public accessing waste	Daily during any intrusive works	Works in accordance with agreed WMS	Performance checklist/report
		Inspection to evidence of erosion or sediment migration			
		Waste disposal – appropriate classification and waste disposal location	Sample at a rate of 1/25 m^3 of soil.	NSW EPA waste guidelines	Environmental Consultant - Waste classification report. Waste tracking documentation.
	Imported soil	Test to ensure suitable for site use	Sample at a rate of 1/25 m^3 of soil.	NSW EPA waste guidelines	Environmental Consultant - VENM or ENM certification.
Sediment on roads	Access roads and surrounding streets	No sediment to be spread on or offsite	Daily during any intrusive works	Works in accordance with agreed WMS	Photographs

6.2 CORRECTIVE ACTION

STA is responsible for ensuring the ongoing safe condition of the site.

An environmental non-conformance will be detected through verification processes such as monitoring, inspections and close supervision of subcontractor activities. The process for managing environmental issues are summarised as follows:

- When an environmental issue is detected, the details will be recorded;
- STA will then investigate the reasons for the issue and determine appropriate corrective or preventative actions and the responsibility and time for completion of the actions. The details of the discussion will be entered into an Environmental Incident and Action Register or similar;
- Once an action is completed, the register will be updated to close the action including input of comments and completion date;
- The Environmental Incident and Action Register will be reviewed weekly during periods of intrusive works onsite and otherwise on an annual basis to ensure actions are being implemented effectively;
- Where an issue is of a more serious nature, has been identified repeatedly or exceeds regulatory obligations, the work on the identified operation will be stopped until action is taken to eliminate the environmental issue.

6.3 REVISION OF THIS EMP

This EMP is considered a “working document” and will be updated as required to ensure that the document is effective in managing environmental impacts on the site and surrounding areas, for example:

- When site conditions or remediation technologies change;
- Environmental conditions change;
- An incident occurs;
- To maintain currency with legislation, guidelines and standards.

Under the approved VMP there is a requirement for annual review and revision of the EMP.

7 REFERENCES

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- ENRS, 2018 Groundwater Monitoring Event (GME) Report – April 2018 STA Bus Depot Monavale 58 Darley Street, Mona Vale, NSW, 2103
- ENRS, 2016c Draft: Groundwater Monitoring Event (GME) Report Round 6 – September 2016 STA Bus Depot Monavale 58 Darley Street, Mona Vale, NSW, 2103
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- WSP, 2012b Soil and Groundwater Delineation Report, Mona Vale Bus Depot, 58 Darley Street, Mona Vale, NSW
- WSP, 2013a Offsite Soil and Groundwater Delineation Report, Mona Vale Bus Depot, 58 Darley Street, Mona Vale, NSW
- WSP, 2013b Remedial Action Plan, STA Mona Vale Bus Depot – 58 Darley St, Mona Vale NSW
- WSP, 2015 Remedial Action Plan (Revised 2015) State Transit Mona Vale Bus Depot – 58 Darley St, Mona Vale NSW
- WSP, 2017a Soil Vapour Assessment- Mona Vale Bus Depot 58 Darley Street, Mona Vale NSW
- WSP, 2017b Passive Skimmer Trial- Mona Vale Bus Depot, 58 Darley Street, Mona Vale NSW
- WSP, 2017c Environmental Management Plan - Mona Vale Bus Depot, 58 Darley Street, Mona Vale NSW
- WSP, 2017d Soil Vapour Assessment - STA Bus Depot 58 Darley Street, Mona Vale NSW

- WSP, 2017e Multiphase Vapour Extraction (MPVE) State Transit Authority Bus Depot, Mona Vale August 2017
- WSP, 2017f Multiphase Vapour Extraction (MPVE) State Transit Authority Bus depot, Mona Vale November 2017 (Second event)
- WSP, 2018 Multiphase Vapour Extraction (MPVE) State Transit Authority Bus Depot, Mona Vale January 2018 (Third Event)
- WSP, 2019a Groundwater Monitoring Event – October 2018 STA Mona Vale Bus Depot 58 Darley Street, Mona Vale, NSW (report dated January 2019)
- WSP, 2019b Groundwater Monitoring Event – May 2019 STA Mona Vale Bus Depot 58 Darley Street, Mona Vale, NSW (report dated July 2019)
- WSP, 2020a Groundwater Monitoring Event – Oct 2019 and Feb 2020, STA Mona Vale Bus Depot 58 Darley Street, Mona Vale NSW dated March 2020.
- WSP, 2020b Factual Record of Well Installation Works, Mona Vale Bus Depot, 58 Darley Street, Mona Vale, NSW dated March 2020
- WSP, 2020c Offsite Vapour Intrusion Assessment, STA Mona Vale dated March 2020
- WSP, 2020d, Data Gap Assessment, STA Mona Vale Bus Depot, 58 Darley Street, Mona Vale NSW dated April
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8 LIMITATIONS

This Report is provided by WSP Australia Pty Limited (*WSP*) for State Transit Authority (*Client*) in response to specific instructions from the Client and in accordance with WSP's proposal dated 21 May 2020 and agreement with the Client dated 21 May 2020 (*Agreement*).

8.1 PERMITTED PURPOSE

This Report is provided by WSP for the purpose described in the Agreement and no responsibility is accepted by WSP for the use of the Report in whole or in part, for any other purpose (*Permitted Purpose*).

8.2 QUALIFICATIONS AND ASSUMPTIONS

The services undertaken by WSP in preparing this Report were limited to those specifically detailed in the Report and are subject to the scope, qualifications, assumptions and limitations set out in the Report or otherwise communicated to the Client.

Except as otherwise stated in the Report and to the extent that statements, opinions, facts, conclusion and / or recommendations in the Report (*Conclusions*) are based in whole or in part on information provided by the Client and other parties identified in the report (*Information)*, those Conclusions are based on assumptions by WSP of the reliability, adequacy, accuracy and completeness of the Information and have not been verified. WSP accepts no responsibility for the Information.

The Conclusions are reflective of the current Site conditions and cannot be regarded as absolute without further extensive intrusive investigations, outside the scope of the services set out in the Agreement and are indicative of the environmental condition of the Site at the time of preparing the Report. As a general principle, vertical and horizontal soil or groundwater conditions are not uniform. No monitoring, common or intrusive testing or sampling technique can eliminate the possibility that monitoring or testing results or samples taken, are not totally representative of soil and / or groundwater conditions encountered at the Site. It should also be recognised that Site conditions, including subsurface conditions can change with time due to the presence and concentration of contaminants, changing natural forces and man-made influences.

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

WSP has prepared the Report without regard to any special interest of any person other than the Client when undertaking the services described in the Agreement or in preparing the Report.

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(without limitation) changes in policy, legislation, guidelines, scientific knowledge; and changes in interpretation of policy by statutory authorities); may require further investigation or subsequent re-evaluation of the Conclusions.

This Report can only be relied upon for the Permitted Purpose and may not be relied upon for any other purpose. The Report does not purport to recommend or induce a decision to make (or not make) any purchase, disposal, investment, divestment, financial commitment or otherwise. It is the responsibility of the Client to accept (if the Client so chooses) the Conclusions and implement any recommendations in an appropriate, suitable and timely manner.

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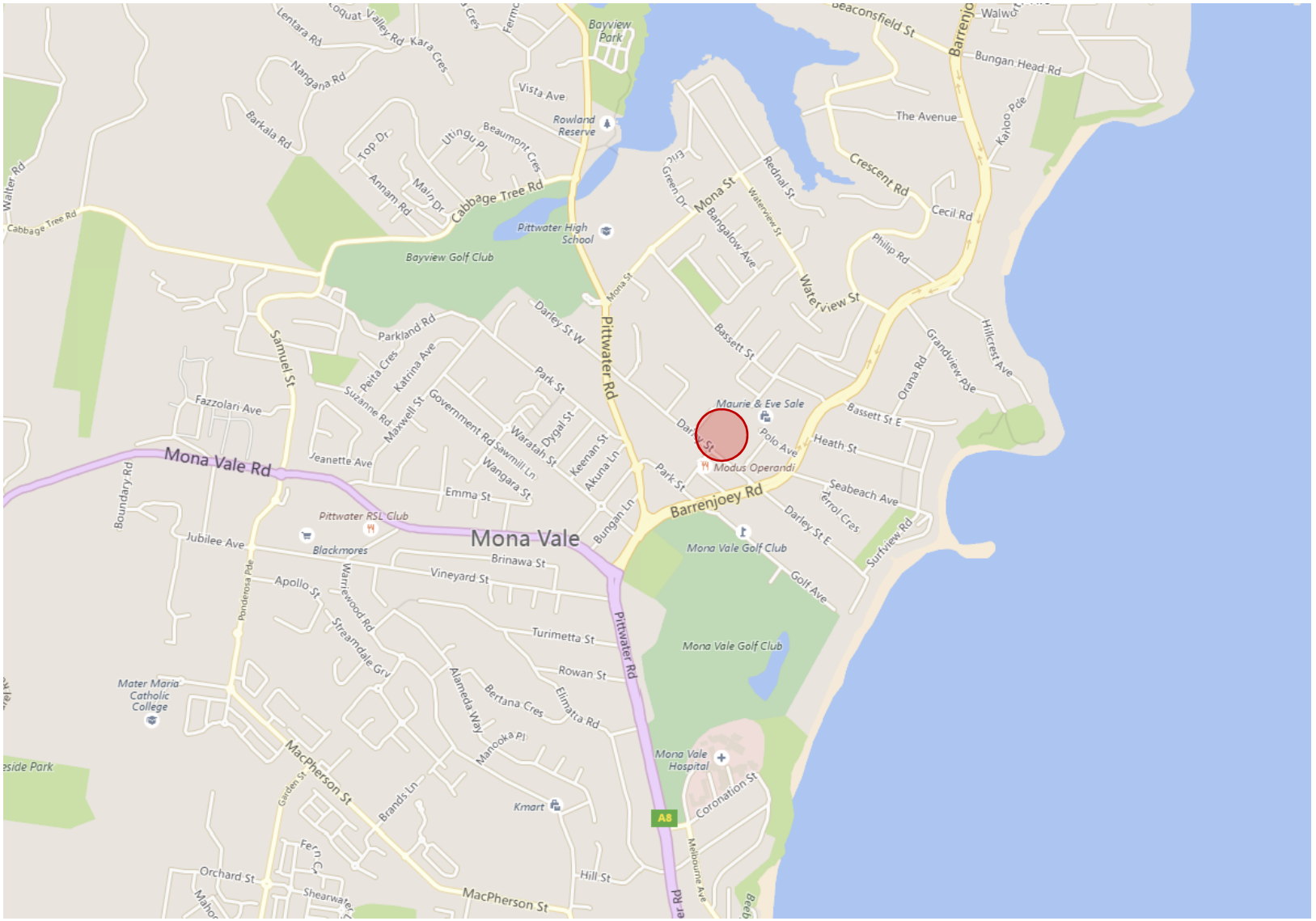
APPENDIX A

FIGURES

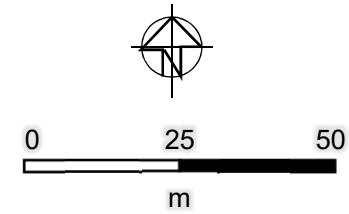


Source: Bing Maps

Figure 1 Site Location
PS111744 – EMP
STA Bus Depot, 58 Darley Street Mona Vale

Basemap Source: NSW Government – Six Maps

Figure 2 Site and Surrounds
PS111744 – EMP
STA Bus Depot, 58 Darley Street Mona Vale

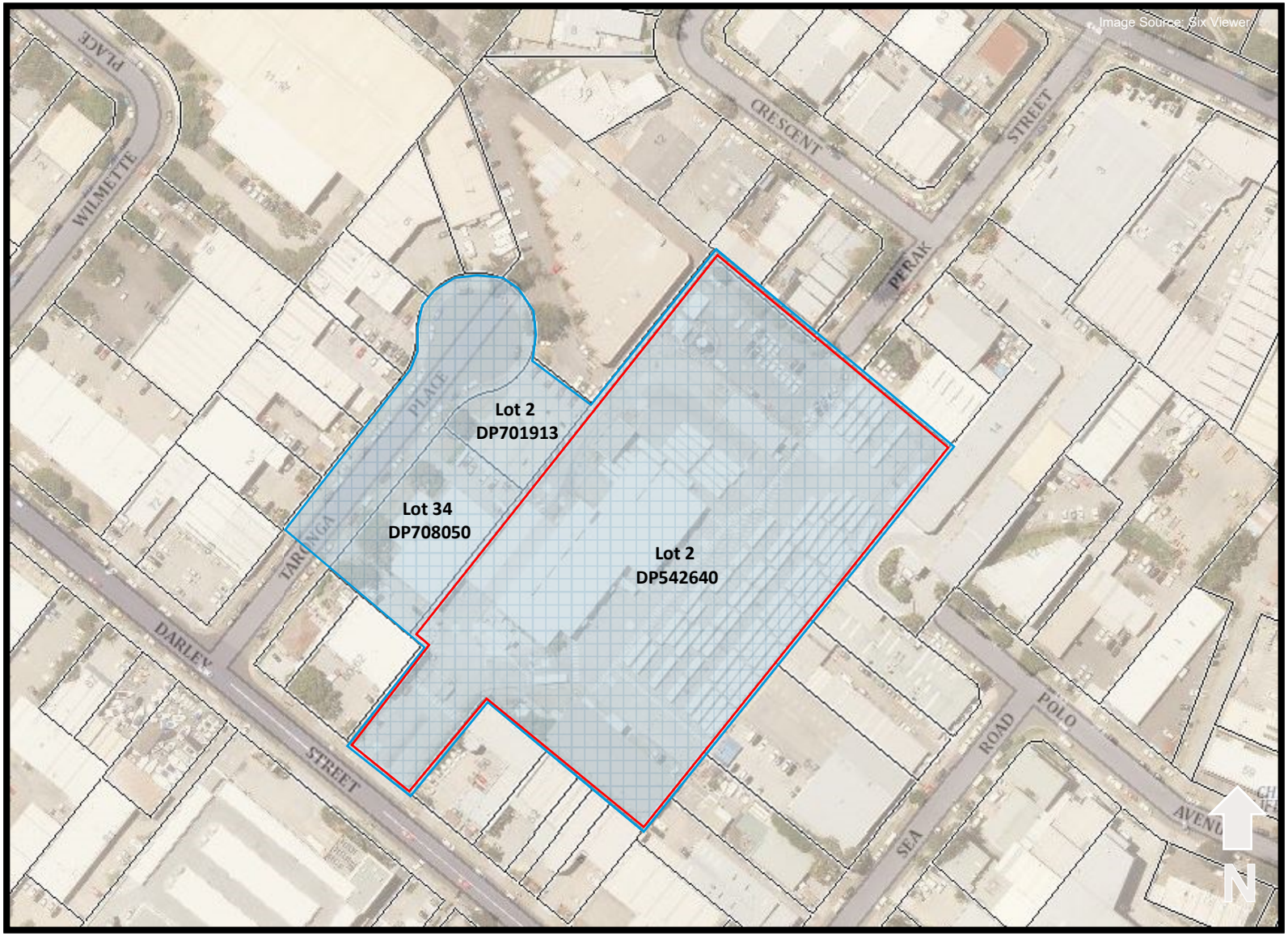


Site Boundary

Extent of EMP's relevance

Basemap Source: NSW Government – Six Maps

Figure 3 Site Current and Historical Features
PS111744 – EMP
STA Bus Depot, 58 Darley Street Mona Vale



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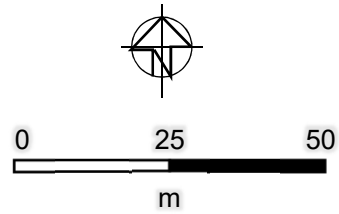
Site Boundary

Extent of EMP's relevance

Figure 4 Extent of EMP
PS111744 – EMP
STA Bus Depot, 58 Darley Street Mona Vale

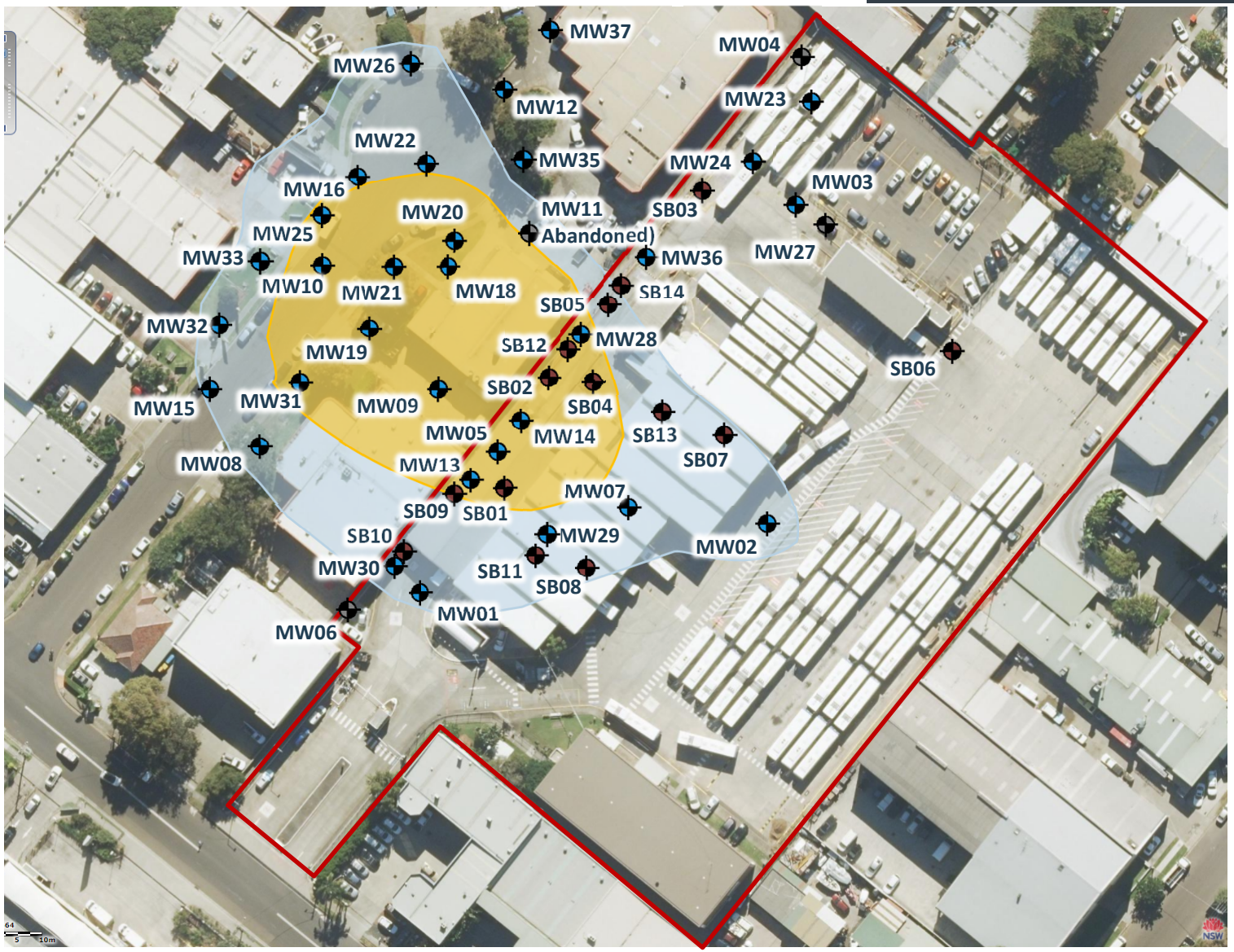


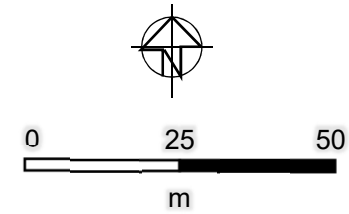
Site Boundary

- Newly Installed Wells
- Gauged Wells
- Skimmer Wells
- Lost Wells
- Proposed wells

Basemap Source: NSW Government – Six Maps

Figure 5 Well Locations
PS111744 – EMP
STA Bus Depot, 58 Darley Street Mona Vale





Site Boundary

PSH Present

Dissolved Hydrocarbons

Groundwater Well

Soil Borehole

Lost or Abandoned well

Basemap Source: NSW Government – Six Maps

Figure 6 Soil Boreholes and Groundwater Wells
PS111744 - Remediation Action Plan
STA Bus Depot, 58 Darley Street Mona Vale

APPENDIX B

SUMMARY OF INVESTIGATIONS AND REMEDIATION, AND OVERVIEW OF CONTAMINATION EXTENT

B1 SUMMARY OF INVESTIGATION AND REMEDAITION TO DATE

B1.1 INTRODUCTION

This chapter provides an overview of the investigation and remediation efforts to date. The information is a summary of the chronology with an outline of remediation activities and an overview of the contamination

For more complete details refer to the RAP (WSP, 2020e).

B1.2 CHRONOLOGY OF WORKS

The site's environmental assessment and remediation chronology includes:

- 2012, February – Stage 2 soil and groundwater investigation conducted by WSP. Soil bores SB01 to SB08 and groundwater wells MW01 to MW04 drilled and sampled. Soil and groundwater impacts discovered near the refuelling area.
- 2012, September – Onsite soil and groundwater delineation works by WSP. Soil bores SB08 to SB14 and groundwater wells MW05 to MW07 drilled and sampled. Soil and groundwater impacts near the refuelling area assumed to extend beyond the boundary.
- 2013, May – offsite soil and groundwater delineation works by WSP. Groundwater wells MW08 to MW12 installed and sampled. Soil and groundwater impacts exist offsite to the west. Without remedial works possible risk to receptors flagged recommendation to develop a remedial strategy.
- 2013, June – Remediation action plan developed for the site. Focus of risk assessment, installation of skimming system on site boundary and removal of legacy infrastructure pits and tanks in the refuelling area, along with implementation of a monitoring program.
- 2013, October – a 2,000 litre spill sump was pumped out of residual product and then backfilled with 25 mPa concrete. 6.74 tonnes of contaminated soils excavated adjacent the backfilled abandoned spill sump (AES)
- 2013, October – Installation by ENSR of three additional groundwater wells; MW15 down-gradient of MW8; MW16 down-gradient of MW11; and MW17 downgradient from MW10 (on other side of buildings). This information was required to delineate Phase Separate Hydrocarbon (PSH) down-gradient of MW10 and delineate the dissolved phase plume down-gradient of MW8 and MW11. Onsite skimmer system installed in MW05, MW13 and MW14.
- 2013, November – MW15, MW16 and MW17 – installed for to assess extent of PSH. Aquifer tests by ENRS (falling head slug tests) to determine the hydraulic properties of the underlying aquifer and product thickness;
- 2013, November – Re-sampling by ENRS of groundwater in new and selected existing monitoring wells for contaminants of concern and MNA parameters
- 2014, January – 1st Round GME for offsite MNA by ENRS;
- 2014, April – Decommissioning by excavation and offsite removal of 1x 35 kL AST and 1x 35 kL UST (both diesel) located in the pump house area;
- 2014, June – 2nd Round GME for offsite MNA by ENRS;
- 2014, October – 3rd Round GME for offsite MNA by ENRS;

- 2014, June – Comparison by ENSR of laboratory results against standard chromatograph charts to confirm the primary form of hydrocarbon contamination at the site is associated with diesel product;
- 2014, June – Two monitoring wells (MW08 and MW12) were re-drilled by AES under ENRS (new wells MW08-B and MW12-B) after the original bores became blocked and were not accessible for sampling. The replacement wells were sampled during the June and October 2014 groundwater monitoring events (GME);
- 2014, October – Door knock and field survey of nearby properties to assess the potential for offsite sources of contamination, conducted by STA and ENRS;
- 2015, February – 4th Round GME for offsite MNA by ENRS;
- 2015, April – 1st Round of Multi-Phase Vacuum Extraction (MPVE) using trailer mounted unit to remove product from accessible offsite wells by ENRS;
- 2015, April –Revised Remediation Action Plan (WSP) to acknowledge and capture the findings of works that had been completed and review the approach. The RAP recommended risk assessment and trialling of active PSH recovery technologies, along with ongoing monitoring.
- 2015, September – Installation by AES under ENRS of two additional groundwater wells. MW19 was constructed between MW09 and MW10, whilst MW18 was positioned between MW10 and MW11. The aim of these wells (MW18 and MW19) was to further delineate the lateral extent of the plume downgradient of MW09 and provide additional points for PSH extraction from large diameter wells.
- 2015, November – 2nd Round of MPVE event for product recovery from offsite wells by ENRS;
- 2015, December – 5th Round GME for offsite MNA including newly installed MW18 and MW19 by ENRS;
- 2015, December – 3rd Round of MPE event for product recovery from offsite wells by ENRS;
- 2016, June – Installation by AES under ENRS of five additional groundwater wells. MW20 and MW21 were installed within the road reserve adjacent private property where MW11 and MW18 were no longer accessible. MW22, MW25 and MW26 were installed down hydraulic gradient of the existing bore network;
- 2016, July – Preliminary Risk Assessment report (ENRS) issued based on existing groundwater data with general findings the plume was relatively stable and modelled vapour intrusion rates did not exceed the threshold criteria for human health and ecological receptors. Recommendations were to continue monitoring and update the risk assessment with site specific soil vapour data;
- 2016, September – 6th Round GME for offsite MNA by ENRS;
- 2016, September – GME to validate onsite UPSS decommission;
- 2016, October – 4th Round of MPVE event for product recovery from offsite wells by ENRS;
- 2017, January – Passive skimmer trial commenced by WSP.
- 2017, February – Passive skimmer trial completed and soil vapour assessment conducted (WSP). The sub-slab vapour study found that vapour risks to commercial industrial users of the site and surrounds were acceptably low;
- 2017, February – 7th Round GME for offsite MNA by ENRS;
- 2017, June – Additional soil vapour monitoring event (WSP). The study corroborated the findings of the initial sub-slab vapour monitoring indicating acceptable risk to commercial/industrial users on the site and surrounds.
- 2017, August – 1st MPVE event for product recovery from offsite wells by WSP;
- 2017, August – 8th Round GME for offsite MNA by ENRS;
- 2017, November – 2nd MPVE event for product recovery from offsite wells by WSP;
- 2018, January – 3rd MPVE event for product recovery from offsite wells by WSP;

- 2018, April – 9th Round GME for offsite MNA by ENRS;
- 2018, April – Commission semi-permanent PSH recovery system in selected monitoring wells adjoining Taronga Place.
- 2018, October – 10th Round GME for offsite MNA by WSP;
- 2019, May – 11th Round GME for offsite MNA by WSP
- 2019, Nov – 12th Round GME for offsite MNA by WSP
- 2019, Dec – Installation of additional groundwater monitoring wells to address data gaps listed within the VMP
- 2020, Feb – Limited groundwater sampling of newly installed monitoring wells. Surface water sampling to address data gap within the VMP. Completion of a vapour assessment of two commercial buildings (Pittwater Joinery and Reece Plumbing) located directly west of the STA bus depot at 9 and 10 Taronga Place, Mona Vale, NSW, respectively, to address data gap within the VMP.

B1.3 REMEDIATION AND INFRASTRUCTURE WORKS

The following table provides a summary of capital works and remediation strategies implemented at the Site to date.

WORKS	STATUS	WORKS DETAIL	CONTRACTOR
Source abandonment (diesel spill sump pit), soil excavation and offsite disposal	Completed October, 2013	The 2,000 litre spill sump was pumped out of residual product and then backfilled with 25 mPa concrete. 6.74 tonnes of heaviest contaminated soils, in a 2m x 3m footprint, were excavated adjacent the backfilled abandoned spill sump, between sump and the western boundary of the Site. The excavation was backfilled with suitable certified soils and the concrete slab in the fuel area driveway was reinstated	Australian Environmental Services (AES) Worth Recycling (soil disposal)
Installation of two additional monitoring wells for enhanced free phase recovery within groundwater impacted zone	Completed October 2013	Additional wells (MW13 and MW14) were installed on the western boundary of the Site, adjacent to MW05. Refer Figure 5, Appendix A for well locations	AES subcontracted to ENRS
Operation of an onsite active free phase recovery system. The skimmer system utilised monitoring wells MW05, MW13 and MW14 between 2013 and 2017. In 2018 STA extended the scope of skimming works to also include offsite wells MW09, MW19 and MW21	Commenced in October 2013 – continued till March 2018 Program extended to offsite in April 2018	Field observations indicate that approximately 1,600 – 1,700 litres of product have been recovered in the period since commissioning. Preliminary result pending.	AES

WORKS	STATUS	WORKS DETAIL	CONTRACTOR
Decommissioning by excavation and offsite removal of 1x 35 kL AST and 1x 35 kL UST (both diesel) and the pump house area.	Completed April 2014 by Petrolink	UST and AST soil validation samples were reported below the validation criteria. Pump House area was only excavated to a depth of 0.5 m with validation samples showing elevated levels of TRH and PAHs remaining.	Petrolink
Installation of additional wells to existing network of 5 wells for the purpose of delineation and monitoring of natural attenuation. Various mobilisation.	November 2013 June 2014 September 2015 June 2016	MW15, MW16 and MW17 – installed for to assess extent of PSH. MW08-B and MW12-B – installed after the original bores became blocked and were not accessible for sampling MW18 and MW19 - further assess lateral extent of plume and provide additional points for PSH extraction from large diameter wells. MW20 and MW21 - within road reserve adjacent private property as MW11 and MW18 no longer accessible. MW22, MW25 and MW26 - down gradient of existing bore network to further assess offsite migration. Refer Figure 5, Appendix A for well locations	ENRS
Passive skimmer trial	Commenced January 2017 completed February 2017	Three fortnightly rounds of skimmer maintenance targeting offsite wells. Approximately 18 L recovered.	WSP
Multi-Phase Vacuum Extraction (MPVE) trial works	Phase 1 Commenced April 2015, completed October 2016 Phase 2 commenced August 2017 completed January 2018	Three rounds of MPVE targeting offsite wells. Approximately 70 L recovered. Three rounds of MPVE targeting offsite wells. Approximately 360 L recovered.	AES subcontracted to ENRS EPS subcontracted to WSP

B1.4 EXTENT OF CONTAMINATION

B1.4.1 SOIL AND SOIL VAPOUR CONTAMINATION

Past soil assessments have shown PAHs and heavy metal concentrations to be generally below health-based investigation levels (HILs) for commercial/industrial sites. Similarly, the concentrations of BTEXN have been less than heath screening levels (HSLs) for vapour intrusion under commercial/industrial land use scenarios. In general, BTEX was non-detect but on occasion naphthalene was present, consistent with the presence of phase separated diesel.

Total recoverable hydrocarbons were generally below the HSLs, except for samples in SB02, SB04 and SB12 which were inferred to marginally exceed the F1 criteria. These locations were all in close proximity to the now abandoned former waste oil UST. These, and other locations, particularly around refuelling bay and along the former fuel line on the western boundary, also exhibited elevated hydrocarbons across the C_{10} to C_{28} range.

It is noted that across all locations tested the most elevated TRHs were detected at a depth of around 1.8 to 2.0 m consistent with the water table level. On only a few occasions (SB01, SB02 and MW05 – in proximity to the refuelling bay) were elevated hydrocarbons found at depths of less than or equal to 1 m depth. This finding indicates that the hydrocarbons in soils are predominantly associated with the PSH plume beneath the site and not with widespread surface spillage.

In order to understand the actual risk posed to site (and offsite) personnel by the presence of residual hydrocarbons in the soil and groundwater two rounds of sub-slab vapour analysis have been conducted along sites western boundary. The assessments showed that all results for BTEXN and F1 were less than HSLs for commercial industrial use. This result is consistent with diesel contamination.

B1.4.2 PHASE SEPARATED HYDROCARBON PRESENCE AND TRENDS.

The PSH exists as a light non-aqueous phase liquid (LNAPL) above the ground water. The groundwater monitoring program has assisted in understanding the extent and in assessing the stability of PSH.

In summary, wells containing PSH include:

- Onsite wells MW05, MW13 and MW14 located downgradient of the refuelling bay, on the western site boundary;
- Offsite wells MW09, MW10, MW18, MW19, MW20, MW21, MW25, MW31, MW32 and MW33 located west (downgradient) of the site.
- The most downgradient point in which PSH has been detected in MW33 which was installed in December 2019 and gauged in February 2020 with approximately 0.123 m.
- The total inferred area of the PSH impact is approximately 4,500 m^2.

The temporal gauging data generally shows that the PSH fluctuates between 0.1 m and 0.7 m thickness. Within this range there appears to be a relatively high degree of variability. In general, the PSH thicknesses recorded follow parallel lines indicating the degree of partitioning of PSH may be affected by environmental conditions such as rainfall. In wetter seasons the PSH appears to generally be thicker compared to levels recorded after dryer periods.

B1.4.3 PRESENCE OF DISSOLVED CONTAMINANTS

A dissolved phase hydrocarbon plume is present in association with the PSH plume. In general, the hydrocarbon plume exhibits very low BTEX and low naphthalene. The F1 component of the hydrocarbons generally comprises less than 2% of the total TRH. The dominant fractions are the F2 and F3 fractions consistent with diesel impact.

No results exceeded the HSL criteria indicating the vapour intrusion risk is acceptably low. This result is consistent with the findings of the risk assessment (ENRS, 2016) and the sub slab vapour assessments (WSP, 2017d and WSP 2020c).

GILs for protection of marine ecosystems have been exceeded on a number of occasions. While no BTEX results exceeded these criteria, the naphthalene concentrations in MW09, MW10, MW19, MW20 and MW21 all exceeded the criteria. However, these locations are all PSH affected and so the results may be subject to cross contamination from the product that the sampling equipment must pass through to obtain a water sample. Typically, groundwater samples are not collected from PSH impacted wells.

Results from downgradient locations with no measurable PSH, including MW22, and MW26, whilst on occasions having detectable naphthalene have not exceeded the criteria to date. This indicates that while the PSH may be extensive and contains naphthalene at levels that would exceed the ecological criteria, the dissolved plume surrounding the PSH is likely to be relatively short with concentrations unlikely to exceed the site criteria.

With respect to inorganic contaminants, nitrate is frequently detectable in the groundwater and in MW15 and MW17. The source is unlikely to relate to the site use as a bus depot. Within the dissolved plume, the lower redox conditions mean that the dominant nitrogen species is ammonium, which exceeds site criteria in MW07, MW12, MW16, MW22, MW23, MW24 and MW26.

Copper, nickel and zinc have been observed to fluctuate in wells MW15, MW16 and MW17 exceeding marine GILs on occasions. These compounds are also unlikely to relate to site activities and may be either of natural origin or result from dissolution from overlying fill into percolating water.

Arsenic has been observed to be unusually elevated across a number of wells, at levels exceeding GILs for marine ecosystems and also GILs for drinking water in MW02, MW09, MW10, MW11, MW16, MW18, MW19, MW20, MW21, MW22 and MW26. The historically most concentrated results were from the offsite (and now abandoned) MW11, approximately one order of magnitude higher than the criteria. The concentrations of arsenic appear relatively stable over time. The source of the arsenic is unknown, possibly dating from pre 1960s when the site and surrounds were vacant or agricultural land, possibly comprising turf farms.

There does appear to be a spatial relationship between the arsenic and the hydrocarbon plume. It is possible that the redox conditions generated by the plume are resulting in greater dissolution of arsenic from the solid phase.

B1.4.4 EVIDENCE OF NATURAL ATTENUATION

A common natural attenuation process involves petroleum hydrocarbons acting as electron donors in oxidation-reduction reactions resulting in biodegradation of hydrocarbon molecules. Monitoring the concentrations of certain electron acceptors, or by-products of respiration in the groundwater can indicate whether natural attenuation processes are taking place on a hydrocarbon plume (DEP, 2004).

Overall, there is strong correlations between natural attenuation indicators and the plume footprint. The range of natural attenuation parameter concentrations indicates that the system is in a dynamic state. The natural groundwater provides various sources of electron acceptors as nitrate and sulfate, however, these are clearly insufficient to maintain optimised conditions for aerobic degradation as they are generally non-detect or at very low concentrations within and downgradient of the plume. It is likely that the rate of degradation is limited by the availability of electron acceptors.

APPENDIX C

CONCEPTUAL SITE MODEL

C1 CONCEPTUAL SITE MODEL

C1.1 INTRODUCTION

The information herein summarises the conceptual site model as presented in the RAP (WSP, 20202e) for further details refer to the RAP.

C1.2 SUMMARY OF RISK

A summary of plausible pathways, and a qualitative assessment of the risk of those pathways resulting in an unacceptable exposure to a receptor is summarised in Table C1.1. In the site's present condition, the identified contaminants present a low risk to human receptors. In the event of excavation or earthworks which expose impacted soils or groundwater, there is a moderate risk to human health via ingestion or dermal contact with contaminated soils or groundwater which would require management under a Construction Environmental Management Plan (CEMP) and site specific safe work method statements (SWMS). The site EMP has been prepared for the site and surrounds to assist in management of these risks.

For the off-site neighbouring buildings, vapour risk has been shown via vapour flux through building floor slabs and via direct indoor air measurements to be acceptably low. The contaminants present a low to moderate risk to on-site and offsite ecological receptors. Given the industrial nature of the site setting and using of surrounding properties the local ecology is not considered to be of high value. Nevertheless, the plume may result in stunting of vegetation where dissolved oxygen is low due to the microbial activity.

Risks to more distant downgradient human and ecological receptors are unlikely given the low toxicity of the PSH constituents and the evidence for microbial degradation occurring, which, coupled with PSH removal, will limit the dissolved phase plume spread. It is possible that the hydrocarbons may migrate more rapidly via preferential pathways provided by local services however based on the discussion provided in the Data Gaps Assessment report (WSP, 2020d) the pathway to the stormwater system at present is incomplete, but the risk warrants ongoing monitoring. Inorganic contamination of the groundwater, primarily an arsenic plume, is present beneath the site and surrounds. This is unlikely to relate the Bus Depot activities and may be a more regional issue possibly related to historical agricultural or turf production, or possibly a geochemical effect releasing arsenic from the mineral phase due to redox conditions resulting from the plume.

Risks presented by the arsenic plume are unlikely to be significant to general commercial and industrial use of the site and surrounds but would be of concern during excavations works. However, the precautions required under the EMP for minimising dermal and ingestion risks presented by the hydrocarbons during construction works would assist in managing this risk as well.

Ecological risk associated with the arsenic is unknown as the extent of the plume is uncertain. Risk to residents some distance from the site is also uncertain, however, given the groundwater is unlikely to be used for potable supply the risk is likely to be of a recreational exposure scenario. Results from the groundwater in the vicinity of the site have generally been lower than health-based recreational criteria.

Table C1.1 Summary of source/pathway/receptor analysis

IDENTIFIED SOURCES	PLAUSIBLE PATHWAY	POTENTIAL RECEPTOR	QUALITATIVE RISK	COMMENTS / RATIONALE
Hydrocarbon impacts to the site and surrounds including: — Localised diesel impacts in soil onsite — PSH located above the water table (~2 mbgl) on the western boundary and extending offsite, to the far side of Taronga Place, to the west. — Dissolved phase hydrocarbons in association with the PSH impacts.	Ingestion or dermal contact with known contaminated water or soils	Site and neighboring site workers and future occupants	Negligible	The onsite soil contamination is located beneath pavements, with the majority of known impacts at a depth of approximately 2 m bgl. Offsite soil impacts relate to the PSH that has spread from the site at the soil/water interface and is present at depths of approximately 2 mbgl. Therefore, directed contact with impacted soil or groundwater during typical onsite or offsite activities will not occur.
		Construction or maintenance workers	Low	Given the location of the contamination the only plausible linkage for direct contact is associated with excavation activities. The risk of encountering hydrocarbon contamination has been notified to Dial Before You Dig and notification is provided on various utility plans accessed by that service. Measures to minimize risk during excavation works are provided in the site EMP (WSP, 2017c). Control measures should be developed in project specific Safe Work Method Statements.
	Migration of contaminants with groundwater resulting in potential exposure to more distant receptors	Down gradient residential occupants extracting groundwater from domestic bores	Low to Negligible	A search of the Bureau of Meteorology (BOM) Groundwater Explorer database revealed 14 groundwater bores for water supply use within a 1 km radius of the site. All these, however, were either located hydraulically up gradient of the site, or based on their construction depth are likely to be intercepting regional groundwater aquifers within the underlying sandstone. The nearest of these bores is GW026581, located 60 m to the south south west of the site installed to a depth of 93 m. One well (GW018803) is located in a hydraulically downgradient position and is installed within the alluvium. However, this well is 975 m from the site, and has its purpose stated as “Other”. As the dissolved phase plume is not known to have migrated further than 80 m offsite, it is unlikely that contamination derived from the identified hydrocarbon plume would reach this well. Furthermore, its location in parkland and stated purpose

IDENTIFIED SOURCES	PLAUSIBLE PATHWAY	POTENTIAL RECEPTOR	QUALITATIVE RISK	COMMENTS / RATIONALE
Hydrocarbon impacts to the site and surrounds including: — Localised diesel impacts in soil onsite — PSH located above the water table (~2 mbgl) on the western boundary and extending offsite, to the far side of Taronga Place, to the west. — Dissolved phase hydrocarbons in association with the PSH impacts.				mean that it is unlikely this water would be used for potable supply.
		Recreational users and ecological receptors of Cahill Creek 950 m north west and Winnererremy Bay 1 km from the site.	Low to Negligible	Given the extent of the plume and evidence for active biodegradation, it is unlikely that the contamination could migrate through sediments to these receiving waters. Moreover, the hydrocarbons present in the PSH, which forms the source of dissolved phase impacts, contain negligible BTEX which is the most toxic component of fuel. Naphthalene exceeds ecological criteria only in bores that have PSH. Therefore, it is unlikely this contaminant would migrate in groundwater to the receptors. Surface water samples were collected from upstream, at the site boundary or downstream along the stormwater channel. The results indicated that no detectable hydrocarbons were present in the stormwater drain upstream, at the site boundary or downstream of the site. Therefore, it is unlikely that the contamination is leaking into the system putting the ecology of the creek or downstream receptors at risk.
		Vegetation onsite and offsite within and downgradient of the contaminant plume	Moderate	There is minimal vegetation present on the site, the majority of which is located up gradient or cross gradient of the hydrocarbon plume. Most of the vegetation on the adjacent properties (Pittwater Joinery and Reece Plumbing) are mature trees which have been present since 2003 and have most likely adapted to any contamination that is present in the soil or groundwater. The low DO conditions may result in stunted growth of trees within and downgradient of the plume.

IDENTIFIED SOURCES	PLAUSIBLE PATHWAY	POTENTIAL RECEPTOR	QUALITATIVE RISK	COMMENTS / RATIONALE
Hydrocarbon impacts to the site and surrounds including: — Localised diesel impacts in soil onsite — PSH located above the water table (~2 mbgl) on the western boundary and extending offsite, to the far side of Taronga Place, to the west. — Dissolved phase hydrocarbons in association with the PSH impacts.	Accelerator migration of contaminants through preferential pathways.	Underlying groundwater and surface water receptors	Low to Negligible	The PSH plume has migrated west of the site across areas where municipal services exist in Taronga Place. Whilst the majority of these services are likely to be well above the impact, two potential deeper services have been identified including the stormwater easement to the north west of the plume and a sewer line that crosses Taronga Place and follows the northern boundary of No. 4 Taronga Place (Lot 7, DP701913), it was considered possible that the sewer line could intercept the groundwater level. Two shallow wells (MW36 and MW37) installed adjacent the stormwater drainage culvert were gauged on 7 February 2020 and determined to be dry. Therefore, the backfill sands adjacent to the stormwater drain do not appear to be a complete pathway for PSH migration at this time. Moreover, surface water testing of the stormwater has corroborated this finding with no detectable hydrocarbons measured in the February 2020 GME (WSP, 2020a).
	Inhalation of vapours or ingestion of air borne contaminants during site operations or excavation / trenching	Site workers Occupants of adjacent properties General public accessing Taronga Place	Negligible	The sources of contamination are mainly diesel products which are inherently less volatile than petroleum-based products. The soil vapour assessments conducted by WSP in 2017 indicated that sub slab vapour concentrations were unlikely to pose a risk to site workers or occupants of the adjacent Reece Plumbing and Pittwater Joinery properties. In February 2020, a vapour assessment was completed using flux, indoor and ambient air testing methodologies on the two commercial properties adjacent to the site (9 Taronga Place [Lot 2 DP701913] and 10 Taronga Place [Lot 34 DP708050]) which overly the main PSH impact. Results indicated that that the diesel plume is not causing a vapour intrusion risk to the occupants of the two commercial buildings tested in this evaluation. Furthermore, there was no evidence of any other compound that was presenting a significant vapour flux into either building.

IDENTIFIED SOURCES	PLAUSIBLE PATHWAY	POTENTIAL RECEPTOR	QUALITATIVE RISK	COMMENTS / RATIONALE
				As the contamination is limited to shallow soils and groundwater that is predominantly covered by concrete slab, the risk of generating airborne contaminants such as dust are minimal unless the concrete slab is compromised and/or if unsealed landscaped areas are disturbed due to trenching or excavation works. The EMP (WSP, 2017c) provides measures to minimizing generation of dust during future works and these should be adopted in project specific work method statements.
Inorganic contaminants in groundwater (arsenic, lead, nickel and zinc) beneath the site and surrounds	Ingestion or dermal contact with known contaminated water	Site and neighboring site workers and future occupants	Negligible	The contamination has been identified in groundwater which is present at approximately 2 mbgl. Therefore, direct contact with impacted soil or groundwater during typical onsite or offsite activities will not occur.
		Construction or maintenance workers	Low	Given the location of the contamination the only plausible linkage for direct contact is associated with excavation activities. Measures to minimize risk via dermal contact for hydrocarbons during excavation works are provided in the site EMP (WSP, 2017c), these should also be effective at mitigating risks associated with the inorganic contamination. Control measures should be developed in project specific Safe Work Method Statements. Of the contaminants identified the arsenic is of most concern.
	Migration of contaminants with groundwater resulting in potential exposure to more distant receptors	Down gradient residential occupants extracting groundwater from domestic bores Recreational users and ecological receptors of the storm water channel Cahill Creek and Winnererremy Bay.	Low to Moderate	The source of the arsenic plume, and its extent are unknown, and it could potentially represent a regional issue. It is unlikely to relate to the Bus Depot operations. It is unlikely that local residents would use the groundwater for potable supply. It is possibly they use the groundwater for swimming pools or watering lawns. The results to date generally fall beneath recreational criteria (applying 10 × multiplier to convert drinking water guidelines to recreational criteria as per NHMRC, 2008 Guidelines for Managing Risks in Recreational water).

IDENTIFIED SOURCES	PLAUSIBLE PATHWAY	POTENTIAL RECEPTOR	QUALITATIVE RISK	COMMENTS / RATIONALE
				If groundwater was to migrate to open waters the risk to recreational users would be similarly low. Risk to ecological receptors could be moderate given the concentrations in the groundwater are up to an order of magnitude above the criteria. It would, however, be expected that significant dilution would occur at the discharge point.
		Vegetation onsite and offsite within the contaminant plume	Moderate	There is minimal vegetation present on the site. Most of the vegetation on the adjacent properties (Pittwater Joinery and Reece Plumbing) are mature trees which have been present since 2003. The trees appear healthy and actively growing.