Intended for
Torque Projects for Ingenia Communities

Document type
Remedial Action Plan

Date
September 2018

Project Number
318000371-001

Site Location
321 Boomerang Drive, Blueys Beach, NSW

REMEDIAL ACTION PLAN
PALMS OASIS CARAVAN PARK BLUEYS BEACH

RAMBOLL

REMEDIAL ACTION PLAN
PALMS OASIS CARAVAN PARK BLUEYS BEACH, NSW

Revision	**Final**
Date	**7 September 2018**
Made by	**Natalie Gilbert**
Checked by	**Steve Cadman**
Approved by	**Fiona Robinson**
Description	Ramboll was engaged by Torque Projects to prepare this Remedial Action Plan for Palm Oasis Caravan Park Service Station, Blueys Beach, NSW.

Ref 318000371-001

Revision	Date	Prepared by	Checked by	Approved by	Description
00	7/7/2018	N Gilbert	S Cadman	F Robinson	Draft for client
01	7/9/2018	N Gilbert	S Cadman	F Robinson	Final

Ramboll Australia Pty Ltd
Level 2, Unit 18
50 Glebe Road
PO Box 435
The Junction
NSW 2291
Australia
T +61 2 4962 5444
www.ramboll.com

CONTENTS

APPENDICES

ACRONYMS AND ABBREVIATIONS

ACM	Asbestos Containing Materials
AEC	Area of Environmental Concern
AHD	Australian Height Datum
ALS	Australian Laboratory Services
AMP	Asbestos Management Plan
ASET	Australian Safer Environment and Technology Pty Ltd.
ANZECC	Australian and New Zealand Environment and Conservation Council
ASS	Actual Acid Sulfate Soils
ASSMP	Acid Sulfate Soils Management Plan
Aurora	Aurora Environmental Consulting Pty Ltd
B(a)P	Benzo(a)pyrene
BGL	Below Ground Level
BMW	BMW Australia Ltd Pty
BTEXN	Benzene, Toluene, Ethylbenzene, Xylenes, Naphthalene
CEMP	Construction Environmental Management Plan
CLMP	Construction Contaminated Land Management Plan
CN	Cyanide (total or free)
CSM	Conceptual Site Model
DQO	Data Quality Objective
DA	Development Application
Douglas	Douglas Partners Pty Ltd
EIL	Ecological Investigation Level
ENM	Excavated Natural Material
EPA	Environment Protection Authority
ESA	Environmental Site Assessment
GILs	Groundwater Investigation Levels
GW	Groundwater Well
Ha	Hectare
HASP	Health and Safety Plan
HTS	Hunter Tech Services Pty Ltd
JSEA	Job Safety Environment Assessment
km	Kilometres
Leighton	Leighton O'Brien Field Services Pty Ltd
L	Litre
LOR	Limit of Reporting
m	Metres
Mercury	Inorganic mercury unless noted otherwise
Metals	As: Arsenic, Cd: Cadmium, Cr: Chromium, Cu: Copper, Fe: Iron, Ni: Nickel,
Pb: Lead, Zn:	Zinc, Hg: Mercury
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Litre
mbgl	Metres below ground level
mg/L	Micrograms per Litre
MW	Monitoring Well
NATA	National Association of Testing Authorities
NC	Not Calculated
ND	Not Detected
NEHF	National Environmental Health Forum
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
OCPs	Organochlorine Pesticides
OH&S	Occupational Health & Safety
OPPs	Organophosphorus Pesticides

PASS	Potential Acid Sulfate Soils
PAEC	Potential Area of Environmental Concern
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PID	Photo-ionisation detector
PQL	Practical Quantitation Limit
pH	a measure of acidity, hydrogen ion activity
QA/QC	Quality Assurance/Quality Control
Ramboll	Ramboll Australia Pty Ltd
RAP	Remedial Action Plan
RPD	Relative Percent Difference
SAQP	Sampling, Analysis & Quality Plan
SILs	Soil Investigation Levels
SVOCs	Semi Volatile Organic Compounds
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons
UCL	Upper Confidence Limit
UFP	Unexpected Finds Protocol
UPSS	Underground Petroleum Storage System
UST	Underground Storage Tank
VENM	Virgin Excavated Natural Material
VOCs	Volatile Organic Compounds
µg/L	Micrograms per Litre

1. INTRODUCTION

1.1 Preamble

Ramboll Australia Pty Ltd (Ramboll) was engaged by Torque Projects Pty Ltd, (Torque), acting as project manager for the site owner and developer, Ingenia Communities Pty Ltd, (Ingenia), to prepare a Remedial Action Plan (RAP) for the proposed removal of Underground Petroleum Storage System (UPSS) infrastructure located at the Palms Oasis caravan park located at 321 Boomerang Drive, Blueys Beach, New South Wales (the site). The site location is shown on **Figure 1**.

The UPSS to be excavated and removed comprises three Underground Storage Tanks (USTs) and associated pumps, vents and fuel lines. The site layout and UST locations are shown on **Figure 2**.

The RAP is being prepared as part of a separate DA to DA1 – Alterations and Additions to the wider caravan park site into a long term residential lifestyle village. The RAP aims to provide guidance to the management and construction teams involved in the proposed works on environmental controls and management of soil and water during the works. It also forms an advisory document for regulatory agencies and other relevant stakeholders.

1.2 Objectives

The objectives of this RAP are to:

- Detail the preferred methodology to remove the UPSS and any potential contamination identified during the works
- Define the appropriate environmental management requirements during excavation works
- Describe the validation investigations necessary to demonstrate the UPSS and any associated contamination has been effectively removed
- Facilitate the provision of a site validation report upon completion of the works, including a site suitability statement for the proposed ongoing residential/recreational land use
- Minimise impacts from the site on the environment and on public health and safety during UPSS removal works and
- Maximise the protection of workers involved with UPSS removal

1.3 Scope of Work

To meet the objectives of the RAP, Ramboll has completed the following scope of work:

- Reviewed and summarised available reports and related correspondence from previous environmental investigations undertaken at the site
- Detailed the physical and chemical characteristics of the site
- Establish the Data Quality Objectives (DQOs) for the remediation works works
- Develop and implement a sampling plan, including the development of a quality assurance/quality control (QA/QC) program for the sampling works
- Identified possible remedial options for hydrocarbon impacted material and evaluated these in order to determine the most appropriate remedial option
- Consulted with regulatory guidelines
- Develop the remedial goals and detailed the remedial strategy including contingency planning and site management provisions and
- Development of a validation plan to validate completion of the site remediation and confirm the suitability of the site for the proposed use.

1.4 Regulatory Framework and Guidelines

This RAP has been prepared in general accordance with the following guidance documents:

- Australia and New Zealand Environment and Conservation Council, *Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000)
- National Environment Protection Council (NEPC), *National Environment Protection (Assessment of Site Contamination) Measure* 1999, as amended 2013 (NEPM)

- NSW Office of Environment and Heritage, *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (OEH, 2011)
- NSW Environment Protection Authority (NSW EPA), *Guidelines on the Duty to Report Contamination under the CLM Act 1997* (EPA, 2015)
- NSW Environment Protection Authority (NSW EPA), *Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation* 2014 (EPA, 2014).
- NSW EPA, *Sampling Design Guidelines* (EPA, 1995)
- NSW Department of Environment and Conservation, *Contaminated Sites: Guidelines for the Assessment and Management of Groundwater Contamination* (DEC, 2007)
- NSW DEC, *Guidelines for the Site Auditor Scheme (3rd Edition)* (NSW EPA 2017)
- NSW EPA, *Waste Classification Guidelines, Part 1: Classifying Waste* (EPA, 2014)
- NSW EPA, *Waste Classification Guidelines, Part 4: Acid Sulphate Soils* (EPA, 2014)
- NSW EPA, *Environmental Guidelines: Solid Waste Landfills* (EPA, 1996)
- Department of Environment and Climate Change and Water, *Vapour Intrusion: Technical Practice Note* (DECCW, 2010)
- NSW EPA, *Technical Note: Investigation of Service Station Sites* (EPA, 2014)
- Australian Standard AS/NZS 5667.11:1998. *Water Quality - Sampling - Guidance on Sampling of Groundwaters* (Standards Australia, 1998a)
- Australian Standard AS 5667.1:1998. *Water Quality – Sampling – Part 1: Guidance on the Design of Sampling Programs, Sampling Techniques and the Preservation and Handing of Samples* (Standards Australia, 1998b)
- State Environment Protection Policy (SEPP) 55 – *Remediation of Land (1998) (SEPP 55)*

Specifically, Clauses 13 and 15 of the NSW Protection of the Environment Operations (Underground Petroleum Storage System) Regulation 2014 (NSW EPA 2014) requires a validation report to be prepared after the USTs are decommissioned or removed. The validation report must be submitted to the relevant local authority within 60 days of decommissioning or removal, or completion of remediation.

The Section 10.7 certificate for the caravan park property, including the service station site, identified the land as being within a coastal zone site, as defined by SEPP 71. The Coastal Management SEPP (2018) which has since replaced SEPP71 now excludes the service station area of the site from the SEPP. The requirement for development consent is triggered by the site's location within a wildlife corridor defined under clause 7.9 of the Great Lakes Council Local Environmental Plan, 2014, and shown in the Protection of Wildlife Corridors Map.

The NSW WorkCover Authority is responsible for occupational health and safety issues relating to decommissioning and removal of tanks from a site. The following WorkCover requirements must be met during decommissioning:

- The tank and contents are made safe in line with Code of Practice: Storage and handling of dangerous goods (NSW WorkCover Authority 2005) and the Work Health and Safety Act 2011
- WorkCover notified of the abandonment within seven days using the prescribed approval form, so the tank can be removed from its database, and
- If the tank is to be removed from the ground, it must be correctly disposed of in accordance with NSW environmental and safety requirements and industry best practice: Australian Standard (AS, 4976 [2008]): Removal and Disposal of Underground Petroleum Storage Tanks and AS 1940-1993: The Storage and Handling of Flammable and Combustible Liquids.

2. SITE INFORMATION

2.1 Site Location

The site, for the purposes of this RAP, is defined as the service station facility, located within the Palms Oasis caravan park property at 321 Boomerang Drive, Blueys Beach on the central, northern NSW coast. The site is located on the Boomerang Drive road frontage. The service station site covers an area of approximately 400m^2. The site location is presented in **Figure 1**.

The caravan park is currently zoned RE2 Private Recreation and E2 Environmental Conservation (western portion) under the Great Lakes Environmental Plan 2014, covering an area of approximately 7.4 ha., with the developed lot about 4.5ha in Lot 1 in DP 862876, County of Gloucester, Parish of Forster.

2.2 Site Setting and Surrounding Environment

Table 1 below provides a summary of the site conditions and surrounding environment gathered from the previous investigations referenced in **Section 2.4**.

Table 1: Summary of Site Conditions and Surrounding Environment

Surrounding land use	The service station site is contained within the Palms Oasis caravan park which borders the site to the west, north and east. Boomerang Drive forms the southern boundary of the site. Further to the west, in the western half of the caravan park the land is largely undeveloped, with some bushland in the western corner. Further east the site is developed for use as a caravan park comprising amenities, cooking facilities, and swimming pool, administration, and holiday cabins. The site is shown on **Figure 2**.
Topography and drainage	The site is a relatively flat, paved area with a slight slope from the road towards the central service station area. Surface water would be expected to flow from the road and collect in a central drain and flow west into the subsurface stormwater system. Surface water features in the area of the site include Wallis Creek, which flows into the large barrier estuary lake, Lake Wallis, located less than 1 km to the north-west of the site. The ocean at Blueys Beach is located approximately 1.4 km to the east of the site. (Google Earth™). Groundwater from the site is expected to flow towards Wallis Creek, approximately 700 m north-west of the site.
Geology plus location and extent of fill	The 1:250000 Newcastle Geology map indicates the site is underlain by lower Carboniferous-aged sandstones siltstones and claystones. The investigations conducted by Aurora indicated a clayey weathered siltstone/claystone profile under minor fill (likely associated with the service station construction). The weathered bedrock was encountered approximately 3 to 5 mbgl , overlain by a silty clay profile. Generally the geology encountered in this area during the investigations consisted of the following: FILL: Silty, gravelly clay underlying sand and concrete from a depth of 0.0 to 1.0 mbgl. Silty Clay, overlying weathered bedrock between 3 to 5 mbgl to a maximum drill depth of 6.0 mbgl.
Hydrogeology	Groundwater was encountered at approximately 2 mbgl (in the residual clay soils) and water level measurements indicated a north-west flow direction.

Table 1: Summary of Site Conditions and Surrounding Environment

	The hydrogeology map (Land Insight and Resources 2018) report the aquifer type on site indicated a regional fractured or fissured, extensive aquifers of low to moderate productivity. The site is not located within a groundwater exclusion zone however is located within Underground Petroleum Storage System (UPSS) Sensitive zone. Field measurements of groundwater quality by Ramboll in 2018 indicated: pH values range from 4.77 in MW7 (acidic) to 6.32 in MW1 (slightly acidic). The conductivity results indicate all wells to be slightly brackish to brackish water. Mildly oxidising conditions were found in most wells except for MW1, MW2 and MW3, which had mildly reducing conditions.

2.3 UPSS Infrastructure

Ingenia is seeking to remove the following USTs and their associated infrastructure:

- Two 11,800L USTs, (petrol and diesel);
- One 16,200L petrol UST; and
- fuel bowsers, piping and vents.

The USTs are located on-site in the forecourt of the service station on the Boomerang Drive frontage, on the southern side of the caravan park site (refer to **Figure 2**).

Based on the 2016 assessment results (Aurora 2016a and b) the tanks are installed into the clayey weathered siltstone/claystone profile under minor fill.

2.4 Previous Environmental Investigations

Four previous environmental investigations have been conducted for the service station site consisting of:

- *Asbestos Survey Report, Palms Oasis Caravan Park,* Hunter Tech Services, March 2016
- *Environmental Site Assessment Report Palms Oasis Caravan Park*, Aurora Environmental Consulting, April 2016 (Aurora 2016)
- *Environmental Delineation Assessment Report Palms Oasis Caravan Park*, Aurora Environmental Consulting, October 2016 (Aurora 2016a)
- *Groundwater Monitoring Palms Oasis Caravan Park, Blueys Beach NSW*, Ramboll, February 2018

A summary of these investigations is presented in the following sections.

2.5 Asbestos Survey Report, Palms Oasis Caravan Park, Hunter Tech Services, March 2016

2.5.1 Objective and Scope of Works

Hunter Tech Services Pty Ltd (HTS) was commissioned by Aspen to undertake an Asbestos-Containing Materials (ACM) Survey and Risk Assessment of selected buildings at the Palm Oasis Caravan Park to identify all visible and accessible ACM. The surveyed buildings included the Shop which was within the service station site area.

2.5.2 Results, Conclusions and Recommendations

A register of survey results, including photographs was included in the report, however ACM was not detected in any of the buildings surveyed at the site. HTS recommended that if any materials were identified as likely to contain asbestos at the site, the following recommendations should apply:

- Any works involving the stabilisation or removal of ACM should be undertaken by a Class A or B licensed asbestos removal contractor under controlled asbestos conditions in accordance with all relevant regulations.
- Removal of ACM is to be undertaken in accordance with the regulations and requirements of the NSW Government and Safe Work Australia, which are:
  - NSW Work Health and Safety Act 2011
  - NSW Work Health and Safety Regulations 2011
  - Code of Practice: How to Manage and Control Asbestos in the Workplace
  - Code of Practice: How to Safely Remove Asbestos
  - Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres (2nd Edition)

2.6 Environmental Site Assessment Report Palms Oasis Caravan Park, Aurora Environmental Consulting, April 2016

In 2016, Aurora Environmental Consulting Pty Ltd was retained to undertake an environmental assessment of the service station and surrounding Caravan Park to assess the impacts of the storage of fuel products on the site soil and groundwater and the resulting risks to continued commercial use of the service station and residential use of the park.

2.6.1 Objective and Scope of Works

The scope of the investigations encompassed:

- A review of site background information and available site history
- Site investigation comprising drilling of six boreholes in the service station area and sampling and analysis of soil for total petroleum hydrocarbons (TPH), benzene, toluene, ethyl-benzene, xylene and naphthalene (BTEXN) and lead
- Installation of three groundwater monitoring wells into three of the boreholes and subsequent sampling and analysis of groundwater for TPH, BTEXN and lead

2.6.2 Results, Conclusions and Recommendations

Aurora (2016) reported that the site contained an operational service station facility including:

- A total of three USTs, installed in the early 1990s at the time of site commissioning
- Two USTs had a capacity of 11800 Litres and contained PULP 95 and ADF fuel, respectively. One UST had a capacity of 16200 Litres and contained ULP 91.
- Three fuel dispenser pumps, located below the canopy which dispensed various grades of fuels
- Vent lines located in the canopy
- A retail store outlet attached to the service station facility

The conclusions for this investigation are presented in the following section.

2.7 Environmental Delineation Assessment Report Palms Oasis Caravan Park, Aurora Environmental Consulting, October 2016

2.7.1 Objective and Scope of Works

Briefly the scope of the investigations encompassed:

- Following a review of the results from the March investigation, further boreholes were drilled to define the extent of observed impacted groundwater and a further six groundwater wells were installed to the west, northwest, north and east of the service station site in the surrounding caravan park
- Soil and groundwater (from both the initial wells and the new wells) was sampled and analysed for the potential contaminants of concern
- A visual and odour inspection was conducted in September 2017 which indicated only a mild hydrocarbon odour in MW3 with no indication of a sheen in the wells.

2.7.2 Results, Conclusions and Recommendations

The main findings of the ESA and Delineation Assessment Report comprised the following:

- The site geology comprised a weathered clayey soil profile overlying weathered siltstones and claystones
- Groundwater was encountered at about 2 metres below ground level (mbgl) and the groundwater flow direction was determined towards the north-west
- Soil samples analysed as part of the investigations (on and off the service station site) were found to have concentrations of petroleum hydrocarbons at either below detectable limits or within guideline criteria
- Petroleum hydrocarbon concentrations in the groundwater were found above guideline criteria for ecological receptors across the service station area but not in the wells installed down gradient in the caravan park
- Petroleum hydrocarbon contaminant concentrations did not exceed human health guidelines (for vapour intrusion) for either commercial/industrial use (service station area) or residential use (caravan park), in any wells
- Aurora indicated that the levels of contaminants in the groundwater may require notification to the NSW EPA reporting under section 60 of the *Contaminated Land Management Act* (1997)
- The service station wells are located approximately 280 m from the external property boundary in the direction of groundwater flow.

2.8 Groundwater Monitoring Palms Oasis Caravan Park, Blueys Beach NSW, Ramboll, February 2018

In 2018, Ramboll were retained to undertake an updated round of sampling and laboratory analysis to assess ongoing impacts on groundwater at the service station site within the caravan park.

2.8.1 Objective and Scope of Works

Briefly the scope of the investigations encompassed:

- A preliminary review of the existing site investigation reports for assessments conducted in 2016 by Aurora
- Groundwater monitoring of the nine site groundwater wells and analysis of samples for a range of contaminants of concern including total recoverable hydrocarbons (TRH), volatile aromatic hydrocarbons (VOCs), BTEXN, polycyclic aromatic, hydrocarbons, (PAHs) and lead.

2.8.2 Results

- Results indicated concentrations of petroleum hydrocarbons, including mono-aromatic hydrocarbons (benzene, ethyl-benzene, toluene, and xylene) and naphthalene to be present at concentrations consistent with the previous investigations conducted by Aurora (Aurora 2016a and b)
- Fieldwork also confirmed similarly consistent depth to groundwater and groundwater flow directions.
- There were no separate phase hydrocarbons observed in any well.
- Concentrations of benzene, xylene and naphthalene exceeded the Groundwater Investigation Limits (GILs) relevant to the site, although they were below health screening criteria for inhalation and direct contact.
- Contaminant concentrations appeared to be decreasing over time in the groundwater collected from the service station wells MW1 and MW2, and increasing in MW3, on the down-hydraulic gradient side of the service station.
- Concentrations at the down-gradient wells, MW4, MW5 and MW6 in the residential caravan park area, remained low and near detection levels however had increased which may be indicative of the migration of the contaminant plume to the north-west, towards the residential area of the caravan park.
- Considering the data gaps, there was no apparent complete pathway from the contaminant source (USTs and dissolved concentrations of petroleum hydrocarbons) to a receptor, and no indication that contamination had migrated beyond the site.

2.8.3 Conclusions and Recommendations

The groundwater assessment concluded:

- elevated contaminants in groundwater at the service station and the potential off-site migration towards sensitive receptors including the residential area of the caravan park requires action.
- Further monitoring is required to evaluate if the site warrants a potential risk of harm and notification to the NSW EPA under Section 60 of the NSW Contaminated Land Management Act 1997.
- Monitoring in accordance with the UPSS is required.

2.9 Summary of Previous Investigations

Previous assessments undertaken for the site have identified limited groundwater contamination to be present at the service station and off-site migration of contaminants towards sensitive receptors was evident.

No asbestos containing materials were identified in the service station buildings.

Initial investigation (Aurora 2016a) found limited soil contamination (TRH and BTEX) however potential localised soil contamination is likely to exist around the UPSS which may require management or remediation.

3. CONCEPTUAL SITE MODEL

A conceptual site model (CSM) is a site-specific qualitative description of the source(s) of contamination, the pathway(s) by which contaminants may migrate through the environmental media, and the populations (human or ecological) that may potentially be exposed. This relationship is commonly known as a Source-Pathway-Receptor (SPR) linkage. Where one or more elements of the SPR linkage are missing, the exposure pathway is considered to be incomplete and no further assessment is required.

Table 2: Conceptual Site Model

Consideration	Details
Potential Onsite Sources of Contamination associated with UPSS Infrastructure	Current potential sources of onsite contamination associated with UPSS infrastructure include: • USTs; • Fuel dispensing pumps; • Fuel lines; and • Fill points. The contaminants of potential concern (COPC) associated with the above sources include TRH, BTEX, PAHs and lead.
Other Potential Sources of Contamination	Other potential sources of contamination, other than the identified UPSS infrastructure include the imported fill of an unknown origin
Potential Transport Mechanisms and Exposure Pathways for Contaminants	Migration of vapours through soil and service trenches. Potential for vapour accumulation in enclosed spaces Soil leaching and groundwater transport Stormwater runoff
Potential Receptors of Contamination	Potential receptors of contamination sourced from the site were identified as: • Human receptors at the site, including workers and visitors (indoor and outdoor air) and construction / intrusive maintenance workers • Surrounding land users (indoor and outdoor) • Workers carrying out installation or maintenance of underground services on or near the site • Beneficial users of groundwater located in the surrounding area (if any) • Marine waters and aquaculture in Wallis Creek and Lake Wallis.

4. REMEDIATION ACCEPTANCE CRITERIA (RAC)

4.1 Soil

The criteria proposed for the assessment of soil contamination were sourced from the following reference:

- National Environment Protection Council (NEPC), National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended 2013 (NEPM, 2013)

The guidelines for residential land use are considered the most appropriate given the ongoing proposed land use for a residential community.

The guidelines adopted for the site from the NEPM are as follows:

- HIL A – health investigation level for residential use including the planned low density lifestyle village and also community facilities. The HILs are applicable for assessing human health risk via all relevant pathways of exposure. The HILs are generic to all soil types and apply generally to a depth of 3m below the surface for residential use.
- HSL A – health screening levels for residential use for soil vapour intrusion from petroleum hydrocarbons are guidelines that prevent accumulation of vapours at concentrations that may represent a health risk. The HSLs are derived for various depths and are for the same generic land uses as for the HILs. The guidelines are relevant where soils are beneath building or structures such as confined spaces.
- EIL for residential use – ecological investigations levels applicable for assessing risk to terrestrial ecosystems. EILs depend on specific soil physicochemical properties and generally apply to the top 2m of soil.
- ESLs for residential use – ecological screening levels developed for selected petroleum hydrocarbon compounds and fractions and are applicable for assessing risk to terrestrial ecosystems. These are also generally applicable to the top 2m of soil.
- Management Limits where concentrations above these limits may indicate poor aesthetics, high odour and potentially explosive vapour. Management limits are to be applied after consideration of relevant ESLs and HSLs.
- HSLs for Direct Contact have been adopted for the direct contact of contaminated soil.
- HSLs for Intrusive Maintenance Workers have been adopted for workers who carry out work in shallow trenches (maximum depth of 1m). Exposure may occur through inhalation of volatiles of through direct contact with contaminated soils from surface to 2m below ground surface (Friebel and Nadebaum, 2011).

The following tables tabulate the adopted soil assessment criteria.

Table 3: Soil Assessment Criteria – Health and Ecological Investigation Levels

Contaminant (mg/kg)	HIL A - Residential	EIL Residential
Metals		
Lead	300	270
PAHs		
Naphthalene	--	170
Carcinogenic PAH (B(a)P equivalent)	3	--
Sum of reported PAH	300	--

Table 4: Soil Health Screening Levels for Vapour Intrusion HSL A – Clay[1]

Contaminant (mg/kg)	0 to <1m	1m to <2m	2m to <4m	4m+
Toluene	480	NL	NL	NL
Ethylbenzene	NL	NL	NL	NL
Xylenes	110	310	NL	NL
Naphthalene	5	NL	NL	NL
Benzene	0.7	1	2	3
F1[2]	50	90	150	290
F2[3]	280	NL	NL	NL

NL: The soil saturation concentration (Csat) is defined as the soil concentration at which the porewater phase cannot dissolve any more of an individual chemical. The soil vapour that is in equilibrium with the porewater will be at its maximum. If the derived soil HSL exceeds Csat, a soil vapour source concentration for a petroleum mixture could not exceed a level that would result in the maximum allowable vapour risk for the given scenario. For these scenarios, no HSL is presented for these chemicals and the HSL is shown as 'not limiting' or 'NL'.

1. For soil texture classification undertaken in accord with AS 1726, the classifications of sand, silt and clay may be applied as coarse , fine with liquid limit <50% and fine with liquid limit>50% respectively, as the underlying properties to develop the HSLs may reasonably be selected to be similar. Where there is uncertainty, either a conservative approach may be adopted or laboratory analysis should be carried out. At the site, previous investigation has identified CLAY as the principal soil texture.
2. To obtain F1 subtract the sum of BTEX concentrations from the C6-C10 fraction.
3. To obtain F2 subtract naphthalene from the >C10-C16 fraction.

Table 5: Environmental Screening Levels, Management Limits and Direct Contact for Petroleum Hydrocarbons and speciated PAHs in Soil

Contaminant (mg/kg)	ESL (Fine) Residential	Management Limit[1]	Direct Contact[4]
F1 C6-C10	180[2,3]	800	4,400
F2 >C10-C16	120[3]	1,000	3,300
F3 >C16-C34	1,300	3,500	4,500
F4 >C34-C40	5,600	10,000	6,300
Benzene	65	--	100
Toluene	105	--	14,000

Table 5: Environmental Screening Levels, Management Limits and Direct Contact for Petroleum Hydrocarbons and speciated PAHs in Soil

Ethylbenzene	125	--	4,500
Xylenes	45[6]	--	12,000
Naphthalene	370	--	1,400
B(a)P	72[5]	--	--

1. Management limits are applied after consideration of relevant ESLs and HSLs. Separate management limits for naphthalene are not available hence these should not be subtracted from F2.
2. To obtain F1 subtract the sum of BTEX concentrations from C6-C10 fraction.
3. The ESL is of moderate reliability and all remaining ESLs are of low reliability.
4. Direct Contact are applied to surface soils or soils that could result in immediate contact.
5. Benzo(a)Pyrene ESL adopted values based on Canadian Council of Ministers of the Environment (CCME) 2008 guidelines developed using a species sensitivity distribution (SSD) for eco-toxicity data from five independent studies involving three soil invertebrate taxa and two plant taxa (14 endpoints) in preference to NEPM low reliability data.
6. Fine grained value adopted as it is the most conservative value.

Table 6: Soil Health Screening Levels for Vapour Intrusion – Intrusive Maintenance Worker (Shallow Trench) – Clay[1]

Contaminant (mg/kg)	0 to <2m	2m to <4m	4m+
Toluene	NL	NL	NL
Ethylbenzene	NL	NL	NL
Xylenes	NL	NL	NL
Naphthalene	NL	NL	NL
Benzene	350	NL	NL
F1[2]	NL	NL	NL
F2[3]	NL	NL	NL

NL: The soil saturation concentration (Csat) is defined as the soil concentration at which the porewater phase cannot dissolve any more of an individual chemical. The soil vapour that is in equilibrium with the porewater will be at its maximum. If the derived soil HSL exceeds Csat, a soil vapour source concentration for a petroleum mixture could not exceed a level that would result in the maximum allowable vapour risk for the given scenario. For these scenarios, no HSL is presented for these chemicals and the HSL is shown as 'not limiting' or 'NL'.

1. For soil texture classification undertaken in accord with AS 1726, the classifications of sand, silt and clay may be applied as coarse, fine with liquid limit <50% and fine with liquid limit>50% respectively, as the underlying properties to develop the HSLs may reasonably be selected to be similar. Where there is uncertainty, either a conservative approach may be adopted or laboratory analysis should be carried out.

4.2 Asbestos

The HSLs for asbestos are applicable for assessing human health risk via the exposure pathway of inhalation of airborne asbestos and are presented in **Table 7**. The HSLs are generic to all soil types.

Table 7: Health Screening Levels for Asbestos Contamination in Soil (w/w)

Form of asbestos	Screening Level
Bonded ACM	0.05%
FA and AF[1] (friable asbestos)	0.001%
All forms of asbestos	No visible asbestos for surface soil

Fibrous Asbestos (FA) is asbestos material that is in a degraded condition such that it can be broken or crumbled by hand pressure. Asbestos Fines (AF) includes free fibres, small fibre bundles and also small fragments of bonded ACM that pass through a 7 mm x 7 mm sieve.

1 The screening level of 0.001% w/w asbestos in soil for FA and AF (i.e. non-bonded/ friable asbestos) only applies where the FA and FA are able to be quantified by gravimetric procedures. This screening level is not applicable to free fibres.

4.3 Waste Criteria

The criteria to be used for the assessment of the soil for disposal off-site are the NSW EPA *Waste Classification Guidelines*, 2014.

Waste classification is two tiered. The first set of guidelines is based on total contaminant concentrations, whereas the second set of guidelines, if contaminant concentrations are exceeded are based on a leachable (TCLP) concentration and a total contaminant concentration. Material can be classified as General Solid Waste (GSW), Restricted Solid Waste (RSW) or Hazardous Waste by these guidelines.

Where soils contain asbestos, this is pre-classified as Special Waste – Asbestos, with the relevant waste classification of GSW, RSW or Hazardous Waste accordingly.

5. REMEDIAL ACTION PLAN

5.1 Remediation Goal

The goal of the remediation works is to remove the UPSS facility and associated infrastructure and any affected soils to render the site suitable for residential landuse.

Target soil concentrations for the site contaminants of concern are presented in **Section 4.**

5.2 Remediation Extent

The extent of the remediation is defined as the areal extent of the service station site as shown in **Figure 2** and to a vertical depth of approximately 3m.

5.3 Remediation Options

As part of the development of the site, the removal of the UPSS facility is required.

Remediation options for any affected soils are considered to include:

1. Excavation and off-site disposal of contaminated soil
2. On-site containment via capping of contaminated soil and implementation of a Long Term Environmental Management Plan

5.3.1 Excavation and Off-site Disposal

Excavation and off-site disposal involves the excavation of contaminated soils and disposal to a landfill licensed to accept the waste. This option involves the removal of contamination from the site.

Once the remediation has been completed and it has been demonstrated via validation sampling that no contaminant concentrations remain above the adopted remediation acceptance criteria, the site will be considered to be suitable for residential land use.

5.3.2 On-site Containment via Capping

On-site containment via capping involves the placement of a cap over contaminated soil. As the soil contamination remains on-site, long term management is required to prevent exposure to the contaminated soil.

The cap shall include a marker layer comprising high visibility (orange or similar) geotextile material followed by one of the following:

- Concrete slab
- Permanent hardstand paving
- other capping types such as clay or geosynthetic clay layer (GCL)

Generally, on-site containment of impacted soils is not a suitable remediation strategy where contamination potentially extends below the groundwater surface where the presence of soil contamination can potentially form an ongoing source to groundwater.,

Long term management will be via a Long Term Environmental Management Plan, which will detail management requirements. The existence of the capping and the Long Term Environmental Management Plan will be included on the Section 10.7 Certificate for the property.

This option does not remove contamination from the site and a legacy remains.

5.4 Preferred Remediation Option

The preferred remediation option is the removal of the UPSS and remediation of impacted soils and groundwater by off-site disposal.

A detailed summary of the remediation option is presented in **Section 6.**

5.5 Contingency Plan

Table 8 outlines the potential failure scenarios that could occur and the contingency mechanisms that would be implemented to achieve the overall remediation objective.

Table 8: Remediation Contingency Planning

Failure Scenario	Contingency Response
1. Contaminated soil extends offsite	The contaminated material beyond the site boundary would be temporarily left in place. The environmental consultant would consider options for management of the contamination which may include a risk assessment, identification of a methodology to remove the soils, or implementation of an in-situ remediation technology. If deemed to present a potential risk to offsite land users, further sampling of soils will be undertaken to delineate the extent of remaining contamination, prior to remediation.
2. Identification of unexpected contaminated materials during the removal of the USTs.	Stop work in that area and contact the environmental consultant. Additional validation samples and analytes may be required to be collected and analysed
3. Validation samples fail criteria.	At the direction of the environmental consultant, excavate additional soil and revalidate that area or assess other potential remediation or validation options
4. Groundwater ingress into excavation during validation.	Due to the low permeability of the sub-surface material, groundwater ingress is expected to be slow. The environmental consultant will collect validation samples immediately on judging that the excavation has extended to the vertical limits of contamination. If significant groundwater ingress is encountered (ie, where inflow makes further excavation impractical) then excavations will require dewatering and disposal to an appropriately licensed facility prior to collection of validation samples and / or backfilling.
5. Additional USTs are identified.	Follow same procedures as per the identified USTs.
6. Soil classifies as hazardous waste.	The environmental consultant will review options to either pre-treat by landfarming on site or transport to a licensed offsite treatment facility
7. Environmental and / or OHS Controls Fail or environmental or OHS monitoring indicates potential hazards.	The environmental consultant will implement additional options for site management in consultation with the project manager.
8. Observations during the remedial works suggests that significant groundwater contamination could be present.	Any retained liquids in the UST excavation will be pumped out and disposed of by a licensed liquid waste contractor. The environmental consultant will undertake further groundwater monitoring from existing wells and potentially new wells. If further groundwater remediation is considered necessary, prepare an addendum to the RAP detailing sampling, remediation and validation procedures.
9. Other	Any other unexpected events which may affect the outcome of the remediation and validation would be notified to the environmental consultant. At that time potential actions to address the unexpected event will be assessed and presented.

5.6 Interim Site Management

The site is paved and underlying soils are not accessible to the public. The service station will have ceased operation prior to commencement of remediation works.

If delays with works occur it is recommended that the site is fenced to prevent casual access.

Compliance with UPSS regulations regarding monitoring should also be maintained until remedial works are commenced.

6. PROPOSED UPSS REMOVAL METHODOLOGY

The following sections present a description of a nominal work plan for removal/remediation of the UPSS facilities at the site.

Actual methodologies may differ based on input from contractors and Ingenia's requirements.

6.1 Task 1 – Project Preparation

6.1.1 Notify Local Authorities

The works will qualify as Category 1 Remediation Work (requiring development consent) as the site is located within a wildlife corridor as defined under Clause 7.9 of the Great Lakes Local Environment Plan, 2014 and shown in the Protection of Wildlife Corridors Map.

However, the RAP (and the remediation described within it) will form part of the project described in the Development Application (supported by a Statement of Environmental Effects (SEE)), seeking approval, then works approval should be covered.

Given consent, the local authorities (in this case Mid-Coast Council) would be notified 30 days prior to the commencement of works (and within 30 days of completion).

6.1.2 Engagement of Contractors

Engagement of contractors, in particular the UST removal contractor. Ensure contractor agreements are signed, insurances are in place and applicable licences (i.e. NSW WorkCover Restricted Demolition licensee) are up to date and the scope of works is clear.

6.1.3 Preparation of H&S Documentation

A site-specific Health and Safety Plan (HASP) will be utilised at the Site, with task-specific Job Safety and Environment Assessment (JSEA) provided by subcontractors.

6.1.4 Underground Utility Clearances

The UST removal contractor ("the sub-contractor") will locate any services within the excavation area and disconnect as required.

6.2 Task 2 – Environmental Controls

The environmental controls will be implemented prior to commencement of the works and will include, but not be limited to, the following:

- Control of Site access / egress;
- Soil/erosion management;
- Excavation water (groundwater and surface water) management;
- Stockpile management;
- Material tracking and disposal; and
- Noise, odour, dust, and vibration controls.

A summary of the environmental controls is provided in **Section 8** of this report.

6.3 Task 3 – UPSS Removal

6.3.1 USTs Removal Preparation Works

A suitable qualified contractor will be engaged to remove the USTs and associated infrastructure in accordance with AS4976 – the Removal and Disposal of Underground Petroleum Storage Tanks. It is assumed that the maximum required excavation around the USTs is limited to 1 metre (m) either side of the tank shell and 4 metres below ground level (m bgl).

UST removal preparation works will generally involve the following:

- Pre-start induction – all personnel to undertake induction including SWMS and site specific training prior to commencement of works. Minimum PPE to be inspected (long longs, lace up boots and high visibility vest).
- Lower explosive limit (LEL) monitoring – conduct LEL monitoring prior to and whilst works are occurring to ensure that they are not conducted within an explosive atmosphere.

- Service location search – locate services within and adjacent to the excavation areas and locate the positions of the UST vent and bowser supply lines.
- Ground penetrating radar (GPR) survey – confirm the locations and footprints of the USTs.
- Establish temporary fencing – temporary fencing and safety signage to be established around the excavation and stockpile areas.
- Electrical disconnection and isolation of the USTs and bowsers– electrical disconnection and isolation of the USTs and the bowser by a suitably qualified electrician.
- Physical disconnection of bowsers – physically disconnect and bleed any remnant product within the supply lines back into the USTs. Cap fuel lines.
- Liquid waste/fuel removal – removal of liquid waste/fuel (diesel and petrol) from within the USTs and dispose offsite at a suitably licensed facility.
- Establish environmental controls - installation of 200 micron thick impermeable plastic within the base of and along the length of the temporary fencing where excavated soils are to be stockpiled to prevent the offsite migration of soil. The stockpile will be situated on hardstand. A mobile fogging unit will be established adjacent to the excavation area to suppress potential odours, if required, whilst the contractors are onsite.
- Concrete cutting – saw cut concrete forecourt above the footprints of the USTs.

6.3.2 Removal of USTs

- Excavate concrete forecourt – excavate and temporarily stockpile on site the remaining concrete forecourt that was previously cut located above the footprint of the USTs.
- Excavate UST's overburden – excavate and temporarily stockpile onsite the UST's overburden to expose to top of the USTs and associated fittings/pipe work.
- De-gas UST (nitrogen purge) – nitrogen purge USTs until monitors indicate oxygen levels within the UST at 5% or less.
- Onsite destruction of USTs – render nitrogen purged USTs incapable of acting as vessels to eliminate vapour recharge within the USTs.
- Excavate UST concrete anchors and packing sands – excavate and stockpile on site the UST's concrete strip anchors. The packing sands adjacent to the USTs will be removed and stockpiled onsite so as to free the USTs for removal from the excavation.
- Offsite disposal of stockpiled concrete – excavated concrete from the forecourt and the UST's anchors will be disposed offsite. If the concrete has strong hydrocarbon odours then it will be disposed offsite as contaminated waste at an appropriately licensed waste disposal facility.
- Removal of USTs from excavation – the three USTs will be lifted out of the excavation and loaded on to a truck for offsite transport and disposal.
- Offsite transport and disposal of destroyed USTs and bowser – offsite transport and disposal of USTs and bowsers. A UST Destruction Certificate will be provide upon completion of the works.
- Excavation of remaining soil material – excavation and stockpiling of additional soil from the walls and floor of the excavation at the direction of the environmental consultant.
- Validation sampling by the environmental consultant from the walls and floor of the excavation/s (See **Section 7.1)**.
- Demobilisation – make safe and temporally demobilise (potentially backfill into the excavation) until receipt of analytical results.

6.4 Task 4 - Excavation of Hydrocarbon Impacted Material and Stockpile Management

Based on the anticipated excavation dimensions, Ramboll estimates that approximately 150-200 m^3 of stockpile soil may be generated during the works.

All soil removed during the excavation works will be temporarily stockpiled on-site in a designated area until laboratory results are received. Based on the laboratory results, the soil will be either reused on-site to backfill the excavations or will be disposed of off-site to a licensed landfill facility. Any stockpiled material will be bound by silt-trapping barriers for the control of silt and surface water runoff. Sediment erosion control devices shall be installed and will be maintained throughout the works as required.

Options for managing these stockpiles are discussed below.

6.4.1.1 Option 1 – Backfilling

If stockpile samples meet analytical requirements for backfilling then backfilling will occur. This will be supplemented by VENM and compacted to a 98% compaction density ratio.

In addition to the analytical sampling described below, soil samples will be field-screened with a calibrated PID. Field staff will inspect the backfill materials and note whether visual evidence of potential contamination is present (odours, staining or anthropogenic materials).

6.4.2 Option 2: Off-site disposal

If offsite disposal of excavated materials is required, the works will be undertaken in accordance with the *Waste Classification Guidelines* (NSW DECC, 2014). Selected soil samples will be analysed for broad range of analytes and leachability testing using the Toxicity Characteristic Leaching Procedure (TCLP).

6.5 Task 5 - Reinstate and Grade the Excavation

Site reinstatement will be undertaken as soon as practical following the completion of excavation, remedial works (if any).

The UST excavation will be reinstated in 200mm layers with previously excavated stockpiled material if deemed suitable for re-use following chemical assessment and with imported VENM (replacement volume of UST and associated concrete anchors). Compaction testing of the surface layer of the backfilled material to confirm that a compaction density of 98% has been achieved.

Backfilling will be completed by using clean material, free of organic matter and compacted in horizontal layers not more than 250 mm thick concrete to 95% of the standard maximum dry density of soil.

Field staff will collect photographic documentation of the demolition, to document progression of the works.

Soils may be re-used on site or taken off site for reuse as Virgin Excavated Natural Materials. VENM is an exempt material under the waste legislation and does not specifically require testing but is based on an assessment of the potential for contamination. Where there is uncertainty, testing may be undertaken. Excavated natural material can also be re-used once tested. If ENM were to be generated for off-site re-use this would need to meet the requirements of the relevant Resource Recovery Order.

6.5.1 Imported Fill

Any fill imported to the site will be validated as VENM, ENM or materials that meet the Resource Recovery Exemptions prior to import in accordance with Protection of the Environment Operations Act 1997 (POEO Act) and guidance provided by the NSW EPA.

7. VALIDATION OF REMEDIATION

7.1 Validation Sampling and Analysis

Validation sampling will be required to demonstrate that, following removal of the UPSS and any impacted soils, remaining soils are within the adopted guidelines for the site. A summary of the validation methodology is presented in the following sections.

7.1.1 Excavation Characterisation Sampling

Following removal of the USTs, fuel dispensing pumps, fuel lines and other associated facilities, and completion of excavation works, soil characterisation / validation sampling of the resulting excavations will be undertaken.

Characterisation sampling will be conducted in accordance with NSW EPA, *Technical Note: Investigation of Service Station Sites* (EPA, 2014). The frequency of sampling is provided below:

- **Tank Pit Excavation - Walls:** one sample every 10 linear metres, samples to be selected for analyis based on results of field screening results using a PID and field observations, and distributed across soil types (i.e. multiple wall samples may be collected and analysed);
- **Tank Pit Excavation - Base:** one sample beneath each removed UST and / or every 10 m^2 thereafter;
- A minimum of five samples per tank pit excavation (one from each wall and one from the base) will be collected.
- **Fuel Dispensing Pumps – Base:** one sample beneath each removed fuel dispensing pump;
- **Fuel Lines – Base:** one sample per 10 linear metres of trenching from excavated fuel lines.

Excavation characterisation samples will be analysed for total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAHs) and lead. The soil test results will be compared against the remediation acceptance criteria (RACs) detailed in **Section 4**.

7.1.2 Surface / Excavation Water Characterisation Sampling

Surface water or water that accumulates in the excavations and that is suspected of being contaminated may be sampled (a nominal one sample per excavation) and analysed for classification or compliance purposes.

7.1.3 Stockpile Characterisation Sampling

Soil removed during excavation works will be sampled at an approximate rate of one per 25 m^3, or one sample per stockpile (for stockpiles smaller than 25 m^3).

If off-site disposal of excavated materials is required, this will be undertaken in accordance with the *Waste Classification Guidelines* (NSW DECC, 2014). An environmental consultant will prepare a Waste Classification Letter for any soils requiring offsite disposal, the letter will detail the waste classification and volumes of the relevant excavated materials.

Materials will be transported from the Site to the selected landfill by an appropriately licensed contractor. Disposal dockets from the landfill facility will be obtained and provided in the final report as evidence of appropriate disposal.

Stockpile characterisation samples will be analysed for total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, and xylenes (BTEX), Polycyclic aromatic hydrocarbons (PAHs) heavy metals and selected samples for asbestos. Selected soil samples will also be analysed for leachability testing using the Toxicity Characteristic Leaching Procedure (TCLP).

7.1.4 Imported Fill Characterisation Sampling

If imported fill is required at the Site for reinstatement of excavations, only certified Virgin Excavated Natural Materials (VENM) will be imported onto the site. Import dockets will be obtained and provided in the final report as evidence of suitability.

An environmental consultant will also observe materials as they are imported and placed on-site.

If a VENM certificate is unavailable, samples of the imported fill will be collected at an approximate rate of one per 100 m^3 and submitted for laboratory analysis.

Imported VENM samples will be analysed for TRH, BTEX, metals, PAHs, heavy metals, PCBs, OCP/OPP and asbestos.

7.1.5 Laboratory Analysis

Soil samples will be placed in laboratory provided jars appropriate for the analysis requested and transported to a National Association of Testing Authorities (NATA) accredited laboratory.

7.1.6 UPSS Compliance and Reporting

A Validation Report will be prepared for the site at the completion of the validation sampling and receipt of laboratory results. The validation report will be prepared in accordance with *UPSS technical note: Site validation reporting (DECCW), Guidelines for consultants reporting on contaminated sites (EPA 1997), UPSS Regulation 2014* and the NSW EPA *Guidelines for Consultants Reporting on Contaminated Sites* (NSW EPA 1997).

The Validation Report will summarise the UST removal works, remedial actions (if any), investigation, and validation works at the Site, including:

- Report text including description of methodologies and field procedures used during the field works, and results of completed works;
- Figures showing site infrastructure and material stockpiles;
- Tables summarising analytical results;
- Photographs documenting the progression of field works;
- Disposal dockets for materials disposed offsite including UST destruction certificates;
- VENM certificates (as required);
- Calibration records for any field measurement equipment used by the environmental consultant;
- Laboratory certificates and chain-of-custody (COC) documentation; and
- A clear conclusion stating whether or not the UPSS have been effectively decommissioned.

The *UPSS Regulation 2014* requires the validation report for a site to be submitted to the relevant local authority within 60 days of completion of the validation or remediation works. The report is used by the council to support future planning decisions about the land uses.

NOTE: if significant contamination is identified from the field work and/or laboratory analysis, a validation report may not be able to be completed without further remediation and/or risk assessment (refer to Section ***Error! Reference source not found. - Error! Reference source not found.****).*

7.2 Remediation Criteria

The remediation criteria (remediation acceptance criteria) are those outlined in **Section 4**.

7.3 Validation Data Quality Objectives

In order to achieve the objectives and purpose of the investigation, both the field and laboratory programs must be deemed representative of the actual extent of contamination in soil. As such, specific Data Quality Objectives (DQOs) have been developed for the validation of field and analytical data obtained during the sampling program. The DQO process is a systematic, seven step process that defines the criteria that the sampling should satisfy in accordance with the requirements of DEC (2006) *Guidelines for the NSW Site Auditor Scheme (2nd Edition)*.

The DQOs are summarised in the following sections.

7.3.1 Step 1: State the problem

Ingenia intend to redevelop the greater caravan park property for use as a residential lifestyle village (long term occupation). The site currently occupied by the service station will also be used in this development potentially as a community building as part of the proposed lifestyle village.

Therefore, the primary objective of the project is to ensure that the site is suitable for this redevelopment. Ingenia intends to remove existing UPSS infrastructure from the site as part of the re-development process. The presence of USTs and associated infrastructure generate the potential for soil and/or groundwater at the site to have been contaminated. Previous investigations undertaken at the site to date (refer **Section 2.4**) have identified minor soil contamination and limited groundwater contamination around the service station. There is a potential for localised soil contamination to exist around the UPSS which may require management and/or remediation. Therefore, the secondary objective of the project is to ensure that contaminated fill and soil materials (if identified) are appropriately disposed in accordance with regulatory requirements. Significant groundwater has not been identified and remediation and/or further assessment of groundwater is not considered necessary.

7.3.2 Step 2: Identify the decisions

To achieve the objective of the project, project decisions include:

- Analytical results of the validation sampling program comply with the RAC (refer **Section 4**),
- Visual and documented evidence that the UPSS infrastructure has been appropriately disposed of
- Evidence that all soils imported to the site meet the RAC
- Evidence that all wastes exported from the site have been legally disposed of.

7.3.3 Step 3: Identify the decision inputs

The primary inputs are:

- The results of laboratory analysis of validation samples
- The use of appropriate field sampling methods
- The use of appropriate laboratory methods for all analysis
- The use of appropriate RAC
- Use of the DQO Process (as detailed in this section)
- Confirmation that the DQIs have been achieved
- Evidence of UPSS disposal
- Certification of suitability of imported fill
- Evidence of legal disposal of wastes

7.3.4 Step 4: Definition of the boundaries of the remedial works

This is defined by reference to the site address (refer to **Section 1, Section 2.1 Figures 1** and **2**), while the approximate boundaries of the proposed remediation area (including estimated volumes and excavation depths) is described in **Section 5.2.**

7.3.5 Step 5: Develop decision rules

The following decision rules will be applied:

- Comparison of the results of validation sampling to the RAC;
- If required, assessment of validation data through checking that each individual sample concentration does not exceed the RAC by more than 250%;
- If required, calculation of the standard deviation of the data. The standard deviation should be less than 50% of the RAC; and
- Assessment of the reliability of both the field and laboratory programs by reference to DQIs
- Assessment of import soils and exported wastes which will comprise soils (and other unsuitable materials designated for disposal off-site

7.3.6 Step 6: Specification of the acceptable limits on decision errors

Acceptable limits on decision errors have been developed based on the Data Quality Indicators (DQIs) of precision, accuracy, representativeness, comparability and completeness. The DQIs for this investigation are outlined below:

Table 9: Data Quality Indicators (DQIs)

Field	Laboratory	Acceptability Limits
Completeness - A measure of the amount of useable data (expressed as a %) from a data collection activity		
All critical locations sampled as per sampling plan All samples collected as per sampling plan Experienced sampler Documentation correct	All critical samples analysed and all analytes analysed per sampling plan Appropriate Practical Quantitation Limits (PQLs) Sample documentation complete Sample holding times complied with laboratory specifications Matrix interference	As per NEPM (2013)
Comparability - The confidence (expressed qualitatively) that data may be considered to be equivalent for each sampling and analytical event		
Experienced sampler In the event of multiple sampling events: Same types of samples collected Same sampling depths (groundwater) Same sampling methodologies used Climatic conditions	Same analytical methods used Same PQLs Same units Same primary and secondary laboratories	As per NEPM (2013)
Representativeness - The confidence (expressed qualitatively) that data are representative of each media present on the site		
Appropriate media sampled (fill, natural) according to sampling plan. Relevant media sampled and preserved according to sampling plan.	All samples analysed according to sampling plan	As per NEPM (2013)
Precision - A quantitative measure of the variability (or reproducibility) of data		
Collection of duplicate samples at a rate of 1 in 10 samples for intra-laboratory and 1 in 20 samples for inter-laboratory. Sampling methodologies appropriate and complied with sampling plan All laboratories will be NATA accredited.	Analysis of: Blind duplicate samples Split duplicate samples Laboratory duplicate samples	 RPD of <=50% RPD of <= 50% RPD of <= 50%
Accuracy - A quantitative measure of the closeness of reported data to the true value		

Table 9: Data Quality Indicators (DQIs)

Field	Laboratory	Acceptability Limits
Collection of one rinsate blank per day of sampling and one trip spike per laboratory report submission. Sampling methodologies appropriate and complied with the sampling plan Laboratory quality assurance testing completed in accordance with NEPM requirements	Analysis of: Rinsate blanks	Non-detect (minor metal concentrations)
	Trip spikes	Non-detect
	Laboratory quality control	70 to 130%
	Method blanks	70 to 130%
	Matrix spikes	70 to 130% or 60 to 140% (phenols)
	Surrogate spikes	70 to 130%
	Laboratory control sample	

The potential for significant decision errors will be minimised by:

- Ensuring that all data satisfies the DQIs by completion of all quality assurance/ quality control (QA/QC) requirements;
- Assessing whether appropriate sampling and analytical densities were completed for the purposes of the investigation; and
- Ensuring that the criteria set for the investigation were appropriate for the proposed use of the site.

8. CONSTRUCTION ENVIRONMENTAL MANAGEMENT

It is expected that minimal environmental impact will be associated with the UPSS removal given the developed area around the site comprises hardstand and pavement and the works are minor occurring over a short duration.

Additional environmental management controls are outlined in the following sections.

8.1 Air Emissions

Potential air emissions from the odours released from the walls and floors from the open excavation and from the stockpiled /transported soil prior to final disposal. This will be depended on contamination being identified and the level of contamination.

If considered necessary, the following odour management procedures could be used:

- Undertaking the excavation works in a staged manner to limit the surface area of odorous material exposed;
- Application of odour suppressants via spray applicator; and / or
- Covering of the stockpiled and transported soil, to suppress the release of the odours.

In addition, as a precautionary management measure, air monitoring will be carried out during the excavation works using a PID measuring VOCs. Air quality within the work area and within workers' breathing zones will be monitored during the site activities using the PID. All workers will immediately withdraw from the work area if VOCs are greater than 10ppm in the workers' breathing zone. The Site Supervisor must approve re-entry into the work area. A range of actions from the use of respirators by site personnel, to watering or covering of stockpiles, to the suspension of site works will be assigned to different PID action levels.

Records of air monitoring conducted during excavation works will be made available to relevant regulatory officers (i.e., NSW EPA and Sydney City Council) upon request.

8.2 Dust

The UST Removal Works on the site will involve excavation works, stockpiling, transportation and placement of soil and general movement of vehicles across the site. Dust generation is therefore considered to be a potential environmental impact to the surrounding environment and the public

The following potential sources of dust generation have been identified, and the following potential measures can be taken to minimise dust levels is they become visible high:

Excavation Areas

- If dust migration from excavation areas is considered excessive due to high winds, the works will be delayed or limited during these periods.
- Fast turnaround times on laboratory samples to minimise excavated area exposure times.

Stockpile Areas

- The temporary stockpiling of the impacted soils may result in dust generation. If excessive dust is generated, the material will be covered by a plastic/geo-fabric sheet. This will aid in minimising the off-site movement of dust. In addition, regular dampening of stockpiles with water mist may also be carried out to minimise dust generation. The amount of water used for dust suppression will be kept to a minimum in order to prevent runoff.
- Where stockpiles are placed on non-paved areas, plastic/geo-fabric sheeting will be placed under stockpiles to prevent contaminants from seeping into uncontaminated soils.

Haulage of Soils

- All trucks transporting contaminated soil (for disposal) or imported fill to the site shall be covered in order to minimise dust generation.

- Consideration for a tyre grid/wash may be required to prevent dust being transported off-site via vehicular movement to and from the site.
- All contractors working on site will be briefed on the need to keep dust generation to a minimum.
- Note that where a visual inspection of the dust levels indicates that unacceptable levels are being generated, work will cease until measures have been undertaken to reduce the dust, or until weather conditions are more suitable. This may involve an alteration of the work plan or the use of water sprays.

8.3 Asbestos

The remedial works on the site will involve excavation works and it given the presence of fill on the site, there is a potential for asbestos fibres or fragments of asbestos-containing materials (ACM) may be encountered in the soil during these works. This RAP addresses the remediation of contamination previously identified at the site only. Staff will be visually inspecting the contaminated soil for asbestos fibres and fragments throughout the excavation works and all workers will have a Tyvek suit and respirator available in case asbestos is suspected during excavation works

Should asbestos be encountered at the site, it shall not be disturbed, works will stop immediately and the Project Manager/Project Director will be contacted. A suitable asbestos management plan shall be implemented and PPE worn, and suitably qualified asbestos contractors engaged for removal / transport to a licensed landfill.

8.4 Noise Controls

Any noise impact associated with the site works is acknowledged as an important environmental issue.

Some noise will be generated during the excavation activities when using machinery such as excavator, backhoe and soil screening equipment. Contractors are bound to comply with the statutory regulations regarding noise limitations in residential and commercial areas and hours as restricted by Mid-Coast Council.

In the event that these measures are not sufficient to reduce noise levels, a noise-monitoring program may be implemented. This program would involve short-term operator attended noise surveys at the noise source, as well as at surrounding properties to quantify the contribution of noise levels from the site to the ambient background levels.

Nominal hours of operation will be:

- 7:00 am to 6:00 pm Mondays to Fridays, inclusive;
- 8:00 am to 1:00 pm Saturdays; and
- at no time on Sundays or public holidays.

8.5 Soil Management

The UPSS removal program will be undertaken in a staged approach as follows:

- Designated areas will be excavated using a large excavator and the soil will be directly transported to the stockpile area and placed in a stockpile to be sampled for classification;
- Should the laboratory results reveal that the soil is impacted with hydrocarbons, the soil may be land-farmed and then reinstated on-site or transported off-site for disposal; and
- Validation sampling of the excavation and stockpiles will be performed on an ongoing basis as excavations are extended.
- Site plans detailing excavation areas, validation samples and soil movements will be recorded during the remediation works. All stockpiles will be labelled to ensure that the stockpiles are properly classified according to contaminant concentrations and to ensure that mixing of differently classified soils does not occur.
- The soil removed during the excavation works will be stockpiled on paved areas or polyethylene sheeting (if required), and will be bounded with silt barriers to ensure that any

surface runoff is not impacted by the soil. The stockpiles will not be placed near drainage lines, gutters or stormwater pits.

- Additional drainage control works will be constructed on-site should the need arise. If wet weather conditions are encountered, excavation works will cease and stockpiles possibly covered with HDPE lining to prevent runoff (if required).
- The excavation and stockpile areas will be isolated from the surrounding site areas through the use of temporary barricades and fencing.

8.6 Erosion and Sediment Control

Erosion and sediment controls that prevent dispersion of contaminated soil shall be implemented whenever soil is exposed onsite until the site is completely covered/stabilised or revegetated.

The following erosion and sediment control measures shall be implemented in the following order:

1. Diversion of surface water upslope of the excavation and stockpile areas.
2. Stockpile soil on flat land where possible and out of any drainage lines.
3. Cover stockpiled material completely to prevent wind- blown dust or sediment runoff during rainfall events.
4. Install sediment fence down slope of completely covered soil stockpiles to capture any runoff.
5. Inspect the erosion and sediment controls weekly, before and immediately following rain events and maintain controls as required.
6. Inspect vehicle access point after each vehicle leaves site and remove any material tracked offsite and place back onsite in a location where it cannot cause water pollution.
7. The Contractor is to keep themselves informed of weather conditions and the potential for rain events and proactively manage the site.
8. Refer to the NSW Blue Book for details and diagrams at http://www.environment.nsw.gov.au/resources/water/BlueBookVol1.pdf

8.7 Water Management

Seepage water, groundwater and stormwater may collect and accumulate in open excavations. In the event of water accumulating within the excavations additional management measures may need to be considered. Based on previous groundwater investigations, the level of seepage is expected to be low and the level of groundwater contamination is expected to be low.

Surface water runoff will be controlled on the site to ensure that potentially impacted material and / or water is not discharged to the surrounding area. The surface water runoff and any sediment entrained in the water will be managed by installing silt control barriers along the perimeter of the site to filter solid particles from the surface water, as it may flow off-site. Silt control barriers will also be placed around the stockpiles of excavated soils, where the migration of potentially impacted material can occur.

Daily checks of all fences and silt barriers will be undertaken and any built up sediments will be removed and placed in the stockpiles if excessive. In addition, silt control barriers will be replaced if they have deteriorated.

8.8 Access Restriction

As the site will be classified as a construction area it will be necessary to restrict access solely to authorised staff and contractors who have appropriate levels of personal protective equipment. A temporary fence will surround the perimeter of the site during site works to limit unauthorised access. Signage, including contractor details and contact numbers, will be erected near the gate at the site. The signage will remain displayed on the site entrance throughout the duration of the remediation works. The site supervisor shall control site access and shall authorise visitors on an "as needed" basis.

8.9 Traffic

No major traffic disruptions are expected as a result of the on-site works. All excavation and other equipment will be transported to the site in accordance with standard regulatory requirements.

8.10 Contact Details

The key stakeholders and their roles and responsibilities are outlined in **Table 10**. At this stage the specific personal in the roles are to be confirmed, (TBC).

Table 10: Roles and Responsibilities

Name & Role	Responsibility
Project Director TBC	- Lead the Project Team; - Has overall responsibility for the safe and successful completion of the project; and - Responsible for delivery of the project to BMW's satisfaction.
Project Management & Support TBC	- Responsible for day-to-day aspects associated with delivery of the investigation; - Responsible for scheduling, communications, financial management and liaison with BMW; - Coordinate meetings, site inspections, investigations, document preparation and submittal of deliverables; and -Will be technically supported by the Project Director.
Field Manager-TBC	- Responsible for supervising and conducting fieldworks as directed by the Project Manager; and - Aid the Project Manager in any activities listed above. - Development of the validation report.
Demolition Sub-contractor Project Manager	- Liaise with Project Manager regarding scheduling, timing and availability of excavation equipment; - Support Field Manager and other field staff with remediation and excavation works, as needed; - Provide documentation of offsite waste disposal to Project Manager.

8.11 Ongoing Site Monitoring

Ongoing monitoring will be determined based on the finding of the excavation and validation reporting. In the event ongoing monitoring is required, an environmental monitoring plan will be prepared.

At this stage it is envisaged that continued groundwater monitoring may be required to confirm reduction of impacts following removal of the UPSS infrastructure and potentially, any contaminated soils. A groundwater monitoring plan may be prepared as part of the validation report.

9. CONCLUSIONS

Ingenia Communities are developing the site and surrounding caravan park area as a long term residential lifestyle village.

As part of the development, removal of the service station facility including the UPSS infrastructure and remediation of any affected soil and potentially groundwater is required.

Previous investigation has identified the presence of limited existing soil and groundwater contamination from petroleum hydrocarbons.

In order to render the site suitable for the planned residential landuse, remediation of affected soils is proposed during the UPSS removal works.

Soils will be excavated and either re-used on site, where possible, or disposed of offsite to a suitably licenced landfill following completion of a validation program.

Ramboll concludes that the site can be made suitable for the proposed residential use following the successful completion and validation of remediation.

10. LIMITATIONS

Ramboll Australia Pty Ltd (Ramboll) prepared this report in accordance with the scope of work as outlined in our proposal to Torque Projects (for Ingenia Communities) dated 28 May 2018 and in accordance with our understanding and interpretation of current regulatory standards.

A representative program of sampling and laboratory analyses will be undertaken as part of this investigation, based on past and present known uses of the site. While every care has been taken, concentrations of contaminants measured may not be representative of conditions between the locations sampled and investigated. We cannot therefore preclude the presence of materials that may be hazardous. Site conditions may change over time. This report is based on conditions encountered at the site at the time of the report and Ramboll disclaims responsibility for any changes that may have occurred after this time.

The conclusions presented in this report represent Ramboll's professional judgment based on information made available during the course of this assignment and are true and correct to the best of Ramboll's knowledge as at the date of the assessment.

Ramboll did not independently verify all of the written or oral information provided to Ramboll during the course of this investigation. While Ramboll has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided to Ramboll was itself complete and accurate.

This report does not purport to give legal advice. This advice can only be given by qualified legal advisors.

10.1 User Reliance

This report has been prepared exclusively for Torque Projects (acting for Ingenia Communities) and may not be relied upon by any other person or entity without Ramboll's express written permission.

11. REFERENCES

Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) 2003, Minimum Construction Requirements for Water Bores in Australia, Queensland Department of Natural Resources and Water.

Aurora Environmental Consulting Pty Ltd, Environmental Site Assessment Report, Palms Oasis Caravan Park, 321 Boomerang Drive, Blueys Beach NSW 2428, April 2016, (2016a)

Aurora Environmental Consulting Pty Ltd, Environmental Delineation Assessment Report Palms Oasis Caravan Park 321 Boomerang Drive Blueys Beach NSW 2428, October 2016, (2016b)

Australian and New Zealand Environment Conservation Council and Agriculture Resource Management Council of Australia and New Zealand (ANZECC/ARMCANZ) 2000. Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

Friebel, E. and Nadebaum, P., 2011, Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater, CRC CARE Technical Report No. 10, Cooperative Research Centre for Contamination Assessment and Remediation of the Environment, Adelaide, Australia.

National Environment Protection Council (NEPC) 1999. National Environment Protection (Assessment of Site Contamination) Measure (NEPM, as amended).

NSW Department of Environment and Conservation (DEC) 2007. Guidelines for the Assessment and Management of Groundwater Contamination.

NSW Environment Protection Authority (EPA) 1995. Sampling Design Guidelines, September 1995.

NSW Department of Environment and Conservation (NSW DEC), Guidelines for the NSW Site Auditor Scheme (Second Edition) (NSW DEC, 2006).

NSW Environment Protection Authority (NSW EPA), Sampling Design Guidelines (NSW EPA, 1995) NSW EPA, Waste Classification Guidelines. Part 1: Classifying Waste November 2014 (NSW EPA, 2014).

NSW Office of Environment and Heritage (NSW OEH), Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites (NSW OEH, 2011).

Ramboll Australia Pty Ltd, Groundwater Monitoring Palms Oasis Caravan Park, Blueys Beach NSW, February 2018, (2018a)

Ramboll Australia Pty Ltd, Phase 1 Environmental Site Assessment, 321 Boomerang Drive, Blueys Beach, NSW, June 2018b, (2018b)

WorkCover NSW (2011). Code of Practice - How to manage and control asbestos in the workplace.

WorkCover NSW (2014). Managing Asbestos in or on Soil.

APPENDIX 1
FIGURES

Service Station RAP, Palms Oasis Caravan Park, Blueys Beach, NSW 2428

Site Locality

RAMBOLL

JOB NO: 318000371-001

DATE: July 2018

FIGURE 1

Client: Ingenia Communities Pty Ltd	Palms Oasis Caravan Park – Service Station RAP - Site Layout
RAMBOLL JOB NO: 318000371-001 Date: July 2018	FIGURE 2