HOLDMARK PTY LTD

REMEDIATION ACTION PLAN
STAGE A, SHEPHERDS BAY URBAN RENEWAL PROJECT
MEADOWBANK, NSW

Report E2009 AF
1 December 2014

Environmental Investigations Australia
Contamination | Remediation | Geotechnical

REPORT DISTRIBUTION

Remediation Action Plan
Stage A, Shepherds Bay Urban Renewal Project
Meadowbank, NSW

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Date: 1 December 2014

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Revision	Details	Date	Amended By

EXECUTIVE SUMMARY

Holdmark Pty Ltd engaged Environmental Investigations Australia Pty Ltd (EI) to provide a Remediation Action Plan (RAP) for Stage A, Shepherds Bay Urban Renewal Project, located at Meadowbank, NSW ('the site').

The objectives of the Remediation Action Plan were to:

- Minimise the environmental and health/safety impact on site workers and the general public during site remediation.
- Maximise the protection of workers involved with site remediation.
- Minimises potential exposure to contaminants in soil, air and groundwater.
- Render the site safe for proposed residential land use.
- Minimises impacts to site users and the located environment following remediation.

Based on the site history and limited intrusive investigations that:

- WorkCover search revealed the presence of two underground storage tanks (UST's) at 157 Church Street, Ryde (Former Stuart Bros Pty Ltd yard), with evidence stating a single UST and associated infrastructure (i.e. vents, fuel lines and filling points) was abandoned using the concrete filling method. Evidence collected during the site walkover inspection suggests the second tank remains present at the site, and may have been used historically for the storage of kerosene, used for heating of the commercial building. As tanks remain, it is assumed no soil excavation or validation has taken place;
- Results of soil samples collected from soil test boreholes BH701 - BH709 reported concentrations of the screened heavy metals to be below the adopted human health based SILs;
- Results of soil sample BH702-1 was found to exceed the ecological criteria for Zinc (2,700 mg/kg), collected from within a residual clay material present at the north western corner of the site, within the car parking area. As the proposed development plans include removal of all soils within the Stage A site, for the construction of a basement car park, it is expected that these soils will be removed, therefore the application of the ecological criteria will not be realised at the site;
- Heavy metal concentrations (i.e. copper and zinc) were found to exceed the GILs adopted for this assessment, within the majority of the groundwater wells present at the site. The identified elevated groundwater concentrations are considered to be within background fluctuations of naturally occurring levels for these heavy metals in the Sydney metropolitan groundwater catchment area, and it can be inferred that the detected groundwater levels of these heavy metals do not pose an immediate threat to human health or the environment;
- Acetone was identified within all groundwater monitoring wells present at the site, however the concentrations identified were considered to be minor, and were present within the upstream well for the site. As the maximum concentration of acetone is present within the upstream well of the site, the source of this contaminant is therefore not present at the site itself, and is considered to be from an upstream, off-site source

Based on the findings of the Groundwater Assessment and Environmental Site Assessment, the scope of this RAP is to:

- Review of the available environmental assessments and requirements of the NSW Department of Planning and Infrastructure (DPI) and NSW Environmental Protection Authority (EPA).

- Establishment of remediation goals and remediation criteria with respect to soil suitability for the intended residential land use.
- Review of available remediation option and evaluate and assist with selection of appropriate remedial strategies, taking into consideration the remediation goals and the practicality of the remedial options.
- Providing guidance so that the remedial works are carried out in accordance with relevant legislation.
- Removal and validation of the two in-situ underground storage tanks for petrol/diesel and kerosene within the former Stuart Bros Pty Ltd yard.

EI concludes that the Site can be made suitable for residential land use by implementing the proposed scope of works in the Remediation Action Plan, which may include further investigations to delineate identified groundwater impacts.

CONTACT TELEPHONE NUMBERS

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Environmental Consultant Details	Environmental Investigations Australia Pty Ltd Mr Eric Gerges 02 9516 0722

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1 INTRODUCTION

1.1 BACKGROUND AND PURPOSE

Holdmark Pty Ltd engaged Environmental Investigations Australia Pty Ltd (EI) to prepare a Remediation Action Plan (RAP) for Stage A, Shepherds Bay Urban Renewal Project, located at 155-157 Church Street, Ryde, NSW ('the site'). Refer to Figure 1.

Stage A of The Shepherds Bay Urban Renewal Project is comprises of the following lots:

- Lots 13 to 15 DP 738232.
- Lot DP 809282.
- Lot DP 851723.

The site is situated within the Local Government Area of the City of Ryde Council, and covers a total area of approximately 0.04 hectares (3,952 m^2), as depicted in the site plan presented as Figure 2.

1.2 PROPOSED DEVELOPMENT

Stage A of the development has been designated for the construction of a single multi storey development intended for mixed land uses. Current development plans indicate that the entire site will be utilised for the development and will involve the construction of a building four to ten storeys high, with two level basement car parking facilities. No significant open spaces have been proposed within Stage A. Refer to Appendix A for the proposed development plans.

1.3 REGULATORY FRAMEWORK

The RAP has been developed considering the following regulatory standards and guidelines:

- Contaminated Land Management Act (1997).
- Work Health and Safety Act (2011).
- Protection of the Environment (Underground Petroleum Storage System) Regulation (2014).
- Protection of the Environment Operations (Waste) Regulation (2005).
- SEPP 55 (1998) State Environment Planning Policy 55, The Remediation of Land.
- EPA (2011) Guidelines for Consultants Reporting on Contaminated Sites.
- DEC (2007) Guidelines for the Assessment and Management of Groundwater Contamination, NSW Department of Environment and Conservation (DEC, later renamed OEH), March 2007.
- DEC (2006) Guidelines for the NSW Site Auditor Scheme (2nd Edition), NSW DEC, April 2006.

- DEC (2009) Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997.
- ANZECC and Agriculture and Resource Management Council of Australia and New Zealand (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Paper No.4.
- EPA (2014) Technical Note: Investigation of Service Station Sites, NSW EPA, April 2014.
- NEPC (1999) National Environmental Protection (Assessment of Site Contamination) Measure, National Environmental Protection Council (DEC) (April 2013).

1.4 OBJECTIVES

The overall aim of this RAP is to provide a work plan for the delineation and remediation of the identified contaminated materials and infrastructure so land redevelopment may proceed without posing unacceptable risks to human health and/or the environment.

The primary objectives therefore are to:

- Minimise the environmental and health/safety impact on site workers and the general public during site remediation.
- Maximise the protection of workers involved with site remediation.
- Minimises potential exposure to contaminants in soil, air and groundwater.
- Render the site safe for proposed residential land use with minimal access to soil.
- Minimises impacts to site users and the located environment following remediation.

1.5 SCOPE OF WORKS

Accordingly the scope of the RAP is as follows:

- Review of the available environmental assessments and requirements of the NSW Department of Planning and Infrastructure (DPI) and NSW Environmental Protection Authority (EPA).
- Establishment of remediation goals and remediation criteria with respect to soil suitability for the intended residential land use.
- Review of available remediation option and evaluate and assist with selection of appropriate remedial strategies, taking into consideration the remediation goals and the practicality of the remedial options.
- Providing guidance so that the remedial works are carried out in accordance with relevant legislation.
- Removal of the two in-situ underground storage tanks for petrol/diesel and kerosene within the former Stuart Bros Pty Ltd yard (refer to Figure 2).

2 SITE DESCRIPTION

2.1 PROPERTY IDENTIFICATION, LOCATION AND PHYSICAL SETTING

The site identification details and associated information are presented in Table 2-1, while the site locality is shown in Figure 1.

Table 2-1 Site Identification, Location and Zoning

Attribute	Description
Street Address	155-157 Church Street, Ryde, NSW 2112
Location Description	Approximately 11 km north west of Sydney central business district, a square shaped block bound by Well Street (north), Church Street (east) and The Loop Road (south and west).
Site Area / GDA	Stages A of the development was approximately 0.04 hectares (3,952 m^2, from SIX maps, reference www.six.nsw.gov.au). Northern corner GDA Lat -33.821539545, Long: 151.096558689
Site Owner	Church Street Property Investments Pty Ltd, considered to be a subsidiary company of Holdmark Pty Ltd.
Lot and Deposited Plan (DP)	Lot 13 to 15 DP 738232, Lot 7 DP 809282 and Lot 100 DP 851723.
State Survey Marks	A State Survey Mark (SSM) is situated within the northern roundabout, at the intersection of The Loop Road and Well Street, being SS122866. (Source: www.six.nsw.gov.au)
Local Government Authority	City of Ryde Council
Parish	Hunters Hill
County	Cumberland
Current Zoning	B4 – Mixed Use (Ryde Draft Local Environment Plan, 2011)

At the time of this assessment, the site was occupied by 'Golf Cart World' a retail and service outlet for golf carts.

2.2 LOCAL LAND USE

The site is situated within an area of mixed use and current uses on surrounding land are described in Table 2-2.

Table 2-2 Local Land Use

Direction Relative to Site	Land Use Description
North	Well Street, following by the construction of a high density residential development and residential land uses beyond.
East	Church Street, followed by residential and recreational land uses.
South	The Loop Road as well as the Parramatta Valley Cycleway and Parramatta River.
West	The Loop Road, followed by high density residential land uses.

2.3 REGIONAL SETTING

Local ground topography, geology, soil landscape and hydrogeological information are summarised in Table 2-3.

Table 2-3 Topographical, Geological, Soil Landscape and Hydrogeological Information

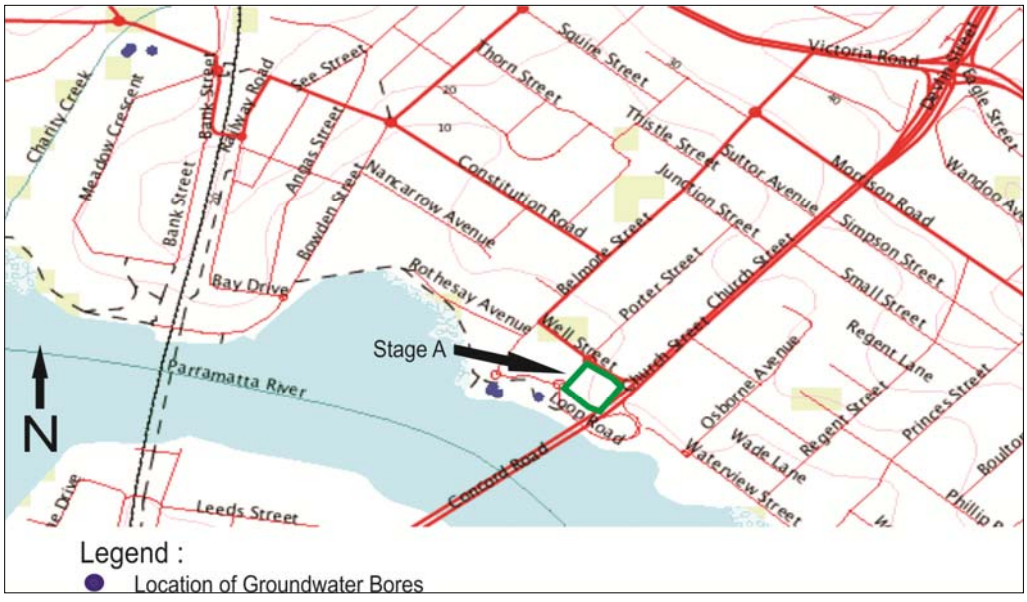
Attribute	Description
Ground Topography	The site is present at the edge of a ridgeline which descends to the south towards Parramatta River, from a RL of approximately 10 – 12 mAHD along the northern boundary of the site, to approximately 10 mAHD along the southern boundary (Ref: H Ramsay & Co. Pty Ltd Survey). The shores of Parramatta River are located directly to the south of the site, along with typical features of a marine estuary (sands, mangroves, exposed rock). The site topography is generally flat.
Site Drainage	Stormwater at the site appears to drain to the municipal stormwater system via onsite drainage. The land present at the north of the site was found vacant and covered with graded gravels. No drainage was apparent. Therefore within this part of the site it is expected that stormwater would discharge to land.
Regional Geology	The site is likely underlain by Hawkesbury Sandstone (*Rh)*. Hawkesbury Sandstone is described as medium to coarse-grained quartz sandstone, very minor shale and laminite lenses. Estuarine deposits may be present along the southern boundary of the site. *(Ref. 1:100 000 Geological Series Sheet 9130 – Sydney)*
Soil Landscapes	The Soil Conservation Service of NSW *Soil Landscapes of the Sydney 1:100,000 Sheet* (*Ref: Chapman and Murphy, 1989*) indicated that the site overlies the *Gymea (Gy*) erosional soil landscape. This landscape includes undulating to rolling rises and low hills on Hawkesbury Sandstone. With shallow to moderately deep *Yellow Earths* and *Earthy Sands* on crests and inside of benches, localised *Gleyed Podzolic Soils* and *Yellow Podzolic Soils* on shale lenses, and *Siliceous and Leached Sands* along drainage lines. Limitations of this soil profile include localised steep slopes, high soil erosion, rock outcrops, and shallow highly permeable soils with very low soil fertility.
Acid Sulfate Soil Risk	The *Acid Sulfate Soil Risk Map* (Ref: *Prospect_Parramatta 1:25,000 scale; Murphy, 1997*) indicates the subject land lies within the map class description of No Known Occurrence. The land is located on Hawkesbury Sandstone so no acid sulphate soil management is required. The *City of Ryde Council Draft Local Environmental Plan 2011- Acid Sulfate Soils Risk Class Map* indicates that the site lies within a Class 5 ASS area. Council consent is therefore required prior to commencing any works within 500m of Class 1, 2, 3 or 4 land, with a ground elevation of below 5m Australian Height Datum (AHD) and where the water table is likely to be lowered below 1m AHD on adjacent Class 1, 2, 3 or 4 land.

Attribute	Description
Soil Salinity Risk	Considering that the underlying bedrock comprises sandstone of the Hawkesbury Sandstone, EI considers that the salinity risk to the development is low (Ref: Salinity Potential in Western Sydney, 2002). Salinity testing of residual sandy clay soils in development Stages 6 to 9 indicated 'non sodic' soil conditions within residual soils, with an ESP value of 1.33%. Furthermore, the calculated salinity for this 'loam' unit was found to be 0.1 dS/m, classed as non-saline (*Site Investigations for Urban Salinity, Department of Land and Water Conservation, 2002).*
Typical Vadose Zone Soil Types	Thin surficial sandy fill overlying weathered sandstone.
Depth to Groundwater	Groundwater was encountered at 7.0 m BTOC during the groundwater investigation and based on local topography it is assumed to generally flow in a southerly direction, toward Parramatta River.
Groundwater Types	Groundwater is expected to occur in the underlying sandstone fractures and bedding planes and is expected to flow toward Parramatta River.
Nearest Water Body	Parramatta River is located approximately 60 meters (m) south of the site, which is considered to be the nearest receiving water body, and is considered to be marine and part of Sydney Harbour.

2.4 GROUNDWATER BORE RECORDS AND LOCAL GROUNDWATER USE

An online search of registered groundwater bores was conducted by EI on the 9 May 2014 through the NSW Natural Resource Atlas database (*Ref.* http://www.nratlas.nsw.gov.au). There were approximately 7 registered bores within about 1 km of the site, however no feature information was able to be obtained for any of these bores. Furthermore, all identified bores were generally located west and south-east of the main catchment area covered by the Shepherds Bay Concept Plan and are therefore cross-gradient from the groundwater flow direction of the site, as shown below in Photo 1. Due to the cross gradient location of these features, these are not considered receptors for any potential site contamination identified at the site. A bore location plan as well as the detailed information regarding the identified bores is attached in Figure 2.

Photo 1: NR Atlas Search map showing location of groundwater bores within 1 km radius of the site.



3 PREVIOUS ENVIRONMENTAL ASSESSMENT

In preparing this RAP, EI considered the following environmental reports:

- Environmental Site Assessment, Stage A of the Shepherds Bay Urban Renewal Project, EI report No. E2009 AC, dated 2 June 2014 (EI 2014a).
- Groundwater Investigation, Shepherds Bay Urban Renewal Project, Meadowbank, NSW 2112, EI report No. E2008 AS, dated 24 January 2014 (EI 2014b).

3.1 SUMMARY OF PREVIOUS INVESTIGATION FINDINGS

A summary of EI's environmental works and key findings is outlined in Table 3-1.

Table 3-1 Summary of Previous Investigation Works and Findings

Assessment Details	Project Tasks and Findings
Groundwater Investigation (EI, 2014a)	
Work Objectives	The objectives of the groundwater investigation were to evaluate the potential for site groundwater contamination on the basis of historical land uses, anecdotal and documentary evidence of possible pollutant sources, and to make recommendations as to whether further targeted groundwater assessment was required for any of the specific stages of the development, in accordance with Clause 39 and 40 of the Concept Approval of the Shepherds Bay Urban Renewal Project.
Scope of Works	• Review of the Concept Plan Application, Approval and associated technical documents including the preliminary contamination assessment reports; • Review of available topographical, geological, hydrogeological (including registered water bores), soil landscape and acid sulfate soil maps for the project area; • Review of selected historical aerial photographs archived at NSW Land and Property Information in order to review previous site use and the historical sequence of land development in the neighbouring area; • Review of existing contamination reports the main development stages (e.g. Stage 1, Stages 2 & 3 and Stages 4 &5); • Development of a preliminary conceptual site model (CSM) to assess potential receptors, migration and exposure pathways and risk of exposure; • A review of existing underground services on site and Dial Before You Dig (DBYD) searches; • A detailed site walkover inspection (carried out in conjunction with the various contamination assessment reports for the various stages); • Drilling and installation of 14 boreholes which were converted to monitoring wells (GW101 to GW114) located in a broad grid pattern across the site; • Well development, water level gauging and measurement of physio-chemical parameters to assess depth to water, the overall water quality and to allow interpretation of the groundwater flow direction; • Laboratory analysis of groundwater samples for relevant analytical parameters as determined from the site history survey and field observations during the investigation program; and • Data interpretation and reporting.

Assessment Details	Project Tasks and Findings
Conclusions (related to Stage A)	• The site was free of statutory notices issued by the NSW EPA. One notified site is located near the concept area and is the former Council depot located in Parsonage Street, Ryde; • Fourteen (14) groundwater monitoring wells were install over the site is a broad grid. Six (6) previous monitoring wells were also installed on the Stage 1 property (EI, 2013). The wells were installed to 9 and 12 m in depth. • Groundwater was encountered at depths ranging from 1.3 to 7.4 meters below top of casing, with groundwater flow expected to be toward Shepherds Bay. Groundwater is generally present in the underlying sandstone or within the alluvial/residual soil materials in the western third of the site; • Groundwater sampling identified Cadmium, Copper and Zinc concentrations exceeded fresh water and marine GILs in all wells, • Groundwater sampling identified Nickel concentrations exceeded fresh water and marine GILs in the majority of the wells except GW1, GW101 and GW105. • Groundwater samples identified Petroleum hydrocarbons compounds, PAHs, BTEX compounds and volatile organic compounds (trichloroethene, cis 1,2 dichloroethene and acetone) were detected at low concentrations in selected wells but the concentrations did not exceed aquatic protection or vapour intrusion HSLs • The heavy metals detected in the groundwater were considered to be a regional impact and therefore were considered a low risk to the environment. • The conceptual site model suggests that the main exposure pathway was to site workers during construction. It also considered that there was a low risk to surface water from the various heavy metals. • In summary and within the limitations of normal environmental assessments (Section 14), it is considered that there is a low risk of widespread groundwater contamination within the Shepherds Bay Urban Renewal Project. It is also considered that any groundwater impact is unlikely to prevent the redevelopment of the sites for residential and open space development.
Recommendations (related to Stage A)	• Completion of the individual staged environmental site assessments including WorkCover Dangerous Goods searches to assess potential for further underground or above ground contamination sources; • Completion of additional groundwater monitor wells and groundwater gauging and sampling in the additional stages to: - Assess the impact of the potential sources identified in 1) above; - Confirm or modify the existing conceptual site model based on any new of additional information (including any potential changes in groundwater flow direction); and - Assess whether dewatering or other hydraulic control measure are required for the construction of any basements particularly in Concept Plan Stages 6, 7, 8 and 9. Any future off-site disposal of site groundwater from site excavations, requires waste classification in accordance with the DECCW (2009) Waste Classification Guidelines or sampling and analysis against surface water quality guidelines for marine and Sydney Harbour Water Quality Objectives. • Preparation and implementation of a Remediation Action Plan for the Development Stages to outline the removal of any hotspot identified, as well as the known USTs and any unexpected finds; • Validate that the development areas are remediated in accordance with respective EPA guidelines; • Preparation of a final site validation report by a qualified environmental consultant, certifying site suitability for the proposed development; and • To assess the groundwater flow directions it is recommended that all new and existing wells be located and surveyed to Australian Height Datum and to Geocentric Datum of Australia 1994 (GDA94) (latitude and longitude) or Grid coordinates: (Map Grid of Australia 1994 (MGA94)) and water levels gauged by experienced environmental consultant.
Environmental Site Assessment (EI, 2014b)	

Assessment Details	Project Tasks and Findings
Work Objectives	In accordance with the Concept Approval (Clause 38) the proponent is required to undertake a detailed contamination assessment for any future development applications. The primary objectives of this ESA were therefore to: • Evaluate the potential for site contamination on the basis of historical land uses, anecdotal and documentary evidence of possible pollutant sources; and • To investigate the degree of any potential contamination by means of limited intrusive sampling and laboratory analysis, for relevant contaminants
Scope of Works	Desktop Study • A review of relevant topographical, geological, hydrogeological and soil landscape maps for the project area; • A review of the previous environmental reports readily available for the site; • Search of historical aerial photographs archived at NSW Land and Property Information in order to review previous site use and the historical sequence of land development in the neighbouring area; • A land titles search, also conducted through NSW Land and Property Information for information relating to site ownership; • Site history survey involving a detailed search of City of Ryde Council records for information relating to operational site history and/or relevant environmental incidents; • A search through the NSW EPA / OEH Land Information records to confirm that there are no statutory notices current on the site under the Unhealthy Building Land Act (1990) or the Contaminated Land Management Act (1997); • A search of the Stored Chemical Information Database (SCID) and microfiche records held by WorkCover NSW relating to possible underground tank approvals and locations; and • A review of existing underground services on site. Field Work • A detailed site walkover inspection; • Construction of test boreholes at nine preliminary locations (BH701 – BH709) distributed in a herringbone pattern across accessible areas of the site; • Multiple level soil sampling down to natural soils; • Laboratory analysis of selected soil samples for relevant analytical parameters as determined from the site history survey and field observations during the investigation program; and • Data interpretation and reporting
Conclusions	Based on the site history and limited intrusive investigations that: • WorkCover search revealed the presence of two underground storage tanks (UST's) at 157 Church Street, Ryde (Former Stuart Bros Pty Ltd yard), with evidence stating a single UST and associated infrastructure (i.e. vents, fuel lines and filling points) was abandoned using the concrete filling method. Evidence collected during the site walkover inspection suggests the second tank remains present at the site, and may have been used historically for the storage of kerosene, used for heating of the commercial building. As tanks remain, it is assumed no soil excavation or validation has taken place; • Results of soil samples collected from soil test boreholes BH701 - BH709 reported concentrations of the screened heavy metals to be below the adopted human health based SILs; • Results of soil sample BH702-1 was found to exceed the ecological criteria for Zinc (2,700 mg/kg), collected from within a residual clay material present at the north western corner of the site, within the car parking area. As the proposed development plans include removal of all soils within the Stage A site, for the construction of a basement car park, it is expected that these soils will be removed, therefore the application of the ecological criteria will not be realised at the site; • Heavy metal concentrations (i.e. copper and zinc) were found to exceed the GILs adopted for this assessment, within the majority of the groundwater wells present at the site. The identified elevated groundwater concentrations are considered to be within background fluctuations of naturally occurring

Assessment Details	Project Tasks and Findings
	levels for these heavy metals in the Sydney metropolitan groundwater catchment area, and it can be inferred that the detected groundwater levels of these heavy metals do not pose an immediate threat to human health or the environment; • Acetone was identified within all groundwater monitoring wells present at the site, however the concentrations identified were considered to be minor, and were present within the upstream well for the site. As the maximum concentration of acetone is present within the upstream well of the site, the source of this contaminant is therefore not present at the site itself, and is considered to be from an upstream, off-site source
Recommendations	• Preparation and implementation of a Remediation Action Plan to outline the removal of the USTs identified within the western and eastern parts of the site and any unexpected finds identified during construction; • Any material being removed from site (including virgin excavated natural materials or VENM) be classified for off-site disposal in accordance the DECCW (2009) Waste Classification Guidelines; and • Any material being imported to the site should be assessed for potential contamination in accordance with NSW EPA guidelines as being suitable for the intended use or be classified as VENM.

4 CONCEPTUAL SITE MODEL

In accordance with NEPM (2013) Schedule B2 – Guideline on Site Characterisation and to aid in the assessment of data collection for the site, EI developed a conceptual site model (CSM) assessing plausible pollutant linkages between potential contamination sources, migration pathways and receptors. The CSM provides a framework for the review of the reliability and useability of the data collected and to identify data gaps in the existing site characterisation.

4.1 CHEMICAL HAZARDS AND CONTAMINATION SOURCES

On the basis of site history and search findings (described in Section 3) EI consider potential chemical hazards and onsite contamination sources to be as follows:

- Buried pockets of waste or potential contaminating material within the fill soils of on-site.
- The potential presence of USTs on site at the locations indicated in Figure 2.
- Impacts from previous commercial manufacturing activities at the site.
- Hazardous materials, including identified asbestos and potential asbestos-containing materials (ACM) from building products.

4.2 CHEMICALS OF CONCERN

Based on the findings of the site contamination appraisal (EI 2014a & b) the potential contaminants at the site are considered to be:

- In soils – the potential presence of hydrocarbon impacted soils within the immediate vicinity of the UST's; and
- In groundwater – heavy metals (cadmium, copper, lead, nickel and zinc), acetone and potentially petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene and xylenes (BTEX) and poly aromatic hydrocarbons (PAH) associated with USTs.

4.3 CURRENT POTENTIAL EXPOSURE PATHWAYS AND RECEPTORS

Potential source-pathway-receptor linkages identified by EI and as shown in Figure 4-1 include:

- On site ingestion or dermal contact with impacted soils by on-site intrusive workers.
- Inhalation of vapours by on-site workers undertaking intrusive works originating from either impacted soils or groundwater.
- Migration of contaminants via the groundwater pathway to Parramatta River, which is the closest, potential environmental receptor located immediately down hydraulic gradient of the site.
- Inhalation of vapours by off-site residents originating from either impacted soils or groundwater.

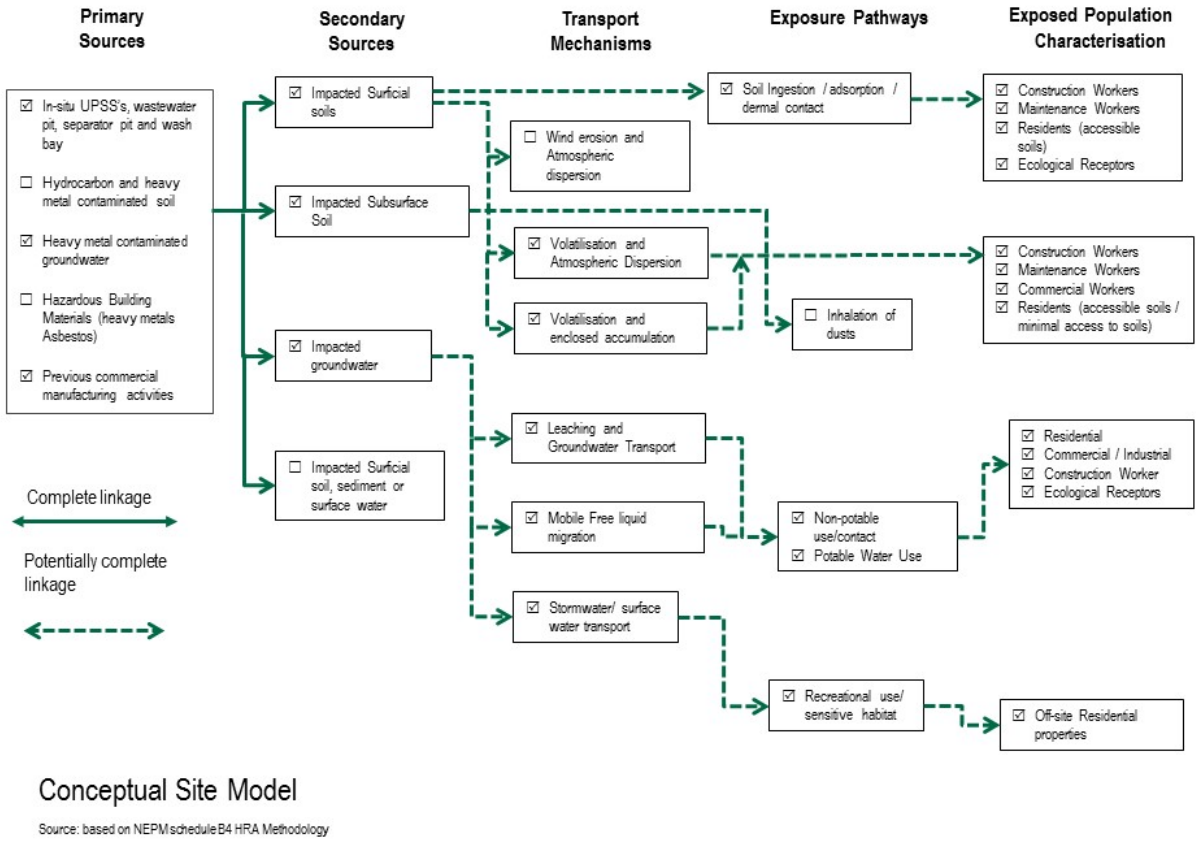


Figure 4-1 Conceptual Site Model for Stage A - 155-157 Church Street, Ryde, NSW

Based on surrounding land uses identified at the site, the closest human receptors for any site contamination are the occupants of the residential land uses, as well as the users of the recreational parks nearby. The closest environmental receptors for the site are the ecological communities within the Parramatta River (Shepherds Bay) as well as any ecological communities present within nearby parkland.

4.4 DATA GAPS

Based on the conceptual site model derived for the site, the following data gaps have been identified:

- Unknown type and concentration of contaminants within soils located within southern portion of the site, which were inaccessible during the ESA (EI, 2014b).
- Unknown type and concentration of contaminants within soils located adjacent and below to the potential USTs.
- Potential presence of hazardous materials used in building structures.

5 REMEDIATION GOALS AND ACCEPTANCE CRITERIA

5.1 REMEDIATION GOALS

The main goal of the remediation program is to remove primary and secondary contamination sources so as to render the site suitable for high density residential land uses.

This will require the decommissioning and removal for off-site disposal of underground tanks and associated infrastructure (i.e. wastewater and oil-water separator systems, wash bays and pits) and to remediate impacted soil and groundwater, where necessary.

5.2 EXTENT OF REMEDIATION REQUIRED

5.2.1 Expected Remedial Works

The investigations to date have identified areas which potentially require remediation in order to make the site suitable for the proposed residential (with minimal access to soil) and recreational public open space land uses. Based on the investigation findings, it was concluded that the extent of site remediation works necessary would be limited to the following actions:

- The undertaking of a ground penetrating radar screen at targeted areas across the site to determine if any USTs still remain on-site.
- If encountered, the removal of identified USTs and associated infrastructure, as well as any surrounding petroleum hydrocarbon-contaminated soils.
- Soil validation sampling and laboratory testing, following the complete removal of all USTs and affected fill/soil materials across the site.
- Determination of the requirement for an assessment of groundwater quality, should petroleum hydrocarbon-contaminated soils be identified in the soils surrounding the any identified USTs. This may include installation of additional groundwater monitoring wells.

5.2.2 Data Gap Closure Investigations

With reference to Section 4.4, the following data gap closure investigations will be carried out to achieve adequate site characterisation in previously inaccessible parts of the site and in areas where elevated chemical concentrations were identified in site fill soils:

- Prior to any partial demolition, a detailed hazardous materials survey should be undertaken on the remaining structures to identify any potential hazardous substances requiring management; and
- Following demolition of the buildings, soil sampling and laboratory analysis is to be conducted in the building footprints to achieve adequate site characterisation of these previously-inaccessible areas.

5.2.3 Potential Further Investigations

Although limited groundwater investigations have been conducted to date, should localised contamination of groundwater be suspected due to heavy TPH impacted soils being encountered during the UST removal process, the remediation program may need to be revised to include investigation of localised groundwater impacts.

5.3 Soil Remediation Options

In considering the remedial options available for the site, the following issues have been considered:

- The surrounding lands and the geological and hydrogeological characteristics.
- Prioritisation of works in areas of most concern.
- Ability of remedial method to treat contamination with respect to natural and infrastructure limitations.
- Remediation timetable.
- Cost effectiveness.
- Defensible method to ensure the site is remediated to appropriate levels / validation criteria.
- Monitoring and status of remedial works including risk based performance objectives.
- Regulatory compliance.

5.4 Review of Remedial Technologies

Options for abandoning insitu USTs are limited to abandonment in place by filling with an inert substance such as sand or cement or removal.

While several remediation technologies are presently available to address both the identified heavy metals impacts and potential hydrocarbon impacts posed by the presence of in-situ USTs. Selection and implementation of any remedial method depends initially on the proposed land use criteria to ensure protection of human health and the environment. Remedial options are then chosen by assessing the feasibility of each option to reach the clean-up goal and evaluating the costs and acceptability of the option. Remediation should also consider the concepts of ecologically sustainable development (ESD), which attempts to balance acceptable environmental risk/outcomes to the social and economic costs while protecting the biodiversity and heritage.

Several methodologies are currently available to address both hydrocarbon and heavy metal, contaminated soils, each with a number of advantages and disadvantages. It is likely that implementation of a combination of remedial management measures may be required, including:

- No action.
- Natural attenuation.
- Ongoing management.
- Capping and containment.
- Excavation and off-site disposal.

Note that no groundwater remediation has been assessed at present as preliminary assessments of groundwater quality indicate no widespread contamination. However, should hydrocarbon impacts be identified during the removal of the in-situ USTs, further assessment of groundwater may be required.

Advantages, disadvantages and suitability of available soil remedial technologies are summarised in Table 5-1.

Table 5-1 Remedial Technology Review – Soils

Remediation methodology	Description	Advantages	Disadvantages	Suitability
No Action	'No Action' can be considered if: • There is no measurable contamination; • Contaminant concentrations are below assessment guidelines; • Contaminants are not mobile; or • Exposure to contaminated soils is unlikely.	No remediation costs Creates minimal disturbance to the site Retains material on-site	It has been reported that there are several USTs on site. The removal of the USTs is required to make the site suitable for residential purposes. The contamination status of soils surrounding any USTs on site is unknown. Contamination would remain in situ allowing potential off-site migration of contamination and impacts on groundwater. Would pose limitations on land use options. Requires an Environmental Management Plan and ongoing monitoring.	As there are USTs that require removal the "do nothing" option is not considered to be suitable.
On-site bioremediation	Excavated soils are thoroughly broken down and aerated, mixed with microorganisms and nutrients, stockpiled and aerated in above ground enclosures.	Cost effective if soils are utilised on-site. Lower disposal costs. Limited requirement to import fill material to site. Retains material on-site.	It has been reported that there are several USTs on site. The removal of the USTs is required to make the site suitable for residential purposes. Undefined remediation timeframe. Potential for odour problems. Uncertainty of successful results, particularly for the heavy-end hydrocarbons.	As: • There are USTs that require removal; and • Excavation and off-site disposal of excess excavated material is required for construction of the proposed development; The "On-site bioremediation" option is not considered to be suitable.
Consolidation and/or capping	Risk minimisation approach where impacted soils are managed on-site by capping the ground surface with a clean, impermeable layer of fill material.	Effectively removes risk to human health by eliminating exposure pathways.	It has been reported that there are several USTs on site. The removal of the USTs is required to make the site suitable for residential purposes. Importance of maintaining integrity of capping materials. Contamination would remain in situ allowing potential off-site migration of contamination and impacts on groundwater.	As: • there are USTs that require removal; and • Excavation and off-site disposal of excess excavated material is required for construction of the proposed development; The "Consolidation and/or capping" option is not considered to be suitable.

Remediation methodology	Description	Advantages	Disadvantages	Suitability
			Would pose limitations on land use options. Requires an Environmental Management Plan and ongoing monitoring.	
Natural attenuation	Allowing the contaminants to biodegrade naturally following removal of the contamination source.	No remedial excavation of site. Retains materials on site. Sustainable, cost effective remediation method.	It has been reported that there are several USTs on site. The removal of the USTs is required to make the site suitable for residential purposes. Slow process. Potential for contamination to further impact on the groundwater aquifer and nearby environmental receptors. Would require Environmental Management Plan and ongoing monitoring.	As: • there are USTs that require removal; and • Excavation and off-site disposal of excess excavated material is required for construction of the proposed development; A "Natural attenuation" remedial option is not considered to be suitable.
Excavation and off-site disposal	Excavate impacted materials. Transport directly to a licensed landfill facility.	Fast – impacted material removed immediately, significantly reducing potential for impact to groundwater. No storage or treatment problems. Reduced vapour/odour issues as impacted materials removed from site. Minimal design and management costs.	Transfer of waste to another location (licensed waste facility). High costs associated with the disposal of waste soils. May require some additional testing (including TCLP) to enable waste classification prior to disposal.	As: • there are USTs that require removal; and • Excavation and off-site disposal of excess excavated material is required for construction of the proposed development; • This remediation option will not interfere with the construction timetable A "Excavation and off-site disposal of soils and USTs is considered to be a suitable remediation option.

5.5 SOIL CRITERIA

5.5.1 Soils to Remain On-Site

As the proposed site development shall comprise various uses, (including high density residential use), as shown in Figure 2, a number of different soil remediation criteria shall be adopted for the applicable areas of the site to be used as clean up levels. Soil remediation criteria are based on NEPM (2013):

- Residential A *Health Investigation Levels* for residential settings with gardens and accessible soil (including child care centres, preschools and primary schools);
- *Residential B Health Investigation Levels* for residential settings with minimal opportunities for soil access (including dwellings with fully and permanently paved yard space such as high-rise buildings and apartments); and
- *Recreational C Health Investigation Levels* for recreational settings with recreational public open space such as parks, playgrounds, playing fields, secondary schools and footpaths.

Ecological investigation levels for the protection of terrestrial ecosystems – urban residential and recreational public open space shall be adopted for landscaped areas. These thresholds are presented in NEPM (2013) Schedule B1 *Guideline on Investigation Levels for Soil and Groundwater.* The proposed criteria with respect to the potential contaminants of concern in soils are detailed in Table 5-2 Soil Remediation Criteria.

Table 5-2 Soil Remediation Criteria

Chemical	Unit	PQL	HILs/HSLs Residential A	HILs/HSLs Residential B	HILs/HSLs Recreational C	ESLs[2] & EILs[3]
			Metals			
Arsenic – As	mg / kg	3	100	500 / 100 (EIL[5])	300 / 100	100
Cadmium - Cd	mg / kg	0.3	20	150	90	
Chromium(VI) – Cr(VI)	mg / kg	0.3	100	500	300	415
Copper – Cu	mg / kg	0.5	6,000	30,000	17,000	210
Lead – Pb	mg / kg	1	300	1,200	600	1,100
Mercury – Hg (inorganic)	mg / kg	0.01	40	120	80	
Nickel – Ni	mg / kg	0.5	400	1,200	1,200	75
Zinc – Zn	mg / kg	0.5	7,400	60,000	30,000	180
Cyanide (free)	mg/kg	1	250	300	240	
			Petroleum Hydrocarbons			
F1*	mg / kg	25	45 (0m - <1m)[1] 70 (1m - <2m) 110 (2m - <4m) 200 (4m+)		NL	180
F2**	mg / kg	25	110 (0m - <1m)[1]		NL	120

Chemical	Unit	PQL	HILs/HSLs Residential A	HILs/HSLs Residential B	HILs/HSLs Recreational C	ESLs[2] & EILs[3]
			240 (1m - <2m) 440 (2m - <4m) NL (4m+)			
F3 (>C16-C34)	mg / kg	90	2,500	2,500	2,500	300
F4 (>C34-C40)	mg / kg	120	10,000	10,000	10,000	2,800
Polycyclic Aromatic Hydrocarbons						
Naphthalene	mg / kg	0.1	3[1]	NL	NL	170
Benzo(α)pyrene	mg / kg	0.1	1	1	1	0.7
Carcinogenic PAHs (as B(α)P TEQ)***	TEQ	0.2	3	4	3	
Total PAHs	mg / kg	0.8	300	400	300	
Phenols	mg / kg		3,000	45,000	40,000	
Monocyclic Aromatic Hydrocarbons (BTEX)						
Benzene	mg / kg	0.1	0.5[1]	0.5[1]	NL	50
Toluene	mg / kg	0.1	160 (0m - <1m), 220 (1m - <2m) 310 (2m - <4m) 540 (4m+)		NL	85
Ethyl benzene	mg / kg	0.1	55	NL	NL	70
Xylenes (total)	mg / kg	0.3	40 (0m - <1m), 60 (1m - <2m) 95 (2m - <4m) 170 (4m+)		NL	105
Asbestos HSLs[4]						
Bonded Asbestos	w / w		0.01%	0.04%	0.02%	
Friable Asbestos (FA & AF) [6]			0.001%	0.001%	0.001%	
All forms of Asbestos			No visible in surface soils	No visible in surface soils	No visible in surface soils	

Notes:
Residential A = NEPM 2013, HILs / HSLs for Private Garden Areas (Residential with Accessible Soils)
Residential B = NEPM 2013, HILs / HSLs Remaining Site Areas (Residential with Minimal Access to Soil)
Recreational C = NEPM 2013, HILs / HSLs Recreational Site Areas (Public Open Space)
* = To obtain F1 subtract the sum of BTEX concentrations from the C_6-C_{10} fraction.
** = To obtain F2 subtract Naphthalene from the >C_{10}-C_{16} fraction.
*** = Carcinogenic PAHs HIL is based on the 8 carcinogenic PAHs and their TEFs (potency relative to Benzo(α)pyrene) – ref. footnote (6) of NEPC (2013) *Schedule (B1)* Table 1A(1) for further details.
[1] = Soil Health Screening Levels (HSLs) developed for selected petroleum compounds and fractions, applicable to assessing human health risk via the inhalation and direct contact pathways, ref. NEPC (2013) *Schedule B1* Table 1A(3).

[2] = Ecological Screening Levels (ESLs) developed for selected petroleum hydrocarbon compounds and total recoverable hydrocarbon (TRH) fractions, applicable for assessing risk to terrestrial ecosystems (apply to top 2m of soil), ref. NEPC (2013) *Schedule B1* Table 1B(6).
[3] = Environmental Investigation Levels (EILs) generic values for aged As, fresh DDT and fresh naphthalene in soils irrespective of their physicochemical properties (apply to top 2m of soil), ref. NEPC (2013) *Schedule B1* Table 1B(5).
[4] = Health Screening Levels (HSLs) for asbestos contamination in soil, ref. NEPC (2013) *Schedule B1* Table 7.
Relevant HSLs, ESLs and EILs values will be adopted based on site specific aspects and conditions.
[5] = Health Screening Levels (HSLs) for sand based on the assumed maximum depth of basement excavation, ref. NEPC (2013) Schedule B1 Table 7. Relevant HSLs, ESLs and EILs RAC values will be adopted based on site specific aspects and conditions.
[6] = FA – Fibrous Asbestos, AF – Asbestos Fines (Ref. NEPM 2013, Schedule B1, Table 7).
NR = no registered criteria value. ND = 'none detected' NL – Not limiting

Conformance with the criteria will be deemed to have been attained when either all validation samples show contaminant concentrations that are below the specified criteria, or, as a minimum, the 95% upper confidence limit (UCL) mean concentration values of each contaminant in the remediated area (i.e. across the excavated surface), are below the respective remediation criteria. Note the standard deviation of all results shall be less than 50% of the relevant criteria and no single sample shall exceed the relevant criteria by more than 250%.

5.5.2 Excavated Soils Intended for Off-Site Disposal

Prior to being removed from the site, excavated soils must be classified in accordance with the DECCW (2009) *Waste Classification Guidelines* (the 'Waste Guidelines'). Under these guidelines, soils may be classified into the following groups: *General Solid Waste, Restricted Solid Waste* or *Hazardous Waste*, subject to laboratory test results for total and leachable contaminant levels, the later involving the *Toxicity Characteristics Leaching Procedure* (TCLP). In order to classify the waste, the total contaminant concentrations and TCLP results for each parameter will be compared against the respective Waste Guidelines thresholds (*Ref*. Tables 5-3 and 5-4). Soils containing asbestos may also be classified as *Special Waste (Asbestos Waste)*, assuming no other contaminant is present at such a level as to render the material *Restricted Solid Waste* or *Hazardous Waste*.

Table 5-3 Contaminant Thresholds for Waste Classification without Leachate Testing

Contaminant	Maximum Values of *Specific Contaminant Concentration* for Classification without TCLP	
	General Solid Waste CT1 (mg/kg)	Restricted Solid Waste CT2 (mg/kg)
Arsenic	100	400
Benzene	10	40
Benzo(a)pyrene	0.8	3.2
Cadmium	20	80
Chromium (VI)	100	400
Ethyl benzene	600	2400
Lead	100	400
Mercury	4	16
Nickel	40	160
Toluene	288	1152
Xylenes (total)	1000	4000

Table 5-4 Waste Classification using TCLP and SCC Values

Contaminant	Maximum Values for *Leachable Concentration* and Specific Contaminant Concentration when used together			
	General Solid Waste		*Restricted Solid Waste*	
	Leachable Concentration	Specific Contaminant Concentration	Leachable Concentration	Specific Contaminant Concentration
	TCLP1 (mg/L)	SCC1 (mg/kg)	TCLP2 (mg/L)	SCC2 (mg/kg)
Arsenic	5.0	500	20	2000
Benzene	0.5	18	2	72
Benzo(a)pyrene	0.04	10	0.16	23
Cadmium	1.0	100	4	400
Chromium (VI)	5	1900	20	7600
Ethylbenzene	30	1080	120	4320
Lead	5	1500	20	6000
Mercury	0.2	50	0.8	200
Nickel	2	1050	8	4200
TRH C_6-C_9	N/A	650	N/A	2600
TRH C_{10}-C_{36}	N/A	10000	N/A	40000
Phenol (non-halogenated)	14.4	518	57.6	2073
PAHs (total)	N/A	200	N/A	800
Xylenes	50	1800	200	7200

Note: N/A = not applicable (assessed using SCC1 and SCC2 values, only)

Should the analytical results exceed the SCC2 and/or TCLP2 thresholds, then the materials will be classified as *Hazardous Waste*. In such cases, material stabilisation treatment with EPA approval may be required for offsite disposal. This approach is discussed in more detail under the contingency plan in Section 8.

5.6 GROUNDWATER CRITERIA

For the further investigation of groundwater at the site and given the proximity of the site to the Parramatta River, which is subject to tidal influences, analytical results for groundwater will be assessed against the following criteria:

- NEPM (2013) Groundwater Investigation Levels for the protection of Marine Waters.
- NEPM (2013) Groundwater Investigation Levels for the protection of Fresh Waters (where NEPM 2013 does not provide Marine water criteria).
- NEPM (2013) Groundwater Investigation Levels for the protection of Drinking Water (where NEPM 2013 does not provide Marine or Fresh water criteria).

5.7 DATA QUALITY OBJECTIVES

In accordance with the USEPA (2006) *Data Quality Assessment* and the DEC (2006) *Guidelines for the NSW Site Auditor Scheme*, the process of developing Data Quality Objectives (DQO) was used by the EI assessment team to

determine the appropriate level of data quality needed for the specific data requirements of the project. The DQO process that was applied for this assessment is documented as follows:

(a) State the Problem

The site is to be developed for mixed land use including multi-storey residential apartments with recreational public open space and basement car parking. There are several locations which potentially contain USTs. In addition concentrations of metals in several locations exceeded the environmental investigation levels.

Given the potential presence of the USTs the site is currently considered unsuitable for redevelopment.

The presence or absence of the USTs must be confirmed and if present the USTs and concentrations hydrocarbons and /or metals in impacted soil and groundwater must be made suitable for the proposed development.

Following bulk excavation of the site to allow for construction of the basement car park, confirmation that the site is suitable for the propose development is required.

A conceptual site model based on existing information is provided in Section 4.

(b) Identify the Decision

Investigations are required to determine if USTs are present, if they are present they are to be removed along with any hydrocarbon impacted soils and validation sampling undertaken to confirm that any contamination has been removed, the soils have been removed off site with appropriate waste classification and the site is suitable for the intended development.

Validation sampling of all areas subject to bulk excavation works is to be undertaken to confirm that any contamination has been removed, the soils have been removed off site with appropriate waste classification and the site is suitable for the intended development.

The completeness of the remediation works will be determined by the further assessment and the subsequent validation analyses. Remediation will be deemed to be complete when all validation samples of any remedial work meet the remediation criteria, and/or when the remediation goals have been attained (e.g. the contamination risk is reduced to acceptable levels). The required decisions are therefore related to answering the following two questions:

- Is the soil and groundwater quality suitable for the proposed land use? and
- Will site soils and groundwater require further remediation and/or special management before the site can be used for residential purposes?

(c) Identify Inputs to the Decision

Inputs to the decision will include:

- Ground penetrating radar outputs.
- Additional sampling and analysis.
- Soil validation sampling of any remedial works.

- Systematic soil validation sampling from remediated excavation surfaces.
- Sampling from stockpiled material for waste classification.
- Laboratory analytical results for tested validation samples.
- Assessment of analytical results in relation to the remediation criteria.

(d) Define the Boundary of the Assessment

Lateral - The boundary of the assessment is defined by the boundary of the subject site.

Vertical – as the depth of the proposed basement has not been confirmed, the vertical extent of the study will be to the maximum depth necessary to remove the USTs from existing ground level.

Temporal – the findings of this assessment will hold true for as long as the site use remains passive in nature; that is, for as long as the site is used for residential, commercial and public, recreational open space land uses and there are no activities taking place onsite or on the immediately adjacent properties that may compromise onsite environmental conditions.

(e) Develop a Decision Rule

Laboratory test results will be assessed against the adopted remediation criteria for soils remaining on site, and against SCC/TCLP thresholds for waste classification for soils to be disposed off-site. Should the remediation criteria be exceeded then additional excavations and/or investigations will be required to delineate vertical and lateral extent of contamination. Laboratory test results will be accepted if:

- All contracted laboratories are accredited by NATA for the analyses undertaken.
- All detection limits fall below the remediation criteria.
- Analyte concentrations in rinsate (i.e. blank) samples do not vary significantly from concentrations in the distilled water used for equipment rinsing.
- RPDs for duplicate samples are within accepted limits.
- Laboratory QA/QC protocols and results comply with NEPM requirements.

Further decisions are also required following the additional assessment. This may require updating of the RAP to include soil gas (soil vapour) and groundwater remediation or management.

(f) Specify Acceptable Limits on Decision Errors

The remediation consultant must identify the potential decision errors, evaluate the potential consequences and severity of decision error consequences, define the null hypothesis and specify what level of false positive or false negative decision error will be acceptable for the validation assessment. Details are to be presented in the final validation assessment report.

Specific limits for this project are to be in accordance with the appropriate NSW EPA guidance, appropriate indicators of data quality and standard procedures for field sampling and handling. Tolerable limits will be quantified as follows:

- Sampling on a 20 m grid will allow detection of a circular hotspot with a nominal diameter of 23.5 m with 95% certainty.
- The acceptance of the site as validated will be based on the probability that the 95% Upper Confidence Limits (UCL) of the data will satisfy the given site criteria. Therefore a limit on the decision error will be 5% that a conclusive statement may be incorrect.

Soil and groundwater concentrations for chemicals of concern that are below investigation criteria made or approved by the NSW EPA will be treated as acceptable and indicative of suitability for the proposed land use(s).

(g) Optimise the Design for Obtaining Data

In order to identify the most resource-effective sampling and analysis design for general data that are expected to satisfy the DQOs:

- Written instructions will be used to guide field personnel in the required fieldwork activities.
- Representative soil samples will be collected from the USTs excavations and analysed to allow characterisation of soils. A review of the results will be undertaken to determine if additional sampling is warranted. Additional investigations would be considered to be warranted where soil concentrations are found to exceed remediation criteria endorsed by the NSW EPA, relevant to the proposed land use(s).
- In order to facilitate the development and prevent unnecessary delays due to rework (in case of failed validation samples) the builder/subcontractor responsible for excavation works will be required to liaise closely with the environmental consultant as to required turnaround time for samples.

6 REMEDIATION STRATEGY & REGULATORY COMPLIANCE

6.1 PREFERRED REMEDIATION STRATEGY

Based on the assessment of remedial technologies, the potential risks to human health and the environment, and considering the cost effectiveness of each remedial technique, the preferred remedial strategy for the sites is excavation and off-site disposal to be undertaken in stages and involves:

- A hazardous materials assessment conducted on the on the remaining buildings prior to any demolition;
- Site demolition to allow further assessment;
- A Ground Penetrating Radar survey of areas potentially containing USTs;
- Removal of sources of contamination by decommissioning and appropriate off-site disposal of site infrastructure, including all, underground petroleum storage systems,
- Classification and disposal of all wastes (including contaminated soils) by licensed transport to approved/licensed, off site, waste facilities;
- Validation sampling of the bulk excavation areas of the site based on an 20 m grid and
- Remediation of the impacted soils (where required) using a combination of the following:
  - Excavation and disposal of impacted soils to a licensed landfill facility;
  - Excavation and on-site separation of highly impacted soils (where concentrations exceed criteria for classification as restricted solid waste) for additional waste classification prior to disposal; and

Material derived from the site, including contaminated soil, rock and fill would be removed by truck to a suitable licenced disposal facility or recycled if classified as virgin excavated natural material (VENM) or excavated natural material (ENM) in accordance with the general waste exemptions (DECCW, 2009). The potential environment impacts relating to the demolition, remediation and offsite disposal are discussed further in Section 11.

As groundwater impacts have not yet been confirmed, remedial action for groundwater at the site is not proposed at this stage, but may be considered at a later stage if warranted.

6.2 REGULATORY COMPLIANCE

Remediation work which requires development consent is known as Category 1 work. Category 1 refers to work:

- Classed as *designated development* under Schedule 3 of the EPA&A Regulation or under a planning instrument;
- Proposed on land identified as critical habitat under the Threatened Species Conservation Act 1995;
- Where consideration of s. 5A of the EP&A Act indicates remediation work is likely to have a significant effect on threatened species, populations, ecological communities or their habitats;
- Proposed in an area or zone identified in a planning instrument as being an area of environmental significance such as scenic areas, wetlands; and
- Requiring consent under another state environmental planning policy or a regional environmental plan.

All other remediation work is classified as Category 2 works, which may be carried out without development consent. Since the proposed site development is not covered under any of the above prerequisites, it is considered to be Category 2 Remediation Work.

The following notifications, licenses and approvals will be required to undertake the site remediation works:

- Council approval of the RAP document and notification for Category 2 remediation works (i.e. 30 days' notice prior to works commencement);
- Notification of tank disposal under UPSS and WorkCover regulations,
- Provision of tank validation report to NSW EPA within 60 days of the completion of remedial works in accordance with the UPSS regulations (2014); and
- Documentary receipts and evidence of disposal of classified waste fill/soils at an appropriately-licensed landfill facility. NSW EPA require a cradle to grave approach in the management of waste. Non-compliance with the waste guidelines can result in significant fines in accordance with the NSW Protection of the Environment Operations Act.

7 REMEDIATION METHODOLOGY

Details on the methodology to be employed for the key work tasks are described below. They will not necessarily be conducted in the indicated sequence. Sequence of remediation will be based on the work schedule of the relevant stakeholders, and will be completed in conjunction with the site development works.

7.1 TASK 1 – SITE PREPARATION AND LICENCES / APPROVALS

At least 30 days prior to the commencement of remediation, notice shall be given to Ryde City Council. A list of all required work permits will be obtained from Council and arrangements are to be made to obtain the necessary approvals from the relevant regulatory authorities.

The site itself will be prepared in accordance with the requirements of the Environmental Management Plan outlined in Section 11.

Once cleared, a thorough walkover inspection of the site shall be conducted, to assess for visible evidence indicating the presence of UPSS and/or contamination.

7.2 TASK 2 – ADDITIONAL INVESTIGATION WORKS

The results from the assessment phase (EI, 2014) indicated that up to two abandoned USTs are present on site, possibly resulting in petroleum hydrocarbon contamination of nearby fill soils. A geophysical survey utilising a combination of investigation methodologies including a ground penetrating radar and hand excavation; using a hand auger should be conducted in the areas of suspected tanks by a suitable, qualified contractor, in order to confirm the exact position of known underground tanks and infrastructure, as well as to survey for any additional, unknown (or forgotten) UPSS that may still be present on the site.

The required approximate locations for the GPR search are shown on Figure 3.

7.3 TASK 3 – UNDERGROUND PETROLEUM STORAGE SYSTEMS (UPSS)

If USTs are identified residual liquids may be present within the underground tanks, product lines, pits and drains that remain on the site. Any liquid waste should be removed and classified for disposal purposes as defined in NSW DECCW (2009) waste guidelines.

The following methodology is proposed for these areas, as well as any other UPSS which may be subsequently encountered during the data-closure investigations and site remediation phase:

- Appropriate decommissioning and removal the UPSS in accordance with:
  - AS4976 – 2008, Australian Standard for the removal and disposal of underground petroleum storage tanks;
  - POEO (Underground Petroleum Storage System) Regulations (2014); and
  - NSW WorkCover and other requirements under the Work Health and Safety Act and associated regulations.
- Field screening of soil samples collected from the base and side walls of the final excavations in accordance with EPA (2014) *Technical Note: Investigation of Service Station Sites*, during which, a portable photo-ionisation

detector (PID) will be used as a field screening tool to provide indicative (semi-quantitative) data in relation to VOC concentrations in soil headspace samples, together with visual and olfactory observations.

- Validation samples will be collected from excavation surfaces (walls and bases) for laboratory analysis for petroleum hydrocarbons, BTEX, PAHs and heavy metals.

Petroleum hydrocarbon impacted soils are to be stockpiled separately from other site fill/soils, for ex-situ, waste classification assessment. Water that may collect within remedial excavations will require water sampling and testing to enable appropriate disposal and /or recycling.

7.4 TASK 4 – SITE WIDE FILL LAYERS

The following methodology is proposed for bulk natural soil excavations, as part of the construction of the basement car parking facilities:

- After removal of any USTs identified during the GPR search, (as described in Section 7.2), bulk excavation of the remaining soils may be commenced as necessary to allow for the construction of the basement level;
- A waste classification certificate will be prepared for bulk excavated material by the environmental consultant; however, the construction contractor must establish a material tracking system as part of a site-specific waste soil management plan, to ensure appropriate documentation of material disposal and final reporting;
- It is preferable to excavate and load materials directly onto waste soil transport vehicles; however, should temporary stockpiling be required due to the discovery of unexpected finds (i.e. potentially contaminated materials) stockpiles, once sampled for laboratory testing and waste classification, must be quarantined (i.e. no additional material may be added) until it is removed from the site;
- Any material excavated which exhibits signs of potential contamination (i.e. odours, sheen, fragments of potential asbestos-containing material, or unusual colours) is to be stockpiled separately and prevented from mixing with 'clean' excavated material and examined by the environmental consultant who will determine if additional characterisation prior to off-site disposal is required; and
- Residual soils may be able to be classified as Excavated Natural Material (ENM) or virgin excavated natural materials (VENM) depending on analytical results for the suspected contaminants. Both ENM and VENM can be reused or recycled, however, the environmental consultant must be involved with this process to ensure appropriate documentation and reporting in accordance with NSW EPA Waste compliance regulations.

7.4.1 Excavation Considerations

Excavation depths should be in accordance with DA conditions. If further excavation is required, it should not jeopardise the stability of adjoining properties and structures.

7.4.2 Stockpiling of Contaminated Material

Due to the volume of soil to be excavated and removed from site, soils should be segregated and stockpiled by material type and sampled further to allow preparation of a waste classification certificate for off-site disposal.

All stockpiles of contaminated material (≤2m height) must either be placed within a plastic lined, bunded area and covered with weighted plastic sheeting at the end of each day. On-site stockpiles of potentially contaminated material must be stockpiled as above if on remediated areas, but lining is not required if stockpiles are placed on yet to be remediated areas. Furthermore, stockpiles should be surrounded by star pickets and marking tape, or other suitable

material, to clearly delineate their boundaries. Stockpiles shall be lightly conditioned by sprinkler to prevent dust blow. Should the stockpile remain *in-situ* for over 24 hours, silt fences or hay bales should be erected around each stockpile to prevent losses from surface erosion (runoff).

7.5 TASK 5 – WASTE CLASSIFICATION OF STOCKPILED FILL/SOILS

Prior to being assigned to an appropriate waste disposal facility, all waste fill/soils will be classified in accordance with the DECCW (2009) *Waste Classification Guidelines.* If prior immobilisation treatment of the waste soils is required, disposal consent will be obtained from the NSW EPA prior to spoil transport.

All excavated soils shall be stockpiled separately within the designated excavation area, or transported to a suitable compound (with appropriate waste tracking documentation) for temporary storage, to enable waste classification sampling and testing. All stockpile heights must be limited to a maximum of 2 m. After waste classification, the materials will be transported and disposed to EPA-licensed, waste landfill facilities.

In accordance with the NEPM (2013) guidelines, stockpiled fill/soils will be sampled and laboratory analysed for waste classification purposes in accordance with the following methodology:

- Collection of one sample per 25 m^3 of stockpiled material for the fill/soils produced by the UST excavation
  - Note: a minimum of three samples per stockpile will be collected;
- Collection of one intra-laboratory duplicate for every 20 primary samples collected and one inter-laboratory duplicate for every 20 primary samples collected;
- Collection of one rinsate blank per sampling round;
- Analysis of all samples for heavy metals (including lead), TRHs, BTEX and PAHs; and
- Preparation of a Waste Classification Certificate detailing the interpreted soil waste classification for each stockpile, to enable appropriate off-site disposal.

The proposed sampling plan may be varied due to site constraints; however guidance from the appointed Environmental Project Manager must be sought to ensure that deviations from this RAP are properly documented, as required under the OEH (2011) guidelines. Where anomalies in fill/soil consistency are noted (such as heavy staining, odour and/or presence of waste or oils), additional sampling and analysis may be necessary and guidance in this regard should be sought from the appointed Environmental Project Manager.

If the stockpiled materials contain concentrations of contaminants that exceed the disposal guidelines for *Restricted Solid Waste* (i.e. the materials are classed as potentially *Hazardous Waste*), they will be held on-site pending the determination of alternative disposal arrangements and/or on-site treatment. If required, disposal consent will be sought from the EPA NSW prior to spoil transport. Contingency measures to handle and manage the disposal of spoil materials that fail to meet landfill threshold criteria are provided in Section 8.

7.6 TASK 6 – OFF-SITE DISPOSAL OF FILL/SOILS

Classified fill/soils that are deemed suitable for disposal shall be loaded onto EPA-licensed waste vehicles for transport to the designated landfill facility. Waste transport contractors must carry a copy of the relevant Waste Classification Certificate with every transported load. Other important requirements are as follows:

7.6.1 Loading and Transport of Contaminated Material

Direct loading of contaminated fill / soils to appropriate transport vehicles is preferred, with the transport of contaminated material off the site to be via a clearly distinguished haul route. Removal of waste materials from the site shall only be carried out by a recognised contractor holding the appropriate EPA NSW licenses, consents and approvals.

Details of all contaminated materials removed from the site shall be documented by the contractor with copies of weighbridge slips, trip tickets and consignment disposal confirmation (where appropriate). Such information should be provided to the remediation consultant for reporting purposes. A site log shall be maintained by the contractor for each discrete excavation (numbered locations) to enable the tracking of disposed loads against on-site origin and location of the materials and corresponding (validation) sample numbers.

Measures shall be implemented to ensure no contaminated material is spilled onto public roadways or tracked off-site on vehicle wheels. Such measures will include the deployment of a vehicle washing/cleaning facility, which should be placed at a location before the egress point on the site. The facility shall be able to handle all vehicles and plant operating on-site.

All trucks transporting soils from the site are to be covered with tarpaulins (or equivalent).

Residue from the cleaning facility will be collected periodically and either dewatered on site in a contained bunded area or disposed as a slurry to an approved facility. Such residue will be deemed contaminated unless shown by validation to be below criteria.

The proposed waste transport route will be notified to Council and truck dispatch shall be logged and recorded by the contractor for each load leaving the site.

7.6.2 Disposal of Contaminated Material and Waste Tracking

All contaminated materials excavated and removed from the site shall be disposed at an appropriately licensed landfill facility. Copies of all necessary approvals shall be provided to the remediation consultant prior to any contaminated material being removed from the site.

Copies of all consignment notes (issued as dockets or similar) for the transport, receipt and disposal of the materials will be maintained as part of the site log and made available to the remediation consultant for inspection and use in reports upon request.

All relevant analysis results shall be made available to the remediation contractor to enable selection of a suitable disposal location.

7.7 TASK 7 – CERTIFICATION OF IMPORTED BACKFILL MATERIAL

Should soils be required to backfill excavations, the imported filling material is to be certified as meeting the criteria by the supplying contractor. Analytical results presented by the contractor to validate imported filling must be derived using NATA-accredited methods, obtained on representative samples that were collected at an appropriate frequency (e.g. 1 sample per 25 m^3). All imported clean fill validation results must be included in the final site validation report.

Should excavated materials be identified to be potentially uncontaminated, or potentially suitable for reuse on the subject site, the following confirmation procedure shall be undertaken:

- The identified material is to be visually assessed to determine whether the material can be physically isolated from other potentially contaminated material;
- Should it be found that isolation on a visual basis is feasible, the identified 'clean' materials shall be stockpiled separately in a demarcated area, which is either concrete-paved, or lined with an impermeable membrane;
- Verification sampling and analysis shall be conducted on the isolated material at a nominal minimal frequency of one sample per $25m^3$; and
- Subject to analytical results showing TRH and BTEX and/or heavy metal concentrations that are within the criteria, isolated 'clean' materials may then be reused as filling material on-site, along with any additional imported and validated backfill materials.

NOTE: Before any soil or rock materials are imported onto the site under the VENM classification for backfilling purposes, supporting documentation must be submitted for review by the appointed Environmental Project Manager for approval.

8 CONTINGENCY MANAGEMENT AND MEASURES

8.1 CONTINGENCY MANAGEMENT

Contingency plans for anticipated problems that may arise on-site during the course of the site preparation works comprising demolition and remediation are presented below in Table 8-1.

Table 8-1 Contingency Management Plans

Anticipated Problems	Corrective Actions
Chemical/ fuel spill	Stop work, notify above site project manager. Use accessible soil or appropriate absorbent material on site to absorb the spill (if practicable). Stockpile the impacted material in a secure location, sample and determine the appropriate disposal/treatment option.
Excessive Dust	Use water sprays to suppress the dust or stop site activities generating the dust until it abates.
Excessive Noise	Identify the source, isolate the source if possible, modify the actions of the source or erect temporary noise barriers if required.
Excessive Odours/Vapours	Stage works to minimise odours/vapours. If excessive organic odours/vapours are being generated, stop works and monitor ambient air across site for organic vapours with a PID and odours at site boundaries. Implement control measures including respirators for on-site workers, use of odour suppressants, wetting down of excavated material.
Excessive rainfall	Ensure sediment and surface water controls are operating correctly. If possible divert surface water away from active work areas or excavations.
Water in excavations	Collect samples and assess against relevant NSW DECCW *Waste Classification Guidelines (2009)* assessment criteria, to enable disposal options to be formulated.
Leaking machinery or equipment	Stop the identified leak (if possible). Clean up the spill with absorbent material. Stockpile the impacted material in a secure location, sample and determine the appropriate disposal/treatment option.
Failure of erosion or sedimentation control measures	Stop work, repair failed control measure.
Unearthing unexpected materials, fill or waste	Stop activities, contact the site project manager. Prepare a management plan to address the issue.
Identification of cultural or building heritage items	Stop work and notify site project manager. Prepare action or conservation plan as required.
Equipment failures	Ensure that spare equipment is on hand at site, or that the failed equipment can be serviced by site personnel or a local contractor.
Complaint Management	Notify Client, Project Managers and Environmental Consultant (if required) following complaint. Report complaint as per management procedures. Implement control measures to address reason of complaint (if possible). Notify complainant of results of remedial actions.

8.2 REMEDIAL CONTINGENCIES

At this stage it is anticipated that the proposed remedial technologies should be effective in dealing with the contamination present, however remedial contingencies may be required should the scenarios detailed in the Table 8-2 arise.

Table 8-2 Remedial Contingencies

Scenario	Remedial Contingencies/Actions Required
Highly contaminated soils not identified during previous investigation are encountered, particularly at site boundaries.	Work to be suspended until the Environmental Project Manager can further assess impacted soils/ materials and associated risks.
Highly impacted material identified in rock joints/discontinuities.	Additional assessment may be required to assess depth of impact and migration pathways.
Additional underground systems are encountered at the site.	Systems to be removed and the excavations appropriately validated and backfilled by experienced contractor. Tank removal works reported by appropriate environmental consultant in accordance with DEC guidelines.
Highly impacted sludges are located in "cleaned" UPSSs or during concrete removal works.	The leachability of the lead, other heavy metals and hydrocarbons will need to be assessed before disposal options are considered.
Asbestos wastes are encountered.	Work to be suspended and asbestos work removed by a suitably qualified contactor, in accordance with WorkCover regulations.
Residual soil impacts remain on-site between site boundary and basement excavation	Review/assess potential vapour hazard If there is a vapour risk additional remedial measures may be required including installation of a vapour barrier or passive or active vapour extraction system.
Contaminated groundwater (including LNAPL or DNAPL) encountered.	Review of groundwater conditions on site, may require further groundwater investigations / remediation and longer-term management plan. Any dewatering may require approval under the Water Management Act (2000) Remedial measures may include, source removal, natural attenuation, bioremediation, PSH recovery using active pumping (including hydraulic control), installation of a groundwater permeability barrier or similar or in-situ oxidation or stabilisation.
Groundwater contaminant plume is identified and is migrating off-site or there are increases in concentration due to increased infiltration (following demolition).	Review contaminant increase and analytes. Review active remediation alternatives (if necessary). Ensure down-gradient monitoring is undertaken. Carry out fate and transport modelling (if required) and assess the need for further action.
Contamination is identified near heritage items or significant trees (if identified).	Stop work. Review contaminant concentrations and risks to heritage items / flora. Assess human health and environmental risks if contamination remains in place. Review natural attenuation options.
Changes in proposed future land uses at the site.	Review of the remediation works completed for the site.

8.3 CONTINGENCY MEASURES

In the event that additional soil contamination, in the form of odours, colour and/or oily residues, is intercepted at any time during the proposed remedial works, excavation in that area will temporarily cease and under no circumstances shall the contractor, or any site personnel undertake to move such materials, without prior advice by the appointed environmental specialist. The area shall be isolated with mobile barricades and the principal environmental consultant notified. Representative samples will be screened for VOCs using a PID and analysed according to the EPA (1995) *Sampling Design Guidelines* and EPA (2014) *Minimum recommended soil sampling* for the suspected contaminants.

Such soils are to be stockpiled separately and depending on their waste classification, disposed according to the DECCW (2009) *Waste Classification Guidelines*. All impacted materials in the excavated area, as well as the stockpile footprint (should the stockpile be formed on un-protected ground), will be removed by excavation and stockpiled until all corresponding contamination has been removed.

Contaminated spoil materials that fail to meet the criteria will be handled as follows:

1. Materials will be carefully excavated and placed in separately demarcated and contained locations and separately stockpiled on the basis of on-site observations and the contaminant exceedences detected.

2. Stockpiles of excavated materials will be appropriately bunded with hay bales/sandbags and if required, covered and/or lined with impermeable plastic sheeting, or alternatively placed in an appropriate container e.g. waste skip, with appropriate cover.

3. Sampling and analysis of segregated stockpiles will be conducted to determine the concentrations of the target contaminant parameters in the excavated materials.

4. Disposal arrangements will be determined based on sampling results as follows:

    - material that falls below the CT1 thresholds for *General Solid Waste* as outlined in Table 5-3 shall be collected and disposed direct to landfill;

    - material that exceeds the CT1 screening thresholds for and shall be tested for leachability with respect to the elevated contaminants using the TCLP method, and subject to meeting the relevant disposal requirements, will be dispatched off-site for disposal as either *General Solid Waste* or *Restricted Solid Waste*; and

    - those materials that exceed the *TCLP2/SCC2* criteria for landfill disposal, as outlined in Table 5-4, shall be further segregated into separate stockpiles and await alternate treatment and disposal arrangements.

5. Stockpiled materials that cannot be landfilled directly (i.e. those that are awaiting TCLP results or that fail the combined specific concentration and TCLP testing, or require to be stored pending treatment), will be covered by anchored geotextile to prevent erosion and wind blow of contaminated materials.

6. Approval of the immobilisation method for materials exceeding the leaching guidelines must be obtained from the EPA NSW and disposal consent must be sought from the Hazardous Material Advice Unit prior to the removal of such wastes from the site.

If highly contaminated soils, not identified during previous investigation, are encountered, particularly at site boundaries, then the environmental consultant is to be engaged to assess the situation and provide advice on further courses of action, including any additional measures that may be required (i.e. such as vapour risk assessment).

8.4 PRELIMINARY SCHEDULE

The schedule of site preparation and remedial works is being finalised as approval is being sought for the demolition of various buildings. Depending on this sequence of demolition, the further investigation and some remedial works can be undertaken. The schedule of remedial works would be finalised following DA approval An estimated schedule for the remediation works is detailed overleaf in Table 8-3. The finalised schedule would be presented in any detailed EMP following consent of the DA.

Table 8-3 Preliminary remediation schedule

Timeframe	Action
Start	Review of Remedial Action Plan by Council Preparation of OH&S plan, Asbestos Management Plan (AMP), EMP and contractor work method statements.
1st Month	Preparation of acid sulfate soil management plan Removal of tanks and pipe work. Removal and validation of USTs.
2nd – 4th Month	Finalisation of validation sampling. Preparation of final validation report (may be compilation of earlier reports).

9 VALIDATION PLAN

The remediation of the UST and associated infrastructure will be deemed acceptable based on the achievement of the following two validation objectives:

1. Excavated Areas – Validation of areas where impacted fill/soils have been excavated will involve sampling and analysis to ensure that contaminant concentrations at the base and walls of the area are within the Remediation Acceptance Criteria. The sampling frequency shall be in accordance with the NEPC (2013) and EPA (1995) sampling design guidelines and all tests shall be performed by NATA-accredited environmental analytical laboratories.

2. *Backfill Materials* – Should backfilling be required, validation of imported fill materials used for the backfilling of remediated areas would be required to verify their suitability for the proposed land use. Sampling shall be conducted at a nominal density of 1 sample per 25 m^3 up to a volume of 200 m^3, with all tests performed by NATA-accredited environmental analytical laboratories.

9.1 SOIL VALIDATION

9.1.1 Validation Sampling Frequency

UST Excavation is to be validated in accordance to the rational being described in Table 1: Minimum recommended soil sampling presented in the EPA (2014) *Technical Note: Investigation of Service Station Sites*.

Soil validation samples from the various surfaces of remaining remedial excavations will be collected and analysed at the following approximate frequencies:

- Base of Excavation – 1 sample per 25m^2;
- Walls of Excavation – 1 sample per 5 lineal metres;
- Stockpiled Materials – dependant on off-site disposal or re-use on site; and
- Final Ground Surface – 1 sample per 100 m^2.

Stockpiled materials shall also require sampling at a rate as described within Section 7.5

Excavation of contaminated material shall continue until the analytical results indicate compliance with the criteria (i.e. either the concentrations of all contaminants are within the criteria, or the 95% UCL average contaminant concentration for each detected parameter is within the criteria). If results indicate that additional excavation is necessary, the excavation shall be extended until the excavation surface samples indicate that the location is validated as meeting the criteria for each respective contaminant.

If the levels of contaminants are found to exceed the criteria for solid waste, soil treatment by stabilisation and/or micro-encapsulation may be required before disposal.

9.1.2 Sample Collection and Handling

Soil validation sampling will be directly from the exposed surface of excavation, or from the material brought to the surface by the backhoe/excavator bucket. Sampling data shall be recorded to comply with routine chain of custody requirements.

The general sampling, handling, transport and tracking procedures shall comprise:

- The use of stainless steel sampling equipment;
- Washing of all sampling equipment, including hand tools or excavator parts in contact with the sample, in a 3% solution of phosphate free detergent (e.g. *Decon 90*) then rinsing with potable water prior to each sample being collected; transfer of the sample into new glass jars or plastic bags, with each plastic bag individually sealed to eliminate cross contamination during transportation to the laboratory;
- Labelling of the sample containers with individual and unique identification including Project No., Sample No., Sampling depth, date and time of sampling;
- Placement of the containers into a chilled, enclosed and secure container for transport to the laboratory; and
- Use of chain of custody documentation to ensure that sample tracking and custody can be cross-checked at any point in the transfer of samples from the field to ultimate hand-over to the environmental laboratory.

9.2 Sample Containment, Preservation and Holding Times

Samples shall be contained and preserved in accordance with the following standard environmental protocols:

- Metals - 250g glass jar / refrigeration 4^{o}C / 6 months (maximum holding period);
- TRH/BTEX - 250g glass jar / refrigeration 4^{o}C / 14 days (maximum holding period);
- PAH - 250g glass jar / refrigeration 4^{o}C / 14 days (maximum holding period); and
- Asbestos - 10 Litre resealable plastic (polyethylene) bag / no refrigeration / indefinite holding time.

9.3 Validation Sample Analysis and Reporting

Each excavation and ground surface sample obtained for soil validation purposes will be analysed for TRHs and BTEX, as well as any other relevant contaminant that may be identified during the waste soil classification process (e.g. heavy metals, VOCs). Testing of imported materials intended for backfilling of excavated areas shall include but not be limited to the minimum suite specified for imported fill under the NSW EPA (2014) Technical Note for Service Station Sites (e.g. heavy metals, TRHs, BTEX, PAHs, OCPs, PCBs and asbestos).

All results shall be presented in a final remediation and validation report, prepared by a qualified environmental consultant in accordance with the OEH (2011) *Guidelines for Consultants Reporting on Contaminated Sites*. This report shall be submitted to Council at the completion of the remediation works program.

The report shall confirm that the site has been remediated to a suitable standard for the proposed development and occupation and that no related adverse environmental effects have occurred as a result of the temporary works. It shall also include details of the remediation methodology, the total volume and final disposal destinations for all contaminated materials removed from site, and confirm that placed fill meets the adopted remediation criteria.

No building construction other than the necessary demolition and excavation works will commence until the remediation and validation report has been accepted by Council.

9.4 QUALITY ASSURANCE & QUALITY CONTROL PLAN

9.4.1 Field QA/QC

Quality assurance (QA) and quality control (QC) procedures will be adopted throughout the field sampling programme to ensure sampling precision and accuracy, which will be assessed through the analysis of 10% field duplicate/replicate samples.

Appropriate sampling procedures will be undertaken to prevent cross contamination, in accordance with EI's Standard Operating Procedures Manual, which specifies that:

- Standard operating procedures are followed;
- Site safety plans are developed prior to works commencement;
- Split duplicate field samples are collected and analysed;
- Samples are stored under secure, temperature controlled conditions;
- Chain of custody documentation is employed for the handling, transport and delivery of samples to the contracted environmental laboratory; and
- Contaminated soil, fill or groundwater originating from the site area is disposed in accordance with relevant regulatory guidelines.

In total, field QA/QC will include one in 20 samples to be tested as blind field duplicates, one in 20 samples to be tested as inter-laboratory duplicates (ILD), as well as one VOC trip blank sample and one equipment wash blank sample per sample batch.

9.4.2 Laboratory Quality Assurance and Quality Control

The contract laboratory will conduct in-house QA/QC procedures involving the routine analysis of:

- Reagent blanks;
- Spike recoveries;
- Laboratory duplicates;
- Calibration standards and blanks;
- QC statistical data; and
- Control standards and recovery plots.

9.4.3 Achievement of Data Quality Objectives

Based on the analysis of quality control samples (i.e. duplicates/replicates and in-house laboratory QA/QC procedures), the following data quality objectives are required to be achieved:

- Conformance with specified holding times;
- Accuracy of spiked samples will be in the range of 70-130%;
- Field and laboratory duplicates and replicates samples will have a precision average of +/- 30% relative per cent difference (RPD), and
- Field duplicates will be collected at a frequency of 20% of all samples.

An assessment of the overall data quality should be presented in the final validation report, in accordance with the DEC (2006) *Guidelines for the NSW Site Auditor Scheme*.

9.5 VALIDATION REPORTING

The final site remediation and validation report shall confirm that the soils have been remediated to a suitable standard for the proposed development. It shall also state that no related adverse environmental effects have occurred as a result of the temporary (remedial) works. The site validation report will be completed in accordance with the EPA NSW Contaminated Sites (2011) Guidelines for consultants reporting on Contaminated Sites. The report shall be submitted to Council and/or the EPA site auditor at the completion of the site remediation works.

10 WORK HEALTH SAFETY ISSUES

10.1 ACTS AND REGULATIONS

The contractors shall ensure that all aspects of the works comply with relevant regulations, acts and guidelines. As a minimum, the following Acts and Regulations must be adhered to:

- Work Health and Safety Act 2011.
- Work Health and Safety Regulations 2011.

The Australian Standards are the minimum compliance standard for the work described herein. Where there is no applicable Australian Standard, ISO or other equivalent standard may be used with the prior consent.

Before undertaking works on site, all personnel will be made aware of the officer responsible for implementing health and safety procedures. All personnel should read and understand the Occupational Health and Safety Plan prior to commencing site works and sign a statement to that effect. Contractors employed at the site will be responsible for ensuring that their employees are aware of and comply with, the requirements of this document.

10.2 CODES OF PRACTICE

The Work Health and Safety Approved Codes of Practice 2011 (WHS Codes of Practice) provide practical guidance to support the WHS Act and WHS Regulations. The Codes of Practice in effect in Australia that may apply to the scope of work which should be followed include, but may not be limited to:

- How to Manage Work Health and Safety Risks, Code of Practice (December 2011);
- Managing the Work Environment and Facilities Code of Practice (December 2011);
- Work Health and Safety Consultation, Co-operation and Co-ordination Code of Practice (December 2011);
- Managing Noise and Preventing Hearing Loss at Work Code of Practice (December 2011);
- Hazardous Manual Tasks Code of Practice (December 2011);
- AS 2601 (2011) – The Demolition of Structures;
- AS 1940 (2004) – The Storage and Handling of Flammable and Combustible Liquids;
- AS 2436 (2010) – Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites;
- AS/NZS 3012 (2010) – Electrical Installations: Construction and Demolition Sites;
- AS/NZS 2865 (1995) – Safe working in confined spaces; and
- AS 4976 (2008) – The removal and disposal of underground petroleum storage tanks.

10.3 LICENCES, PERMITS AND CONSENT

The contractor shall at his cost, obtain the necessary permits, approvals, consents and/or licenses to undertake the works described herein. Should the development application for the works specify any conditions specific to the demolition or remediation works, all conditions must be complied with.

It is the contractor's responsibility, with assistance from client/owner(s) of the site to ensure that all other permits, approvals, consents or licences are current.

10.4 SITE HAZARDS

10.4.1 Chemical Hazards

On sites of this nature, chemical compounds or substances that may be present include heavy metals, TRHs, VOCs (including BTEX) PAHs and asbestos.

. The possible risks to site personnel associated with these contaminants include:

- Ingestion of contaminated soil or water;
- Dermal contact with contaminated soil or water; and
- Inhalation of dusts, aerosols or vapours containing contaminants.

The migration pathways have been assessed and can be found within the Conceptual Site Model for the site (Section 4).

10.4.2 Physical Hazards

The following hazards are associated with conditions that may be created during site works:

- Heat exposure;
- Buried services;
- Noise;
- Dust;
- Electrical equipment;
- The operation of heavy plant equipment;
- Confined Space associated with UST removal; and
- Potential explosive atmosphere associated with UST removal.

10.5 SAFE WORK PRACTICES

Personnel will endeavour, wherever possible, to avoid direct contact with potentially contaminated material. Workers are to ensure that surface waters or groundwater is not ingested or swallowed and that direct skin contact with soil and water is avoided.

All personnel on site will be required to wear the following protection at all times:

- Steel-capped boots;
- Safety glasses or safety goggles with side shields (as necessary);

- Hard hat; and
- Hearing protection when working in the vicinity of machinery or plant equipment (if noise levels exceed exposure standards).

Contractor must prepare Health and Safety Plan in accordance with appropriate guidelines and regulations.

10.6 INCIDENT RESPONSE

Site preparation works will include extensive demolition and site preparation including remedial works, which will involve numerous project teams, machinery and vehicles handling on site soils, some of which have been identified as contaminated and/or potentially hazardous (i.e. building waste, asbestos, USTs, contaminated soils, etc.).

While various environmental management and occupational safety plans will be developed to protect human health and the environment, incidents may occur which pose a risk to the various stakeholders. To mitigate these risks and ensure that a suitable response is carried out quickly, a response plan to any incident that may occur on site will be prepared and various responsibilities assigned. The site health hand safety plan and environmental management plan will document these procedures and responsibilities and incident contact numbers should be maintained in an on-site register.

All other relevant emergency contact numbers such as Police, Fire Brigade, and Hospital will be listed in the Health and Safety Plan and posted on-site for easy access.

As part of the process to manage incident response, various contingency management issues are documented in the following section.

11 ENVIRONMENTAL MANAGEMENT PLAN

11.1 ENVIRONMENTAL MANAGEMENT RESPONSIBILITIES

11.1.1 Principal Project Manager

A representative of Holdmark Pty Ltd will be nominated as the Principal Project Manager (PPM) and will be responsible for the overall management of the site remedial activities.

11.1.2 Property Owner

The current owner of the site will also be responsible for the management of the site and associated remedial activities, particularly with respect to policy and operational procedures.

11.1.3 Environmental Management Coordinator

It is understood that Holdmark Pty Ltd will appoint an Environmental Management Coordinator (EMC), who will:

- Ensure that the site remediation works are carried out in an environmentally responsible manner;
- Liaise between the appointed Environmental Consultant and Council providing regular updates and informing of any problems encountered;
- Ensure that all environmental protection measures are in place and are functioning correctly during site remediation works; and
- Report any environmental issues to owner.

11.1.4 Demolition and Remediation Contractor

It is understood that Holdmark Pty Ltd will appoint a Demolition and Remediation Contractor, who will:

- Ensure that all operations are carried out as identified in the RAP (demolition and remediation), as directed by the PPM and EMC;
- Induct all employees, subcontractors and authorised visitors on procedures with respect to site works, WHS and environmental management procedures;
- Report any environmental issues to EMC; and
- Maintain site induction, site visitor and complaint registers.

11.2 STATUTORY REQUIREMENTS

The work shall be undertaken with all due regard to the minimisation of environmental effects and to meet all statutory requirements. The successful contractor shall have in place an Environmental Management Plan (EMP) such that work on the site complies with the requirements of the following Acts:

- Protection of the Environment Operations Act (1997);
- Contaminated Land Management Act (1997);

- Ryde City Council Development Control Plan and Liverpool City Council Environmental Site Management; and
- Work Health and Safety Act (2011) (WorkCover).

The contractor shall also be responsible to ensure that the site works comply with the following conditions:

- Fugitive emissions and dust leaving the confines of the site must be suitably controlled and minimised;
- Water containing any suspended matter or contaminants must not leave the site in a manner which could pollute the environment, and must be minimised and suitably controlled;
- Vehicles shall be cleaned and secured so that no mud, soil or water are deposited on any public roadways or adjacent areas; and
- Noise and vibration levels at the site boundaries must comply with the legislative requirements.

In order to achieve minimisation of adverse environmental effects, the following measures are recommended to be adopted by the appointed contractor.

11.3 Traffic Management

All vehicular traffic shall use only routes approved by the Council to and from the selected landfill. All loads shall be tarpaulin-covered and lightly wetted to ensure that no materials or dust are dropped or deposited outside, or within the site. Each truck prior to exiting the site, shall be inspected prior to despatch and either logged out as clean (wheels and chassis), or hosed down within the wheel wash / wash down bay until designated as 'clean'.

11.4 Excavations

Records of all excavations and stockpile locations shall be maintained. All unsealed contaminated stockpile locations will be re-validated following spoil removal. A site diary or log will also be maintained to record daily progress, abnormal occurrences, incidents, truck movements and load characteristics.

11.5 Stormwater Management and Control

Appropriate measures shall be taken to ensure that potentially contaminated water does not leave the site. Such measures should include, but not be limited to:

- Construction of stormwater diversion channel and linear drainage sumps with catch pits in the remediation area to divert and isolate stormwater from any contaminated areas;
- Provision of sediment traps including geotextiles or hay bales; and
- Discharge of any water to drains and water bodies must meet the appropriate effluent discharge consent condition under the *Pollution Control Act* or *Protection of the Environmental Operations Act*. This will be verified by sampling and analyses undertaken by the contractor. Laboratory analytical reports for tested discharge waters must be maintained on site and made available for inspection by Council's representative or the relevant authority.

11.6 Control of Dust and Odour

Control of dust and odour during the course of the remediation works shall be maintained by the contractor and may include but not necessarily be limited to:

- The use of a water cart, as and when appropriate, to eliminate wind-blown dust;
- Use of sprays or sprinklers on stockpiles or loads to lightly condition the material;
- Use of tarpaulin or tack-coat emulsion or sprays to prevent dust blow from stockpiles or from vehicle loads;
- Covering of stockpiles or loads with polythene or geotextile membranes;
- Restriction of stockpile heights to 2 m above surrounding site level;
- Ceasing works during periods of inclement weather such as high winds or heavy rain; and
- Regular checking of the fugitive dust and odour issues to ensure compliance with the EMP requirements, undertaking immediate remedial measures to rectify any cases of excessive dust or odour (e.g. use of misting sprays or odour masking agent).

11.7 Noise Control

Noise and vibration will be restricted to reasonable levels. All plant and machinery used on site will be noise muffled to ensure that noise emissions do not breach statutory levels. Working hours will be restricted to those specified by Council (e.g. 7 am to 7 pm weekdays and 8 am to 1 pm Saturdays; no work is permitted on Sundays of Public Holidays).

11.8 Monitoring of Truck Loading

All loads will be lightly conditioned and covered before leaving the site. Each load of contaminated spoil leaving the site shall be accounted for, such that its origin, despatch time, cleanliness of the vehicle, route, destination and arrival time are recorded. Appropriate (trip ticket) docket information confirming disposal shall be maintained for inspection.

11.9 Working Hours

It is anticipated that the works will be undertaken during normal working hours. It is assumed for the purpose of the RAP that normal working hours will be as follows:

- Monday to Friday: 7:00 am to 5:00 pm.
- Saturday: 7:00 am to 1:00 pm.
- Sunday and Public Holidays: No works, without prior arrangement with council.

12 STATEMENT OF LIMITATIONS

The findings presented in this report are the result of discrete and specific sampling methodologies used in accordance with best industry practices and standards. Due to the site-specific nature of soil sampling from point locations, it is considered likely that all variations in subsurface conditions across a site cannot be fully defined, no matter how comprehensive the field investigation program.

While normal assessments of data reliability have been made, EI assumes no responsibility or liability for errors in any data obtained from previous assessments conducted on site, regulatory agencies (e.g. Council, EPA), statements from sources outside of EI, or developments resulting from situations outside the scope of works of this project.

Despite all reasonable care and diligence, the ground conditions encountered and concentrations of contaminants measured may not be representative of conditions between the locations sampled and investigated. In addition, site characteristics may change at any time in response to variations in natural conditions, chemical reactions and other events, e.g. groundwater movement and or spillages of contaminating substances. These changes may occur subsequent to EI's investigations and assessment.

EI's assessment is necessarily based upon the result of the site investigation and the restricted program of surface and subsurface sampling, screening and chemical testing which was set out in the proposal. Neither EI, nor any other reputable consultant, can provide unqualified warranties nor does EI assume any liability for site conditions not observed or accessible during the time of the investigations.

This report was prepared for the above named client and no responsibility is accepted for use of any part of this report in any other context or for any other purpose or by other third parties. This report does not purport to provide legal advice.

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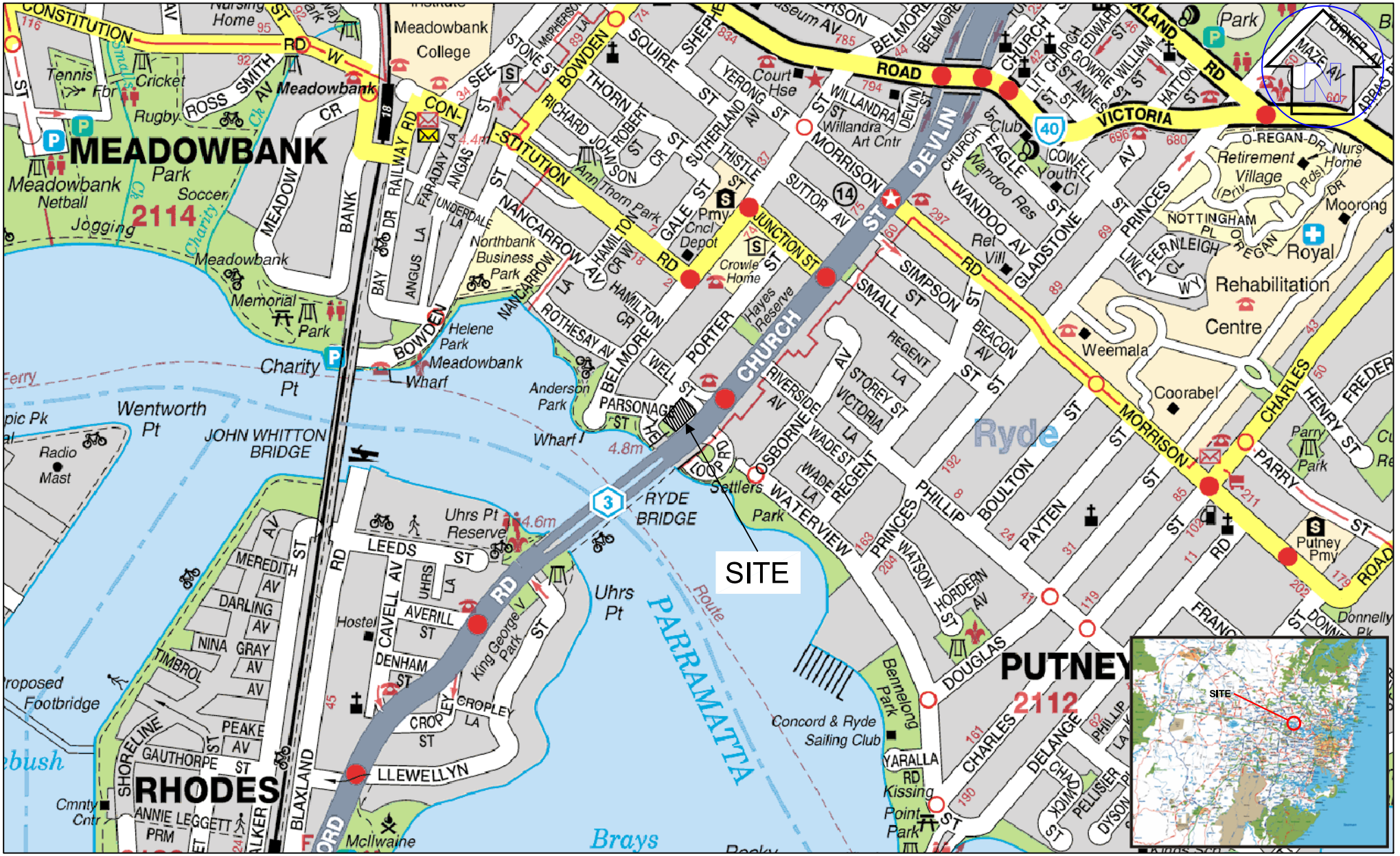
ABBREVIATIONS

AHD	Australian Height Datum
ASS	Acid sulfate soils
ANZECC	Australian and New Zealand Environment Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
B(a)P	Benzo(a)Pyrene
BH	Borehole
BTEX	Benzene, Toluene, Ethyl benzene, Xylene
COC	Chain of Custody
DEC	Department of Environment and Conservation, NSW
DECC	Department of Environment and Climate Change, NSW (formerly DEC)
DA	Development Application
DO	Dissolved Oxygen
DP	Deposited Plan
EC	Electrical Conductivity
Eh	Redox potential
EPA	Environment Protection Authority
EMP	Environmental Management Plan
F1	TPH C6 – C10 less the sum of BTEX concentrations
F2	TPH >C10 – C16 less the concentration of naphthalene
GIL	Groundwater Investigation Level
GME	Groundwater monitoring event
HIL	Health-based Investigation Level
HSL	Health-based Screening Level
km	Kilometres
m	Metres
mAHD	Metres relative to Australian Height Datum
mBGL	Metres below ground level
mg/m3	Milligrams per cubic metre
mg/L	Milligrams per litre
µg/L	Micrograms per litre
mV	Millivolts
MW	Monitoring well
NATA	National Association of Testing Authorities, Australia
NEPC	National Environmental Protection Council
OEH	Office of Environment and Heritage, NSW (formerly DEC, DECC, DECCW)
PAHs	Polycyclic Aromatic Hydrocarbons
pH	Measure of the acidity or basicity of an aqueous solution
ppbv	Parts per billion by volume
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance / Quality Control
RAP	Remediation Action Plan

SWL	Standing Water Level
TCLP	Toxicity Characteristics Leaching Procedure
TPHs	Total Petroleum Hydrocarbons
UCL	Upper Confidence Limit
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank

FIGURES

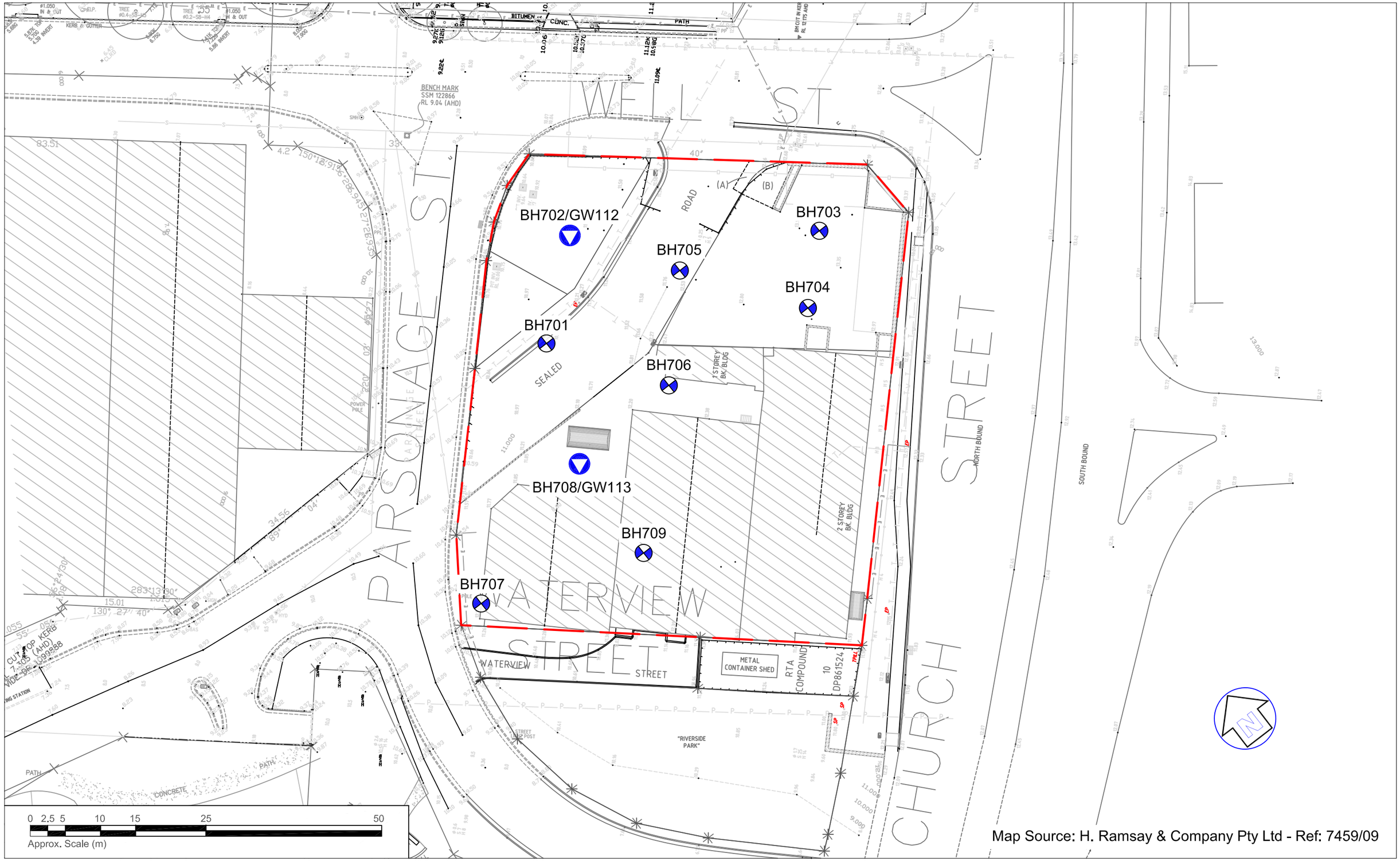


Environmental Investigations Australia Contamination | Remediation | Geotechnical Suite 6.01, 55 Miller Street, PYRMONT 2009 Ph (02) 9516 0722 Fax (02) 9518 5088	Drawn:	R.P.
	Approved:	M.D.
	Date:	24-11-14
	Approx Scale:	N.T.S

Holdmark Pty Ltd
Remediation Action Plan
Stage A
Shepherds Bay Urban Renewal, Meadowbank NSW
Locality Plan

Figure:
1

Project: E2009 AF



LEGEND

- Borehole location
- Monitoring well/Borehole location
- Approx. site boundary
- Approx. Underground Storage Tank location

Environmental Investigations Australia
Contamination | Remediation | Geotechnical
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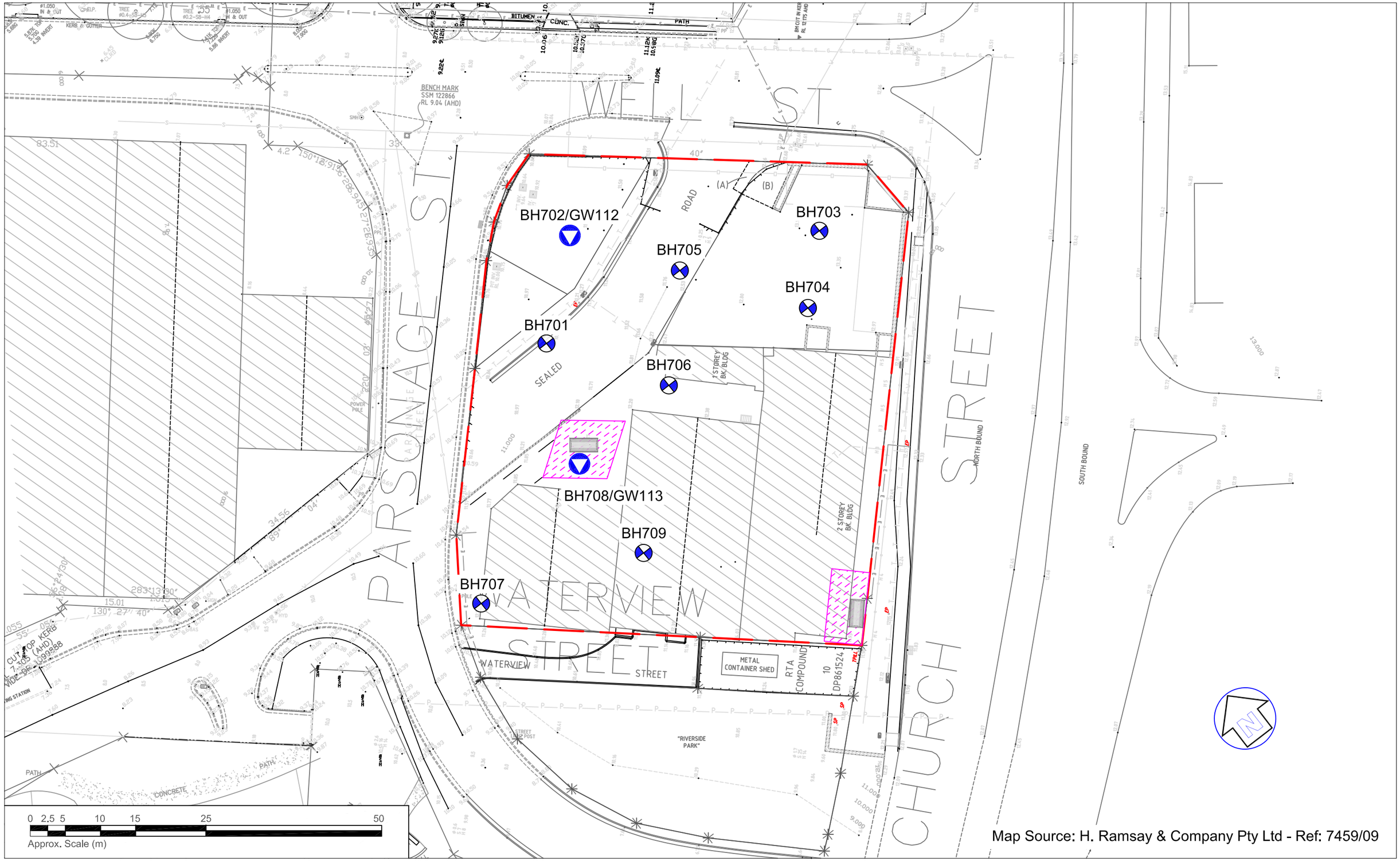
Drawn:	R.P
Approved:	M.D
Date:	24-11-14
Approx Scale:	1:500 @ A3

Holdmark Pty Ltd
Remediation Action Plan
Stage A
Shepherds Bay Urban Renewal,
Meadowbank, NSW
Sampling Location Plan

Figure: 2

Project: E2009 AF



Map Source: H. Ramsay & Company Pty Ltd - Ref: 7459/09

LEGEND

- Borehole location
- Monitoring well/Borehole location
- Approx. site boundary
- Ground penetrating radar locations
- Approx. Underground Storage Tank location

Environmental Investigations Australia
Contamination | Remediation | Geotechnical
Suite 6.01, 55 Miller Street, PYRMONT 2009
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Drawn:	R.P
Approved:	M.D
Date:	24-11-14
Approx Scale:	1:500 @ A3

Holdmark Pty Ltd
Remediation Action Plan
Stage A
Shepherds Bay Urban Renewal,
Meadowbank, NSW
Additional Investigaiton Locations

Figure: 3

Project: E2009 AF

APPENDIX A

Proposed Development Plans

SHEPHERDS BAY URBAN RENEWAL, MEADOWBANK

AMENDED CONCEPT PLAN TO COMPLY WITH PART B OF CONCEPT APPROVAL (MP09_0216)

FOR HOLDMARK PROPERTY GROUP PTY LTD
JUNE 2013
REVISION 1

PLACE
PLANNING **DESIGN** ENVIRONMENT

ROBERTSON+MARKS

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NOM.ARCH. DAVID MAYES 3190 JOHN RYAN 3181 BRIAN MANN 5975 ANDREW SCARVELIS

NOTE: ** INCREASED HEIGHT TO MEET PMF FLOOD LEVEL ALLOWANCE IN THIS LOCATION. (REFER TO ANNEXURE 15 SUPPLEMENTARY LETTER)

SHEPHERDS BAY URBAN RENEWAL

0 10 20 30 40 50 100 200 500m

PREFERRED PROJECT MASTER PLAN

MAXIMUM HEIGHTS WITH SETBACKS

PPR 001-D

Job no: 10068 , Date: 02/11/13 , Scale: 1 : 1000

ROBERTSON + MARKS

SHEPHERDS BAY URBAN RENEWAL

SHEPHERDS BAY

INDICATIVE STOREY PLAN: (BASED ON COMPLIANCE WITH SEPP 65 CEILING HEIGHT RULE OF THUMB)

CONSTITUTION ROAD
NANCARROW AVENUE
ROTHESAY AVENUE
BOWDEN STREET
HAMILTON CRESCENT WEST
BELMORE STREET
PORTER STREET
CHURCH STREET
WELL STREET
PARSONAGE STREET
LOOP ROAD
ANGAS STREET
BAY DRIVE
STORMWATER EASEMENT

6 STOREYS
5 STOREYS
4 STOREYS
12.5m tall building, 4 STOREYS
18m tall trees 6 STOREYS
CAFE / KIOSK

LEGEND:

- 10 STOREYS
- 8 STOREYS
- 7 STOREYS
- 6+2 POPUP STOREYS
- 6+1 POPUP STOREYS
- 6 STOREYS
- 5+1 POPUP STOREYS
- 5 STOREYS
- 4 STOREYS
- 3 STOREYS
- 2 STOREYS
- 1 STOREY

NOTE: STOREYS - TOTAL HEIGHT OF BUILDING AS MEASURED FROM GROUND FLOOR.

0 10 20 30 40 50 100 200 500m

PREFERRED PROJECT MASTER PLAN

Indicative Concept Plan Storeys Plan

PPR 002-D

Job no: 10068 , Date: 02/11/13 , Scale: 1 : 1000

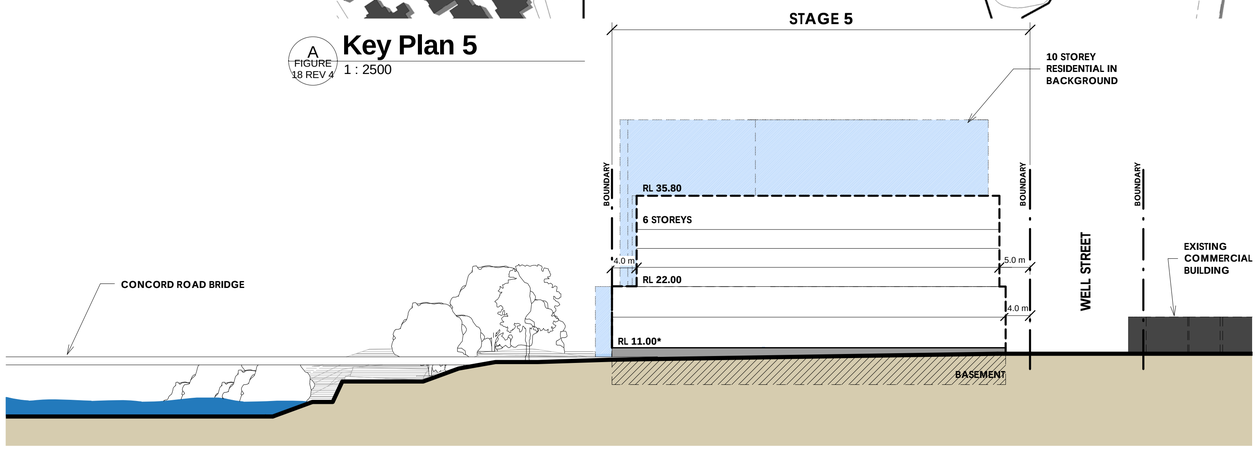
ROBERTSON + MARKS

5.

A FIGURE 18 REV 4

Key Plan 5

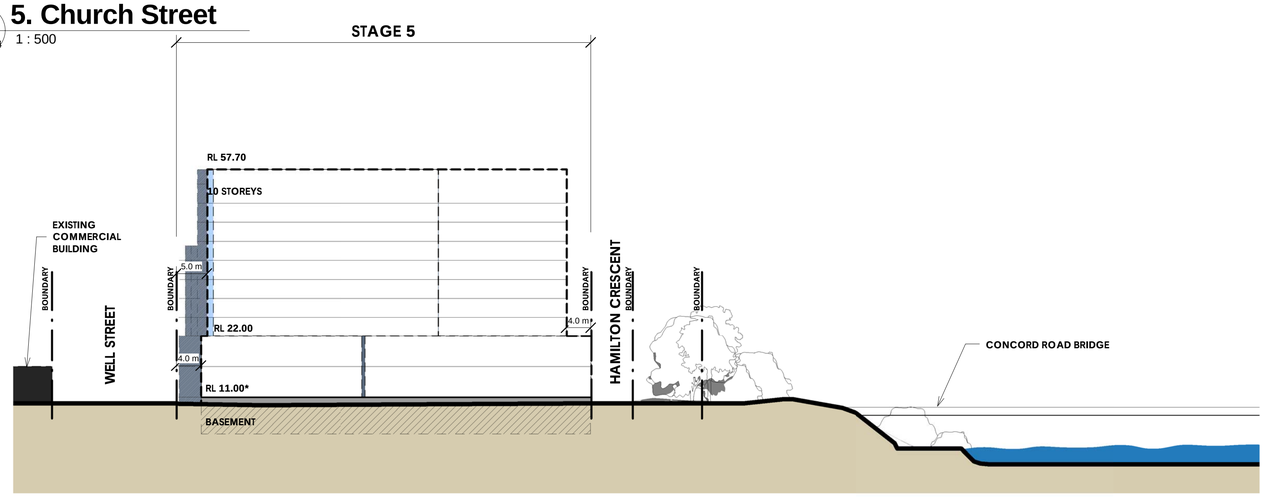
1 : 2500



1 FIGURE 18 REV 4

5. Church Street

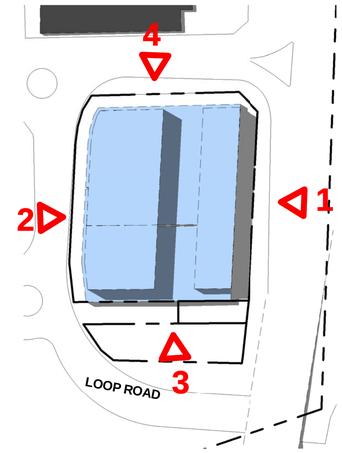
1 : 500



2 FIGURE 18 REV 4

5. Parsonage Street

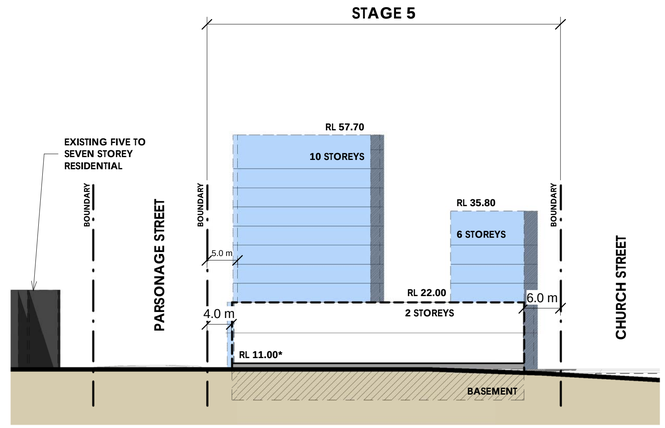
1 : 500



B FIGURE 18 REV 4

5. Building Envelope Plan

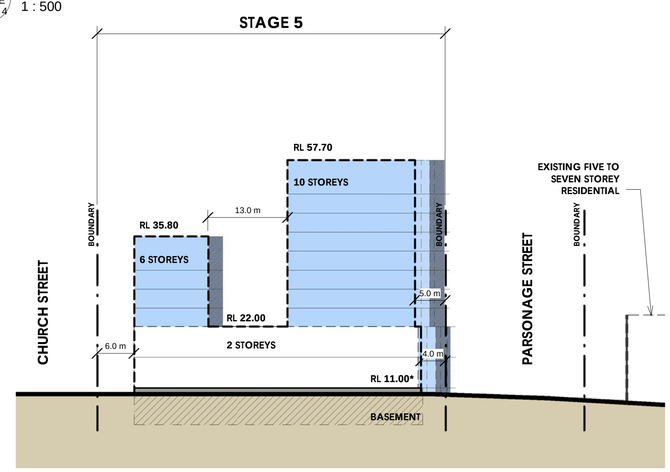
1 : 1000



3 FIGURE 18 REV 4

5. Elevation 3

1 : 500



4 FIGURE 18 REV 4

5. Well Street

1 : 500

NOTE: SCALED TO A1 SIZE SHEET. * ASSUMED GROUND RL AS PER METHOD OF DEFINING HEIGHT (PG 33, Fig 12)

SHEPHERDS BAY URBAN RENEWAL

0 10 20 30 40 50 100 200 500m

PREFERRED PROJECT MASTER PLAN

STAGE 5. BUILDING ENVELOPE CONTROL DIAGRAMS

FIGURE 18 REV 4

Job no: 10068 , Date: 01/18/12 , Scale: As indicated

ROBERTSON + MARKS