

Remediation Action Plan

138-140 Campbell Hill Road, Chester Hill,
NSW

Prepared for Abel Tasman Village Association PL | 23 August 2016

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Document Information

Client:	Abel Tasman Village Association Pty Ltd
Project:	Remedial Action Plan
Project Number:	16166
Report Title:	Remedial Action Plan 138-140 Campbell Hill Road, Chester Hill, NSW
Date:	23 August 2016
Document Name:	16166 RAP(Rev1)
Revision Number	Revision 1
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Abbreviations

Abbreviation	Description
°C	Degrees Celsius
ug/L	Micrograms per litre
ACM	Asbestos-Containing Materials
AHD	Australian Height Datum
AMG	Australian Map Grid
ANZECC	Australian and New Zealand Environment and Conservation Council
ASLP	Australian Standard Leaching Procedure
ASS	Acid Sulfate Soils
BGS	Below Ground Surface
BTEX	Benzene, Toluene, Ethyl-benzene, Xylenes
COC	Chain of Custody
COPC	Constituents of Potential Concern
CSM	Conceptual Site Model
DEC	Department of Environment & Conservation (now EPA)
DECC	Department of Environment & Climate Changed (now EPA)
DECCW	Department of Environment, Climate Change and Water (now EPA)
DO	Dissolved Oxygen
DQI	Data Quality Indicator(s)
DQO	Data Quality Objective(s)
EC	Electrical Conductivity
Eh	Redox Potential
EIL	Ecologically-based Investigation Level
ENM	Excavated Natural Material
EMP	Environmental Management Plan
EPA	Environment Protection Authority
ESA	Environmental Site Assessment
FA	Fibrous Asbestos
FB	Field Blank (quality control sample)
GAC	Granular Activated Carbon
GIL	Groundwater Investigation Level(s)
GPR	Ground Penetrating Radar
GSW	General Solid Waste
GSW (Special Waste)	Asbestos Waste
Ha	Hectares
HIL	Health-based Investigation Level
HSE	Health Safety and Environment
HSL	Health-based Screening Level
HW	Hazardous Waste
IL	Investigation Level(s)
LCS	Laboratory Control Sample
LNAPL	Light Non-Aqueous Phase Liquid(s)
LOR	Limit of Reporting



m	metre
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
MNA	Monitored Natural Attenuation
MPVE	Multi-phase vacuum extraction
MS	Matrix Spike or Mass Spectrometry or Mass Spectra
mS	milliSiemen
MSD	Matrix Spike Duplicate
MTBE	Methyl-tert Butyl Ether
mV	milli-Volts
MW	Monitoring Well
N/A	Not Applicable
NAPL	Non-Aqueous Phase Liquid(s)
NATA	National Association of Testing Laboratories
NEPM	National Environment Protection Measure
OCPs	Organochlorine Pesticides
OPPs	Organophosphorous Pesticides
PSH	Phase-Separated Hydrocarbons (same as LNAPL)
PAH	Polycyclic Aromatic Hydrocarbon
PID	Photo-Ionisation Detector
PQL	Practical Quantitation Limit
QA	Quality Assurance
QC	Quality Control
HRA	Health Risk Assessment
RAP	Remediation Action Plan
RB	Rinsate Blank (quality control sample)
RPD	Relative Percentage Difference
RSW	Restricted Solid Waste
SAS	Site Audit Statement
SB	Soil Bore
SWL	Standing Water Level
TB	Trip Blank
TBA	To be advised
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
UCL	Upper Confidence Level
USCS	Unified Soil Classification System
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WHS	Work Health and Safety



1 Introduction & Background

1.1 Background

Environmental Strategies Pty Ltd (ES) has been engaged by the Abel Tasman Village Association Pty Ltd care of Thomas Murphy & Co Solicitors to complete a Remediation Action Plan (RAP) for remediation works to be completed at 138-140 Campbell Hill Road, Chester Hill, NSW, herein referred to as the 'site'. Refer to **Figure 1, Appendix A** for a site location. At present the site comprises a former service station which has been vacated with underground petroleum infrastructure and site building comprising of brick kiosk and workshop remaining. The approximate size of the site is 2,193m². Refer to **Figure 2, Appendix A** for the site layout.

To the knowledge of Environmental Strategies, only one historical investigation has previously been completed at the site, this was:

- *Environmental Strategies, March 2014 (ES 2014), Phase 1 & 2 Environmental Site Assessment, 138-140 Campbell Hill Rd, Chester Hill, NSW; and*

A summary of the previous report is provided in Section 3 below. The current buildings on the site are proposed to be demolished to help facilitate the sale of the property. The RAP will provide a framework to ensure that the identified and any unexpected environmental liabilities uncovered during the demolition works are appropriately remediated and or managed.

1.2 Objectives

The purpose of the RAP is to provide a detailed plan of activities, procedures and objectives to ensure the effective and controlled remediation of the site. It describes the procedures and standards to be followed throughout the project to facilitate successful remediation and or management of the site and ensure protection of human health and the environment.

The objectives of the RAP are to:

- Summarise the site characteristics;
- Delineate onsite soil and groundwater impacts;
- Identify historic infrastructure that is required to be removed;
- Define the extent of remediation required;
- Assess appropriate remediation options and select preferred option;
- Document the remediation methodology, including the associated safety and environmental management controls;
- Establish the requirements for the derivation and/or selection of validation criteria relevant to the likely future land-use and detail the validation program (including reporting);
- Identify the regulatory requirements relevant to the proposed remedial works; and
- Outline any potential ongoing monitoring or management requirements to ensure the continued protection of human health and the environment.



2 Site Description and Surrounding Environment

2.1 Site Location and Identification

The site occupies an area of approximately 2,193 m² and is roughly rectangular in shape and is owned by JP Holdings Pty Ltd. The land is divided into three lots. The land zoning is Local Centre (under Bankstown City Council Draft LEP 2012). The site is occupied by a former service station (of area 1625.1m²) on two lots (Lot 6 DP 30305 and Lot 7 DP 30305) and an additional, adjacent vacant block of land to the north (Lot 5 DP 30305). The former service station has an interconnected kiosk and automotive workshop building, former service station infrastructure comprising of three disconnected fuel pump islands and four identified underground storage tanks (USTs), a former retail shop building and a vacant automotive workshop and outdoor canopy.

The former service station site building is surrounded by a hardstand forecourt comprising sealed concrete pavement which slopes to the south.

The hardstand was noted as being in good to fair condition. The vacant northern half of the site was relatively flat and turfed. **Table 2-1** provides a summary of the site details.

Table 2-1 Summary Site Details

Site Characteristic	Detail	
Street Address	138-140 Campbell Hill Road, Chester Hill, NSW 2162	
Legal Description	Lot 5 DP 30305, Lot 6 DP 30305, Lot 7 DP 30305	
Local Government Area	Bankstown City Council	
Land Zoning	Bankstown City Council LEP 2001: Business – other centres SEPP 2008: General Housing (ePlanning search 8/1/2014) Bankstown City Council Draft LEP 2012: Local Centre	
Site Area	Lot 5 DP 30305	556.4m ²
	Lot 6 DP 30305	588.1m ²
	Lot 7 DP 30305	1037m ²
	Total site area	2193m²
Geographic Coordinates	Latitude: -33.882077°	Longitude: 150.997412°

2.2 Current Site Use

ES conducted a site walkover on Tuesday 8 August 2016 to review current site condition. The site was not in use and was surrounded entirely by mesh fencing. The service station and automotive workshop portion was disused with the forecourt pavement and site buildings observed to be in fair to poor condition. Three former bowser islands were noted on the Site.



The site's groundwater wells were still in place. The adjacent lot (5) remained vacant and turfed.

2.3 Proposed Site Use

ES understand that there is current proposal to redevelop the site as an aged care facility comprising of medium density residential use with minimal access to soils. It is noted that consideration to low density residential land use with access to soil has not been considered in previous investigations or when preparing this RAP.

2.4 Site History

This section provides a summary of site history information referenced from the ESA (ES, 2014). ES has reviewed historical title information and aerial photographs, held by the NSW Department of Lands, from 1928, 1955, 1965, 1982, 1998 and 2005.

In summary, the site has been a service station from at least 1965.

Title to the current site area (Lots 5, 6 and 7 DP 30305) was held by the Public Trustee, for the Council of the Municipality of Bankstown, until 1936 when it was transferred to Joseph McHale, Carrier and remained under ownership of members of the McHale family until 2013, except for the period between 1968-1984, when all or part of the land was held by Waldron Motors and Engineering Company Pty Ltd. The Shell Company of Australia Limited leased part of the land between 1958 and 1968.

With respect to planning certification for the site under section 149(2) and 149(5) of the Environmental Planning & Assessment Act (1979), ES has summarised the following from the ES, 2014 report:

- *Lot 5 and Lot 6 DP 30305 is complying development under the General Housing Code, Housing Alterations Code, General Commercial and Industrial Code, Subdivisions Code, General Development Code and Demolition Code within the State Environmental Planning Policy (Exempt and Complying Development Codes) 2008 may be carried out on the land*
- *The land on Lot 5, Lot 6 and Lot 7 DP 30305 is affected by Draft Bankstown Local Environmental Plan 2010; Bankstown Local Environmental Plan 2001 Amendments and Planning Proposals; State Environmental Planning Policies (SEPPs), Proposed State Environmental Planning Policies and Deemed State Environmental Planning Policies; and Bankstown Development Control Plan 2005. The land is affected by Bankstown City Council Section 94A Development Contributions Plan 2009.*
- *Under Section 59(2) of the Contaminated Land Management Act 1997, the council has not been advised that the site is significantly contaminated land. The site is not subject to a management order, a voluntary management proposal, an ongoing maintenance order or a site audit statement.*

2.4.1 Anecdotal information

In 2014, ES noted the following anecdotal information from interviews with site owner's representative:

- Prior to 2014, the site has had one owner for approximately forty years;
- The site has been leased as a former retail service station site;



- More recently, the site had been leased as a mechanic's workshop and other non-contaminating uses (e.g. small, retail clothing sales);
- A waste oil tank on the site was reported to be subject to routine pump out by a waste contractor;
- The onsite building was not accessed by ES with the exception of the mechanic's workshop, which appeared to be in very good condition and had no below ground service pits or sink with associated plumbing.

2.4.2 Site Notices

At the time of reporting, there were no records of written notices issued by the EPA under the CLM Act. It is important to note that the contaminated land public record is not a listing of all contaminated sites in New South Wales, nor is it a list of all contaminated sites of which the NSW EPA has knowledge.

A search of the Protection of the Environment Operations (POEO) Act public register found there are no environmental protection licenses, applications, notices, audits, or pollution studies and reduction programs listed for the Site

2.4.3 Dangerous Goods

WorkCover NSW responded to a search request lodged 17 December 2013 for Dangerous Goods Licenses at the Site with information on Dangerous Goods License 35/013682 relating to the storage of dangerous goods at the Site. **Table 2-2** summarises copies of the most recent documents that WorkCover NSW provided on Dangerous Goods License 35/013682 that have been referenced from ES, 2014.

The tanks are understood to have been installed in circa 1972 based on information provided. ES understands from the anecdotal information provided from the former client that tank replacement was performed in approximately 2001.

A 75KL UST was installed on the site in circa 2001 and this was confirmed by the ES services survey. Anecdotal information provided at the time of investigation (ES, 2014) suggested that at least one of the tanks listed in the table below was removed from the site in circa 2001 and replaced with the reported 75KL UST. ES also observed in 2014 that the LPG Decanting Cylinder had been removed from the site.

Therefore, it is apparent that the available DG license details (dated April 2000) appear to be out of date. Please refer to ES **Figure 2 in Appendix A** of this report to observe the approximate locations of four USTs that were detected on the site from the services search (a limited GPR survey) that was undertaken prior to the commencement of ES field works.

Table 2-2 Summary of WorkCover NSW Database Records

Depot Number	Type of Depot	Licensed maximum storage capacity	UN Number	Product or common name	Historical products identified
Details of license at 29 April 2000					
1	Underground storage tank	27276 L	1203	Premium unleaded	Leaded petrol
2	Underground	13638 L	1203	Unleaded	Leaded



Depot Number	Type of Depot	Licensed maximum storage capacity	UN Number	Product or common name	Historical products identified
	storage tank			petrol	petrol
3	Underground storage tank	9092 L	1203	Super	Unleaded petrol
4	Underground storage tank	9092 L	1203	Diesel	Unleaded petrol
5	Underground storage tank	12273 L	1203	Not in use	Leaded petrol
6	Aboveground storage tank	4500 L	OOC1	Not in use	Diesel
7	Decanting cylinder (AST)	190 kg	1075	LPG	LPG

2.5 Surrounding Land use

The current surrounding land use is as follows:

- North: low density residential zoning
- West: educational campus buildings
- East: Campbell Hill Road then Business – Other Centres zoning under the Bankstown City Council LEP (2001), or General Housing under SEPP (Complying Development) including commercial retail businesses and a former service station to the south east on Waldron Road (notably, hydraulically downgradient of the site).
- South: Waldron Road then Medium Density Residential zoning under Bankstown City Council LEP (2001), or General Housing under SEPP (Complying Development). There was also a former service station southeast of the Site.

2.6 Sensitive Environments

The nearest sensitive environments are as follows:

- The nearest residential properties are located adjacent and west of the site and approximately 20 metres (m) south of the site;
- Educational facilities and sporting fields, approximately 50m west of the site; and
- A channelized headwater tributary approximately 600m south west of the site.
- Duck River approximately 1500m ENE (upgradient of the Site).

2.7 Topography

The Site is located on a low relief plain with a shallow gradient to the South South West (SSW.)



2.8 Hydrology

The Site is governed by the Sydney Metro Catchment Management Authority. The nearest watercourses are the Duck River approximately 1500m ENE and an unnamed, channelized headwater tributary of Prospect Creek above the Georges River, approximately 600m South West.

2.9 Geology

The Site is located approximately 180m NNW of the Fairfield Basin Geosyncline in plain sediments underlain by the Bringelly Shale (shale, carbonaceous claystone, claystone, laminate, fine to medium-grained lithic sandstone, rare coral and tuff), which is the uppermost unit of the Wianamatta Group.

Soil classification data for the Site was obtained from the Bicentennial Atlas of NSW “Soils of NSW” data available through the NSW Natural Resources Atlas database (on 8 January 2014). The map identifies soils at the site as Deep Structured Red Clay Loams based on information compiled from soil landscape, land system, geology or geomorphological maps at a scale of 1:100,000 or smaller.

2.10 Hydrogeology

A groundwater bore search was conducted through the NSW Natural Resource Atlas database on 8 January 2014. The bore search results from the Environmental Site Assessment (ES, 2014) have been summarised in this section. The search revealed four registered groundwater bores located approximately 300m west of the subject site for private use. No groundwater depth or quality data was recorded in the bore information records.

2.11 Acid Sulfate Soil Risk

Acid Sulfate Soil Risk has been mapped at 1:25,000 scale for coastal NSW. A search of the map data through the NSW Natural Resource Atlas (on 8 January 2014) indicated the area had not been classified within the Acid Sulfate Soils Risk Map scheme. Based on the information known about the local geology, the Site is likely to have a considerable thickness of clay underlying any fill material and not likely to be affected by Acid Sulfate Soils at the depths of the present investigation (<4m).



3 Previous Investigation

One assessment has previously been conducted on the site, the results of which are discussed below.

3.1 Environmental Site Assessment, Environmental Strategies, March 2014

In March 2014, ES conducted a Detailed Environmental Site Assessment which comprised of a desk top Preliminary Site Investigation (Phase 1) involving a review of public record pertaining to the site and a site walkover and an intrusive soil and groundwater investigation (Phase 2).

3.1.1 Phase 1 Desktop Assessment Summary

The potential contamination issues identified on the site have been summarised below:

- Lead based paints and asbestos associated with existing building structures
- Heavy metals, hydrocarbons and asbestos associated with imported fill on the site.
- Leaded petrol and hydrocarbons associated with the former fuel and waste oil storage systems.

3.1.2 Areas of Environmental Concern

Based on the history review and field observation from both onsite and offsite sources, areas of environmental concern (AEC) were identified and are presented in **Table 3-1** below.

Table 3-1 Areas of Environmental Concern and the Contaminants of Potential Concern

Area of Environmental Concern (AEC)	Contaminants of Potential Concern (COPC)	Likely sources of potential contamination
Four former bowser islands	TPH, BTEX, PAH, Pb	Possible localised spills and leaks, or fuel line leakages
Four existing underground storage tanks and one former underground storage tank	TPH, BTEX, PAH, Pb	Possible leaks from tanks or refuelling lines
Former above ground storage tank historically located north of the wire mesh fence and west of the building	TPH, BTEX, PAH	Former diesel storage tank, possible localised spills and leaks
Waste oil tank on the northern wall of the mechanic's workshop	TPH, BTEX, PAH	Possible leaks or spills
Fill material on the Site, below concrete slab	TPH, BTEX, PAH, Metals-8, Asbestos	Imported contamination from fill brought onsite
Fill material in vacant lot, Lot 5, DP 30305	Potential asbestos cement in fill materials TPH, BTEX, PAH, Pb	Potential storage and vehicle wash-down area
Fill material in vacant area	Potential asbestos cement in fill materials, or	Potential storage and vehicle wash-



Area of Environmental Concern (AEC)	Contaminants of Potential Concern (COPC)	Likely sources of potential contamination
west of the building	associated with building refuse stored on the Site TPH, BTEX, PAH, Pb	down area
Groundwater below the Site	TPH, BTEX, PAH, Pb	Potential environmental receptor of contamination through infiltration of rain or storm water and leaching of contaminants in surface and subsurface media.

3.1.3 Potentially Contaminated Media

Potentially contaminated media present at the site may include:

- Fill material;
- Natural soil; and
- Groundwater.

Natural soils and groundwater may have been contaminated by localised spills and leaks around the Underground Petroleum Storage System (UPSS) and AST.

3.1.4 Potential for Migration

Contaminants generally migrate from site via a combination of windblown dust, infiltration, leaching, groundwater movement and surface runoff. The potential for contaminants to migrate is a combination of:

- The nature of the contaminants (solid/liquid and mobility characteristics);
- The extent of the contaminants (localised or widespread);
- The location of the contaminants (surface soils or at depth);
- The site environmental setting (topography, geology, hydrology, and hydrogeology).

The potential contaminants of concern identified as part of the site history review and the site inspection are in both solid and liquid phase, of both potentially localised and widespread extent.

3.1.5 Phase 2 Investigation Summary

Ten soil boreholes (to a depth of 0.5m into natural material) were advanced across the site and three were converted into groundwater monitoring wells (maximum 10 mBGL). The soil bores were targeted to the known areas of potential environmental concern on the site which primarily included the former UPSS. Monitoring wells were installed downgradient of the USTs so that a baseline assessment of groundwater conditions could be obtained prior to possible removal of the Underground Petroleum Storage System (UPSS) in general accordance with the Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2008.

Soil samples were collected from the subsurface fill and natural material and analysed for TPH, BTEX, PAHs, Heavy metals (arsenic, calcium, chromium, copper, nickel, lead, zinc and



mercury) and asbestos. Results were compared against the NEPM 1999 (Amended 2013) HIL/HSL-B and/or HIL/HSL D Guidelines (based on information provided to ES by the client.)

Concentrations of TPH, BTEX, PAHs, heavy metals (arsenic, calcium, chromium, copper, nickel, lead, zinc and mercury and asbestos in soil were all below the adopted soil assessment criteria.

PID measurements ranged between 0.1ppm and 953.3ppm. PID measurements >20ppm were recorded at BH6 (maximum 120ppm) and BH2 (maximum 953.3ppm.) The PID measurements at BH2 indicated hydrocarbon impacted soil in both fill and natural material between 0.15 and 1.5m bgl, however the depth of excavation required to remove the hotspot has not been determined.

Concentrations of TPH, BTEX, PAHs, heavy metals in groundwater were reported to be below the adopted Groundwater Assessment Criteria in all samples, with the exception of Lead, which was above the adopted criteria (3.4 mg/L Lead) in MW1 (16 mg/L) and MW3 (6 mg/L). However, ES considers that these levels are reflective of background conditions or field methods and not likely to pose a risk to site users or ecological receptors.

The standing water level (SWL) measured in groundwater monitoring wells MW1, MW2 and MW3 ranged between 1.195 and 1.45m below the ground level after purging.

3.1.6 Site Soils

The subsurface geology observed across the site during the Environmental Site Assessment (ES, 2014) was as follows:

- *Hardstanding was present across the site to a depth of 0.15m, except in the area of the vacant lot, Lot 7 DP 30305, and the area west of the building in Lot 6 DP 30305.*
- *Fill was observed to be present below the hardstanding to a depth of between 0.2 to 0.4m across the site.*
- *West of the building, a surficial layer of concrete rubble and road base fill was observed to 0.05m above natural material.*
- *In the vacant lot, concrete cobbles and refuse (glass fragments, radiator parts) were observed within a 0.2m gravelly silty sand surficial fill layer, vegetated by grass, above natural material.*
- *Reworked natural material below the fill layer was generally a blueish grey to orange silty clay, above brown to greyish-brown silty clays. Weathered silty claystone to clayey siltstone was present at depths below approximately 6.0-7.0m with solid flight auger refusal occurring at 6.8-7.5m.*

Based on the findings and conclusions of the investigation, ES considered that the site could be made suitable for residential use, and recommended the following work:

- *Excavation of the vapour hotspot identified in PID screening at BH2 during tank removal works prior to construction. The required depth of excavation is likely to be no greater than 1.5m based on the depths of elevated PID measurements at laboratory analytical data obtained from BH2 at 1.5m;*
- *The results of laboratory analysis indicated no gross contamination has impacted groundwater hydraulically downgradient of the tanks on the Site. However, removal of tanks and associated infrastructure on the site would be*



required to assess the impacts of potential contamination on local backfill sands around same. Following the removal of underground infrastructure, removal and/or treatment of potentially impacted material (e.g. backfill sands) and validation of excavations and tank pits will be required to ensure no risk remains to human health or the environment;

- *Notably, no gross contamination has been found on the Site; therefore the extent of remediation required is likely to be limited to immediate area around the tanks and removal of the PID hotspot at BH2;*
- *Preparation of a remedial action plan (RAP) to document the remedial strategy to remove the UST infrastructure and installation of additional groundwater monitoring wells.*
- *All waste generated on the site during remediation would need to be assessed under the NSW Waste Guidelines prior to material handling, management and disposal.*

3.2 Additional Site Inspection and Groundwater Gauging Event (Environmental Strategies, 9 August 2016)

An additional site visit and groundwater gauging event was conducted by Environmental Strategies on 9 August 2016 as an update to the previous ESA (ES, 2014). The key findings of the site visit were as follows:

- Gauging and physical bailing of groundwater from the 3 on site monitoring wells (located downgradient of the tank farm and bowzers) indicated that no measurable LNAPL, no detectable odours nor any visible signs of dissolved phase hydrocarbon impact.
- Field observations for groundwater accorded with the findings of the ESA (2014) undertaken for the former owner.
- The forecourt pavement was observed to be in fair condition and was overgrown with weeds.
- The site buildings and canopy were in sound condition.
- The security fencing was in good condition.

3.3 Conceptual Site Model

ES has developed a conceptual site model (CSM) based on the results of the previous investigations undertaken.

3.3.1 Potential Receptors, Exposures and Pathways

The following provides an overview of the potential exposure pathways summarising what is considered in a human health risk assessment model, what is excluded and associated justifications. For an exposure pathway to be considered complete, there must be a:

- *Source of the contaminant, that is, how the contaminant got into the environment;*
- *A transport media for the contaminant to move through the environment (e.g. soil, water or air);*



- *An exposure point, that is, how people can come into contact with the chemicals (e.g. excavation, soil vapour); and*
- *An exposure route, that is, how can the chemical enter the body (e.g. inhalation, ingestion or dermal contact).*

If any of these steps (source, transport media, exposure point or route) is not present, then the exposure pathway is incomplete and hence further assessment of risks is not required. In cases where the exposure pathways are complete, or have the potential to be complete, then the pathways can be considered either significant or insignificant. The significance of the exposure pathway depends on the nature of the contamination present and the evaluation of the likely exposure concentrations that may be associated with the pathway. **Table 3-2** summarises the identified exposure pathways and receptors on the site.

Table 3-2: Identification of Exposure Pathways and Receptors

Receptor	Exposure and Pathway/Mechanism	Activity	Risk/Likelihood
Onsite adult resident or maintenance worker	Inhalation of volatile chemicals identified in soil or groundwater that may migrate into buildings or outdoor air caused by the diffusion and movement of air throughout the building (i.e. lift well, gaps, stairwells, conduits etc.) Direct exposure (dermal absorption or ingestion) to contaminated soils (or dust from hazardous building materials) onsite by users.	Exposure may occur when entering and leaving buildings across the site. Exposure to contaminated soils or dust may occur during maintenance or upgrade works.	High to Moderate
Offsite adult resident or commercial worker.	Inhalation of volatile chemicals identified in soil or groundwater that may migrate into buildings or outdoor air caused by the diffusion and movement of air throughout the building (i.e. lift well, gaps, stairwells, conduits etc.)	Exposure may occur when entering and leaving the buildings or working above a volatile plume.	Low This scenario is unlikely due the fact that there is currently no plume identified at or beyond the southern site boundary.
Down gradient, child and adult user of groundwater.	Inhalation of volatile chemicals that may potentially migrate from drinking water into the breathing space of homes. Ingestion and dermal contact of contamination in groundwater that may migrate down gradient to a domestic drinking water bore.	Using drinking water for domestic purposes.	Low This scenario is unlikely due to the presence of a reticulate water supply in Chester Hill and the fact that there is currently no plume identified at or beyond the southern site boundary.



4 Data Quality Objectives

According to NSW Department of Climate Change (DECC) (2006) *Guidelines for the NSW Site Auditor Scheme* (2nd edition), Data Quality Objectives (DQOs) are qualitative and quantitative criteria that clarify the objectives of an investigation, define the amount and type of data to be collected, and specify the tolerable levels of decision making errors. DQOs ensure that the data collected is of the appropriate quantity (sampling frequency) and quality to allow for sound decisions to be made about the nature and extent of subsurface impacts.

The DQOs derived for the RAP have been developed in accordance with the National Environment Protection (Assessment of Site Contamination) Measure 1999 as amended in 2013 (NEPM, 2013), with general reference to the *NSW EPA Guidelines for Assessing Service Station Sites* (EPA, 1994), *Sampling Design Guidelines* (NSW EPA, 1995) and the *Guidelines for Consultants Reporting on Contaminated Sites* (OEH, 2011).

Using the following seven step DQO process, which has been established by the United States Environmental Protection Agency (US EPA) and is endorsed in AS4482.1-2005, will ensure that appropriate DQOs are established for the Site.

The seven steps are outlined as follows:

- **Step 1:** *State the Problem – concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem.*
- **Step 2:** *Identify the Decision –identify what questions the study will attempt to resolve, and what actions may result.*
- **Step 3:** *Identify the Inputs to the Decision –identify the information that needs to be obtained and the measurements that need to be taken to resolve the decision statement.*
- **Step 4:** *Define the Study Boundaries –specify the time periods and spatial area to which decisions will apply. Determine when and where data should be collected.*
- **Step 5:** *Develop a Decision Rule –define the statistical parameter of interest, specify the action level, and integrate the previous DQO outputs into a single statement that describes the logical basis for choosing among alternative actions.*
- **Step 6:** *Specify Tolerable Limits on Decision Errors –define the decision maker's tolerable decision error rates based on a consideration of the consequences of making an incorrect decision.*
- **Step 7:** *Optimise the Design –evaluate information from the previous steps and generate alternative data collection designs. Choose the most resource-effective design that meets all DQOs.*

The DQOs for the proposed remediation are as follows.



Table 4-1 Data Quality Objectives for the Validation Sampling Program

DQO	Summary
State the Problem	The site proposed for redevelopment has historically been used as a service station and workshop. A soil vapour hotspot at one identified location around a bowser island and the existing USTs are required to be removed from the site along with any residual contaminated soil surrounding them in order to make the site suitable for the proposed residential land use. No groundwater impact has been previously reported on the site.
Identify the Decision	The following decisions will need to be made during the remediation works: -have all hazardous substances been removed from the site? -has all of the infrastructure associated with the storage and delivery of fuel and other fluids been removed from the site? -has impacted soil underlying the identified infrastructure been removed such the remaining soil is suitable for the proposed medium density residential land use? -have any other hotspots of impacted soil identified in other areas of the site been removed such that the remaining soil is suitable for medium residential land use? -has impacted soil that presents an on-going risk to groundwater been removed?
Identify the Inputs to the Decision	Based on previous investigations on the site and a review of previous site history the potential contaminants of concern (COC) in the soil and groundwater on the site are BTEX TPH, PAH, asbestos and lead. The inputs into the decision will be: ▪ Visual inspection of the walls and floors of the final remedial excavations. ▪ Laboratory soil results from validation samples collected from the final remedial excavations of the site UST pits. ▪ Groundwater sampling in MW1, MW2 and MW3 and additional delineation wells required to be installed following demolition of above ground infrastructure (site buildings – workshop and kiosk, forecourt canopy, pump islands etc.)
Define the Study Boundaries	The study boundaries include the site boundary as shown in Figure 2, Appendix A. The areas requiring remediation or further assessment are shown in Figure 2, Appendix A. The vertical extent of active remediation works is expected to extend to a depth of up to 3.5m below ground level (BGL) in the location of the four USTs; up to 1.0m depth in the vicinity of the lines and any pumps and to 1.5m BGL at the identified soil hotspot (BH2).
Develop a Decision Rule	Results of testing on soil validation samples will be assessed against the following criteria (as specified in Section 7): ▪ NEPM (1999, Amended 2013) 'Schedule B(1) Guidelines on Investigation Levels for Soil and Groundwater – Tables 1A(1), 1A(3), 1A(4), 1A(5)' – Health Investigation Level (HIL-B) and Health Screening Level (HSL-B) Residential with minimal access to soils or high density land use; and ▪ NEPM (1999, Amended 2013) 'Schedule B(1) Guidelines on Investigation Levels for Soil and Groundwater – Tables 1(B) 1- 1(B)7 – Ecological Investigation Levels (ELs), Ecological Screening Levels (ESLs) and Management Limits (ML). ▪ NEPM (1999, Amended 2013) 'Schedule B(1) Guidelines on Investigation Levels for Soil and Groundwater – Tables 1 (C) –Groundwater Investigation Levels (GILs).



DQO	Summary
	▪ NSW EPA (2006) Guidelines for the NSW Site Auditor Scheme It is noted that the assessment of validation data may be based on the 95% Upper Confidence Limit (UCL), for heavy metals and PAHs provided that: ▪ The standard deviation of the dataset is less than 50% of the assessment criterion; and ▪ No single result is more than 2.5 times the assessment criterion. The 95% UCL should not be used for assessment of volatile contaminants (i.e. TPH, BTEX or VOC compounds). Results of testing on groundwater samples will be assessed against the following guidelines as specified in Section 7: ▪ NEPM (1999, Amended 2013) 'Schedule B(1) Guidelines on Investigation Levels for Soil and Groundwater – Tables 1 (C) –Groundwater Investigation Levels (GILs). ▪ ANZECC (2000) Guidelines for Fresh and Marine Water Quality trigger values for the protection of 95% of species
Specify Tolerable Limits on Decision Errors	The acceptable limits for field and laboratory QA/QA results are as follows: • Relative percent difference (%RPD) for field duplicates is less than 50% for all analytes. • Recovery of matrix spikes and surrogate spikes between 70 and 130% or 50% RPD for matrix spike duplicate RPDs for organics only; and • 70 to 130% recovery on trip spike samples. Where acceptable limits for field duplicates are not met, a discussion on low biased error will be provided.
Optimise the Design	Validation data will be collected in accordance with the Validation Plan specified in Section 7.3. This is presented as the most cost-effective validation plan which meets guideline structures.



5 Remediation Options

5.1 Remediation Objectives

The remediation objectives are outlined as follows:

- Remediate the site to a level enabling a medium-high density residential scenario with minimal access to soils;
- Determine if reduction of groundwater contaminants is required to ensure there are no unacceptable risks to human health and the environment;
- Validate the remedial works in accordance with the relevant EPA guidelines and the validation plan included in Section 8 of this RAP; and
- Document the validation process.

5.2 Regulatory Requirements

The land is governed by environmental planning instruments including but not limited to, Bankstown City Council's Development Control Plan (DCP) and Local Environment Plan (LEP) and the State Environmental Planning Policy (SEPP 55).

For the purposes of obtaining managed works approval from the Council, ES is of the opinion that the aforementioned objectives will be met with appropriate levels of management and minimal disturbance to human health and the surrounding environment as 'Category 2 Remediation Works' as defined by the State Environment Planning Policy (SEPP 55) under the Environmental Planning and Assessment Act 1979.

5.3 Extent of Remediation

The following are the areas identified as requiring remediation/management:

- 4 USTs, 1 above ground storage tank (AST) and associated infrastructure (i.e. fuel bowzers, lines, fill points, vent lines) on the site;
- Soil vapour hotspot (currently undelineated) at BH2 (>950ppm) but estimated to be approximately 20m² in area by 1.7mBGL in depth;

This RAP focuses on the removal of all known existing USTs, AST and associated petroleum infrastructure onsite in addition to soil and groundwater validation. Groundwater on the downgradient boundary of the site does not appear to have been impacted by historic site activities. The absence of impacts to groundwater indicates that potential contamination associated with the UPSS infrastructure may have been contained to the immediate vicinity of the tank pits and lines, however it is noted that investigative sampling between the forecourt bowser area and tank farm has historically been limited for safety reasons.

5.4 Review of Soil Remedial Options

The Contaminated Sites Guidelines for the NSW Auditor Scheme (DEC 2006) states that the policy of the then Australian and New Zealand Environment and Conservation Council (ANZECC) and the National Health and Medical Research Council (NHMRC) on the remediation of contaminated sites as published in the Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC & NHMRC 1992) is followed in NSW. This means that soil remediation and management is implemented in the following preferred order:



- *On-site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level;*
- *Off-site treatment of excavated soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site;*
- *Removal of contaminated soil to an approved site or facility, followed, where necessary, by replacement with clean fill; and*
- *Consolidation and isolation of the soil on-site by containment within a properly designed barrier.*

Table 5-1 Soil Remedial Options Screening Matrix

Remedial Option	Review Discussion	Conclusion
Option 1 On-site land farming treatment of the soil so that the contaminants are either destroyed or the associated hazards are reduced to an acceptable level.	<u>Hydrocarbons within soils</u> Exsitu bioremediation (aeration) or land farming of hydrocarbon impacted soil on site. The success of the remediation method is highly dependent on the hydrocarbon fractions that makeup the contamination. Hydrocarbon components (TPHC₆-C₉ and BTEX) are more likely to be remediated via land farming and as such there maybe a need to control potential hydrocarbon emissions and odours, given the proximity to residential sites. Land farming may not remove all hydrocarbons from soil, as there may be residual impact if remediated soils are reused on site. Given that the site is adjacent to residential areas and public use areas, and relatively small in size the time required to remediate the soil and the potential need to control hydrocarbon emissions, this option may not be considered feasible in meeting remedial objectives. However, as a cost effective measure, this option maybe viable where waste classification or field screening indicators identify impacted soil will not meet a General Solid Waste classification. The impacted soils will be placed in an engineered aeration cell for approximately 4 weeks. The cell will be subjected to aeration via a SVE pump and odour suppressant applied.	Landfarming is not suitable but may be considered as an option if appropriate management is applied through aeration cells.
Option 2 Off-site land farming treatment of the soil so that the contaminants are either destroyed or the associated hazards are reduced to an acceptable level.	<u>Hydrocarbons within soils</u> As above (Option1), however, there is a reduction in noise and dust emissions on site in comparison to on-site treatment (Option 1), but these are offset by increased transporting costs and hazards to public safety associated with transporting the untreated materials from site.	Not a suitable option but could be applied by an appropriately registered landfill.



Remedial Option	Review Discussion	Conclusion
<u>Option 3</u> Excavation and offsite removal of the impacted material.	<u>Hydrocarbons within soils</u> There are currently suitably licensed waste facilities in the Sydney Metropolitan region capable of receiving hydrocarbon contaminated soils (following waste classification). Offsite disposal of impacted material is likely the fastest method of remediating soil impacts at the site. This option generates the highest quantity of waste, since the materials are disposed to landfill rather than treated and reused (i.e. Options 1 & 2). However, given the small site area for on-site remediation in a residential area, offsite disposal is the preferred remedial Option.	The preferred option.
<u>Option 4</u> Consolidation and isolation of the soil by on-site containment within a properly designed barrier and ongoing management.	Containment of hydrocarbon impacted material is not an appropriate method of remediation given that the contaminant is mobile, potentially volatile and reactive. Potential exposure to contamination would require management by the implementation of an ongoing Environmental Management Plan. There must be acceptance on the part of the ultimate custodian of the land that future controls will be implemented, and that a notation will be made on the Title of the land. The benefit of this option is that there is no cost to dispose of the impacted fill materials, however it could be an ongoing source to groundwater contamination at the site or a potential source of vapour under proposed building structures. Containment of hydrocarbon impacted soil at the site is not the preferred Option.	Not a suitable option for the proposed residential development.

5.5 Preferred Remediation Option

With consideration to NSW EPA's endorsed guideline hierarchies for soil remediation options and groundwater cleanup objectives (DEC 2007), and to the site specific contaminants and environmental setting, the preferred remediation strategy is outlined as follows:

Primary Source Control

- *Decommissioning and removal of the UST and fuel infrastructure in accordance with relevant Australian and industry standards;*

All works in relation to exposure, removal and disposal of the USTs must be undertaken by a WorkCover licensed demolition contractor.

The safe removal and decommissioning of USTs is to be undertaken by a suitably licensed contractor in accordance with Work Health and Safety Regulation 2011 and the following:

- *Australian Standard AS 4976-2008: The removal and disposal of underground petroleum storage tanks*
- *Australian Standard AS4897-2008: The design, installation and operation of underground petroleum storage systems*



- *Australian Standard AS 1940-2004: The storage and handling of flammable and combustible liquids*
- *Australian Standard AS/NZS 60079.10.1: Explosive atmospheres – Classification of areas – Explosive gas atmospheres*
- *Australian Standard AS/NZS 60079.29.1: Explosive atmospheres – Gas detectors – Performance requirements of detectors for flammable gases*
- *NSW WorkCover July 2015 Code of practice – Demolition work*
- *NSW WorkCover July 2015 Code of practice – Excavation work*
- *NSW EPA April 2014 Technical Note: Investigation of Service Stations*
- *UPSS Technical Note: Site validation reporting (DECCW 2010a)*
- *Guidelines for Consultants Reporting on Contaminated Sites (OEH 2011)*

Soil

- Identification of any hydrocarbon impacted soils by chasing of contamination outwards from known locations of impact in proximity of petroleum infrastructure, during removal of infrastructure (including above ground and underground tanks (ASTS/USTs), fuel feed lines, vents, fill points, dispenser islands, waste oil/wastewater systems);
- Excavation and off-site disposal of any impacted backfill material and surrounding soils; and
- Where instructed by the client, reinstatement of site levels using validated imported fill (virgin excavated natural material and or excavated natural material) or surplus material sourced from the site. Any material imported to site must be assessed as suitable for the proposed land use and have been assessed and re-use in accordance with the NSW EPA 2014 Waste Guidelines. Similarly, any material removed from the site must also be appropriately characterised in accordance with the NSW EPA 2014 Waste Guidelines.

Groundwater

- A groundwater monitoring event conducted following removal of the UPSS and associated infrastructure to determine any changes in concentrations from the previous sampling round in 2014.



6 Remedial Plan

A summary of the remedial scope of works for soil is provided as follows, and includes removal of primary sources of potential groundwater contamination (i.e. leaking UPSS):

- Excavation and off-site disposal of fuel infrastructure to a licensed destruction facility.
- Identification and excavation of contaminated backfill sands/surrounding soils (known contaminated soils and additional impacted soils in proximity of USTs and fuel infrastructure) to the extent practicable.
- Validation of the walls and base of the excavations at the following frequencies:
- Two samples from the base of each UST location (~total 8 samples);
- One sample per wall of each UST excavation at a depth of approximately 2m, targeting any soil contamination resulting from potentially leaking USTs. Where a single excavation is used to remove multiple USTs the additional samples shall be likewise collected and submitted for analysis (~total 16 samples);
- One sample from the pit water of each UST (~total 4 samples) where water is present where backfill sands appear to be contaminated;
- Soil samples from beneath fuel lines at a rate of 1 per 5 m linear; (~ total 8 samples)
- One sample from beneath each former bowser (dispenser) location (~total 6 samples);
- One sample from beneath the remote fill points (~total 2 samples);
- Samples from base and walls of excavations of known contaminated soils (including in the vicinity of the vapour plume identified at BH2) at the rate of 1 sample per 5 m linear, or 1 sample per 25 m² (~total max. 5 samples)
- Samples from beneath the above ground storage tank in the potential area of spill or alternatively, at depth intervals 0-200mm and 200mm-500mm at a rate of 1 sample per 25m³ (~ total 6 samples)
- Samples from the excavations beneath the workshop pits and/or hoists targeting below the base of the structures. (~total 6 samples)
- Soils identified as contaminated are to be classified under the NSW EPA (2014) Waste Classification Guidelines and disposed off-site.
- Validation sampling of groundwater from the three downgradient monitoring wells for petroleum hydrocarbon contamination following completion of remedial excavation.

6.1 Define the Boundary of Contamination

The boundaries of the contaminated area shall be determined by the excavation works. It is possible that contaminated soils will require to be additionally chased out from the walls and base of the excavations formed by the removal of the petroleum infrastructure where practicable. Based on available data, the estimated area for excavation at BH2 is 20m².



6.2 Site Establishment

All safety and environmental controls are to be implemented as the first stage of remediation works. These controls will include:

- Locate and isolate all required utilities in proximity of the works, note that some lines have been abandoned in-situ and the safety status of the tanks has also not been confirmed. It appears that the tanks may have not been made safe prior to site closure (i.e. slurry/sand filled) due to the presence of one remaining on-site pump/bowser under the canopy;
- Work area security fencing (in place);
- Site signage and contact numbers;
- Sediment fencing (attached to security fencing); and
- Stormwater runoff sediment controls (hay bales).

6.3 Removal of USTs and Associated Fuel Infrastructure

The UST area is located to the south of the site building in the southern portion of the site.

The UST and associated fuel infrastructure will be removed off site and destroyed by an authorised/licensed ES sub-contractor. Samples from the UST area excavation will be collected with the aid of an excavator bucket. Soil samples would be collected from each wall at 5m intervals both horizontally, 2m vertically and at the base of the excavation. Samples along excavated fuel lines will be taken every 5m linear metres.

The volume of soil to be excavated and validated is unknown. If contaminated soil is identified, the soil will be excavated and stockpiled separately. Refer to **Table 7.1** for details of the sampling validation program.

6.4 Delineation and Excavation of Impacted Soils

Impacted soils, where they are identified either visually, from olfactory detection or through the use of a Photo-ionisation Detector (PID), shall be 'chased' out.

This will be conducted under the direction and supervision of a suitably qualified and experienced environmental professional. The procedure for undertaking this excavation activity will be by:

- Observation of tank pit and associated fuel infrastructure excavations and identification of impacted soils;
- Excavation of impacted soils to lateral and vertical extent of physically identifiable impact, with additional break up and removal of concrete to remove soils where impact extends laterally; and
- Impacted soils to be disposed offsite to an appropriately licensed waste facility in NSW.

6.5 Soil and stockpile management

Soil must be stockpiled in a manner and location to minimise adverse effects on the receiving environment from wind and/or rainfall. In particular, silt controls must be adequately placed around the perimeter of stockpiled material. Stockpiles must be clearly marked and records maintained to track the disposal of soil from the site.



Excavated soil material that is considered to be unsuitable for onsite reuse will be disposed of at a NSW licensed waste facility.

6.6 Residual Groundwater/Seepage Water from Excavations

In the event that seepage is encountered within the excavations, or if significant rainfall events result in impacted water requiring to be removed from the excavation during the remediation works, the water will be pumped from the excavation by a licensed contractor and disposed of off-site as “liquid waste” in accordance with NSW EPA Waste Classification Guidelines (2014). Based on our understanding of contaminants on the site, liquid waste at the site is likely to be coded J120 - Waste oil / hydrocarbon mixtures / emulsions in water.

6.7 Validation

Validation of the remedial works, will be an integral part of the works, to demonstrate that the remediation objectives have been achieved. Details of the validation program are provided in Section 7.

6.8 Backfilling of Excavations

Upon confirmation of soil validation, excavations will be reinstated using a combination of validated material from onsite and validated imported fill (if required). Reinstated materials will be backfilled in layers of 0.5 m and compacted to the site engineers satisfaction, this is should be to a minimum standard 95% compaction.

The excavations will be finished level with the surrounding site surface, re-pavement is not necessary.

6.9 Site Dis-establishment

On completion of the remediation works all plant/equipment and safety/environmental controls shall be removed from the site. Details are provided in the Site Management Plan in Section 9.



7 Validation Plan

7.1 Soil Sampling Methodology

Samples of near surface material and stockpiled soils shall be collected by appropriately trained and experienced personnel using of a stainless steel hand trowel or by hand using nitrile gloves. The hand trowel will be thoroughly decontaminated using phosphate free detergent and distilled water before each sample is collected. Where deeper soil samples are required on excavation walls, these shall be collected using an excavator. Samples shall be collected from the centre of the excavator bucket ensuring that no part of the sample has contacted the sides of the excavator bucket.

Sufficient sample material will be collected to allow both field and laboratory analyses. Additional samples will be collected from any soil horizons which exhibit staining, odours, or other physical evidence of potential contamination.

During the collection of soil samples, features such as seepage, discolouration, staining, odours and other indications of contamination will be noted on the field documentation. Collected soil samples will be immediately transferred to laboratory supplied 250mL sample jars and filled to the top to minimise headspace. The sample containers will be transferred to a chilled esky for sample preservation prior to and during shipment to the testing laboratory. A chain-of-custody form will be completed and forwarded with the samples to the testing laboratory.

7.2 Groundwater Sampling Methodology

The three onsite monitoring wells were previously developed using a stainless steel bailer on 15/1/2014. The stainless steel bailer was cleaned with a Decon-90 Wash mixture and rinsed with water between each well. Between 30 L and 40 L of water was removed from MW1, MW2 and MW3 during development.

The three onsite wells were then gauged one week later on 24 January 2013 using an interface probe prior to purging and sampling. The wells were then purged until groundwater quality parameters stabilised to within 10% (or ± 0.1 pH unit) of the previous reading, using a low flow peristaltic pump to minimise losses of VOCs.

The three onsite wells were gauged again by ES on 9 August 2016 prior to preparation of this RAP using an interface probe with each of them recording no observable impact or detectable odour (PID <0ppm.)

Sampling of the three wells is proposed for validation purposes. Wells will be purged (approximately 3-5 times the well volume until the measured water quality parameters stabilise) prior to sampling using a low flow sampling (minimal drawdown) method using a Micropurge or Peristaltic pump in accordance with ES Standard Operating Procedures (SOP-07) for Groundwater Sampling which have been derived from national and international standards including:

- *Australian Standard AS/NZS 5667.11:1998 ISO 5667-11:1993 Water quality—Sampling Part 11: Guidance on sampling of groundwaters;*
- *USEPA (1996) Low-flow (minimal drawdown) Groundwater Sampling Procedures;*
- *VIC EPA (2000) Groundwater Sampling Guidelines; and*
- *Geoscience Australia (2009), Groundwater Sampling and Analysis – A Field Guide.*



Water quality parameters will be recorded during sampling including pH, redox potential, electrical conductivity, dissolved oxygen and temperature. Disposable tubing will be used at each monitoring well and the interface probe will be thoroughly decontaminated between gauging and sampling events with a phosphate free detergent (Decon-90) and rinsed with potable water.

Samples will be collected directly into appropriately preserved laboratory supplied sampling containers. The samples for metals analysis will be filtered in the laboratory using a 0.45 micron millipore filter unit prior to analysis.

Field records of the purging and sampling event will be provided in the validation report.

7.3 Proposed Validation Sampling and Analytical Program

NATA accredited labs are to be used for all laboratory analyses. Any method not NATA accredited will require justification.

Laboratory analysis of samples will be conducted with reference to COPCs listed in

Table 7-1.

The proposed soil and groundwater validation sampling and analytical program is outlined in

Table 7-1.

Table 7-1 Soil and Groundwater Validation Sampling and Analytical Program

Item	Proposed Sample frequency (Minimum Requirement)			Analytes	ES Primary Sample Allowance
	Excavated Floors	Excavated Walls	Materials		
UST Pits (4 USTs)	2/UST	1/ Wall (per 5m linear) of UST excavation repeated at 2m depth if required. Replicated for each substrate change within excavation.	N/A	TPH/BTEX/PAHs/ lead	24
Fuel Lines (~30m)	1/5m linear	N/A	N/A	TPH/BTEX/PAHs/ lead	6
Remote Fill point area (1 identified)	1/point	N/A	N/A	TPH/BTEX/PAHs/ lead	1
UST Pit water (4)	1/UST	N/A	N/A	TPH/BTEX/PAHs/ lead	4
Beneath AST (1)	1/AST	N/A	N/A	TPH/BTEX/PAHs/ lead	5



Item	Proposed Sample frequency (Minimum Requirement)			Analytes	ES Primary Sample Allowance
	Excavated Floors	Excavated Walls	Materials		
Bowers/Pumps (6)	1/pump	N/A	N/A	TPH/BTEX/PAHs/ lead	6
Workshop Hoists (1 identified, no pits identified)	1/5m linear	1/ Wall (per 5m linear) of excavation repeated at 2m depth if required.	N/A	TPH/BTEX/PAHs/ VOCs/lead	5
Identified Areas of Concern for contaminated soil removal (BH2 ~Area 20m ² ~35m ³)	1/25m ²	1/5m linear	N/A	TPH/BTEX/PAHs/ lead	6
Additional excavations for contaminated soil removal	1/25m ²	1/5m linear	N/A	TPH/BTEX/PAHs/ VOCs/lead	0
Treated UST backfill sands to be reused on site	N/A	N/A	1/25m ³ or part thereof	TPH/BTEX/PAHs/ lead	0
Imported Soils (VENM) for backfill	N/A	N/A	Min. 3 composite samples per source site*	8 metals/TPH/BTEX PAHs/OCs/OPPs/PCBs Asbestos	0
Total Primary Soil Sample Allowance (Est. only from review of ES, 2014 report)				As above	57
Total Primary Groundwater Sample Allowance (Sampling from 3 existing monitoring wells – MW1, MW2 and MW3 on southern site boundary)				TPH, BTEX, PAH, lead	3
Total Quality Control (QC) Samples (based on min. NEPM 2013 requirements as outlined in Table 7-5)					10

7.4 Laboratory Analysis and Methods

The tables in this section list the laboratory analytical methods for soil and groundwater at the proposed Primary and Secondary laboratories for this project.

Table 7-2 Laboratory methods for soils (Primary Laboratory - Envirolab)

Method ID	Methodology Summary (Envirolab)	Analyte(s)	LOR (Envirolab)
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Method ID	Methodology Summary (Envirolab)	Analyte(s)	LOR (Envirolab)
Org-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.	naphthalene	1 mg/kg
Metals-021 CV-AAS	Determination of Mercury by Cold Vapour AAS.	Mercury	0.1 mg/kg
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.	TRHC6 - C9 TRHC6 - C10 Benzene Toluene Ethylbenzene m+p-Xylene o-Xylene	25 mg/kg 25 mg/kg 0.2 mg/kg 0.5 mg/kg 1 mg/kg 2 mg/kg 1 mg/kg
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater. Note Naphthalene is determined from the VOC analysis.	TRHC10 - C14 TRHC15 - C28 TRHC29 - C36 TRH >C10-C16 TRH >C16-C34 TRH >C34-C40	50 mg/kg 100 mg/kg 100 mg/kg 50 mg/kg 100 mg/kg 100 mg/kg
Org-012 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.	PAHs in Soil (unless otherwise indicated) Benzo(b+k)fluoranthene Benzo(a)pyrene	0.1 mg/kg 0.2 mg/kg 0.05 mg/kg
Metals-020 ICP-AES	Determination of various metals by ICP-AES.	Arsenic Cadmium Chromium Copper Lead Mercury Nickel Zinc	4 mg/kg 0.4 mg/kg 1 mg/kg 1 mg/kg 1 mg/kg 0.1 mg/kg 1 mg/kg 1 mg/kg
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard	Asbestos in Soil	No visible asbestos for surface soil
Inorg-001	pH- Measured using pH meter and electrode in accordance with APHA 22 nd Ed, 4500- H+	pH	-
Metals-009	Determination of exchangeable cations and cation exchange capacity in soil based on Rayment and Lyons 2011	CEC	1 meq/100g

Table 7-3 Laboratory Methods for Soils (Secondary Laboratory – Advanced Analytical)

Method ID	Method Description	Analyte Description	LOR
04-001	Metals by ICP-OES	Arsenic	1 mg/kg
		Cadmium	1 mg/kg
		Chromium	1 mg/kg
		Copper	1 mg/kg
		Lead	1 mg/kg
		Nickel	1 mg/kg
		Zinc	1 mg/kg
04-002	Mercury by CVAAS	Mercury	0.1 mg/kg



Method ID	Method Description	Analyte Description	LOR
04-021	TRH C6-9 & BTEX by P&T GCMS	Benzene	0.2 mg/kg
		Toluene	0.2 mg/kg
		Ethyl Benzene	0.2 mg/kg
		m+p xylenes	0.4 mg/kg
		o-xylene	0.2 mg/kg
		Total BTEX	1.2 mg/kg
04-047	VOC compounds by P&T GCMS	Naphthalene	0.4 mg/kg
04-021	TRH C6-9 & BTEX by P&T GCMS	TRH C6-C10	25 mg/kg
04-020	TRH by GC-FID	TRH >C10-C16	50 mg/kg
		TRH >C16-C34	100 mg/kg
		TRH >C34-C40	100 mg/kg
04-022	PAHs & Phenols by GCMS	Naphthalene	0.5 mg/kg
		Acenaphthylene	0.5 mg/kg
		Acenaphthene	0.5 mg/kg
		Fluorene	0.5 mg/kg
		Phenanthrene	0.5 mg/kg
		Anthracene	0.5 mg/kg
		Fluoranthene	0.5 mg/kg
		Pyrene	0.5 mg/kg
		Benz(a)anthracene	0.5 mg/kg
		Chrysene	0.5 mg/kg
		Benzo(b)&(k)fluoranthene	1 mg/kg
		Benzo(a)pyrene	0.5 mg/kg
		Indeno(1,2,3-cd)pyrene	0.5 mg/kg
		Dibenz(a,h)anthracene	0.5 mg/kg
		Benzo(g,h,i)perylene	0.5 mg/kg
		Coronene*	0.5 mg/kg
		Benzo(e)pyrene*	0.5 mg/kg
		Perylene*	0.5 mg/kg

Table 7-4 Laboratory methods for water (Primary Laboratory - Envirolab)

Method ID	Methodology Summary	Analyte(s)	LOR mg/L (Envirolab)
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater. Note Naphthalene is determined from the VOC analysis.	TRHC10 - C14 TRHC15 - C28 TRHC29 - C36 TRH >C10-C16 TRH >C16-C34 TRH >C34-C40	50 mg/L 100 mg/L 100 mg/L 50 mg/L 100 mg/L 100 mg/L
Org-012 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.	PAHs in Water (unless otherwise indicated) Benzo(b+k)fluoranthene	1 mg/L 2 mg/L
Org-013	Water samples are analysed directly by purge and trap GC-MS.	VOCs in water (unless otherwise indicated) Dichlorodifluoromethane Chloromethane Vinyl Chloride Bromomethane Chloroethane Trichlorofluoromethane Naphthalene	1 mg/L 10 mg/L 10 mg/L 10 mg/L 10 mg/L 10 mg/L 10 mg/L 1 mg/L



Method ID	Methodology Summary	Analyte(s)	LOR mg/L (Envirolab)
Org-016	Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.	TRHC6 - C9 TRHC6 - C10 Benzene Toluene Ethylbenzene m+p-Xylene o-Xylene	10 mg/L 10 mg/L 1 mg/L 1 mg/L 1 mg/L 2 mg/L 1 mg/L
Metals-022 ICP-MS	Determination of various metals by ICP-MS.	Lead – Dissolved	1 mg/L

Table 7-5 Laboratory Methods for Water (Secondary Laboratory – Advanced Analytical)

Method ID	Methodology Description	Analyte Description	LOR
04-003	Metals by ICP-OES	Lead - Total	0.006 mg/L
04-021	TRH C6-9 & BTEX by P&T GCMS	Benzene Toluene Ethyl Benzene m+p xylenes o-xylene Total BTEX TRH C6-C10	1 µg/L 2 µg/L 2 µg/L 4 µg/L 2 µg/L 11 µg/L 25 µg/L
04-030	TRH by GC-FID	TRH >C10-C16 TRH >C16-C34 TRH >C34-C40	50 µg/L 100 µg/L 100 µg/L
04-047	VOC compounds by P&T GCMS	Naphthalene	4 µg/L
04-031	PAHs & Phenols by GCMS	PAHs Naphthalene Acenaphthylene Acenaphthene Fluorene Phenanthrene Anthracene Fluoranthene Pyrene Benz(a)anthracene Chrysene Benzo(b)&(k)fluoranthene Benzo(a)pyrene Indeno(1,2,3-cd)pyrene Dibenz(a,h)anthracene Benzo(g,h,i)perylene Coronene* Benzo(e)pyrene* Perylene*	1 µg/L 1 µg/L 1 µg/L 1 µg/L 1 µg/L 1 µg/L 1 µg/L 1 µg/L 1 µg/L 1 µg/L 1 µg/L 2 µg/L 1 µg/L 1 µg/L 1 µg/L 1 µg/L 1 µg/L 1 µg/L 1 µg/L

7.5 Rationale for Selection of Soil Validation (Site Assessment) Criteria

The Soil Assessment Criteria (SAC) have been based on the potential for residential development (medium density with minimal access to soils) at the Site as indicated by the client. ES plans to adopt the following Soil Assessment Criteria:

- *NEPM (1999, Amended April 2013) Schedule B (1) Guideline on the Investigation Levels for Soil and Groundwater Health Investigation Level B – residential with minimal opportunities for soil access includes dwellings with fully and permanently paved yard space such as high-rise buildings and flats;*

- *NEPM (1999, Amended April 2013) Schedule B (1) Guideline on the Investigation Levels for Soil and Groundwater, Residential Soil Health Screening Levels A/B;*
- *NEPM (1999, Amended April 2013) Schedule B (1) Guideline on the Investigation Levels for Soil and Groundwater, Ecological Screening Levels (urban residential areas and public open space); NEPC (1999, Amended April 2013) Schedule B (1) Guideline on the Investigation Levels for Soil and Groundwater, Soil-specific Ecological Investigation Levels*

7.5.1 Discussion

The NEPM (2013) HIL/HSLs have been adopted in the absence of site specific remedial criteria and are sufficiently conservative to allow the site to be made suitable for medium density residential land use. No validation criteria has been provided for offsite (open space, residential) soils as this RAP does not cover remediation of offsite soil and groundwater.

The soil concentrations will also be assessed against the HSLs B to evaluate the risk posed from vapour intrusion. The NEPM has generally adopted the Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC Care) HSLs for soil with some minor deviations. The soil HSLs are based on depth of impacts, overlying soil type and land use. The selection of HSL B was based on the intended use of the site, the potential receptor/s onsite and the exposure that may be experienced. After a review of subsurface conditions the HSLs for clay are considered to be the most appropriate for soils at the site.

Both the EIL and ESL guidelines were selected to evaluate the risk of historical practices at the site (importation of fill) to terrestrial ecosystems within the initial 2m bgl. It is noted that the EILs were calculated for the site in ES 2014 in accordance with the methodology outlined in the NEPM 2013 Schedule B1 Section 2.5 and B5c these were also utilised within this RAP. Additionally, the appropriate soil guidelines are those outlined in the NEPM (2013) Soil HIL B as the proposed future use of the site is medium density residential with assumed minimal opportunity for soil access.

Management limits (ML) have also been adopted because of both the former and currently in-situ abandoned USTs at the site. ML are used to consider the potential formation of light non aqueous phase liquids, fire and explosion risks and damage to buried infrastructure. Fine-grained soil type was selected due to the soil types observed at the site during intrusive works.

The Soil Assessment Criteria (SAC) for Validation are presented in **Table 7-6** below.

Table 7-6 Soil Criteria (all units in mg/kg) – Fine soil/Clay

Analyte	SAC (mg/kg)			EIL/ESL ³	Source
Depth dependent criteria	0 to <1m	1 to <2m	2 to <4m		
BTEX					
Benzene	0.7	1	2	65	NEPM (2013) HSL B ¹
Toluene	480	220	NL	105	NEPM (2013) HSL B ¹
Ethylbenzene	NL	NL	NL	125	NEPM (2013) HSL B ¹
Xylene	110	310	NL	45	NEPM (2013) HSL B ¹
TRH					
TRH C ₆ -C ₁₀ (less BTEX)	50	90	150	180	NEPM (2013) HSL B ¹



Analyte	SAC (mg/kg)			EIL/ESL ³	Source
TRH >C ₁₀ -C ₁₆ (less naphthalene)	280	NL	NL	-	NEPM (2013) HSL B ¹
Non Depth dependent criteria					
TRH C ₆ -C ₁₀	800	Fine		120	NEPM (2013) Management Limit ²
TRH >C ₁₀ -C ₁₆	1,000	Fine		120	NEPM (2013) Management Limit ²
TRH >C ₁₆ -C ₃₄	3,500	Fine		1,300	NEPM (2013) Management Limit ²
TRH >C ₃₄ -C ₄₀	10,000	Fine		5,600	NEPM (2013) Management Limit ²
PAHs					
Naphthalene	5	NL	NL	170	NEPM (2013) HSL B ¹
Benzo(a)pyrene (TEQ)	4			-	NEPM (2013) HIL B
Benzo(a)pyrene	-			0.7	
Total PAH	400			-	NEPM (2013) HIL B
Metals					
Arsenic	500			100 ³	NEPM (2013) HIL B
Cadmium	150			-	NEPM (2013) HIL B
Chromium	500			400 ³	NEPM (2013) HIL B
Copper	30,000			210 ³	NEPM (2013) HIL B
Lead	1,200			1,100 ³	NEPM (2013) HIL B
Nickel	1,200			270 ³	NEPM (2013) HIL B
Zinc	60,000			700 ³	NEPM (2013) HIL B
Mercury	120			-	NEPM (2013) HIL B
Asbestos ID	Non detect				

Table Notes:

- 1 Soil HSL for vapour intrusions. The site's geology consists of mostly fine texture clay soils and fill materials. The HSLs for a clay matrix have been adopted for an initial screening purposes.
 - 2 Management Limit adopted for Coarse Soils adopted for the sake of conservatism.
 - 3 NEPM ASC (2013) Schedule B (1) Guideline on the Investigation Levels for Soil and Groundwater Ecological Investigation Level (EILs) EILs were calculated for the site in accordance with the methodology outlined in the NEPM 2013 Schedule B1 Section 2.5 and B5c.
 - 4 Asbestos criteria of non-detect adopted for initial screening purposes
- NL – Non-limiting. No limit specified.
HSL – Health Based Screening Level.
HIL – Health Investigation Level.
TEQ – Toxicity Equivalency Quotient

7.5.2 Application of Soil Criteria

For soil to be considered as validated (i.e., not posing an unacceptable risk), either: all reported concentrations are below the site remediation criteria; or the following statistical criteria shall be adopted with respect to the health based criteria:

- *The upper 95% confidence limit on the average concentration for each analyte (calculated for samples collected from consistent soil horizons, stratigraphy or material types) must be below the adopted criterion;*
- *No single analyte concentration shall exceed 250% of the adopted criterion; and*
- *The standard deviation of the results must be less than 50% of the criterion.*



In addition to the numerical criteria, consideration shall be given to the presence of odorous soils (caused by contamination) and anthropogenic inclusions (rubble and deleterious matter).

7.5.3 Imported Soil Criteria

The importation of material to reinstate excavations may be necessary during the proposed remediation works. In accordance with current NSW EPA policy, only material that does not represent an environmental or health risk at the receiving site may be considered for beneficial re-use. In accordance with this requirement, only Virgin Excavated Natural Material (VENM) or material approved as beneficial re-use may be imported to reinstate the excavations.

7.6 Groundwater Investigation and Validation Criteria

Groundwater Assessment Criteria are selected to mitigate risks to human health and ecological receptors. ES adopted criteria from the *NEPC (1999, Amended April 2013)* to assess the risk of vapour intrusion due to potential contamination of groundwater by BTEX, TPH, PAH and lead: *NEPM (April 2013) NEPM (1999) Schedule B (1) Guideline on the Investigation Levels for Soil and Groundwater, Groundwater Health Screening Levels for Vapour Intrusion*.

In accordance with the *NEPM (1999, Amended April 2013) Schedule B (6) Guidelines on Risk Based Assessment of Groundwater Contamination* it is necessary to determine the relevant environmental values and hence appropriate guideline assessment criteria for the site.

To determine the most appropriate Groundwater Assessment Criteria (GAC), ES considered the environmental values presented in **Table 7-7**. These have been referenced from Appendix 2 of *NSW DEC (2007) Guidelines for the Assessment and Management of Groundwater Contamination* and the *NEPM (1999, Amended April 2013) Schedule B (6)*.

Table 7-7 Assessment of Environmental Values Associated with Site Groundwater

Environmental Values	ES Comment
Aquatic Ecosystems (Freshwater and Marine Water)	The nearest watercourses are the Duck River approximately 1500m ENE and an unnamed, channelised headwater tributary of Prospect Creek above the Georges River, approximately 600m SW.
Human Uses (Drinking Water)	Four private monitoring bores are installed approximately 300m west of the Site. No groundwater depth or quality data was recorded in the bore information records.
Agricultural Use – Stock Watering and irrigation	The land zoning within a 500m radius of the Site includes open space, recreation, special uses, business, industrial and residential zones. It does not include agricultural or rural land uses with a likelihood of agricultural stock watering or irrigation activities.
Cultural and Spiritual Values	ES is not aware of any cultural / spiritual values associated with the surface and / or groundwater in this area.

Bearing the above in mind, ES consider that for the protection of environmental values the most appropriate guideline values to be applied in relation to the Site is the most sensitive of the ANZECC Fresh Water Criteria using 95% Limit of Protection referenced in the *NEPC (April*



2013) NEPM (1999) Schedule B(1) Guideline on the Investigations Levels for Soil and Groundwater as Groundwater Investigation Levels for Fresh Waters in Slightly Disturbed Ecosystems. Applying the criteria for Slightly Disturbed Ecosystems is considered to be a conservative approach for groundwater in an urban/industrial area which may potentially discharge ultimately to surface waters of the Georges River catchment.

- *NEPM (1999, Amended April 2013) Schedule B (1) Guideline on the Investigation Levels for Soil and Groundwater, Groundwater Investigation Levels for Fresh Waters in Slightly Disturbed Ecosystems*
- *NEPM (1999, Amended April 2013) Schedule B (1) Guideline on the Investigation Levels for Soil and Groundwater, Groundwater Health Screening Levels for Vapour Intrusion*

7.6.1 Discussion

GILs have been selected as an initial screening level as they provide concentrations which once exceeded require further investigation into points of extraction and use. With respect to use of groundwater for human purposes, the site is located within a residential area that has ready access to a potable reticulated water source. Furthermore, with in ES 2014 it was noted that no registered groundwater abstraction bores existed within a 0.5km radius of the site. As such, the groundwater at the site, and within the immediate region, is considered unlikely to be used for drinking water. Given these factors the GILs for drinking water are not considered to be applicable to the site, while the GIL for freshwater aquatic ecosystems are applicable as they apply to typically slightly too moderate disturbed systems, of which the site is located.

In relation to the above description of the HSL selection for the site, HSL B will also be applied for screening of groundwater analytical concentrations for the potential of vapour intrusion. A review of the well installation log for MW1, MW2 and MW3 indicates that the wells are installed within clay at approximately 1.2 and 1.4m bgl. In this case a conservative approach has been adopted and the relevant HSLs for clay have been adopted to allow for preliminary screening.

7.6.2 Application of Groundwater Criteria

For groundwater to be considered as validated (i.e., groundwater concentrations reduced and stabilised or below the adopted assessment criteria) all reported concentrations are below the adopted criteria for three consecutive monitoring rounds or reduction/static conditions in three consecutive (tri-annually, 1 round each 4 months over a 12 month period) rounds by statistically justified downward or flat trend in concentrations.

The adopted groundwater validation criteria have generally been chosen by selecting the most sensitive (lowest) criterion for each of the individual contaminants of concern. There is one exception to this general rule:

- *In the case where the laboratory limit of reporting (LOR) is less than the most sensitive criterion for an individual contaminant of concern, then the LOR has been used as the adopted groundwater acceptance criteria.*

The groundwater investigation and validation criteria has been summarised in **Table 7-8** below.



Table 7-8 Groundwater Investigation and Validation Criteria (ug/L)

Analyte	GAC (ug/L) Residential	GAC (ug/L) Open Space	GAC (ug/L) Commercial/Industrial
	Onsite and Neighbouring Residential	Road & footpath (Offsite)	Neighbouring (Offsite)
Benzene	800 ¹ / 950 ⁴ / 10 ⁷	NL ²	5,000 ³
Toluene	NL ¹ / 180 ⁶	NL ²	NL ³
Ethylbenzene	NL ¹ / 80 ⁶	NL ²	NL ³
Xylenes	NL ¹ / 550 ⁴	NL ²	NL ³
TRH C₆-C₁₀ (less BTEX)	1,000 ¹	NL ²	6,000 ³
TRH >C₁₀-C₁₆ (less naphthalene)	1,000 ¹	NL ²	NL ³
Naphthalene	NL ¹ / 16 ⁴	NL ² / 16 ⁴	NL ³ / 16 ⁴
Lead	3.4ug/L ⁸	3.4ug/L ⁸	3.4ug/L ⁸

Table Notes:

1 NEPM (2013) Health Screening Level (HSL) A - Residential.

2 NEPM (2013) HSL C – Open Space.

3 NEPM (2013) HSL D – Commercial/Industrial.

4 ANZECC (2000) 95% Freshwater

5 Limit of Reporting (LOR) Used as screening criteria

6 ANZECC (2000) 95% Freshwater – Low Reliability criteria adopted as there is insufficient data to derive a reliable trigger value.

7 ANZECC (2000) Recreational Water Quality

8 NEPM 2013/ANZECC 2000 Groundwater Investigation Level (GIL) Marine Receiving Waters – 95% Level of Protection of Species

9 NL – Non-limiting. No limit specified.

HSL – Health Based Screening Level.

The site's geology consists of clay and sandstone. The HSLs for a sand matrix have been adopted for all depth profiles for the sake of conservatism

Site standing groundwater is at approximately 3.0m below ground level. The 2 to <4m category has been adopted.

7.7 Quality Assurance / Quality Control

The purpose of utilising QA/QC samples is to identify any contaminants that may be introduced into the soil and groundwater samples during bottle handling, sampling collection, sample handling, or laboratory analytical procedures.

To assess the usability of the data prior to making decisions, the data will be assessed against pre-determined Data Quality Indicators (DQIs) for completeness, comparability, representativeness, precision and accuracy.

The pre-determined Data Quality Indicators (DQIs) established for the project are discussed below in relation to precision, accuracy, representativeness, comparability, completeness and sensitivity (PARCCS parameters), and are shown in Table 7-9.

- *Precision - measures the reproducibility of measurements under a given set of conditions. The precision of the laboratory data and sampling techniques is assessed by calculating the Relative Percent Difference (RPD) of duplicate samples.*
- *Accuracy - measures the bias in a measurement system. The accuracy of the laboratory data that is generated during this study is a measure of the closeness of the analytical results obtained by a method to the 'true' value.*



Accuracy is assessed by reference to the analytical results of laboratory control samples, laboratory spikes and analyses against reference standards.

- *Representativeness –expresses the degree which sample data accurately and precisely represents a characteristic of a population or an environmental condition. Representativeness is achieved by collecting samples on a representative basis across the site, and by using an adequate number of sample locations to characterise the site to the required accuracy.*
- *Comparability - expresses the confidence with which one data set can be compared with another. This is achieved through maintaining a level of consistency in techniques used to collect samples; and ensuring analysing laboratories use consistent analysis techniques; and reporting methods.*
- *Completeness – is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is set at there being sufficient valid data generated during the study.*
- *Sensitivity – expresses the appropriateness of the chosen laboratory methods, including the limits of reporting, in producing reliable data in relation to the adopted site assessment criteria.*

Table 7-9 Summary of Data Quality Indicators for Soil and Groundwater Validation Program

Data Quality Objective	Frequency	Data Quality Indicator
<u>Precision</u>		
Blind duplicates (intra laboratory)	1 / 20 samples	30-50% RPD ¹
Split duplicates (inter laboratory)	1 / 20 samples	30-50% RPD ¹
Trip blank	1 / site media / sampling event	<LOR
Trip spike	1 / site media / sampling event	70-130%
Rinsate blank	1 / media / sampling event	<LOR
Laboratory duplicate	1 per lab batch	30-50% RPD ¹
<u>Accuracy</u>		
Surrogate spikes	All organic analytes	70-130% recovery
Matrix spikes	1 per lab batch	70-130% recovery
<u>Laboratory control samples</u>	1 per lab batch	70-130% recovery
<u>Representativeness</u>		
Sampling appropriate for media and analytes	All media / analytes	-
Laboratory blanks	1 per lab batch	<LOR
Samples extracted and analysed within holding times.	All samples	14 days for soil/7 days for groundwater analysis for organics 6 months for inorganics
<u>Comparability</u>		
Standard operating procedures for sample collection & handling	All Samples	All samples
Standard analytical methods used for all analyses	All Samples	All samples
Consistent field conditions, sampling staff and laboratory analysis	All Samples	All samples
Limits of reporting appropriate and consistent	All Samples	All samples
<u>Completeness</u>		



Data Quality Objective	Frequency	Data Quality Indicator
Sample description and COCs completed and appropriate	All Samples	All samples
Appropriate documentation	All Samples	All samples
Satisfactory frequency and result for QC samples	All QA/QC samples	95%
Data from critical samples is considered valid	All samples	Critical samples valid
<u>Sensitivity</u>		
Analytical methods and limits of recovery appropriate for media and adopted site assessment criteria	-	LOR<Site assessment criteria

Notes:

- 1 If the RPD between duplicates is greater than the pre-determined data quality indicator, a judgment will be made as to whether the excess is critical in relation to the validation of the data set or unacceptable sampling error is occurring in the field.

7.8 Validation Reporting

At the completion of the remedial works a Validation Report will be prepared in general accordance with the *NSW EPA Guidelines for Consultants Reporting on Contaminated Sites (OEHS 2011)*, documenting the works as completed. This report will contain information including:

- *Details of the remediation works conducted;*
- *Information demonstrating that the objectives of the RAP have been achieved, in particular the validation sample results and assessment of the data against both the pre-defined data quality objectives and the remediation acceptance (validation) criteria;*
- *Information demonstrating compliance with appropriate regulations and guidelines;*
- *Any variations to the strategy undertaken during the implementation of the remedial works;*
- *Details of any environmental incidents occurring during the course of the remedial works and the actions undertaken in response to these incidents;*
- *Asbestos clearance certificates (if required); and*
- *Other information as appropriate, including requirements (if any) for ongoing monitoring / management.*

The report will serve to document the remediation works for future reference.



8 Contingency Plan

A review of remediation works has been undertaken to identify potential risks to meeting the specified site validation criteria. A number of potential risks have been identified. These are listed following with contingencies that will be implemented to ensure that validation criteria are met.

8.1 Unexpected Finds

The possibility exists for undiscovered hazards to be present at the site.

Environmental sampling is based on chemical analytes identified as a potential concern during a documented process of reviewing historical site activities. However, ground conditions between sampling points may vary, and further hazards may arise from unexpected sources and/or in unexpected locations. The nature of any undiscovered hazards which may be present at the site are generally detectable through visual or olfactory means, for example:

- *Petroleum contaminated soils (staining / discolouration visible);*
- *Volatile Organic Compound contaminated soils (odorous).*
- *Fragments of asbestos-containing materials (visible);*
- *Significant ash and/or slag contaminated soils / fill materials (visible);*
- *Additional USTs that have not been previously identified.*

As a precautionary measure to ensure the protection of the workforce and surrounding community, should any unexpected potentially hazardous substance be encountered the works should cease immediately before being assessed by a suitably qualified and experienced environmental professional.

The sampling strategy for each “unexpected find” shall be designed by a suitably qualified and experienced environmental professional. The strategy will, however, be aimed at determining the nature of the substance – that is, is it hazardous and, if so, at concentrations which pose an unacceptable risk to human health or the environment.

The sampling frequency of the identified substance / materials shall meet the minimum requirements the *NSW EPA Sampling Design Guidelines* (1995).

8.2 Excessive Odours from Works

Based on the possibility of identified petroleum hydrocarbon contaminants identification during UST removal, off- site odour complaints are possible. Where complaints occur the following will be undertaken:

- *Installation of an odour screening / masking system at the site boundaries;*
- *Disturbance of soils during meteorologically favourable periods only; and/or*
- *Covering of impacted soils.*

8.3 Remediation Strategy Unsuccessful

Where additional contamination is encountered during remediation beyond the areas and sampling requirements stated in Table 7-1, additional excavation and validation of



excavations will be required. ES will obtain authorisation to proceed prior to completing additional excavations and disposing of material.

In addition, further monitoring wells would be proposed to determine the extent of any groundwater plumes that are identified during remediation or a qualitative risk assessment completed to determine the risk to receptors from impacted groundwater. In this instance, an ongoing groundwater management plan may also need to be prepared for the site to ensure that the identified plume appropriately managed.



9 Site Management Plan

The following section contains appropriate details to eliminate / manage potential environmental impacts as may be generated by the site remediation works.

9.1 Hours of Operation

Remediation works shall only be permitted during the following hours:

- *Monday to Friday:* 7:00 am to 6:00 pm
- *Saturdays:* 8:00 am to 1:00 pm
- *Sundays and Public Holidays:* No work permitted.

Emergency work is permitted to be completed outside of these hours.

9.2 Soil and Water Management

All works shall be conducted in strict accordance with the soil and water management measures outlined in this section and Bankstown City Council's 'Soil Erosion and Sedimentation Control Guidelines' which outline the requirements for preparation of a soil and water management plan.

To prevent the migration of impacted soil/sediment off site, silt fences shall be constructed at the down-gradient works area boundaries, as per the specifications contained in Managing Urban Stormwater – Soil and Construction Volume 1, 4th Edition, NSW Government, March 2004. Any material which is collected behind the sediment controls shall be treated as potentially contaminated and will be suitably managed.

In a storm event, the sediment controls located on-site will need to be monitored and replaced or altered if necessary. Collected material will need to be suitably managed in accordance with remediation works.

9.2.1 Site Access

During remediation works, perimeter fencing will be maintained to restrict access to the works area. Only authorised persons will be able to enter the works area.

Vehicle access to the works area shall be stabilised to prevent the tracking of soil around the site and the adjoining driveway/access point to the road will be swept or cleaned on an as-needed basis. Any collected materials shall be treated as potentially contaminated and will be suitably managed.

9.2.2 Stockpiles

The following procedures will be implemented:

- No stockpiles of soil or other materials shall be placed on footpaths or nature strips unless prior Council approval has been obtained.
- All stockpiles of soil or other materials shall be placed away from drainage lines, gutters or stormwater pits or inlets.
- All stockpiles of soil or other materials likely to generate dust or odours shall be covered (where practical).
- All stockpiles of contaminated soil shall be stored in a secure area and be covered if remaining more than 24 hours (where practical).

- Stockpiled soil will be assessed for its suitability to be reused as backfill on site. Sampling and laboratory analysis of the stockpiled soil would be conducted in accordance with *NEPM (2013)* with results compared to **Table 7.7, Section 7** and the *NSW EPA(2014) Waste Classification Guidelines*.

9.2.3 Excavation Pump-out

Excavation pump out water (if any) shall be pumped from the excavation by a licensed contractor and disposed of off-site as “liquid waste” in accordance with *NSW EPA (2014) Waste Classification Guidelines*.

All excavation pump-out water must also be analysed for suspended solid concentrations, pH and any contaminants of concern, prior to discharge to the stormwater system. The analytical results must comply with relevant EPA and ANZECC standards for water quality. Other options for the disposal of excavation pump-out water include disposal to sewer with prior approval from Sydney Water, or off-site disposal by a liquid waste transporter for treatment/disposal to an appropriate waste treatment/processing facility

9.2.4 Landscaping/Rehabilitation

All exposed areas shall be progressively stabilised and revegetated or resealed on the completion of remediation works. This is proposed to be managed by the construction contractor after removal of the petroleum infrastructure.

9.2.5 Bunding

Although land farming is not currently proposed, all land farming areas for hydrocarbon-contaminated soils shall be bunded to contain surface water runoff from the land farm areas and to prevent the leaching of hydrocarbons into the subsurface.

9.3 Noise

The remediation works shall comply with the *Protection of the Environment Operations Act 1997 (POEO) Noise Control Regulation 2008* for the control of noise from construction sites.

All machinery and equipment used on site will be in good working order and with the fitted with appropriate silencers when necessary.

9.4 Vibration

The use of plant and machinery shall not cause vibrations to be felt or capable to be measured at the neighbouring premises.

9.5 Air Quality

9.5.1 Dust Control

During the remediation of the petroleum hydrocarbon impacted areas, dust levels will be monitored and minimised by using mist sprays as necessary. Dust shall also be controlled by ensuring vehicles leave via the designated (stabilised) site access point.

9.5.2 Odour

Given the nature of the soils being removed from the site, there may be odour issues. Where complaints occur, the contingency measures associated with odour control will be implemented. This may include additional odour suppression actions will be taken to reduce



the odours as necessary, which may include: increasing the amount of covering of excavations / stockpiles; mist sprays; odour suppressants; or maintenance of equipment.

9.6 Material Transporting

Trucks will be loaded in a designated area away from the contaminated material excavations. The transporting contractor shall ensure that there is no material tracked out onto the street and that the load is securely covered. In addition, all site vehicles must leave the site in a forward direction.

All appropriate road rules shall be observed and state roads will be selected as far as practicable over local roads when deciding on the transport route to the off-site material disposal location.

Where material is to be imported, controls are to be implemented to maintain separation between contaminated and non-contaminated materials.

9.7 Hazardous Materials

All hazardous and/or intractable wastes (if any) shall be removed and disposed of in accordance with the relevant regulatory requirements. In particular, any hazardous wastes will be transported by an EPA licensed transporter.

9.8 Disposal of Contaminated Soil

All soil will be appropriately classified, managed (handled and transported) and disposed in accordance with *NSW EPA (2014) Waste Classification Guidelines*. Waste receipt documentation will be obtained from the waste transporter or the relevant licensed waste facility to track waste volumes from the site to the final disposal destination of the waste.

9.9 Imported Fill

If any materials are required to be imported on site to re-establish existing ground levels, then only material meeting the requirements outlined in Section 7.5.3 will be accepted onto the site.

9.10 Groundwater

Groundwater is not intended to be extracted during remediation works. Groundwater has been previously assessed to not be impacted for the Contaminants of Potential Concern on the downgradient boundary of the site. Any groundwater removed from the site will be analysed and compared to the criteria stated in **Table 7.9** prior to discharge to the local storm water system. Under no circumstance will polluted/ contaminated site water be allowed to discharge to the stormwater system. Prior approval from Sydney Water will be sought before disposing of groundwater to sewer.

9.11 Site Signage and Contact Numbers

Throughout the duration of the works appropriate signage shall be erected around the remediation area with the contact details of the remediation contractor and project manager.

9.12 Complaint Reporting and Resolution

Complaints from adjoining site occupants or workers on site will be directed initially to the remediation contractor on site. Following that, discussion with the environmental consultant and the complainant will investigate the issue and remedy it as required or applicable.



10 Health and Safety

The principal remedial contractor should prepare a separate construction and environmental management Plan (CEMP) prior to the remediation works beginning. The information presented below is not exhaustive and is to be included along with additional relevant information in the CEMP. The objectives of the health and safety plan are:

- *To apply standard procedures that reduce risks resulting from the above works;*
- *To ensure all employees are provided with appropriate training, equipment and support to consistently perform their duties in a safe manner; and*
- *To have procedures to protect other site workers and the general public. These objectives will be achieved by:*
 - *Assignment of responsibilities;*
 - *An evaluation of hazards;*
 - *Establishment of personal protection standards and mandatory safety practices and procedures; and*
 - *Provision for contingencies that may arise while operations are being conducted at the site.*

This health and safety section does not provide safety information specific to construction and other demolition or excavation activities carried out by contractors, such as the safe operation, maintenance and inspection of plant, etc. Contractors will be required to prepare their own Safe Work Method Statements for their work activities. All parties working on the site shall comply with all applicable Health and Safety legislation, regulations, codes and guidelines.

10.1 Responsibilities

Client Supervisor/Manager

The client supervisor/manager is responsible for:

- *Advice on obtaining development approval;*
- *Helping to ensure all works are compliant with the development approval; and*
- *Assisting with community consultation.*

The client supervisor/manager contact details will be provided prior to the works.

Remediation Contractor

The remediation contractor is responsible for:

- *Ensuring all works are undertaken as per the RAP;*
- *Ensuring all works are undertaken in accordance appropriate regulations and standards;*
- *Ensuring all works are undertaken as per the health and safety plan;*
- *Ensuring a copy of the health and safety plan is available at the site during the remediation/validation activities;*



- *Confirming individuals are competent in performing allotted tasks;*
- *Liaison with the client supervisor/manager and contractor representatives, as appropriate, regarding safety matters; and*
- *Investigation and reporting of incidents and accidents.*

The remediation contractor contact details will be provided prior to commencement of works.

Environmental Consultant

The environmental consultant is responsible for:

- *Undertake remediation and validation sampling as per the RAP;*
- *Ensuring consultant works are undertaken as per the health and safety plan;*
- *Liaison with the contractor representatives, as appropriate, regarding safety matters; and*
- *Undertake validation and reporting as per the RAP.*

The environmental consultant contact details are provided in Table 13.1.

Table 10-1 Contact Details

Client's	Details
Supervisor / Manager	
Name	To be advised (TBA)
Company	TBA
Address	TBA
Contact Phone	TBA
Remediation Contractor	
Name	TBA
Company	TBA
Address	TBA
Contact Phone	TBA
Environmental Consultant	
Name	Ben Munro
Company	Environmental Strategies Pty Ltd
Address	Suite 15201 2 Locomotive St Eveleigh NSW 2131
Contact Phone	02 9690 2555

10.1.1 Other Members of the Site Workforce

Every individual worker is responsible for conducting their allocated tasks in a safe manner and in accordance with their training and experience. They must give due consideration to the safety of all others in their proximity and cooperate in matters of health and safety. All workers must leave their work areas in such a condition that the location will not be hazardous to others at any time.



10.2 Hazards

The known or potential hazards associated with the work activities are listed below:

- *Chemical hazards associated with the presence of contaminated soil and fuel tanks;*
- *Physical hazards, including:*
 - *Work in or near excavations;*
 - *Operating machinery;*
 - *Heat stress and UV exposure;*
 - *Underground or overhead services;*
 - *Manual handling; and*
 - *Noise.*

In the event of the discovery of any condition that would suggest the existence of a situation more hazardous than anticipated, or of any new hazard that could potentially cause serious harm to personnel or the environment, work will be suspended until the Project Manager has been notified and appropriate instructions have been provided to field personnel.

10.2.1 Chemical Hazards

The main chemical hazards associated with the remediation/validation works are petroleum hydrocarbons.

When working with contaminated materials in general, care must be taken to ensure that the contamination is not introduced to the worker via ingestion, inhalation or absorption. Appropriate Personal Protective Equipment (PPE) relevant to the task should be worn at all times.

10.2.2 Physical Hazards

Operating Machinery

Heavy plant and equipment operating in the vicinity of field personnel presents a risk of physical injury. Personnel should be cognisant of their position in relation to operating machinery at all times. Personnel must wear high visibility clothing when onsite.

Never walk behind or to the side of any operating equipment without the operator's knowledge. Do not assume that the operator knows your position. Personnel should stay at least 1 m from the operational area of heavy equipment and should not stand directly below any load or piece of equipment (e.g. backhoes, excavators, vehicles).

Work In or Near Excavations

No site personnel are to stand closer than 0.5m to the edge of an excavation. No site personnel are to enter excavation greater than 1 m deep. Additionally, at the end of each day excavations are to be barricaded to prevent access.

Cuts and Abrasions

The manual work associated with the remediation works gives rise to the risk of cuts and abrasions to personnel working in the area. As well as the direct consequences of any cut or abrasion, such injuries can lead to the possibility of exposure to contaminants through the



wound as well as diseases such as tetanus. To minimise the risk of direct or indirect injury, personnel will wear the personal protective equipment described.

Heat Stress and UV Exposure

Site personnel may experience heat stress due to a combination of elevated ambient temperatures and the concurrent use of personal protection equipment; this depends in part on the type of work and the time of year.

In addition to heat stress, overexposure to UV radiation in sunlight can result in sunburn to exposed skin. The use of a high protection sunscreen (SPF15 or greater) on all exposed skin is recommended. Hats (including hard hats in specified areas) will also provide additional sun protection during the peak (i.e. 10:00 am to 3:00 pm) sun period. Sunglasses should be worn (where appropriate) to protect eyes from effects of UV exposure.

Underground Services

There is the potential for underground services (electricity, natural gas lines, water, telephone, sewer, and stormwater) to be present beneath the work area. The remediation contractor shall ensure that appropriate procedures will be taken to minimise the risk associated with excavation near services.

Aboveground Electrical Hazards

All electrical plant and equipment must comply with the requirements of Australian Standard AS 3000. Hand held Portable tools shall comply with AS/NZS 3160 "hand-held Portable electric tools" and shall be double insulated.

Cord connected Portable hand lamps shall comply with AS/NZS 3118. A Residual Current Device (RCD) shall protect plug-in Portable equipment, which is connected to a supply above Extra Low Voltage - 12-24volts (including equipment supplied from a generator or welding set). RCD protection shall be provided during maintenance of Portable electrical equipment at all times while the equipment is connected to a power supply above Extra Low Voltage, irrespective of whether power is switched ON or OFF. RCD's shall comply with AS 3190 and shall be type II units, rated to trip at or below 30 milliamps within 40 milliseconds.

Manual Handling

When lifting or handling heavy objects, use correct lifting techniques, bending the knees not the back. If the item to be lifted is too heavy or awkward for one person to lift, seek assistance from other company employees or use mechanical help.

Noise

Long-term exposure to high levels of noise is unlikely. However, operating machinery may cause significant noise exposures for short periods. Earplugs or earmuffs should be worn in any situation where noise levels make normal conversation difficult.

10.3 Personal Protective Equipment

All workers who may come into direct contact with contaminated soil will wear the following personal protective equipment:

- *overalls or long sleeved collared shirt;*
- *heavy duty outer gloves (e.g. leather) where there is a risk of cuts or abrasions, otherwise PVC outer gloves if in direct contact with contaminated soil;*
- *steel capped boots;*

- 
- *safety glasses;*
 - *high visibility vest or jacket; and*
 - *hard hat.*

It is further noted that additional PPE may be required as part of the WorkCover permitting process. If this occurs, then the above PPE requirements will be upgraded to reflect WorkCover's requirements.

In the event that workers will be exposed to highly odorous soil conditions during remediation works the following additional PPE should be adopted:

- *Impermeable disposable overalls; and*
- *Half or full face respirator with organic vapour cartridge (as per action levels identified in Table 10-2).*

A PID shall be used to monitor the concentrations of VOCs within the workspace, with the following action levels at which the additional PPE mentioned above is required.



Table 10-2 Action Levels for Respirator Use

Instrument	Airborne Levels	Level of Protection
PID	< 1 ppm	No additional protection
PID and/or Dräger or Kitagawa tubes	> 1 ppm	Half or full faced respirator*
PID and/or Dräger or Kitagawa tubes	> 10 ppm** or > 1 ppm on the site boundary	Stop work, cover excavation to minimise production of volatiles

*If action levels exceed the action level following 5 minutes, the use of a respirator is required. Organic respirator cartridge to be changed daily.

** 10 times the benzene exposure limit as recommended by 3M Respirator Selection Guide.

10.4 Decontamination Procedures

The decontamination procedures specified below will be followed whenever personnel, plant or equipment leave the site.

Personnel

The following steps should be taken to ensure personnel do not leave the site with potentially contaminated clothing:

- *wash boots in clean water.*
- *remove outer gloves and store for reuse.*
- *remove overalls (if used) and store for reuse.*
- *remove respirator and goggles (if used) and store clean for reuse or decontamination, as appropriate.*
- *thoroughly wash hands and face.*

If any part of a worker's body comes into direct contact with any potentially contaminated material, the affected part(s) should be immediately washed with clean water.

Vehicle, Plant and Equipment

All equipment, including personal protective equipment, will be washed or otherwise cleaned to ensure that contaminated soil, water or dust is removed before it leaves the Site. All plant and equipment will have their outer bodies thoroughly cleaned of soil and sediment before moving off the site.

10.5 Contamination Control Zone

A contamination control zone will be set-up onsite for tank pull remedial works. All personnel entering the contamination control zone must wear the appropriate PPE as discussed above and monitoring procedures must be in place. The lunch shed and office will be located outside of the contamination control zone and will be designated clean zones. Any personal and plant leaving the contamination zone must undergo appropriate decontamination procedures, in a designated area (decontamination zone) as discussed above, prior to entering the site clean zones. The service station will not be operational during remedial works and therefore not accessible to the public.



11 Regulatory Approvals/Licensing

11.1 State Environment Planning Policy Number 55 (SEPP55) Remediation of Land

The proposed remediation works are considered to be classified as “Category 2” Remediation Works under SEPP55 – Remediation of Land of the Contaminated Land Management (CLM) Act 1997 – i.e., remediation does not require specific consent to be consistent with the Council’s policy on contaminated land management but required notification to Council of works 30 days prior to commencement. Bankstown City Council Policy for the Management of Contaminated Land (2015) specifies that consent is not required as follows:

- *Category 2 remediation is all work that is not defined as category 1 remediation. In accordance with clause 16 of SEPP 55, **Council’s Environment Unit must be notified 30 days prior to the commencement of category 2 remediation work.** Council will record all notification that are received for Category 2 remediation. In addition to the information that must be submitted to Council as stipulated in clause 16(2) of SEPP 55, Council requires the following information to also be submitted before remediation work commences:*
 - *Copies of any Preliminary or Detailed Investigations and Remedial Action Plans for the site.*
 - *Contact details for the remediation contractor and/or party responsible for ensuring compliance of remediation work with all relevant regulatory requirements.*
- *Although consent is not required for Category 2 remediation work, Council will need to be satisfied that the site is suitable for the proposed use when considering any subsequent development applications for the subject site. Hence it is recommended that comprehensive records are maintained during the remediation and validation works for all sites*

11.2 Protection of the Environment Operations Act 1997

In relation to the licensing requirements under the Protection of the Environment Operation Act 1997 (POEO Act):

- The works do not fall within the licensing requirements for Contaminated Soil Treatment Works (i.e. works will not incinerate more than 1,000 m³ of contaminated soil per year, treat and store more than 30,000 m³ of contaminated soil or disturb more than 3 hectares of contaminated soil); and
- The works do not fall within the licensing requirements for Crushing, Grinding or Separating Works (i.e. works will not process more than 150 tonnes of material per day or 30,000 tonnes of material per year).

All material to be excavated and removed from the site (including associated activities such as classification) will be undertaken in strict accordance with the requirements of the POEO Act 1997. Such requirements include:

- Ensuring waste is classified appropriately and in accordance with relevant guidelines;
- Waste materials are disposed of to appropriately licensed facilities; and
- Other materials are removed to facilities lawfully able to accept such materials.



11.3 Protection of The Environment Operations (Underground Petroleum Storage Systems) Regulation 2008

Section 13 of the UPSS (EPA 2008) Regulation specifies a validation report must be sent to the relevant local authority no later than 60 days after the remediation on site is complete. The required validation report must be prepared in accordance with EPA endorsed guidelines. All documentation pertaining to the validation report must be kept for 7 years after completion.

11.4 Protection of The Environment Operations (Waste) Regulation 2005

The regulations make requirements relating to non-licensed waste activities and waste transporting. The proposed works on the site will not require to be licensed. Section 48 of the Regulation requires that wastes are stored in an environmentally safe manner and that vehicles used to transport waste must be covered when loaded.

The Regulation exempts certain waste streams from the full waste tracking and record keeping requirements. Waste tracking is required only for special and restricted solid wastes.

11.5 Waste Classification Guidelines, Part 1: Classifying Waste

All wastes generated shall be classified and managed in accordance with the NSW EPA Waste Classification Guidelines (2014).

11.6 Bankstown City Council Policy for the Management of Contaminated Land

Sections 2.3.3 and 2.3.4 of the Bankstown City Council Policy for the Management of Contaminated Land 2015 require that depending on the extent of contamination and the method of remediation (e.g. containment), there may be a need for continual site monitoring and/or restrictions on the development potential of the land. A proper monitoring program should include a monitoring strategy, the parameters to be monitored, the monitoring locations, the frequency of monitoring and the appropriate reporting requirements, however as a general rule, Council prefers remediation strategies that do not rely on site monitoring.

Council will require the applicant to submit to Council a validation report confirming that the remediation goals established in the RAP have been achieved. The validation report will confirm statistically that the remediated site complies with the clean-up criteria, and does not pose an unacceptable risk to human health or the environment. Where these have not been achieved, reasons for such failure must be stated and additional site work shall be proposed that will achieve the original objectives. The validation report shall also detail any ongoing and Management monitoring requirements for the site. As in accordance with the DCP, it is proposed to remediate the land to a standard that is compatible with the new landuse, such that risks from contaminations are reduced to acceptable levels.

11.7 Voluntary Management Proposal

The site has not been notified to NSW EPA under Section 60 of the Contaminated land Management Act, 1997. Environmental Strategies consider that if the remediation as proposed in this RAP, the site may be made suitable for its intended use.



12 Conclusions

This RAP has been prepared to address the issue of potential contamination associated with the fuel storage facilities located on 138-140 Campbell Hill Rd, Chester Hill NSW.

It is considered that the objectives of the onsite remediation will be achieved subject to the successful implementation of the actions contained in this RAP which will enable ongoing use of the site as medium density residential with minimal access to soils.

It is recommended that this RAP is reviewed and endorsed by a NSW EPA Accredited Site Auditor and Bankstown City Council prior to the commencement of remedial works.

Demolition of above ground structures (buildings and canopy) have not been included in the scope of this RAP and can be finalised by the landowner prior to or after removal of UST infrastructure. This is considered an acceptable approach as the removal and validation of the UST infrastructure is considered to be exclusive of general site demolition.



13 References

- Australia and New Zealand Environment and Conservation Council / National Health and Medical Research Council (ANZECC/NHMRC) 1992. Guidelines for the Assessment and Management of Contaminated Sites
- ANZECC (2000), Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand
- Australia and New Zealand Environment and Conservation Council / National Health and Medical Research Council (ANZECC/NHMRC) 1992. Guidelines for the Assessment and Management of Contaminated Sites
- Australian Standard 4432.1-2005 Guide to the investigation and sampling of sites with potentially contaminated soil, Part: Non-hydrocarbon and semi-hydrocarbon compounds (AS4482 2005)
- Australian Standard AS 4976-2008: The removal and disposal of underground petroleum storage tanks
- Australian Standard AS4897-2008: The design, installation and operation of underground petroleum storage systems
- Australian Standard AS 1940-2004: The storage and handling of flammable and combustible liquids
- Australian Standard AS/NZS 60079.10.1: Explosive atmospheres – Classification of areas – Explosive gas atmospheres
- Australian Standard AS/NZS 60079.29.1: Explosive atmospheres – Gas detectors – Performance requirements of detectors for flammable gases
- ANZECC/NHMRC (1992) Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites;
- Bankstown City Council, Policy for the Management of Contaminated Land, (BCC, 2015).
- Department of Environment and Climate Change (2009) Guidelines on the Duty to Report Contamination Under the Contaminated Land Management Act 1997;
- Environmental Strategies, March 2014 (ES 2014), Due Diligence Phase 1 & 2 Environmental Site Assessment, 138-140 Campbell Hill Rd, Chester Hill, NSW;
- National Environment Protection Council (1999) National Environment Protection Measure (NEPM) 1999 – Assessment of Site Contamination Schedule B (1) and B (2);
- NSW Environment Protection Authority (2006) Guidelines for the Site Auditor Scheme Environment Protection Authority;
- NSW Environment Protection Authority (1995) Sampling Design Guidelines. Environment Protection Authority, Chatswood;
- NSW EPA Waste Classification Guidelines (2014);
- NSW DEC (2007) Guidelines for the Assessment and Management of Groundwater Contamination; and



NSW DECC (2009) Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997.

NSW WorkCover July 2015 Code of practice – Demolition work

NSW WorkCover July 2015 Code of practice – Excavation work

NSW EPA April 2014 Technical Note: Investigation of Service Stations

OEH 2011 Guidelines for Consultants Reporting on Contaminated Sites

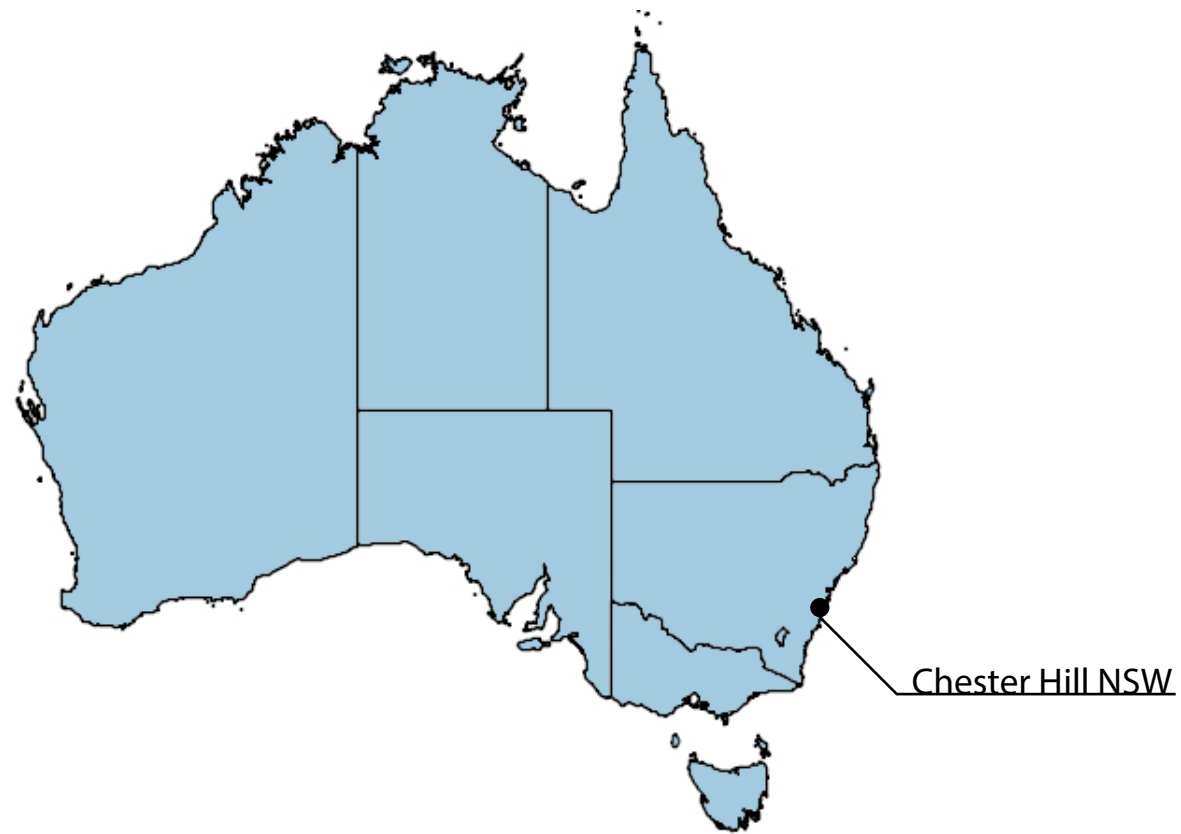
UPSS Technical Note: Site validation reporting (DECCW 2010a)

WorkCover NSW Dangerous Goods License 35/013682

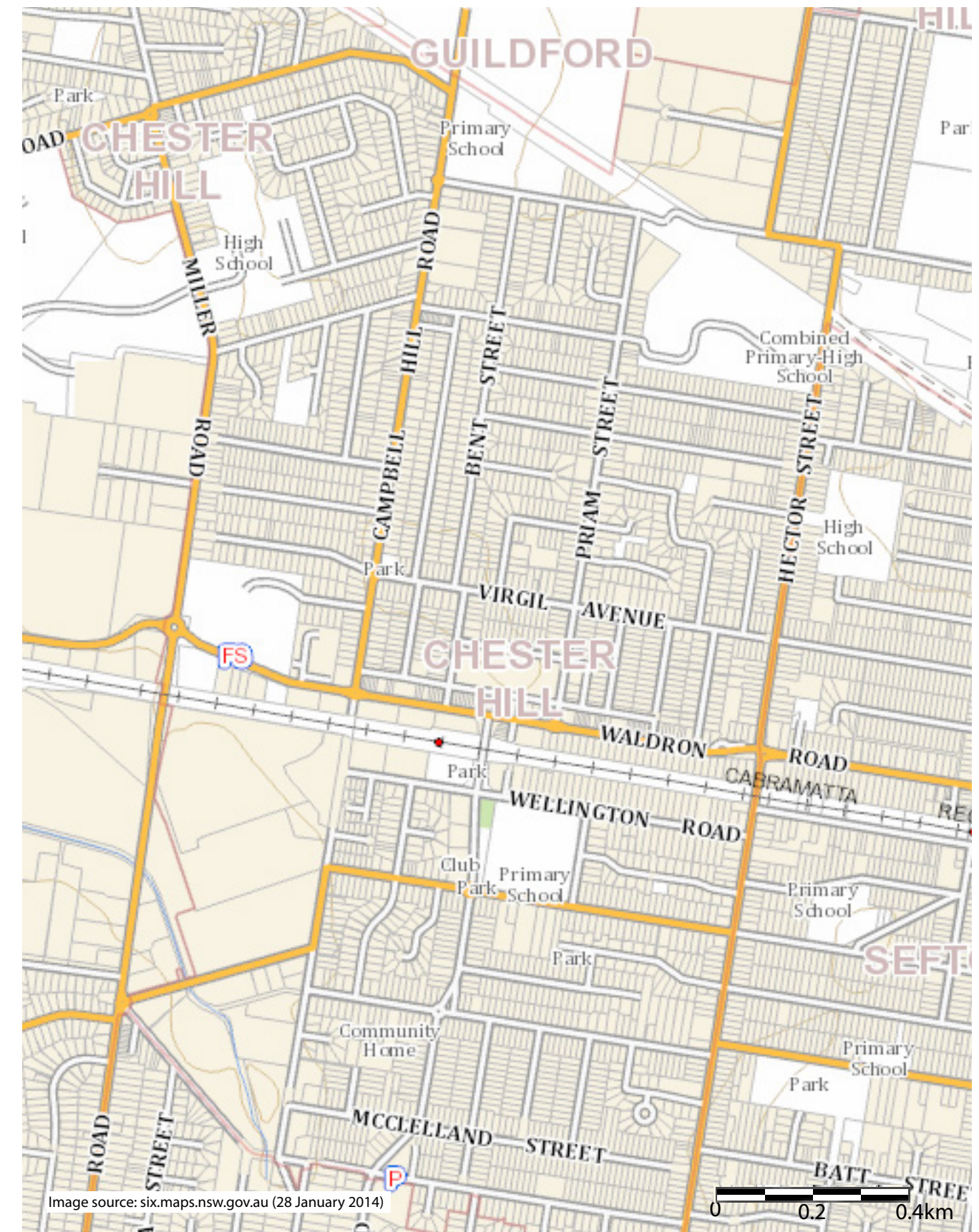
APPENDIX A – SITE FIGURES

COUNTRY

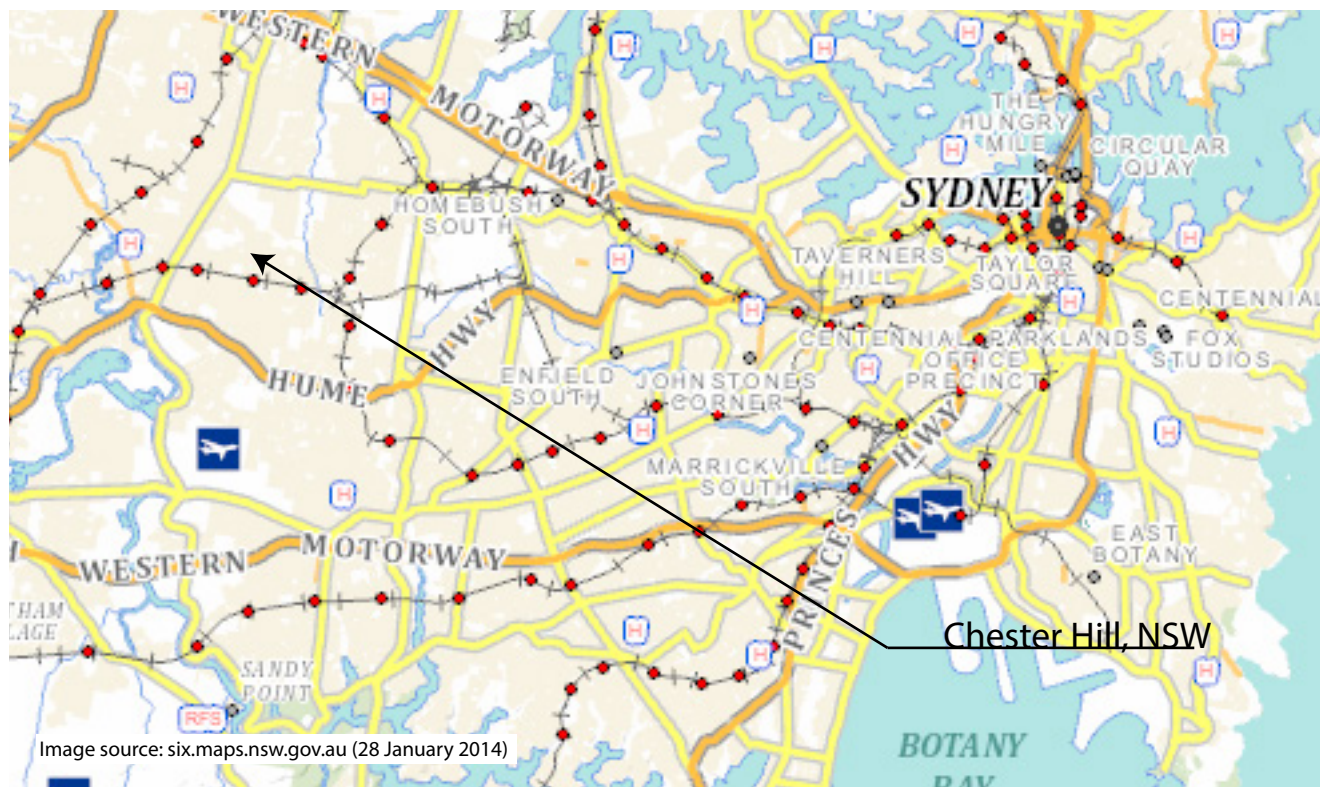
Australia

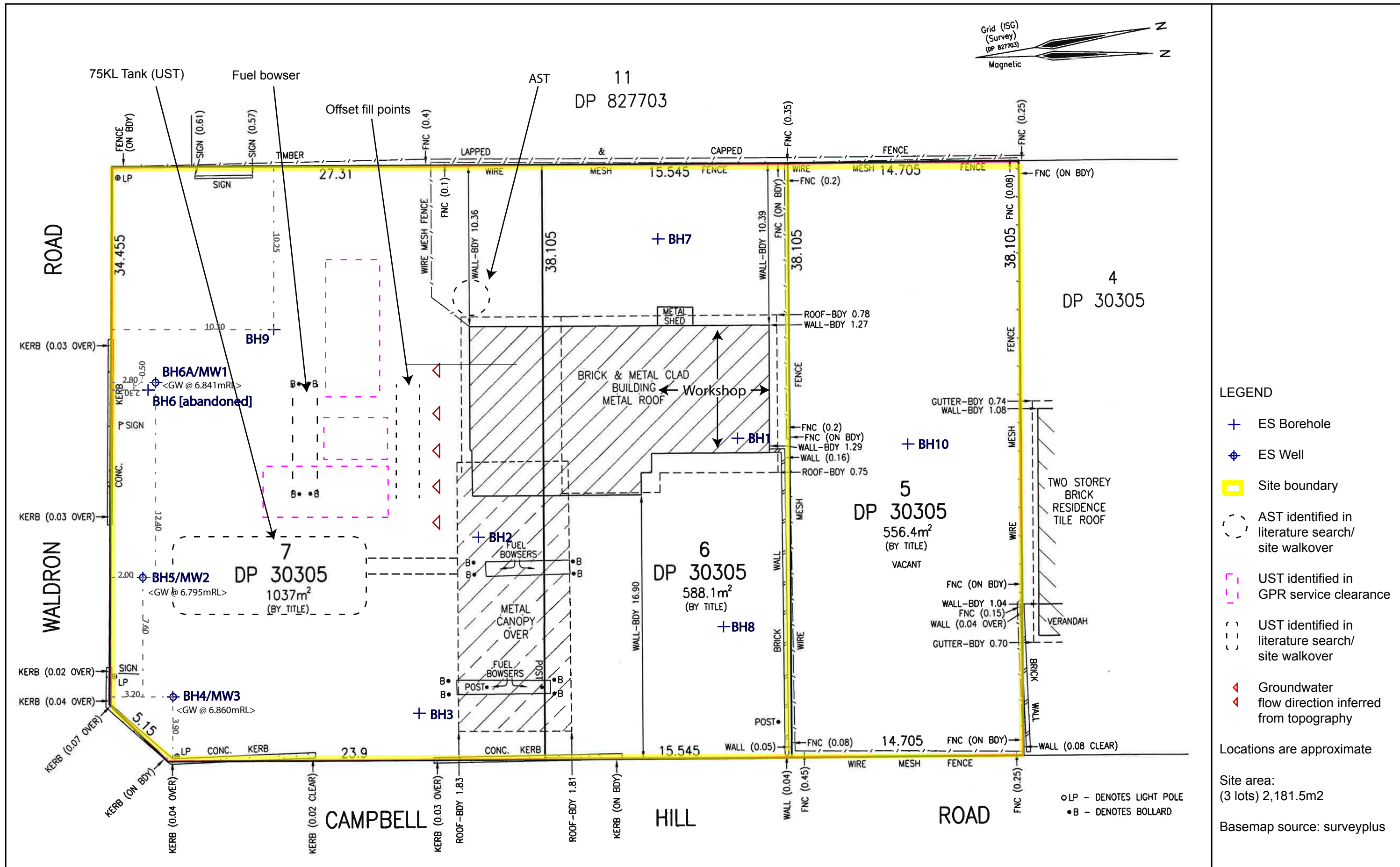


SITE



REGION





APPENDIX B – BORELOGS

Table 1
Groundwater Gauging Results
Environmental Site Assessment
138-140 Campbell Hill Road, Chester Hill NSW

Well ID	Date Measured	Depth to bottom of well (mbtoc)	Pre- / Post-purging	Depth to Water (mbtoc)	Depth to PSH (mbtoc)	PSH Thickness (m)	Product Gravity	Hydraulic Equivalent (m)	Stick up (magl)	Corrected Depth to Water (mbgl)	Relative Level of Top of Casing (mRL)	Water Level (mRL)
MW1	24-Jan-14	6.730	Pre	1.195	-	-	-	-			8.036	6.841
MW2	24-Jan-14	7.400	Pre	1.270	-	-	-	-			8.0645	6.795
MW3	24-Jan-14	6.950	Pre	1.450	-	-	-	-			8.31	6.860

Notes:

MW = Groundwater Monitoring Well

m = metres

mbtoc = metres below top of well casing

mbgl = metres below ground level

mbgl = metres above ground level

mRL = relative level in metres above a zero arbitrary datum

NA = Not Applicable

ID = identification

m = metres

PSH = phase separated hydrocarbons

Pre = pre-purge / pre sampling

Field Equipment Used:

Geotech Interface Probe

Well Gauging Data								
Well ID	Date	pH	Temp (C)	EC (mS/cm)	DO (mg/L)	Eh* (mV)	TDS** (mg/L)	Comments
MW1	24-Jan-14	6.61	25.1	11.18	0.05	303	7.27	Clear, no odour, no sheen; to silty, light brown
MW2	24-Jan-14	6.74	24.4	9.87	0.33	307	6.42	Clear, no odour, no sheen; to silty, light brown
MW3	24-Jan-14	6.79	23.7	8.41	0.21	337	5.47	Clear, no odour, no sheen; to cloudy, light brown
	Min	6.61	23.7	8.41	0.05	303	5.47	
	Max	6.79	25.1	11.18	0.33	337	7.27	

Well Development Data								
Well ID	Date	pH	Temp (C)	EC (mS/cm)	DO (mg/L)	Eh* (mV)	TDS** (mg/L)	Comments
MW1	15-Jan-14	-	-	-	-	-	-	No odour or sheen, very silty dark brown/grey
MW2	15-Jan-14	-	-	-	-	-	-	No odour or sheen, very silty dark brown/grey
MW3	15-Jan-14	-	-	-	-	-	-	No odour or sheen, very silty dark brown/grey

Notes:

T = Temperature (C)

DO = Dissolve Oxygen (mg/L)

EC = Electrical Conductivity (µS/cm)

PID = Photo Ionization Device - measurement in air at well annulus

HC = hydrocarbon

ND = No data

*Eh = Redox Potential (mV), note that 199mV has been added to field data measured using Ag/AgCl electrode to correct data to standard hydrogen electrode values

** TDS (mg/l) = EC (mS/cm) x 0.65. Conversion derived from chemical analysis results (Davidson 1995).

Field Equipment Used:

FLMV Water Quality Meter, Serial No. V4287

Peristaltic pump

Table 3
Groundwater Well Survey
Environmental Site Assessment
138-140 Campbell Hill Road, Chester Hill NSW

Site/Well ID	Description	FS	BM [arbitrary]	FS RL	BS	BS RL (m)	Difference	Half error	Corrected RL	Comments
		(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	
BH9	ground level	1.400	10	8.600	1.390	8.610	0.010	0.0050	8.6050	
MW3	top of casing	1.700	10	8.300	1.680	8.320	0.020	0.0100	8.3100	
MW2	top of casing	1.943	10	8.057	1.928	8.072	0.015	0.0075	8.0645	
MW1	top of casing	1.968	10	8.032	1.960	8.040	0.008	0.0040	8.0360	

Notes:

FS Foresight
BS Backsight
BM Benchmark
RL Relative level below arbitrary benchmark
Half error Half the difference between the Foresight and Backsight

Location	Depth	NEMP 2013 Lithology	pH	CEC	Logged Lithology
BH1	0.5	CLAY			Silty CLAY
BH2	0.5	CLAY			Silty CLAY
BH10	1.5	CLAY	5.3	15	Silty CLAY
BH1	1	CLAY			Silty CLAY
BH4	1	CLAY			Silty CLAY
BH5	1	CLAY			Silty CLAY/Weathered SHALE
BH9	1	CLAY			Silty CLAY
BH6A	6.8	CLAY			SILTY SHALE
BH5	7.5	CLAY			Silty CLAY/Weathered SHALE
BH6A	1	SILT			Silty CLAY/Weathered SILTSTONE
BH7	1	SILT			SILTSTONE
BH8	4	SILT			Weathered Siltstone
BH9	7	SILT			Clayey SILTSTONE/Silty CLAY above refusal
BH7	0.1	SAND	7.0	22	Roadbase
BH5	1.5	SAND			Silty CLAY above 50% lithics
BH7	7	SAND			Silty CLAY above Refusal

[illegible]

Location	Depth	NEPM 2013 Lithology	pH	CEC	Logged Lithology																			
BH1	0.5	CLAY			Silty CLAY	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<3	<1	-	23
BH3	0.5	CLAY			Silty CLAY	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<3	<1	-	23
BH10	0.5	CLAY	5.3	15	Silty CLAY	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<3	<1	5.3	19
BH1	1	CLAY			Silty CLAY	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<3	<1	-	15
BH4	1	CLAY			Silty CLAY	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<3	<1	-	16
BH5	1	CLAY			Silty CLAY/Weathered SHALE	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<3	<1	-	13
BH9	1	CLAY			Silty CLAY	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<3	<1	-	13
BH6A	6.8	CLAY			Silty SHALE	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<3	<1	-	13
BH5	7.5	CLAY			Silty CLAY/Weathered SHALE	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<3	<1	-	11
BH6A	1	SILT			Silty CLAY/Weathered SILTSTONE	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<3	<1	-	10
BH2	4	SILT			SILTSTONE	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<3	<1	-	9.2
BH8	4	SILT			Weathered Siltstone	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<3	<1	-	9.2
BH9	7	SILT			Clayey SILTSTONE/Silty CLAY above refusal	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<3	<1	-	11
BH7	0.1	SAND	7.0	22	Roadbase	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<3	<1	7	20
BH2	1.5	SAND			Silty CLAY above 50% lithics	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<3	<1	-	22
BH4	7	SAND			Silty CLAY above Refusal	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<3	<1	-	13

[illegible]

				Dissolved Metals	PAH																TRH (NEPM 1999)				TRH NEPM 2013				BTEXN									
				Lead (Filtered)	B(a)P Total Potency Equivalent	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a) pyrene	Benzo(b)&(k)fluoranthene	Benzo(g,h,i)perylene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	PAHs (Sum of total)	Phenanthrene	Pyrene	C6 - C9	C10 - C14	C15 - C28	C29-C36	C6-C10	C>10-C16	>C16-C34	>C34-C40	Benzene	Toluene	Ethylbenzene	Xylene (m & p)	Xylene (p)	Xylene (o)	Naphthalene	C6-C10 less BTEX (F1)	>C6-C10 less Naphthalene (F2)
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L		
EQL (Grab samples)				30	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	50	100	100	100	50	100	100	10	10	10	20		10	10	-	-	
EQL (Well samples)				1	5	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	10	50	100	100	10	50	100	100	1	1	1	2		1	1	10	50	
NEPM 2013 Groundwater HSLs for Vapour Intrusion, 2 to <4m, Sand																												800	NL	NL	NL	NL	NL	NL	NL	1000	1000	
NEPM 2013 Groundwater HSLs for Vapour Intrusion, 4 to <8m, Sand																												800	NL	NL	NL	NL	NL	NL	NL	1000	1000	
ANZECC 95% Level of Protection				3.4 ^{#2}				ID	ID				ID			16		ID										950	ID	ID	ID	200	350	16				
NEPM 2013 GIIL s. Fresh Waters ^A				3.4 ^{#2}												16												950					350	16				
Field ID	Location	Depth	Date																																			
Seepage water																																						
GRAB1 ^B	MW1	1.400	15/01/2014	<30	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	0	<1	<1	<100	<50	<100	<100	<100	<50	<100	<100	<10	<10	<10	<20		<10	<10	-	-		
Groundwater well samples																																						
MW1	MW1	1.195	24/01/2014	16	<5	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	0	<1	<1	<10	<50	<100	<100	<10	<50	<100	<100	<1	<1	<1	<2		<1	<1	<10	<50		
MW2	MW2	1.270	24/01/2014	2	<5	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<1	0	<1	<1	<10	<50	<100	<100	<10	<50	<100	<100	<1	<1	<1	<2		<1	<1	<10	<50	
MW3	MW3	1.45	24/01/2014	6	<5	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	0	<1	<1	<10	<50	<100	<100	<10	<50	<100	<100	<1	<1	1	<2		<1	<1	<10	<50		
Statistical Summary (Groundwater well samples only)																																						
Number of Results				3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Number of Detects				3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0		0	0	0	0
Minimum Concentration				2	<5	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<1	0	<1	<1	<10	<50	<100	<100	<10	<50	<100	<100	<1	<1	<1	<2		<1	<1	<10	<50	
Minimum Detect				2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	ND		ND	ND	ND	ND
Maximum Concentration				16	<5	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<1	0	<1	<1	<10	<50	<100	<100	<10	<50	<100	<100	<1	<1	1	<2		<1	<1	<10	<50	
Maximum Detect				16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	ND		ND	ND	ND	ND
Average Concentration				8	2.5	0.5	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0	0.5	0.5	5	25	50	50	5	25	50	50	0.5	0.5	0.67	1		0.5	0.5	5	25	
Median Concentration				6	2.5	0.5	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0	0.5	0.5	5	25	50	50	5	25	50	50	0.5	0.5	0.5	1		0.5	0.5	5	25	
Standard Deviation				7.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.29	0		0	0	0	0	
Number of Guideline Exceedances				2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	
Number of Guideline Exceedances(Detects Only)				2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	

Comments
A. Investigation levels apply to typical slightly-moderately disturbed systems.
B. GRAB1 was a screening sample of seepage water at MW1 which did not conform to standard QAQC procedures for water sampling. Different analytical methods were used and the sample should not be directly compared with groundwater well samples
#1 pH>6.5
#2 Criteria based on hardness value of 30mg/L CaCO₃

Field Duplicates (soil)
Filter: SDG in('104071','103612')

SDG	103612	103612	
Field ID	BH5	DUP1	RPD
Date Sampled	15/01/2014	15/01/2014	

Method Type	ChemName	Units	EQL			
8 metals in soil	Arsenic	mg/kg	4	6.0	5.0	18
	Cadmium	mg/kg	0.4	<0.4	<0.4	0
	Chromium (III+VI)	mg/kg	1	15.0	10.0	40
	Copper	mg/kg	1	50.0	46.0	8
	Lead	mg/kg	1	17.0	16.0	6
	Mercury	mg/kg	0.1	<0.1	<0.1	0
	Nickel	mg/kg	1	20.0	19.0	5
	Zinc	mg/kg	1	72.0	70.0	3
soil						
Moisture	Moisture	%	0.1	11.0	9.3	17
PAHs in Soil	B(a)P Total Potency Equivalent	mg/kg	0.5	<0.5	<0.5	0
	Acenaphthene	mg/kg	0.1	<0.1	<0.1	0
	Acenaphthylene	mg/kg	0.1	<0.1	<0.1	0
	Anthracene	mg/kg	0.1	<0.1	<0.1	0
	Benz(a)anthracene	mg/kg	0.1	<0.1	<0.1	0
	Benzo(a) pyrene	mg/kg	0.05	<0.05	<0.05	0
	Benzo(b)&(k)fluoranthene	mg/kg	0.2	<0.2	<0.2	0
	Benzo(g,h,i)perylene	mg/kg	0.1	<0.1	<0.1	0
	Chrysene	mg/kg	0.1	<0.1	<0.1	0
	Dibenz(a,h)anthracene	mg/kg	0.1	<0.1	<0.1	0
	Fluoranthene	mg/kg	0.1	<0.1	<0.1	0
	Fluorene	mg/kg	0.1	<0.1	<0.1	0
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	<0.1	<0.1	0
	Naphthalene	mg/kg	0.1	<0.1	<0.1	0
	PAHs (Sum of total)	mg/kg		0.14	0.0	200
	Phenanthrene	mg/kg	0.1	0.1	<0.1	0
	Pyrene	mg/kg	0.1	<0.1	<0.1	0
oil						
TRH Soil C10-C40 NEPM	C10-C16	mg/kg	50	<50.0	<50.0	0
	C16-C34	mg/kg	100	<100.0	<100.0	0
	C34-C40	mg/kg	100	<100.0	<100.0	0
	F2-NAPHTHALENE	mg/kg	50	<50.0	<50.0	0
	C10 - C14	mg/kg	50	<50.0	<50.0	0
	C15 - C28	mg/kg	100	<100.0	<100.0	0
	C29-C36	mg/kg	100	<100.0	<100.0	0
10-C40 NEPM						
VTRH & BTEXN in Soil NEPM	Benzene	mg/kg	0.2	<0.2	<0.2	0
	Ethylbenzene	mg/kg	1	<1.0	<1.0	0
	Naphthalene	mg/kg	1	<1.0	<1.0	0
	Toluene	mg/kg	0.5	<0.5	<0.5	0
	C6 - C9	mg/kg	25	<25.0	<25.0	0
	Xylene (m & p)	mg/kg	2	<2.0	<2.0	0
	Xylene (o)	mg/kg	1	<1.0	<1.0	0
	C6-C10 less BTEX (F1)	mg/kg	25	<25.0	<25.0	0
	C6-C10	mg/kg	25	<25.0	<25.0	0

*RPDs have only been considered where a concentration is greater than 1 times the EQL.

**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 100 (1-5 x EQL); 75 (5-10 x EQL); 30 (> 10 x EQL))

***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laboratory

Field Duplicates (water)
Filter: SDG in('104071','103612')

SDG Field ID Date Sampled	104071 MW2 24/01/2014	104071 DUP1 24/01/2014	RPD	104071 MW1 24/01/2014	Interlab_D TRIP1 24/01/2014	RPD
---------------------------------	-----------------------------	------------------------------	-----	-----------------------------	-----------------------------------	-----

Method_Type	ChemName	Units	EQL						
8 HM in water - dissolved	Lead (Filtered)	mg/l	0.001	0.002	0.016	156			
ter - dissolved									
PAHs in Water	B(a)P Total Potency Equivalent	mg/l	0.005	<0.005	<0.005	0			
	Acenaphthene	µg/L	1	<1.0	<1.0	0	<1.0	<1.0	0
	Acenaphthylene	µg/L	1	<1.0	<1.0	0	<1.0	<1.0	0
	Anthracene	µg/L	1	<1.0	<1.0	0	<1.0	<1.0	0
	Benz(a)anthracene	µg/L	1	<1.0	<1.0	0	<1.0	<1.0	0
	Benzo(a) pyrene	µg/L	1	<1.0	<1.0	0	<1.0	<1.0	0
	Benzo(b)&(k)fluoranthene	µg/L	2	<2.0	<2.0	0	<2.0	<2.0	0
	Benzo(g,h,i)perylene	µg/L	1	<1.0	<1.0	0	<1.0	<1.0	0
	Chrysene	µg/L	1	<1.0	<1.0	0	<1.0	<1.0	0
	Dibenz(a,h)anthracene	µg/L	1	<1.0	<1.0	0	<1.0	<1.0	0
	Fluoranthene	µg/L	1	<1.0	<1.0	0	<1.0	<1.0	0
	Fluorene	µg/L	1	<1.0	<1.0	0	<1.0	<1.0	0
	Indeno(1,2,3-c,d)pyrene	µg/L	1	<1.0	<1.0	0	<1.0	<1.0	0
	Naphthalene	µg/L	1 (Primary): 4 (Interlab)	<1.0	<1.0	0	<1.0	<1.0	0
	PAHs (Sum of total)	µg/L	1	0.0	0.0	0			
	Phenanthrene	µg/L	1	<1.0	<1.0	0	<1.0	<1.0	0
	Pyrene	µg/L	1	<1.0	<1.0	0	<1.0	<1.0	0
ater									
TRH Water(C10-C40) NEPM	C10-C16	mg/l	0.05	<0.05	<0.05	0			
	C16-C34	mg/l	0.1	<0.1	<0.1	0			
	C34-C40	mg/l	0.1	<0.1	<0.1	0			
	F2-NAPHTHALENE	mg/l	0.05	<0.05	<0.05	0			
	C10 - C14	µg/L	50	<50.0	<50.0	0	<50.0	<50.0	0
	C15 - C28	µg/L	100	<100.0	<100.0	0	<100.0	<100.0	0
	C29-C36	µg/L	100	<100.0	<100.0	0	<100.0	<100.0	0
(C10-C40) NEPM									
VTRH & BTEXN in Water NEPM	Benzene	µg/L	1	<1.0	<1.0	0	<1.0	<1.0	0
	Ethylbenzene	µg/L	1 (Primary): 2 (Interlab)	<1.0	<1.0	0	<1.0	<2.0	0
	Naphthalene	µg/L	1 (Primary): 4 (Interlab)	<1.0	<1.0	0	<1.0	<1.0	0
	Toluene	µg/L	1 (Primary): 2 (Interlab)	<1.0	<1.0	0	<1.0	<2.0	0
	C6 - C9	µg/L	10 (Primary): 25 (Interlab)	<10.0	<10.0	0	<10.0	<25.0	0
	Xylene (m & p)	µg/L	2 (Primary): 4 (Interlab)	<2.0	<2.0	0	<2.0	<4.0	0
	Xylene (o)	µg/L	1 (Primary): 2 (Interlab)	<1.0	<1.0	0	<1.0	<2.0	0
	C6-C10 less BTEX (F1)	mg/l	0.01	<0.01	<0.01	0			
	C6-C10	mg/l	0.01	<0.01	<0.01	0			

*RPDs have only been considered where a concentration is greater than 1 times the EQL.

**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 100 (1-5 x EQL); 75 (5-10 x EQL); 30 (> 10 x EQL))

***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laboratory

APPENDIX C – SUMMARY OF RESULTS

Borehole Log



Environmental Strategies
PROVIDING BENEFITS

Environmental Strategies Pty Ltd
Suite 15201, Locomotive Workshop
2 Locomotive Street
Eveleigh NSW 2012
Tel: +61 (0)2 9690 2555
www.environmentalstrategies.com.au

Hole ID. **BH1**
Project Number: **13126**
Hole Depth: **4.00 m**
Sheet: **1 of 1**

Project Name: **Chester Hill**
Location / Site: **138-140 Campbell Hill Road, Chester Hill NSW**
Client: **Chevelle**
Drilling Company: **Numac Drilling**
Drill Method: **Hand Auger / Solid Stem Auger**

Date Started: **14/01/2014**
Date Completed: **14/01/2014**
Ground Level :
Top of Casing :
Easting:
Northing:

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests		Observations / Comments
									PID ppm	ID No.	
Hand Auger		0.13				Fill	CONCRETE.				
		0.20					FILL - SAND.				
		0.5			CL		Silty CLAY - red / grey mottled, plastic, with subrounded gravel.	slightly moist	0.6	BH1_0.5	
		1.00			CL		Silty CLAY - grey, some red mottles, becoming stiff, plastic.	slightly moist	0.3	BH1_1.0	
Solid Stem Auger		1.5			CL				0.1		
		2.00				Natural	Weathered SHALE - light brown, stiff, some clay bands.	slightly moist			
		2.5									
		3.0							0.3		
		3.5									
		4.00							0.1	BH1_4.0	
							End of Hole at 4.00 m				

Additional Comments



Strike Groundwater Level



Static Groundwater Level



Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: Colin Biggs
Checked By: Claire Hardgrove

Date: 14/01/2014
Date: 23/01/2014

ES LOG LT CHESTER HILL 13126.GPJ ES.GDT 23/1/14 3:34:58 PM

Borehole Log



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Eveleigh NSW 2012
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www.environmentalstrategies.com.au

Hole ID. **BH2**
Project Number: **13126**
Hole Depth: **4.00 m**
Sheet: **1 of 1**

Project Name: **Chester Hill**
Location / Site: **138-140 Campbell Hill Road, Chester Hill NSW**
Client: **Chevelle**
Drilling Company: **Numac Drilling**
Drill Method: **Hand Auger / Solid Stem Auger**

Date Started: **14/01/2014**
Date Completed: **14/01/2014**
Ground Level :
Top of Casing :
Easting:
Northing:

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests		Observations / Comments
									PID ppm	ID No.	
CC		0.15				Fill	CONCRETE.				
Hand Auger		0.30				Fill	FILL - Sandy CLAY, dark brown, 2% rootlets, <5% siltstone lithics.	moist	805	BH2_0.2	Strong hydrocarbon odour.
		0.5				CL	Silty CLAY - brown, plastic. Orange brown from 0.5m. blueish grey from 0.6m, >50% orange mottling.	moist	899.1		High PID result likely associated with a former leaky fuel line to the bowser in the vicinity of BH2. The site representative J McHale indicated the leaky fuel line had been removed approximately 15 years previous.
		1.0				CL			953.3	BH2_0.5	
		1.50				CL	<20% mottling from 1.2m, grades to blueish grey with <10% reddish orange mottling, stiff, rootlets, crumbly.	slightly moist	562	BH2_1.0	
Solid Stem Auger		2.00				CL	Weathered SILTSTONE / Silty CLAY - 50% reddish brown siltstone lithics, 50% blueish grey orange silty clay.	slightly moist	62.1	BH2_1.5	Top of weathering profile at 1.5m.
		2.5				Natural	Weathered Clayey SILTSTONE.	dry	1.3		
		3.0							50		
		4.00							2.5	BH2_4.0	
							End of Hole at 4.00 m				

Additional Comments



Strike Groundwater Level



Static Groundwater Level



Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **Claire Hardgrove**
Checked By: **Claire Hardgrove**

Date: **14/01/2014**
Date: **23/01/2014**

ES LOG LT CHESTER HILL 13126.GPJ ES.GDT 23/1/14 3:34:59 PM

Borehole Log



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Hole ID. **BH3**
Project Number: **13126**
Hole Depth: **4.00 m**
Sheet: **1 of 1**

Project Name: **Chester Hill**
Location / Site: **138-140 Campbell Hill Road, Chester Hill NSW**
Client: **Chevelle**
Drilling Company: **Numac Drilling**
Drill Method: **Hand Auger / Solid Stem Auger**

Date Started: **14/01/2014**
Date Completed: **14/01/2014**
Ground Level :
Top of Casing :
Easting:
Northing:

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests		Observations / Comments
									PID ppm	ID No.	
CC		0.15 0.20				Fill	CONCRETE.				
Hand Auger							FILL - Silty SAND, well sorted.	damp / moist	---	BH3_0.2	Rootlets rare below 0.4m, <5% rounded mudstone grits. Branches from 0.65 to 0.75m, 2-5% vegetation (twigs / bark). 15% bark at 1.0m, tree roots common for 100mm. Mottling and moisture decrease from 1.2m, vegetation absent.
		0.5				CL	Silty CLAY - brownish orange with red mottling, weathering to dark brown, with shale fragments, minor vegetation (rootlets), angular lithics. Orange brown from 0.5m. blueish grey clay from 0.6m, orange mottling.		1.2	BH3_0.5	
		1.0					Dark orange red mottling intensifying, possible of water pathway.		0.5		
		1.46 1.50				CI	Silty CLAY - grey, stiff, micaceous, <1% rootlets, <10% mottling, red lithic siltstone fragments.	sl.moist / dry	0.2		
Solid Stem Auger		2.00					Weathered SILTSTONE - grey, increasing lithics.		0.5		
		2.5					Weathered Clayey SILTSTONE - brown.	dry	1.0		
		3.0							0.4	BH3_4.0	
		4.00					End of Hole at 4.00 m				

Additional Comments



Strike Groundwater Level



Static Groundwater Level



Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **Claire Hardgrove**
Checked By: **Claire Hardgrove**

Date: **14/01/2014**
Date: **23/01/2014**

ES LOG LT CHESTER HILL 13126.GPJ ES.GDT 23/1/14 3:35:01 PM

Monitoring Well Log



Environmental Strategies
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www.environmentalstrategies.com.au

Hole ID. **BH4/MW3**
Project Number: **13126**
Hole Depth: **7.00 m**
Sheet: **1 of 1**

Project Name: **Chester Hill**
Location / Site: **138-140 Campbell Hill Road, Chester Hill NSW**
Client: **Chevelle**
Drilling Company: **Numac Drilling**
Drill Method: **Hand Auger / Solid Stem Auger**

Date Started: **15/01/2014**
Date Completed: **15/01/2014**
Ground Level :
Top of Casing :
Easting:
Northing:

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests		Observations / Comments	Well Details	Well Construction
									PID ppm	ID No.			
Hand Auger	0.15	0.40	0.5		CL	Fill	CONCRETE.	moist	0.1	BH4_0.2	Faint hydrocarbon odour at 0.5m? <5% root matter at 0.6m, sandier, increasing plasticity. Black brown shale grits to 5mm at 0.7m. Plasticity decreasing from 0.9m, low moisture, gravel gone, no vegetation, stiff. 30% mottling at 1.1m. Sample falling off bottom of auger from 1.2m.		Casing
							FILL - Silty SAND, brown, well sorted.	slightly moist	0.2	BH4_1.0			
Solid Stem Auger	1.0	1.20	1.5		CL	Natural	Silty CLAY - blueish grey, 20% orange mottling increasing to 60% at 0.8m.	slightly moist	0.1	BH4_0.2			
							Weathered SILTSTONE / Silty CLAY - dark brown / blueish grey, 40% lithics.	slightly moist	0.1	BH4_1.0			
							Grey layered silty clays, laminations well preserved, stiff.	dry	0.1	BH4_1.0			
							Weathered SILTSTONE - dark brown.	dry	0.1	BH4_1.0			
							Silty CLAY - brown, <30% siltstone lithics.	dry	0.1	BH4_1.0			
							Silty CLAY - brown.	dry	0.2	BH4_1.0			
							Weathered SILTSTONE - brown.	dry	0.1	BH4_1.0			
							Moderately hard from 5.0m, decreasing to slightly hard at 6.5m.	dry	0.1	BH4_1.0			
							Weathered MUDSTONE - brown.	dry	0.3	BH4_1.0			
							Silty CLAY at 7.0m - brown, soft, plastic.	sl.moist	0.1	BH4_7.0			
							End of Hole at 7.00 m Refusal.						

Additional Comments

Strike Groundwater Level

Static Groundwater Level



Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **Claire Hardgrove**
Checked By: **Claire Hardgrove**

Date: **15/01/2014**
Date: **23/01/2014**

ES LOG LT CHESTER HILL 13126.GPJ ES.GDT 23/1/14 3:35:02 PM

Monitoring Well Log



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Hole ID. **BH5/MW2**
Project Number: **13126**
Hole Depth: **7.50 m**
Sheet: **1 of 1**

Project Name: **Chester Hill**
Location / Site: **138-140 Campbell Hill Road, Chester Hill NSW**
Client: **Chevelle**
Drilling Company: **Numac Drilling**
Drill Method: **Hand Auger / Solid Stem Auger**

Date Started: **15/01/2014**
Date Completed: **15/01/2014**
Ground Level :
Top of Casing :
Easting:
Northing:

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests			Observations / Comments	Well Details	Well Construction
									PID ppm	ID No.	DUP TRIP			
Hand Auger		0.15 0.20				Fill	CONCRETE. FILL - SAND, orange, medium grained, well sorted, well rounded.	slightly moist	0.0	BH5_0.2		Peaty odour.		
		0.5				CL	Silty CLAY - blueish green to orange, high plasticity, very fine to fine, thinly laminated, <2% sand.		0.1					
		1.00					Decreasing grained size to very fine silty clay, alternating plastic and dry / crumbly layers between 0.8 and 1.0m.	very dry	0.2	BH5_1.0		Tree root at 0.6m. Band of decomposing tree roots 0.6 to 0.8m, 50mm gravelly layer at 0.65m (blueish red, very fine grained sandstone gravel up to 8mm). Dry and crumbly layer at 0.8m with soft weathered lithics (clayey siltstone) up to 20mm for 50mm. Hand auger refusal at 1.0m.		
		1.5					Weathered Silty SHALE - brown, breaks between fingers but doesn't crumble, micaceous.		0.0					
		2.0							0.1					
		2.5							0.1					
		3.0							0.2					
		3.5							0.2					
		4.0							0.2					
		4.5							0.2					
		5.0							0.2					
		5.5							0.2					
		6.0							0.2					
		6.5					Colour changes slightly at 6.5m from brown to blackish brown.		1.2					
		7.00					Silty CLAY and Weathered Silty SHALE - plastic.	dry	0.6	BH5_7.3 BH5_7.5	Dup1 Trip1			
		7.50					End of Hole at 7.50 m Refusal.							
		8.0												

Additional Comments

Dup1 / Trip 1 from BH5_7.5.

Strike Groundwater Level

Static Groundwater Level



Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **Claire Hardgrove**
Checked By: **Claire Hardgrove**

Date: **15/01/2014**
Date: **23/01/2014**

ES LOG LT CHESTER HILL 13126.GPJ ES.GDT 23/1/14 3:35:04 PM

Borehole Log



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Hole ID. **BH6**
Project Number: **13126**
Hole Depth: **1.50 m**
Sheet: **1 of 1**

Project Name: **Chester Hill**
Location / Site: **138-140 Campbell Hill Road, Chester Hill NSW**
Client: **Chevelle**
Drilling Company: **Numac Drilling**
Drill Method: **Hand Auger / Solid Stem Auger**

Date Started: **15/01/2014**
Date Completed: **15/01/2014**
Ground Level :
Top of Casing :
Easting:
Northing:

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests		Observations / Comments
									PID ppm	ID No.	
CC		0.15 0.20					CONCRETE.				
Hand Auger		0.5				Fill	FILL - SAND, orange, medium. FILL - Silty CLAY, mottled orange / red / grey, plastic, shale fragments.	slightly moist	120	BH6_0.2	
		1.0					Slightly stiff at 0.8m, gradually increasing and stiffer to 0.9m.		17.6	BH6_0.5	Slight hydrocarbon odour, hydrocarbon sheen in 0.5m sample.
Solid Stem Auger		1.50					Weathered clayey siltstone fragments and very fine grained sandy siltstone, micaceous.		13.5	BH6_0.9	Sample quantity low. Hand auger refusal at 0.9m.
		2.0					End of Hole at 1.50 m Terminated on pipe. Hole relocated.				
		2.5									
		3.0									
		3.5									
		4.0									

Additional Comments



Strike Groundwater Level



Static Groundwater Level



Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **Claire Hardgrove**
Checked By: **Claire Hardgrove**

Date: **15/01/2014**
Date: **23/01/2014**

Borehole Log



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Hole ID. **BH6A/MW1**
Project Number: **13126**
Hole Depth: **6.80 m**
Sheet: **1 of 1**

Project Name: **Chester Hill**
Location / Site: **138-140 Campbell Hill Road, Chester Hill NSW**
Client: **Chevelle**
Drilling Company: **Numac Drilling**
Drill Method: **Hand Auger / Solid Stem Auger**

Date Started: **15/01/2014**
Date Completed: **15/01/2014**
Ground Level :
Top of Casing :
Easting:
Northing:

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests		Observations / Comments	Well Details	Well Construction
									PID ppm	ID No.			
Hand Auger		0.15				Fill	CONCRETE.						
		0.30					FILL - CLAY with Sand pockets, brownish, blueish grey orange, orange sand, slightly plastic, sand is medium grained, well sorted, well graded.		0.7	BH6A_0.2	No hydrocarbon odour. 5% vegetation (rootlets, decaying roots). No hydrocarbon odour. 5% vegetation. 2-3% reddish fill sand mixed in backfill at 0.7 to 0.8m, may be off side of hole, possibly weathered sandstone.		
		0.5			CL		Silty CLAY - blueish grey orange, slightly plastic, noticeably stiffer at 0.7m but still slightly plastic, orange mottled below 0.82m.		0.6	BH6A_0.5			
		0.90							0.7	BH6A_0.9			
		1.0							0.8	BH6A_0.93			
		1.50			ML		Weathered Clayey SILTSTONE - brown.		0.5	BH6A_1.0			
		2.00					Clayey SILT - brown.		0.8				
Solid Stem Auger		2.5					Clayey SILTSTONE - brown, >50% lithics (brown hard siltstone, unable to be broken between fingers) in cuttings.		0.7				
		3.0					Lithics from below 3.0m can be broken by fingers (slightly competent).		0.6				
		3.5											
		4.00					Clayey SILTSTONE - grey, slightly competent.						
		4.5											
		5.00					Clayey SILTSTONE - brown.		0.4				
		5.5											
		6.00					Silty SHALE - blackish brown, slightly competent.	slightly moist	0.5	BH6A_6.0			
		6.5											
		6.80					End of Hole at 6.80 m		0.6	BH6A_6.8			
		7.0											
		7.5											

Additional Comments



Strike Groundwater Level



Static Groundwater Level



Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **Claire Hardgrove**
Checked By: **Claire Hardgrove**

Date: **15/01/2014**
Date: **23/01/2014**

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Borehole Log



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Hole ID. **BH7**
Project Number: **13126**
Hole Depth: **4.00 m**
Sheet: **1 of 1**

Project Name: **Chester Hill**
Location / Site: **138-140 Campbell Hill Road, Chester Hill NSW**
Client: **Chevelle**
Drilling Company: **Numac Drilling**
Drill Method: **Hand Auger / Solid Stem Auger**

Date Started: **14/01/2014**
Date Completed: **14/01/2014**
Ground Level :
Top of Casing :
Easting:
Northing:

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests		Observations / Comments
									PID ppm	ID No.	
Hand Auger		0.05				Fill	CONCRETE fragments.	dry	3.4	BH7_0.1	Insufficient material for sample of roadbase. Material 0.1 to 0.3m is possibly the upper part of natural with the fines eroded out. No obvious contact between fill and natural.
		0.10				Fill	ROADBASE.	dry			
		0.30				Fill	FILL - Clayey Sandy SILT, brown.	dry			
		0.5				Fill	Silty CLAY - orange / grey, 5% lithic fragments (siltstone).	dry	0.7		
Solid Stem Auger		1.0				CL					Progress slowed from 2.5m.
		1.5				Natural			0.1		
		2.0				Natural	grading to				
		2.50				Natural	Weathered SILTSTONE - brown, hard.	dry			
		3.0				Natural	Very hard from 3.0m.		0.2		
		3.5				Natural					
		4.00				Natural			0.2	BH7_4.0	
							End of Hole at 4.00 m				

Additional Comments



Strike Groundwater Level



Static Groundwater Level



Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **Claire Hardgrove**
Checked By: **Claire Hardgrove**

Date: **14/01/2014**
Date: **23/01/2014**

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Borehole Log



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Hole ID. **BH8**
Project Number: **13126**
Hole Depth: **4.00 m**
Sheet: **1 of 1**

Project Name: **Chester Hill**
Location / Site: **138-140 Campbell Hill Road, Chester Hill NSW**
Client: **Chevelle**
Drilling Company: **Numac Drilling**
Drill Method: **Hand Auger / Solid Stem Auger**

Date Started: **14/01/2014**
Date Completed: **14/01/2014**
Ground Level :
Top of Casing :
Easting:
Northing:

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests		Observations / Comments
									PID ppm	ID No.	
CC		0.15				Fill	CONCRETE.				
Hand Auger		0.25					FILL - Sandy CLAY, blueish grey, 60% orange mottling, 5% grits.	slightly moist			
		0.50			CL		Silty CLAY - brown, black mottling, plastic, rare grits, reddish purple shale fragments up to 20mm.	slightly moist	0.5		
		1.0			CL		Silty CLAY - blueish grey, >50% orange mottling, plastic, rare sand and grits.				
		1.20			CL		Silty CLAY - alternating approximately 50mm layers of grey reddish brown silty clay and grey silty clay, grading into brown weathered shale from 1.4m.	slightly moist	0.4		
Solid Stem Auger		1.45					Weathered SHALE - brown.				
		2.00				Natural	Sandy Silty CLAY - brown.		0.2		
		3.0			CL		Upper part of Weathered Siltstone (Bringelly Shale) at 3.0m.		0.2		
		4.00					Weathered SILTSTONE, brownish grey, (mostly lithics) at 4.0m.		0.2	BH8_4.0	
							End of Hole at 4.00 m				

Additional Comments

Strike Groundwater Level

Static Groundwater Level



Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **Claire Hardgrove**
Checked By: **Claire Hardgrove**

Date: **14/01/2014**
Date: **23/01/2014**

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Borehole Log



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Hole ID. **BH9/MW**
Project Number: **13126**
Hole Depth: **7.00 m**
Sheet: **1 of 1**

Project Name: **Chester Hill**
Location / Site: **138-140 Campbell Hill Road, Chester Hill NSW**
Client: **Chevelle**
Drilling Company: **Numac Drilling**
Drill Method: **Hand Auger / Solid Stem Auger**

Date Started: **15/01/2014**
Date Completed: **15/01/2014**
Ground Level :
Top of Casing :
Easting:
Northing:

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests		Observations / Comments	Well Details	Well Construction
									PID ppm	ID No.			
CC		0.15				Fill	CONCRETE.						
Hand Auger		0.30					FILL - Sandy CLAY, orange to clear sand, orange brown clay, sand is medium grained, well sorted, well rounded, 10% vegetation (roots).	dry	0.7	BH9_0.15			
		0.50			CL			very moist	1.0		Peaty odour.		
		0.60			CL				0.9	BH9_0.5			
		1.0			CL		Silty CLAY / Sandy MUD - black grey, very soft.	dry	0.7	BH9_1.0	Slight hydrocarbon odour at 0.6m.		
		1.40			CL		Silty CLAY - orange brown, minor sand, <5% vegetation.				2-3% orange to clear sand at 0.7m, rounded, medium grained, well sorted.		
Solid Stem Auger		1.5			CL		Silty CLAY - grey / blueish grey to orange, 5% vegetation.	dry	0.4		Plastic from approximately 0.8m.		
		2.00			CL		Silty CLAY - brown, slightly stiff, top of shale.	dry	0.3		Slightly plastic from 1.0m, very fine sand / siltstone lithic fragments <5%, decreasing plasticity down hole.		
		2.5			CL		Silty CLAY - brown, 20% lithics (weathered silty mudstone).				Hand auger refusal at 1.5m.		
		3.00				Natural	Weathered Clayey SILTSTONE - orange brown, >50% lithics, slightly hard but can snap with fingers.	dry	0.2				
		3.5											
		4.0						very dry	0.2		Progress slowed and very dry from 4.0m, very hard.		
		4.5											
		5.00					Weathered Clayey SILTSTONE - greyish brown.	very dry	0.4				
		5.5											
		6.00					Weathered Clayey SILTSTONE (50%) / Silty CLAY (50%) - greyish brown, slightly plastic.	slightly moist	0.2		Decreasing dryness.		
		6.5											
		7.00					End of Hole at 7.00 m Refusal.		0.3	BH9_7.0	Clay balling in auger.		
		7.5											

Additional Comments

Strike Groundwater Level

Static Groundwater Level



Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **Claire Hardgrove**
Checked By: **Claire Hardgrove**

Date: **15/01/2014**
Date: **23/01/2014**

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Borehole Log



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Hole ID. **BH10**
Project Number: **13126**
Hole Depth: **4.00 m**
Sheet: **1 of 1**

Project Name: **Chester Hill**
Location / Site: **138-140 Campbell Hill Road, Chester Hill NSW**
Client: **Chevelle**
Drilling Company: **Numac Drilling**
Drill Method: **Hand Auger / Solid Stem Auger**

Date Started: **14/01/2014**
Date Completed: **14/01/2014**
Ground Level :
Top of Casing :
Easting:
Northing:

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests		Observations / Comments
									PID ppm	ID No.	
							Grass on surface.				
Hand Auger		0.20				Fill	FILL - Silty SAND, with coarse angular gravel to 10mm, concrete cobbles, foreign material including glass, radiator cap.	dry	0.2	BH10_0.5	Change in lithology is gradational to 3.0m.
		0.5			CL		Silty CLAY - reddish brown, stiff, with 5% rounded shale gravels <5mm, weathered shales.		0.2		
		1.00			CL		Silty CLAY - grey, 40% red mottling, extremely weathered shale.	dry	0.2		
		1.70			CL		Silty CLAY - brownish grey, weathered shale. With 15% orange mottling below 2.0m.	dry	0.2		
Solid Stem Auger		2.90				Natural					
		3.00			CL		Weathered Clayey SILTSTONE - micaceous.	dry	0.2		
		3.50			CL		Sandy Silty CLAY - brown, 30% orange mottling, with <5% sand, with <10% angular siltstone fragments.		0.2		
		4.00					Weathered Clayey SILTSTONE - micaceous.		0.5	BH10_4.0	
							End of Hole at 4.00 m				

Additional Comments



Strike Groundwater Level



Static Groundwater Level



Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **Claire Hardgrove**
Checked By: **Claire Hardgrove**

Date: **14/01/2014**
Date: **23/01/2014**

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