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Integrated Practical Solutions

Preliminary Site Investigation

Proposed Rezoning (Area 1) and Georges Cove Marina (Area 2)
146 Newbridge Road, Moorebank

Prepared for
Mirvac Homes NSW Pty Ltd and Tanlane Pty Ltd

Project 71459.10
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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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1. Introduction

Douglas Partners Pty Ltd (DP) has prepared this Preliminary Site Investigation (PSI) in order to support a planning proposal to allow a residential use in two areas (for the purpose of this report designated as Area 1 and Area 2) within the overall site located at 146 Newbridge Road, Moorebank. The site has been subject to several studies, Development Applications and planning proposals. The investigation was commissioned by Mirvac Homes NSW Pty Ltd and Tanlane Pty Ltd and was undertaken in accordance with DP's proposal SYD180001 (Rev1) dated 17 January 2018.

The objective of this PSI is to assess the potential for site contamination within Areas 1 and 2 and evaluate whether they are (or can be made) suitable for the proposed rezoning (Area 1) and enabling clause (Area 2) that would permit residential land use. The objective is to also identify whether any additional investigations and/or site remediation is required in order to render Area 1 and Area 2 suitable for residential land use.

Previous contamination assessments have been conducted at the site which encompasses Areas 1 and 2. This PSI contains a review of these reports supplemented by additional sampling, covering soil contamination and hazardous ground gases in order to augment the existing data. It is noted that assessment and management of existing surface water quality issues associated with the former dredge ponds is being addressed by overlapping reports prepared by others (refer to Section 3).

1.1 Site Identification

The overall site is located at 146 Newbridge Road, Moorebank, legally identified as Lot 7 DP 1065574, and covers an approximate area of 22 ha (Drawing 1, Appendix B). The previous Development Applications and planning proposals at the site have generally related to two distinct areas within the overall 146 Newbridge Road site being:

- The northern part of the site comprising a proposed residential estate; and
- The southern part of the site comprising the former dredge ponds.

The boundary between the northern proposed residential estate and the southern former dredge ponds can be loosely defined by the northern extent of the dredge ponds.

The two areas within the wider site which are the subject of this report have been designated Area 1 and Area 2. Area 1 is within the proposed residential estate (i.e. northern part of the site) and Area 2 is located to the south, within the former dredge pond area (i.e. southern part of the site). A site plan depicting the relevant overall site boundary, northern and southern part of the site boundaries and Areas 1 and 2 within these boundaries are shown on Drawing 1, Appendix B.

The following is understood in relation to subject Areas 1 and 2:

- Area 1 (area to be rezoned R3) – The first part being a rezoning of a portion of land from RE2 Private Open Space to R3 Residential to join the existing zoned R3 residential area subject to development under an application with Liverpool City Council. Area 1 covers an approximate area of 0.5 ha.
- Area 2 (residential use envelope) – The second part is for the approval of an enabling clause for terraces and residential flat buildings over part of the existing zoned RE2. Area 2 covers an approximate area of 3 ha and is currently partially submerged (i.e. within the dredge pond). The approximate area of the above water land within Area 2 is estimated to be 0.8 ha.

The sites operate under two environment protection licences (EPLs). EPL No. 10490 is for the recycling facility (northern site including Area 1) and EPL No. 4612 is for the dredge ponds (including Area 2).

2. Scope of Work

The scope of work for the PSI comprised the following:

- Undertake a review of relevant previous investigation including aspects related to the site history;
- Drilling of three boreholes (MW101, MW102 and MW103) to a maximum depth of up to 5.5 m (until groundwater was reached). Install a landfill gas monitoring well at each location;
- Excavation of two test pits (TP101 and TP102), to a depth of 3.0 m, and collection of soil samples from regular depth intervals;
- Surveying of borehole and test pit coordinates using a hand-held GPS (coordinates) and interpolating elevation from an existing survey plan provided by the client;
- Field sampling and laboratory analysis in compliance with standard environmental protocols, including a Quality Assurance/Quality Control (QA/QC) plan consisting of 10% replicate sampling (intra and inter-laboratory replicate samples), trip spikes, trip blanks, appropriate chain of custody procedures and in–house laboratory QA/QC testing;
- Screening of all samples collected with a photoionisation detector (PID) to assess the likely presence or absence of volatile organic compounds (VOC);
- Submission of selected soil samples (including QC samples) and two material samples (fragments of fibre cement) for analysis of a combination of the following common contaminants at a NATA accredited laboratory:
  - priority metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc);
  - total recoverable hydrocarbons (TRH);
  - monocyclic aromatic hydrocarbons (benzene, toluene, ethylbenzene and xylenes – BTEX);
  - polycyclic aromatic hydrocarbons (PAH);
  - organochlorine pesticides (OCP), organophosphorus pesticides (OPP);
  - polychlorinated biphenyls (PCB);
  - total phenols;
  - asbestos (in soil and material fragments).

- Conduct two landfill gas monitoring events using a GA 5000 landfill gas analyser to measure gas concentrations and flow rates from each of the three installed wells; and
- Preparation of this PSI report detailing the methodology and results of the assessment with reference to EPA approved guidelines, including NEPC (2013).

3. Previous Investigations

A number of previous investigations have been undertaken by DP, Dames and Moore Pty Ltd (D&M), Environmental Investigation Services (EIS), Jeffery and Katauskas Pty Ltd (J&K) and EMM Consulting Pty Limited (EMM). These investigations have covered various areas of the site including Areas 1 and 2.

A summary of the relevant reports that are known to DP is provided in Table 1, below. The summary is not an exhaustive list.

Table 1: List of Previous Reports

Author	Year	Project No.	Report Title / Letter Report Title
D&M	1994	unknown	Report on Groundwater Sampling
DP	1999	27879	Proposed Environmental Monitoring Program, Sorting, Recovery and Transfer (SRT) Facility, 146 Newbridge Road, Moorebank
D&M	2000	unknown	Landfill Groundwater and Surface Water Monitoring and Assessment Program
DP	2002a	30410	Preliminary Geotechnical Assessment, 146 Newbridge Road, Moorebank
DP	2002b	30410	Report on Preliminary Contamination Assessment, Proposed Residential Development, 146 Newbridge Road, Moorebank
DP	2002c	30410	Geotechnical Assessment, 146 Newbridge Road, Moorebank
DP	2005	43479	Proposed Mixed Commercial / Residential Development, 146 Newbridge Road, Moorebank
DP	2008	45642.00	Preliminary Desktop Review, Benedict Sand and Gravel, Moorebank
DP	2009a	45642.01	Desktop Review, Benedict Sand and Gravel, Moorebank
DP	2009b	45642.02	Environmental and Geotechnical Advice, Benedict Sand and Gravel, 146 Newbridge Road, Moorebank
DP	2009c	45642.03	Review of Foundation Options, Proposed Residential Development, 146 Newbridge Road, Moorebank
DP	2009d	71459.00	Compaction and Grading, 146 Newbridge Road, Moorebank
EIS	2013	E26930KBrpt	Stage 1 Environmental Site Assessment for Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
J&K	2013	26930Zrpt	Geotechnical Investigation for Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

Author	Year	Project No.	Report Title / Letter Report Title
EIS	2014a	E26930KBrpt -HGG	Preliminary Hazardous Ground Gas Screening for the Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
EIS	2014b	E26930KBlet -HGGR2	Hazardous Ground Gas (HGG) Screening Results (Round 2), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
EIS	2014c	E26930KBlet -HGGR3	Hazardous Ground Gas (HGG) Screening Results (Round 3), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
EIS	2014d	E26930KBlet -HGGR4	Hazardous Ground Gas (HGG) Screening Results (Round 4), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
EIS	2014e	E26930KBlet -HGGR5	Hazardous Ground Gas (HGG) Screening Results (Round 5), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
DP	2014a	71459.01	Initial Comments on the Design of Landfill Gas Mitigation Measures 146 Newbridge Road, Moorebank Stage 1
DP	2014b	71459.01	Draft Concept Design for Landfill Gas Mitigation Measures 146 Newbridge Road, Moorebank Stage 1
EMM	2015	J14149RP1	Preliminary Investigation of Contamination, Proposed Georges Cove Marina
DP	2015a	71459.02	Construction Environmental Management Plan, Proposed Retaining Wall, 146 Newbridge Road, Moorebank, NSW
DP	2015b	71459.02	Sampling and Analysis Quality Plan, Proposed Residential Subdivision, 146 Newbridge Road, Moorebank, NSW
DP	2015c	71459.04	Report on Geotechnical Investigation, Proposed Residential Subdivision, 146 Newbridge Road, Moorebank
DP	2015d	71459.05	Report on Geotechnical Investigation, Retaining Wall, 146 Newbridge Road, Moorebank
EMM	2016a	J14149RP1	Supplementary Preliminary Investigation, Proposed Georges Cove Marina
EMM	2016b	J14149RP1	Remediation Action Plan, Proposed Georges Cove Marina
DP	2016	71459.03 Rev1	Detailed Site Investigation, Proposed Residential Development, 146 Newbridge Road, Moorebank
J&K	2016a	26930Zrpt Rev3	Geotechnical Evaluation for Proposed Residential Subdivision at 146 Newbridge Road, Moorebank, NSW
J&K	2016b	26903Zemail 3	Response to RAP Comments
DP	2017a	71459.06	Groundwater Data Review, Proposed Residential Development, 146 Newbridge Road, Moorebank
DP	2017b	71459.06 Rev5	Remediation Action Plan, Proposed Residential Development, 146 Newbridge Road, Moorebank
J&K	2017	26930Zrpt Rev5	Geotechnical Evaluation for Proposed Residential Subdivision at 146 Newbridge Road, Moorebank, NSW

The previous geotechnical and environmental (contamination) investigations carried out at the site have generally confirmed the presence of fill containing a component of construction and demolition waste of varying thickness of up to 11.5 m at the central portion of the site immediately north of the former dredge ponds.

4. Site Information

4.1 Geology, Topography and Hydrogeology

A review of the regional Penrith 1:100,000 Geology Sheet indicates that the site is underlain by the following natural formations:

- South and central sections – Quaternary (Qpn) aged deposits of medium grained sand and silty clay; and
- North, north-east and sections – Tertiary (Ta) aged deposits of clayey quartzose sand and clay.

Mapping and previous drilling indicates that the Tertiary and Quaternary deposits are underlain by shale bedrock.

Figure 1: Regional geology (source: Penrith 1:100,000 Geology Sheet)

A review summarised in EIS (2013) of the acid sulphate soil (ASS) risk map for Liverpool prepared by Department of Land and Water Conservation (1997) indicates that the site is located in the following ASS risk area:

- High Probability Risk Area – south and west sections of the site associated with low lying swamp areas. The depth of occurrence in this area is between 1 m and 3 m below ground level (bgl) associated with alluvial plains, alluvial swamps, alluvial levees and sand plains; and
- Disturbed Terrain – north, central and east sections of the site associated with the filled areas. The classification is adopted in large scale filled areas which often occur during reclamation of low lying swamps for urban development, in areas which may have been mined or dredged or have undergone significant ground disturbance through general urban development or the construction of dams and levees.

A review summarised in EIS (2013) of groundwater bores registered with the NSW Office of Water (NOW) was undertaken. The search was limited to registered bores located within approximately 1 km radius of the site. The search indicated that two registered bores were located within this radius. The boreholes were registered for irrigation (GW024357) and domestic (GW023146) purposes. The irrigation bore is located approximately 800 m to the east of the site beyond Georges River. The domestic bore is located approximately 1.2 km to the north-east of the site. Both the bores are in close proximity of Georges River and the associated flood plain. Based on the distance of the bores and the regional topography, these bores were not considered to be potential receptors of any contamination that may be present at the site.

EIS (2013) noted that the stratigraphy of the site is expected to consist of relatively high permeability alluvial soils overlying deep shale bedrock. Based on these conditions and the results of the groundwater bore search, groundwater may be a potential resource in the vicinity of the site.

4.2 Site History of Northern Part of the Site Including Area 1

The detailed site history information on the northern part of the site is provided in DP (2002b) and EIS (2013). A summary of the site history information extracted from the EIS (2013) report is provided in Table 2, below.

Table 2: Summary of Site History (EIS, 2013)

Timeline	Details / Summary	Source of Information
1884 to 1924	The site was owned by private citizens and The Church of England Property Trust Diocese of Sydney. A portion of the land was owned by Perpetual Trustee Company Limited between 1920 and 1923. Based on a review of the 1930 aerial photograph, it is assumed that the site was predominantly vacant prior to 1930.	Land Title Records & Aerial Photos
1923 to 1947	The site was owned by New Bankstown Limited and The Greenacre Park Limited. A section of the site was also owned by private citizens between 1924 and 1965. A review of the 1943 historical aerial photograph indicates that cattle rearing and grazing activity had commenced at the site after 1930. Sections of the site had been cleared of vegetation during this period.	Land Title Records & Aerial Photos
1947 to 1997	The site was owned by Echo Dairies Pty Ltd and a few private individuals including Anthony Francis Brady (a dairyman). A review of the historical aerial photographs indicates that large sections of the site were cleared during this period for cattle grazing. Warehouses were constructed at the site and low lying areas in some sections were filled to form level ground. A dam was created in the north section of the site which was subsequently filled. A storm water channel/drain was created along the west site boundary. The aerial photos indicate that the dairy activity at the site appeared to have ceased some time prior to 1982. Large sections of the site were filled between 1982 and 1991. Stockpiles were visible at the site in the 1991 aerial photograph which indicates the commencement of waste processing/dredging activity at	Land Title Records & Aerial Photos

Timeline	Details / Summary	Source of Information
	the wider site (i.e. to the south of the proposed development area).	
1997 to present	The site as at 2013 was owned by Tanlane Pty Ltd. Some filling was undertaken predominantly in 1993 and 1994 (according to the client). The site Land Title Records started to appear similar to the present layout from at least 2005. Council records indicate that a DA was submitted for the construction of a new road bridge at the subject site. A statement of environmental effects was prepared and submitted to council for the proposed development. The EPA has issued two licences (No. 4612, dated 2000 and 10490, dated 2001) under the POEO Act for the wider site. A number of variation notices were subsequently issued under s.58 of the Act between 2002 and 2013. Based on a review of the EPA information, the scheduled activities at the site included: • Crushing, grinding or separating; land-based extractive activity; and water-based extractive activity; • Storage/transfer/separation of various waste streams; • Importation of virgin excavated natural material (VENM) and potential acid sulfate soil (PASS) for backfilling sand quarry (according to the site owner, only minor quantities of PASS was ever accepted at the site); • Dredging activities; • Landfilling activities; • Recovery, storage and processing (non-thermal treatment) of general waste including VENM; general solid waste (non-putrescible); general or specific exempted waste; wood waste; waste; paper or cardboard; gyprock; glass; building and demolition waste; asphalt waste (including asphalt resulting from road construction and waterproofing works); and waste tyres. A clean up notice (No. 1051596) was issued under s.91 of the Act to Benedict Reclamations in October 2005. The notice was for the clean-up of bonded asbestos containing material (bonded ACM) – fibro encountered in some stockpiles at the site. It is understood that the clean-up order was promptly complied with.	Historical Aerial Photos, Client (Tanlane), Council and NSW EPA records

4.3 Site History of Southern Part of the Site (Dredge Ponds) Including Area 2

The detailed site history information on the southern part of the site is provided in EMM (2015). EMM (2015) indicated that prior to 1960 the site (and potentially all of Lot 7 DP 1065574) was used for vegetable farming, and then as a dairy from 1960 to 1972. The report refers to a landfilling consent issued in 1972 (assumed to apply to the entirety of Lot 7 DP 1065574), and refers to evidence that parts of the site were used for landfilling between 1972 and 1993, although does not elaborate on the nature of that evidence. The report further indicates that development consent for sand mining was

granted in 1993, which required the landfilling consent to be surrendered, and that stockpiles of waste were removed from the site in 1992 prior to commencement of sand mining activities.

Based on the information provided in the EMM (2015) report the only visible evidence of potential landfilling on the site was what appeared to be a patch of cleared land in the northern area of the site in the 1978 aerial photograph, with an access track connecting it to what appeared to be an operational area on the northern portion of the site.

There was no evidence of land disturbance on the site to the south of this cleared patch in the 1978 aerial photograph. In addition, no evidence of land disturbance was evident anywhere on the Area 2 site in the 1986 aerial photograph, suggesting that the previous disturbance was restored by that stage. It is worth noting that the location of the cleared patch of land from the 1978 aerial photograph currently coincides with the northern portion of the dredge pond, suggesting that the land that was the subject of that activity in the 1978 aerial photograph was removed prior to, or during, the sand extraction operations on the Area 2 site.

5. Summary of Relevant Previous Investigations

The following subsections provide a summary of the conclusions and/or recommendations of those reports most relevant to the known site contamination issues.

5.1 Previous Investigations and Remediation Action Plan for Area 1

Area 1 is part of the northern portion of site and the proposed residential development (i.e. the Moorebank Cove Residential Site). Consequently, Area 1 has been included in all investigation and remediation works undertaken as part of the DP (2017b) Remediation Action Plan (RAP). Additionally, this site is currently subject to a Statutory Site Audit by a NSW EPA accredited site auditor under the *Contamination Land Management Act* 1997 (NSW) as part of the remediation works.

Given that Area 1 has a proposed remediation strategy that will render the site suitable for the proposed residential development (i.e. the Moorebank Cove Residential Site), no additional intrusive site investigation is considered to be necessary on Area 1. Subject to the appropriate remediation and validation of this part of the site under the existing RAP (DP, 2017b) it is considered that Area 1 will be suitable for the proposed zone boundary change permitting R3 medium density residential development. On this basis, Area 1 has not been considered further by this PSI, however, some related comments are also provided in Section 13.

5.2 Previous Investigations and Remediation Action Plan for Area 2

The historical land uses of interest from a contamination perspective include landfilling (entire property), material recycling (northern portion only), and sand mining. A substantial portion of the Area 2 site currently consists of a dredge pond formed by suction dredge sand mining operations. The land surrounding the dredge pond consists of sandy to silty alluvial deposits, overlain in areas by fill material.

As part of the EMM (2016a) supplementary investigation, soil, sediment and groundwater tests were undertaken, in addition to previous testing undertaken in the preliminary investigation and other historical testing. The test locations from each of these investigations that fall within Area 2 are shown on Drawing 2, Appendix B.

A summary of the results from these investigations relevant to Area 2 are included alongside the current results of this investigation in the Table C1, Appendix C. In general contaminant concentrations were low and within the site assessment criteria (SAC) adopted for this assessment (see Section 10). There were, however some minor exceedances of the TRH (C_{16}-C_{34}) and benzo(a)pyrene (B(a)P) SAC for ecological screening level (ESL) in some sediment / soil samples. However, these results are not considered to be of concern as the final landform of the site has not yet been established and as such their location is unlikely to support a terrestrial ecology (i.e. some exceedances are currently submerged at the base of the pond). Further discussion of the previous EMM results in the context of the SAC adopted for this investigation is included in Section 12.4

It is noted that the EMM RAP (EMM 2016b) concluded:

> *'…this RAP identifies a range of actions to minimise risks to human health or ecology within the marina basin and adjoining Georges River…The land is suitable it its contaminated state (or will be suitable after remediation) for the proposed future land use as a proposed marina development as well as for high-density residential dwellings with minimal opportunities for soil access…' (EMM, 2016b Section 7.1)*

6. Site Description

As part of the fieldwork a site walkover was undertaken on 16 March 2018. Selected photographs from the site walkover are included in Appendix D. In summary the following was observed:

- Area 1: At the time of inspection, Area 1 was a cleared area undergoing geotechnical improvement (compaction) / remediation and levelling as part of the redevelopment and RAP for the northern residential development (photo 1). Remediation of Area 1 involves the construction of a 3.0 m thick compacted clay cap with the upper ≥1.6 m comprising imported VENM (NB: importation and placement of VENM had not yet commenced at the time of the site inspection). The western boundary of the area was bordered by trees (photo 2); and
- Area 2: At the time of inspection, Area 2 comprised the western portion of the former dredge pond area. The dredge ponds are separated from the adjacent Georges River by a narrow (~15 m at narrowest point) strip of land which largely comprises an access track / road along the western boundary of the area (photo 3). A strip of land was present at the western boundary of Area 2 and the remainder of the area comprised a dredge pond (refer to photographs 3, 4, 5 and 6, Appendix D). . Grassed areas with some shrubs, some stockpiles (photo 3 and 5) and some building materials (photo 4) are located between the road and the pond. Area 2 also contains a narrow, low lying grass covered spit, perpendicular to the access track, which extended east into the pond (photo 7). An open unlined drainage channel was located on along the western boundary of the site.

6.1 Proposed Development at Area 2

The proposed development involves the construction of terraced houses and residential flat buildings in the approximate configuration shown on Drawing 2, Appendix B. The development would require filling of the portion of the pond within the footprint of the residential use envelope. The filling / contouring of the land is also anticipated to require cut/fill of the current land area at the western boundary of Area 2.

In summary, the existing landform will require significant filling / re-contouring prior to form the foundation for the proposed residential buildings.

7. Conceptual Site Model of Area 2

A conceptual site model (CSM) is a representation of site-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors (linkages). The CSM provides the framework for identifying how the site became contaminated and how potential receptors may be exposed to contamination either in the present or the future i.e. it enables an assessment of the potential source – pathway – receptor linkages. A CSM was developed by EMM in EMM (2016b).

The CSM in EMM (2016b) includes a focus of surface water quality issues associated with the former dredge ponds. The CSM developed in this report is related specifically to Area 2 and the residential use envelope. Aspects of the site-wide CSM, in particular, those related to surface water, are covered by EMM (2016b).

Potential Sources
Based on the available information, the following potential sources of contamination and associated contaminants of potential concern (COPC) have been identified.

S1 – Filling used to form the current site levels:
COPC include metals, TRH, BTEX, PAH, OCP, OPP, PCB, phenols, asbestos and hazardous ground gases (HGG) (i.e. landfill gas) such as methane.
S2 – Historical industrial uses and landfilling immediately north of Area 2 (i.e. Area 1 and beyond):
COPC include metals, TRH, BTEX, PAH, PCB, asbestos and hazardous ground gases (HGG) (i.e. landfill gas) such as methane.

Potential Receptors
Human health receptors:
R1 – Construction and maintenance workers;
R2 – Current users; and
R3 – Adjacent site users (i.e. residents).

Environmental Receptors:
R4 – Water bodies (former dredge ponds and the adjacent Georges River);
R5 – Water Ecology (within the former dredge ponds adjacent Georges River)
R6 – Groundwater; and
R7 – Terrestrial ecology (within the landscaped areas of the proposed development).

Potential Pathways

P1 – Ingestion and dermal contact;
P2 – Inhalation of dust and/or vapours and explosive risk (methane);
P3 – Surface water run-off;
P4 – Leaching of contaminants and vertical migration into groundwater; and
P5 – Lateral migration of groundwater directly to the former dredge ponds adjacent Georges River.

Summary of Potential Complete Pathways

A 'source–pathway–receptor' approach has been used to assess the potential risks of harm being caused to human, water or environmental receptors from contamination sources on or in the vicinity of the site, via exposure pathways (complete pathways). The possible pathways between the above sources (S1 and S2) and receptors (R1 to R7) are provided in Table 3 below.

Table 3: Summary of Potentially Complete Exposure Pathways

Source	Transport Pathway	Receptor	Risk Management Action Recommended
S1: Filling metals, TRH, BTEX, PAH, OCP, OPP, PCB, phenols, asbestos and HGG (i.e. landfill gas) such as methane **S2: Historical industrial uses and landfilling immediately north of Area 2 (i.e. Area 1 and beyond)** metals, TRH, BTEX, PAH, OCP, OPP, PCB, phenols, asbestos and HGG (i.e. landfill gas) such as methane	P1: Ingestion and dermal contact	R1: Construction and maintenance workers R2: Current users R7: Terrestrial Ecology	An intrusive investigation is recommended to assess possible contamination including chemical testing of the soils and landfill gas. If the site soils are contaminated at unacceptable levels, mitigation / remediation measures will need to be implemented to manage the risk to the identified receptors. If the land is affected by HGG then landfill gas mitigation measures would be required to be incorporated into the proposed development
	P2: Inhalation of dust and/or vapours and explosive risk (methane)	R1: Construction and maintenance workers R2: Current users R3: Adjacent users (residents)	
	P3 – Surface water run-off	R4: Water bodies (former dredge ponds and Georges River) R5: Water Ecology (within former dredge ponds and Georges River)	
	P5: Lateral migration of groundwater directly to the former dredge ponds adjacent Georges River		
	P4 – Leaching of contaminants and vertical migration into groundwater	R6: Groundwater	

8. Data Quality Objectives for Investigation of Area 2

8.1 Introduction

The PSI with limited sampling was devised with reference to the seven step data quality objective (DQO) process which is provided in Appendix B, Schedule B2 of NEPC (2013). The DQO process adopted for DP (2016) has been used for the current investigation and has been modified accordingly (i.e. excludes surface water and groundwater).

The DQO process is outlined as follows:

8.2 State the Problem

The site is proposed to be redeveloped as a residential subdivision. Previous investigations have identified potential sources of soil contamination and groundwater contamination associated with the sites history as a landfill. The "problem" to be addressed is that the extent and nature of potential contamination on site is not fully understood; it is unclear whether the site is suitable for the proposed redevelopment and if contamination poses a risk to human health or the environment during and after the redevelopment works. The objective of the investigation is therefore to further characterise the nature and extent of contamination at the site and make recommendations for further targeted investigations and remediation to render the site suitable for the proposed redevelopment works.

8.3 Identify the Decision / Goal of the Study

Based on the site history of landfilling, it is considered that the contaminants of concern are various organic and inorganic compounds (refer to the CSM in Section 7) for various media including soil, soil gas, groundwater and surface water. As such, the analysis focused on those contaminants relevant to the media of this investigation, (i.e. soil contamination and hazardous ground gases).

The analytical data for soil was compared to relevant SAC including HIL, HSL, EIL and ESL for residential land use land use as per Tables 1A and 1B in Schedule B1, NEPC (2013). The analytical data for soil gas was compared to relevant gas screening value (GSV) and characteristic gas situation (CGS) as per EPA (2012) or other relevant guidance, as appropriate.

The suitability of the site for the proposed residential development was based on a comparison of the analytical results for all contaminants of concern to the adopted SAC and, if necessary, compared to the 95% UCL of the mean concentrations (relevant to soil contamination under certain circumstances).

The following specific decisions were made, as appropriate:

- What is the conceptual site model (i.e. sources, receptors, migration pathways, exposure)?
- Do the existing fill materials and/or natural soils pose a potential risk to identified receptors?
- Does the existing soil gas beneath the site pose a potential risk (toxic, explosion or asphyxiation) to identified receptors?
- Is the data sufficient to make a decision regarding the abovementioned risks, the compatibility of the site for the proposed development or are additional investigations required?

- Does contamination at the site, if encountered, trigger the Duty to Report requirements under the *Contaminated Land Management Act* 1997 (NSW)?
- Are there any off-site migration issues that need to be considered?
- Is the data sufficient to enable the preparation of a RAP and/or Environmental Management Plan (EMP) should the data suggest these are required?

8.4 Identify Inputs to the Decision

Inputs into the decisions were as follows:

- Collection and review of site history information presented in previous investigations undertaken as summarised in Section 4.3, including information regarding previous and current activities undertaken on the site and the surrounding areas;
- Regional geology, topography, ASS risk mapping and hydrogeology;
- Soil samples and landfill gas readings were collected from accessible and relevant areas and analysed for the identified contaminants of concern;
- The lithology of the site as described in the test bore and pit logs;
- If site conditions suggest additional contaminants of concern e.g. if the condition of subsurface material encountered whilst drilling encounter particular odours, further analysis was undertaken;
- Field and laboratory QA/QC data to assess the suitability of the environmental data for the assessment;
- All analysis was undertaken at a NATA accredited laboratory; and
- The results were compared with the SAC, GSV and CGS criteria discussed in Section 10.

8.5 Define the Study Boundaries

The site is identified as Area 2 which is part (generally the south-western portion) of Lot 7 in Deposited Plan 1065574. The site is shown on Drawing 1, Appendix B. Area 2 is rectangular shaped and cover an area of approximately 3 ha, with above water portion estimated to be approximately 0.8 ha. The vertical boundary of the study is the vertical extent of any identified contamination.

8.6 Develop an Analytical Approach (or Decision Rule)

The information obtained during the assessment has been used to characterise the site in terms of contamination issues and risk to human health and/or the environment. The decision rules used in characterising the site were as follows:

- Laboratory test results for fill/soil were assessed individually or statistically, if considered appropriate, to determine the 95% UCL of the mean concentration for each analyte or analyte group (of like materials);
- Laboratory test results for targeted locations were assessed individually;

- The adopted SAC, GSV and CGS are from EPA endorsed guidelines;
- Where such criteria are not available, other recognised national or international standards were used;
- The contaminant concentrations in fill/soil should meet the following criteria, or further investigation or remedial action is required if:
    - The concentration of the contaminant in soil is more than 2.5 times the SAC. Any location more than 2.5 times the adopted site criteria is classified as a 'hotspot', requiring further assessment / management;
    - The calculated 95% UCL for a relevant area and discrete impacted fill/soil stratum (excluding any 'hotspot' concentrations) exceeds the adopted SAC;
    - The standard deviation of the results is greater than 50% of the SAC;
- Further investigation, remediation and/or management to be recommended where the site was found to be contaminated or containing contamination 'hotspots'; and
- The landfill gas data has been evaluated in the context of relevant GSV and CGS and the degree of impact will inform the proposed gas mitigations that may be required for the proposed development.

Field and laboratory test results was considered useable for the assessment after evaluation against the following data quality indicators (DQIs):

- Precision – a measure of variability or reproducibility of data;
- Accuracy – a measure of closeness of the data to the 'true' value;
- Representativeness – the confidence (qualitative) of data representativeness of media present on site;
- Completeness – a measure of the amount of usable data from a data collection activity; and
- Comparability – the confidence (qualitative) that data may be considered to be equivalent for each sampling and analytical event.

8.7 Specify Limits on the Decision Error

Considering that the future site use/development will involve residential land use, decision errors for the respective contaminants of concern for fill/soil were:

1. Deciding that the site's fill/soil exceeds the SAC when they truly do not; and
2. Deciding that the site's fill/soils are within the SAC when they are truly not.

Decision errors for the proposed assessment were minimised and measured by the following:

- Compare new data with available previous investigations to determine the possible range of the parameters of interest;
- The sampling regime targeted key strata identified to account for site variability;
- Sample collection and handling techniques was with reference to DP's *Field Procedures Manual*;

- Samples were prepared and analysed by a NATA accredited laboratory with the acceptance limits for laboratory QA/QC parameters based on the laboratory reported acceptance limits and those stated in NEPC (2013);
- The analyte selection was based on the available site history, past site activities, site features and the findings of the previous investigations. The potential for contaminants other than those proposed to be analysed is currently considered to be low based on the current CSM;
- The SAC, GSV and CGS were adopted from established and EPA endorsed guidelines where available. The SAC, GSV and CGS have risk probabilities already incorporated; and
- Only NATA accredited laboratories using NATA endorsed methods were used to perform laboratory analysis. Where NATA endorsed methods are not used, the reasons have been stated. The effect of using non-NATA methods (if relevant) on the decision making process has been explained.

8.8 Optimise the Design for Obtaining Data

Sampling design and procedures that were implemented to optimise data collection for achieving the DQOs included the following:

- Only NATA accredited laboratories using NATA endorsed methods were used to perform laboratory analysis whenever possible;
- Targeted soil sampling (within access constraints) was generally used to provide indicative coverage of the site;
- To optimise the selection of soil samples for chemical analysis, all samples collected were screened using a PID allowing for site assessment and sample selection. In addition, additional soil samples were collected but kept 'on hold' pending details of initial analysis and were analysed if further delineation was required; and
- Adequately experienced environmental scientists conducted fieldwork and sample analysis interpretation.

9. Rationale and Methodology

The following provides a summary of the basis on which sampling was undertaken to meet the objectives of this PSI. It is noted that groundwater and surface water assessment was outside the purview of this investigation and has been addressed by EMM (2016b).

9.1 Soil Contamination Sampling Rationale

The intrusive investigation was undertaken as a preliminary investigation to identify the likelihood of significant or widespread soil contamination or landfill gas impacts within Area 2. Given Area 1 is already being addressed by the RAP (DP, 2017b), the majority of Area 2 is submerged, and has been previously tested by EMM), soil sampling from two locations (TP101 and TP102) within the above

water portion of Area 2 was considered suitable for this preliminary investigation. Focus was also on landfill gas and asbestos in soil as these were omitted from previous investigations on Area 2.

Table A of NSW EPA (1995) recommends a minimum of for site characterisation based on the detection of circular hot spots using a systemic grid sampling pattern. For a site of 3 ha (entire Area 2), the recommended number of test locations is 40 and for a site of 0.8 ha (current above water footprint) the recommended number of test locations is 19. Previous soil and sediment test locations reported by EMM include five test pits (above water land) and seven sediment samples (submerged land). The two test pits by DP and the previous five by EMM gives a total of seven test locations over a 0.8 ha area which is approximately 40% of the recommended sampling density. This overall sampling density is considered appropriate given the preliminary nature of the current investigation. Whilst sediment sample results have been interpreted as soils samples for the remainder of the land, there remains a significant amount of land forming earthworks required for the currently submerged land.

9.2 Landfill Gas Sampling Rationale

As remediation, including landfill gas, within Area 1 is being addressed by the RAP (DP, 2017b), assessment of this area was not considered warranted. With respect to Area 2, landfill gas monitoring was located in the area which was reasonably accessible and where ground gas was most likely to be present, viz. in the land forming the western portion of the site.

10. Site Assessment Criteria

10.1 Soil

The proposed use for the site after development is residential, including terraces, the most sensitive land use (i.e. residential with accessible soils) and flats (i.e. residential with minimal opportunities for soil access with fully and permanently paved yard space). The relevant SAC have been selected accordingly.

The analytical results from the laboratory testing have been assessed (as a Tier 1 assessment) against the investigation and screening levels in Schedule B1 of NEPC (2013). This guideline has been endorsed by the NSW EPA under the *Contaminated Land Management* Act 1997. The Schedule provides investigation and screening levels for commonly encountered contaminants which are applicable to generic land uses and include consideration of, where relevant, the soil type and the depth of contamination.

10.1.1 Health Investigation and Screening Levels

The HILs and HSLs are scientifically-based, generic assessment criteria designed to be used in the first stage (Tier 1) of an assessment of potential risks to human health from chronic exposure to contaminants. HILs are applicable to assessing health risks arising from direct contact to a range of contaminants. HSLs are used to assess selected petroleum compounds and fractions to assess the risk to human health via inhalation and direct contact with affected soils and groundwater.

HSLs have been developed for a range of petroleum hydrocarbons as either petrol or diesel mixtures, and for different land uses, media, pathways, soil types and depths to contamination.

The investigation and screening levels are not intended to be used as clean up levels. They establish concentrations above which further appropriate investigation (e.g. Tier 2) should be undertaken. They are intentionally conservative and are based on a reasonable worst-case scenario for four generic land uses.

Potential exposure pathways considered were:

- Soil vapour intrusion (for hydrocarbon contamination); and
- Direct contact.

Soil types considered were:

- Sand (conservative), given the general variability of soil types at the site.

Depth to contamination considered was:

- 0 to <1 m for soil HSLs have been adopted as an initial conservative screen; and
- HILs apply generally to the top 3 m of soil for residential land use.

Relevant land use criteria considered were:

- **HIL-A** – Residential with garden/accessible soils; and
- **HSL-A** – Residential with garden/accessible soils.

For petroleum hydrocarbons, the exposure scenario for an intrusive maintenance worker has also been considered and these criteria are extracted from the CRC CARE Technical Reports on which the NEPC (2013) HSLs are based.

Only those contaminants common to both Table 1A(1) (NEPC, 2013) and the list of potential contaminants applied to samples from the proposed analyte list have been included. The adopted soil HILs and HSLs are shown on Table 4.

Table 4: Health Investigation and Screening Levels (HILs/HSLs) in mg/kg

Contaminants		Direct Contact		Vapour Intrusion	
		Resident /Site user HIL/HSL-A	Intrusive Worker	Resident /Site user (sand) HSL-A	Intrusive Worker
Heavy Metals	Arsenic	100	-	-	-
	Cadmium	20	-	-	-
	Chromium (VI)	100	-	-	-
	Copper	6000	-	-	-
	Lead	300	-	-	-
	Mercury (inorganic)	40	-	-	-
	Nickel	400	-	-	-
	Zinc	7400	-	-	-
PAH	Benzo(a)pyrene TEQ [1]	3	-	-	-
	Total PAH	300	-	-	-
	Naphthalene	1400	29,000	3	NL
TRH	$C_6 - C_{10}$ (less BTEX) [F1]	4,400	82,000	40 (silt)	NL
	$>C_{10}$-C_{16} (less Naphthalene) [F2]	3300	62,000	110	NL
	$>C_{16}$-C_{34}	4500	85,000	-	-
	$>C_{34}$-C_{40}	6300	120,000	-	-
BTEX	Benzene	100	1100	0.5	77
	Toluene	14,000	120,000	160	NL
	Ethyl Benzene	4500	85,000	55	NL
	Xylene	12,000	130,000	40	NL
OCP/ OPP	Aldrin + Dieldrin	6	-	-	-
	Chlordane	50	-	-	-
	DDT+DDE+DDD	240	-	-	-
	Endosulfan	270	-	-	-
	Endrin	10	-	-	-
	Heptachlor	6	-	-	-
	HCB	10	-	-	-
	Methoxychlor	300	-	-	-

Contaminants	Direct Contact		Vapour Intrusion	
	Resident /Site user HIL/HSL-A	Intrusive Worker	Resident /Site user (sand) HSL-A	Intrusive Worker
Chlorpyrifos	160	-	-	-
PCB	1	-	-	-
Phenols	3000	-	-	-
Cyanide	250	-	-	-

Notes to Table 4:

1 - sum of carcinogenic PAH

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

10.1.2 Ecological Investigation and Screening Levels

Ecological Investigation Levels (EILs) have been developed and discussed in NEPC (2013) for selected metals and organic compounds and are applicable for assessing risk to terrestrial ecosystems. EILs depend on specific soil physiochemical properties and land use scenarios and generally apply to the top 2 m of soil, which essentially corresponds to the root zone and habitation zone of many species. The EIL is determined for a contaminant using the following formula:

EIL = ABC + ACL, where

ABC = Ambient Background Concentration
ACL = Added Contaminant Limit

The ABC of a contaminant is the soil concentration in a specific locality that is the sum of naturally occurring background levels and the contaminants levels that have been introduced from diffuse or non-point sources (e.g. motor vehicle emissions). The ABC is determined through direct measurement at an appropriate reference site (preferred) or through the use of methods defined by Olszowy et al. (1995) or Hamon et al. (2004) (NEPC, 2013).

ACLs are based on the soil characteristics of estimated pH, CEC and clay content.

EILs (and ACLs where appropriate) have been derived for only a short list of contaminants including As, Cu, Cr (III), DDT, naphthalene, Ni, Pb and Zn. An *Interactive (Excel) Calculation Spreadsheet* may be used for calculating site-specific EILs, and has been provided in the ASC NEPM Toolbox.

EILs were calculated based on the results from previous investigations by DP and EIS on the residential estate that covers the northern portion of the property (and includes Area 1). These EILS were adopted for this investigation and are as follows:

- Average pH 9 (range 7.1 to 10.7) based on 15 soil pH sample results within the upper 2.0 m of the soil profile;
- Average CEC 23 (range 4.3 to 39) based on 14 soil CEC sample results within the upper 2.0 m of the soil profile;
- Clay content 14% (EIS, 2013); and
- NSW traffic and 'low' traffic volume.

Table 5: Ecological Investigation Levels (EILs) in mg/kg

Analyte		EIL
Metals	Arsenic	100
	Cadmium	NC
	Chromium (III)	450
	Copper	230
	Lead	1100
	Mercury (inorganic)	NC
	Nickel	300
	Zinc	850
OCP	DDT	180
PAH	Naphthalene	170

Notes to Table 5:
NC - No Criteria

Ecological Screening Levels (ESLs) are used to assess the risk of selected petroleum hydrocarbon compounds, BTEX and benzo(a)pyrene to terrestrial ecosystems. ESLs apply to the top 2 m of the soil profile, which essentially corresponds to the root zone and habitation zone of many species.

ESLs have been derived in NEPC (2013) for the same four petroleum fractions as the HSLs (F1 to F4) as well as BTEX and Benzo(a)pyrene. The ESLs are shown on the following table. The following site specific data and assumptions have been used to determine the ESLs:

- The ESLs will apply to the top 2 m of the soil profile;
- The ESLs for urban residential and public open space apply; and
- A "coarse" soil texture (conservative) has been adopted as an initial screen given the general variability of soil types at the site.

Table 6: Ecological Screening Levels (ESLs) in mg/kg

Analyte		ESL	Comments
TRH	$C_6 – C_{10}$ (less BTEX) [F1]	180*	All ESLs are low reliability apart from those marked with * which are moderate reliability
	$>C_{10}$-C_{16} (less Naphthalene) [F2]	120*	
	$>C_{16}$-C_{34} (F3)	300	
	$>C_{34}$-C_{40} (F4)	2800	
BTEX	Benzene	50	
	Toluene	85	
	Ethyl Benzene	70	
	Xylenes	105	
PAH	B(a)P	0.7	

10.1.3 Management Limits for Petroleum Hydrocarbons

In addition to appropriate consideration and application of the HSLs, there are additional considerations which reflect the nature and properties of petroleum hydrocarbons, including:

- Formation of observable light non-aqueous phase liquids (LNAPL);
- Fire and explosion hazards; and
- Effects on buried infrastructure e.g. penetration of, or damage to, in-ground services.

Management Limits to avoid or minimise these potential effects have been adopted in NEPC (2013) as interim Tier 1 guidance. Management Limits have been derived for the same four petroleum fractions as the HSLs (F1 to F4). The adopted Management Limits are shown on the following table. The following site specific data and assumptions have been used to determine the Management Limits:

- The Management Limits will apply to any depth within the soil profile;
- The Management Limits for residential, parkland and open space apply; and
- A “coarse” soil texture (conservative) has been adopted as an initial screen given the general variability of soil types at the site.

Table 7: Management Limits in mg/kg

Analyte		Management Limit
TRH	$C_6 – C_{10}$ (F1)	700
	$>C_{10}$-C_{16} (F2)	1000
	$>C_{16}$-C_{34} (F3)	2500
	$>C_{34}$-C_{40} (F4)	10,000

Notes to Table 7: Separate management limits for BTEX and naphthalene are not available hence these should not be subtracted from the relevant fractions to obtain F1 and F2

10.2 Landfill Gas

According to the NSW EPA (2012), methane (CH_4) is a flammable gas that is explosive in the concentration range 5% to 15% v/v in air (somewhat different ranges may apply in atmospheres with enhanced or reduced oxygen concentrations). Methane is also a potential asphyxiant if its presence displaces oxygen thereby resulting in an environment with low oxygen concentration. It is less dense than air.

Carbon dioxide (CO_2) is an asphyxiant and toxic gas that is significantly denser than air. Carbon monoxide (CO) is an acutely toxic gas that is also flammable and potentially explosive. It has neutral buoyancy in air. Hydrogen is a flammable, potentially explosive gas that is much less dense than air. Hydrogen sulphide (H_2S) is a flammable and acutely toxic gas that is denser than air. It is highly odorous, and a nuisance, at low concentrations.

Trace gases may also be present depending on the nature of the source material, particularly if landfilled wastes are involved, including volatile organic compounds.

SAC from CIRIA (2007) and as adopted by NSW EPA (2012) (originally modified from Wilson and Card (2007)) for the GSV and CGS have been used to evaluate landfill gas. The GSV and CGS are summarised in the table reproduced from NSW EPA (2012), below.

Table 8: Modified Wilson and Card Classification (NSW EPA, 2012)

	Gas screening value threshold (L/hr)	Characteristic gas situation	Risk classification	Additional factors	Typical sources
	<0.07	1	Very low risk	Typically methane <1% v/v and/or carbon dioxide <5% v/v, otherwise consider increase to Situation 2	Natural soils with low organic content Typical fill
	<0.7	2	Low risk	Borehole flow rate not to exceed 70 L/hr, otherwise consider increase to Situation 3	Natural soils with high organic content Fill
	<3.5	3	Moderate risk		Old inert waste landfill Flooded mine workings
	<15	4	Moderate to high risk	Consider need for Level 3 risk assessment	Mine workings susceptible to flooding Closed putrescible waste landfill
	<70	5	High risk	Level 3 risk assessment required	Shallow, un-flooded abandoned mine workings
	>70	6	Very high risk		Recent putrescible waste landfill

Notes:

1. Site characterisation should be based on gas monitoring of concentrations and borehole flow rates for the minimum periods defined in Section 3.4.
2. Source of gas and generation potential must be identified in the conceptual site model.
3. Soil gas investigation should be in accordance with the guidance provided in Section 3.4.
4. Where there is no detectable flow, the lower measurement limit of the instrument should be used.
5. To determine a GSV of <0.07, instruments capable of making accurate concentration measurement to 0.5% v/v and flow measurement to 0.1 L/hr are recommended.

11. Fieldwork

11.1 Drilling and Soil Sampling

A DP Environmental Scientist conducted the fieldwork. A 35T excavator was used to excavate two test pits (TP101 and TP102) to a depth of 3.0 m bgl. Samples were collected at regular depth intervals and based on observed changes in strata and upon obvious sign of contamination such as fibrous material.

Environmental sampling was performed according to standard operating procedures outlined in the DP *Field Procedures Manual*. All sampling data was recorded on DP chain of custody sheets. The general sampling and sample management procedures comprised:

- Collection of samples from the test pit walls and the excavator bucket (for depths below 1 m). Samples were placed into laboratory-prepared glass jars with Teflon lined lids by hand, capping immediately and ensuring headspace within the sample jar is minimised;
- Collection of a replicate sample in a zip-lock bag for PID screening;
- A new disposable nitrile glove was worn by the field scientist / engineer for each sample collected thereby precluding potential cross-contamination;
- Collection of 10% replicate samples for QC purposes;
- Labelling of sample containers with individual and unique identification details, including project number, sample location and sample depth (where applicable); and
- Placement of the sample jars into a cooled, insulated and sealed container for transport to the laboratory.

The headspace in the zip-lock bag sample was allowed to equilibrate and was screened using the PID. The PID had a 10.6eV lamp and was calibrated with isobutylene gas at 100 ppm and with fresh air.

Test pit locations are shown on Drawing 2, Appendix B.

11.2 Drilling and Installation of Landfill Gas Monitoring Wells

A Geoprobe with an auger was utilised for the drilling of the three boreholes (MW101, MW102 and MW103) to depths between 4.0 and 5.5 m bgl. Wells were installed in these three boreholes for landfill gas monitoring.

Wells were constructed using class 18 uPVC machine slotted screen and blank sections. The screened section of each well was backfilled with a washed sand filter pack to approximately 0.5 m above the screened interval. Each well was completed with a hydrated bentonite plug generally 0.4 m thick and concrete at the surface with a 0.5 to 1.0 m stick-up and well cap with gas sampling nipple.

Monitoring well locations are shown on Drawing 2, Appendix B.

11.3 Landfill Gas Monitoring

Monitoring of gas concentrations and flow rates was undertaken using a calibrated GA5000 on two occasions, 20 March and 9 April 2018. The monitoring was conducted according to the following procedure:

- Atmospheric pressure was recorded prior to monitoring;
- The inlet hose of a GAG000 was connected to the well gas cap using a 'quick connect' fitting; and
- Peak and stabilised readings of carbon dioxide, methane, hydrogen sulphide, carbon monoxide and oxygen were recorded upon stabilisation of parameters and at 30 second intervals for a period of five minutes.

12. Results

12.1 Field Observations

Details of the subsurface conditions encountered in the boreholes and test pits are provided in the logs included in Appendix E. Logs should be read in conjunction with the accompanying standard notes defining classification methods and descriptive terms.

The subsurface conditions at Area 2 are broadly summarised as follows:

FILLING: Silty sand, clayey sand and clay filling with some gravel to a depth of 4.0 m bgl (MW103) or test pit / borehole termination (>3.0 m at TP101 and TP102 and >4.0 m at MW101, MW102). Anthropogenic inclusions including brick, glass, tile, wood, fragments of fibre cement were present within the filling at some of the test locations;

CLAY: Clay from a depth of 4.0 m to 5.0 m bgl at MW103; and

SANDY CLAY: Sandy clay from 5.0 m to 5.5 m bgl (borehole termination) at MW103.

Free groundwater was observed in all three boreholes whilst augering at depths of between at 2.7 m (MW102) and 5.5 m (MW103) bgl.

Fragments of fibre cement (potential bonded asbestos containing material (ACM)) were observed in TP101 and TP 102. This is consistent with other areas of the property and the observed presence of building waste in the fill.

Photographs depicting the typical profile of filling at TP101 and TP102 are included in Appendix D.

12.2 Field Screening Results for Soil

Replicate soil samples collected in zip-lock plastic bags were allowed to equilibrate under ambient temperatures before screening for total photoionisable compounds (i.e. VOC) using a calibrated PID.

Results of sample screening are shown on the test pit logs presented in Appendix E. The PID readings were all generally low ranging between 6 ppm to 13 ppm. The screening results suggest the general absence of gross VOC contamination.

12.3 Landfill Gas Monitoring

Landfill gas monitoring was undertaken on 20 March 2018 and 9 April 2018. Table 9 provides a summary of the results and calculated GSV and CGS for the two monitoring events. Atmospheric pressure readings were between 1017 and 1021 mb during the monitoring events.

Table 9: Landfill Gas Monitoring Results

MW	Date	Flow Rate Peak (L/h) [1]	Methane Peak %	CO_2 Peak %	GSV= flow x highest Methane or CO_2	CGS [2]
MW101	20/3/2018	<0.1	0.1	11.1	0.011	2
	9/4/2018	-0.1	0.0	10.9	0.011	2
MW102	20/3/2018	<0.1	2.1	4.2	0.004	2
	9/4/2018	<0.1	0.0	4.6	0.005	1
MW103	20/3/2018	<0.1	0.1	4.8	0.005	1
	9/4/2018	0.1	0.0	4.5	0.005	1

Notes to table:

1. The flow rate used to calculate the GSV was the detection limit of the instrument for <0.1 L/h readings and negative readings were assumed as the equivalent positive reading as recommended in NSW EPA (2012)
2. Where methane >1% or CO_2 >5% CGS was increased to Situation 2 as per Table 6 of NSW EPA (2012)

The maximum recorded concentration of methane was 2.1% at MW102 on 20 March 2018 and the maximum recorded concentration of CO_2 was 11.1% at MW101 on 20 March 2018. The landfill gas results indicate generally low concentration and flow readings with a calculated CGS of 1 for all three monitoring wells. However, as per Table 6 is NSW EPA (2012), consideration should be given to raising the CGS to 2 where methane exceeds 1% and/or CO_2 exceeds 5%. The concentrations of landfill gas are comparatively lower than that on the northern part of the site comprising a proposed residential estate (i.e. encompassing Area 1). This may be due to Area 2 having been subject to more sand mining and less subsequent landfilling compared to the land to the north of the former dredge ponds. It should be noted however that this monitoring is only preliminary in nature (i.e. two monitoring events) and hence further monitoring would be required to confirm (or otherwise) these CGS values.

The landfill gas management approach adopted by the NSW EPA (2012) guidelines was based on British Standard BS 8485:2007, which was superseded by the 2015 version. BS 8495:2015 Code of Practice for Design of Protective Measures for Ground Gases (note: this guideline is not listed as being made or endorsed under S.105 of the CLMA) resulted in some changes to the required gas protection guidance values and scoring system for protection measures that were provided in Tables 7 and 8 of the NSW EPA (2012) guideline. If continued monitoring indicates that a CGS if 2 is appropriate for the site, then relevant measure(s) or system element(s) required to achieve a score consistent with what is required based on the CGS of 2 which is 3.5 points.

Field sampling records are included in Appendix F. A copy of the GA5000 calibration certificate is also included in Appendix F.

12.4 Analytical Laboratory Results

Summary results tables including analytical results and relevant SAC are summarised in Table C1, Appendix C. The results summary includes previous soil and sediment test locations that fall within the Area 2 boundary as summarised in EMM (2016b). Given that the ponds will be filled to create a new landform (building foundation) within the Area 2 residential use envelope, sediment samples have been interpreted as soil samples and have not been compared against sediment quality guidelines as they were in EMM (2016b).

Six samples were tested for a range of organic and inorganic contaminants as part of the current investigation (i.e. TP101 and TP102). Detectable concentrations of metals and PAH were well below the adopted SAC. The results for TRH, BTEX, OCP, OPP, PCB and phenols were below the laboratory reporting limit in all six samples.

One fragment of fibre cement from each test pit was tested for asbestos and each was confirmed to contain chrysotile and amosite asbestos.

Laboratory reports with associated chain of custody documentation are also presented in Appendix H.

Five samples collected from five test pits within Area 2 (i.e. TP3, TP5, TP6, TP13 and TP14) were tested for a range of organic and inorganic contaminants as part of the previous EMM investigations. Seven sediment samples were also collected and tested from within the Area 2 footprint for a range of organic and inorganic contaminants as part of the previous EMM investigations. These results were compared against the relevant SAC and as discussed above, the sediment samples have been interpreted as soil samples as that is what the sediment will ultimately become under the proposed development.

The EMM results for soil and sediment samples collected from within Area 2 are summarised as follows:

- Concentrations of metals in the 12 samples tested were all below the adopted SAC;
- Concentrations of TRH in the 12 samples tested were all below the adopted SAC with the exception of two sediment samples which exceeded the adopted ESL;
- Concentrations of BTEX in the 12 samples tested were below the laboratory reporting limit and were therefore below the adopted SAC;
- Concentrations of PAH in the 12 samples tested were all below the adopted SAC with the exception of three sediment samples and one soil sample which exceeded the adopted ESL;
- Concentrations of OCP in the three samples tested were below the laboratory reporting limit and were therefore below the adopted SAC;
- Concentrations of OPP in the two samples tested were below the laboratory reporting limit and were therefore below the adopted SAC; and
- Concentrations of PCB in the two samples tested were below the laboratory reporting limit and were therefore below the adopted SAC.

The previous EMM results which exceed the ESL are not considered to be of concern as although the final landform of the site has yet to be established their location is highly unlikely to support a terrestrial ecology (i.e. some are currently submerged at the base of the pond). Moreover, any landscaped areas within Area 2 are likely to be formed using imported materials.

12.5 Data Quality Assurance and Quality Control

Field and laboratory quality assurance and quality control (QA/QC) procedures formed an integral part of the assessment. The QA/QC procedures and results are included in Appendix G. Overall, the standard operating procedures (SOPs) were complied with in the field, and the field and laboratory QC samples were generally within the acceptance criteria. On this basis, it is considered that an acceptable level of field and laboratory precision and consistency was achieved and that the laboratory data sets are reliable, accurate and useable for this assessment.

13. Conclusions and Recommendations

Area 1 has previously been investigated by DP and is within the remediation area for the northern portion of the property (DP 2017b). These remedial works are currently being undertaken and will result in land suitable for the proposed medium density R3 residential estate (i.e. northern part of the site, including Area 1). By extension, Area 1 is therefore considered suitable for rezoning to allow medium density R3 residential land use as per the current planning proposal (including residential land use with no accessible soils and/or with some accessible soils, as appropriate).

Concentrations of contaminants within Area 2 were all below the adopted SAC with the exception of some minor exceedances of the ESL, however, the exceedances are not considered to be of concern. Bonded ACM was encountered in the fill at the two test pits TP101 and TP102. A full asbestos investigation would be required to quantify the concentration of bonded ACM and fibrous asbestos and asbestos fines (FA and AF) in filling against relevant Tier 1 screening criteria for asbestos. Alternatively, the development could adopt a cap and contain strategy in relation to asbestos in filling and this would require a long-term environmental management plan (EMP).

It is noted that any potential impacts on surface water in the dredge ponds and adjacent Georges River from groundwater and the soils and sediments is being addressed by EMM (2016b) and hence is outside the purview of this investigation. Further to this, DP notes that the filling of the ponds is going to introduce new material (fill) into direct contact with the pond surface water body. Any filling should be conducted so as not to adversely affect water quality.

A suitable filling protocol should therefore be implemented for the ponds and Area 2 more broadly. This would essentially comprise an addendum to the EMM (2016b) RAP. On completion of the final landform, a Detailed Site Investigation (DSI) of Area 2 is recommended in order to confirm the placed fill meets the SAC for use as residential (terrace houses and residential flat buildings). This should involve a sampling density which meets the recommended minimum density for site characterisation as per Table A in NSW EPA (1995) Sampling Design Guidelines. Alternatively, a rigorous testing programme on the fill used to create the final landform under the filling protocol could go some way to

negating the need for a post-placement / post-filling DSI. A primary consideration in the selection of fill to place in the ponds would be to minimise the risk of surface water contamination.

Whilst the initial screening for landfill gas has indicated a generally low risk, given the results across the rest of the property, the final gas risk profile would need to be confirmed through additional monitoring events and on completion of the final landform. If ultimately it was deemed that landfill gas protection systems were required in Area 2, it is anticipated that such measures could be addressed in a similar way that has been adopted for the residential properties across the northern portion of property as another addendum to the EMM (2016b) RAP in the proposed marina (Area 2).

In summary, based on the findings of the current investigation it is considered that Area 2 is suitable for residential land use to allow residential terraces and residential flat buildings, as per the current planning proposal, as per the current planning proposal, provided that:

- An asbestos investigation is undertaken to verify whether asbestos is present at concentrations exceeding the relevant Tier 1 screening criteria;
- Additional groundwater investigations are undertaken to evaluate whether per- and poly-fluoroalkyl substances (PFAS) is present in groundwater at concentrations which may adversely impact surface water;
- Further gas monitoring is undertaken and demonstrates that mitigation systems can be suitably installed and operated within the proposed building designs. Preliminary landfill gas monitoring indicates that the residential use envelope may require landfill gas mitigations. If continued monitoring indicates that mitigations are required, an addendum to the EMM (2016b) RAP must be prepared to address this specific issue. Further to this, it is understood that buildings currently being proposed involves suspended slabs under which mitigation systems could be readily incorporated into the design, if necessary;
- An addendum to the EMM (2016b) RAP is prepared that deals with asbestos issues (if required based on the outcome of dot-point one) and the filling of the ponds and addresses:
    - a) protection of human health of future residents; and
    - b) protection of surface water quality in the dredge ponds, in particular, if there is a plan to open the dredge ponds to the Georges River in the future;
- A post-filling DSI is completed across Area 2 that addresses:
    - a) protection of human health of future residents (i.e. testing of soil within the residential use envelope);
    - b) protection of surface water quality in the dredge ponds, in particular, if there is a plan to open the dredge ponds to the Georges River in the future;
    - c) based on the results of the DSI, if required, an addendum to the EMM (2016b) RAP is completed to outline the additional remediation requirements associated with:
        - The residential use envelope and protection of human health of future residents, including gas mitigation;
        - Protection of surface water quality, in particular, if there is a plan to open the dredge ponds to the Georges River in the future; and
    - d) site remediation is undertaken and completed with reference to the EMM (2016b) RAP and any addendums to the RAP as described above. The remediation must be validated in

line with relevant NSW EPA endorsed guidelines including NSW OEH (2011) Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites.

14. References

BSI 8485 (2015) Code of Practice for Design of Protective Measures for Ground Gases

CIRIA (2007) C665 Assessing Risks Posed by Hazardous Ground Gases to Buildings

Dames & Moore (1994) Report on Groundwater Sampling

Dames & Moore (2000) Landfill Groundwater and Surface Water Monitoring and Assessment Program

DP (1999) Proposed Environmental Monitoring Program, Sorting, Recovery and Transfer (SRT) Facility, 146 Newbridge Road, Moorebank

DP (2002a) Preliminary Geotechnical Assessment, 146 Newbridge Road, Moorebank

DP (2002b) Report on Preliminary Contamination Assessment, Proposed Residential Development, 146 Newbridge Road, Moorebank

DP (2002c) Geotechnical Assessment, 146 Newbridge Road, Moorebank

DP (2005) Proposed Mixed Commercial / Residential Development, 146 Newbridge Road, Moorebank

DP (2008) Preliminary Desktop Review, Benedict Sand and Gravel, Moorebank

DP (2009a) Desktop Review, Benedict Sand and Gravel, Moorebank

DP (2009b) Environmental and Geotechnical Advice, Benedict Sand and Gravel, 146 Newbridge Road, Moorebank

DP (2009c) Review of Foundation Options, Proposed Residential Development, 146 Newbridge Road, Moorebank

DP (2009d) Compaction and Grading, 146 Newbridge Road, Moorebank

DP (2014a) Initial Comments on the Design of Landfill Gas Mitigation Measures 146 Newbridge Road, Moorebank Stage 1

DP (2014b) Draft Concept Design for Landfill Gas Mitigation Measures, 146 Newbridge Road, Moorebank Stage 1

DP (2015a) Construction Environmental Management Plan, Proposed Retaining Wall, 146 Newbridge Road, Moorebank, NSW

DP (2015b) Sampling and Analysis Quality Plan, Proposed Residential Subdivision, 146 Newbridge Road, Moorebank, NSW

DP (2015c) Report on Geotechnical Investigation, Proposed Residential Subdivision, 146 Newbridge Road, Moorebank

DP (2015d) Report on Geotechnical Investigation, Retaining Wall, 146 Newbridge Road, Moorebank

DP (2016) Detailed Site Investigation, Proposed Residential Development, 146 Newbridge Road, Moorebank (Rev1)

DP (2017a) Groundwater Data Review, Proposed Residential Development, 146 Newbridge Road, Moorebank

DP (2017b) Remediation Action Plan, Proposed Residential Development, 146 Newbridge Road, Moorebank (Rev5)

EIS (2013) Stage 1 Environmental Site Assessment for Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EIS (2014a) Preliminary Hazardous Ground Gas Screening for the Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EIS (2014b) Hazardous Ground Gas (HGG) Screening Results (Round 2), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EIS (2014c) Hazardous Ground Gas (HGG) Screening Results (Round 3), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EIS (2014d) Hazardous Ground Gas (HGG) Screening Results (Round 4), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EIS (2014e) Hazardous Ground Gas (HGG) Screening Results (Round 5), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EMM (2015) Preliminary Investigation of Contamination, Proposed Georges Cove Marina

EMM (2016a) Supplementary Preliminary Investigation, Proposed Georges Cove Marina

EMM (2016b) Remediation Action Plan, Proposed Georges Cove Marina

J&K (2013) Geotechnical Investigation for Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

J&K (2016) Geotechnical Evaluation for Proposed Residential Subdivision at 146 Newbridge Road, Moorebank, NSW

J&K (2017) Geotechnical Evaluation for Proposed Residential Subdivision at 146 Newbridge Road, Moorebank, NSW

J&K (2016b) Response to RAP Comments (ref: 26903Zemail3)

NEPC (2013) National Environment Protection (Assessment of Site Contamination) Measure 1999 amended 2013

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

NSW OEH (2011) Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites

15. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 146 Newbridge Road (Areas 1 and 2 rezoning) in accordance with DP's proposal SYD180001 (Rev1) dated 17 January 2018 and acceptance received from Mirvac Homes NSW Pty Ltd. The work was carried out under the agreed contract. This report is provided for the exclusive use of Mirvac Homes NSW Pty Ltd and Tanlane Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This

design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the environmental components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

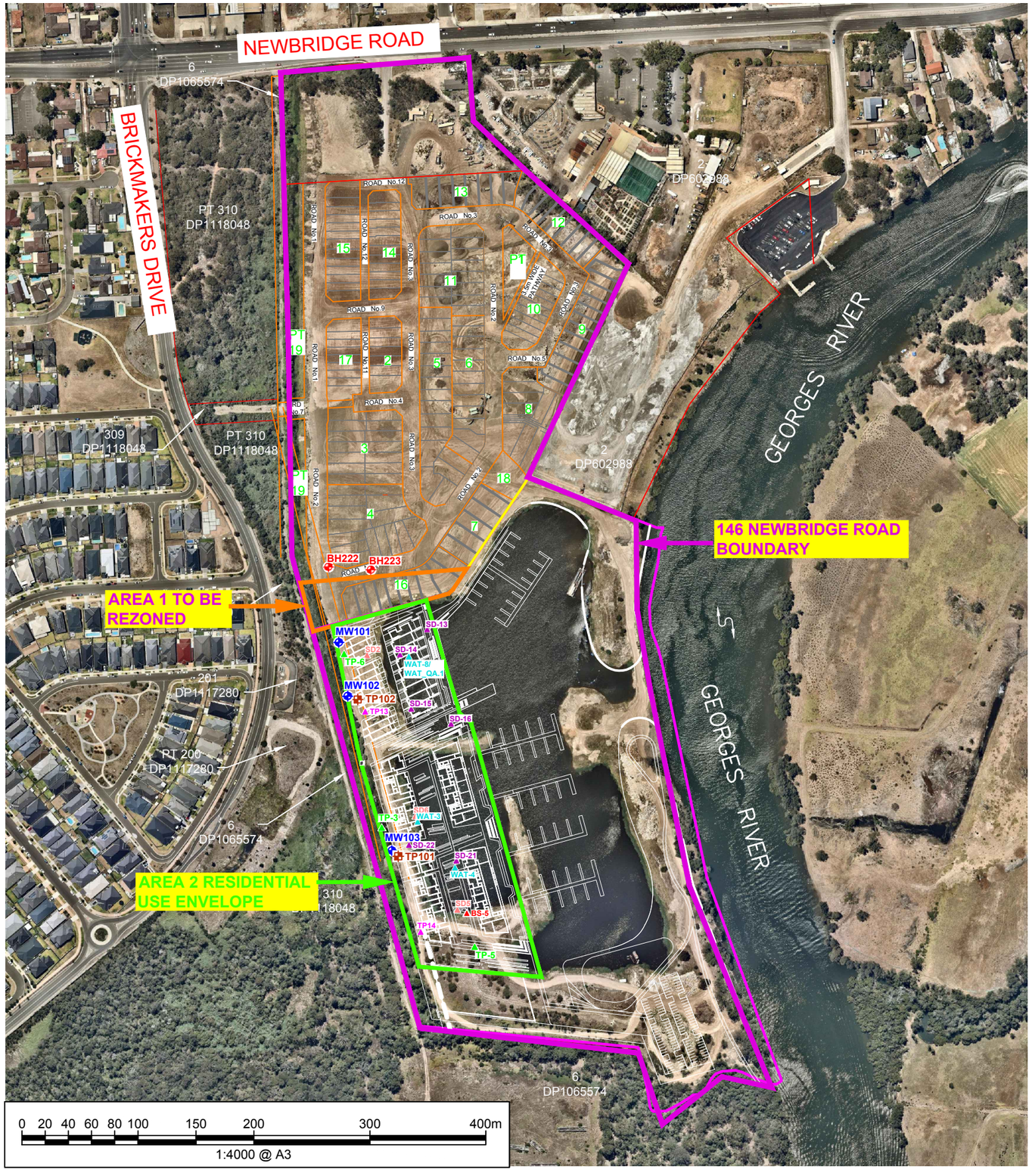
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Appendix B

Drawings



Locality Plan

NOTE:
1: Base image from Nearmap.com (Dated 21.1.2018)
2: Test locations are approximate only and are shown with reference to existing features
3: Survey is from JMD Development Consultants Ref: 14005-GEO1

LEGEND

- Current test pit location
- Previous borehole location
- Gas monitoring bore

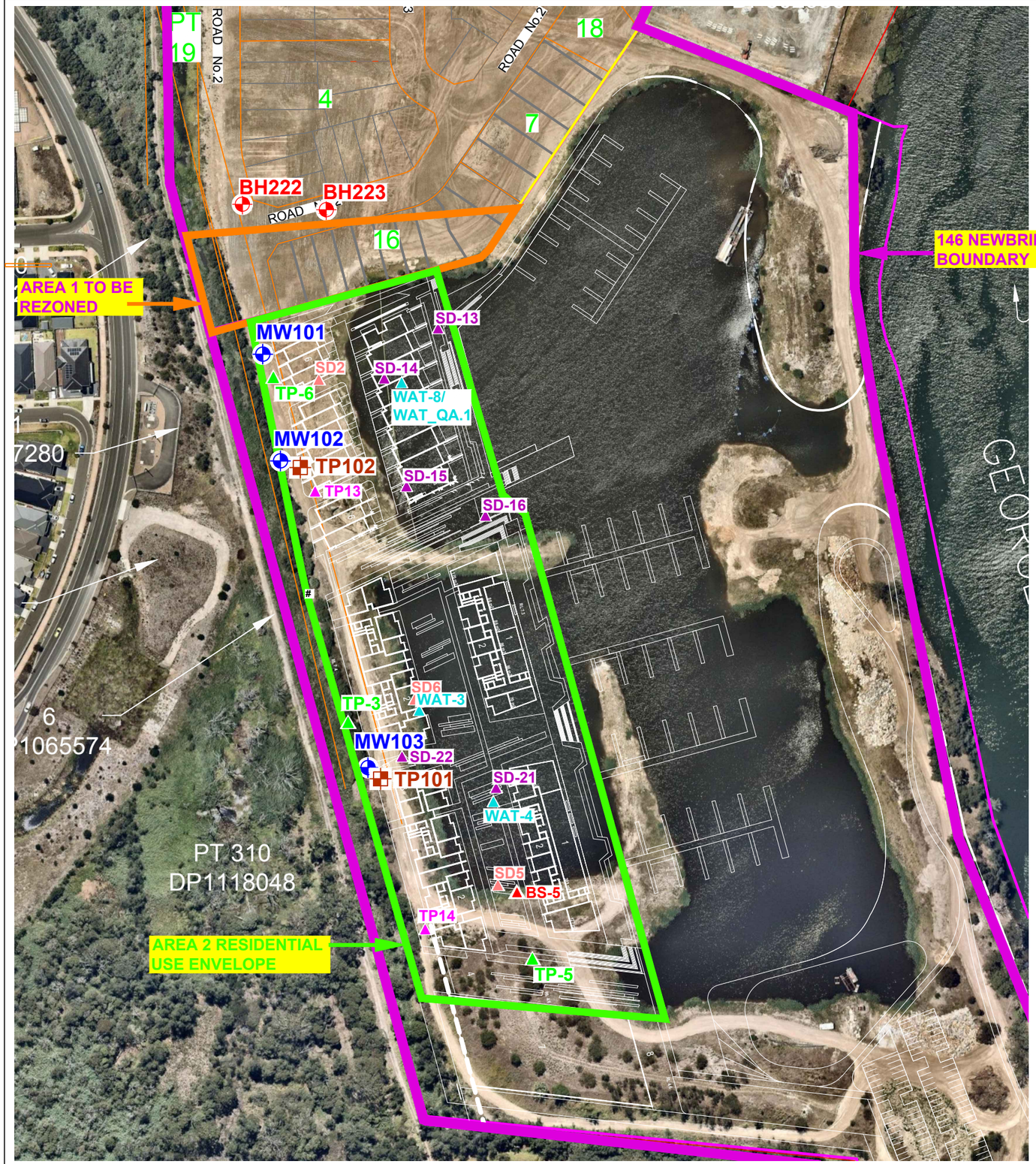
INVESTIGATION BY EMM

- SPI Test pit location
- SPI Sediment sample location
- SPI Dregded pond water sample location
- PI Sediment sample location
- PI Test pit location
- # SPI and historic groundwater sample location
- Historic groundwater sample l ocation

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Mirvac Homes Nsw Pty Ltd		TITLE: **Test Locations**
OFFICE: Sydney	DRAWN BY: PSCH	**Proposed Residential Development (Rezoning)**
SCALE: 1:4000 @ A3	DATE: 10.4.2018	**146 Newbridge Road, MOOREBANK**

PROJECT No: 71459.10
DRAWING No: 1
REVISION: 0



0 10 20 30 40 60 80 100 150 200m

1:2000 @ A3

NOTE:
1: Base image from Nearmap.com (Dated 21.1.2018)
2: Test locations are approximate only and are shown with reference to existing features
3: Survey is from JMD Development Consultants Ref: 14005-GEO1

LEGEND

- Current test pit location
- Previous borehole location
- Gas monitoring bore

INVESTIGATION BY EMM

- SPI Test pit location
- SPI Sediment sample location
- SPI Dregded pond water sample location
- PI Sediment sample location
- PI Test pit location
- # SPI and historic groundwater sample location
- Historic groundwater sample l ocation

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Mirvac Homes Nsw Pty Ltd		TITLE: **Test Locations**	PROJECT No: 71459.10
OFFICE: Sydney	DRAWN BY: PSCH	**Proposed Residential Development (Rezoning)**	DRAWING No: 2
SCALE: 1:2000 @ A3	DATE: 10.4.2018	**146 Newbridge Road, MOOREBANK**	REVISION: 0

Appendix C

Table C1: Summary of Laboratory Results

Table C1: Summary of Laboratory Results

Metals

Field_ID	Sample Dep	Sample Date	Matrix Description	Arsenic (mg/kg)	Cadmium (mg/kg)	Chromium (III+VI) (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Zinc (mg/kg)
PQL				4	0.4	1	1	1	0.1	1	1
CRC Care Direct Contact HSL-A											
CRC Care Direct Contact Intrusive Maintenance Worker											
CRC Care Intrusive MW Soil HSL Vapour I, Sand 0-2m											
NEPM 2013 EILs Res/Open Space Aged				100		450	230	1100		300	850
NEPM 2013 Table 1A(1) HILs Res A Soil				100	20	100	6000	300	40	400	7400
NEPM 2013 Table 1A(3) Res A/B Soil HSL for Vapour Intrusion, Sand 0-1m											
NEPM 2013 Table 1B(6) ESLs for Urban Res, Coarse Soil 0-2m											
NEPM 2013 Table 1B(7) Management Limits in Res / Parkland, Coarse Soil											
DP Results, Current Investigation April 2018											
TP101	0.2-0.3	16/03/2018	Filling	6	<0.4	15	41	100	0.1	10	240
BD1/20180316	0.2-0.3	16/03/2018	Filling	6	0.4	16	43	110	0.1	10	220
TP101	1.9-2	16/03/2018	Filling	4	<0.4	16	14	42	<0.1	6	47
TP101	2.8-2.9	16/03/2018	Filling	-	-	-	-	-	-	-	-
TP102	0.2-0.3	16/03/2018	Filling	5	<0.4	9	15	24	<0.1	10	41
TP102	0.4-0.5	16/03/2018	Filling	-	-	-	-	-	-	-	-
TP102	0.9-1	16/03/2018	Filling	5	<0.4	9	15	28	<0.1	6	54
TP101	-	16/03/2018	Material	-	-	-	-	-	-	-	-
TP102	-	16/03/2018	Material	-	-	-	-	-	-	-	-
Trip Spike	-	16/03/2018	Soil	-	-	-	-	-	-	-	-
Trip Blank	-	16/03/2018	Soil	-	-	-	-	-	-	-	-
EMM Results, Preliminary Investigation, July 2015											
SOIL											
TP-3	0.5	3/06/2018	Filling	7	<1	18	65	112	0.1	10	217
TP-5	0.5	3/06/2018	Filling	6	<1	33	176	144	0.1	15	309
TP-6	0.5	3/06/2018	Filling	<5	<1	3	<5	7	<0.1	7	21
SEDIMENT											
SD-2	-	3/06/2018	Sediment	<5	<1	<2	<5	20	<0.1	<2	16
SD-5	-	3/06/2018	Sediment	15	1	33	96	268	0.5	17	316
SD-6	-	3/06/2018	Sediment	<5	<1	9	21	49	<0.1	6	60
EMM Results, Supplementary Preliminary Investigation, March 2016											
SOIL											
TP-13	1.5	9/11/2015	Filling	<5	<1	8	24	53	<0.1	8	95
TP-14	3.1	9/11/2015	Filling	8	<1	8	10	11	<0.1	17	23
SEDIMENT											
SD-13	-	9/11/2015	Sediment	12	<1	30	71	197	0.4	16	388
SD-14	-	9/11/2015	Sediment	14	<1	27	54	134	0.2	15	180
SD-15	-	9/11/2015	Sediment	15	<1	34	82	229	0.5	18	309
SD-16	-	9/11/2015	Sediment	15	<1	36	93	239	0.5	19	345

TRH

Field_ID	Sample Dep	Sample Date	Matrix Description	C10-C16 (mg/kg)	C16-C34 (mg/kg)	C34-C40 (mg/kg)	F2-NAPHTHALENE (mg/kg)	C10 - C14 (mg/kg)	C15 - C28 (mg/kg)	C29-C36 (mg/kg)	C10 - C40 (Sum of total) (mg/kg)
PQL				50	100	100	50	50	100	100	50
CRC Care Direct Contact HSL-A				3300	4500	6300					
CRC Care Direct Contact Intrusive Maintenance Worker				62000	85000	120000					
CRC Care Intrusive MW Soil HSL Vapour I, Sand 0-2m							NL				
NEPM 2013 EILs Res/Open Space Aged											
NEPM 2013 Table 1A(1) HILs Res A Soil											
NEPM 2013 Table 1A(3) Res A/B Soil HSL for Vapour Intrusion, Sand 0-1m							110				
NEPM 2013 Table 1B(6) ESLs for Urban Res, Coarse Soil 0-2m					300	2800	120				
NEPM 2013 Table 1B(7) Management Limits in Res / Parkland, Coarse Soil				1000	2500	10000					
DP Results, Current Investigation April 2018											
TP101	0.2-0.3	16/03/2018	Filling	<50	<100	<100	<50	<50	<100	<100	<50
BD1/20180316	0.2-0.3	16/03/2018	Filling	<50	<100	<100	<50	<50	<100	<100	<50
TP101	1.9-2	16/03/2018	Filling	<50	<100	<100	<50	<50	<100	<100	<50
TP101	2.8-2.9	16/03/2018	Filling	-	-	-	-	-	-	-	-
TP102	0.2-0.3	16/03/2018	Filling	<50	<100	<100	<50	<50	<100	<100	<50
TP102	0.4-0.5	16/03/2018	Filling	-	-	-	-	-	-	-	-
TP102	0.9-1	16/03/2018	Filling	<50	<100	<100	<50	<50	<100	<100	<50
TP101	-	16/03/2018	Material	-	-	-	-	-	-	-	-
TP102	-	16/03/2018	Material	-	-	-	-	-	-	-	-
Trip Spike	-	16/03/2018	Soil	-	-	-	-	-	-	-	-
Trip Blank	-	16/03/2018	Soil	-	-	-	-	-	-	-	-
EMM Results, Preliminary Investigation, July 2015											
SOIL											
TP-3	0.5	3/06/2018	Filling	<50	210	110	<50	<50	128	140	320
TP-5	0.5	3/06/2018	Filling	<50	100	<100	<50	<50	<100	<100	100
TP-6	0.5	3/06/2018	Filling	<50	<100	<100	<50	<50	<100	<100	<50
SEDIMENT											
SD-2	-	3/06/2018	Sediment	<50	<100	<100	<50	<50	<100	<100	<50
SD-5	-	3/06/2018	Sediment	<50	490	340	<50	<50	180	460	830
SD-6	-	3/06/2018	Sediment	<50	200	<100	<50	<50	120	120	200
EMM Results, Supplementary Preliminary Investigation, March 2016											
SOIL											
TP-13	1.5	9/11/2015	Filling	<50	240	<100	<50	<50	140	150	-
TP-14	3.1	9/11/2015	Filling	<50	<100	<100	<50	<50	<100	<100	-
SEDIMENT											
SD-13	-	9/11/2015	Sediment	<50	350	120	<50	<50	200	230	470
SD-14	-	9/11/2015	Sediment	<50	<100	<100	<50	<50	<100	<100	<50
SD-15	-	9/11/2015	Sediment	<50	<100	<100	<50	<50	<100	<100	<50
SD-16	-	9/11/2015	Sediment	<50	260	<100	<50	<50	140	160	260

BTEX

Field_ID	Sample Dep	Sample Date	Matrix Description	Benzene (mg/kg)	Ethylbenzene (mg/kg)	Naphthalene (mg/kg)	Toluene (mg/kg)	C6 - C9 (mg/kg)	Xylene (m & p) (mg/kg)	Xylene (o) (mg/kg)	Xylene Total (mg/kg)	C6-C10 less BTEX (F1) (mg/kg)	C6-C10 (mg/kg)
PQL				0.2	1	1	0.5	25	2	1	1	25	25
CRC Care Direct Contact HSL-A				100	4500	1400	14000				12000		4400
CRC Care Direct Contact Intrusive Maintenance Worker				1100	85000	29000	120000				130000		82000
CRC Care Intrusive MW Soil HSL Vapour I, Sand 0-2m				77	NL	NL	NL				NL	NL	
NEPM 2013 EILs Res/Open Space Aged						170							
NEPM 2013 Table 1A(1) HILs Res A Soil													
NEPM 2013 Table 1A(3) Res A/B Soil HSL for Vapour Intrusion, Sand 0-1m				0.5	55	3	160				40	45	
NEPM 2013 Table 1B(6) ESLs for Urban Res, Coarse Soil 0-2m				50	70		85				105	180	
NEPM 2013 Table 1B(7) Management Limits in Res / Parkland, Coarse Soil													700
DP Results, Current Investigation April 2018													
TP101	0.2-0.3	16/03/2018	Filling	<0.2	<1	<1	<0.5	<25	<2	<1	<1	<25	<25
BD1/20180316	0.2-0.3	16/03/2018	Filling	<0.2	<1	<1	<0.5	<25	<2	<1	<1	<25	<25
TP101	1.9-2	16/03/2018	Filling	<0.2	<1	<1	<0.5	<25	<2	<1	<1	<25	<25
TP101	2.8-2.9	16/03/2018	Filling	-	-	-	-	-	-	-	-	-	-
TP102	0.2-0.3	16/03/2018	Filling	<0.2	<1	<1	<0.5	<25	<2	<1	<1	<25	<25
TP102	0.4-0.5	16/03/2018	Filling	-	-	-	-	-	-	-	-	-	-
TP102	0.9-1	16/03/2018	Filling	<0.2	<1	<1	<0.5	<25	<2	<1	<1	<25	<25
TP101	-	16/03/2018	Material	-	-	-	-	-	-	-	-	-	-
TP102	-	16/03/2018	Material	-	-	-	-	-	-	-	-	-	-
Trip Spike	-	16/03/2018	Soil	-	-	-	-	-	-	-	-	-	-
Trip Blank	-	16/03/2018	Soil	<0.2	<1	-	<0.5	-	<2	<1	-	-	-
EMM Results, Preliminary Investigation, July 2015													
SOIL													
TP-3	0.5	3/06/2018	Filling	<0.2	<0.5	<1	<0.5	<10	<0.5	<0.5	<0.2	<10	<10
TP-5	0.5	3/06/2018	Filling	<0.2	<0.5	<1	<0.5	<10	<0.5	<0.5	<0.2	<10	<10
TP-6	0.5	3/06/2018	Filling	<0.2	<0.5	<1	<0.5	<10	<0.5	<0.5	<0.2	<10	<10
SEDIMENT													
SD-2	-	3/06/2018	Sediment	<0.2	<0.5	<1	<0.5	<10	<0.5	<0.5	<0.2	<10	<10
SD-5	-	3/06/2018	Sediment	<0.2	<0.5	<1	<0.5	<10	<0.5	<0.5	<0.2	<10	<10
SD-6	-	3/06/2018	Sediment	<0.2	<0.5	<1	<0.5	<10	<0.5	<0.5	<0.2	<10	<10
EMM Results, Supplementary Preliminary Investigation, March 2016													
SOIL													
TP-13	1.5	9/11/2015	Filling	<0.2	<0.5	<1	<0.5	<10	<0.5	<0.5	<0.2	<10	<10
TP-14	3.1	9/11/2015	Filling	<0.2	<0.5	<1	<0.5	<10	<0.5	<0.5	<0.2	<10	<10
SEDIMENT													
SD-13	-	9/11/2015	Sediment	<0.2	<0.5	<1	<0.5	<10	<0.5	<0.5	<0.2	<10	<10
SD-14	-	9/11/2015	Sediment	<0.2	<0.5	<1	<0.5	<10	<0.5	<0.5	<0.2	<10	<10
SD-15	-	9/11/2015	Sediment	<0.2	<0.5	<1	<0.5	<10	<0.5	<0.5	<0.2	<10	<10
SD-16	-	9/11/2015	Sediment	<0.2	<0.5	<1	<0.5	<10	<0.5	<0.5	<0.2	<10	<10

PAH

Field_ID	Sample Dep	Sample Date	Matrix Description	Acenaphthene (mg/kg)	Acenaphthylene (mg/kg)	Anthracene (mg/kg)	Benz(a)anthracene (mg/kg)	Benzo(a) pyrene (mg/kg)	Benzo(a)pyrene TEQ calc(PQL) (mg/kg)	Benzo(b,j+k)fluoranthene (mg/kg)	Benzo(g,h,i)perylene (mg/kg)	Chrysene (mg/kg)	Dibenz(a,h)anthracene (mg/kg)	Fluoranthene (mg/kg)	Fluorene (mg/kg)	Indeno(1,2,3-c,d)pyrene (mg/kg)	Naphthalene (mg/kg)	Phenanthrene (mg/kg)	Pyrene (mg/kg)	Total +ve PAHs (mg/kg)
PQL				0.1	0.1	0.1	0.1	0.05	0.5	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.05
CRC Care Direct Contact HSL-A																	1400			
CRC Care Direct Contact Intrusive Maintenance Worker																	29000			
CRC Care Intrusive MW Soil HSL Vapour I, Sand 0-2m																	NL			
NEPM 2013 EILs Res/Open Space Aged																	170			
NEPM 2013 Table 1A(1) HILs Res A Soil									3											300
NEPM 2013 Table 1A(3) Res A/B Soil HSL for Vapour Intrusion, Sand 0-1m																	3			
NEPM 2013 Table 1B(6) ESLs for Urban Res, Coarse Soil 0-2m								0.7												
NEPM 2013 Table 1B(7) Management Limits in Res / Parkland, Coarse Soil																				
DP Results, Current Investigation April 2018																				
TP101	0.2-0.3	16/03/2018	Filling	<0.1	<0.1	<0.1	0.3	0.3	0.5	0.5	0.2	0.2	<0.1	0.4	<0.1	0.2	<0.1	0.1	0.5	2.7
BD1/20180316	0.2-0.3	16/03/2018	Filling	<0.1	0.1	0.2	0.5	0.53	0.8	0.8	0.3	0.4	<0.1	0.9	<0.1	0.2	<0.1	0.4	0.9	5.4
TP101	1.9-2	16/03/2018	Filling	<0.1	<0.1	<0.1	0.1	0.1	<0.5	<0.2	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	0.2	0.58
TP101	2.8-2.9	16/03/2018	Filling	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP102	0.2-0.3	16/03/2018	Filling	<0.1	<0.1	<0.1	0.1	0.2	<0.5	0.3	0.1	0.1	<0.1	0.3	<0.1	<0.1	<0.1	0.1	0.3	1.5
TP102	0.4-0.5	16/03/2018	Filling	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP102	0.9-1	16/03/2018	Filling	<0.1	<0.1	<0.1	0.2	0.2	<0.5	0.3	0.1	0.1	<0.1	0.3	<0.1	<0.1	<0.1	0.1	0.3	1.5
TP101	-	16/03/2018	Material	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP102	-	16/03/2018	Material	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trip Spike	-	16/03/2018	Soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trip Blank	-	16/03/2018	Soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EMM Results, Preliminary Investigation, July 2015																				
SOIL																				
TP-3	0.5	3/06/2018	Filling	<0.5	<0.5	<0.5	0.9	0.8	1.6	-	<0.5	0.8	<0.5	2.3	<0.5	<0.5	<0.5	1.1	2.2	8.9
TP-5	0.5	3/06/2018	Filling	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	-	<0.5	<0.5	<0.5	0.7	<0.5	<0.5	<0.5	<0.5	0.8	1.5
TP-6	0.5	3/06/2018	Filling	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	-	<0.5	<0.5	<0.5	0.9	<0.5	<0.5	<0.5	0.6	0.8	2.3
SEDIMENT																				
SD-2	-	3/06/2018	Sediment	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SD-5	-	3/06/2018	Sediment	<0.5	<0.5	<0.5	0.9	1.2	2	-	<0.5	0.9	<0.5	2.2	<0.5	<0.5	<0.5	<0.5	2.4	8.5
SD-6	-	3/06/2018	Sediment	<0.5	<0.5	<0.5	1.5	1.3	2.2	-	<0.5	1.4	<0.5	4	<0.5	<0.5	<0.5	3.6	4.2	17
EMM Results, Supplementary Preliminary Investigation, March 2016																				
SOIL																				
TP-13	1.5	9/11/2015	Filling	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
TP-14	3.1	9/11/2015	Filling	<0.8	<0.8	<0.8	<0.8	<0.8	1.2	-	-	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.5
SEDIMENT																				
SD-13	-	9/11/2015	Sediment	<0.8	<0.8	<0.8	0.9	1	1.8	-	<0.8	0.8	<0.8	1.6	<0.8	<0.8	<0.8	<0.8	1.7	7.2
SD-14	-	9/11/2015	Sediment	<0.8	<0.8	<0.8	<0.8	<0.8	1.2	-	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
SD-15	-	9/11/2015	Sediment	<0.8	<0.8	<0.8	<0.8	<0.8	1.2	-	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
SD-16	-	9/11/2015	Sediment	<0.8	<0.8	<0.8	<0.8	<0.8	1.2	-	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8

OCP

Field_ID	Sample Dep	Sample Date	Matrix Description	4,4-DDE (mg/kg)	a-BHC (mg/kg)	Aldrin (mg/kg)	b-BHC (mg/kg)	Chlordane (cis) (mg/kg)	Chlordane (trans) (mg/kg)	d-BHC (mg/kg)	DDD (mg/kg)	DDT (mg/kg)	DDT+DDE+DDD (mg/kg)	Dieldrin (mg/kg)	Endosulfan I (mg/kg)	Endosulfan II (mg/kg)	Endosulfan sulphate (mg/kg)	Endrin (mg/kg)	Endrin aldehyde (mg/kg)
PQL				0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
CRC Care Direct Contact HSL-A																			
CRC Care Direct Contact Intrusive Maintenance Worker																			
CRC Care Intrusive MW Soil HSL Vapour I, Sand 0-2m																			
NEPM 2013 EILs Res/Open Space Aged												180							
NEPM 2013 Table 1A(1) HILs Res A Soil													240					10	
NEPM 2013 Table 1A(3) Res A/B Soil HSL for Vapour Intrusion, Sand 0-1m																			
NEPM 2013 Table 1B(6) ESLs for Urban Res, Coarse Soil 0-2m																			
NEPM 2013 Table 1B(7) Management Limits in Res / Parkland, Coarse Soil																			
DP Results, Current Investigation April 2018																			
TP101	0.2-0.3	16/03/2018	Filling	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
BD1/20180316	0.2-0.3	16/03/2018	Filling	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP101	1.9-2	16/03/2018	Filling	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP101	2.8-2.9	16/03/2018	Filling	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP102	0.2-0.3	16/03/2018	Filling	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TP102	0.4-0.5	16/03/2018	Filling	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP102	0.9-1	16/03/2018	Filling	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP101	-	16/03/2018	Material	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP102	-	16/03/2018	Material	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trip Spike	-	16/03/2018	Soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trip Blank	-	16/03/2018	Soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EMM Results, Preliminary Investigation, July 2015																			
SOIL																			
TP-3	0.5	3/06/2018	Filling	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP-5	0.5	3/06/2018	Filling	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05
TP-6	0.5	3/06/2018	Filling	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SEDIMENT																			
SD-2	-	3/06/2018	Sediment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SD-5	-	3/06/2018	Sediment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SD-6	-	3/06/2018	Sediment	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05
EMM Results, Supplementary Preliminary Investigation, March 2016																			
SOIL																			
TP-13	1.5	9/11/2015	Filling	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP-14	3.1	9/11/2015	Filling	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SEDIMENT																			
SD-13	-	9/11/2015	Sediment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SD-14	-	9/11/2015	Sediment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SD-15	-	9/11/2015	Sediment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SD-16	-	9/11/2015	Sediment	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Table C1: Summary of Laboratory Results

											OPP																	PCB									
						g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Hexachlorobenzene	Methoxychlor	Azinophos methyl	Bromophos-ethyl	Chlorpyrifos	Chlorpyrifos-methyl	Diazinon	Dichlorvos	Dimethoate	Ethion	Fenitrothion	Malathion	Parathion	Ronnel	Arochlor 1016	Arochlor 1221	Arochlor 1232	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	PCBs (Sum of total)	Phenolics Total	Asbestos
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	g/kg
PQL						0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	5	0.1/0.001
CRC Care Direct Contact HSL-A																																				
CRC Care Direct Contact Intrusive Maintenance Worker																																				
CRC Care Intrusive MW Soil HSL Vapour I, Sand 0-2m																																				
NEPM 2013 EILs Res/Open Space Aged																																				
NEPM 2013 Table 1A(1) HILs Res A Soil							6		10	300			160																	1		0.001
NEPM 2013 Table 1A(3) Res A/B Soil HSL for Vapour Intrusion, Sand 0-1m																																				
NEPM 2013 Table 1B(6) ESLs for Urban Res, Coarse Soil 0-2m																																				
NEPM 2013 Table 1B(7) Management Limits in Res / Parkland, Coarse Soil																																				
Field_ID	**Sample Dep**	**Sample Date**	**Matrix Description**																																	
DP Results, Current Investigation April 2018																																				
TP101	0.2-0.3	16/03/2018	Filling			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	NAD
B01/20180316	0.2-0.3	16/03/2018	Filling			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP101	1.9-2	16/03/2018	Filling			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP101	2.8-2.9	16/03/2018	Filling			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.001
TP102	0.2-0.3	16/03/2018	Filling			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.001
TP102	0.4-0.5	16/03/2018	Filling			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.001
TP102	0.9-1	16/03/2018	Filling			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP101	-	16/03/2018	Material			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Chrysotile
TP102	-	16/03/2018	Material			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Chrysotile/Amosite
Trip Spike	-	16/03/2018	Soil			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trip Blank	-	16/03/2018	Soil			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EMM Results, Preliminary Investigation, July 2015																																				
SOIL																																				
TP-3	0.5	3/06/2018	Filling			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP-5	0.5	3/06/2018	Filling			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.2	-	-	-	-	-	-	-	-	-	-	-
TP-6	0.5	3/06/2018	Filling			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
SEDIMENT																																				
SD-2	-	3/06/2018	Sediment			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SD-5	-	3/06/2018	Sediment			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SD-6	-	3/06/2018	Sediment			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.2	-	-	-	-	-	-	-	-	<0.05	-	-
EMM Results, Supplementary Preliminary Investigation, March 2016																																				
SOIL																																				
TP-13	1.5	9/11/2015	Filling			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP-14	3.1	9/11/2015	Filling			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SEDIMENT																																				
SD-13	-	9/11/2015	Sediment			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SD-14	-	9/11/2015	Sediment			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SD-15	-	9/11/2015	Sediment			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SD-16	-	9/11/2015	Sediment			<0.05	<0.05	<0.05	<0.05	<0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix D

Site Photographs

Photo 1 - Area 1, facing east.

Photo 2 - Area 1, facing west.

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs**	PROJECT: 71459.10
		PLATE No: D1
	146 Newbridge Road, Moorebank	REV: A
	CLIENT: Mirvac Homes NSW Pty Ltd	DATE: 26-Apr-18

Photo 3 - Area 2, facing south

Photo 4 - Area 2, facing south

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs**	PROJECT: 71459.10
		PLATE No: D2
	146 Newbridge Road, Moorebank	REV: A
	CLIENT: Mirvac Homes NSW Pty Ltd	DATE: 26-Apr-18

Photo 5 - Area 2, facing north

Photo 6 - Area 2, facing north, with MW102

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs**	PROJECT: 71459.10
		PLATE No: D3
	146 Newbridge Road, Moorebank	REV: A
	CLIENT: Mirvac Homes NSW Pty Ltd	DATE: 26-Apr-18

Photo 7 - Area 2, facing south east

Photo 8 - TP101 (typical filling profile)

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs**	PROJECT: 71459.10
		PLATE No: D4
	146 Newbridge Road, Moorebank	REV: A
	CLIENT: Mirvac Homes NSW Pty Ltd	DATE: 26-Apr-18

Photo 9 - TP102 (typical filling profile)

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs**	PROJECT: 71459.10
		PLATE No: D5
	146 Newbridge Road, Moorebank	REV: A
	CLIENT: Mirvac Homes NSW Pty Ltd	DATE: 26-Apr-18

Appendix E

Test Pit and Borehole Logs

Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Soil Descriptions

Douglas Partners

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726-1993, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Symbols & Abbreviations

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

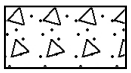
Symbols & Abbreviations

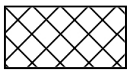
Graphic Symbols for Soil and Rock

General

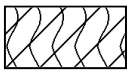

Asphalt

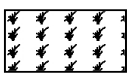

Road base

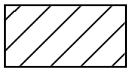

Concrete

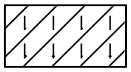

Filling

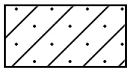
Soils


Topsoil

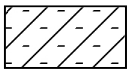

Peat

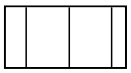

Clay

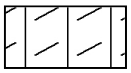

Silty clay

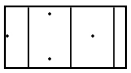

Sandy clay

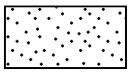

Gravelly clay

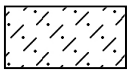

Shaly clay

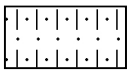

Silt


Clayey silt


Sandy silt

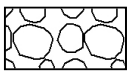

Sand

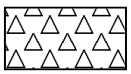

Clayey sand


Silty sand


Gravel

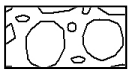

Sandy gravel


Cobbles, boulders

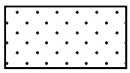

Talus

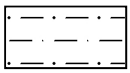
Sedimentary Rocks

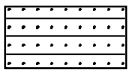

Boulder conglomerate

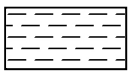

Conglomerate


Conglomeratic sandstone

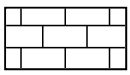

Sandstone


Siltstone

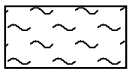

Laminite

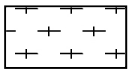

Mudstone, claystone, shale

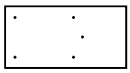

Coal


Limestone

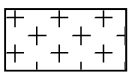
Metamorphic Rocks

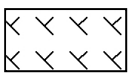

Slate, phyllite, schist

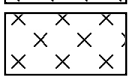

Gneiss

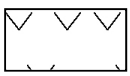

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

BOREHOLE LOG

CLIENT: Mirvac Homes NSW Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.45 AHD*
EASTING: 311832
NORTHING: 6243373
DIP/AZIMUTH: 90°/--

BORE No: MW101
PROJECT No: 71459.10
DATE: 16/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0	FILLING - dark brown silty sand filling with some fine to medium igneous gravel with a trace of charcoal							Concrete 0.0-0.1m Bentonite 0.1-0.5m
	2.0	FILLING - dark brown clay filling with some fine igneous gravel. - moist below 2.5m							Gravel 0.5-4.0m Machine slotted PVC screen 1.0-4.0m
	4.0	- wet at 4.0m Bore discontinued at 4.0m							End cap

RIG: Geoprobe **DRILLER:** Terratest **LOGGED:** NW **CASING:** Uncased

TYPE OF BORING: Solid flight auger to 4.0m

WATER OBSERVATIONS: Free groundwater observed at 4.0m

REMARKS: Stick up 1.0m*. Interpolated by JMD from their site survey completed 2 November 2017

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Mirvac Homes NSW Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.45 AHD*
EASTING: 311840
NORTHING: 6243327
DIP/AZIMUTH: 90°/--

BORE No: MW102
PROJECT No: 71459.10
DATE: 16/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILLING - brown silty sand filling with some fine igneous gravel, glass and brick fragments							Concrete 0.0-0.1m Bentonite 0.1-0.5m Gravel 0.5 - 2.7m Machine slotted PVC screen 0.7-2.7m End cap
		- dark brown below 2m							
		- becoming wet at 2.5m - collapsed below 2.7m							
	4.0	- in dark brown sandy clay filling Bore discontinued at 4.0m							

RIG: Geoprobe **DRILLER:** Terratest **LOGGED:** NW **CASING:** Uncased

TYPE OF BORING: Solid flight auger to 4.0m

WATER OBSERVATIONS: Free groundwater observed at 2.7m

REMARKS: Stick up 0.7m*. Interpolated by JMD from their site survey completed 2 November 2017

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Mirvac Homes NSW Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.45 AHD*
EASTING: 311878
NORTHING: 6243194
DIP/AZIMUTH: 90°/--

BORE No: MW103
PROJECT No: 71459.10
DATE: 16/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0	FILLING - brown silty sand filling with some fine to medium igneous gravel, glass fragments							Concrete 0.0-0.1m Bentonite 0.1-0.4m
	1.5	FILLING - brown clay sand filling with fine to coarse igneous gravel and some brick fragments							Gravel 0.4-5.5m Machine slotted PVC screen 0.5-5.5m
	4.0	CLAY - dark brown, mottled grey clay							
	5.0	SANDY CLAY - dark grey sandy clay							End Cap
	5.5	Bore discontinued at 5.5m							

RIG: Geoprobe **DRILLER:** Terratest **LOGGED:** NW **CASING:** Uncased

TYPE OF BORING: Solid flight auger to 5.5m

WATER OBSERVATIONS: Free groundwater observed at 5.5m

REMARKS: Stick up 0.5m*. Interpolated by JMD from their site survey completed 2 November 2017

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Mirvac Homes NSW Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.45 AHD*
EASTING: 311846
NORTHING: 6243323
DIP/AZIMUTH: 90°/--

BORE No: TP102
PROJECT No: 71459.10
DATE: 16/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILLING - silty sand filling with some fine to medium igneous gravel, brick fragments, tile fragments, crushed sandstone, glass fragments, with a trace of rootlets, charcoal, plastic sheeting, slag fragments, terracotta pipe fragments, fibre cement fragments.		D	0.2 0.3		PID = 7		
				D	0.4 0.5		PID = 9		
	1			D	0.9 1.0		PID = 12		1
		- whole bricks and concrete fragments (>200mm diameter) below 1.5m							
	2			D	1.9 2.0		PID =11		2
		- metal fragments below 2.5m							
	3 3.0			D	2.9 3.0		PID = 13		3
		Bore discontinued at 3.0m Target depth reached							
	4								4
	5								5
	6								6
	7								7
	8								8
	9								9

RIG: 35T Excavator - 500mm wide bucket **DRILLER:** **LOGGED:** NW **CASING:**

TYPE OF BORING:

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: BD2/20180316 taken from 0.2-0.3m*. Interpolated by JMD from their site survey completed 2 November 2017

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Mirvac Homes NSW Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.45 AHD*
EASTING: 311881
NORTHING: 6243188
DIP/AZIMUTH: 90°/--

BORE No: TP101
PROJECT No: 71459.10
DATE: 16/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILLING - dark brown silty sand filling with some fine to medium igneous gravel, glass fragments, wood fragments and a trace of shell fragments. asbestos observed		D	0.2		PID = 7		
				D	0.3 0.4		PID = 8		
	0.6				0.5				
		FILLING - brown, red clay filling with some brick fragments, fine to coarse igenous gravel, with a trace of wood and tile fragments		D	0.9 1.0		PID = 7		
				D	1.9 2.0		PID = 8		
		- fragment of fibre cement observed at 2.8m		D	2.9		PID = 6		
	3.0	Bore discontinued at 3.0m Target depth reached			3.0				

RIG: 35T Excavator - 500mm wide bucket **DRILLER:** **LOGGED:** NW **CASING:**

TYPE OF BORING:

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: BD1/20180316 taken from 0.2-0.3m*. Interpolated by JMD from their site survey completed 2 November 2017

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

Appendix F

Landfill Gas Field Results

Douglas Partners
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Landfill Gas Monitoring

Client: **Benedict** Date: 20/3/18

Project: **Landfill Gas Monitoring** Project Number: 71459.10

Location: **146 Newbridge Road, Moorebank**

Well ID: MW101

Time: 12.19 Pressure Mb: 1021

1018 mb

Time (sec)	Concentration (% v/v)			CO (ppm)	H_2S (ppm)	Flow (l/h)
	CH_4	CO_2	O_2			
0	0.0	1.7	12.8	0	0	0.0
30	0.0	9.3	3.4	0	0	0.0
60	0.1	9.4	3.1	0	0	-0.1
90	0.1	9.5	2.9	0	0	-0.1
120	0.1	9.7	2.5	0	0	0.0
150	0.1	10.1	1.9	0	0	0.0
180	0.1	10.5	1.4	0	0	0.0
210	0.1	10.8	0.9	0	0	0.0
240	0.0	11.0	0.6	0	0	0.0
270	0.0	11.1	0.3	0	0	0.0
300	0.0	11.1	0.1	0	0	0.0

Well ID: MW102

Time: 12:25 Pressure Mb: 1021

Time (sec)	Concentration (% v/v)			CO (ppm)	H_2S (ppm)	Flow (l/h)
	CH_4	CO_2	O_2			
0	0.0	2.5	18.8	0	0	0.0
30	0.0	4.2	15.0	0	0	0.0
60	0.0	4.1	15.0	0	0	0.0
90	0.0	4.1	14.9	0	0	0.0
120	0.0	4.1	14.9	0	0	0.0
150	0.1	4.1	14.9	0	0	0.0
180	0.5	4.1	14.8	0	0	0.0
210	0.8	4.0	14.9	0	0	0.0
240	1.2	3.9	15.1	0	0	0.0
270	1.5	3.7	15.2	0	0	0.0
300	1.8	3.5	15.5	0	0	0.0
360	2.1	3.3	15.7	0	0	0.0
390	2.0	3.1	15.9	0	0	0.0

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Landfill Gas Monitoring

Client: **Benedict**
Project: **Landfill Gas Monitoring**
Location: **146 Newbridge Road, Moorebank**
Well ID: MW103
Time: 12:30
Date: 20/3/18
Project Number: 71459.60
Pressure Mb: 1021
1018mb

Time (sec)	Concentration (% v/v)			CO (ppm)	H_2S (ppm)	Flow (l/h)
	CH_4	CO_2	O_2			
0	0.0	3.2	15.1	0	0	0.0
30	0.0	4.7	11.9	0	0	0.0
60	0.0	4.8	11.9	1	0	0.0
90	0.1	4.7	12.0	1	0	0.0
120	0.1	4.7	12.0	1	0	0.0
150	0.1	4.7	12.1	0	0	0.0
180	0.1	4.6	12.2	0	0	0.0
210	0.1	4.5	12.3	1	0	0.0
240	0.1	4.5	12.4	0	0	0.0
270	0.1	4.4	12.5	0	0	0.0
300	0.1	4.4	12.5	0	0	0.0

Well ID:
Time:
Pressure Mb:

Time (sec)	Concentration (% v/v)			CO (ppm)	H_2S (ppm)	Flow (l/h)
	CH_4	CO_2	O_2			
0						
30						
60						
90						
120						
150						
180						
210						
240						
270						
300						

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Landfill Gas Monitoring

Client: **Benedict** Date: 9/4/18

Project: **Landfill Gas Monitoring** Project Number: 71459.10

Location: **146 Newbridge Road, Moorebank**

Well ID: MW101

Time: 8.30am Pressure Mb: 1017mb

9am 1017mb

Time (sec)	Concentration (% v/v)			CO (ppm)	H_2S (ppm)	Flow (l/h)
	CH_4	CO_2	O_2			
0	0.0	10.2	14.1	2	0	-0.1
30	0.0	10.5	3.4	2	0	-0.1
60	0.0	10.5	3.2	2	0	-0.1
90	0.0	10.5	3.1	3	0	-0.1
120	0.0	10.5	3.1	3	0	-0.1
150	0.0	10.5	3.0	3	0	-0.1
180	0.0	10.6	2.8	4	0	-0.1
210	0.0	10.6	2.7	4	0	-0.2
240	0.0	10.7	2.5	4	0	-0.2
270	0.0	10.8	2.4	4	0	-0.2
300	0.0	10.9	2.2	5	0	-0.2

Well ID: MW102

Time: 8.40am Pressure Mb: 1017mb

9.05am 1017mb

Time (sec)	Concentration (% v/v)			CO (ppm)	H_2S (ppm)	Flow (l/h)
	CH_4	CO_2	O_2			
0	0.0	0.1	19.6	3	0	0.0
30	0.0	4.5	15.4	1	0	-0.0
60	0.0	4.6	15.3	1	0	0.0
90	0.0	4.6	15.3	1	0	-0.1
120	0.0	4.6	15.3	1	0	-0.1
150	0.0	4.6	15.3	0	0	-0.1
180	0.0	4.6	15.3	0	0	-0.1
210	0.0	4.4	15.4	0	0	-0.1
240	0.0	4.3	15.5	0	0	-0.2
270	0.0	4.2	15.6	0	0	-0.2
300	0.0	4.0	15.8	0	0	-0.2

Douglas Partners
Geotechnics | Environment | Groundwater

Landfill Gas Monitoring

Client: **Benedict**

Project: **Landfill Gas Monitoring**

Location: **146 Newbridge Road, Moorebank**

Date: 9/4/18

Project Number: 71459.10

Well ID: MW103

Time: 8.50am

Pressure Mb: 1017mb

9:15am 1017mb

Time (sec)	Concentration (% v/v)			CO (ppm)	H_2S (ppm)	Flow (l/h)
	CH_4	CO_2	O_2			
0	0.0	0.2	19.9	2	0	0.1
30	0.0	4.5	13.7	0	0	-0.1
60	0.0	4.5	13.7	0	0	-0.0
90	0.0	4.5	13.6	0	0	-0.0
120	0.0	4.5	13.6	0	0	-0.0
150	0.0	4.5	13.6	0	0	0.0
180	0.0	4.5	13.5	0	0	0.0
210	0.0	4.5	13.5	1	0	-0.0
240	0.0	4.5	13.5	1	0	0.0
270	0.0	4.5	13.5	1	0	-0.0
300	0.0	4.5	13.5	1	0	-0.0

Well ID:

Time:

Pressure Mb:

Time (sec)	Concentration (% v/v)			CO (ppm)	H_2S (ppm)	Flow (l/h)
	CH_4	CO_2	O_2			
0						
30						
60						
90						
120						
150						
180						
210						
240						
270						
300						

SERVICE OR REPAIR: GA5000

COMPANY	Douglas Partners Pty Ltd				
CONTACT	David Holden				
SERIAL NO.	G500665	**CALL NO.**	158541	**RECEIVED**	07/02/2018

REQUEST/PROBLEM DESCRIPTION
Service & Calibration

This equipment has been calibrated to the manufacturer's specifications, using the standards shown below:

SENSOR	STANDARD	TRACEABILITY LOT NO.	PRE CALIBRATION READING	POST CALIBRATION READING
CH_4	0 %	785304 Cyl: 53	-	0 %
	60 %	591518 Cyl: 18	-	60.0 %
CO_2	40 %	591518 Cyl: 18	-	40.0 %
O_2	0 %	785304 Cyl: 53	-	0 %
	20.9 %	Fresh air	-	20.9 %
CO	0 ppm	785304 Cyl: 53	-	0 ppm
	100 ppm	633347 Cyl: 3	-	100 ppm
H_2S	0 ppm	785304 Cyl: 53	-	0 ppm
	25 ppm	867669 Cyl: 49	-	25 ppm

- ✓ **Instrument examined, firmware: the latest version**
- ✓ **Filters replaced**
- ✓ **Checked the pump**
- ✓ **Checked battery condition**
- ✓ **Calibrated and tested OK**

COMMENTS/ADDITIONAL REPAIRS/SERVICES PERFORMED
Note: Next Factory service is due on 13/08/2018.

SERVICED BY	Milenko	**COMPLETED**	13/02/2017
SIGNATURE	Milenko		

Appendix G

QAQC

DATA QUALITY ASSESSMENT

Q1. FIELD AND LABORATORY QUALITY CONTROL

The field and laboratory quality control (QC) procedures and results are summarised in Tables Q1 and Q2. Reference should be made to the fieldwork and analysis procedures in the report and the laboratory results certificates in Appendix C for further details.

Table Q1: Field QC

Item	Frequency	Acceptance Criteria	Achievement
Intra-laboratory replicates	5% primary samples	RPD <30% inorganics), <50% (organics)	yes[1]
Inter-laboratory replicates	5% primary samples	RPD <30% inorganics), <50% (organics)	No
Trip Spikes	1 per field batch	60-140% recovery	yes
Trip Blanks	1 per field batch	<PQL/LOR	yes
Rinsates	1 per day	<PQL/LOR	No

NOTES: 1 qualitative assessment of RPD results overall; refer Section Q2.1

Given the small number of samples (i.e. four primary samples recorded) inter- laboratory analysis was not considered warranted. Moreover, as samples were collected either directly from the test pit walls or from the middle of the soil in the excavator bucket, a rinsate sample was also not considered warranted.

Table Q2: Laboratory QC

Item	Frequency	Acceptance Criteria	Achievement
Analytical laboratories used		NATA accreditation	yes
Holding times		In accordance with NEPC (2013) which references various Australian and international standards	yes
Laboratory / Reagant Blanks	1 per lab batch	<PQL	yes
Laboratory duplicates	10% primary samples	Laboratory specific [1]	
Matrix Spikes	1 per lab batch	70-130% recovery (inorganics); 60-140% (organics); 10-140% (SVOC, speciated phenols)	yes
Surrogate Spikes	organics by GC	70-130% recovery (inorganics); 60-140% (organics); 10-140% (SVOC, speciated phenols)	yes
Control Samples	1 per lab batch	70-130% recovery (inorganics); 60-140% (organics); 10-140% (SVOC, speciated phenols)	yes

NOTES: 1 ELS: <5xPQL – any RPD; >5xPQL – 0-50%RPD

In summary, the QC data is considered to be of sufficient quality to be acceptable for the assessment.

Intra-Laboratory Replicates

An intra-laboratory replicate was analysed as an internal check of the reproducibility within the primary laboratory ELS and as a measure of consistency of sampling techniques. The comparative results of analysis between original and intra-laboratory replicate samples are summarised in Table Q3.

Note that, where both samples are below laboratory reporting limit (LRL) the difference and RPD has been given as zero. Where one sample is reported below LRL, but a concentration is reported for the other, the LRL value has been used for calculation of the RPD for the less than LRL sample.

Table Q3: Relative Percentage Difference Results – Intra-laboratory Replicates

Lab	Sample ID	Date Sampled	Media	Units	Metals								PAH				TRH				BTEX			
					As	Cd	Cr	Cu	Pb	Hg	Ni	Zn	total	BaP TEQ	BaP	Naphthalene	C6-C10	>C10-C16	>C16-C34	>C34-C40	Benzene	Toluene	Ethylbenzene	xylene
ELS	TP101/0.2-0.3	16/03/2018	filling	mg/kg	6	<0.4	15	41	100	0.1	10	240	2.7	0.5	0.3	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1
ELS	BD1/20180316	16/03/2018	filling	mg/kg	6	0.4	16	43	110	0.1	10	220	5.4	0.8	0.5	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1
Difference				mg/kg	0	0	1	2	10	0	0	20	**2.7**	**0.3**	**0.2**	0	0	0	0	0	0	0	0	0
RPD				%	0	0	6	5	10	0	0	9	**66**	**47**	**50**	0	0	0	0	0	0	0	0	0

Notes: - not applicable, not tested

The calculated RPD values were within the acceptable range of ± 30 for inorganic analytes and ± 50% for organics with the with the exception of those highlighted yellow and bold. However, this is not considered to be significant because:

- The typically low actual differences in the concentrations of the replicate pairs where some RPD exceedances occurred. High RPD values reflect the small differences between two small numbers;
- The replicate pairs being collected from fill soils which were heterogeneous in nature;
- Soil replicates, rather than homogenised soil duplicates, were used to minimise the risk of possible volatile loss, hence greater variability can be expected;
- Most of the recorded concentrations were less than five time the LRL and hence RPD were not considered relevant;
- The majority of RPDs within a replicate pair being within the acceptable limits; and
- All other QA/QC parameters met the DQIs.

Overall, the intra-laboratory replicate comparisons indicate that the sampling techniques were generally consistent and repeatable.

Q2. Data Quality Indicators

The reliability of field procedures and analytical results was assessed against the following data quality indicators (DQIs):

- Completeness – a measure of the amount of usable data from a data collection activity;
- Comparability – the confidence (qualitative) that data may be considered to be equivalent for each sampling and analytical event;
- Representativeness – the confidence (qualitative) of data representativeness of media present on-site;
- Precision – a measure of variability or reproducibility of data; and
- Accuracy – a measure of closeness of the data to the 'true' value.

The DQIs were assessed as outlined in the following Table Q4.

Table Q4: Data Quality Indicators

Data Quality Indicator	Method(s) of Achievement
Completeness	Planned selected target locations sampled (within the site and investigation limitations); Preparation of field logs, sample location plan and chain of custody (COC) records; Laboratory sample receipt information received confirming receipt of samples intact and appropriateness of the chain of custody;

	Samples analysed for contaminants of potential concern (COPC) identified in the Conceptual Site Model (CSM); Completion of COC documentation; NATA endorsed laboratory certificates provided by the laboratory; Satisfactory frequency and results for field and laboratory QC samples as discussed in Section Q1.
Comparability	Using appropriate techniques for sample recovery, storage and transportation, which were the same for the duration of the project; Works undertaken by appropriately experienced and trained DP environmental scientist; Use of NATA registered laboratories, with test methods the same or similar between laboratories; Satisfactory results for field and laboratory QC samples.
Representativeness	Target media sampled; Spatial and temporal distribution of sample locations; Sample numbers recovered and analysed are considered to be representative of the target media and complying with DQOs; Samples were extracted and analysed within holding times; Samples were analysed in accordance with the analysis request.
Precision	Acceptable RPD between original samples and replicates; Satisfactory results for all other field and laboratory QC samples.
Accuracy	Satisfactory results for all field and laboratory QC samples.

Based on the above, it is considered that the DQIs have been complied with. As such, it is concluded that the field and laboratory test data obtained are reliable and useable for this assessment.

Appendix H

Laboratory Certificate of Analysis and Chain of Custody

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

SAMPLE RECEIPT ADVICE

Client Details

Client	Douglas Partners Pty Ltd
Attention	John Russell, Nicola Warton

Sample Login Details

Your reference	71459.10, Moorebank
Envirolab Reference	187468
Date Sample Received	16/03/2018
Date Instructions Received	16/03/2018
Date Results Expected to be Reported	23/03/2018

Sample Condition

Samples received in appropriate condition for analysis	YES
No. of Samples Provided	10 Soil, 2 Material
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	15.2
Cooling Method	Ice Pack
Sampling Date Provided	YES

Comments

Nil

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	**Phone: 02 9910 6200**
Fax: 02 9910 6201	**Fax: 02 9910 6201**
Email: ahie@envirolab.com.au	**Email: jhurst@envirolab.com.au**

Analysis Underway, details on the following page:

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

Sample ID	vTRH(C6-C10)/BTEXN in Soil	svTRH (C10-C40) in Soil	PAHs in Soil	Organochlorine Pesticidesin soil	Organophosphorus Pesticides	PCBsin Soil	Acid Extractable metalsin soil	Total Phenolics (as Phenol)	Asbestos ID - soils	Asbestos ID - materials	Asbestos ID - soils NEPM
TP101-0.2-0.3	✓	✓	✓	✓	✓	✓	✓	✓	✓		
TP101-1.9-2.0	✓	✓	✓				✓				
TP102-0.2-0.3	✓	✓	✓	✓	✓	✓	✓	✓	✓		
TP102-0.9-1.0	✓	✓	✓				✓				
BD1/20180316	✓	✓	✓				✓				
TP101-2.8-2.9											✓
TP102-0.2-0.3											✓
TP102-0.4-0.5											✓
TP101 A1										✓	
TP102 A1										✓	
Trip Spike	✓										
Trip Blank	✓										

The '✓' indicates the testing you have requested. **THIS IS NOT A REPORT OF THE RESULTS.**

Additional Info

Sample storage - Waters are routinely disposed of approximately 1 month and soils approximately 2 months from receipt.
Requests for longer term sample storage must be received in writing.

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 187468

Client Details

Client	Douglas Partners Pty Ltd
Attention	John Russell, Nicola Warton
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**71459.10, Moorebank**
Number of Samples	10 Soil, 2 Material
Date samples received	16/03/2018
Date completed instructions received	16/03/2018

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	23/03/2018
Date of Issue	23/03/2018

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Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Asbestos Approved By
Analysed by Asbestos Approved Identifier: Jessica Hie, Lucy Zhu
Authorised by Asbestos Approved Signatory: Lucy Zhu

Results Approved By
Dragana Tomas, Senior Chemist
Jeremy Faircloth, Organics Supervisor
Long Pham, Team Leader, Metals
Lucy Zhu, Asbsestos Analyst
Nick Sarlamis, Inorganics Supervisor

Authorised By

David Springer, General Manager

vTRH(C6-C10)/BTEXN in Soil						
Our Reference		187468-1	187468-2	187468-3	187468-4	187468-5
Your Reference	UNITS	TP101	TP101	TP102	TP102	BD1/20180316
Depth		0.2-0.3	1.9-2.0	0.2-0.3	0.9-1.0	-
Date Sampled		16/03/2018	16/03/2018	16/03/2018	16/03/2018	16/03/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
Date analysed	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	113	112	110	114	111

vTRH(C6-C10)/BTEXN in Soil			
Our Reference		187468-11	187468-12
Your Reference	UNITS	Trip Spike	Trip Blank
Depth		-	-
Date Sampled		16/03/2018	16/03/2018
Type of sample		Soil	Soil
Date extracted	-	19/03/2018	19/03/2018
Date analysed	-	19/03/2018	19/03/2018
Benzene	mg/kg	103%	<0.2
Toluene	mg/kg	100%	<0.5
Ethylbenzene	mg/kg	104%	<1
m+p-xylene	mg/kg	104%	<2
o-Xylene	mg/kg	103%	<1
Surrogate aaa-Trifluorotoluene	%	97	120

svTRH (C10-C40) in Soil						
Our Reference		187468-1	187468-2	187468-3	187468-4	187468-5
Your Reference	UNITS	TP101	TP101	TP102	TP102	BD1/20180316
Depth		0.2-0.3	1.9-2.0	0.2-0.3	0.9-1.0	-
Date Sampled		16/03/2018	16/03/2018	16/03/2018	16/03/2018	16/03/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
Date analysed	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TRH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{10} -C_{16}	mg/kg	<50	<50	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH >C_{16} -C_{34}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{34} -C_{40}	mg/kg	<100	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	<50	<50	<50	<50
Surrogate o-Terphenyl	%	84	84	83	83	84

PAHs in Soil						
Our Reference		187468-1	187468-2	187468-3	187468-4	187468-5
Your Reference	UNITS	TP101	TP101	TP102	TP102	BD1/20180316
Depth		0.2-0.3	1.9-2.0	0.2-0.3	0.9-1.0	-
Date Sampled		16/03/2018	16/03/2018	16/03/2018	16/03/2018	16/03/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
Date analysed	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.1	<0.1	0.1	0.1	0.4
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	0.2
Fluoranthene	mg/kg	0.4	0.2	0.3	0.3	0.9
Pyrene	mg/kg	0.5	0.2	0.3	0.3	0.9
Benzo(a)anthracene	mg/kg	0.3	0.1	0.1	0.2	0.5
Chrysene	mg/kg	0.2	<0.1	0.1	0.1	0.4
Benzo(b,j+k)fluoranthene	mg/kg	0.5	<0.2	0.3	0.3	0.8
Benzo(a)pyrene	mg/kg	0.3	0.1	0.2	0.2	0.53
Indeno(1,2,3-c,d)pyrene	mg/kg	0.2	<0.1	<0.1	<0.1	0.2
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	0.2	<0.1	0.1	0.1	0.3
Total +ve PAH's	mg/kg	2.7	0.58	1.5	1.5	5.4
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	0.7
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	0.8
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	0.5	<0.5	<0.5	<0.5	0.8
Surrogate p-Terphenyl-d14	%	105	111	99	101	102

Organochlorine Pesticides in soil			
Our Reference		187468-1	187468-3
Your Reference	UNITS	TP101	TP102
Depth		0.2-0.3	0.2-0.3
Date Sampled		16/03/2018	16/03/2018
Type of sample		Soil	Soil
Date extracted	-	19/03/2018	19/03/2018
Date analysed	-	21/03/2018	21/03/2018
HCB	mg/kg	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1	<0.1
Surrogate TCMX	%	114	88

Organophosphorus Pesticides			
Our Reference		187468-1	187468-3
Your Reference	UNITS	TP101	TP102
Depth		0.2-0.3	0.2-0.3
Date Sampled		16/03/2018	16/03/2018
Type of sample		Soil	Soil
Date extracted	-	19/03/2018	19/03/2018
Date analysed	-	21/03/2018	21/03/2018
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1
Surrogate TCMX	%	114	88

PCBs in Soil			
Our Reference		187468-1	187468-3
Your Reference	UNITS	TP101	TP102
Depth		0.2-0.3	0.2-0.3
Date Sampled		16/03/2018	16/03/2018
Type of sample		Soil	Soil
Date extracted	-	19/03/2018	19/03/2018
Date analysed	-	21/03/2018	21/03/2018
Aroclor 1016	mg/kg	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1	<0.1
Surrogate TCLMX	%	114	88

Acid Extractable metals in soil						
Our Reference		187468-1	187468-2	187468-3	187468-4	187468-5
Your Reference	UNITS	TP101	TP101	TP102	TP102	BD1/20180316
Depth		0.2-0.3	1.9-2.0	0.2-0.3	0.9-1.0	-
Date Sampled		16/03/2018	16/03/2018	16/03/2018	16/03/2018	16/03/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
Date analysed	-	22/03/2018	22/03/2018	22/03/2018	22/03/2018	22/03/2018
Arsenic	mg/kg	6	4	5	5	6
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	0.4
Chromium	mg/kg	15	16	9	9	16
Copper	mg/kg	41	14	15	15	43
Lead	mg/kg	100	42	24	28	110
Mercury	mg/kg	0.1	<0.1	<0.1	<0.1	0.1
Nickel	mg/kg	10	6	10	6	10
Zinc	mg/kg	240	47	41	54	220

Misc Soil - Inorg			
Our Reference		187468-1	187468-3
Your Reference	UNITS	TP101	TP102
Depth		0.2-0.3	0.2-0.3
Date Sampled		16/03/2018	16/03/2018
Type of sample		Soil	Soil
Date prepared	-	20/03/2018	20/03/2018
Date analysed	-	20/03/2018	20/03/2018
Total Phenolics (as Phenol)	mg/kg	<5	<5

Moisture						
Our Reference		187468-1	187468-2	187468-3	187468-4	187468-5
Your Reference	UNITS	TP101	TP101	TP102	TP102	BD1/20180316
Depth		0.2-0.3	1.9-2.0	0.2-0.3	0.9-1.0	-
Date Sampled		16/03/2018	16/03/2018	16/03/2018	16/03/2018	16/03/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
Date analysed	-	20/03/2018	20/03/2018	20/03/2018	20/03/2018	20/03/2018
Moisture	%	9.1	11	12	11	9.0

Asbestos ID - soils			
Our Reference		187468-1	187468-3
Your Reference	UNITS	TP101	TP102
Depth		0.2-0.3	0.2-0.3
Date Sampled		16/03/2018	16/03/2018
Type of sample		Soil	Soil
Date analysed	-	22/03/2018	22/03/2018
Sample mass tested	g	Approx. 15g	Approx. 10g
Sample Description	-	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected

Asbestos ID - materials			
Our Reference		187468-9	187468-10
Your Reference	UNITS	TP101 A1	TP102 A1
Depth		-	-
Date Sampled		16/03/2018	16/03/2018
Type of sample		Material	Material
Date analysed	-	21/03/2018	21/03/2018
Mass / Dimension of Sample	-	50x45x5mm	28x25x5mm
Sample Description	-	Beige compressed fibre cement material	Beige compressed fibre cement material
Asbestos ID in materials	-	Chrysotile asbestos detected	Chrysotile asbestos detected Amosite asbestos detected

Asbestos ID - soils NEPM				
Our Reference		187468-6	187468-7	187468-8
Your Reference	UNITS	TP101	TP102	TP102
Depth		2.8-2.9	0.2-0.3	0.4-0.5
Date Sampled		16/03/2018	16/03/2018	16/03/2018
Type of sample		Soil	Soil	Soil
Date analysed	-	20/03/2018	20/03/2018	20/03/2018
Sample mass tested	g	997.6	1,141.8	1,242.1
Sample Description	-	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks
Asbestos ID in soil (AS4964) >0.1g/kg	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected
Total Asbestos[#1]	g/kg	<0.1	<0.1	<0.1
Asbestos ID in soil <0.1g/kg*	-	No visible asbestos detected	No visible asbestos detected	No visible asbestos detected
ACM >7mm Estimation*	g	–	–	–
FA and AF Estimation*	g	–	–	–
FA and AF Estimation*#2	%(w/w)	<0.001	<0.001	<0.001

Method ID	Methodology Summary
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 4964-2004.
ASB-001	Asbestos ID - Identification of asbestos in soil samples using Polarised Light Microscopy and Dispersion Staining Techniques. Minimum 500mL soil sample was analysed as recommended by "National Environment Protection (Assessment of site contamination) Measure, Schedule B1 and "The Guidelines from the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia - May 2009" with a reporting limit of 0.1g/kg (0.01% w/w) as per Australian Standard AS4964-2004. Results reported denoted with * are outside our scope of NATA accreditation. **NOTE** #1 Total Asbestos g/kg was analysed and reported as per Australian Standard AS4964 (This is the sum of ACM >7mm, <7mm and FA/AF) **NOTE** #2 The screening level of 0.001% w/w asbestos in soil for FA and AF only applies where the FA and AF are able to be quantified by gravimetric procedures. This screening level is not applicable to free fibres. Estimation = Estimated asbestos weight Results reported with "--" is equivalent to no visible asbestos identified using Polarised Light microscopy and Dispersion Staining Techniques.
Inorg-008	Moisture content determined by heating at 105+/-5 °C for a minimum of 12 hours.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
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 (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.

Method ID	Methodology Summary
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 (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis. Note, the Total +ve TRH PQL is reflective of the lowest individual PQL and is therefore "Total +ve TRH" is simply a sum of the positive individual TRH fractions (>C10-C40).
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's. Note, the Total +ve reported DDD+DDE+DDT PQL is reflective of the lowest individual PQL and is therefore simply a sum of the positive individually report DDD+DDE+DDT.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD. Note, the Total +ve PCBs PQL is reflective of the lowest individual PQL and is therefore" Total +ve PCBs" is simply a sum of the positive individual PCBs.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-012	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. For soil results:- 1. 'EQ PQL'values are assuming all contributing PAHs reported as <PQL are actually at the PQL. This is the most conservative approach and can give false positive TEQs given that PAHs that contribute to the TEQ calculation may not be present. 2. 'EQ zero'values are assuming all contributing PAHs reported as <PQL are zero. This is the least conservative approach and is more susceptible to false negative TEQs when PAHs that contribute to the TEQ calculation are present but below PQL. 3. 'EQ half PQL'values are assuming all contributing PAHs reported as <PQL are half the stipulated PQL. Hence a mid-point between the most and least conservative approaches above. Note, the Total +ve PAHs PQL is reflective of the lowest individual PQL and is therefore "Total +ve PAHs" is simply a sum of the positive individual PAHs.
Org-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
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.
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. Note, the Total +ve Xylene PQL is reflective of the lowest individual PQL and is therefore "Total +ve Xylenes" is simply a sum of the positive individual Xylenes.

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-3	[NT]
Date extracted	-			19/03/2018	[NT]	[NT]	[NT]	[NT]	19/03/2018	[NT]
Date analysed	-			19/03/2018	[NT]	[NT]	[NT]	[NT]	19/03/2018	[NT]
TRH C_6 - C_9	mg/kg	25	Org-016	<25	[NT]	[NT]	[NT]	[NT]	115	[NT]
TRH C_6 - C_{10}	mg/kg	25	Org-016	<25	[NT]	[NT]	[NT]	[NT]	115	[NT]
Benzene	mg/kg	0.2	Org-016	<0.2	[NT]	[NT]	[NT]	[NT]	93	[NT]
Toluene	mg/kg	0.5	Org-016	<0.5	[NT]	[NT]	[NT]	[NT]	109	[NT]
Ethylbenzene	mg/kg	1	Org-016	<1	[NT]	[NT]	[NT]	[NT]	122	[NT]
m+p-xylene	mg/kg	2	Org-016	<2	[NT]	[NT]	[NT]	[NT]	125	[NT]
o-Xylene	mg/kg	1	Org-016	<1	[NT]	[NT]	[NT]	[NT]	124	[NT]
naphthalene	mg/kg	1	Org-014	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-016	114	[NT]	[NT]	[NT]	[NT]	121	[NT]

QUALITY CONTROL: svTRH (C10-C40) in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-3	[NT]
Date extracted	-			19/03/2018	[NT]	[NT]	[NT]	[NT]	19/03/2018	[NT]
Date analysed	-			19/03/2018	[NT]	[NT]	[NT]	[NT]	19/03/2018	[NT]
TRH C_{10} - C_{14}	mg/kg	50	Org-003	<50	[NT]	[NT]	[NT]	[NT]	109	[NT]
TRH C_{15} - C_{28}	mg/kg	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	95	[NT]
TRH C_{29} - C_{36}	mg/kg	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	92	[NT]
TRH >C_{10} -C_{16}	mg/kg	50	Org-003	<50	[NT]	[NT]	[NT]	[NT]	109	[NT]
TRH >C_{16} -C_{34}	mg/kg	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	95	[NT]
TRH >C_{34} -C_{40}	mg/kg	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	92	[NT]
Surrogate o-Terphenyl	%		Org-003	85	[NT]	[NT]	[NT]	[NT]	92	[NT]

QUALITY CONTROL: PAHs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-3	[NT]
Date extracted	-			19/03/2018	[NT]	[NT]	[NT]	[NT]	19/03/2018	[NT]
Date analysed	-			19/03/2018	[NT]	[NT]	[NT]	[NT]	19/03/2018	[NT]
Naphthalene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	95	[NT]
Acenaphthylene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Fluorene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	96	[NT]
Phenanthrene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	101	[NT]
Anthracene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	97	[NT]
Pyrene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	102	[NT]
Benzo(a)anthracene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	92	[NT]
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-012	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-012	<0.05	[NT]	[NT]	[NT]	[NT]	106	[NT]
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	112	[NT]	[NT]	[NT]	[NT]	114	[NT]

QUALITY CONTROL: Organochlorine Pesticides in soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-7	[NT]
Date extracted	-			19/03/2018	[NT]	[NT]	[NT]	[NT]	19/03/2018	[NT]
Date analysed	-			21/03/2018	[NT]	[NT]	[NT]	[NT]	21/03/2018	[NT]
HCB	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	109	[NT]
gamma-BHC	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
beta-BHC	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	104	[NT]
Heptachlor	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	103	[NT]
delta-BHC	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aldrin	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	102	[NT]
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	105	[NT]
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
pp-DDE	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	110	[NT]
Dieldrin	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	117	[NT]
Endrin	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	106	[NT]
pp-DDD	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	109	[NT]
Endosulfan II	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
pp-DDT	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	117	[NT]
Methoxychlor	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate TCMX	%		Org-005	105	[NT]	[NT]	[NT]	[NT]	111	[NT]

QUALITY CONTROL: Organophosphorus Pesticides					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-7	[NT]
Date extracted	-			19/03/2018	[NT]	[NT]	[NT]	[NT]	19/03/2018	[NT]
Date analysed	-			21/03/2018	[NT]	[NT]	[NT]	[NT]	21/03/2018	[NT]
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	86	[NT]
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Diazinon	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Dichlorvos	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	91	[NT]
Dimethoate	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Ethion	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	90	[NT]
Fenitrothion	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	96	[NT]
Malathion	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	94	[NT]
Parathion	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	108	[NT]
Ronnel	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	94	[NT]
Surrogate TCMX	%		Org-008	105	[NT]	[NT]	[NT]	[NT]	100	[NT]

QUALITY CONTROL: PCBs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-7	[NT]
Date extracted	-			19/03/2018	[NT]	[NT]	[NT]	[NT]	19/03/2018	[NT]
Date analysed	-			21/03/2018	[NT]	[NT]	[NT]	[NT]	21/03/2018	[NT]
Aroclor 1016	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1221	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1232	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1242	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1248	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1254	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	100	[NT]
Aroclor 1260	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate TCLMX	%		Org-006	105	[NT]	[NT]	[NT]	[NT]	100	[NT]

QUALITY CONTROL: Acid Extractable metals in soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-3	[NT]
Date prepared	-			19/03/2018	[NT]	[NT]	[NT]	[NT]	19/03/2018	[NT]
Date analysed	-			22/03/2018	[NT]	[NT]	[NT]	[NT]	22/03/2018	[NT]
Arsenic	mg/kg	4	Metals-020	<4	[NT]	[NT]	[NT]	[NT]	113	[NT]
Cadmium	mg/kg	0.4	Metals-020	<0.4	[NT]	[NT]	[NT]	[NT]	104	[NT]
Chromium	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	110	[NT]
Copper	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	113	[NT]
Lead	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	110	[NT]
Mercury	mg/kg	0.1	Metals-021	<0.1	[NT]	[NT]	[NT]	[NT]	97	[NT]
Nickel	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	110	[NT]
Zinc	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	111	[NT]

QUALITY CONTROL: Misc Soil - Inorg						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-3	[NT]
Date prepared	-			20/03/2018	[NT]	[NT]	[NT]	[NT]	20/03/2018	[NT]
Date analysed	-			20/03/2018	[NT]	[NT]	[NT]	[NT]	20/03/2018	[NT]
Total Phenolics (as Phenol)	mg/kg	5	Inorg-031	<5	[NT]	[NT]	[NT]	[NT]	99	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Report Comments

Asbestos-ID in soil: NEPM
This report is consistent with the reporting recommendations in the National Environment Protection (Assessment of Site Contamination) Measure, Schedule B1, May 2013.
This is reported outside our scope of NATA accreditation.

Douglas Partners
Geotechnics | Environment | Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project No:	71459.10	**Suburb:** Moorebank	**To:** EnviroLab
Project Name:	Proposed Residential development	**Order Number**	
Project Manager:	John Russell	**Sampler:** NW	**Attn:** Aileen Hie
Emails:	John.russell@douglaspartners.com.au	nicola.warton@douglaspartners.com.au	**Phone:**
Date Required:	Standard ☐		**Email:**
Prior Storage:	☐ Esky	Do samples contain 'potential' HBM? Yes ☐ No ☐ (If YES, then handle, transport and store in accordance with FPM HAZID)	

Sample ID	Depth	Lab ID	Date Sampled	Sample Type (S - soil, W - water)	Container Type (G - glass, P - plastic)	Analytes: Combo 8a	Combo 3	Asbestos (fragment ID)	Asbestos AFFA	BTEX					Notes/preservation
TP101	0.2-0.3	1	16/03/18	S	G/P	X									
TP101	1.9-2.0	2	16/03/18	S	G/P		X								
TP102	0.2-0.3	3	16/03/18	S	G/P	X									
TP102	0.9-1.0	4	16/03/18	S	G/P		X								
BD1/20180316		5	16/03/18	S	G/P		X								
TP101	2.8-2.9	6	16/03/18	S	P				X						
TP102	0.2-0.3	7	16/03/18	S	P				X						
TP102	0.4-0.5	8	16/03/18	S	P				X						
TP101 A1		9	16/03/18	fragment	P			X							
TP102 A1		10	16/03/18	fragment	P			X							
Trip Spike		11								X					
Trip Blank		12								X					

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200
Job No: 187468
Date Received: 16/3/18
Time Received: 17:20
Received by: RW
Temp: Cool/Ambient
Cooling: Ice/icepack
Security: Intact/Broken/None

PQL (S) mg/kg	**ANZECC PQLs req'd for all water analytes** ☐
PQL = practical quantitation limit. If none given, default to Laboratory Method Detection Limit	**Lab Report/Reference No:**
Metals to Analyse: 8HM unless specified here:	
Total number of samples in container:	**Relinquished by:** **Transported to laboratory by:**
Send Results to: Douglas Partners Pty Ltd	**Address:** **Phone:** **Fax:**
Signed: NW	**Received by:** EDS Rebecca 16/3/18 17.30 **Date & Time:**

RW