Appendix D

Remediation action plan for DA 24/2017 at Lot 7 DP 1065574

Douglas Partners
Geotechnics / Environment / Groundwater

Remediation Action Plan

Proposed Residential Development
146 Newbridge Road, Moorebank

Prepared for
Benedict Industries Pty Ltd

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Integrated Practical Solutions

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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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Executive Summary

This Remediation Action Plan (RAP) prepared by Douglas Partners Pty Ltd (DP) outlines the remediation strategy for a proposed residential development at 146 Newbridge Road, Moorebank. The report was commissioned by Benedict Industries Pty Ltd (Benedict) and was undertaken in accordance with DP's proposal SYD160329 dated 26 April 2016. The following is understood:

- The RAP will be required for submission as part of a development application (DA) for a proposed residential development at the site;
- The proposed development will involve retaining wall construction, bulk earthworks followed by construction of internal roads, associated infrastructure, residential lots and approximately 180 houses; and
- The site is being audited by Dr Ian Swane, a NSW Environment Protection Authority (EPA) accredited Site Auditor, to facilitate the issue of a site audit statement (SAS) Part B confirming the land can be made suitable for the proposed development.

The overall goal of the remediation programme outlined in the RAP is to render the site suitable for the proposed residential development. Further details are provided in Section 12. The objectives of the RAP are to:

- Set remediation goals that are likely to meet the conditions of a Development Consent so that the redevelopment area will be suitable for the proposed residential land uses and will pose no unacceptable risk to human health or the environment;
- Evaluate the range of remediation options available to address the existing site contamination issues, and thereby reduce risks to acceptable levels;
- Document the preferred remediation techniques and procedures;
- Establish the various safeguards required to complete the remediation work in a safe and environmentally acceptable manner;
- Identify the necessary approvals and licences required by regulatory authorities in order to enable the remediation works to proceed;
- Document a remediation strategy that will address on-site issues affecting future migration of contamination from the site; and
- Document a remediation strategy that will complement other regulatory requirements relevant to the remediation of contamination.

These objectives correspond to those given by NSW EPA guidelines, SEPP55 guidelines and Liverpool Council's contaminated land policy.

The site comprises part (generally the northern half) Lot 7 in Deposited Plan 1065574. The street address is 146 Newbridge Road, Moorebank and the site has a total area of approximately 9 ha. Large scale filling and dredging activity occurred at the site between 1991 and 2000. The wider site currently operates under two NSW EPA licences issued under the POEO Act. Based on a review of the NSW EPA information undertaken by Environmental Investigation Services (EIS) (EIS, 2013), 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 sulphate 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; and
- 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 number of previous geotechnical and environmental (contamination) investigations have been carried out at the site. The investigations 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 southern central portion of the site.

The scope of works comprised the following:

- Undertake a review of the following:
    - Design levels and associated earthworks cut and fill plan;
    - Typical building designs;
    - Geotechnical methodology for ground improvement (i.e. J&K (2016b; 2017));
- Complete a remediation options evaluation for:
    - Residual soil contamination (i.e. capping or excavation and off-site disposal of soil ‘hotspots’);
    - Landfill gas mitigation measures;
    - Groundwater contamination;
- Establish the preferred remedial option for residual soil contamination, landfill gas mitigation measures and groundwater contamination;
- Prepare this RAP that includes the following:
    - Remediation options evaluation, as discussed above;
    - Nomination of the preferred remediation option, as discussed above;
    - Establishment of remediation acceptance criteria (RAC);
    - Provide concept designs for typical landfill gas mitigation measures for dwellings;
    - Provide a methodology for the validation of remedial work (excluding construction quality assurance (CQA) for gas mitigation measures);
    - Contingency measures for unexpected finds;
    - Reference to community engagement prepared by the developer as part of the Environmental Impact Statement (EIS);
    - Inclusion of a sampling and analysis quality plan (SAQP) which specifies sampling and monitoring requirements during remediation and construction.

Based on the conceptual site model (CSM), the extent of remediation required is summarised as follows:

- Removal of localised soil contamination ‘hotspots’ or the placement of a physical barrier (e.g. capping) to prevent the exposure of receptors (human and ecological) to the soil contamination; and
- Incorporation of the relevant measure(s) or system element(s) into dwelling construction to achieve a score consistent with what is required based on the characteristic gas situation (CGS) of 3. This will also be relevant to any associated infrastructure in which landfill gas can accumulate.

The remediation options considered for residual soil contamination and landfill gas including their ranking, are summarised in Table E1 and E2, below. Groundwater contamination is to be addressed by validation monitoring and various contingency options.

Consideration of the various options is influenced by the fact that the proposed development involves a 3.0 m thick engineered cap of which the upper 1.6 m will be imported VENM. The options evaluation is outlined in the following table.

Table E1: Remediation Options Evaluation for Residual Soil Contamination

Option	Evaluation	Option Ranking
Option 1: Do nothing	In the context of the proposed development involving a 3.0 m thick engineered cap of which the upper 1.6 m will be imported VENM, this option is not considered appropriate.	Not applicable.
Option 2: On site treatment prior to off-site disposal	There is a significant quantity of fill on the site. The known soil contaminants include inorganics (lead and copper) and organics (TRH, PCB and B(a)P) exceeding NSW EPA soil investigation levels (SIL). With the exception of TRH and PCB, the other contaminants are not readily amenable to treatment (destruction) and therefore this option is not considered appropriate. Notwithstanding, in order to reduce contaminant levels and specifically to neutralise areas of high methane gas generation (hotspots), deep waste (fill) material could be excavated and organic matter (mainly timber) removed by screening and manual removal from the screens). The removed material would be disposed off-site and the remaining materials returned to the excavation. Whilst this method is costly and labour intensive the intention is to reduce contaminant loading (principally in terms of potential ground gas and groundwater (TDS and ammonia, associated with timber) emissions) and although the method will not remove all organic material from the excavated materials it is nevertheless considered to be a both a practical and reasonably efficient means of substantially mitigating potential environmental emissions and thus reducing longer term risks.	Not applicable.
Option 3: Off-site treatment prior to off-site disposal	The known soil contaminants include inorganics (lead and copper) and organics (TRH, PCB and B(a)P). With the exception of TRH and PCB, the other contaminants are not readily amenable to treatment (destruction) and therefore this option is not considered appropriate.	Not applicable.
Option 4: Off-site disposal to landfill	This option is considered to be both feasible and practical for near surface contamination. It is not considered feasible and practical for deeper (e.g. >2 m) contamination. Excavation could be adopted to facilitate the removal and off-site disposal of materials containing ‘hotspot’ levels of contamination, in particular gas hotspots.	2 Contingency.

Option	Evaluation	Option Ranking
	Excavation could be adopted to facilitate the removal and off-site disposal of materials containing 'hotspot' levels of contamination such as high concentrations of: • Biodegradable material that form gas hotspots and/or generate leachate; • Drummed waste or areas where fuel leaks occurred that pose soil vapour and/or groundwater contamination risks; and • Unexpected finds.	
Option 5: Containment of the impacted soil on site beneath an engineered barrier	In the context of the proposed development involving a 3.0 m thick engineered cap of which the upper 1.6 m will be imported VENM, this option is considered to be both feasible and practical.	1 Preferred

Given the proposed 3.0 m thick engineered cap of which the upper 1.6 m will be imported VENM, the preferred option for residual soil contamination at the site is containment of the impacted soil on site beneath an engineered barrier (Option 5).

Landfill gas monitoring data to date indicates that there is currently an unacceptable risk of the migration of landfill gas into structures (e.g. dwelling) associated with proposed development. The recent monitoring conducted as part of the detailed site investigation (DSI) suggests that a CGS of 3 is appropriate for this site.

The options evaluation is outlined in the following table.

Table E2: Remediation Options Evaluation for Landfill Gas

Option	Evaluation	Option Ranking
Option 1: Do nothing	A potentially complete pathway (explosion and/or asphyxiation risk) exists between the source of the landfill gas and the future site users (dwelling occupants). This option is not considered appropriate.	Not applicable.
Option 2: Complete removal of the landfill gas source	There is a significant quantity of fill (i.e. the primary source of the gas) on the site. Complete removal of the fill is not considered to be feasible or practical. This option is not considered appropriate.	Not applicable.
Option 3: Partial removal of the landfill gas source	There is a significant quantity of fill (i.e. the primary source of the gas) on the site. Partial removal of 'unacceptable' gas generating fill may lower the CGS for the site.	1 Preferred (already being undertaken).

Option	Evaluation	Option Ranking
Option 4: Engineered landfill gas mitigation measures for the entire site	An active system may not be suitable for residential land use because effective long term operation may not be feasible. This option could involve the installation of an array of landfill gas extraction wells fitted with air pumps spread across the site. This could also be incorporated into the 3 m thick 'engineered fill' blanket. This option is likely to involve a significant amount of engineering design and the ongoing maintenance of any active extraction that may be required.	2 Contingency.
Option 5: Engineered landfill gas mitigation measures (passive) for each proposed structure	This option is considered to be both feasible and practical subject to the incorporation of passive measures only.	1 Preferred.
Option 6: Engineered landfill gas mitigation measures (passive and active) for each proposed structure	This option is not considered to be feasible or practical due to the incorporation of active measures that would require ongoing maintenance.	2 Contingency.

It is noted here that Option 5 in the above table applies only for engineered landfill gas mitigation measures for each proposed structure. For this type of 'brown field' site Option 5 remains the only practical and cost effective remedial measure for the proposed residential use of the land and whilst development of landfill gas affected land is this way is fairly new in Australia similar types of development are now quite common in Europe and particularly in UK. In the latter the various authorities have developed considerable amounts of guidance over a number of years (for example Protective measures for housing on gas contaminated land, BSI 8485 (2015) *Code of Practice for Design of Protective Measures for Ground Gases* and accordingly it is considered that there should be no unsurmountable impediments to facilitating a similar type of development at the current site. Such sites when properly engineered have been successfully developed and accepted by both the Local Authorities and future property owners and as such there is no reason why a similar approach should not be adopted at this site. Option 5 above is given a higher ranking than Option 4 on the basis that engineered landfill gas mitigation measures other than the application of a 3.0 m cap are not considered necessary other than in built structures as any gas reaching the surface in these areas will be diluted and dispersed by normal air movements.

The preferred option for landfill gas concentration / volume reduction is the partial removal of the landfill gas source 'hot spots' (already being undertaken) and passive engineered landfill gas mitigation measures for each proposed structure (e.g. venting and/or gas resistant membranes beneath concrete slabs) (Options 3 and 5). Passive measures are considered appropriate for this development as opposed to active measures which would require home owners to maintain an active system.

The partial removal of unacceptable landfill gas sources and associated waste from the fill will have the added benefits of:

- The removal of a portion of metal waste by screening some metal out of the fill prior to its use as backfill. The metal waste in fill is currently leaching dissolved metals into groundwater and is likely to be having a net adverse impact on groundwater quality beneath the site;
- The removal of a portion of timber and other general waste by screening timber and other general waste out of the fill prior to its use as backfill. The timber and other general waste in fill is currently leaching contaminants such as dissolved metals, degradable by-products (ammonia, nutrients), OCPs (assuming discarded containers of OCP are present) and TDS into groundwater and is likely to be having a net adverse impact on groundwater quality beneath the site; and
- Removal and disposal of bonded ACM from excavated waste.

Additional benefits of removing unacceptable landfill gas sources include:

- Reduce the degree of reliance on landfill gas mitigation measures since landfill gas levels remaining at depth at the site would be reduced to the extent practicable;
- Reduce greenhouse gas emissions to the extent practicable; and
- Reduce the leachate generation of the landfill waste to the extent practicable.

Given that Option 5 has been adopted, it must be understood that a final validation report and a Section A Site Audit Statement (SAS) will not be provided until all building structure / foundations had been constructed.

Remediation will occur in three distinct stages being:

- Stage 1: Site Preparation Earthworks;
    - Stage 1a: Areas Requiring Deep Excavation;
    - Stage 1b: General Site Preparation Earthworks;
- Stage 2: VENM Capping; and
- Stage 3: Installation of Landfill Gas Mitigations.

The Stage 3 landfill gas mitigations can be divided into two sub-stages as follows:

- Stage 3a: Design the measure(s) or system element(s) to achieve a score consistent with what is required based on the CGS of 3 (i.e. 4.5 points); and
- Stage 3b: Installation of the measure(s) or system element(s) and compliance with the relevant CQA.

Stage 3 works will be done as part of the future detailed design and separate Development Application (DA) of the individual homes.

The relevant landfill gas mitigation measure(s) or system element(s) required will be subject to detailed design. It is envisaged that detailed design will occur in consultation with the project design team as it will form an integral component of the building / construction drawings that will need to be prepared prior to construction. This RAP puts forward a concept design only.

In conclusion, it is considered that remediation of the site in accordance with the procedures and validation methods outlined in this RAP will render the site suitable for the proposed residential development.

The proposed validation monitoring of landfill gas and surface water may also allow modifications (e.g. a lowering of the CGS for the site) to the proposed scope and general methodology of remediation that has been recommended in this RAP. Any modifications would be subject to approval by the Site Auditor and agreement with the Geotechnical Consultant.

The detailed design of buildings incorporating the required gas mitigation measure(s) or system element(s) will necessarily be undertaken at the appropriate point in time of the project and under a separate DA associated with Stage 3 of the remediation.

DP considers that this RAP has met the objectives of an RAP specified in NSW EPA guidelines, SEPP55 guidelines and Council’s contaminated land policy. These objectives are to:

- Set remediation goals that are likely to meet the conditions of a Development Consent so that the redevelopment area will be suitable for the proposed residential land uses and will pose no unacceptable risk to human health or the environment;
- Evaluate the range of remediation options available to address the existing site contamination issues, and thereby reduce risks to acceptable levels;
- Document the preferred remediation techniques and procedures;
- Establish the various safeguards required to complete the remediation work in a safe and environmentally acceptable manner;
- Identify the necessary approvals and licences required by regulatory authorities in order to enable the remediation works to proceed;
- Document a remediation strategy that will address on-site issues affecting future migration of contamination from the site; and
- Document a remediation strategy that will complement other regulatory requirements relevant to the remediation of contamination.

The proposed remediation strategy has included tasks that will address uncertainties that currently exist in relation to groundwater quality, composition of the 3 m ‘engineered fill blanket’ and the finalised GSV and CGS, as required by the NSW OEH (2011) guidelines.

DP considers that the site can be made suitable for its intended residential land use if the site is remediated in accordance with this RAP, and managed in accordance with a Long Term (passive) EMP, as required by NSW OEH (2011) guidelines.

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Remediation Action Plan
Proposed Residential Development
146 Newbridge Road, Moorebank

1. Introduction

This Remediation Action Plan (RAP) prepared by Douglas Partners Pty Ltd (DP) outlines the remediation strategy for a proposed residential development at 146 Newbridge Road, Moorebank. The report was commissioned in an email dated 27 April 2016 by Mr Ernest Dupere of Benedict Industries Pty Ltd (Benedict) and was undertaken in accordance with DP's proposal SYD160329 dated 26 April 2016. The following is understood:

- The RAP will be required for submission as part of a development application (DA) for a proposed residential development at the site; and
- The site is being audited by Dr Ian Swane, a NSW Environment Protection Authority (NSW EPA) accredited Site Auditor, to facilitate the issue of a site audit statement (SAS) Part B confirming the land can be made suitable for the proposed development.

The overall goal of the remediation programme outlined in the RAP is to render the site suitable for the proposed residential development. Further details are provided in Section 12. The objectives of the RAP are to:

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- Document a remediation strategy that will address on-site issues affecting future migration of contamination from the site; and
- Document a remediation strategy that will complement other regulatory requirements relevant to the remediation of contamination.

These objectives correspond to those given by NSW EPA guidelines, SEPP55 guidelines and Liverpool Council's contaminated land policy.

A site plan and locality map is shown on Drawing 1, Appendix A. A site plan of previous test locations overlaid on a recent Nearmap aerial photograph flown 13 February 2016 is shown on Drawing 2, Appendix A.

2. Background Information

2.1 Site Identification

The site comprises part (generally the northern half) Lot 7 in Deposited Plan 1065574. The street address is 146 Newbridge Road, Moorebank and the site has a total area of approximately 9 ha.

The site boundary is shown on Drawing 1, Appendix A. The drawing also shows land to the south of the 'site' which is the remainder of Lot 7 in Deposited Plan 1065574. It is understood that this southern portion is also proposed to be developed as a marina and that this development is the subject of a separate DA and is covered by other documentation not relevant to this RAP.

A copy of the latest survey plan of the site showing topographic contours is included in Appendix B.

2.2 Site Condition and Surrounding Environment

The site comprises a recycling facility involving the storage / transfer / separation of various waste streams for crushing, grinding and processing into recycled building products. The site is unsealed and several stockpiles of recycled products are present. A residential dwelling is present at the north-eastern corner of the site. Over the previous months, the number and volume of stockpiled products have been slowly depleting and site infrastructure such as the weighbridge and above-ground storage tank (AST) is being decommissioned.

Low lying parts of the Moorebank area adjacent to the Georges River are flood prone, but the site is already above the 1 in 100 year flood level. Notwithstanding redevelopment of the site will require the present ground surface to be raised by approximately 1.6 m for site formation and civil purposes. The need to raise the ground surface for construction purposes has been considered when assessing remediation options for the site.

No major structures or buried services remain at the site.

The immediate surrounds of the subject site included the following land uses:

- North – Newbridge Road and an industrial area beyond;
- South – Ponds associated with the wider site;
- East – The "Flowerpower" (a garden centre) site is located to the north-east of the subject site. Dense bushland is located to the south-east and Georges River beyond; and
- West – Entry/access road to the west and bushland beyond.

2.3 Groundwater Dependant Ecosystems

Information on groundwater dependant ecosystems (GDEs) at and in the vicinity of the site is available from the Bureau of Meteorology (BOM) GDE Atlas. A review of the atlas indicates that no GDEs are present at or adjacent to the site.

3. Proposed Development

The proposed development will involve retaining wall construction, bulk earthworks followed by construction of internal roads, associated infrastructure, residential lots and houses. The bulk earthworks will involve cut and fill of existing material with a net deficit of soil. The net deficit will require an average 1.6 m thickness of imported virgin excavated natural material (VENM) fill across the site.

The construction of the retailing wall along the western site boundary is the subject of a separate DA. Works undertaken associated with the construction of the retaining wall should be done with reference to DP (2015a) *Construction Environmental Management Plan, Proposed Retaining Wall, 146 Newbridge Road, Moorebank, NSW*. This RAP relates to the remaining work associated with the proposed residential development.

The approximately 180 residential dwellings will comprise a mix of terrace homes, duplex (semi-detached) homes and detached homes. The final lot layout may be subject to minor changes as detailed design progresses. Notwithstanding, any such changes should not affect the overall remediation strategy documented in this RAP as the entire development area is to be remediated to a condition suitable for residential land use as defined in NEPC (2013) under land-use setting ‘Residential A’.

The following drawings that depict the various aspects of the proposed development are provided in Appendix B:

- Drawing 14005-FILL2 Preliminary Fill Plan of the Residential Portion of Lot 7 DP1065574 Above the Bottom of the Capping Layer (i.e. 3 m below FSL), dated 1 September 2016;
- Drawing 14005E10 Overall Plan Showing Catchments, dated 20 November 2016; and
- Drawing MP01-B-01-12-2016 Concept Plan Reduced Site Area Option 20y, dated 21 November 2016.

The residential houses will be Torrens Title and have private ownership (no body corporate) with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms may also present. Construction of houses would via conventional building construction techniques using licensed builders rather than being supervised by qualified civil engineers as noted in BS8485:2015 (see text box below), thus requiring separate construction quality control and supervision during the installation of the landfill gas mitigation system (see Section 16.4).

BS8485:2015 (page 21), defines:

- Type A building as "private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms present. Probably conventional building construction **(rather than civil engineering)**. Examples include private housing and some retail premises."
- Type B building as "private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium size rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels."
- Type C building as "commercial building with central building management control of any alterations to the building or its uses and central building management control of the maintenance of the building, including the gas protection measures. Single occupancy of ground floor and basement areas. Small to large size rooms with active ventilation or good passive ventilation of all rooms and other internal spaces throughout ground floor and basement areas. Probably civil engineering construction. Examples include offices, some retail premises, and parts of some public buildings (such as schools, hospitals, leisure centres and parts of hotels).

4. List of Previous Reports

A number of previous investigations have been undertaken at the site by DP, Dames and Moore Pty Ltd (D&M), Environmental Investigation Services (EIS) and Jeffery and Katauskas Pty Ltd (J&K) (EIS is a division of J&K).

A summary of the relevant reports that are known to DP is provided in Table 1, below. The summary is not an exhaustive list, however, indicates the site has been subject to several investigations in the past.

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
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

Author	Year	Project No.	Report Title / Letter Report Title
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
J&K	2017	26930Zrpt Rev5	Geotechnical Evaluation for Proposed Residential Subdivision at 146 Newbridge Road, Moorebank, NSW
DP	2017b	71459.06	Sampling and Analysis Quality Plan, Validation Monitoring, Proposed Residential Development, 146 Newbridge Road, Moorebank

5. Scope of Works

The scope of works comprised the following:

- Undertake a review of the following:
  - Design levels and associated earthworks cut and fill plan;
  - Typical building designs;
  - Geotechnical methodology for ground improvement (i.e. J&K (2016b; 2017));
- Complete a remediation options evaluation for:
  - Residual soil contamination (i.e. capping or excavation and off-site disposal of soil ‘hotspots’);
  - Landfill gas mitigation measures;

  - Groundwater contamination;
- Establish the preferred remedial option for residual soil contamination, landfill gas mitigation measures and groundwater contamination;
- Prepare this RAP that includes the following:
  - Remediation options evaluation, as discussed above;
  - Nomination of the preferred remediation option, as discussed above;
  - Establishment of remediation acceptance criteria (RAC);
  - Provide concept designs for typical landfill gas mitigation measures for dwellings;
  - Provide a methodology for the validation of remedial work (excluding construction quality assurance (CQA) for gas mitigation measures);
  - Contingency measures for unexpected finds;
  - Reference to community engagement prepared by the developer as part of the Environmental Impact Statement (EIS);
  - Inclusion of a sampling and analysis quality plan (SAQP) which specifies sampling and monitoring requirements during remediation and construction.

6. Subsurface Conditions

6.1 Geology

A review summarised in EIS (2013) of the regional geological map of Penrith (1991) indicates that the site is underlain by the following formations:

- South and central sections – Quaternary aged deposits of medium grained sand and silty clay; and
- North, east and south-east sections – Tertiary aged deposits of clayey quartzose sand and clay.

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

6.2 Fill

Fill encountered at the site during DP (2016) comprised sand, clay, silty clay, clayey sand, sandy clay, crushed sandstone, gravel, crushed glass (fine sand to silt particle size), in filling to depths of 0.7 m to 9.2 m and to borehole termination (typically refusal on buried obstructions in the filling) in BH201 at 3.8 m, BH202 at 6.1 m, BH203 at 4.5 m, BH205 at 4.9 m, BH209 at 5.4 m, BH210 at 4.05 m, BH212 at 6.0 m, BH213 at 3.8 m, BH215 at 3.7, BH218 at 8.35, BH220 at 2.6 m, BH221 at 4.9 m, BH222 at 2.9 m and BH118a at 6.4 m. Anthropogenic materials (typically construction and demolition waste including concrete, timber, glass, brick, asphalt, steel, plastic, terracotta and cotton / fabric) were observed throughout the filling at the majority of boreholes consistent with the known history of burial of demolition waste at the site. Bonded asbestos containing material (ACM) and fibrous asbestos and asbestos fines (FA/AF) has also been detected in the fill that was excavated from the trial remediation excavations (refer to Section 10.3). Assuming an average thickness of fill at the site of 4.0 m, the total quantity of fill would be 360,000 m^3.

The fill is likely to have been placed in an uncontrolled manner without geotechnical compaction. The fill is compressible and the site will require a program of geotechnical ground improvement as part of site remediation and development work (refer to Section 11). Drawing 2, extracted from DP (2015c) showing fill thickness contours across the site is included in Appendix A.

6.3 Acid Sulphate Soil Risk

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 heavy ground disturbance through general urban development or the construction of dams and levees.

6.4 Hydrogeology

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.

Groundwater wells at the site, including those installed by J&K, were surveyed using a dGPS. Groundwater levels were gauged on 17 September 2016 using an electronic oil/water interface meter prior to developing the wells. The measured water levels were between 1.76 m bgl (1.09 m AHD) and 6.43 m bgl (0.72 m AHD) prior to development of the wells as gauged on 17 September 2015. Groundwater was also measured at similar depths when sampled.

Based on the groundwater level measurements, flow was to the north towards Newbridge Road, east towards the Georges River, to the south towards the ponds and to the west towards the open drainage channel. The inferred groundwater level contours are shown on Drawing 7 and 8, Appendix C. Essentially groundwater appears to be mounded within the site and flowing radially towards adjacent water bodies and low points. This is to be expected as the permeability of fill at the site is likely to be variable but higher than the natural landforms surrounding the site and water bodies are located to the east, south and west of the site.

7. Summary of Site History

The detailed site history information 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 raising 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 achieve 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 the wider site (i.e. to the south of the proposed development area).	Land Title Records & Aerial Photos
1997 to present	The site as at present is owned by Tanlane Pty Ltd. Large scale filling and dredging activity has occurred between 1991 and 2000. 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	Historical Aerial Photos, Council and NSW EPA records

Timeline	Details / Summary	Source of Information
	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 NSW 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 NSW 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 VENM and potential acid sulphate 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.	

8. 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.

8.1 DP (2002b)

DP was commissioned to undertake a Preliminary Contamination Assessment (PCA) for the proposed residential development at the site in 2002. The PCA was confined to the subject site which was formerly identified as Lot 1 in DP515738. The PCA was undertaken in conjunction with a geotechnical investigation commissioned for the proposed development. The objectives of the PCA were to:

- Determine the general level of potential contamination;
- Identify the potential for off-site migration of contamination; and

- Provide a preliminary view of the suitability of the site for the proposed development.

The investigation included:

- Drilling 12 boreholes in selected areas across the site; and
- Sampling the fill and natural soil profiles; and analysis of selected samples for a range of organic and inorganic contaminants.

The results of the investigation are summarised below:

- The boreholes encountered fill material ranging in depth from approximately 3.7 m to 8.7 m bgl. The fill contained inclusions of gravel and sand with some concrete, bricks, wood and clay;
- Natural alluvial soil comprising clay and sand was encountered beneath the fill;
- Groundwater seepage was encountered in the boreholes at depths of approximately 3.5 m to 5.8 m bgl;
- The majority of the analytical results were below the adopted site assessment criteria (SAC) which included the former Health Investigation Levels (HILs) Category A 'Residential Sites with Gardens and Accessible Soil' and the threshold concentrations for sensitive sites outlined in the NEPC (1999) *National Environment Protection (Assessment of Site Contamination) Measure 1999*, which has recently been superseded by NEPC (2013) *National Environment Protection (Assessment of Site Contamination) Measure 1999* as amended 2013;
- Elevations of lead above the SAC were encountered in four samples. However, the statistical analysis undertaken on the lead results indicated that the results were below the SAC;
- An elevated concentration of benzo(a)pyrene (B(a)P) above the SAC was encountered in one sample. However, the statistical analysis undertaken on the B(a)P results indicated that the results were below the SAC;
- The exceedances were not considered to pose a significant risk to human health; and
- Elevations above the provisional phyto-toxicity based guidelines levels (PPILs) (now superseded by EILs in NEPC (2013)) were encountered for cadmium and zinc in two samples. These samples were obtained from depths of approximately 2 m and 4 m below ground level and were not considered to pose a risk to the shallow plant root zone (particularly in the context of a proposed cap at the site).

Based on the findings of the PCA, DP concluded that the site may be suitable for the proposed residential development provided further testing is undertaken to adequately characterise the groundwater and soil gas quality at the site.

8.2 EIS (2013)

The EIS (2013) investigation was limited to the subsurface soil profile, with the stockpile located on site at the time not being subject to the investigation. The objectives of the Stage 1 Environmental Site Assessment (ESA) were to identify the key areas of environmental concern (AEC) and to prepare a preliminary conceptual site model (PCSM) for the site. The objectives also included identifying widespread soil and groundwater contamination issues and the potential for the occurrence of acid sulphate soil (ASS) and hazardous ground gases (HGG) at the site.

The results of laboratory chemical analysis on the selected soil samples indicated the following:

- Monocyclic aromatic hydrocarbons (benzene, toluene, ethylbenzene and xylenes – BTEX), volatile organic compounds (VOC), organochlorine pesticides (OCP), organophosphorus pesticides (OPP) and polychlorinated biphenyls (PCB) were below the adopted SAC;
- The majority of the results for metals were below the HIL-A SAC. One fill sample JK16/0.0-0.2 had an elevated concentration of lead of 350 mg/kg above the SAC of 300 mg/kg. The elevated lead result was less than 250% of the SAC and the 95% upper confidence limit (UCL) of the arithmetic mean was calculated using the lead data from the fill soil samples. The 95% UCL for lead was 107 mg/kg which was below the HIL-A of 300 mg/kg. The Standard Deviation (SD) was less than 50% of the SAC;
- One fill sample JK7/2.7-3.0 recorded a total chromium concentration of 2800 mg/kg which was above the adopted Environmental Investigation Level (EIL) of 413 mg/kg;
- The majority of the results were below the Health Screening Level (HSL) A SAC. One surficial fill sample JK13/0.0-0.2 encountered an elevated concentration of total recoverable hydrocarbons (TRH) $>C_{10}$-C_{16} (TRH F2) of 190 mg/kg above the SAC of 110 mg/kg. The elevated TRH F2 result was less than 250% of the SAC and within the acceptance criteria outlined in Section 3. The 95% UCL was calculated using the TRH F2 data from the fill soil samples. The 95% UCL for TRH F2 was 43.94 mg/kg which is below the HSL-A of 110 mg/kg. The SD was less than 50% of the SAC. Seven individual fill samples encountered mid to heavy fraction TRH concentrations which were above the adopted Environmental Screening Levels (ESLs);
- The majority of the results for polycyclic aromatic hydrocarbons (PAH) were below the HIL-A SAC. One fill sample JK12/1.3-1.5 encountered an elevated concentration of B(a)P toxicity equivalency quotient (TEQ) of 13 mg/kg above the SAC of 3 mg/kg. The elevated B(a)P TEQ result was greater than 250% of the SAC (i.e. is a ‘hotspot’). Twelve fill samples had elevated B(a)P concentrations which were above the adopted ESL criteria;
- Asbestos was encountered in JK10/7.3 -7.5, no other asbestos was detected in any of the other boreholes. Seven fibre cement fragments from the surface of the site were tested for asbestos with six pieces confirmed to be bonded asbestos containing materials (ACM); and
- Acid sulphate soil results indicated that the majority of the results (eight samples only, five of fill, three of natural) were within the acidic to very acidic range. The adopted S_{POS} criterion of 0.03% was exceeded for samples of both fill and natural soils, suggesting that some potential acid sulphate soils may have been used to fill the site. The calculated preliminary liming rate required for neutralisation ranged from 2 kg Ca_3/tonne to 15 kg Ca_3/tonne.

The results of laboratory chemical analysis on the groundwater samples collected from the four groundwater monitoring wells by EIS indicated the following:

- TRH, BTEX, OCP, VOC and PCB were all below the adopted groundwater investigation levels (GILs);
- Detectable concentrations of OCP (DDE, DDT and dieldrin) were recorded at some monitoring wells, however, at concentrations below the GIL;
- Elevated concentrations of individual metals were recorded above the ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* GILs as follows:
    - Arsenic at MW9 recorded a concentration of 33 µg/L which exceeded the GIL of 24 µg/L;

  - Copper at MW9 and MW16 recorded a concentration of 12 µg/L and 2 µg/L, respectively, which exceeded the GIL of 1.4 µg/L;
  - Lead at MW9 recorded a concentration of 4 µg/L which exceeded the GIL of 3.4 µg/L;
  - Nickel at MW9 and MW16 recorded a concentration of 120 µg/L and 26 µg/L, respectively, which exceeded the GIL of 11 µg/L;
  - Zinc at MW9 and MW12 recorded a concentration of 200 µg/L and 39 µg/L, respectively, which exceeded the GIL of 8 µg/L;
- The majority of results for PAH were below the GILs. MW16 recorded a detectable concentration of naphthalene at 0.2 µg/L, which exceeded the USEPA criterion for tap water of 0.14 µg/L but below the ANZECC 2000 GIL; and
- Detectable concentrations of chlorpyrifos were recorded in the majority of the groundwater samples. The concentrations were above ANZECC 2000 GIL of 0.01µg/L. However, all of the results were below the NHMRC (2011) *Australian Drinking Water Guidelines* GILs.

The main areas of environmental concern (AEC) identified by EIS are summarised as follows:

- Uncontrolled large scale filling activity has been historically undertaken at the site associated with the commercial land uses. This has occurred since at least the 1950s and was not regulated during the initial years;
- The preliminary screening has indicated the presence of HGG at the site. The main source of HGG is considered to be the organic inclusions in the deeper filled areas. However, there may also be a potential for HGG generation to be associated with the swampy alluvial soils;
- The site has formerly been used as a dairy and for cattle grazing purposes. Some sections of the site were filled during this land use;
- Commercial activities associated with the current use of the site for resource recovery and waste processing could have a potential impact on the site; and
- Hazardous building material associated with the demolition of built structures can result in site contamination.

Data gaps identified by EIS include:

- Specific point sources of potential contamination associated with the AEC have not been adequately investigated;
- Deep fill at the site has not been adequately characterised;
- Large sections of the site have not been investigated (the NSW EPA sampling design guidelines recommend 107 evenly spaced sampling points);
- The occurrence of HGG has not been adequately characterised; and
- Inaccessible areas (buildings and densely vegetated areas along the east west site boundaries) have not been investigated.

Based on the scope of works undertaken, EIS were of the opinion that the AEC at the site pose a risk to the identified receptors. EIS considered that the site can be made suitable for the proposed residential land use provided that suitable measures are untaken to address the data gaps and risks identified at the site. EIS recommended undertaking the following additional work:

- A preliminary HGG assessment should be undertaken to better characterise the risk associated with HGG. The assessment should include a PCSM for HGG; and
- A Stage 2 ESA should be undertaken to meet the NSW EPA recommended sampling density. The Stage 2 ESA should target the data gaps identified in their report.

Based on the findings of the above investigations, EIS noted that consideration should be made to address the following:

- A remediation strategy to render the site suitable for the proposed residential land use;
- Assess the requirement for a Quantitative Health Risk Assessment (in accordance with enHealth and Appendix VII of the Guidelines for the NSW Site Auditor Scheme, 2006) for HGG and other remnant contamination that may remain on site; and
- Assess the requirements for an Environmental Management Plan (EMP) for the ongoing management of contamination remaining on site.

8.3 EIS (2014a)

The EIS (2014a) investigation involved the design and implementation of a field sampling program which included installation of monitoring wells to assess HGG. The initial sampling plan proposed 19 HGG sampling locations, but due to site access constraints, only 13 locations were drilled with four existing groundwater monitoring wells utilised as HGG sampling locations. The spacing of the wells varies and is generally in the order of 30 m to >60 m apart.

The HGG monitoring data in EIS (2014a) is summarised as follows:

- Methane concentrations ranged from 0.01 %v/v to 30 %v/v. The majority of the higher CH_4 concentrations were associated with the deep fill areas;
- Carbon dioxide concentrations ranged from 0.05 %v/v to 31.2 %v/v. The higher CO_2 concentrations were generally associated with the higher CH_4;
- Oxygen concentrations ranged from 0 %v/v to 30.6 %v/v. The O_2 concentrations generally decreased with higher CH_4 concentrations in the deeper fill areas;
- Carbon monoxide[1] concentrations ranged from 0 ppm to 117 ppm. There was no major trend observed in the CO concentrations;
- Hydrogen sulphide concentrations ranged from 0 ppm to 40 ppm. Higher values of H_2S were recorded in the boreholes during drilling when compared to readings obtained from monitoring wells on completion of drilling; and

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[1] Carbon monoxide and hydrogen sulphide are both reported in EIS reports as percent, however, DP assumes that this unit should be in parts per million (ppm) which is the common unit on landfill gas analysers and we have changed it accordingly.

- Atmospheric pressure readings ranged from 1013 hPa to 1024 hPa.

Based on the scope of works undertaken, EIS were of the opinion that the HGG encountered at the subject site poses a risk to the receptors and future development of the site. Prior to remediation/management of the site, EIS recommended undertaking the following additional work to better characterise the risks:

- "Long term monitoring of HGG should be undertaken at the site. Considering the end land use for residential with gardens, the CIRIA (2007) *C665 Assessing Risks Posed by Hazardous Ground Gases to Buildings* recommends a minimum monitoring period of 24 months;
- Additional HGG monitoring wells should be installed when site access becomes available to better assess the source and generation of HGG. The CIRIA C665 guideline recommends a grid spacing of <25 m for sensitive sites such as residential houses with gardens;
- A Stage 2 ESA should be undertaken to meet the NSW EPA (1995) *Sampling Design Guidelines* recommended sampling density;
- A Quantitative Health Risk Assessment (in accordance with enHealth guidelines and Appendix VII of the DEC (2006) *Guidelines for the NSW Site Auditor Scheme*) should be undertaken by a suitability qualified risk assessor for the contamination remaining on site;
- In the event site remediation is chosen (either excavation and removal of fill or capping and passive / active gas venting), a Remediation Action Plan (RAP) should be prepared for the site;
- In the event the capping / management options are chosen, a Construction Management Plan (CMP) should be prepared to document the gas mitigation / management measures required to be implemented during construction;
- A Validation Assessment (VA) report should be prepared to document the remediation action undertaken at the site;
- An Environmental Management Plan (EMP) should be prepared for the ongoing management of contamination remaining on site. The EMP will require establishment of appropriate public notification under Section 149(2) of the *Environmental Planning and Assessment Act* NSW 1979 or a covenant registered on the title to land under Section 88B of the *Conveyancing Act* NSW 1919;
- Prepare an appropriate work, health and safety plan (WHS) for the contaminants encountered at this site; and
- Inspections during demolition and excavation work to assess any unexpected conditions or subsurface facilities that may be discovered between investigation locations. This should facilitate appropriate adjustment of the works program and schedule in relation to the changed site conditions. Inspections should be undertaken by experienced environmental personnel."

8.4 EIS (2014b)

The EIS (2014b) investigation involved a continuation (Round 2) of the monitoring to assess HGG. The monitoring was undertaken on 21 February 2014.

The HGG monitoring data in EIS (2014b) was summarised by EIS as follows:

- The CH_4 concentrations ranged from 0 %v/v to 28.4 %v/v. The majority of the higher concentrations were associated with the deep fill areas;
- The CO_2 concentrations ranged from 0.5 %v/v to 31.3 %v/v. The high CO_2 concentrations were generally associated with the high CH_4 concentrations in the deeper fill areas of the site;
- The O_2 concentrations ranged from 0 %v/v to 18.7 %v/v. The O_2 concentrations generally decreased with higher CH_4 concentrations in the deeper fill areas of the site;
- The CO concentrations ranged from 0 ppm to 2 ppm. There was no major trend observed by EIS in the CO concentrations;
- The H_2S concentrations ranged from 0 ppm to 4 ppm. Higher values of H_2S were noted in the boreholes during drilling (see (EIS, 2014a) report) when compared to readings obtained during this screening;
- The atmospheric pressure reading during the screening ranged from 1016 hPa to 1019 hPa. A difference of 3 hPa was recorded; and
- The peak flow ranged from 0 L/hr to 4.7 L/hr over the monitoring duration of three minutes at each location.

A preliminary qualitative risk assessment (PQRA) was presented in EIS (2014a). The report recommended reviewing the PQRA based on the results of subsequent monitoring. EIS used the additional flow data obtained during the second round of screening to calculate the Gas Screening Value (GSV) and the Characteristic Gas Situation (CGS) in order to comment on the level of protection required for future development of the site.

The GSV for the site was calculated by EIS to be 2.82 L/hr. The GSV was used to calculate a CGS of 3 using the modified Wilson and Card classification which is in the moderate risk category. EIS concluded that for the proposed low density residential development with a CGS of 3, protection measures should be adopted to achieve a protection score of four or higher.

8.5 EIS (2014c)

The EIS (2014c) investigation involved a continuation (Round 3) of the monitoring to assess HGG. The monitoring was undertaken on 7 March 2014.

The HGG monitoring data in EIS (2014c) was summarised by EIS as follows:

- The CH_4 concentrations ranged from 0 %v/v to 35 %v/v. The majority of the higher concentrations were associated with the deep fill areas;
- The CO_2 concentrations ranged from 0.1 %v/v to 33.1 %v/v. The high CO_2 concentrations were generally associated with the high CH_4 concentrations in the deeper fill areas of the site;
- The O_2 concentrations ranged from 0 %v/v to 20.2 %v/v. The O_2 concentrations generally decreased with higher CH_4 concentrations in the deeper fill areas of the site;
- The CO concentrations ranged from 0 ppm to 2 ppm. There was no major trend observed by EIS in the CO concentrations;

- The H_2S concentrations ranged from 0 ppm to 18 ppm. Higher values of H_2S were noted in the boreholes during drilling (see EIS HGG (2014a) report) when compared to readings obtained during this screening;
- The atmospheric pressure reading during the screening ranged from 1018 hPa to 1021 hPa. A difference of 3 hPa was recorded; and
- The peak flow ranged from -0.1 L/hr to 7.3 L/hr over the monitoring duration of three minutes at each location.

The GSV for the site was calculated by EIS to be 5.11 L/hr (with EIS noting the uncertainty relating to the sampling device). The GSV was used to calculate a CGS of 4 using the modified Wilson and Card classification which is in the moderate to high risk category.

EIS concluded that for the proposed low density residential development with a CGS4, protection measures should be adopted to achieve a protection score of six or higher. EIS also noted that NSW EPA guidelines recommend adopting pathway intervention and a high level of management for residential development at CGS4 and above and that consideration should also be made to undertaking a Level 2 risk assessment.

8.6 EIS (2014d)

The EIS (2014d) investigation involved a continuation (Round 4) of the monitoring to assess HGG. The monitoring was undertaken on 1 April 2014.

The HGG monitoring data in EIS (2014d) was summarised by EIS as follows:

- The CH_4 concentrations ranged from 0.1 %v/v to 37.2 %v/v. The majority of the higher concentrations were associated with the deep fill areas. There was a general increase in the concentrations when compared to the previous rounds;
- The CO_2 concentrations ranged from 0.3 %v/v to 35.2 %v/v. The high CO_2 concentrations were generally associated with the high CH_4 concentrations in the deeper fill areas of the site. There was a general increase in the concentrations when compared to the previous rounds;
- The O_2 concentrations ranged from 0 %v/v to 5 %v/v. The O_2 concentrations generally decreased with higher CH_4 concentrations in the deeper fill areas of the site. There was a general decrease in the concentrations when compared to the previous rounds;
- The CO concentrations ranged from 0 ppm to 1 ppm. There was no major trend observed by EIS in the CO concentrations;
- The H_2S concentrations ranged from 0 ppm to 177 ppm. Higher values of H_2S were noted in the boreholes during drilling (see EIS HGG 2014a report) when compared to readings obtained during this screening. Monitoring well JK118 encountered a very high concentration of H2S of 177 ppm. The previous maximum concentration encountered in this monitoring well was 21 ppm during drilling on 28 January 2014;
- The atmospheric pressure reading during the screening was 1020 hPa; and

- The peak flows recorded using the GA5000 ranged from 0.1 L/hr to 4.5 L/hr over the monitoring duration of 3 minutes at each location. The peak flows recorded using the GFM unit ranged from 0 L/hr to 3.6 L/hr at selected locations. The peak flows recorded using the Risiteck unit ranged from 0.13 L/hr to 1.65 L/hr at selected locations.

The comparison of the flow rates in monitoring wells JK104, JK107 and JK119 indicated that the readings recorded by the GA5000 and the GFM units were generally within the same range. The results obtained from the Risiteck unit were not considered to be sufficiently accurate for further consideration.

The GSV for the site was calculated by EIS to be 2.72 L/hr. The GSV was used to calculate a CGS of 3 using the modified Wilson and Card classification which is in the moderate risk category. EIS concluded that for the proposed low density residential development with a CGS of 3, protection measures should be adopted to achieve a protection score of four or higher.

8.7 EIS (2014e)

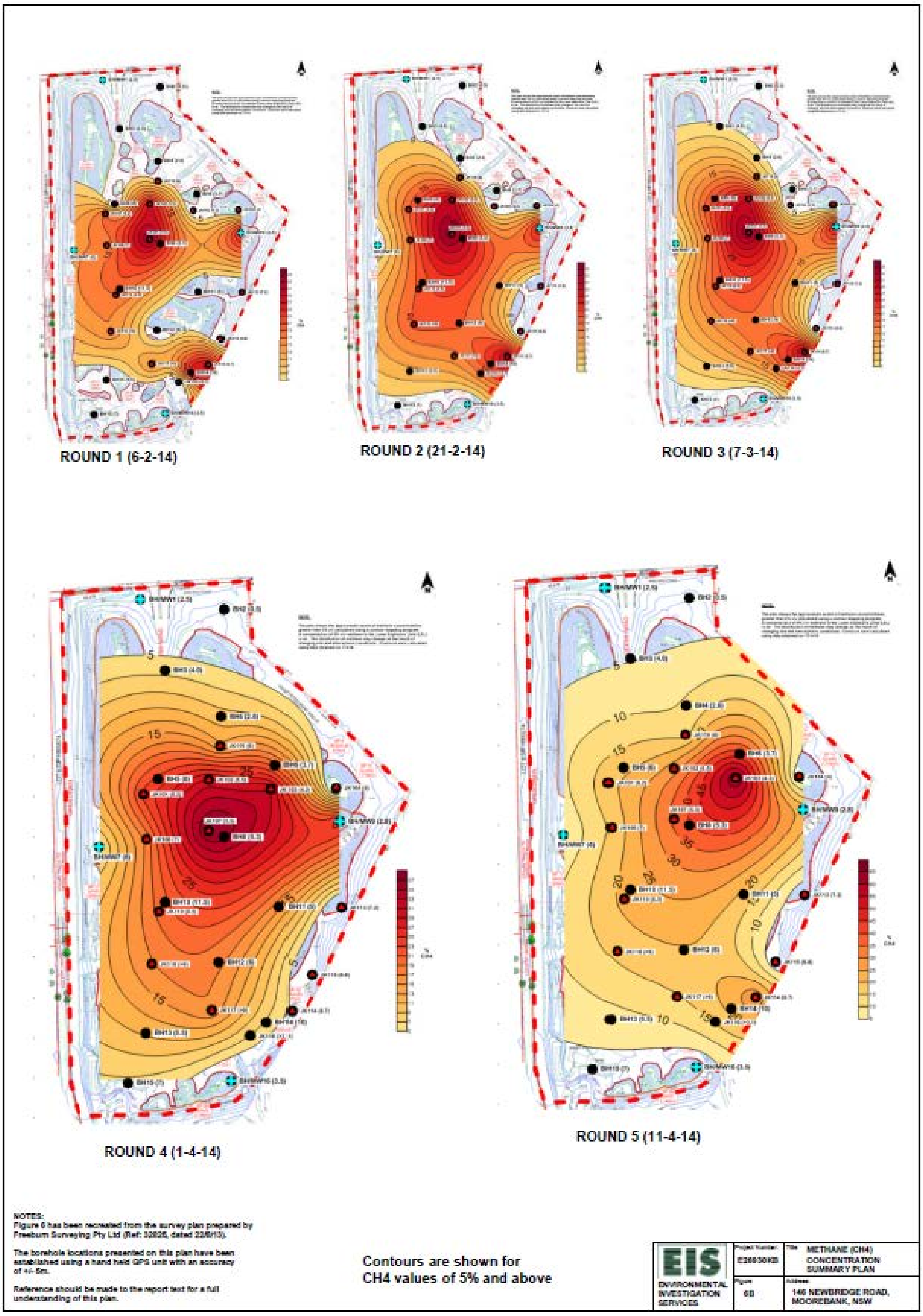
The EIS (2014e) investigation involved a continuation (Round 5) of the monitoring to assess HGG. The monitoring was undertaken on 11 April 2014.

The HGG monitoring data in EIS (2014e) was summarised by EIS as follows:

- The CH_4 concentrations ranged from 0 %v/v to 65.4 %v/v. Monitoring well JK103 encountered a very high reading of 65.4 %v/v. The concentrations were rechecked at separate intervals during the monitoring event to validate the reading. The repeat monitoring results from JK103 were 58 %v/v and 63.6 %v/v. The majority of the higher concentrations were associated with the deep fill areas;
- The CO_2 concentrations ranged from 0.4 %v/v to 21.2 %v/v;
- The O_2 concentrations ranged from 0 %v/v to 21.2 %v/v. The O_2 concentrations generally decreased with higher CH_4 concentrations in the deeper fill areas of the site;
- The CO concentrations ranged from 0 ppm to 6 ppm. There was no major trend observed by EIS in the CO concentrations;
- The H_2S concentrations ranged from 0 ppm to 206 ppm. Higher values of H_2S were noted in the boreholes during drilling (see EIS HGG 2014a report) when compared to readings obtained during this screening. Monitoring well JK118 encountered a very high concentration of H_2S of 206 ppm. The previous maximum concentration encountered in this monitoring well was 177 ppm during the fourth round;
- The atmospheric pressure reading during the screening was 1003 hPa. The atmospheric pressure had been falling steadily from a high of 1025 hPa recorded at the BOM weather station at Bankstown Airport on Monday 7 April 2014; and
- The peak flow ranged from -5.4 L/hr to 2.3 L/hr over the monitoring duration of 3 minutes at each location.

The GSV for the site was calculated by EIS to be 4.77 L/hr. The GSV was used to calculate a CGS of 4 using the modified Wilson and Card classification which is in the moderate to high risk category. EIS concluded that for the proposed low density residential development with a CGS4, protection measures should be adopted to achieve a protection score of six or higher.

A summary of the five HGG monitoring rounds extracted from EIS (2014e) is shown on Figure 1, below.



NOTES:
Figure 6 has been recreated from the survey plan prepared by Freeburn Surveying Pty Ltd (Ref: 32005, dated 22/8/13).

The borehole locations presented on this plan have been established using a hand held GPS unit with an accuracy of +/- 5m.

Reference should be made to the report text for a full understanding of this plan.

Contours are shown for
CH4 values of 5% and above

Figure 1: Methane Concentration Summary Plan (EIS, 2014e)

8.8 DP (2014a)

DP initially proposed four tasks namely:

- Review of the site investigation reports by EIS particularly the EIS (2014a);
- Provision of concept landfill gas mitigation design for low - medium density residential development including the likely development scenarios (e.g. residential house with slab, external services and public open space);
- Preliminary discussions with the builder (Mirvac Group) to discuss the build-ability of the concept landfill gas mitigation system(s) and initial discussions with the Site Auditor (yet to be confirmed at the time) to confirm in principal agreement; and
- Provision of a Stage 1 report for auditor review.

The DP (2014a) review concluded that, given the data to date it should be assumed that a minimum of three levels of gas mitigation is required. DP recommended that further monitoring works are undertaken to avoid overly conservative design requirements. In this regard, it was also recommended that a review of the earthworks requirements are undertaken with a view to establishing if the earthworks can be incorporated into the mitigation design (e.g. low permeable capping layer).

8.9 DP (2014b)

The scope of DP (2014b) was to provide the concept landfill gas mitigation design as discussed in Section 8.8 above.

The DP (2014b) draft concept design concluded that monitoring by EIS has indicated a CGS of 4 requiring a gas mitigation system design with a score of at least six. A passive landfill gas mitigation system design comprising at least three (and likely four) levels of protection was therefore required. The proposed concept design comprised several main elements as outlined in the report including: a clay cap, a gas drainage (collection and dispersal system) layer, a gas protective membrane and sealed concrete slab.

DP concluded that combined these should afford a score of >6 points as required by NSW EPA (2012) *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases*.

The report also noted that final design, specifications and suppliers can be provided once the initial concept design is reviewed and agreed by the Site Auditor and is demonstrably buildable.

8.10 DP (2016)

Conclusions

The findings of the DSI, DP (2016), were generally consistent with previous investigations insofar as the drilling programme encountered uncontrolled filling with a component of construction and demolition waste to thicknesses of up to 9.2 m. Many boreholes met refusal on buried obstructions in the filling.

A site plan of previous test locations overlaid on a recent Nearmap aerial photograph flown 13 February 2016 is shown on Drawing 2, Appendix A. For reference, the Drawing set from DP (2016) is reproduced in Appendix C.

The contaminant concentrations in soil were generally consistent with previous investigations with the exception of the PCB hotspot encountered at BH220. PCB has not previously been detected at the site, but this is most likely attributable to the heterogeneous nature of the waste filling.

Ongoing landfill gas monitoring has confirmed CGS3 and thus the need to incorporate gas mitigation systems into the building design for proposed residential dwellings.

Some contaminants in soil at the site including various metals have been detected at elevated concentrations in groundwater, in particular, zinc. TCLP testing on a limited number of samples also indicates some degree of leachability for some metals including zinc. Concentrations of zinc in surface water bodies adjacent to the site were, however, lower than concentrations in the groundwater.

Under certain circumstances, the OCP Aldrin will oxidise to form Dieldrin. Detectable concentrations of Dieldrin were recorded in all (serviceable) groundwater monitoring wells at the site and in the dredge pond and Georges River surface water bodies. Aldrin and/or Dieldrin have been detected in soil at the site at concentrations below the HIL. It is possible that the source of the Dieldrin in groundwater and surface water is the fill at the site.

In addition, the DSI (DP 2016) found exceedances of ammonia above the ANZECC (2000) guideline levels for the protection of 95% of species. Various heavy metals and pesticides were also present in groundwater at levels exceeding the guidelines. It is considered more than likely that these contaminants are derived from the materials buried in the landfill, or possibly from other upstream diffuse sources. The likely receptor for groundwater migrating from the site is the Georges River and its related ecosystem (as it is unlikely that a groundwater dependent ecosystem exists between (or beneath) the site and the Georges River), and as such this receptor i.e. the reach along and down gradient of the site boundary would represent the most adjacent compliance point.

DP (2009) indicated that monitoring wells installed along the Georges River riparian strip to the south east of the site (wells BS-1-BS-4) indicated that results in 2007 were found to be consistent with the (adopted) trigger values for the period before landfilling practices took place on the site.

Background water quality data from the Georges River indicate that environmental values in the Georges River have already been degraded (upstream of the landfill) and accordingly it would be reasonable to adopt a modified set of values at the receptor. Accordingly it was proposed that the existing testing data, augmented by an ongoing programme of monitoring for the duration of the construction programme, is subject to Mann-Kendall trend analysis to determine whether the reported levels are stable or declining (or otherwise) and depending on the results that a separate groundwater ecological risk assessment be provided as part of the site validation documentation (refer to Section 16.1.8). This will require additional monitoring wells to be installed within the site (i.e. replacement wells for those wells recently destroyed) and along the site perimeter in order to provide a fate and transport model with respect to the principal contaminants. Depending on the results measures to mitigate groundwater impacts beyond the site boundary may be necessary, but in all likelihood will be predicated on partial removal and reduction of the main contaminant sources in the landfill and if necessary the construction of a groundwater (reactive) barrier which selectively removes or reduces the contaminant loading whilst allowing unimpeded groundwater flow. Validation of the success of this arrangement would most likely involve a programme of ongoing monitoring administered via an EMP with the objective of ensuring compliance with the agreed groundwater target values. Construction of any necessary barrier, and any related ongoing groundwater or surface water monitoring, if considered necessary, can take place as a separate exercise without interfering with the main remediation and validation programme. It is noted that subsequent surface water monitoring has resulted in a modification to the monitoring requirements set out in the DSI. These are set out in Section 16.1.8, Section 16.9 and Section 23.

The PAH that was detected in filling does not appear to be leaching and migrating vertically to groundwater. This is probably due to the low solubility of the majority of PAH compounds. TCLP testing on a limited number of samples also indicates the PAH is unlikely to leach. PAH was not detected in any groundwater or surface water samples with the exception of JKBH/MW16 as reported in EIS (2013).

Based on the findings of DP (2016) which is considered to have sufficiently characterised the site under the requirements of NEPM (2013) and generally in accordance with guidelines made or approved by EPA under the CLMA and in general compliance with SEPP-55 (1995), it was considered that the site can be made suitable for the proposed residential development subject to the development of a suitable RAP and the implementation of appropriate site remediation as per the recommendations outlined in DP (2016) and reproduced below.

The site Environment Protection Licence – 10490 version dated: 10-Sep-2015 under Section O5.6 required that: *the last licensee must prepare and submit to the EPA within three months of cessation all activities at the premises permitted by this licence, a closure plan in accordance with section 76 of the Protection of the Environment Operations Act 1997*. This process will need to be integrated with the DA process and site remediation activities.

Advice on the geotechnical considerations for the project was being provided to Benedict by J&K. The geotechnical methodology for remediating the site from a geotechnical standpoint (i.e. ground improvement) was summarised by J&K. The summary was provided in Appendix J of DP (2016). This summary has since been superseded by J&K (2016b and 2017). Reference to the J&K (2016a; 2016b and 2017) should not be interpreted to imply that DP endorses the proposed methodology for geotechnical site improvement.

Recommendations

A RAP should be prepared with reference to NSW OEH (2011) that outlines the requirements for site remediation necessary in order to render the site suitable for the proposed residential development.

There are several 'hotspots' of soil contamination that will require remediation. The RAP should determine which 'hotspots' (if any) will need to be remediated and this will be determined based on the proposed final site levels and the thickness of imported VENM that will be used to cap the site.

Based on the ongoing landfill gas monitoring at the site, gas mitigation systems will need to be incorporated into the building design for proposed dwellings.

Additional landfill gas monitoring wells should be installed, in particular, in the footprint on any remediation excavations following the screening and backfilling process. They should also be installed at previously inaccessible areas of the site when stockpiles have been moved. The additional monitoring data should be used to finalise the levels of gas mitigation that will be required.

The recent monitoring conducted as part of this DSI suggests that a CGS of 3 is likely to be appropriate for this site as opposed to the previously recommended CGS of 4. The historical worst case CGS of 4 appears to be an outlier in the overall monitoring dataset. With reference to NSW EPA (2012), a CGS of 3 is typical of "old inert waste landfill" which is consistent with the filling at this site. Ongoing monitoring will be required to confirm the CGS.

The following table provides a summary of the GSV and CGS for the four monitoring events reported in DP (2016).

Table 3: Summary of Maximum Results for the Four Landfill Gas Monitoring Events

Date	Flow Rate Peak	Methane Peak %	GSV	CO_2 Peak %	GSV	CGS [1]
19/08/15	0.9	24.6	0.22	15.9	0.14	2
1/10/15	0.7	24.2	0.17	14.5	0.10	2
27/10/15	0.6	32.5	0.20	13.8	0.08	2
10/02/16	6.8	25.3	1.72	23.8	1.62	3

Notes to table:

1. Where methane >1% or CO_2 >5% CGS was increased to Situation 2 as per Table 6 of NSW EPA (2012)

The landfill gas results indicate that over the four monitoring events, a worst case CGS of 3 was recorded using the modified Wilson and Card classification which is in the moderate risk category.

The RAP will thus need to outline the relevant measure or system element to achieve a score consistent with what is required based on the CGS of 3.

The site remediation will need to be integrated with the geotechnical site improvements (i.e. as per J&K geotechnical reports).

All or some of the following additional soil investigations were recommended when stockpiles have been removed from the site and a decision is finalised on the thickness of imported VENM that will be used to cap the site to achieve final design levels:

- Targeted near surface sampling at the diesel above ground storage tank (AST) and the drum storage area following their decommissioning;
- Delineation testing in the area of the PCB, PAH and lead 'hotspots' (if required); and
- Grid based sampling across the site with a focus on previously inaccessible areas (i.e. beneath existing stockpiles) in order to meet the NSW EPA (1995) *Sampling Design Guidelines* recommended sampling density.

DP (2016) also recommended ongoing landfill gas monitoring be undertaken including the installation of additional monitoring wells as discussed above.

8.11 Summary Results of Previous Investigations

The summary results tables from the DP (2016) and EIS (2013) including analytical results and relevant assessment criteria are appended as follows:

- Appendix D: Summary of Soil Results (DP, 2016);
- Appendix E: Summary of Landfill Gas Results and Summary of Non-Methane Organic Compound Results (DP, 2016);
- Appendix F: Summary of Groundwater and Surface Water Results (DP, 2016); and
- Appendix G: Summary of EIS Soil and Groundwater Results (EIS, 2013).

8.12 Uncertainties and Data Gaps in Assessments

Despite the volume of testing undertaken on the site various uncertainties and data gaps still exist. Clarification of these uncertainties and/or plugging of the data gaps from the current assessments will be addressed by additional investigations / site work undertaken as part of the proposed remediation works. These issues and sections in the RAP where the proposed strategies are set out include:

- Groundwater contamination assessments that address issues that include, but may not be limited to, natural background groundwater quality, environmental values to be protected, groundwater quality migrating off-site, site-specific risk assessment, fate-and-transport, management response to contamination, clean-up to the extent practical – The proposed strategy is documented in Section 16.1.1;
- Practicality assessments into measures to reduce landfill gas and leachate generation. The proposed strategy is documented in Section 10.1; and
- The geotechnical performance of the as-constructed cap and building foundations to be supported by the cap – The proposed strategy is documented in Section 19.1.4.

9. Conceptual Site Model

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 preliminary CSM was developed by EIS in EIS (2013) and several investigations have been undertaken since that time. The refined CSM based on those investigations is reproduced herein.

The potential sources of contamination and contaminants of concern within the site have been identified and summarised in the Table 4, below.

Table 4: Potential Contamination Sources and Contaminants of Concern

Potential Source	Description of Potential Contaminating Activity	Contaminants of Concern
1. Large scale filling	Filling activity has occurred at the site since the use of the site for agricultural/commercial purposes (from at least 1950s). During the early years, due to lack of regulation, uncontrolled filling could have occurred. Filling of low lying swamps/vegetation could result in the generation of ground gasses. The site drainage has been significantly altered and artificial drainage including dams, channels/drains etc. have been created. Large scale filling at the site appeared to have occurred between 1982 and 1991 associated with the commercial use for waste processing / dredging and recycling activities. A review of the NSW EPA records indicate that various waste streams including wood, tyres, general solid waste (non-putrescible) etc. were permitted to be imported onto the site. The boreholes drilled for previous investigations encountered deep fill in the central and south sections of the site where the majority of the filling has occurred. The batters along the subject site boundary provide an indication of the level of filling. The contaminants in filling may provide a diffuse source of groundwater (and possibly surface water) contamination.	Metals, TRH, BTEX, VOC, PAH, OCP, OPP, PCB, asbestos, nutrients (nitrate, nitrite and phosphorous) and HGG including methane, carbon dioxide, carbon monoxide and hydrogen sulphide, trace NMOC in soils and groundwater, and ammonia (in water only) which may affect environmental quality and or recreational users of the Georges River.
2. Past agricultural activities	Prior to commercial operations the site was used for dairy and cattle grazing. Potential contamination during this period could have occurred with the use of pesticides and herbicides.	Metals, OCP and OPP
3. Current site use for Resource Recovery and Processing	The site is licenced to receive various waste streams, including general solid waste (non-putrescible), wood, tyres, asphaltic gravel etc. The site is also licenced to carry out extractive activities, with various metals used in the extraction process. Petroleum hydrocarbons including oil, diesel etc. are used and kept on site along with car batteries. Asbestos (typically bonded ACM) has previously been found in stockpiles, in fill and at the ground surface within the site. Generation of asbestos fibres caused by the crushing and/or processing of waste containing bonded asbestos fragments.	Metals, TRH/BTEX, PAH, OCP, OPP, PCB, oil and grease, sulphuric acid (associated with batteries) and asbestos

Potential Source	Description of Potential Contaminating Activity	Contaminants of Concern
4. Hazardous building materials	Former buildings within the site may have contained hazardous building materials (e.g. bonded ACM). A single storey cottage located within the site may contain hazardous building materials. Buried services containing asbestos which may affect maintenance workers / utility workers.	Asbestos, SMF, lead and PCB

Notes to Table 4:
TRH – Total recoverable hydrocarbons including light, mid and heavy fractions
BTEX – Monocyclic aromatic hydrocarbons – benzene, toluene, ethylbenzene and xylenes
VOC – Volatile organic compounds includes BTEX compounds
PAHs – Polycyclic aromatic hydrocarbons
OCPs – Organochlorine pesticides
OPPs – Organophosphorus pesticides
PCBs – Polychlorinated Biphenyls
SMF – Synthetic mineral fibres

The potential contamination sources (S) on the site are therefore:

- S1 – Large scale filling;
- S2 – Past agricultural activities which may have used pesticides or herbicides;
- S3 – Current site activities which may contribute to contaminants entering the soil; and
- S4 – Buildings that could have been constructed using asbestos, or other hazardous building materials.

The following potential human receptors (R) have been identified:

- R1 – Current site users;
- R2 – Construction workers (during site redevelopment);
- R3 – Future site users (including occupants) following construction of the proposed residential development;
- R4 – Residents and users of surrounding lands; and
- R5 – Maintenance workers undertaking excavation work within or below the 3 m thick ‘engineered fill’ blanket.

The following potential ecological receptors (ER)[2] have been identified:

- ER1 – Local ecology (upper 2.0 m of the proposed final landform);
- ER2 – Open drainage channel located on along the western boundary of the site;
- ER3 – Dredge ponds and associated aquatic ecosystem located to the south of the site; and

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[2] Note that available data indicate that groundwater dependant ecosystems are not a potential ecological receptor, as shown by the data provided in Sections 2.3 and 8.10.

- ER4 – Georges River located approximately 120 m to the east of the site. The Georges River is located adjacent to the southern end of the site. When the dredge ponds are removed and reinstated to become a marina the area will be opened to the river as part of a future development that is proposed to be constructed under a separate DA.

Potentially complete exposure pathways (P) for contamination to impact on the identified receptors include the following:

Primarily relevant to human receptors:

- P1 – Ingestion and dermal contact;
- P2 – Inhalation of dust and/or vapours including HGG;
- P3 – Explosion and/or asphyxiation due to the accumulation of HGG in structures (existing or proposed); and
- P4 – Abstraction and use (e.g. for drinking or irrigation) of contaminated groundwater;
- P5 – Recreational (human health) impacts on Georges River users.

Primarily relevant to ecological receptors:

- P6 – Direct contact with local ecology (upper 2.0 m of the proposed final landform);
- P7 – Surface water run-off;
- P8 – Leaching of contaminants from soil / fill and vertical migration to groundwater; and
- P9 – Lateral migration of contaminants in groundwater which provides base flow to water bodies (e.g. lateral transport of ammonia, chlorpyrifos and/or zinc via groundwater which discharges to the Georges River or open drainage channel), i.e. impacts on Georges River ecosystem. [Note: groundwater dependent ecosystems are unlikely and if present are likely to have already been substantially modified by the existence of the landfill for over 20 years.]

A ‘source–pathway–receptor’ approach has been used to assess the potential risks of harm being caused to current and future human, water or environmental receptors from contamination sources on or in the vicinity of the site, via exposure pathways. The possible pathways between the above sources (S1, S2, S3 and S4) and receptors (R1-R4, ER1-ER4) are provided in the table below.

Table 5: Conceptual Site Model

Source	Exposure Pathway	Receptor	Comment
S1: Large scale filling S2: Past agricultural activities S3: Current site uses S4: Hazardous building material	P1 – Ingestion and dermal contact.	R1/R2/R3/R5: Current site users, construction workers, future site users and maintenance workers.	- Complete exposure pathway considered to exist. - Can be managed by adoption of appropriate work health and safety procedures during remediation. The remediation strategy can render the exposure pathway incomplete for future site users (including occupants).
	P2 – Inhalation of dust and/or vapours including HGG.	R1/R2/R3/R4/R5: Current site users, construction workers, future site users, users of adjacent lands and maintenance workers.	- Complete exposure pathway considered to exist for inhalation of dust. - Incomplete exposure pathway considered to exist for vapours given the general absence of structures at the site. - Can be managed by adoption of appropriate work health and safety procedures during remediation. The remediation strategy to be adopted will render the exposure pathway incomplete for future site users (including occupants) when structures in which gas can accumulate will be present at the site and also to adjacent land users.
	P3 – Explosion and/or asphyxiation due to the accumulation of HGG in structures (existing or proposed).	R1/R2/R3: Current site users, construction workers, and future site users (post redevelopment).	- Incomplete exposure pathway considered to exist for HGG given the general absence of structures at the site. - Can be managed by adoption of appropriate work health and safety procedures during remediation. The remediation strategy can render the exposure pathway incomplete for future site users (including occupants).
	P4 – Abstraction and use (e.g. for drinking or irrigation) of contaminated groundwater.	R1/R3/R4: Current site users, future site users, and adjacent site users.	- Incomplete exposure pathway considered to exist given the general absence of groundwater abstraction at the site. - No known groundwater abstraction in the immediate vicinity of the site. - The remediation strategy to be adopted will render the exposure pathway incomplete for future site users (including occupants) by imposing restrictions on groundwater abstraction (i.e. future groundwater abstraction from the site would be restricted by the need for land owners to comply with a long term (passive) EMP).

Source	Exposure Pathway	Receptor	Comment
	P5 – Recreational (human health) impacts on Georges River users	R4: Adjacent site users.	- Potentially complete exposure pathway considered to exist, however, further investigations would be required to confirm whether lateral migration is occurring and to evaluate any adverse impacts to the receptors.
	P6 – Direct contact with local ecology (upper 2.0 m of the proposed final landform).	ER1 – Local ecology.	- Complete exposure pathway considered to exist. - The remediation strategy can render the exposure pathway incomplete for the upper ~2.0 m of the proposed final landform.
	P7 – Surface water run-off.	ER1/ER2/ER3/ER4 – Local ecology, open drainage channel (west), dredge ponds (south), Georges River (east).	- Complete exposure pathway considered to exist, however, further investigations would be required to evaluate any adverse impacts to the receptors.
	P8 – Leaching of contaminants from soil / fill and vertical migration to groundwater.	ER2/ER3/ER4 – Open drainage channel (west), dredge ponds (south), Georges River (east).	- Complete exposure pathway dependent on P8 discussed below.
	P9 – Lateral migration of contaminants in groundwater which provides base flow to water bodies.	ER1/ER2/ER3/ER4 – Local ecology, open drainage channel (west), dredge ponds (south), Georges River (east).	- Potentially complete exposure pathway considered to exist, however, further investigations would be required to confirm whether lateral migration is occurring and to evaluate any adverse impacts to the receptors.

Notes to table:

S2, S3 and S4 are generally considered comparably insignificant to S1 and generally indistinguishable to the release and transport of contaminants which may have occurred due to S1

10. Remediation Trials

10.1 Overview

The redevelopment of the site from a landfill and waste processing facility to a residential estate has the potential to provide significant environmental and community benefits. These benefits include:

- Improvement of amenity;
- Placement of a cap and therefore improvements to local groundwater and surface water quality; and
- Public access to a proposed marina development located to the south of the site (offsite) and Georges River.

The remediation of the site presented a number of technological challenges, which included:

- Small scale treatment trials to reduce landfill gas hotspots and leachate generating waste;
- Larger scale treatment trial; and
- Compaction trials on landfill waste.

These challenges have been addressed through a program of trials, which are described in the following sections.

10.2 Small Scale Treatment Trials

Trial remediation excavations were initiated by Benedict in the vicinity of landfill gas wells JK102 and JK107 (now destroyed). The intention of the excavations was to stockpile screen and backfill the trial excavations and monitor landfill gas in the vicinity of the backfilled excavations to evaluate whether the process resulted in a significant reduction in the methane production (concentrations). The screening process is understood to have included the removal of methane generating timber from the fill that was retained on the screen prior to backfilling with the remaining material.

Both monitoring wells (JK102 and JK107 (now destroyed) had previously recorded methane concentrations of around 30 %v/v. JK102 was retained following backfilling of the excavation and has since recorded methane concentrations of between 12 %v/v and 13.2 %v/v over three monitoring events suggesting a reduction in methane concentration volume of two thirds of those prior to excavations.

JK107 (destroyed) was replaced by JKBH/MW107a following backfilling of the excavation. A shallow gas well JK107b was installed adjacent to JKBH/MW107a. The wells have recorded methane concentrations of:

- JKBH/MW107a – between 3 %v/v (first monitoring event following backfilling) and 16.4 %v/v (most recent monitoring event following backfilling) over three monitoring events suggesting a gas concentration reduction of half; and
- JK107b – between 10.2 %v/v (first monitoring event following backfilling) and 17.3 %v/v (most recent monitoring event following backfilling) over three monitoring events suggesting a gas concentration reduction of half to one third.

The results at JKBH/MW107a and JK107b had indicated a trending increase in methane concentrations but still significantly less than the original results. The on-going landfill gas monitoring (Section 16.1.8) will provide further data on the trial remediation excavations. Results yet to be formally reported have indicated a stabilising concentration of methane and flow rate at JKBH/MW107a and JK107b consistent with a CGS of 2.

A survey of these excavations was not undertaken and the lateral and vertical extent of the excavation was determined by Benedict. The excavations were inspected by DP and fill excavated contained a component of construction and demolition rubble including timber and other organic material. The separation / screening of excavated material and backfilling of these excavations was undertaken by Benedict and it is understood from Benedict that timber removed from the fill was transported to their Menangle timber recycling facility.

Removal of methane generating timber also has the potential to reduce leachate generation impacts to groundwater.

10.3 Larger Scale Treatment Trials

Another trial remediation excavation has been excavated at the central ‘deep fill’ portion of the site encompassing BH/MW218. The excavation footprint is visible on Drawing 2, Appendix A. The primary purpose of the trial, as with the earlier trial, was to stockpile screen and backfill the excavation and monitor landfill gas in the vicinity of the backfilled excavation to evaluate whether the process resulted in a significant reduction in methane production (concentrations) in the relevant adjacent wells. There are also anticipated benefits to groundwater quality beneath this portion of the site As removal of methane generating timber also has the potential to reduce leachate generation impacts to groundwater. The secondary purpose of the trial was associated with geotechnical site improvement.

The screening process is understood to have included the removal of methane generating timber from the fill that was retained on the screen prior to backfilling with the remaining material. Monitoring following backfilling would also be required to fully assess the result of the trial remediation excavation at this location. The approximate outline of the current trial remediation excavation and its lateral dimensions are shown in Figure 2, below.

It is understood that excavated site materials have been used to backfill (minus screened out timber) along with other stockpiled materials currently on site (refer to Section 10.3.2).

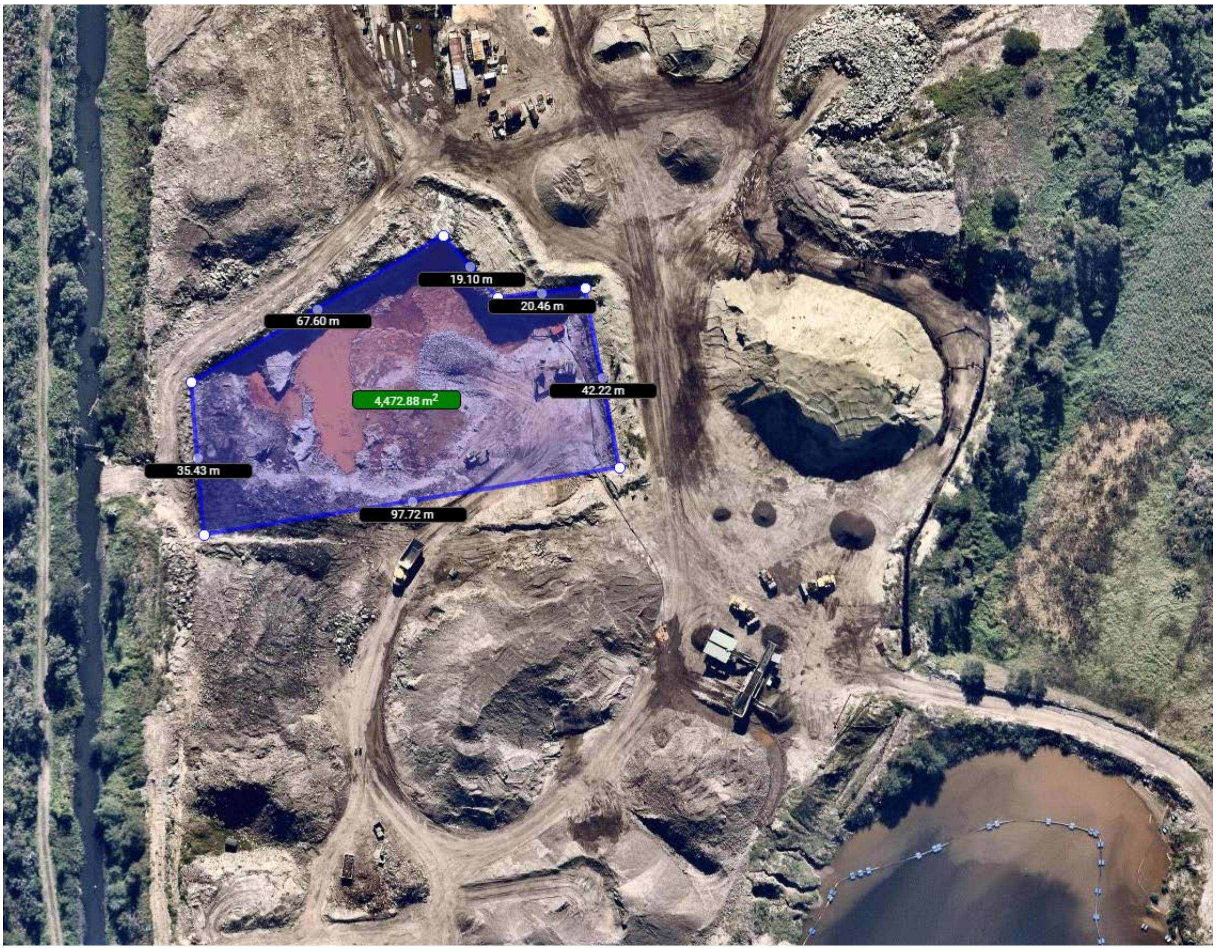


Figure 2: Excavation at the deep fill portion of the site (source: Nearmap, flown 5 May 2016)

The excavation was inspected by DP and the Site Auditor on 5 May 2016. Benedict staff provided an overview of the operation which involved the following:

- The excavation was being dewatered by a pump and dewatered fluid was discharged overland to flow into the dredge ponds located to the south of the proposed development;
- Excavation of those fill materials that presently comprise a significant contribution to landfill gas and leachate, followed by their separation into various product / waste streams;
- Oversize concrete and brick (>120mm) was to be crushed and reused on-site as a coarse fill;
- Soils were being screened and then hand-picked to remove unsuitable materials. The screen fractions were <16 mm, 16 – 40 mm and 40 – 120 mm;
- Timber waste was being removed from the fill and recycled at a licensed Benedict green waste facility;
- Metal waste was being removed from the fill and recycled by a metal waste recycler;
- Other deleterious materials extracted from the excavated material (e.g. rubber, plastics, vegetation, asbestos, bitumen, drums/containers) were being removed from the fill and disposed to landfill; and
- Coarse fill and soils are to be treated and validated to criteria specified in this RAP and validated by the Environmental Consultant. These materials are then to be backfilled and compacted in accordance with directions from the project Geotechnical Engineer (J&K) (refer to Section 11).

10.3.1 Potential Acid Sulphate Soil at the Base of Current Trial Remediation Excavation

Iron staining at the base of the excavation was observed. The staining may be indicative of the oxidation of naturally occurring acid sulphate soils beneath the fill. It is recommended that testing of the soils and water at the base of the excavation is undertaken to evaluate whether:

- Potential acid sulphate (PASS) soils are being oxidised;
- The pH and dissolved metal concentrations in the dewatered fluid is being affected by the generation of sulphuric acid; and
- Liming of the excavation base should occur to neutralise the acid generating capacity of any exposed PASS (if present).

As necessary, reference was made to the procedures outlined in the acid sulphate soil management plan provided in the CEMP (DP, 2015a).

10.3.2 Results of Testing Associated with the Current Trial Remediation Excavation

Stockpiled material from the excavation (stockpile SSP1) was tested and reported (Validation of Screening Process) on 8 June 2016, and subsequently on 5 October and 13 October 2016. The assessment comprised:

- Testing of approximately 4400 m^3 of <16 mm screened material from stockpile 1' (SSP1); and
- Testing at the base of the excavation (acid sulphate soil sample and dewater sample).

In summary the testing determined that:

- The acid sulphate soil results indicated that one of the two samples is potential acid sulphate soil (PASS). The water sample (field filtered) collected from the ponded water at the base of excavation had relatively low concentrations of dissolved metals compared to those detected in groundwater wells in the vicinity of the excavation;
- Organic matter results on soil ranged from 18,000 mg/kg to 23,000 mg/kg suggesting on the micro to macro scale that organic matter in the screened soil is 1.8% to 2.3%;
- The foreign materials content test on soil (bulk >10L sample) ranged from 1% to 2.4% (i.e. <5% which was the nominal target set by the RAP);
- A grid-based walkover over accessible areas of the northern 'raw feed' stockpile was undertaken and four fragments of asbestos containing material (ACM) were observed. The southern 'raw feed' stockpile was inaccessible due to steep stockpile walls; and
- Asbestos (ACM or fibrous asbestos (FA) and asbestos fines (AF)) was detected in five of the eight 500 ml samples and the concentration of FA and AF in one sample exceeded the NEPC (2013) residential land use criterion of 0.001% w/w.

PCB was recorded in all soil samples, however, at concentrations that were below the adopted remediation acceptance criteria (RAC) of 1 mg/kg.

The following summary was provided by Benedict Industries Pty Ltd (Benedict) in relation to the screening process for materials from SSP1:

- *Prior to processing the material is dampened or is damp due to the nature of the material and the location it has been removed from;*
- *Whilst screening the material to remove timber and other contaminants no asbestos pieces are or have been picked/removed during the screening process;*
- *All pickers (labourers) on the conveyer wear PPE gear which includes eye, hearing, hard hats, gloves and P2 respirator masks;*
- *Since commencing screening operations on 3 March 2016 and 14 June 2016, Presna (NATA accredited environmental consultants) have been contracted to carry out airborne asbestos monitoring on site at Moorebank whilst screening operations are active;*
- *237 individual (air) monitoring samples have been tested;*
- *The airborne asbestos monitors are placed on picking platforms adjacent to pickers and inside earthmoving equipment such as excavators and wheel loaders which are working on the screening process;*
- *Of the 237 individual monitor samples, no asbestos fibres have been recorded in the samples;*
- *During the placement of the screened material, which has recently commenced, airborne asbestos monitoring has been conducted and a water cart has been used to dampen the material (if required); and*
- *Benedict will continue to monitor for the duration of the screening and placing of site materials at Moorebank.*

The report dated 5 October 2016 and related results as well as a subsequent report and 13 October 2016 which describe a similar process involving the excavation of a further 7000 m^3 of materials are provided in Appendix H. Additional data collected associated with this trial remediation excavation consists of soil testing data and inspection records. This information will be incorporated into a report prepared by the Environmental Consultant during the preliminary works stage, as discussed in Section 16.1.4.

The potential for reduction in leachate generation from the treatment trials will be assessed through an additional surface water investigations undertaken as part of preliminary work, as described in Section 16.1.8.

10.4 Compaction Trials on Landfilled Waste

Based on information provided to DP (full details provided in DP (2015c)), two Trial Areas A and B were subjected to forty passes of a three sided roller. Landpac's report is included in Appendix D. The results of the high energy impact compaction (HEIC) trial indicated that after 40 passes of HEIC, the near surface profile appears to have been compacted in both trial areas based on the low to medium results of the 'continuous impact response'.

The measured settlements (obtained by GPS methods) indicate an average settlement of 63 mm for Area A and 60 mm for Area B. The range of settlement, however, indicated that the settlement for Area A ranged from less than 20 mm to 200 mm with some minor areas up to 300 mm. Area B has a similar range of settlement. The difference in settlements is often expressed over a short distance and is not necessarily 'uniform' across the site.

HEIC is generally considered to be effective over depths of about 1 - 2 m for clayey material which appears to make up most of the filling material. Therefore, it could be expected that HEIC has created a compacted layer of approximately 1 m to 2 m thick across the trail area. However, the filling beneath 'compacted layer' is expected to have not been noticeably affected by the HEIC.

Landpac concluded that the HEIC provided a relatively uniform subgrade over the trial areas except for one localised area in Area A.

11. Geotechnical Site Improvement

Advice on the geotechnical considerations for the project is currently being provided to Benedict by the project Geotechnical Consultant J&K. The geotechnical methodology for remediating the site from a geotechnical standpoint (i.e. ground improvement) is outlined in J&K (2016a). Auditor comments on geotechnical aspects of the project prompted the issue of a response by J&K dated 22 August 2016 (J&K, 2016b). Additional comments were addressed in an update of the J&K (2016a) report in J&K (2017). J&K (2016b; 2017) are included in Appendix I.

In order to assess the total and differential settlement at the surface of the subdivision site, a geotechnical model was prepared by J&K. This geotechnical model was used in their numerical analysis. The model divides the subsurface profile into a number of soil units. Geotechnical parameters were selected for each unit based on the borehole and CPT information, available literature and case studies (J&K 2017).

Figure 3, below, extracted from J&K (2017) shows a long section of the site model with the existing fill and proposed 3 m thick ‘engineered fill’ blanket that was used in the analysis to predict long term settlement.

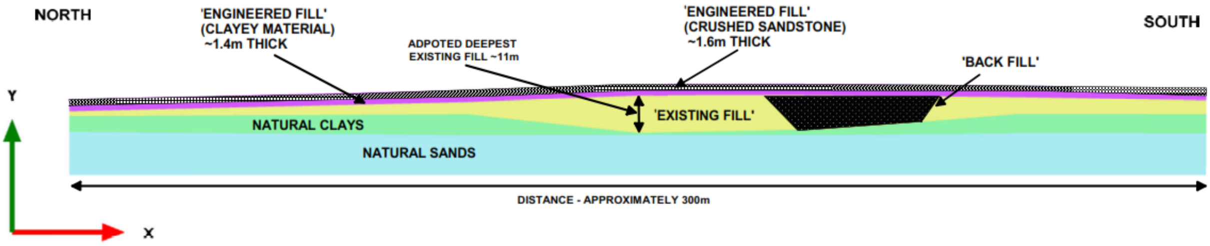


Figure 3: Long Section of Site with Proposed ‘Engineered Fill’ Blanket (J&K, 2016a)

It is understood that in order to further address geotechnical issues identified as part of the site audit process beyond that provided by J&K (2016b), the following has been undertaken in order to refine the design:

- The geotechnical settlement analysis that evaluates the predicted total and differential settlements was be re-run; and
- As part of the analysis, consideration was given to the decay of organic material within the site fill based on existing and recently obtained soil organic content data.

J&K (2017) notes that, “settlement due to decomposition of organics present in subsoils can occur. Although significant organics were removed from the ‘existing fill’ in the methane hotspot areas, we consider that it is those very organics causing the high methane. In the overall ‘existing fill’, we have assumed an organic content of about 5% (i.e. higher than the organics measured by DP (the project environmentalist) in the ‘existing fill’ after selection and blending for use as ‘backfill’. As the organics are expected to be spread throughout the ‘existing fill’ mass and given their age, we do not expect that they will be significant relative to the ongoing creep settlement of the ‘existing fill’ nor are they expected to affect likely differential settlements. Further, we anticipate that the creep settlement recommended for landfills includes an element of decomposition. The presence of organics has therefore been ignored in our analyses.”

J&K (2017) note further that, based on their modelling, “the maximum settlement of about 60mm after 50 years occurs in the area of deeper ‘existing fill’, to the north of the area which was excavated and backfilled for environmental reasons. Over the remainder of the site, the total settlement varies between about 10 mm (over the north) and 40 mm (towards the south) depending on the depth of ‘existing fill’. However, a maximum differential settlement over a distance of 30 m of about 40 mm is indicated. This differential settlement occurs in an area which straddles the ‘existing fill’ – ‘backfill’ interface.”

Based on a review of the J&K (2017) report and input from the client, and relevant to the site remediation aspect of the project, the following is understood:

- There is a net deficit of soil / fill at the site to reach final design levels;
- The entire site area will be excavated to 3 m below the design subgrade level (i.e. the subgrade level being the top level of the 3 m thick 'engineered fill' blanket);
- Based on the current site levels and the current Fill Plan (Appendix B), the placement of the 3 m thick 'engineered fill' blanket equates to 1.4 m of site derived fill and 1.6 m of imported fill;
- The earthworks of the 3 m thick 'engineered fill' blanket will comprise of two distinct layers being:
    - Lower 1.4 m of site derived fill (over 8 ha being a compacted in-situ volume of approximately 126,000 m^3); and
    - Upper 1.6 m imported VENM fill (over 9 ha being a compacted in-situ volume of approximately 144,000 m^3).

Therefore, on the basis of the required earthworks for geotechnical site improvements, the proposed development will necessarily involve the placement of a 1.6 m thick engineered VENM cap (e.g. crushed sandstone) across the site. This VENM cap will therefore be taken into consideration in the selection of the appropriate remediation option(s).

12. Identification of Remediation Goals

The goals of the remediation are to render the site suitable for the proposed development. In doing so, the potentially complete exposure pathways between identified site contamination (i.e. localised soil contamination and landfill gas) between the source and receptors will need to be rendered incomplete.

Additional remediation goals include:

- Demonstrating that the proposed remediation strategy for the site is environmentally justifiable, practical and technically feasible;
- Adopting remediation criteria appropriate for the future use of the site to mitigate possible impacts to human health and the environment;
- Mitigating possible off-site migration of contaminants;
- Consideration of the principles of ecologically sustainable development in line with Section 9 of the Contaminated Land Management Act 1997;
- Minimising waste generation under the Waste Avoidance and Resource Recovery Act 2001; and
- Demonstrating that the plans for site management of remediation work considers issues related to worker health and safety, environmental management, community relations and site contingencies such as unexpected finds.

13. Extent of Remediation Required

Based on the CSM, the extent of remediation required is summarised as follows:

- Removal of localised soil contamination ‘hotspots’ or the placement of a physical barrier (e.g. capping) to prevent the exposure of receptors (human and ecological) to the soil contamination;
- Incorporation of the relevant measure(s) or system element(s) into dwelling construction based on a CGS of 3 and a gas protection score of 4.5, as defined by NSW EPA (2012) and British Standard BS 8485:2015. This will also be relevant to any associated infrastructure in which landfill gas can accumulate, such as services, hardstand areas etc. Open landscaped areas are not considered likely to pose a risk as any landfill gas (methane) which finds its way to the surface through the proposed capping system in these areas will dissipate (dilute and disperse) into the atmosphere to levels which do not pose a significant risk and as such will not pose a hazard or cause any reduction in amenity to site users;
- Excavation and removal of major sources of methane gas generation at the site (where practicable);
- Excavation and removal of sources of major groundwater contamination at the site (where practicable);
- Construction of a 3 m thick cap to cover and preclude exposure to remaining contamination or aesthetic impacts arising from buried waste;
- Removal of hazardous building waste if any from demolition of existing or former structures; and
- Removal of abandoned buried services (if any).

Groundwater and surface water data suggests that some contaminants likely to be from filling have migrated into groundwater. Further investigations are proposed to evaluate the background surface water quality and leachability of fill soils using a neutral leaching test procedure.

With regard to the extent of the proposed landfill gas mitigation measures i.e. other than the 3.0 m thick site capping, these additional measures (see Section 14.3) will be restricted to residential footprints and service corridors because of the higher risk that would occur should gas reach the surface and become confined in constructed voids or cavities within built structures. Under such circumstances soil gas (principally) methane may accumulate to levels which become flammable or explosive, whereas in open space areas the gas would disperse to safe levels.

14. Remediation Options Evaluation and Preferred Remediation Option

14.1 General

In general, options for remediation include the following, given in the NSW EPA’s preferred order (DEC, 2006):

- On-site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level;
- Off-site treatment of excavated soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site;

- Removal of contaminated soil to an approved site or facility, followed where necessary by replacement with clean fill; and
- Consolidation and isolation of the soil by on-site containment within a properly designed barrier.

These options were considered in light of the known conditions on the site and the practicality and cost associated with on-site treatment, off-site treatment and wholesale excavation. In the case of the latter removal of all materials would simply burden another site and comprise a waste of diminishing landfill resources and would in any event be contrary to the principals of waste minimisation and sustainability espoused by the NSW EPA. Moreover, the proposal to retain waste materials on site complies with NSW EPA's waste hierarchy as follows:

- **Waste Avoidance -** including action to reduce the amount of waste generated by households, industry and all levels of government;
- **Resource recovery** - including re-use, recycling, reprocessing and energy recovery, consistent with the most efficient use of the recovered resources; and
- **Waste disposal** - including management of all disposal options in the most environmentally responsible manner.

As shown in Figure 4 below disposal of waste is the least preferred option whereas waste avoidance as proposed at this site, is the most preferable option.

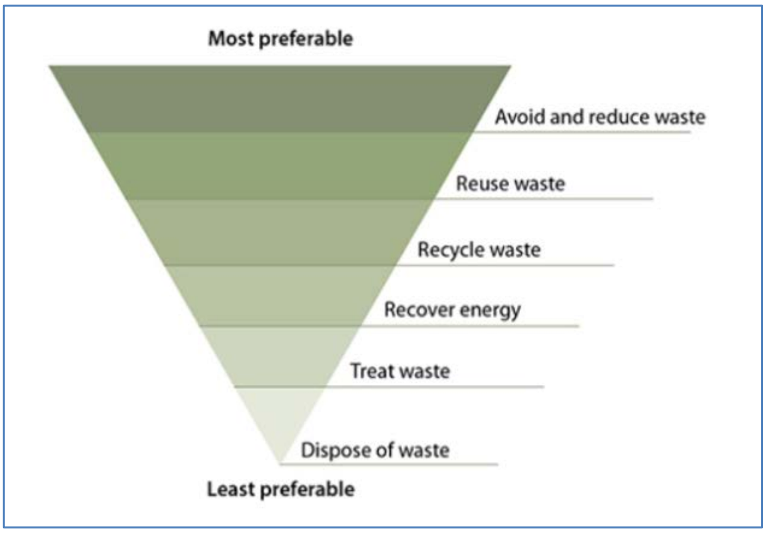


Figure 4: NSW EPA Waste hierarchy http://www.epa.nsw.gov.au/wastestrategy/waste-hierarchy.htm

The RAP has evaluated remediation options for the three types of materials that need to be remediated, these being:

- Contaminated soil (Section 14.2);
- Landfill gas (Section 14.3); and
- Groundwater (Section 14.4).

Development of the site will require the elevation of the ground surface to be raised by 1.6 m once cut to fill exercises are complete and to facilitate final land form shaping and capping (including road levels and drains) to proposed design surfaces. The upper 1.4 m of the site soils will also need to be excavated and re-compacted as part of a geotechnical ground improvement program to form a 3 m thick ‘engineered fill’ blanket. This site development work has the potential to address some of the issues posed by contamination at the site and has been considered when evaluating remediation options.

14.2 Remediation Options for Residual Soil Contamination

The proposed development will necessarily involve the placement of a 3.0 m thick engineered cap of which the upper 1.6 m will be imported VENM across the site.

Options for soil remediation include:

- Option 1: Do nothing;
- Option 2: On site treatment prior to off-site disposal;
- Option 3: Off-site treatment prior to off-site disposal;
- Option 4: Off-site disposal to landfill; and
- Option 5: Containment of the impacted soil on site beneath an engineered barrier.

Consideration of the various options is influenced by the fact that the proposed development involves a 1.6 m thick engineered VENM cap. The options evaluation is outlined in the following table.

Table 6: Remediation Options Evaluation for Residual Soil Contamination

Option	Evaluation	Option Ranking
Option 1: Do nothing	In the context of the proposed development involving a 3.0 m thick engineered cap of which the upper 1.6 m will be imported VENM, this option is not considered appropriate.	Not applicable.
Option 2: On site treatment prior to off-site disposal	There is a significant quantity of fill on the site. The known soil contaminants exceeding NSW EPA soil investigation levels (SIL) include inorganics (lead and copper) and organics (TRH, PCB and B(a)P). With the exception of TRH and PCB, the other contaminants are not readily amenable to treatment (destruction) and therefore this option is not considered appropriate. Notwithstanding, in order to reduce contaminant levels and specifically to neutralise areas of high methane gas generation (hotspots), deep waste (fill) material could be excavated and organic matter (mainly timber) removed by screening and manual removal from the screens). The removed material would be disposed off-site and the remaining materials returned to the excavation. Whilst this method is costly and labour intensive the	Not applicable.

Option	Evaluation	Option Ranking
	intention is to reduce contaminant loading (principally in terms of potential ground gas and groundwater (TDS and ammonia, associated with timber) emissions) and although the method will not remove all organic material from the excavated materials it is nevertheless considered to be a both a practical and reasonably efficient means of substantially mitigating potential environmental emissions and thus reducing longer term risks.	
Option 3: Off-site treatment prior to off-site disposal	The known soil contaminants include inorganics (lead and copper) and organics (TRH, PCB and B(a)P). With the exception of TRH and PCB, the other contaminants are not readily amenable to treatment (destruction) and therefore this option is not considered appropriate.	Not applicable.
Option 4: Off-site disposal to landfill	This option is considered to be both feasible and practical for near surface contamination. It is not considered feasible and practical for deeper (e.g. >2 m) contamination. Excavation could be adopted to facilitate the removal and off-site disposal of materials containing 'hotspot' levels of contamination such as high concentrations of: • Biodegradable material that form gas hotspots and/or generate leachate; • Drummed waste or areas where fuel leaks occurred that pose soil vapour and/or groundwater contamination risks; and • Unexpected finds.	2 Contingency.
Option 5: Containment of the impacted soil on site beneath an engineered barrier	In the context of the proposed development involving a 3.0 m thick engineered cap of which the upper 1.6 m will be imported VENM, this option is considered to be both feasible and practical.	1 Preferred

Given the proposed 3.0 m thick engineered cap of which the upper 1.6 m will be imported VENM, the preferred option for residual soil contamination at the site is containment of the impacted soil on site beneath an engineered barrier (Option 5). In the context of a proposed capping strategy, the additional targeted sampling recommended in the DSI (DP, 2016) at soil contamination 'hotspots', are not considered to be necessary (refer to comment on Option 4, below). Targeted sampling should, however, be undertaken following decommissioning of the diesel AST. Option 4 is considered feasible to address contamination hotspots at the site, which are found to be generating high amounts of landfill gas or had the potential to impact groundwater quality migrating off-site or air quality during earthworks. An investigation program to locate these hotspots is proposed as part of preliminary works at the site, which is discussed in Section 16.1.

14.3 Remediation Options for Landfill Gas

Landfill gas monitoring data to date indicates that there is currently an unacceptable risk of the migration of landfill gas into structures (e.g. dwelling) associated with proposed development. The recent monitoring conducted as part of this DSI suggests that a CGS of 3 is appropriate for this site.

Options for landfill gas remediation include:

- Option 1: Do nothing;
- Option 2: Complete removal of the landfill gas source;
- Option 3: Partial removal of the landfill gas source (partial solution that would need to be coupled with Option 4 or Option 5). Partial removal would involve either:
    - removal of pockets of fill with high organic content;
    - removal of pockets of fill with high organic content and screening a proportion of the organic material out of the fill prior to its re-use to backfill excavation(s);
- Option 4: Engineered landfill gas mitigation measures for the entire site (e.g. drainage blanket across the entire site likely coupled with active landfill gas extraction system);
- Option 5: Engineered landfill gas mitigation measures (passive) for each structure (e.g. venting and/or gas resistant membranes beneath concrete slabs); and
- Option 6: Engineered landfill gas mitigation measures (passive and active) for each structure (e.g. active venting and/or gas resistant membranes beneath concrete slabs).

The options evaluation is outlined in the following table.

Table 7: Remediation Options Evaluation for Landfill Gas

Option	Evaluation	Option Ranking
Option 1: Do nothing	A potentially complete pathway (explosion and/or asphyxiation risk) exists between the source of the landfill gas and the future site users (dwelling occupants). This option is not considered appropriate.	Not applicable.
Option 2: Complete removal of the landfill gas source	There is a significant quantity of fill (i.e. the primary source of the gas) on the site. Complete removal of the fill is not considered to be feasible or practical. This option is not considered appropriate.	Not applicable.
Option 3: Partial removal of the landfill gas source	There is a significant quantity of fill (i.e. the primary source of the gas) on the site. Partial removal of 'unacceptable' gas generating fill may lower the CGS for the site.	1 Preferred (already being undertaken).
Option 4: Engineered landfill gas mitigation measures for the entire site	An active system may not be suitable for residential land because effective long term may operation not be feasible. This option could involve the installation of an array of landfill gas extraction wells fitted with air pumps spread across the site. This could also be incorporated into the 3 m thick 'engineered fill' blanket. This option is likely to involve a significant amount of engineering design and the ongoing maintenance of any active extraction that may be required. This contingency is discussed in Section 16.6.	2 Contingency.
Option 5: Engineered landfill gas mitigation measures (passive) for each proposed structure	This option is considered to be both feasible and practical subject to the incorporation of passive measures only.	1 Preferred.
Option 6: Engineered landfill gas mitigation measures (passive and active) for each proposed structure	This option is not considered to be feasible or practical due to the incorporation of active measures that would require ongoing maintenance.	2 Contingency.

It is noted here that Option 5 in the above table applies only for engineered landfill gas mitigation measures for each proposed structure. For this type of 'brown field' site Option 5 remains the only practical and cost effective remedial measure for the proposed residential use of the land and whilst development of landfill gas affected land is this way is fairly new in Australia similar types of development are now quite common in Europe and particularly in UK. In the latter the various authorities have developed considerable amounts of guidance over a number of years (for example Protective measures for housing on gas contaminated land, BSI 8485 (2015) *Code of Practice for Design of Protective Measures for Ground Gases* and accordingly it is considered that there should be no unsurmountable impediments to facilitating a similar type of development at the current site. Such sites when properly engineered have been successfully developed and accepted by both the Local Authorities and future property owners and as such there is no reason why a similar approach should not be adopted at this site. Option 5 above is given a higher ranking than Option 4 on the basis that engineered landfill gas mitigation measures other than the application of a 3.0 m cap are not considered necessary other than in built structures as any gas reaching the surface in these areas will be diluted and dispersed by normal air movements.

The preferred option for landfill gas concentration / volume reduction is the partial removal of the landfill gas source ‘hot spots’ (already being undertaken) and passive engineered landfill gas mitigation measures for each proposed structure (e.g. venting and/or gas resistant membranes beneath concrete slabs) (Options 3 and 5). Passive measures are considered appropriate for this development as opposed to active measures which would require home owners to maintain an active system (which is not considered practical or feasible).

The partial removal of unacceptable landfill gas sources and associated waste from the fill will have the added benefits of:

- The removal of a portion of metal waste by screening some metal out of the fill prior to its use as backfill. The metal waste in fill is currently leaching dissolved metals into groundwater and is likely to be having a net adverse impact on groundwater quality beneath the site;
- The removal of a portion of timber and other general waste by screening some timber and other general waste out of the fill prior to its use as backfill. The timber and other general waste in fill is currently leaching contaminants such as dissolved metals, degradable by-products (ammonia, nutrients), OCPs (assuming discarded containers of OCP are present) and TDS into groundwater and is likely to be having a net adverse impact on groundwater quality beneath the site; and
- Removal and disposal of bonded ACM from excavated waste.

Additional benefits of removing unacceptable landfill gas sources include:

- Reduce the degree of reliance on landfill gas mitigation measures since landfill gas levels remaining at depth at the site would be reduced to the extent practicable;
- Reduce greenhouse gas emissions to the extent practicable; and
- Reduce the leachate generation of the landfill waste to the extent practicable.

14.4 Remediation Options for Contaminated Groundwater

The condition of groundwater beneath the site is not considered likely to require further remediation but will be subject to further surface water monitoring (groundwater discharge point) during site remediation and construction. In the unlikely event that surface water monitoring shows a decline in conditions groundwater remediation options could involve the following:

- A ‘do nothing’ strategy;
- Selective source removal;
- A long term MNA programme to demonstrate a continued decrease in key contaminants emanating for the site (as represented by water quality in the dredge pond i.e. proposed marina with a contingency for groundwater investigation if considered necessary);

- Installation of an impermeable barrier wall to prevent the flow of contaminant-impacted groundwater to the point(s) of compliance (i.e. adjacent surface water bodies); or
- Installation of a permeable reactive barrier wall to treat contaminant-impacted groundwater prior to its discharge to the point(s) of compliance (i.e. adjacent surface water bodies).

Source removal is the NSW EPA's preferred strategy with construction of a cut of wall not preferred.

14.5 Summary of Preferred Remediation Options

In summary, the preferred remediation options are:

- Soil – containment of the impacted soil on site beneath an engineered barrier (Option 5) coupled with the selective excavation and removal of hotspots from buried fill;
- Landfill gas –removal of all unacceptable landfill gas sources (already being undertaken) and installation of engineered landfill gas mitigation measures for each proposed structure (e.g. venting and gas resistant membranes beneath concrete slabs) (Options 3 and 5). This option has the added benefit of the selective removal of some waste from deep fill areas impacting groundwater quality;
- Groundwater and surface water – monitoring of dredge pond and Georges River water quality during remediation and construction (for a period of 12 months from the date of this RAP) to demonstrate that groundwater impacts are not occurring at the nearest sensitive receptor and that trends in improved water quality, since dredging ceased, continue and are thus not likely to impact the Georges River when the marina is opened;
- General:
  - Removal of hazardous building materials from former building areas; and
  - Removal of buried services that may contain asbestos/wastes.

The RAP has assumed that the preferred remediation strategy is to be applied across the whole site. Should the Environmental Consultant consider that the preferred remediation strategy is not required at an area, then a report justifying variations to the RAP for the area shall be prepared by the Environmental Consultant in accordance with NSW EPA guidelines. The report is to be reviewed and approved by the Site Auditor prior to the commencement of Stage 1 work.

The establishment of whether any groundwater and/or surface water remediation is required (considered unlikely) will be evaluated as part of the proposed validation surface water monitoring programme (refer to Section 16.1.8 and DP (2017b)).

15. Remediation Acceptance Criteria

15.1 Upper 3 m of Soil

As described in Section 11, a 3 m thick 'engineered fill' blanket is required to be placed across the site for geotechnical purposes. Based on the current site levels and the current Fill Plan (Appendix B), the placement of the 3 m thick 'engineered fill' blanket will comprise 1.4 m of site derived fill, overlain by 1.6 m of imported VENM fill. The RAC for the upper 3 m of soil has been derived with this in mind and the RAP therefore requires that the 3 m thick 'engineered fill' blanket comprises a 'clean soil' cap.

The upper surface of the 3 m thick 'engineered fill' blanket is defined as the underside level of the house ground slab. A basic schematic of the configuration of the upper 3 m of soil (cap) is shown in Figure 5, below.

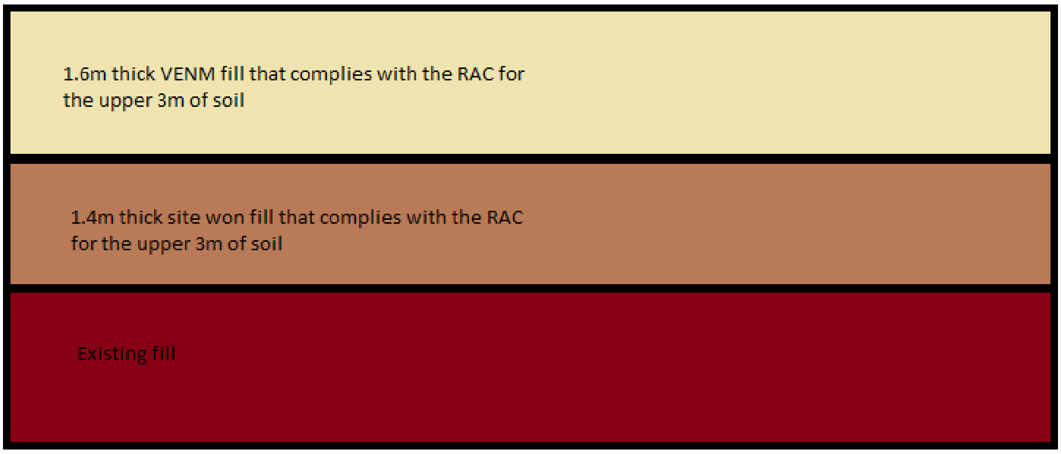


Figure 5: Configuration of the Upper 3 m of Soil with Underlying 'Existing Fill'

The following drawing included in Appendix B, shows the typical details of cap depth, location of house slab and the proposed benching of the site at the individual lot scale that will impact upon the cap post-placement and which locally will reduce the cap thickness because of cut to fill operations to form the slab area in each house lot and to form the gravel blankets (part of the LFG mitigation system):

- Drawing 14005E15 Typical House Benching Section Showing Cut and Fill within the Capping Layer, dated 13 March 2017.

In the absence of a Tier 2 site-specific human health risk assessment from which to derive site-specific clean-up criteria, relevant generic Tier 1 health-based investigation levels (HILs), health-based screening levels (HSL) ecological investigation levels (EIL), ecological screening level (ESL) and 'management limits' have been adopted as the remediation acceptance criteria (RAC) for the upper 3 m of soil. The criteria are the same as those adopted for the DP (2016) DSI for residential land use.

The following general assumptions have been applied in the derivation of the RAC for the upper 3 m of soil:

- The HILs are generic to all soil types and apply generally to a depth of 3 m below the surface for residential use. This is consistent with the thickness of the proposed 3 m thick 'engineered fill' blanket;
- On this basis, the HILs are considered appropriate to adopt as the RAC for the upper 3 m of soil;
- The HSLs are depth and soil type dependant. Fill at the site is highly variable. The HSLs for 0 to <1 m for sand soil are considered appropriate to adopt as the RAC for the upper 3 m of soil;
- EILs and ESLs generally apply to the upper 2 m of soil. The upper 1.6 m of soil will be imported VENM with the remaining 1.4 m being site derived filling. On this basis, the EILs and ESLs derived to evaluate soil for the DSI (DP, 2016) for the upper 3 m of soil will be adopted as the RAC. NEPC (2013) guidelines do not provide EILs for cadmium, mercury (inorganic) and manganese and site-specific values were not derived by past site investigations. In light of this data gap, EILs for these three metals are based on the Column 3 (absolute maximum value) criteria in the ENM Order 2014; and
- The RAC for each contaminant of concern corresponds to the lowest concentration in each case.

DEC (2006) (and updates) indicate that, '…*soil investigation and screening levels* (i.e. NEPM, 2013) *are not appropriate for assessing fill material that has recently been received or is intended to be received on site*…'. VENM is defined in the Waste Classification Guidelines (NSW EPA, 2014) but no specific testing regime or comparative criteria are specified. Accordingly in order to assess imported fill all VENM to be received at the site will also require to comply with the criteria set out in the FMP (Appendix J).

Table 8a: Remediation Acceptance Criteria (HIL and HSL) for the Upper 3 m of Soil (mg/kg)

Contaminants		Direct Contact	Vapour Intrusion
		Resident / Site user HIL/HSL-A	Resident / Site user (sand) HSL-A
Metals	Arsenic	100	-
	Cadmium	20	-
	Chromium (VI)	100	-
	Copper	6000	-
	Lead	300	-
	Mercury (inorganic)	40	-
	Nickel	400	-
	Zinc	7400	-
	Manganese	3800	-
PAH	Benzo(a)pyrene TEQ [1]	3	-
	Total PAH	300	-
	Naphthalene	1400	3
TRH	C_6 – C_{10} (less BTEX) [F1]	4400	40 (silt)
	>C_{10}-C_{16} (less Naphthalene) [F2]	3300	110
	>C_{16}-C_{34}	4500	-
	>C_{34}-C_{40}	6300	-
BTEX	Benzene	100	0.5
	Toluene	14,000	160
	Ethyl Benzene	4500	55
	Xylene	12,000	40
OCP/ OPP	Aldrin + Dieldrin	6	-
	Chlordane	50	-
	DDT+DDE+DDD	240	-
	Endosulfan	270	-
	Endrin	10	-
	Heptachlor	6	-
	HCB	10	-
	Methoxychlor	300	-
	Chlorpyrifos	160	-
PCB		1	-
Phenols		3000	-

Notes to Table 8a:

1 - sum of carcinogenic PAH

Table 8b: Remediation Acceptance Criteria (EIL) for the Upper 3 m of Soil (mg/kg)

Analyte		EIL	ENM Order 2014
Metals	Arsenic	100	-
	Cadmium	NC	1
	Chromium (III)	450	-
	Copper	230	-
	Lead	1100	-
	Mercury (inorganic)	NC	1
	Nickel	300	-
	Zinc	850	-
	Manganese	NC	-
OCP	DDT	180	-
PAH	Naphthalene	170	-

Notes to Table 8b:
NC - No Criteria

Table 8c: Remediation Acceptance Criteria (ESL) for the Upper 3 m of Soil (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	

Table 8d: Remediation Acceptance Criteria (Management Limits) for the Upper 3 m of Soil (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 8d:

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

Any asbestos-impacted soil to be re-used on site must be validated in accordance with the methods described in DoH (2009) to demonstrate that asbestos is below the relevant criteria as follows:

- Asbestos containing material (ACM) 0.01% w/w;
- Fibrous asbestos and asbestos fines (FA and AF) 0.001% w/w; and
- No visible asbestos for surface soils.

Aesthetic considerations relevant to the upper 3 m of soil at this site with reference to NEPC (2013) include:

- Highly malodorous soils;
- Discoloured chemical deposits or soil staining; and
- The presence of a deep-fill profile of green waste or large quantities of timber waste that could generate hazardous levels of methane.

In order to address aesthetic considerations outlined above, the following RAC for the upper 3 m of soil will be applied:

- No malodorous soils;
- No significant discoloured chemical deposits or soil staining;
- A significant reduction in organic matter (approximately ≥70%); and
- Anthropogenic materials ≤ 5%.

The RAC for anthropogenic materials of ≤ 5% and for a ‘significant reduction in organic matter’ for the lower 1.4 m of the 3 m thick engineered cap are provisional. The refinement of these RAC should be based on initial testing results of screened site-won material.

Tolerances for the thickness of the 1.6 m thick VENM layer, the overall thickness of the 3.0 m thick ‘engineered fill’ blanket, and the top level of the 3.0 m thick blanket are as follows:

- Thickness of the VENM layer (nominally 1.6m) is not less than 1.50 m except in localised areas of construction (see below);
- The overall thickness of the ‘engineered fill’ blanket (nominally 3.0 m) is generally not less than 2.50 m in housing lots, or 2.30 m locally where construction of the houses takes place (noting that during slab construction up to 0.5 m (0.7 m where a gravel blanket is to be placed) of the

engineering fill may need to be stripped locally to form the final building platforms (see Sections 6.4, 7.2 and 7.4 of J&K (2017) and JMD drawing in Appendix B);

- The overall thickness of the ‘engineered fill’ blanket is not less than 1.0 m where the main sewer is to be installed (see Sydney Water Drawing at Appendix B); and
- The elevation of the top level of the ‘engineered fill’ blanket is within ± 100 mm of the design level except as noted above.

These tolerances may be subject to relative change depending on the progress of earthworks which may involve an increase to the thickness of the VENM layer and a proportional decrease to the thickness of site-won material incorporated into the cap.

15.2 Remediation Acceptance Criteria – Soil Quality below 3 m

For soils below the proposed 3 m thick ‘engineered fill’ blanket, no soil chemical criteria or asbestos criteria would apply for exposure pathways involving ingestion, dermal contact and dust inhalation because future land use at the site would be subject to compliance with a long-term EMP, which will prevent disturbance to soils below the 3 m blanket layer and the extraction of groundwater.

For other exposure pathways, soils below the proposed 3 m thick ‘engineered fill’ blanket must meet the following soil chemical criteria:

- VOC concentrations in soil are below the NEPM (2013) soil vapour criteria;
- Soils do not produce leachate that pose a hazard to the environment (as required by NSW EPA (2007) groundwater guidelines and Sections 10.2 and 10.3 of the NSW EPA (2016) Solid Waste Landfill Guidelines); and
- The investigation and validation data satisfy Data Quality Objectives (DQOs) meeting NSW EPA endorsed guidelines.

If any of these criteria are exceeded, then remedial measures must be implemented to eliminate hazards to health and the environment.

In relation to the VOC issue, the dataset for soil at the site indicates that volatile fraction TRH is not a ubiquitous characteristic of the fill. Moreover, landfill gas mitigation systems are proposed that would also, to some degree, minimise risks from any deep VOC contamination that may be present, accordingly it is unlikely that this issue will require soil removal off site. On this basis, and subject to validation of the soil beneath the diesel AST, this issue is not considered further.

For screened soils i.e. those being returned as fill following bulk excavations and screening during works at the two trial excavation areas a maximum organic content of 10% soil organic matter (SOM) should apply for the purposes of reducing the potential for the materials to generate methane. Without excavation the SOM in other areas cannot be quantified or amended.

15.3 Landfill Gas

The RAC for landfill gas mitigation is to limit the migration of landfill gas into the structures (e.g. residential dwellings) such that no unacceptable risk is posed to future site users. It is pointed out that further remediation work at the site will require ongoing monitoring and in this regard, ongoing development and refinement of the landfill gas RAC designed on the basis of the HGG risk assessment process recommended in NSW EPA (2012).

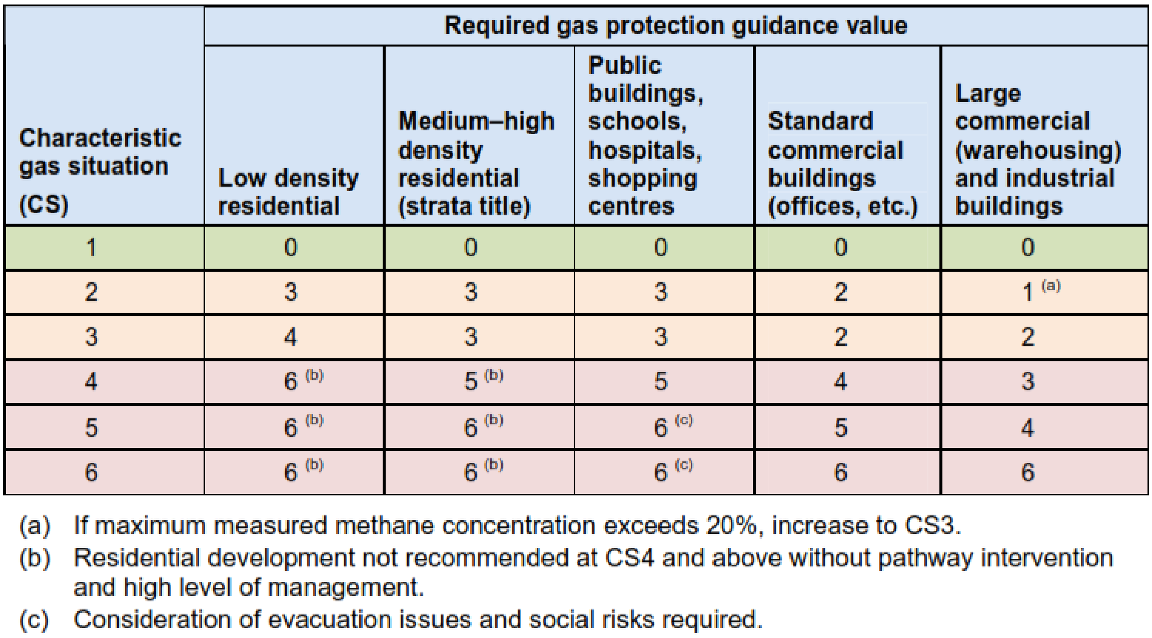
Adopted RAC provided in NSW EPA endorsed guidelines, which comprise the following:

- NSW EPA (2016) Environmental Guidelines: Solid Waste Landfills [Second Edition 2016] (note: this guideline is not listed as being made or endorsed under S.105 of the CLMA);
- NSW EPA (2012) Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases;
- BSI 8485 (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);
- CIRIA (2007) C665 Assessing Risks Posed by Hazardous Ground Gases to Buildings;
- CIRIA (2014) C735 Good Practice on the Testing and Verification of Protection Systems for Buildings against Hazardous Ground Gases (note: this guideline is not listed as being made or endorsed under S.105 of the CLMA); and
- Relevant Australian Standards (note: AS are not listed as being made or endorsed under S.105 of the CLMA).

Meeting the RAC will be achieved by validation of the CQA of relevant measure(s) or system element(s) required to achieve a score consistent with what is required based on the CGS of 3. 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 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. These differences are illustrated below in Tables 9a and 9b (Tables 7 and 8 extracted from NSW EPA (2012) and Tables 9c to 9f (Tables 4 to 7 from BS 8485:2015).

Relevant measure(s) or system element(s) that could be considered and the corresponding point scores from NSW EPA (2012) and BS 8485:2015 as reproduced in Tables 9a to 9f below. The landfill gas mitigation measures adopted for this site must be based on the most conservative outcome provided by the NSW EPA (2012) guideline and BS 8485:2015.

Table 9a: Guidance Values for Gas Protection (NSW EPA, 2012)



Characteristic gas situation (CS)	Required gas protection guidance value				
	Low density residential	Medium–high density residential (strata title)	Public buildings, schools, hospitals, shopping centres	Standard commercial buildings (offices, etc.)	Large commercial (warehousing) and industrial buildings
1	0	0	0	0	0
2	3	3	3	2	1 (a)
3	4	3	3	2	2
4	6 (b)	5 (b)	5	4	3
5	6 (b)	6 (b)	6 (c)	5	4
6	6 (b)	6 (b)	6 (c)	6	6

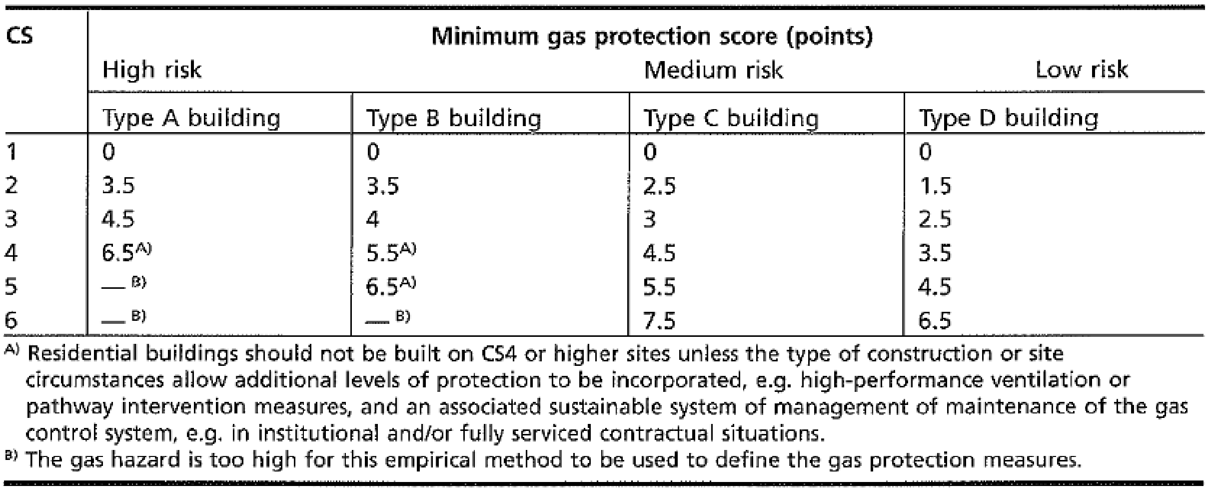
(a) If maximum measured methane concentration exceeds 20%, increase to CS3.
(b) Residential development not recommended at CS4 and above without pathway intervention and high level of management.
(c) Consideration of evacuation issues and social risks required.

Table 9b: Scores for Protection Measures (NSW EPA, 2012)

Measure or system element	Score	Comments
Venting and dilution measures		
Passive sub-floor ventilation with very good performance (steady state concentration of methane over 100% of ventilation layer remains below 1% v/v at a wind speed of 0.3 m/s)	2.5	
Passive sub-floor ventilation with good performance (steady state concentration of methane over 100% of ventilation layer remains below 1% v/v at a wind speed of 1 m/s and below 2.5% v/v at a wind speed of 0.3 m/s)	1	If passive ventilation cannot meet this requirement an active system will be required.
Subfloor ventilation with active abstraction or pressurisation	2.5	Robust management systems must be in place to ensure long-term operation and maintenance.
Ventilated car park (basement or undercroft)	4	Assumes that car park is vented to deal with exhaust fumes in accordance with BCA(a) requirements.
Floor slabs		
Reinforced concrete ground bearing floor slab	0.5	It is good practice to install ventilation in all foundation systems to effect pressure relief as a minimum. Breaches in floor slabs, such as joints, have to be effectively sealed against gas ingress to maintain these performances.
Reinforced concrete ground bearing foundation raft with limited service penetrations cast into slab	1	
Reinforced concrete cast in situ or post-tensioned suspended slab with minimal service penetrations and water bars around all penetrations and at joints	1.5	
Fully tanked basement	2	
Membranes		
Taped and sealed membrane to reasonable levels of workmanship with inspection and validation	0.5	The performance of membranes is dependent upon the design and quality of the installation, protection from and resistance to damage post installation and the integrity of joints in membranes that require joints. Materials that offer some degree of self-sealing and repair are preferred.
Proprietary gas-resistant membrane to reasonable levels of workmanship under independent construction quality assurance (CQA)	1	
Proprietary gas resistant membrane to reasonable levels of workmanship under independent CQA with integrity testing and independent validation	2	
Monitoring and detection (alarms)		
Intermittent monitoring using hand-held equipment	0.5	Monitoring and alarm systems are only valid as part of a combined gas protection system. Where fitted, permanent systems should be installed in the underfloor venting system but can also be provided in the occupied space as a back-up.
Permanent monitoring system installed in the occupied space of the building	1	
Permanent monitoring system installed in the underfloor venting / dilution system	2	
Pathway intervention		
Vertical barriers	–	Required for residential and public buildings at CS4 and above.
Vertical venting systems	–	

(a) Building Code of Australia

Table 9c: Gas Protection Score by CGS and Type of Building (BS 8495:2015)

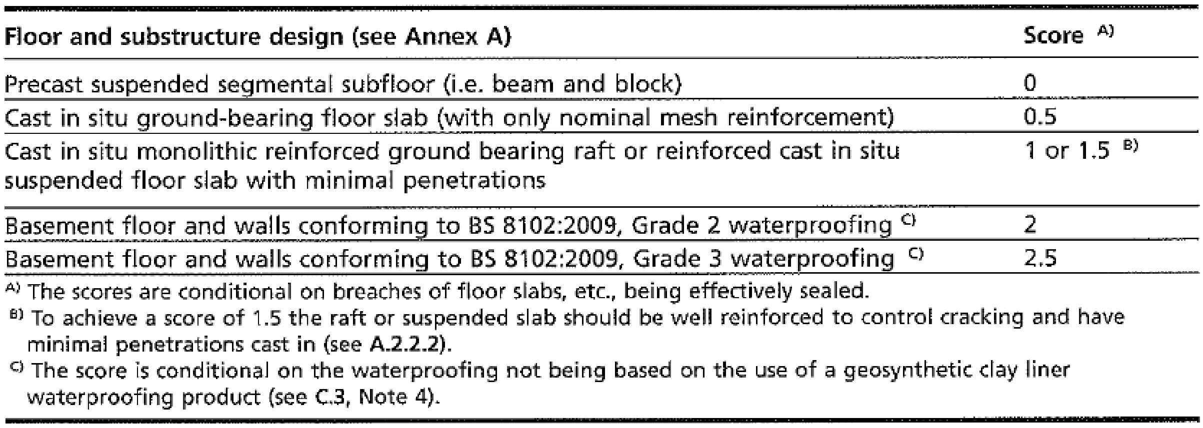


CS	Minimum gas protection score (points)			
	High risk		Medium risk	Low risk
	Type A building	Type B building	Type C building	Type D building
1	0	0	0	0
2	3.5	3.5	2.5	1.5
3	4.5	4	3	2.5
4	6.5 A)	5.5 A)	4.5	3.5
5	— B)	6.5 A)	5.5	4.5
6	— B)	— B)	7.5	6.5

A) Residential buildings should not be built on CS4 or higher sites unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g. high-performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system, e.g. in institutional and/or fully serviced contractual situations.

B) The gas hazard is too high for this empirical method to be used to define the gas protection measures.

Table 9d: Gas Protection Scores for the Structural Barrier (BS 8495:2015)



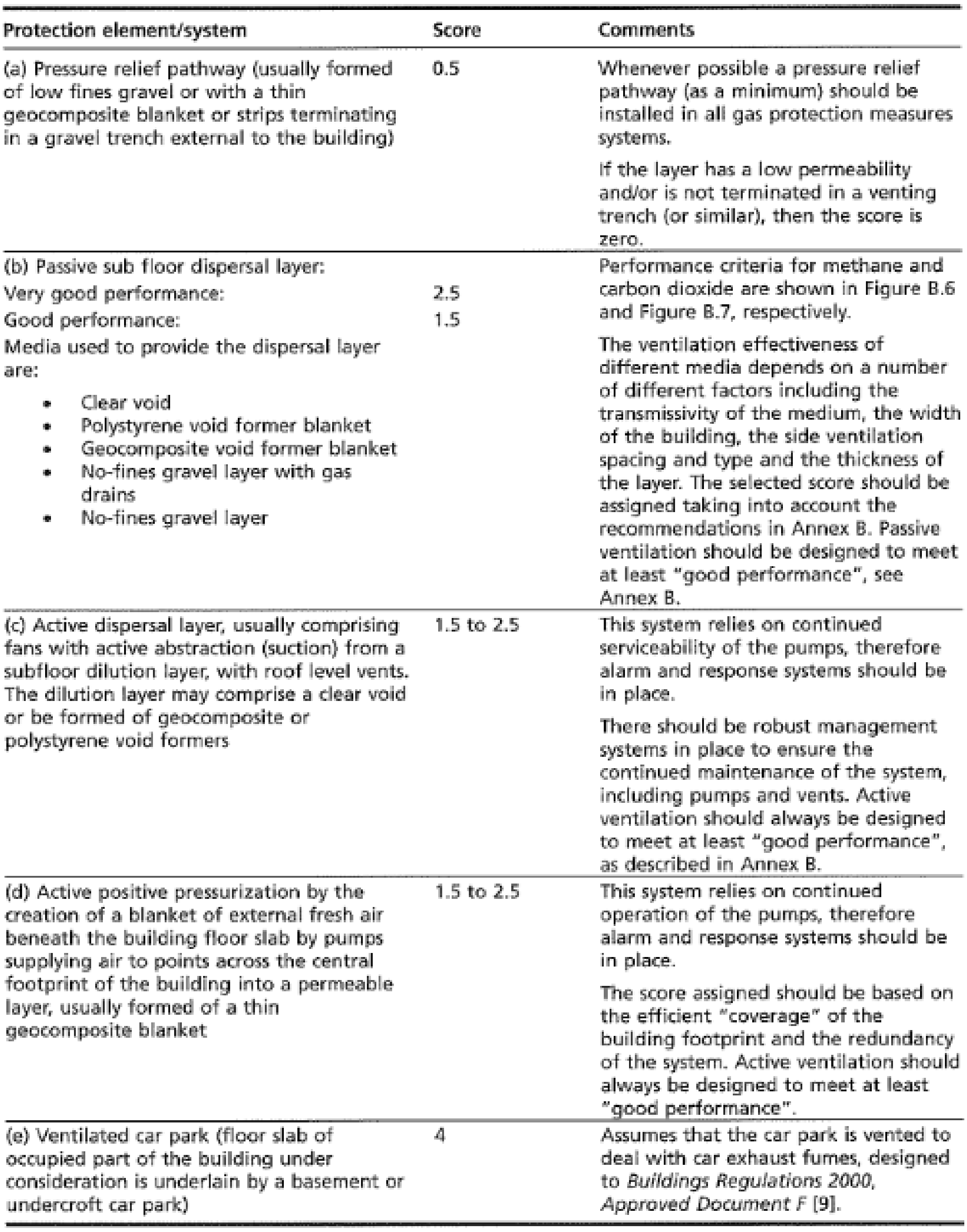
Floor and substructure design (see Annex A)	Score A)
Precast suspended segmental subfloor (i.e. beam and block)	0
Cast in situ ground-bearing floor slab (with only nominal mesh reinforcement)	0.5
Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations	1 or 1.5 B)
Basement floor and walls conforming to BS 8102:2009, Grade 2 waterproofing C)	2
Basement floor and walls conforming to BS 8102:2009, Grade 3 waterproofing C)	2.5

A) The scores are conditional on breaches of floor slabs, etc., being effectively sealed.

B) To achieve a score of 1.5 the raft or suspended slab should be well reinforced to control cracking and have minimal penetrations cast in (see A.2.2.2).

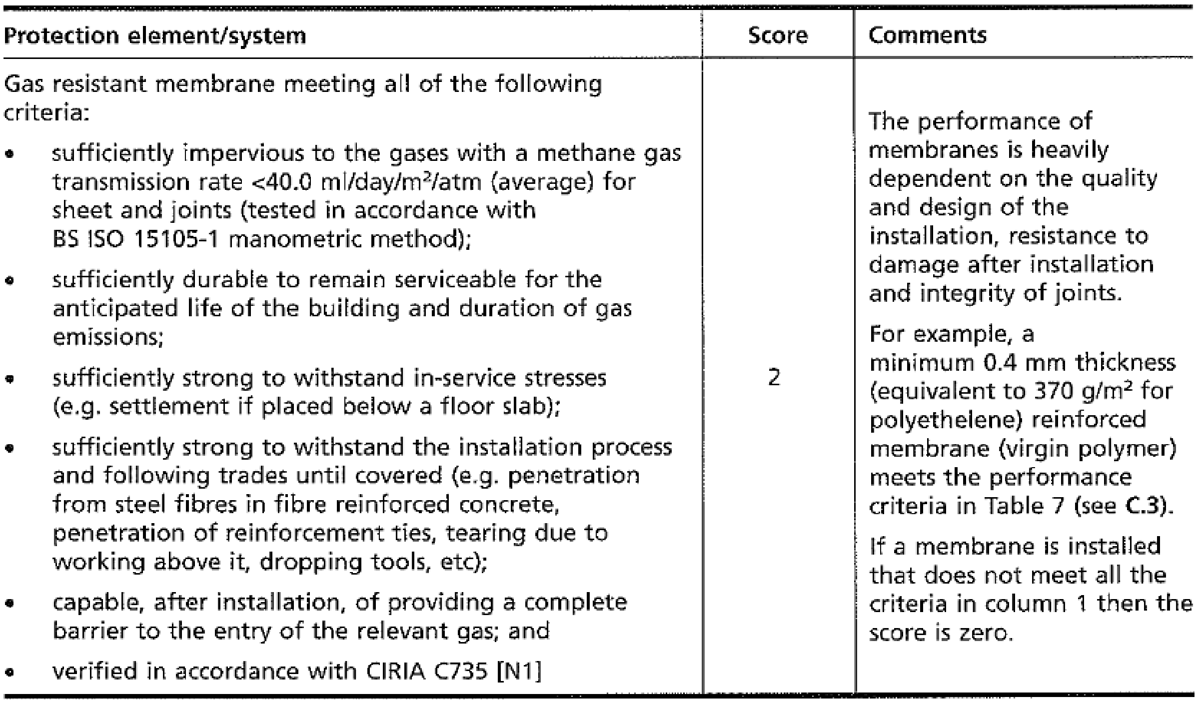
C) The score is conditional on the waterproofing not being based on the use of a geosynthetic clay liner waterproofing product (see C.3, Note 4).

Table 9e: Gas Protection Scores for Ventilation Protection Measures (BS 8495:2015)



Protection element/system	Score	Comments
(a) Pressure relief pathway (usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building)	0.5	Whenever possible a pressure relief pathway (as a minimum) should be installed in all gas protection measures systems. If the layer has a low permeability and/or is not terminated in a venting trench (or similar), then the score is zero.
(b) Passive sub floor dispersal layer:		Performance criteria for methane and carbon dioxide are shown in Figure B.6 and Figure B.7, respectively. The ventilation effectiveness of different media depends on a number of different factors including the transmissivity of the medium, the width of the building, the side ventilation spacing and type and the thickness of the layer. The selected score should be assigned taking into account the recommendations in Annex B. Passive ventilation should be designed to meet at least "good performance", see Annex B.
Very good performance:	2.5	
Good performance:	1.5	
Media used to provide the dispersal layer are: • Clear void • Polystyrene void former blanket • Geocomposite void former blanket • No-fines gravel layer with gas drains • No-fines gravel layer		
(c) Active dispersal layer, usually comprising fans with active abstraction (suction) from a subfloor dilution layer, with roof level vents. The dilution layer may comprise a clear void or be formed of geocomposite or polystyrene void formers	1.5 to 2.5	This system relies on continued serviceability of the pumps, therefore alarm and response systems should be in place. There should be robust management systems in place to ensure the continued maintenance of the system, including pumps and vents. Active ventilation should always be designed to meet at least "good performance", as described in Annex B.
(d) Active positive pressurization by the creation of a blanket of external fresh air beneath the building floor slab by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket	1.5 to 2.5	This system relies on continued operation of the pumps, therefore alarm and response systems should be in place. The score assigned should be based on the efficient "coverage" of the building footprint and the redundancy of the system. Active ventilation should always be designed to meet at least "good performance".
(e) Ventilated car park (floor slab of occupied part of the building under consideration is underlain by a basement or undercroft car park)	4	Assumes that the car park is vented to deal with car exhaust fumes, designed to *Buildings Regulations 2000, Approved Document F* [9].

Table 9f: Gas Protection Scores for the Gas Resistant Membrane (BS 8495:2015)



Protection element/system	Score	Comments
Gas resistant membrane meeting all of the following criteria: • sufficiently impervious to the gases with a methane gas transmission rate <40.0 ml/day/m²/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method); • sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions; • sufficiently strong to withstand in-service stresses (e.g. settlement if placed below a floor slab); • sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc); • capable, after installation, of providing a complete barrier to the entry of the relevant gas; and • verified in accordance with CIRIA C735 [N1]	2	The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation and integrity of joints. For example, a minimum 0.4 mm thickness (equivalent to 370 g/m² for polyethelene) reinforced membrane (virgin polymer) meets the performance criteria in Table 7 (see C.3). If a membrane is installed that does not meet all the criteria in column 1 then the score is zero.

Specifically, the RAC are:

- The landfill gas mitigation measures are designed for a CGS of 3 (possibly revised to CGS 2 pending further validation monitoring) and a gas protection score of 4.5 (possibly revised to a lower required score pending further validation monitoring), as defined by the NSW EPA (2012) and subsequently BS8485:2015;
- Sources of excessive methane gas should be removed to the extent practicable in order to minimise the explosive / health risks, reduce the period that elevated methane concentrations remain at the site, minimise future land use restrictions, and reduce future greenhouse gas emissions to the extent practicable. The data provided in the DP (2016) DSI indicated that prior to the trial excavation in 2015 – 2016, most areas of the site measured peak methane concentrations <10% v/v. The main area of exceedance corresponded to the trial excavation area. The maximum allowable methane levels within the site will be < 10% methane v/v averaged across the site and < 25% methane v/v in any single monitoring location;
- A surface emission criterion of 0.05% v/v methane measured at the end of the Stage 2 work and at any stage during subsequent monitoring. The criteria corresponds to the NSW EPA surface emission criterion given in Sections 5.2 and 10.2 of the NSW EPA (2016) and Section 3.6.2 of EPA (2012);
- Subsurface landfill gas should continue to be monitored at the site during construction and the results provided in the site validation report o be agreed by the Site Auditor;
- The Construction Quality Assurance Plan and Construction Quality Assurance Report for the landfill gas mitigation measures is prepared in accordance with Section 11 of NSW EPA (2016), BS8485:2015, CIRIA (2014) C735 and relevant Australian Standards, with the intention that peak methane levels within buildings and structures constructed at the site remain at levels of < 1% v/v, as recommended in Section 5.4 of the NSW EPA (2016).

The preferred remediation strategy for landfill gas requires that only passive gas management measures, as defined by the NSW EPA (2012) guideline, should be used in order that a Section A SAS can be issued at the end of the Stage 3 construction work.

The detailed design of the landfill gas mitigation measures should be reviewed, approved, and documented by the Site Auditor in a Section B SAS submitted to the Planning Authority prior to the commencement of Stage 3 and prior to the issuing of a Construction Certificate for the proposed housing at the site.

15.4 Groundwater and Surface Water

Groundwater and surface water data collected to date suggests that some contaminants likely to be from filling have migrated into groundwater. Further investigations are proposed to evaluate both the surface water quality (and current trends compared with earlier water quality results) and the leachability of fill soils using a neutral leach test. Notwithstanding current dredge pond monitoring results provided by Benedict suggest that water quality in the pond (future marina) has improved since the cessation of dredging.

The trial remediation excavation (refer to Section 10.3) and validation of the screening process has removed a significant component of material from the waste mass that has been and would have continued to contribute to the groundwater contaminant mass loading over time. It is proposed that neutral leach tests of screened soils are undertaken prior to their backfilling in order to assess the longer term risks posed to groundwater and adjacent surface water bodies from site-won filling.

A surface water and contingency groundwater monitoring programme will be undertaken for the duration of remediation work. The data will be used to assess contaminant concentration trends and whether further action is required as outlined in DP (2017b). All monitoring reports would be reported separately to those aspects of site remediation and validation related to soil and landfill gas in order to compartmentalise the reporting on the various site issues. Further details are provided in Section 16.1.8.

Relevant environmental values that the local community and the NSW EPA have adopted for the Georges River[3] include a healthy aquatic ecology, safe swimming, water looking pleasant and clean, unpolluted water to ensure the long-term viability of ecosystems and a diversity of habitats for native plants and animals. These environmental values are to be adopted as RAC.

15.5 Remediation Acceptance Criteria – Geotechnical

Geotechnical RAC are specified by J&K (2016b; 2017) (Appendix I). The J&K (2016b) report indicates the following geotechnical RAC for the geotechnical operations required on the site:

(i) Proof-roll the base of the proposed ‘backfill’ areas in accordance with the criteria indicated in AS2798 (Section 5.5: Test Rolling);

(ii) ‘Backfill’ to be carried out as follows:

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[3] As described at http://www.environment.nsw.gov.au/ieo/GeorgesRiver/report-01.htm#P49_7497

- The excavated material can be used as backfill subject to approval by the geotechnical engineer prior to, and on completion of, sorting to remove deleterious matter and to remove particle sizes greater than 75mm. The approved material can then be placed in layers not greater than 200mm loose thickness and compacted to a density between 95% and 97% of SMDD. If clayey materials are used, the compacted moisture content should be within 2% of SOMC. Compaction may be carried out in thicker layers using larger particle sizes, subject to confirmation that the required density can be achieved through the full layer thickness. Over compaction should be avoided as this would result in too much of a contrast between the 'existing fill' and the 'backfill' with associated large differential settlements over short horizontal distances. Similarly, under-compaction is undesirable as the creep settlement within the 'backfill' will increase and may also result in larger differential settlements.
- Particular care is required to achieve edge compaction where access for rollers is difficult. Benching the sides of the excavation will facilitate edge compaction.
- The backfill must be subjected to Level 1 testing, carried out at the frequency indicated in AS32798 for the volume of fill involved. The Geotechnical Consultant should be engaged directly on behalf of the client and not as part of the earthworks contractor.

(iii) High Energy Impact Compaction (HEIC) acceptance criteria, based on initial field trials:

- Settlement: average compaction settlement must meet the specification set by the Geotechnical Engineer.
- Uniformity: Soil response based on Continuous Impact Response technology (medium or better).

(iv) 'Engineered Fill' to be carried out as follows:

- The site should be backfilled using select material to achieve the design surface grades, with an 'engineered fill' blanket being no less than 3 m thick. The 'engineered fill' should comprise a well graded granular material (such as ripped or crushed sandstone), which is free of deleterious substances, and has a maximum particle size of 75 mm.
- The fill should be compacted in layers of not greater than 200mm loose thickness, to a minimum density of 98% SMDD. Compaction may be carried out in thicker layers using larger particle sizes, subject to confirmation that the required density can be achieved through the full layer thickness.
- Level 1 density testing should be carried out at the frequency indicated in AS3798 to confirm that the above specifications have been achieved. Preferably the Geotechnical Technical Authority should be engaged directly on behalf of the client and not as part of the earthworks contract.

Further geotechnical RAC are provided in Section 7.2 of J&K (2017).

Relevant to the landfill gas mitigation infrastructure, which may include sub-slab membranes, is the predicted differential settlement. The predicted long-term differential settlements, possibly including circumstances where higher than predicted settlements occur, will need to be accommodated by the detailed design of all gas mitigation measure(s) and system element(s).

15.6 Modifications to Remediation Acceptance Criteria

Modifications to the RAC proposed by the Environmental Consultant and/or Geotechnical Consultant during the course of the project as a result of ongoing monitoring data and/or verification data or final design elements must meet NSW EPA endorsed guidelines and be approved in writing by the Site Auditor prior to the commencement of work that relies on the use of the criteria.

16. Sequence of Remediation

16.1 Preliminary Work

16.1.1 Overview

Approval for remediation earthworks is set out in the development application issued to the Department of Planning and Environment (DPE) as per the request for the Secretary's Environmental Assessment Requirements (SEARs) for the preparation of an EIS. The SEARs letter (SEAR No. 1102) dated 16 November 2016 provides the requirements for the preparation of an EIS. Specially in relation to the RAP the SEARs letter sets out various requirements (see the FMP in Appendix J), including details of the remediation works and details of the types of materials to be received at the site as capping (FMP).

The SEARs letter indicates that the proposed development falls within both the designated and integrated development categories and seeks staged approval of works including contaminated soil treatment works. NSW EPA provided input to the SEARs letter following consultation with DPE.

NSW EPA's main issues were:

- Suitability of the proposed RAP;
- Impacts on water quality and site water management;
- Waste management and disposal;
- Impacts on air quality and any potential odour emissions; and
- Potential noise impacts.

The responsibility for obtaining necessary licenses, permits and approvals and determining the detailed procedures for and sequence of the remediation work will rest with the Contractor and will depend upon the equipment to be used and the overall sequence of the development. Such issues will be dealt with by the EIS. The EIS will be required as part of the DA to be lodged within two years of the issue date of the SEARs letter,

It is the Contractor's responsibility to devise a safe work method statement and to implement proper controls that enable the personnel undertaking the remediation to work in a safe environment. This RAP does not relieve the Contractor or other contractors of their ultimate responsibility for work health and safety of their workforce and to prevent contamination of areas outside the 'remediation' workspace. This RAP sets out general procedures and the minimum standards and guidelines for remediation that will need to be used in preparing the safe work method statement.

All of the above documentation to be prepared by the Contractor must be provided as sets of work procedures that are to be provided to the Environmental Consultant and Site Auditor for their review. Site works should not commence until written approvals of these procedures have been provided by both of the above parties. The required documentation should also include a detailed staging plan for the earthworks to be developed by the remediation contractor to be submitted to the Environmental Consultant for review and approval prior to the commencement of remedial earthworks. A copy of plan should also be provided to the Site Auditor so that milestones can be identified and to enable the Site Auditor to programme and undertake site inspections.

All remedial works will comply with all legislative requirements including, but not limited to, those set out under the following Acts (and their subsequent amendments and regulations):

- Environmentally Hazardous Chemicals Act, 1985;
- Hazardous Chemicals Act, 1985;
- Environmental Offences and Penalties Act, 1989;
- Agricultural and Veterinary Chemicals Act, 1994;
- Protection of the Environment Operations Act, 1997 (POEO Act);
- Contaminated Land Management Act, 1997 (CLM Act);
- Pesticide Act, 1999;
- Work Health and Safety Act, 2011 (WHS Act);
- OHS Amendment (Dangerous Goods) Act, 2003 (including OHS Amendment (Dangerous Goods) Regulation 2005); and
- POEO Amendment Act, 2005 (including POEO Amendment (Scheduled Activities and Waste) Regulation 2008).

Prior to the commencement of site remediation (i.e. bulk earthworks) an inception meeting should be held with the Developer, Remediation Contractor, Builder, Environmental Consultant and Site Auditor. The inception meeting should cover, amongst other things, the requirements of this RAP and the roles and responsibilities of the relevant parties.

In summary the various parties are defined as follows along with their roles and responsibilities:

- The Principal, responsibility to ensure appropriate personnel are appointed to manage and conduct the remediation and validation works;
- Principal's Representative, who is responsible for overseeing the implementation of this RAP;
- Remediation Contractor, who will be responsible for conducting the remediation works and managing the site;
- Environmental Consultant, who will be responsible for providing advice as required for the remediation works and undertaking the validation works in accordance with this RAP;
- Geotechnical Consultant, who will be responsible for providing advice as required related to geotechnical aspects of the remediation works and undertaken validation works in accordance with this RAP; and if necessary; and
- Occupational Hygienist, who will be responsible for asbestos issues including air monitoring.

The Remediation Contractor will be responsible for preparing a list of contacts, including emergency contacts for the site operations and provision of signage at the site to allow the public to contact nominated site personnel out of hours.

Prior to the commencement of site remediation works, the following interim controls will be in place:

- The construction of permanent fences around the subject area meeting appropriate specifications to prevent unauthorised entry; and
- Any pits or unstable areas on site that may generate potential WHS or operational risk will be demarcated and taped off, with appropriate rectification action undertaken (e.g. backfilling of pits as soon as practicable to prevent undue injuries to workers etc.).

A hazardous building materials assessment of buildings / structures remaining at the site, such as the cottage at the north-eastern corner, should be undertaken. The assessment should be undertaken so that these materials can be removed and disposed prior to demolition and not represent a new contamination risk.

Following demolition of any remaining buildings by a licensed contractor and disposal off-site of all demolition waste in accordance with regulatory guidelines, the footprint of each former building area should also be investigated and validated prior to the commencement of major earthworks in the area, to show that no contamination associated with the building / demolition work remains on site prior to capping with VENM as per the FMP and geotechnical RAC. Validation will involve surface sampling of the building footprints and surrounding buffer areas (25 m width in all directions) using densities compliant with the NSW EPA (1995) (Table A).

All relevant tip dockets for off-site disposal of demolition wastes would be provided in the site validation report.

Buried services that are currently present that will need to be removed should also be identified and any hazardous materials disposed off-site.

The major site remediation activities will occur in three distinct stages being:

- Stage 1: Site Preparation Earthworks;
    - Stage 1a: Areas Requiring Deep Excavation;
    - Stage 1b: General Site Preparation Earthworks;
- Stage 2: VENM Capping; and
- Stage 3: Installation of Landfill Gas Mitigations.

16.1.2 Preliminary Work – Duty to Report

Section 60 of the CLM Act places obligation on owners of land and other people to notify the NSW EPA of contamination at a site. Based on the soil, groundwater and landfill gas contamination at this site and, in particular, the off-site migration of contaminated groundwater, there is a duty to report contamination present at the site to the NSW EPA.

DP understands from the client that the NSW EPA has been consulted under the SEARS process.

16.1.3 Regulatory Approvals and Licenses

All relevant regulatory approvals and licenses required to be obtained by the remediation and development work are to be obtained by the site owner prior to the commencement of site work. This includes that the proposed remediation strategy represents Category 1 work under the SEPP 55 guidelines.

Environmental Protection Licenses (EPLs) that currently apply to the site include, but may not be limited to:

- EPL 4612 for land-based extractive activity, crushing, grinding, or separating, water- based extractive activity; and
- EPL 10490 for the recovery of general waste, recovery of waste tyres, waste storage – other types of waste, waste storage – waste tyres.

DP understands from Benedict that these EPLs will be maintained for the duration of the cap construction, and other aspects of site remediation, and that they permit their importation of VENM. In this regard further EPLs are not considered likely to be required, as may otherwise be required under Schedule 3 in Part 1 of The Environmental Planning and Assessment Regulation 2000.

16.1.4 Remediation Excavation Trial Reporting

Current reports on the remediation trial excavations are included in Appendix H. Validation monitoring for landfill gas in the footprint of the trial excavations is proposed under the DP (2017b) SAQP.

16.1.5 Detailed Design of Landfill Gas Mitigation Measures

Landfill gas mitigation measures must be designed to meet the minimum requirements specified in NSW EPA (2012), BS 8485:2015, CIRIA (2014) C735 and relevant Australian Standards.

These minimum requirements include but not be limited to (as per Section 4, BS 8485:2015):

- The protection provided will:
  - prevent ground gas entering buildings;
  - avoid the build-up of hazardous gas beneath buildings or in subsurface infrastructure (e.g. inspection chambers and service runs);
  - avoid the build-up of hazardous ground gas within buildings;
  - demonstrate compliance by monitoring prior to occupation or use, implementing management measures, and by including site-wide measures designed to reduce the gas hazard beneath the building.
- The measures used will be:
  - effective: in that they do what they are intended to do;
  - robust: in that they are not easily compromised, particularly during construction;
  - durable: in that they will remain effective for the required design life of the development; and

  - buildable: in that they can be built given an appropriate standard of workmanship, supervision and verification.
- The effectiveness of the measures will be assessed in terms of the:
  - theoretical effectiveness assuming proper installation; and
  - practical effectiveness (i.e. what it is reasonable to expect to achieve under normal conditions); and
  - long-term effectiveness given the likely durability of materials, etc.
- Extreme events (e.g. exceptional changes in atmospheric pressure, rapid groundwater rise and/or flooding) will be taken into account when defining the Characteristic Gas Situation (CGS) and when selecting/constructing the protective measures.
- The protective measures will include the use of materials that have a defined design life or no known critical time deterioration properties, and will be placed where they might reasonably be expected to continue to perform for the life of a building, that might be in excess of 100 years.

The detailed design is yet to occur, however, the following points provide a guide for the detailed design:

- The private residential buildings to be constructed at the site correspond to Building Type A in Table 3 of BS 8485:2015;
- Only passive mitigation measures, as defined by NSW EPA endorsed guidelines will be used;
- The landfill gas mitigation measures will be designed to meet the standard required by Gas Protection Score 4.5, as derived by Table 4 in BS 8485:2015 for a CGS of 3 and a Building Type of A;
- The design of the measure(s) or system element(s) for the residential development (houses) should include the following general components (subject to actual detailed design) from top down:
  - Concrete Slab;
  - Protective Geotextile;
  - Gas proof membrane appropriately sealed around seams, detailing and penetrations;
  - Cushion geotextile;
  - 100 mm crushed gravel screenings (nominal >20 mm, no fines) with geo-vent collection strips; and
  - Anti-silting geotextile.
- Installation of the venting and gas proof membranes should be undertaken by an experienced Contractor with a track record of installation of gas barriers. The CQA testing should also be undertaken and documented by the installation Contractor or a third party. The documentation should be reviewed by the Environmental Consultant. The Environmental Consultant will validate each stage of the landfill gas mitigation work at each structure and this will comprise a hold point requiring the Site Auditor to inspect a statistically significant number of landfill gas mitigation measures during their installation before further installations are completed. In this regard batches of 2-3 may be validated and inspected initially with this number increasing say 10 per batch as the parties become more familiar with the construction and validation requirements.

Specific elements of the design should give consideration to the following:

- The concrete slab is the structural barrier in the landfill gas mitigation system and will correspond to the “Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab and will be well reinforced to control cracking and have minimal penetrations cast” as specified in Table 5 of BS 8485:2015. The structural barrier will be designed to have a gas protection score of 1.5. When practical, utilities should enter the building above floor level with any conduit or meter housing being properly vented outside of the building;
- The crushed gravel screening layer is the ventilation protection measure in the landfill gas mitigation system and will correspond to the “Passive sub floor dispersal layer with good performance consisting of a non-fines gravel layer with gas drains” as specified in Table 5 of BS 8485:2015. The ventilation protection measure will be designed to have a Gas Protection Score of 1.5;
- The ventilation protection measure would be a 100 mm thick gravel layer with geo-vent collection strips. This design needs to be improved to meet BS 8485:2015. Section B.10 of BS 8485:2015 requires, among other things, that the gravel layer should be at least 200 mm thick, the geocomposite strips should be 1 m wide and at least 12.5 mm thick, and the drains should be at a spacing of not more than 3 m. The drain network should be designed to cause external air to flow though all parts of blanket and not to short circuit between vent points on opposite sides of the building; this is achieved by having interleaved networks of pipes connected to opposite sides of the building, as illustrated in Figure B.12 of BS 8485:2015. The networks should be as symmetrical as possible. Side vents should normally be provided at no more than 10 000 mm centres and have an area equivalent to 1 500 mm2/m run of wall on at least two opposite sides;
- The gas proof membrane in the landfill gas mitigation system will meet the criteria specified in Table 7 of BS 8485:2015 and have a Gas Protection Score of 2.0;
- The risk assessment and all design decisions will be documented and recorded in a design phase report, which should be prepared by competent Environmental, Geotechnical and Structural Engineering Consultants. For the purpose of the RAP, the design phase report has been termed the Landfill Gas Mitigation System Design Report;
- The design phase report shall be prepared in accordance with the minimum requirements specified in Section 8 of BS 8485:2015 and relevant Australian Standards; and
- The design phase report shall be provided to the Site Auditor for review and a written approval provided by the Site Auditor, prior to the commencement of Stage 3 works.

The design can be modified as new landfill gas validation monitoring data becomes available.

The design report will specify the minimum requirements for the installation and verification of the landfill gas mitigation measures. The actual procedures to be used at the site shall be documented in an Installation and Verification Plan prepared by the Contractor and which needs to be reviewed and approved in writing by the Environmental Consultant and by the Site Auditor prior to the commencement of Stage 3 works.

One aspect of the landfill gas mitigation that requires consideration is the lateral (southwards) movement of gas to the proposed marina development. A measure currently proposed under the DA that could mitigate this is the retaining wall along the interface of proposed Lot 2 and Lot 3 (being the boundary of the gas generating land and the marina development). The wall is to be constructed of stacked sandstone rock and will be designed to allow for any laterally moving gas to be vented vertically along the void spaces in the wall to atmosphere.

16.1.6 Clearance of Suspect Areas

The AST fuel storage facility, drum storage areas, the footprints of buildings that contained asbestos following their demolition, the weighbridge, and previously inaccessible areas (i.e. beneath existing stockpiles) are to be subject to soil validation testing in order to meet the EPA (1995) Sampling Design Guidelines recommended sampling density.

Any contamination found as a result of the validation sampling would be remediated as part of the Stage 1 work. A report documenting the results of these investigations should be prepared by the Environmental Consultant in accordance with NSW EPA endorsed guidelines. A copy of the report shall be provided to and approved by the Site Auditor, ideally, prior to the commencement of Stage 2 work.

16.1.7 Acid Sulfate Soil Investigation

Any areas of the site requiring further deep excavations that will disturb potential acid sulfate soil (PASS) will require an acid sulfate soil (ASS) investigation. We understand from Benedict that no further deep excavations are proposed.

16.1.8 Validation Landfill Gas and Surface Water Monitoring Programme

In order to arrive at a final site validation endpoint, the following key monitoring programmes are required to be undertaken throughout the duration of the site remediation programme:

- Landfill gas monitoring in order to:
    - Confirm the current CGS for the site and evaluate whether a reduction to a CGS of 2 may be applicable;
    - Evaluate whether the current remediation trial excavation (refer to Section 10.3) has resulted in a reduction in landfill gas in this area of the site which may potentially lessen the overall CGS for the site (currently CGS 3). Monitoring will need to account for the time required for the backfill to reach anaerobic (highest methane producing) conditions;
- Surface water (and contingency groundwater) monitoring in order to:
    - Establish concentration trends of key contaminants at the points of compliance (i.e. adjacent surface water bodies) (e.g. using Mann-Kendall trend analysis);
    - Confirm whether monitoring needs to be up-scaled to include groundwater monitoring;
    - Confirm whether site specific trigger levels need to be developed and/or an ecological risk assessment (considered unlikely) is required;
    - Confirm whether remediation of groundwater and/or surface water (considered highly unlikely) is required. Remediation options could involve the following:
        - Selective source removal;
        - A long term MNA programme to demonstrate a continued decrease in key contaminants emanating for the site;

- Installation of an impermeable barrier wall to prevent the flow of contaminant-impacted groundwater to the point(s) of compliance (i.e. adjacent surface water bodies); or
- Installation of a permeable reactive barrier wall to treat contaminant-impacted groundwater prior to its discharge to the point(s) of compliance (i.e. adjacent surface water bodies).

The landfill gas and groundwater / surface water monitoring programmes and associated reports will form part of the final site validation report. The primary constraint to the collection of data for these monitoring programmes at the current time is the activities on site which limit the ability to install and maintain monitoring points for the respective media.

16.1.9 Preliminary Long Term Environmental Management Plan

The proposed remediation strategy involves the long-term (post construction) management of contamination that will remain buried at the site. Protocols for the ongoing passive management of this residual contamination will be documented in a Long Term Environmental Management Plan (LTEMP). No ongoing monitoring or active management is envisaged as part of the LTEMP.

Notwithstanding the LTEMP is an important part of the remediation strategy because it will, among other things, advise future property owners:

- That contamination remains at the site and includes landfill gas and buried wastes;
- The long term ownership of the contamination;
- The restrictions that the contamination will place on the future use of the land;
- The level of responsibility that future residential and other types of property owners will have for adhering to the LTEMP;
- The tasks that will need to be undertaken as part of the long term management of residual contamination at the site;
- How the LTEMP will be made legally enforceable by Council including the implementation of the EMP through planning instruments;
- Reporting protocols and requirements;
- A mechanism for progressive improvement and monitoring of compliance with the EMP;
- Compliance auditing of LTEMP implementation;
- The end points that would need to be achieved before the LTEMP could be terminated;
- Contingency measures ; and
- Triggers for defining when contingency measures would need to be implemented.

It is envisaged that a single LTEMP will be prepared for the site as opposed to several EMPs covering different parts of the site.

A preliminary free standing version of the LTEMP will be prepared by the Environmental Consultant, reviewed by the Site Auditor and approved in writing by Liverpool City Council prior to the commencement of Stage 1 works or DA for the first group of houses. This will allow issues of concern to stakeholders to be flagged and addressed prior to the commencement of site work.

The preliminary version of the LTEMP (one document for the entire stie) shall be prepared in accordance with NSW EPA endorsed guidelines. The Environmental Consultant is to notify the Site Auditor during the remediation work of any significant changes that may need to be made to the preliminary version of the LTEMP. The Site Auditor would review any such proposed changes and advise Council of their acceptability.

A final version of the LTEMP will be prepared by the Environmental Consultant as part of the Stage 3 validation report (Section 19.3).

16.1.10 Supplementary Geotechnical Assessments

Geotechnical assessments, as described below, that need to be completed prior to the commencement of Stage 1 work include, but may not be limited to:

- Imported VENM geotechnical requirements (see FMP at Appendix J);
- HEIC specification (see J&K (2017)); and
- Up-dated settlement analysis (refer to Appendix I, J&K, 2017).

A geotechnical procedure needs to be in place for imported VENM to be used for construction of the upper 1.6 m layer of the Stage 2 cap. This is a requirement of Sections 1 and 4.2 of the “Fill Management Protocol for Imported VENM Cap Construction” given in Appendix J of the RAP.

A specification should be prepared for HEIC as per Section 7.2 of J&K (2017). The specification should include, among other things:

- A definition of deleterious subgrade conditions that would require the removal, replacement and/or treatment of soils;
- Requirements for ongoing levelling, survey and possible testing for the HEIC as per J&K (2017); and
- Acceptance criteria that need to be met by the compacted subgrade surface.

The specification should be submitted to and approved by the Environmental Consultant and the Site Auditor prior to the commencement of Stage 1 work.

Up-dated settlement analyses have been provided in J&K (2017), included in Appendix I.

The Supplementary Geotechnical Assessments should be prepared by the Geotechnical Engineer in accordance with relevant Australian Standards. The report should be provided to and approved by the Site Auditor prior to the commencement of Stage 1 work.

16.2 Stage 1: Site Preparation Earthworks

16.2.1 Removal and/or Replacement of Existing Buried Services

The Contractor is to obtain information from the site owner on all known and suspected buried services remaining at the site and to undertake a dial-before-you-dig (DBYD) buried service check. It is understood from Benedict that minimal (if any) buried services are present at the site.

Notwithstanding, where existing services are present, the following should occur in relation to their decommissioning or retention:

- All abandoned buried services at the site must be removed and all asbestos and other waste material disposed off-site to suitably licensed waste facilities;
- The location of all active services that remain at the site should be clearly identified and measures implemented to protect workers and the integrity of these services in accordance with regulatory requirements;
- Active services that are to remain on-site should be accurately located and shown on survey plans, which are to be included in the long term EMP; and
- Active services that are to be replaced as part of development work should be replaced as part of the Stage 1 work and be completed prior to the commencement of Stage 2 work.

The Environmental Consultant should inspect the work associated with the removal and/or replacement of existing buried services at the site and provide documentation in the Stages 1 & 2 validation work that will allow the Site Auditor to conclude that this work was completed in accordance with NSW EPA guidelines and regulatory requirements.

The Contractor shall backfill trenches used to remove buried services in accordance with the geotechnical requirements for constructing the 3m thick 'engineered fill' blanket.

All existing buried services shall be removed from an area, validated by the Environmental Consultant and backfilled in accordance with the geotechnical requirements prior to the commencement of construction of the 3 m thick 'engineered fill' blanket.

16.2.2 Winning On-site Material for Backfill and Cap Construction

16.2.2.1 Requirements for On-Site Materials

The following items need to be completed at the start of the Stage 1 works:

- Backfilling any excavated 'hotspots' (we note that the PCB 'hotspot' may not be able to be identified due to recent near surface earthworks associated with stockpile management);
- Levelling out the site to achieve design subgrade levels on which the 3 m thick 'engineered fill' blanket is to be constructed;
- Backfilling service trenches; and
- Constructing the 1.4 m thick lower layer of the 3 m thick 'engineered fill' blanket.

The on-site materials to be beneficially reused will require treatment in the form of inspection, selective excavation, hand picking, screening and/or validation testing. The level of treatment required will depend on the type of material excavated, the type and extent of contamination present, and how the treated material will be reused.

Material to be used as backfill below the base of the 3 m thick 'engineered fill' blanket will need to be validated to meet the 'Soil Below 3 m' criteria (Section 15.2) and the Geotechnical criteria (Section 15.5). The sampling frequency and protocols to be used for validating these materials are presented in Section 19.1.2 for hotspots and Section 19.1.3 for other areas.

Material to be used to construct the 1.4 m thick lower layer of the 3 m thick ‘engineered fill’ blanket will need to be validated to meet the Upper 3 m of Soil criteria (Section 15.1) and the geotechnical criteria (Section 15.5). The sampling frequency and protocols to be used for validating these materials are presented in Section 19.1.1.

The following are to be provided to the Environmental Consultant and the Site Auditor upon completion of filling the ‘backfill excavations as per Section 7.6 and 7.2, respectively, of J&K (2017):

- The survey of the lateral extent and depth of ‘backfill’ excavations; and
- Level 1 density testing of ‘backfill’ and ‘engineered fill’.

16.2.2.2 Testing Regime on Screening Operation

A testing regime was implemented to evaluate the ability of the screening operation to produce graded products meeting the soil RAC, in particular, with respect to the potential for the screening process to generate fibrous asbestos and asbestos fines (FA and AF) due to the presence of fragments of asbestos containing material (ACM) in the fill. In addition, the testing regime was used to formulate RAC for aesthetic parameters in relation to anthropogenic materials of ≤ 5% and for a ‘significant reduction in organic matter’ (refer to Section 15.1).

The testing regime involved a sampling programme conducted on the stockpiles of screened material that were generated as a result of the larger scale treatment trial remediation excavation. The testing regime comprised the following:

- An initial grid-based survey to determine if visible asbestos contamination is present at the stockpile surface;
- Sampling stockpiles at an initial approximate frequency of one sample per 1000 tonnes (equivalent to approximately one sample per 550 m^3 assuming 1.8 t/m^3). This frequency and the analytes to be tested were subject to review and refinement over time (if required), following an approval from the Site Auditor;
- Analysis of samples for the following contaminants:
  - metals, TRH, BTEX, PAH, OCP, OPP, PCB, phenols and asbestos (10 L sample for ACM and 500 ml sample for FA and AF) as per the RAC in Table 8, and Section 15.1;
- Analysis of samples for the following aesthetic analytes:
  - Anthropogenic material with reference to NSW Roads & Traffic Authority Test Method T276 Foreign Materials Content of Recycled Crushed Concrete; and
  - Organic matter.

A hold point was applied between the results of the initial testing regime and the application of the screening process at other areas of the site discussed below, as determined by the Environmental Consultant, such that:

- Suitable RAC can be derived for anthropogenic materials and organic matter; and
- The testing regime confirms that the screening process is not generating unacceptable levels of FA and AF.

Whilst the initial testing regime was focused on the on the existing stockpiles of screened material that were generated as a result of the larger scale treatment trial remediation excavation (now backfilled), future validation testing will focus only on the screened fill for re-use in the lower 1.4 m of the 3 m thick 'engineered fill' blanket. In this regard, the testing regime comprised an overall 'validation' of the general screening 'processes'.

The results of the testing regime on the screening operations are provided in Appendix H.

16.2.2.3 Additional Areas Requiring Deep Excavation

Based on the results of the larger scale treatment trial remediation excavation (refer to Section 10.3) and which are to be fine-tuned with additional landfill gas investigations, and with due consideration to the overall project earthworks / construction timetable, further areas of the central 'deep fill' portion of the site may be excavated and backfilled in a similar manner to that occurring at the current trial remediation excavation, however, the proponent is unlikely to undertake further excavation due to timing constraints on the future management of contaminated / landfill gas generating fill in-situ (see Figure 6).

The procedure for the Contractor for any areas requiring deep fill excavation should be as follows:

- Excavation of those fill materials that presently comprise a significant contribution to landfill gas, followed by their separation into various product / waste streams;
- Oversize concrete and brick (>120mm) shall be crushed and reused on-site as a coarse fill;
- Screen soils using a mobile mechanical screen and then hand-pick to remove unsuitable materials. The screen fractions should be as per the current trial remediation excavation viz. <16 mm, 16 – 40 mm and 40 – 120 mm;
- Remove timber waste by mechanical means or by hand (depending on size) from the fill as far as is practicable and recycle recovered timber at a Benedict facility that is licenced to take the type of timber that is recovered;
- Remove metal waste from the fill and recycle recovered metal at a metal waste recycler;
- Remove visible ACM from the screen by hand picking and segregate for bagging and disposal. The procedures adopted should comply with the measures specified in 'Managing Asbestos in or on soil' (NSW EPA, 2014) and 'How to safely remove asbestos code of practice, (Safe Work Australia, 2011). For non-friable asbestos (ACM) involving greater than 10 m^2 of fibro sheets or fragments only a Class A or Class B asbestos removal license hold may conduct the asbestos removal work (if uncertain then a licensed removalist should be engaged). All workers involved where greater than 10 m^2 of asbestos is involved must hold current certification. If friable asbestos (FA/AF asbestos) is encountered then only currently licensed Class A asbestos removalists are permitted to conduct asbestos removal or related works. If friable asbestos is present then it is a legal requirement that only a WorkCover Licensed Asbestos Assessor may undertake air monitoring, risk assessments and issue clearance certificates for removal work. The management of asbestos waste will require to meet the requirements of Clause 42 of the POEO (Waste) Regulation (2005), including: (i) storing asbestos waste at the premises in an environmentally safe manner, (ii) keeping non-friable asbestos securely packaged at all times, (ii) keeping friable asbestos in a sealed container, (iii) wetting down asbestos contaminated soil in this case by the use of spray mists during excavation, screening/processing, transport and backfilling], (iv) transporting asbestos in a covered leak proof vehicle, (v) disposing asbestos off-

site to a landfill which can legally accept the waste, (vi) not disposing asbestos in domestic garbage bins, and (vii) preventing the illegal re-use, recycling or dumping of asbestos waste. Further information in this regard is outlined in our correspondence dated 13 October 2016 (Appendix H);

- Remove other deleterious materials extracted from the excavated material (e.g. rubber, plastics, vegetation, asbestos, bitumen, drums/containers) and dispose to landfill;
- Create stockpiles of coarse fill and soils which are to be treated and validated to criteria specified in this RAP and validated by the Environmental Consultant. The criteria to be applied to site won material will vary depending on whether the site won material is placed above or below the blanket subgrade level;
- Undertake validation testing on the stockpiled material with reference to Section 19.1.1 prior to re-use. Material which meets the RAC (Section 15.1) will be deemed suitable (from a contamination standpoint) for re-use in the lower 1.4 m of the 3 m thick ‘engineered fill’ blanket. Stockpiled materials which fail the RAC will be classified as waste and removed to a licensed landfill. Where stockpiles fail the RAC but show no preponderance for leaching, do not contain VOC that could cause a vapour intrusion issue or contain asbestos above the RAC then such material may be used as deep replacement filling in the existing excavation and as it will ultimately be well in excess of 3 m below finished levels;
- The materials are then to be backfilled and compacted in accordance with directions from the project Geotechnical Engineer (J&K) (refer to Section 11); and
- Surveys of levels must be prepared at each stage of the excavations and backfilling process as well as the final application of capping.

Deep excavations should be inspected, documented and approved by the Environmental Consultant prior to the commencement of backfilling (and compaction). The Environmental Consultant should also validate, document and approve the materials to be used to backfill the deep excavations. In each of the above the inspection and documentation of these processes would constitute hold points before further related works are contemplated.

Accordingly the nature and quality of the products derived from the recently completed and any future screening operations should be continuously validated through the remediation works programme and the results included in the site validation report.

16.2.3 Removal of Hotspots

Areas which show elevated concentrations of methane based on prior monitoring results will be excavated and the source of methane (mainly timber) removed. Similarly other hotspots will be excavated and the materials classified as wastes and removed to landfill. Potential other types of hotspot present at the site include hotspots contaminated by large quantities of:

- Biodegradable material that form gas hotspots and/or generate leachate,
- Drummed waste or areas where fuel leaks occurred that pose soil vapour and/or groundwater contamination risks; and
- Unexpected finds.

Protocols that define a hotspot that needs to be remediated are as follows:

- Areas where peak methane concentrations exceed 25% v/v (average of 10% v/v across the site);
- Buried drums or other types of bulk waste containers; and
- Grossly contaminated material based on high odorous or physical appearance.

The sampling frequency and protocols to be used for validating these materials are presented in Section 19.1.2 for hotspots and Section 19.1.3 for other areas. Validation will be suitably documented prior to any further work being undertaken at the hotspot concerned. Once areas have been validated then all such areas should be embargoed for the storage or stockpiling of materials other than imported VENM verified under the FMP.

16.2.4 General Site Preparation Earthworks

The site preparation cut and fill earthworks are to be undertaken by the Contractor in accordance with the procedures outlined in J&K (2017). It is understood from Benedict that no staging of the site preparation is proposed. Should this change, a construction staging plan for the 'Stage 1b General Site Preparation Earthworks' should be prepared by the Contractor and reviewed and approved by the Environmental Consultant and the Site Auditor prior to the commencement of the Stage 1b work. The plan should specify, among other things, how the site area will be subdivided to allow construction of the 3m thick 'engineered fill' blanket to occur in stages across the site together with the start and completion dates for the various works that need to occur in each area.

For the purpose of this RAP, the site preparation earthworks are considered to include the lower 1.4 m of the 3 m thick 'engineered fill' blanket. The procedure for the Contractor for site preparation earthworks should be as follows:

- Backfill the existing site excavations to the Specifications in J&K (2017);
- Undertake cut and fill earthworks to a level of -1.6 m of the subgrade level on which the 3 m thick 'engineered fill' blanket is to be placed;
- Excavate and stockpile site material to a level of the subgrade level on which the 3 m thick 'engineered fill' blanket is to be placed (i.e. excavate to a depth of approximately 1.4 m). This will need to be done in stages to allow for the HEIC in the dot point below. The Environmental Consultant should undertake regular inspections during the excavation and stockpiling exercise;
- Undertake the HEIC works on the exposed subgrade in accordance with the Specification to be prepared as recommended in J&K (2017). The purpose of HEIC is to improve the density of the upper fill materials, particularly those areas of inferior compaction, and to provide a relatively uniform platform onto which to place the 3 m thick 'engineered fill' blanket;
- An accurate survey of the compacted subgrade level should be made as part of the validation program for the construction of the 'engineered fill' blanket. The survey should be undertaken by a licensed surveyor at a grid spacing not exceeded 10m in size and a survey drawing produced that is to be included in the Stages 1 & 2 validation report;
- Undertake validation testing on the stockpiled material with reference to Section 19.1.1 prior to re-use. Material which meets the RAC (Section 15.1) will be deemed suitable (from a contamination / aesthetic standpoint) for re-use in the lower 1.4 m of the 3 m thick 'engineered fill' blanket;
- Subject to approval and at the direction of the Geotechnical Engineer, commence the placement of the lower 1.4 m of the 3 m thick 'engineered fill' blanket in accordance with the Specification in J&K (2017). We note that, as a minimum, the stockpiled material is likely to require screening to

remove oversized material in order to be geotechnically suitable for part of the ‘engineered fill’ blanket and this will be done at the direction of the Geotechnical Engineer; and

- Complete a survey of the finished level to confirm the thickness of VENM required in order to reach the final design levels.

If unexpected conditions are encountered during the remediation (such as buried tanks, significantly stained soils or unexpected contaminated soil or contaminants) reference should be made to the procedures outlined in Section 16.5.

J&K (2017) includes a specification for HEIC of the subgrade which must be undertaken prior to commencing construction of the 3 m capping system. The specification has been prepared by the Geotechnical Consultant and must be approved by Site Auditor prior to the commencement of HEIC works. All related documentation will be presented in the site validation report.

The removal of asbestos, management of failures of the RAC in stockpile and screened material, removal of leachable materials, procedures to be adopted in the event of excavation of ASS, documentary requirements including surveys in Stage 1b will follow the same procedures as described in Stage 1a.

Tracking of excavated materials will be via numbered stockpiles which will subdivided based on the presence of contaminants and be sequentially numbered. The volume and classification of any waste materials designated for off-site disposal will be determined to enable correlation with weighbridge returns of final disposal from the licensed landfill. The volume of remaining stockpiles and their placement destination i.e. back into the excavations will be recorded in a similar fashion. Surveys will verify the area and thickness of each lift following compaction of each 200 mm layer. This system should provide a record of materials movement from origin to repository.

The distinct difference between HEIC surface and the site-won re-compacted material, as opposed to a marker layer (geotextile) is to define the boundary between the existing fill and 3 m thick cap (i.e. the cap being 1.4 m site-won validated material overlain by 1.6 m imported VENM) in the event that any future excavations (post development) extend to this depth. Prior to the placement of the site-won material, any required validation of the site surface, for example in prior hotspot areas or areas of backfill, should be subject to validation assessment. This exercise would represent a hold point in site works enabling Site Auditor inspection of the subgrade (prior to 3 m cap placement) if deemed necessary. The Environmental Consultant must inspect the ground surface, describe the exposed soils, check that the compacted subgrade level agrees with the design level within the specified tolerance and issue a certification letter to the Site Auditor stating that the compacted subgrade surface has been formed in accordance with the RAP and is suitable for construction of the proposed 3 m thick ‘engineered fill’ blanket. Construction of the ‘engineered fill’ blanket should only commence after the Site Auditor has received the certification letter from the Environmental Consultant and approved the commencement of the work.

The types of on-site fill to be used for the lower 1.4 m thick layer of the ‘engineered fill’ blanket will ultimately depend on how much existing fill is used for Benedict’s recycling and processing operations. Only on-site soils that have been validated in accordance with the RAP requirements (Section 19.1) and shown to meet the Residential A SAC (Section 15.1) are to be used to construct the lower 1.4 m of the 3m thick ‘engineered fill’ blanket.

The in-situ volume of on-site fill required to construct the 1.4 m thick lower blanket layer will be subject to confirmation from Benedict. Any deviation from the specified thickness will involve a reduced thickness of site-won material and a corresponding increased thickness of imported VENM.

The protocol to manage site-won stockpiled soils that fail the RAC for the upper 3 m of soil and contaminated soil excavated as part of deeply buried services construction work is as follows:

- Designation of an on-site burial area for the placement of the soils and the location of the burial area must be recorded on a drawing in the validation report;
- Alternatively, this material could be classified and disposed at a suitably licensed off-site waste facility in accordance with Section 17.5 of the RAP.

The Environmental Consultant should ideally inspect the general site preparation earthworks at a frequency not less than once per week and record the inspection findings in the site inspection field record prepared in the field at the time of the site inspection. A photo record of site conditions must also be taken.

The Site Auditor should inspect the 1.4 m thick layer when it has been completed in an area and before the commencement of other work in the area.

16.2.5 Installation of Deeply Buried Services

All services that will be located below the 3 m thick ‘engineered fill’ blanket are to be constructed prior to the placement of the 3 m thick ‘engineered fill’ blanket. Based on the current design, this is understood to comprise the deep trunk sewer main (refer to the drawing of this sewer main in Appendix B). The relevant protocols in Section 21 of this RAP are to be followed during the construction of this service line. Specific geotechnical protocols for the installation of any such services are to be prepared by the Geotechnical Consultant as these services will be below the 3 m thick ‘engineered fill’ blanket.

Protocols for the maintenance of these deeply buried services will be included in the long term EMP.

All deeply buried services shall be constructed in an area prior to the commencement of construction of the 3 m thick ‘engineered fill’ blanket.

16.2.6 Accurate Surveys

Accurate surveys of the following items are to be completed:

- The final subgrade level across the site onto which the 3 m thick ‘engineered fill’ blanket is to be constructed; and
- The top surface of the 1.4 m thick site-won fill layer, which forms the lower layer of the 3 m thick ‘engineered fill’ blanket.

The surveys will be used to determine whether the 3 m thick ‘engineered fill’ blanket has been constructed to the required thickness and top surface elevation. A licensed surveyor should undertake the surveys. The surveys should consist of the measurement of spot heights across the site at grid spacing not larger than 20 x 20 m and to an accuracy of <10 mm. The results of each survey are to be plotted on a scaled surveyor’s drawing, with topographic elevations contoured at intervals of 0.2 m.

Copies of the survey plans are to be provided by the Environmental Consultant in their Stages 1 & 2 and Stage 3 validation reports.

16.3 Stage 2: VENM Capping

16.3.1 Hold Point Requirements

The hold points that need to be met prior to the commencement of Stage 2 VENM capping in an area. These conditions should include, but not be limited to:

- The Geotechnical Engineer has certified in writing that the subgrade and the lower 1.4m layer in the area have been constructed in accordance with and meets all geotechnical requirements, as specified in the geotechnical design reports and this RAP;
- The Environmental Consultant has certified in writing that all existing buried services have been removed from the area, validated by the Environmental Consultant and backfilled in accordance with the geotechnical requirements;
- The Environmental Consultant has certified in writing that all deeply buried services have been constructed in an area;
- The Environmental Consultant has certified in writing that the 1.4 m lower layer of the capping blanket have been validated in accordance with the RAP and the soils meet the Residential A criteria; and
- The Site Auditor has inspected the completed 1.4 m thick layer and issued an approval for the commencement of construction of the 1.6 m VENM layer.

16.3.2 Work Procedures

In summary the procedure for the Contractor for importation and placement of the 1.6 m VENM cap that will form the upper portion of the 3 m thick ‘engineered fill’ blanket:

- Seek approval from the Geotechnical Engineer on the geotechnical suitability of proposed imported VENM which is required to comprise well graded granular material (J&K, 2016a);
- Evaluate VENM source material, from a site contamination standpoint, in accordance with the site Fill Management Protocol for Imported VENM Cap Construction (FMP) (refer to Section 18 and Appendix J);
- Seek approval from the Environmental Consultant that the VENM source material complies with the requirements of the FMP;
- Commence importing VENM;
- Place VENM in accordance with the Specification in J&K (2016a);
- Maintain records of fill importation and placement in accordance with the FMP to provide to the Environmental Consultant to include in the final site validation report;
- The Environmental Consultant should inspect construction of the 1.6m thick VENM layer at an initial frequency not less than once per week and record the inspection findings in the site inspection field record prepared in the field at the time of the site inspection. Inspection frequency can be reduced to coincide with the completion of specified completed areas once the suitability

of any particular VENM source is established. A photo record of site conditions should also be taken; and

- The Site Auditor should inspect the 1.6 m thick layer when it has been completed in an area and before the commencement of other work in the area.

VENM importation will be managed under the FMP (Appendix J). Imported VENM will be progressively validated as set out in the FMP. Notwithstanding validation of the final surface of the 3 m thick capping materials will be undertaken by the Environmental Consultant via grid based sampling, initially on a 30 x 30 m grid, however the sampling grid may be progressively reduced towards a wider grid of 100mx100m, once the provenance of imported VENM is established. The analytical suite will be the same as set out in the FMP. Provision of validation document for this component will comprise a hold point to enable an auditor inspection (it is envisaged that this would combined with the inspection of VENM placement).

16.3.3 Geotechnical Validation

The geotechnical properties of the 3 m thick 'engineered fill' blanket are to be progressively validated as the capping layer is completed. The results of the geotechnical validation are to be documented in a report prepared by the Geotechnical Engineer in accordance with Australian Standards. Further details of the Geotechnical Validation program are provided in Section 19.3.

16.3.4 Stages 1 and 2 Validation Report

The Environmental Consultant shall prepare a validation report at the end of the Stages 1 and 2 works. The purpose of the report will be to document all remediation and validation work undertaken for the Stages 1 and 2 work and provide copies of all collected data in accordance with NSW EPA endorsed guidelines. The report(s) is to include a copy of the geotechnical validation report for the Stages 1 and 2 earthworks including the 3 m thick 'engineered fill blanket'.
The Site Auditor will review the validation report and will assess whether the Stage 1 and 2 work was completed in accordance with the RAP and regulatory requirements. The Site Auditor will document the results of the audit in a Section B site audit statement (SAS) and site audit report (SAR). The Section B SAS would be used by the developer to support the granting of a construction certificate/occupation certificate for the housing, and associated infrastructure work. Follow-up validation reports would then be submitted to the auditor for the Stage 3 work as it is progressively completed across the site, as described in Section 19.

No Stage 3 work is to commence until a Section B SAS has been issued by the Site Auditor that concludes that the Stage 1 and 2 work has been completed and the site is in a condition suitable for the commencement of the Stage 3 work.

16.4 Stage 3: Installation and Verification of Landfill Gas Mitigation Measures

Landfill gas mitigation measures must meet the minimum design, installation and verification (CQA) requirements set out in:

- NSW EPA (2012) *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases* and related (referenced) publications, including:

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

In summary the Stage 3 landfill gas mitigation measures can be divided into two sub-stages as follows:

- Stage 3a: Design the measure(s) or system element(s) to achieve a score consistent with what is required based on the CGS of 3 (i.e. 4.5 points); and
- Stage 3b: Installation of the measure(s) or system element(s) and compliance with the relevant CQA.

16.4.1 Minimum Requirements

The landfill gas mitigation measures shall be designed, installed and verified in accordance with the minimum requirements specified in the NSW EPA (2012) guideline, the BS 8485:2015 Code of Practice, CIRIA (2014) C735 Good Practice on the Testing and Verification of Protection Systems for Buildings against Hazardous Ground Gases and relevant Australian Standards.

16.4.2 Installation and Verification Plan

The Contractor shall prepare an Installation and Verification Plan for the Stage 3 work that meets the minimum requirements specified in Section 16.4.1 and the landfill gas Mitigation System Design Report prepared by the Environmental Consultant and approved by the Site Auditor in Stage 1.

The verification plan for the Stage 3 work shall be presented as a Construction Quality Assurance (CQA) Plan. The Installation and Verification Plan shall be reviewed and approved in writing by the Environmental Consultant and the Site Auditor prior to the commencement of Stage 3 work.

16.4.3 Hold Point Requirements

The hold points that need to be met prior to the commencement of Stage 3 landfill gas mitigation measures in an area include, but not be limited to:

- The Site Auditor has completed a Section B SAS that certifies that the Stage 1 and 2 remediation and validation work has been completed in the area in accordance with the RAP and that the area is in a condition suitable for the commencement of the Stage 3 work;
- The Planning Authority was issued a Development Consent allowing the Stage 3 work to commence in the area; and
- The Site Auditor has approved in writing the Installation and Verification Plan for the Stage 3 landfill gas mitigation measures.

16.4.4 Installation of Landfill Gas Mitigation Measures

The Stage 3 work shall be undertaken in accordance with the approved Installation and Verification Plan. The Environmental Consultant shall regularly inspect the Stage 3 work sufficient to allow the Environmental Consultant to determine whether the landfill gas mitigation measures are being installed and verified in accordance with the approved Installation and Verification Plan. The frequency of the Environmental Consultant's site inspections should not be less than once per week.

The Environmental Consultant shall document the findings of each site inspection in a site inspection field record prepared in the field at the time of the site inspection. A photo record of site conditions should also be taken. During the inspection the Environmental Consultant should determine whether the Contractor's work was being undertaken in accordance with the approved Installation and Verification Plan, the required data and documentation was being generated by the Contractor, and non-conformances are identified and their significance assessed.

Copies of the Environmental Consultant's site inspection field records and site photos are to be included in the Stage 3 validation report. The Environmental Consultant shall notify the Site Auditor without unreasonable delay of any significant defects in the installation and verification work being undertaken by the Contractor.

16.4.5 Verification of Landfill Gas Mitigation Measures

Landfill gas mitigation measures shall be verified and documented by the Contractor in accordance with the minimum requirements specified in Section 8 of BS 8485:2015 and the design phase report. These include, but may not be limited to:

- A description of any measures installed – this could be presented in textual form, as photographic records or by as-built construction drawings (any variations to the pre- construction design should be fully detailed and justification(s) presented);
- Details of who installed the measures;
- Details of who inspected or verified the installation/s and a description of how this took place, together with any constraints (i.e. areas that could not be inspected or tested) or other issues of uncertainty;
- Verification test results, outcome of inspections and compliance data should be provided, either within the main text or as an Annex to the report;
- Any defects identified, together with corrective actions and subsequent verification checks;
- Copies of regulatory correspondence/sign-off;
- Manufacturers' specifications, warranties and/or guarantees;
- Personnel details (such as relevant qualifications);
- Maintenance requirements and/or limitations of the system; and
- A concluding comment about the suitability (or otherwise) of installed gas measures and include the name of the author, company details and date of issue.

The installation and verification documentation for each structure at the site shall be provided in an installation and verification report prepared in accordance with Section 19.2. The Environmental Consultant shall undertake all necessary additional verification work that may be required to meet the minimum requirements.

16.4.6 Stage 3 Validation Report

The Environmental Consultant shall prepare a validation report at the end of the Stage 3 work. The purpose of the report will be to document all remediation and validation work undertaken for the Stage 3 work and provide copies of all collected data in accordance with NSW EPA endorsed guidelines.

A copy of the geotechnical validation report for the Stage 3 work shall be included in Environmental Consultant's validation report.

The validation report would be reviewed by the Site Auditor, who will assess whether the Stage 3 work was completed in accordance with the RAP and regulatory requirements. The Site Auditor will document the results of the audit in a Section A site SAS and SAR only if passive landfill gas mitigation measures have been used and the area is suitable for the intended land uses. The Section A SAS would be used by the developer to support the Planning Authority issuing an Occupation Certificate for housing and associated infrastructure work constructed in the area.

16.5 Contingencies for Unexpected Finds

Given the presence of anthropogenic material in the fill (i.e. building rubble), it is possible that significant quantities of asbestos may also be present. Unexpected conditions also include biodegradable material, odorous waste, leachable material, voids, soft compressible material, and any other material not previously documented as having being present at the site.

If unexpected conditions are encountered during the remediation (such as significant quantities of asbestos, buried tanks, significantly stained soils or unexpected contaminated soil or contaminants), the following general approach will be adopted:

- Stop work in the area of impact and barricade area to prevent access;
- The Site Manager is to contact the Principal's representative and the Environmental Consultant;
- The Environmental Consultant will make an assessment of the severity of the occurrence in terms of the potential impact to human health and the environment;
- The Environmental Consultant will liaise with the Principal's representative as required;
- Provision of advice from the Environmental Consultant to the Principal's representative regarding the recommended course of action;
- Obtaining necessary approvals from Council and the Auditor; and
- Implementation of the agreed management/remediation strategy.

Any areas of fill exhibiting indications of contamination (e.g. buried tanks) or that significantly differ from the materials previously assessed must be characterised as part of the remediation works. If significant quantities of bonded ACM or FA and AF are encountered, a site specific asbestos management plan should be prepared by an occupational hygienist / Environmental Consultant and that work must be undertaken by an appropriately licenced contractor.

Where unexpected finds are reported the Environmental Consultant should independently assess the nature of the find and determine whether the RAP already makes suitable provisions to deal with the situation. It is envisaged that regular (at least weekly) site inspections by the Environmental Consultant will presage earthworks in all areas prior to their scheduled commencement. A detailed daily record of all site works should be maintained by the Remediation Contractor and Environmental Consultant (inspections) and the documents provided in the site validation report. The occurrence and management of all Unexpected Finds is to be documented in the relevant validation report.

16.6 Ground Gas Contingency Measures

Should site conditions warrant the expansion of the landfill gas measures, as noted above, into areas which would otherwise have only been subject to a 3 m engineered capping layer, then the reason for additional measures must be reported and provided to the Site Auditor along with the proposed mitigation design. If required it is anticipated that the design will depend on the severity of the gas concentrations and other factors affecting the CGS and the specific land use (exposure risk) proposed in the affected area.

Conceptually for areas other than residential footprints where the risk (consequence) of gas build up is lower the mitigation system will be correspondingly less protective. For example, in landscaped areas normally the 3m cap will suffice, however if gas emissions are observed then the mitigation system may comprise some or all of the components listed below:

- Earthen cover/bituminous concrete;
- Protective Geotextile;
- Gas proof membrane;
- Geotextile;
- 100 mm crushed gravel screenings (nominal >20 mm, no fines) with geo-vent collection strips; and
- Anti-silting geotextile.

Each modification to the system will require specific design which will depend on circumstances and will require to be agreed by the Site Auditor. Installation, construction validation and reporting will follow the same steps as outlined above.

This RAP is based on the design assumption that only passive landfill gas mitigation measures are required for the long term management of landfill gas at the site following the completion of the Stage 3 work, since it is not feasible for active measures to be used for long term management of residential areas of this nature.

The triggers that will apply for decisions to be made on the need for additional / revised landfill gas mitigation measures will be based on the outcome of proposed validation monitoring (refer to the SAQP – DP, 2017b).

The additional remediation measures that would be undertaken if a CGS of greater than 3 was calculated during validation monitoring may involve further evaluation of risk and/or targeted excavation and off-site disposal and/or on-site screening of gas generating fill.

16.7 Roles and Responsibilities

In summary the various parties are defined as follows along with their roles and responsibilities:

- The Principal, responsibility to ensure appropriate personnel are appointed to manage and conduct the remediation and validation works;
- Principal's Representative, who is responsible for overseeing the implementation of this RAP;
- Remediation Contractor, who will be responsible for conducting the remediation works and managing the site;
- Environmental Consultant, who will be responsible for providing advice as required for the remediation works and undertaking the validation works in accordance with this RAP;
- Geotechnical Consultant, who will be responsible for providing advice as required related to geotechnical aspects of the remediation works and undertaken validation works in accordance with this RAP; and if necessary
- Occupational Hygienist, who will be responsible for asbestos issues including air monitoring.

The Remediation Contractor will be responsible for preparing a list of contacts, including emergency contacts for the site operations and provision of signage at the site to allow the public to contact nominated site personnel out of hours.

The Environmental Consultant is also responsible for inspecting the site and collecting all necessary validation data that will allow the Environmental Consultant to conclude that:

- The remediation and validation work has been undertaken in accordance with the RAP and regulatory requirements; and
- The remediated site at the end of the Stage 3 work is suitable for Residential A land use provided it is managed in accordance with a long-term EMP approved by Council.

The Geotechnical Consultant is also responsible for inspecting the site and collecting all necessary geotechnical validation data that will allow the Geotechnical Consultant to conclude that:

- The earthworks conducted at the site were undertaken in accordance with the RAP and regulatory requirements; and
- The site at the end of the Stage 3 work is geotechnical suitable for residential land use.

16.8 Site Supervision

Supervision of the works will require varying degrees of input from the various parties nominated above. Likely supervision requirements are set out below in Table 10.

Table 10: Supervision Requirements during Remediation

Party	Supervision	Competency
The Principal, responsibility to ensure appropriate personnel are appointed to manage and conduct the remediation and validation works.	As required	Ability to delegate responsibility
Principal's Representative, who is responsible for overseeing the implementation of this RAP.	Daily	Suitably qualified and experienced consultant or contractor
Remediation Contractor, who will be responsible for conducting the remediation works and managing the site;	Daily	Suitably qualified and experienced contractor holding necessary licenses and approvals to do the works
Environmental Consultant, who will be responsible for providing advice as required for the remediation works and undertaking the validation works in accordance with this RAP.	Weekly or as required	Qualified and suitably experienced consultant meeting the definition of competent person as defined in NEPM (2013)
Geotechnical Consultant, who will be responsible for providing advice as required related to geotechnical aspects of the remediation works and undertaken validation works in accordance with this RAP.	Weekly or as required	Qualified professional civil or geotechnical engineering consultant with lead consultant holding EA NER
Occupational Hygienist, who will be responsible for asbestos issues including air monitoring.	As required	WorkCover NSW licensed asbestos assessor and certified full member of the AIOH

Note: the Geotechnical Consultant should inspect the backfill material not only for geotechnical characteristics, but also for physical evidence of contamination that should include, *inter alia*, asbestos fragments, industrial waste (e.g. slag, ash), stained / odorous material, types and proportions of anthropogenic material present, the proportion of timber and degradable material present in the material.

The Geotechnical Consultant must prepare a detailed record of each inspection and provide a copy to the Environmental Consultant for review and inclusion in the site validation report.

16.9 Environmental Monitoring Programme

The environmental monitoring programme to be undertaken during remediation is set out in Table 11 below.

Table 11: Environmental Monitoring Programme during Remediation

Item	Method	Locations	Frequency	Reporting	Party
Dust (air quality)	Approved methods for sampling and analysis of air pollutants in NSW (NSW EPA, 2007) NSW EPA references Australian Standard (AS) 3580.10.1-1991 as the method for measuring deposited particulate matter.	4 locations on site boundary	Monthly	Monthly	EC
Asbestos fibres (air quality)	Membrane filter method	4 locations on site boundary	As required for asbestos-related works		OH
Methane	Surface monitoring as per Environmental Guidelines Solid Waste Landfills (2nd Ed) 2016	10 m transects on final capped areas	Monthly and as required as each fill area is completed	Monthly	EC
Landfill gas (geoprobe)	Landfill gas concentration with triggers to install monitoring wells to allow flow measurements.	20 monitoring points.	Monthly	Monthly	EC
Groundwater (contingency only)	Bore (monitoring well) samples	As established by monitoring programme (refer to Section 16.1.8)	Monthly	Monthly	EC
Surface Water	Grab samples	Two (2) locations in Georges River and two (2) in the dredge pond (proposed marina basin) (4 locations in total)	Monthly	Monthly	EC

Notes: EC Environmental Consultant and OH Occupational Hygienist

The above monitoring requirements for landfill gas (subsurface) and surface water quality are provided in the DP (2017b) SAQP.

Changes to the Environmental Monitoring Programme can only occur after the Site Auditor has issued a written approval of the proposed changes.

17. Management and Waste Classification of Excavated Material

17.1 Stockpiling of Contaminated Material

If required, contaminated material shall be stockpiled at a suitable designated location. Suitable locations include any areas not previously remediated and/or covered with final capping materials (VENM). Stockpiles should not exceed 5 m in height and <100 m^2 footprint and should be suitably positioned and managed to minimise dust and odours (see below). In the absence of a suitable NSW guideline stockpile management should follow the ‘Guideline for stockpile management: Waste and waste derived products for recycling and reuse’, (SA EPA, 2010).

Dust control is recommended for all stockpiled materials and should include light conditioning with water for exposed materials or covering with an anchored geotextile or similar.

All stockpiles of potentially contaminated material to remain on the site overnight shall be surrounded by star pickets and marking tape or other suitable material to clearly delineate their boundaries and be adequately secured in order to reduce the risk of sediment runoff. Should the stockpile remain for over 48 hours they should be appropriately managed to prevent fugitive dust leaving the site (e.g. light wetting or covering with an anchored geotextile depending on weather conditions) and geotextile silt fences or hay bales should be erected around each stockpile to prevent losses by surface erosion.

17.2 Waste Classification

The need for waste classification testing may arise, for example, under the following circumstances:

- Unexpected finds are encountered during the Stage 1: Site Preparation Earthworks;
- Geotechnically unsuitable material requires off-site disposal; and
- Detailed excavations (i.e. footings and buried services) generate excess spoil that requires off-site disposal.

Materials requiring waste classification for off-site disposal purposes should be excavated and stockpiled and classified with reference to NSW EPA (2014a) *Waste Classification Guidelines, Part 1: Classifying Waste*. The adopted sampling frequency for stockpile waste classification sampling will be based on NEPC (2013). NEPC (2013) suggests adopting the Vic EPA (2010) *Soil Sampling* guideline to characterise large stockpiles in excess of 200 m^3. The Vic EPA guideline would be adopted only for stockpiles in excess of 200 m^3. Proposed stockpile sampling frequencies are shown in Table 12, below, however, the sampling frequency could be reviewed (reduced) based on the consistency of the results.

Table 12: Minimum Number of Samples Recommended for Stockpiles

Stockpile Volume (m^3)	No. Samples
<75	3
75 - <100	4
100 - <125	5
125 - <150	6
150 - <175	7
175 - <200	8

Samples shall be screened using a photo-ionisation detector (PID) and analysed as outlined below:

- Analysis of metals, TRH, BTEX, PAH and asbestos (all samples);
- Analysis of PCB, OCP and PCB (one in three samples);
- Analysis of specific samples for any identified additional contaminants of concern. Potential for concern will be based on visual and olfactory observations and PID results; and
- Analysis of selected samples for TCLP for metals and PAH based on total concentration results as appropriate to complete the waste classification.

17.3 Spoil Contingency Plan

Any materials which fail to meet the NSW EPA (2014a) criteria for direct landfill disposal (i.e. Hazardous Waste materials) following initial waste classification assessment will require segregation and separate stockpiling pending further testing and treatment. The contingency plan to cater for the storage, treatment and disposal of these materials is as follows:

- On the basis of on-site observations and the contaminant exceedances recorded, materials will be carefully excavated, segregated and placed in well delineated locations;
- Stockpiles of excavated materials will be appropriately bunded with hay bales / sandbags and if required conditioned with water, covered and/ or lined with anchored impermeable plastic sheeting to prevent dust generation;
- If considered appropriate, further sampling and analysis will be conducted to more fully characterise the subject material, and confirm its contamination status. If the further characterisation works show that the material can be classified as General Solid Waste or Restricted Solid Waste, dispose of the material directly to an appropriately licensed landfill;
- Review potential options for the treatment, re-use or recycling of the material, and adopt options identified to be suitable for the subject material; and
- Review NSW EPA's General Immobilisation Approvals on the NSW EPA website. If an applicable General Immobilisation Approval exists, further assess/dispose of the waste in accordance with the approval and other approvals or licences as required by the NSW EPA.

If no General Immobilisation Approval is applicable to the material, NSW EPA (2014b) *Waste Classification Guidelines Part 2: Immobilisation of Waste* will apply, and the following will be conducted:

- Conduct additional sampling and analysis as required based on the available results to provide information for immobilisation options. In general immobilisation options include natural immobilisation, chemical fixation, micro-encapsulation and macro-encapsulation;
- Investigate, including trials as appropriate, immobilisation treatment options for the material;
- Apply to the NSW EPA for a Specific Immobilisation Approval; and
- Implement the requirements imposed on management/disposal of the material by the NSW EPA including (if applicable) Chemical Control Orders issued under the *Environmentally Hazardous Chemicals Act* 1985 (EHC Act).

17.4 Loading and Transport of Spoil

All transport of waste and disposal of materials must be conducted in accordance with the requirements of the *Protection of the Environment Operations Act* (1997) (POEO Act). All required licences and approvals required for disposal of the material will be obtained prior to removal of the materials from the site.

Transport of spoil shall be *via* a clearly delineated, pre-defined haul route.

Removal of waste materials from the site shall only be carried out by a licensed contractor holding the appropriate licence, consent or approvals to dispose of the waste materials according to the classification outlined in the waste classification guidelines and with the appropriate approvals obtained from the NSW EPA, if required.

The truck dispatch shall be logged and recorded by the Contractor for each load leaving the site and comply with appropriate waste tracking requirements. A record of the truck dispatch will be provided to the Principal's representative. All tip dockets related to off-site disposal of waste materials must be supplied to the Environmental Consultant for inclusion in the site validation report.

17.5 Disposal of Material

When site work associated with this RAP commences at the site, all materials excavated and removed shall be disposed in accordance with the POEO Act and to a facility/site legally able to accept the material. Copies of all necessary approvals from the receiving site shall be given to the Principal's representative prior to any contaminated material being removed from the site. A record of the disposal of materials will be maintained.

All relevant analysis results shall be made available to the Remediation Contractor and proposed receiving site / waste facility to enable selection of a suitable disposal location. Holding arrangements, treatment and disposal requirements for excavated materials which fail to meet the landfill disposal guideline levels are discussed in Section 17.3.

Details of all contaminated and spoil materials removed from the site (including VENM) shall be documented by the contractor with copies of weighbridge slips, trip tickets and consignment disposal confirmation provided to the Environmental Consultant and the Principal's representative. A site log will be maintained by the Principal's representative to track disposed loads against on-site origin.

Accordingly all excavated material be tracked from source to repository, whether refilled on site or disposed off-site and appropriately documented including volumes so that the data can be checked by the Environmental Consultant and independently verified by the Site Auditor. All excavated materials removed from the site shall be tracked from cradle to grave and documented by the Environmental Consultant in validation reports sufficient to allow the Site Auditor to validate that this requirement was met.

18. Imported VENM for Cap

18.1 Imported VENM for Cap

An FMP for the site has been prepared as a stand-alone document (see Appendix J). All imported VENM fill for the upper 1.6 m cap must comply with the FMP. The FMP details the requirements for assessing the VENM prior to importation to the site, with respect to contamination and (if required) salinity, and the procedures to be implemented during the course of VENM importation. Application of the FMP to all soil and rock to be imported to the site will provide a consistent approach to the management of materials with respect to their suitability for use as the proposed cap.

The following should be considered with respect to the implementation of the FMP:

- The FMP applies only to the materials imported for the bulk earthworks and does not apply to other materials imported to the site for the purpose of road construction or drainage works etc.;
- It is the responsibility of Benedict Industries Pty Ltd and its nominated qualified Geotechnical and Environmental Consultants to maintain compliance with the FMP; and
- The suppliers of the materials are required to provide the supporting documentation to verify that the subject material complies with the FMP. It is the suppliers' responsibility to ensure that the supporting documentation is complete and correct. In this regard, the suppliers of materials must be issued with a copy of the FMP.

18.2 Other Materials Required by the Remediation / Redevelopment Work

Other non-VENM materials that are not associated with the VENM cap (the cap is to comprise only VENM) may be imported to the site after works associated with this RAP commence. These materials may include:

- Gravel or recycled aggregate associated with gas drainage layers;
- Materials for road construction and drainage work; and
- Landscaping topsoil for vegetated areas.

These materials are to be managed, tracked and stockpiled separately from the imported VENM and must comply with all regulatory requirements.

19. Site Validation

19.1 Validation Sample Collection and Analysis

19.1.1 Existing Fill to be Incorporated into the 3 m Thick Engineered Fill Blanket

Following the Stage 1a excavation of deep fill areas, screening and stockpiling of this fill and Stage 1b progressive excavation and stockpiling of site material to a level of -3.0 m of final design level (i.e. excavate to a depth of approximately 1.4 m equating to approximately 126 000 m^3), the stockpiled fill will be validated for chemical contaminants and asbestos as follows:

- Collection of validation samples at a frequency of one sample per 500 m^3 with scope to adjust the frequency to one sample per 1000 m^3 depending on the consistency of the results. The sampling frequency is considered appropriate because (i) there is a considerable amount of existing data characterising these materials as set out in the DSI (DP, 2016) and accordingly this sampling regime represents a supplementary data set, and (ii) imported VENM will be placed about the existing fill to a minimum depth of 1.6 m thus preventing normal access and exposure;
- The stockpile soil sampling frequency of one sample per 500 m^3 for all contaminants of concern shall not be adjusted without prior written approval of the Site Auditor. A lower stockpile frequency for some analytes may be justified after the collection and testing of not less than 50 validation stockpile samples;
- Analysis of validation samples for metals, TRH, BTEX, PAH, OCP, OPP, PCB, Phenols and asbestos (10 L sample for ACM and 500 mL sample for FA and AF) as per the RAC in Table 8, and Section 15.1. Neutral leachate tests for heavy metals and PAHs should be undertaken at a frequency of not less than 10% of stockpile validation samples;
- The Environmental Consultant should inspect each stockpile during or following completion of the stockpile formation and again during its removal and placement and will record the inspection findings in the site inspection field record prepared in the field at the time of the site inspection. A photo record of site conditions should also be taken. Auditor inspection should take place as required by the auditor;
- Collection and analysis of QA/QC samples as per Section 20.2; and
- Statistical evaluation of the data set to provide the 95% UCL of the mean concentrations, identification of hotspots (≥ 2.5 x RAC), SD < 50% of the RAC and identification of statistical outliers.

Validation samples should be collected at a minimum rate of eight per batch to allow for a statistical analysis to be undertaken on the batch (if required). In this regard, the Contractor should aim to generate stockpiles of approximately 4000 m^3.

If the validation samples exceed the RAC (Section 15.1) further assessment of the relevant 500 m^3 component should be undertaken to evaluate which portion(s) of the stockpile are suitable for retention on site and which may require off-site disposal.

Following the Stage 1a excavation of deep fill areas, screening and stockpiling of this fill and Stage 1b progressive excavation and stockpiling of site material to a level of -3.0 m of final design level (i.e. excavate to a depth of approximately 1.4 m equating to approximately 126 000 m^3), the stockpiled fill will be validated for aesthetic parameters as defined by the outcome of the development of the RAC for these parameters (refer to Section 15.1).

The validation of the RAC for anthropogenic materials of ≤ 5% may be with reference to either or a combination of:

- NSW Roads & Traffic Authority Test Method T276 Foreign Materials Content of Recycled Crushed Concrete; and
- Qualitative methods (i.e. visual inspection of screened material).

The validation of the RAC for significant reduction in organic matter (approximately ≥ 70%) may be with reference to either or a combination of:

- Organic matter content (macro scale soil test);
- NSW Roads & Traffic Authority Test Method T276 Foreign Materials Content of Recycled Crushed Concrete; and
- Qualitative methods (i.e. visual inspection of screened material).

The physical condition (description, odour, staining, anthropogenic content) of each soil validation should also be recorded and included in the validation report, since these properties correspond to remediation acceptance criteria given in Section 15.1;

Soil samples should be representative of the materials being validated and also target any suspect materials based on physical appearance.

Soil samples from stockpiles should be collected using the procedures specified in Section 7.5 of the NEPM (2013) Schedule B2 guidelines. For example:

- Stockpiles should be managed so they only contain one type of relatively uniform material;
- A uniform sample point distribution should be used across each stockpile, with the sample locations used for each stockpile documented on a plan that is provided in the validation report;
- Samples for inorganic and non-volatile components should be taken at various depths towards the centre of the stockpile from 300 mm below the stockpile surface;
- Samples for volatile and semi-volatile compounds should be taken without delay from a freshly excavated surface 500 mm or greater depth below the stockpile surface;
- Composting of samples will not occur; and
- Systematic sampling directly from excavator buckets during the stockpile formation process or for appraisal of larger stockpiles using appropriate QA/QC processes is an acceptable strategy.

The Environmental Consultant will undertake the validation sampling.

19.1.2 Contingency Excavation of 'Hotspots' Encountered During Earthworks

Should fill 'hotspots' be identified during excavation or stockpile sampling, the 'hotspot' should be removed and the walls and the base and walls of the excavation will be validated as follows:

- Inspection of the excavated surface and collection of validation samples from excavation to characterise the excavation boundary conditions and validate the removal of the 'hotspot' as follows:
    - BASE OF EXCAVATION – approximately one sample over nominal 30 m x 30 m grid (minimum one sample per base);
    - SIDE OF EXCAVATION – one sample per 10 linear metre and 2 m to 3 m depth intervals (minimum one sample per wall);
- Analysis of validation samples for the contaminants of concern (e.g. metals, TRH, BTEX, PAH, OCP, OPP, PCB, phenols or asbestos); and
- Collection and analysis of QA/QC samples as per Section 20.2.

If the validation samples exceed the RAC (Section 15.1) further excavation of the contaminated materials will be required with further validation samples taken until the results are within the RAC.

The Environmental Consultant will undertake the validation sampling.

19.1.3 Backfill Placed below Subgrade Level

The validation protocols for fill used to backfill excavation below the subgrade level of the 3 m thick 'engineered fill' blanket are as follows:

- Undertake a visual inspection of the material and physically remove (or screen out) any gas or leachate generating material;
- Adopt the sampling methodology outlined in Section 19.1.1;
- Analysis of validation samples for TRH, BTEXN as per the RAC in Table 8, and Section 15.2;
- If, after the first 50 samples tested, all results indicate the general absence of VOC contamination (i.e. TRH and/or BTEXN), review and reduce the sample frequency;
- The Environmental Consultant should inspect each stockpile during or following completion of the stockpile formation and again during its removal and placement and record the inspection findings in the site inspection field record prepared in the field at the time of the site inspection. A photo record of site conditions should also be taken;
- Collection and analysis of QA/QC samples as per Section 20.2; and
- Statistical evaluation of the data set to provide the 95% UCL of the mean concentrations, identification of hotspots (≥ 2.5 x RAC), SD < 50% of the RAC and identification of statistical outliers.

19.1.4 Geotechnical Validation

Geotechnical RAC are set out in Section 15.5 as specified by J&K (2017) and in their response to auditor comments dated 22 August 2016 (J&K, 2017). The monitoring, testing and validation of the geotechnical site improvement against the relevant RAC stipulated by J&K will be undertaken the Geotechnical Engineer (J&K). The results of the geotechnical validation will be incorporated as an appendix into the site validation report.

The various geotechnical requirements of the earthworks must be validated and documented by the Geotechnical Consultant. These requirements include, but may not be limited to:

- The proof-rolling the base of proposed 'backfill' areas;
- The HEIC work;
- The type of fill and compaction of the fill used to construct the 3m thick 'engineered fill' blanket; and
- The results of further geotechnical investigations once the 3m thick 'engineered fill' blanket has been completed, as recommended in J&K (2017).

The geotechnical validation report should be confirm the predicted future settlement of building foundations, the site classification and pavement design CBR value.

The geotechnical validation report should include a letter from the design structural engineer confirming that all structures to be built at the site have been designed to tolerate settlements predicted by the Geotechnical Consultant. The geotechnical validation report should be prepared in accordance with relevant Australian Standards and a copy included in the Stages 1 and 2 validation report prepared by the Environmental Consultant.

19.2 Stage 3 – Validation of the Landfill Gas Mitigation Measures

The validation of the measure(s) or system element(s) of the landfill gas mitigation system shall involve a review of the CQA documentation (to be developed on the basis of the proposed structures – refer to Section 16.4) by the Environmental Consultant. The landfill gas mitigation measure(s) or system element(s) installed for every structure constructed at the site shall be verified and documented in a Stage 3 validation report prepared by the Environmental Consultant in accordance with NSW EPA endorsed guidelines.

Validation CQA criteria will include:

- Checking the specification of the supplied anti-silting, cushioning and protective geotextile layers, specification to be determined following receipt of detailed design of the development;
- Confirming the suitability of the gravel blanket materials by undertaking random sampling and PSD analysis of the supplied materials (AS 1289.3.6.1—2009). One sample per building lot will be tested;
- Confirming the suitability of geovent gas collection strips including open area;
- Undertaking visual inspection of gas proof membrane particularly around seals and penetrations and using smoke testing where feasible; and
- Visual inspection of the slab for defects, cracks, unsealed joints etc.

In addition methane validation within built structures and voids e.g. foundations of each building will be undertaken using a GA5000 or similar. A methane trigger level of 10% LEL will be adopted. If the trigger value is exceeded then an assessment of risk and any additional mitigation measures will be made.

The Environmental Consultant shall prepare a Stage 3 validation report for each part of the site, with the number of validation reports needing to be prepared depending on the staging of the residential development and the requirements of the developer. Each Stage 3 validation report shall include a copy of an implementation and verification report prepared by the Contractor who installed the landfill gas mitigation measures together with additional data collected by the Environmental Consultant during the Stage 3 installation and verification work.

The implementation and verification reports shall be prepared by the Contractor in accordance with the minimum requirements specified in the NSW EPA (2012), BS 8485:2015 Code of Practice, CIRIA (2014) C735, and relevant Australian Standards. These minimum requirements should include those already described in this section of the RAP together with, but not be limited to [Section 8, BS 8485:2015]:

- A description of any measures installed – this could be presented in textual form, as photographic records or by as-built construction drawings (any variations to the pre- construction design should be fully detailed and justification(s) presented);
- Details of who installed the measures;
- Details of who inspected or verified the installation/s and a description of how this took place, together with any constraints (i.e. areas that could not be inspected or tested) or other issues of uncertainty;
- Verification test results, outcome of inspections and compliance data should be provided, either within the main text or as an Annex to the report;
- Any defects identified, together with corrective actions and subsequent verification checks;
- Copies of regulatory correspondence/sign off;
- Manufacturers’ specifications, warranties and/or guarantees;
- Personnel details (such as relevant qualifications);
- Maintenance requirements and/or limitations of the system; and
- A concluding comment about the suitability (or otherwise) of installed gas measures and include the name of the author, company details and date of issue.

With each Stage 3 validation report, the Environmental Consultant shall include a final version of the long-term Environmental Management Plan (EMP), based on the preliminary version approved by Council prior to the commencement of remediation work.

For each Stage 3 validation report, the Environmental Consultant is to provide a copy to the Site Auditor. The Site Auditor will then review the Stage 3 validation report and determine whether the documentation demonstrates that the part of the site covered by the report meets NSW EPA requirements for the intended land use. The results of the audit will be documented by the Site Auditor in a SAS/SAR. Copies of the SAS/SAR will be provided to the site owner, developer, the NSW EPA and Council. An Occupation Certificate for the part of the site covered by the SAS/SAR should only be issued after a Section A SAS has been issued stating that the area is suitable for the intended residential land use.

20. Quality Assurance Plan

20.1 Sample Collection and Handling

The general sampling procedures comprise:

- The use of stainless steel or disposable (e.g. nitrile glove) sampling equipment;
- Washing of all re-usable sampling equipment, in contact with the sample, in a 3% solution of phosphate free detergent (Decon 90) then rinsing with distilled water prior to each sample being collected; transfer of the sample into an appropriate sampling container, sealing of containers to minimise cross contamination during transportation to the laboratory;
- Use of laboratory prepared sampling containers for samples for analysis of chemical contaminants (generally comprising new glass jars sealed with Teflon lined lids);
- Labelling of the sample containers with individual and unique identification including Project No. and Sample No.;
- Placement of the containers into a chilled (where necessary), enclosed and secure container for transport to the laboratory; and
- Use of chain-of-custody documentation so that sample tracking and custody can be cross-checked at any point in the transfer of samples from the field to hand-over to the laboratory.

20.2 Field QA/QC

Quality assurance (QA) and quality control (QC) procedures will be adopted throughout the field sampling programme to assess sampling precision and accuracy.

The following QA/QC samples will be collected/prepared and analysed:

- 5% intra-laboratory replicate samples;
- 5% inter-laboratory replicate samples;
- Trip blank samples – one per sampling day (when volatiles are included in the analytical suite); and
- Trip spike samples – one per sampling day (when volatiles are included in the analytical suite).

Appropriate sampling procedures will be undertaken to minimise cross contamination. These include:

- Standard operating procedures are followed;
- Replicate field samples are collected and analysed;
- Samples are stored under secure, temperature controlled conditions;

- Chain-of-custody documentation is employed for the handling, transport and delivery of samples to the selected laboratory; and
- Proper disposal of contaminated soil, fill or surface water originating from the site is completed.

20.3 Laboratory Quality Assurance and Quality Control

A NATA accredited laboratory will be used to conduct analysis. The laboratory will need to undertake analysis in accordance with its accreditation, including in-house QA/QC procedures involving the routine testing of:

- Reagent blanks;
- Spike recovery analysis;
- Laboratory duplicate analysis;
- Analysis of control standards;
- Calibration standards and blanks; and
- Statistical analysis of QC data including control standards and recovery plots.

20.4 Data Quality Objectives and Indicators

The validation assessment is to be conducted in accordance with Data Quality Objectives (DQOs) and QA/QC procedures to assess the repeatability and reliability of the results.

The validation assessment will be planned in accordance with the following DQOs:

- State the Problem;
- Identify the Decision;
- Identify Inputs to the Decision;
- Define the Boundary of the Assessment;
- Develop a Decision Rule;
- Specify Acceptable Limits on Decision Errors; and
- Optimise the Design for Obtaining Data.

A checklist of Data Quality Indicators (DQI) in accordance with NEPC (2013) Schedule B2 will be completed as part of the validation assessment. The DQIs are:

- Documentation completeness;
- Data completeness;
- Data comparability and representativeness; and
- Data precision and accuracy.

Based on a fulfilment of the DQOs and DQIs an assessment of the overall data quality will be presented in the validation assessment report.

21. General Environmental Management Plan

21.1 General

The Contractors will undertake the work with due regard to the minimisation of environmental effects and to meet regulatory and statutory requirements.

The Contractors should have in place an over-arching environmental management plan that incorporates this RAP so that work on the site complies with, but not limited to, the following:

- *Protection of the Environment Operations Act* 1997;
- *Contaminated Land Management Act* 1997;
- *Work Health and Safety Act* 2011; and
- *Work Health and Safety Regulation* 2011.

The following general measures outlined below should be implemented during the remediation phase. All personnel should be made familiar with the following section prior to the commencement of site works as required.

In addition all contractors must meet all requirements of the Liverpool Council LEP. Specifically contractors must note the provisions of Part 6 and Part 7 of the LEP related to site contamination (Section 6.6) and environmentally sensitive land use - acid sulphate soils (Section 7.7)

21.2 Vibration Control

The use of any plant and/or machinery should not cause unacceptable vibrations to nearby properties and should meet Council requirements.

21.3 Dust Control

Dust emissions should be confined within the site boundary. The following dust control procedures will be employed to comply with this requirement as necessary:

- Erection of dust screens around the perimeter of the site;
- Securely covering all loads entering or exiting the site;
- Use of water sprays across the site to suppress dust;
- Covering of all stockpiles of contaminated soil remaining onsite more than 48 hours;
- Dust monitoring as may be required by the Council DA consent; and
- Keeping excavation and stockpile surfaces moist.

21.4 Odour Control

No odours should be detected at any boundary of the site during remediation works by an authorised Council Officer relying solely on sense of smell. The following procedures should be employed to comply with this requirement as required:

- Use of appropriate covering techniques such as plastic sheeting, polythene or geotextile membranes to cover excavation faces or stockpiles;
- Fine spray of water and/or hydrocarbon mitigating agent on the impacted areas/materials;
- The use of water spray, as and when appropriate, to eliminate wind-blown dust;
- Use of sprays or sprinklers on stockpiles or loads to lightly condition the material;
- Restriction of stockpile heights to 5 m above surrounding site level. If required, restrict uncovered stockpiles to appropriate sizes to minimise odour generation;
- Ceasing works during periods of inclement weather such as high winds or heavy rain;
- Regular checking of the fugitive dust and odour issues to ensure compliance. Undertake immediate remediation measures to rectify any cases of excessive dust or odour (e.g. use of misting sprays or odour masking agent); and
- Adequate maintenance of equipment and machinery to minimise exhaust emissions.

21.5 Stormwater Management and Control

As necessary, the remediation contractor shall take appropriate measures to ensure that potentially contaminated water does not leave the site. In particular, stormwater management for the duration of the remediation works shall be utilised and monitored to minimise stormwater flow into adjacent waterways.

21.6 Occupational Health and Safety

The Contractors shall develop a site emergency response plan (ERP) and occupational health and safety plan (OHSP). This will ensure the safety of the personnel working on site, given any likely emergency situation which may occur. The OHSP and ERP should include emergency phone numbers and details of local emergency facilities.

Appropriate fencing and signage should be installed around and within the site to prevent unauthorised access to the site, restricted access remediation areas and/or deep excavations.

All personnel on site should be required to wear the following personnel protective equipment (PPE) at all times:

- Steel-capped boots;
- High visibility clothing; and
- Hard hat meeting AS1801-1981 requirements.

The following additional PPE will be worn as required:

- Hearing protection meeting AS1270-1988 requirements when working around machinery or plant equipment if noise levels exceed exposure standards;
- Safety glasses or safety goggles with side shields meeting AS1337-1992 requirements (as necessary, particularly during demolition);
- Disposable coveralls (if necessary) to prevent contact with splashed contaminated soil, materials or water;
- Nitrile work gloves meeting AS2161-1978 requirements or heavy duty gauntlet gloves; and
- Any additional protection identified by the Environmental Consultant.

In the event that personnel are required to work in areas of potential contact with asbestos, the following PPE in addition to standard construction PPE, should be worn during works involving the handling and/or removal of soils impacted by asbestos:

- Disposable coveralls (rated type 5, cat 3 or equivalent);
- Half-face P1/P2 respirator or equivalent;
- Gloves; and
- Safety footwear which should be laceless.

Excavation, handling, stockpiling, transport etc. of materials containing asbestos should be undertaken by a licensed contractor in accordance with relevant regulatory requirements.

21.6.1 Management of Landfill Gas During Earthworks and Construction

The presence of HGG (landfill gas) has been confirmed at the site. Methane has been detected in landfill gas wells at concentrations which exceed 100% of the lower explosive limit (LEL). In this regard, care should be taken during construction to minimise the likelihood of creating areas in which landfill gas can accumulate such as deep trenches. Standard confined space protocols should apply and the Contractors must be made aware of the additional hazards posed by the presence of landfill gas at the site. Reference should be made to Safe Work Australia (2011) *Confined Spaces, Code of Practice*.

Standard multi-gas LEL meters should be used by site personnel where appropriate. Advice should be sought by the Contractor’s from the Environmental Consultant. Safe Work Australia (2011) states that “a safe atmosphere must be ensured, so far as is reasonably practicable, during work in a confined space. A safe atmosphere in a confined space is one that:

- Has a safe oxygen level;
- Is free of airborne contaminants or any airborne contaminants are in concentrations below their allowable exposure standard (if any); and
- Any flammable gas or vapour in the atmosphere is at concentrations below 5% of its LEL.

21.7 Hours of Operation

All remediation work should be conducted within the hours specified by Council.

21.8 Contingency Plans to Respond to Site Incidents

The key to effective management of incidents is the timely action taken before any situation reaches a reportable or critical level. Therefore, surveillance activities are extremely important, and should be conducted for the measures prescribed herein and any other measures as seen appropriate by the Principal's representative. During work activities on the site, the following inspection or preventative actions must be performed by the main Contractor and carefully documented:

- Regular inspection of works;
- Completion of routine environmental checklists and follow-up of non-compliance situations;
- Maintenance of supervision on-site; and
- An induction process for site personnel involved in the remediation works that includes relevant information on environmental requirements, and ensures that all site personnel are familiar with the site emergency procedures.

The Contractor's site foreman should be responsible for initiating an immediate emergency response using the resources available on the site. Where external assistance is required, the relevant emergency services should be contacted. A list containing contact details for key personnel who may be involved in an environmental emergency response should be completed and be readily available to personnel at all times.

21.9 Identify Regulatory Compliance

The work should be undertaken with all due regard to the minimisation of environmental effects and to meet all statutory requirements, including, inter alia, provisions specified in:

- *Protection of the Environment Operations Act* 1997;
- *Contaminated Land Management Act* 1997;
- *Dangerous Goods Act* 2008;
- *Work Health and Safety Act* 2011;
- *Work Health and Safety Regulation* 2011;
- DUAP NSW EPA (1998) *State Environmental Planning Policy No. 55* (SEPP 55).

21.10 Community Engagement

The developer, Mirvac Homes (NSW) Pty Ltd (Mirvac), or their delegated representative will manage all community and stakeholder engagement. The remediation is part of a Development Application (DA) that requires approval by the consent authority (being Liverpool City Council) and as such also requires certain public consultation. The following consultation (community / stakeholder engagement) has been completed to date:

- Mirvac has met with Council on a number of occasions regarding this development including a formal pre-DA meeting;
- As part of the Environmental Impact Statement (EIS) for the project, Mirvac has actively engaged with the surrounding residents via a letterbox drop of a fact sheet (Appendix K). To date Mirvac has not received any responses;
- Mirvac has also met with the owners of Flower Power (being the adjoining owners to the east) to discuss the development, and have attempted to meet with the owners of Moorebank Recyclers (being the adjoining owners to the south);
- The EIS also requires engagement with the relevant Government authorities and letters have been forwarded to them seeking comment;
- Once lodged at Council, the DA will most likely be exhibited by Council including a mail-out to the affected owners allowing them a month to provide comment; and
- Mirvac is scheduled to meet with the Moorebank Residents' Action Group on 20 December 2016.

In relation to community engagement and the site remediation component of the project, site signage in relation to project contact persons will be limited to that required by DA consent conditions and/or regulatory requirements, with additional signage indicating that public enquires shall be directed to the Mirvac or their delegated representative. A log of any communications between stakeholders (community) and Mirvac (or their delegated representative) shall be recorded.

The Environmental Consultant and Geotechnical Engineer will be available via Mirvac to provide specific feedback on any questions or complaints relevant to the remediation / earthworks component of the project. The log of communications between stakeholders (community) and Mirvac (or their delegated representative) shall be provided to the Environmental Consultant for inclusion in the site validation report.

21.11 Contact Details

The following table provides a list of personnel and contact details relevant to the remediation. The list should be filled in as relevant personnel are appointed to the remediation project.

Table 13: Contact Details

Role	Personnel / Contact	Contact Details (phone)
Principal	Ernest Dupere (Benedict)	0407 282 444
Principal's Representative	Brett Jarvis (Benedict)	0425 282 209
Site Manager	Marko Zrillic (Benedict)	0412 777 358
Environmental Consultant	John Russell (DP)	9809 0666
Gas Barrier Installation Contractor	TBA	TBA
Regulator	NSW EPA (pollution line)	131 555

Role	Personnel / Contact	Contact Details (phone)
Regulator	NSW EPA (general enquiries)	131 555
Consent Authority	Liverpool City Council	1300 36 2170
Utility Provider	Sydney Water	13 20 92
Utility Provider	Power	TBA
Utility Provider	Gas	TBA

Notes to table:

Table to be completed when the contact details are known.

22. Provisional Project Timeframe

The following provides a provisional project timeframe for bulk earthworks and associated remediation earthworks and subsequent construction phases. The project timeframe provided below is only indicative and will be subject to amendment as the project proceeds. The project timeframe should be regularly updated and the Environmental Consultant should provide a revised copy to the Site Auditor every 3-month period.

Table 14: Provisional Project Timeframe

Item	Year 1			Year 2			Year 3			Year 4		
Stage 1a: Deep Fill Earthworks	▨											
Stage 1b: General Site Preparation Earthworks	▨	▨										
Stage 2: VENM Capping			▨	▨ IV1								
Retaining Wall Construction	▩	▩	▩	▩	▩ IV2							
Construction of Dwellings						▩	▩	▩	▩	▩	▩	
Stage 3: Installation of Landfill Gas Mitigations						IV3/ EMP	IV3	IV3	IV3	IV3	IV3	FV

Notes to table:

IV1: Interim Validation Report covering Stages 1 and 2 Earthworks

IV2: Interim Validation Report covering Construction of Retaining Wall

IV3: Interim Validation Reports covering installation of landfill gas mitigation measures for various stages of the development

EMP: Environmental Management Plan (generic document for all dwellings with landfill gas mitigation systems)

FV: Final Validation Report to close out any remaining site validation issues such as long term landfill gas and groundwater / surface water monitoring

At this stage DP understand that a single Section B SAS is required for the entire site. It is not known whether a single Section A SAS will be required for the whole site, or whether more than one Section A SAS will ultimately be necessary to support a staged development.

23. Validation Report

Validation assessment reports will be prepared by the Environmental Consultant for the various stages of the project with reference to OEH (2011) *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*. The reports will be submitted to Council at the completion of the various stages of the remediation works programme. The objective is for the validation reports to confirm that the site has been remediated to a suitable standard for the proposed redevelopment and occupation and that no related adverse human health and environmental effects have occurred as a result of the works. The validation reports will also include a summary of the information from previous investigations.

The major components of the validation reporting are summarised in where the Stages 1 and 2 validation report is discussed in Section 19.1 and the Stage 3 validation reports in Section 19.2.

In summary, the validation report(s) will include:

- Landfill gas and surface water monitoring reports (validation monitoring programme);
- Geotechnical report(s);
- Details of the earthworks;
- Analytical test results (e.g. initial testing regime on screened material from the current trial remediation excavation and subsequent validation of filling to form part of the upper 3 m);
- Waste classification results;
- The final disposal destination of the materials removed from site and disposal dockets, where appropriate including all necessary waste tracking information, waste disposal (weighbridge dockets) and waste reconciliation information verifying that the volumes taken off site match the disposed amounts;
- Photographic record during the works including gas ventilation and membrane installation;
- Gas mitigation CQA documentation, including the results of membrane integrity testing;
- All environmental monitoring results and sampling locations, including air quality, surface water, groundwater, landfill gas, geotechnical validation results, filling and construction records (for the landfill gas mitigation measures), including CQA data;
- Records of imported VENM including all relevant material tracking information as set out in the FMP including movement of material within the site (stockpiling and final repository);
- Details of any unexpected finds or environmental incidents; and
- Survey information confirming the thickness of final site capping.

24. Long Term Environmental Management Plan

A Long Term Environmental Management Plan (LTEMP) will be required for the ongoing management of contamination remaining on site and landfill gas mitigation systems. The (post construction) LTEMP should include:

- Procedures for the management and maintenance of the cap and landfill gas mitigation systems; and
- Procedures for scenarios where the capping or landfill gas mitigation systems need to be penetrated and reinstated.

The LTEMP will require establishment of appropriate public notification under Section 149(2) of the EP&A Act or a covenant registered on the title to land under Section 88B of the Conveyancing Act 1919. The formal LTEMP would be prepared prior to or during remediation and finalised following validation of the remedial activities.

At present it is not feasible to provide exact details of the contents of the LTEMP as this will depend on the outcome of site validation. Notwithstanding, the overall purpose and objectives of the LTEMP will be to set out the measures necessary for the maintenance of environmental mitigation measures for soil, soil gas and groundwater throughout the tenure of proposed land use and will provide a means of managing the remaining contamination on the site within the context of the proposed residential land use. No ongoing monitoring is envisaged in the post construction environment, although the LTEMP will contain contingencies in this regard.

The LTEMP will summarise the nature and extent of remaining contamination on the site and must be imposed on the land under one of the above mechanisms. In addition the LTEMP must be:

(i) agreed with the local council,

(ii) be reasonably legally enforceable as set out in Section 3.4.6 of the Guidelines for the DEC (2006) (or subsequent amendments),

(iii) provide measures to ensure that future on-site and off-site environmental and human health risks are minimised and are maintained at acceptable levels,

(iv) provides a mechanism for updating, revising and reviewing the LTEMP in light of any new environmental information resulting from events, incidents or monitoring,

(v) provide a mechanism to ensure that the LTEMP and any subsequent revisions are provided to all relevant land holders/owner/occupiers within the site,

(vi) provides a mechanism for landholder feedback through an ongoing community consultation mechanism,

(vii) provides a mechanism restricting future groundwater abstraction,

(viii) provides a mechanism to prevent and/or regulate future excavations/penetrations through the capping system beyond the specified depths of 1.6 m (into VENM) and 3 m (engineered cap) for example excavations for service installation or maintenance of buried services,

(ix) requires than development consent is required for any future excavations deeper than 2.5 m bgl from Liverpool City Council,

(x) provides procedures for the filling of planned or inadvertent filling and sealing of breaches in the capping system, and

(xi) requires periodic checking by an environmental / geotechnical consultant to confirm that the overall integrity of the cap has not been compromised and that the capping system remains functional and complies with the requirements of the LTEMP.

Further details are also provided in Section 16.1.9. A preliminary LTEMP will be prepared for auditor agreement and will be provided for approval by Council prior to the finalisation of the Stage 1 works, or will accompany the DA for the first group of houses.

The site will be remediated to the extent that only passive landfill gas mitigation measures will be required, and in order that the final version of the LTEMP will support the preparation of a Section A SAS. The final version of the LTEMP will be prepared by the Environmental Consultant and provided to the Site Auditor for review and approval. The Site Auditor will then send a final version of the LTEMP to Council for their written approval prior to the issuing of a Section A SAS.

The LTEMP will remain in force until such time as the Environmental Consultant, the Site Auditor and NSW EPA agree that it is no longer necessary.

25. Conclusion

It is considered that remediation of the site in accordance with the procedures and validation methods outlined in this RAP will render the site suitable for the proposed residential development.

The proposed validation monitoring of landfill gas and surface water may also allow modifications (e.g. a lowering of the CGS for the site) to the proposed scope and general methodology of remediation that has been recommended in this RAP. Any modifications would be subject to approval by the Site Auditor and agreement with the Geotechnical Consultant.

The detailed design of buildings incorporating the required gas mitigation measure(s) or system element(s) will necessarily be undertaken at the appropriate point in time of the project and under a separate DA associated with Stage 3 of the remediation.

DP considers that this RAP has met the objectives of a RAP specified in NSW EPA guidelines, SEPP55 guidelines and Council’s contaminated land policy. These objectives are to:

- Set remediation goals that are likely to meet the conditions of a Development Consent so that the redevelopment area will be suitable for the proposed residential land uses and will pose no unacceptable risk to human health or the environment;
- Evaluate the range of remediation options available to address the existing site contamination issues, and thereby reduce risks to acceptable levels;
- Document the preferred remediation techniques and procedures;
- Establish the various safeguards required to complete the remediation work in a safe and environmentally acceptable manner;

- Identify the necessary approvals and licences required by regulatory authorities in order to enable the remediation works to proceed;
- Document a remediation strategy that will address on-site issues affecting future migration of contamination from the site; and
- Document a remediation strategy that will complement other regulatory requirements relevant to the remediation of contamination.

The proposed remediation strategy has included tasks that will address uncertainties that currently exist in relation to groundwater quality, composition of the 3 m ‘engineered fill blanket’ and the finalised GSV and CGS, as required by the NSW OEH (2011) guidelines.

DP considers that the site can be made suitable for its intended residential land use if the site is remediated in accordance with the RAP and managed in accordance with a LTEMP, as required by NSW OEH (2011) guidelines.

26. References

ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality

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

CIRIA (2014) C735 Good Practice on the Testing and Verification of Protection Systems for Buildings against Hazardous Ground Gases

DoH (2009) Guidelines for the Assessment and Remediation and Management of Asbestos-Contaminated Sites in Western Australia

DUAP NSW EPA (1998) State Environmental Planning Policy No. 55 (SEPP 55)

Dames & Moore (1994) Report on Groundwater Sampling

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

DEC (2006) Guidelines for the NSW Site Auditor Scheme (2nd Edition)

DEC (2007) Guideline for the Assessment and Management of Groundwater Contamination

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

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 (2016a) 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

NHMRC (2016) Australian Drinking Water Guidelines

NSW EPA (2016) Environmental Guidelines: Solid Waste Landfills [Second Edition 2016]

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

NSW EPA (1995) Sampling Design Guidelines

NSW EPA (2014a) Waste Classification Guidelines, Part 1: Classifying Waste

NSW EPA (2014b) Waste Classification Guidelines Part 2: Immobilisation of Waste

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

SA EPA (2010) Guideline for stockpile management: Waste and waste derived products for recycling and reuse

Safe Work Australia (2011) Confined Spaces, Code of Practice

Vic EPA (2010) Soil Sampling

27. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 146 Newbridge Road, Moorebank in accordance with DP's proposal dated 26 April 2016 and acceptance received from Mr Ernest Dupere dated 26 April 2016. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Benedict Industries 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.

Asbestos has previously been detected by observation or by laboratory analysis at the site, either on the surface of the site, or in filling materials at the test locations sampled and analysed. Building demolition materials, such as concrete, brick, tile, timber, plastic, are ubiquitous throughout the fill at the site, and these are considered as indicative of the possible presence of hazardous building materials (HBM), including asbestos. It is therefore considered possible that HBM, including asbestos, may be during bulk earthworks associated with the proposed development, and hence no warranty can be given that asbestos is not present.

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 associated with future design aspects relevant to our input to the project, 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

Site Drawings

Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Site Locality
Remediation Action Plan
146 Newbridge Road, Moorebank, NSW

N
MGA

OFFICE: Sydney
DRAWN BY: MJC
DATE: 29.04.2016

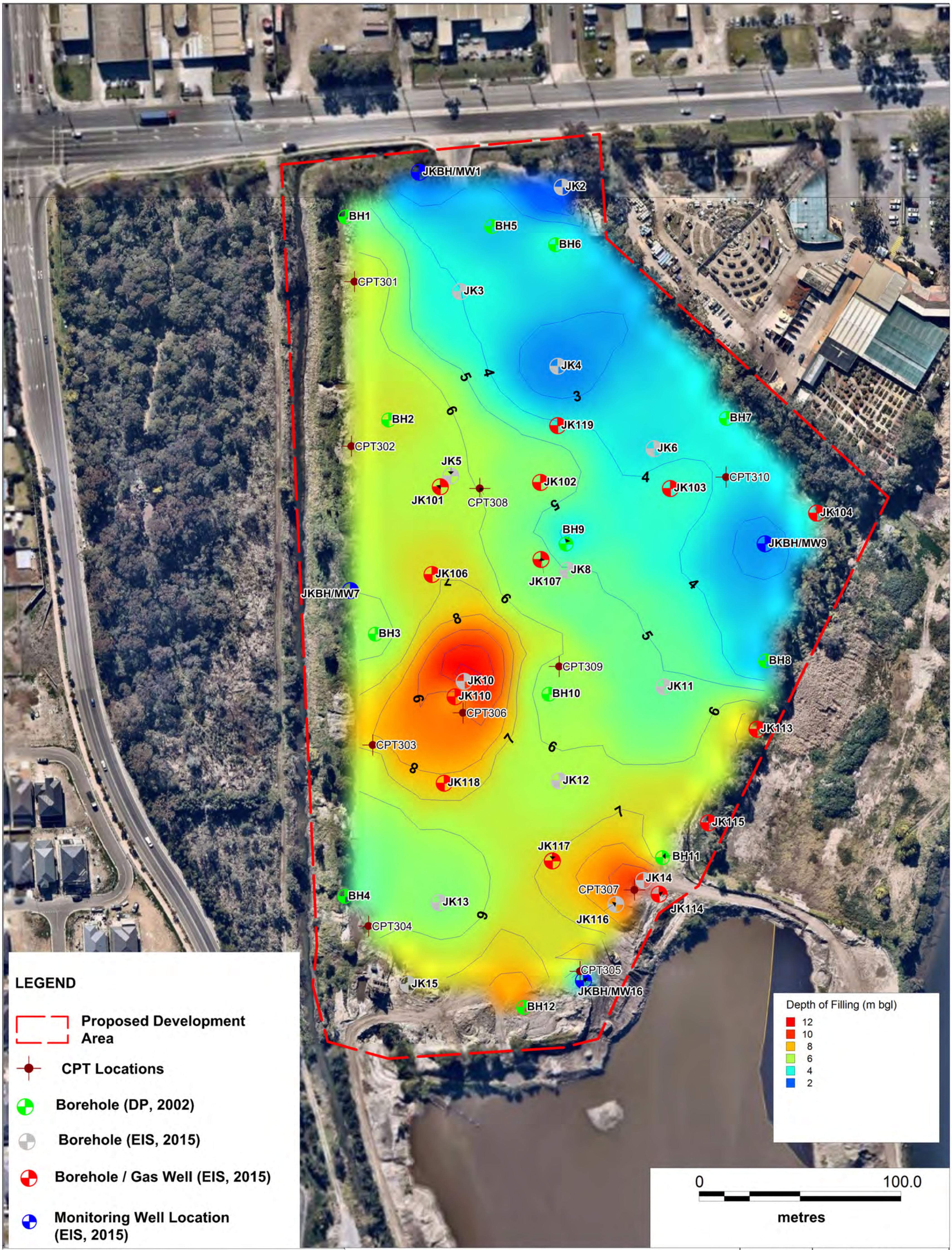
CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.06
DRAWING No: 1
REVISION: A
SCALE: As shown

Douglas Partners
Geotechnics | Environment | Groundwater

TITLE: Previous Test Locations
Remediation Action Plan
146 Newbridge Road, Moorebank, NSW

OFFICE: Sydney
DRAWN BY: MJC
DATE: 29.04.2016

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.06
DRAWING No: 2
REVISION: A
SCALE: As shown



Douglas Partners
Geotechnics | Environment | Groundwater

TITLE: Depth of Filling Contours

146 Newbridge Road, Moorebank, NSW

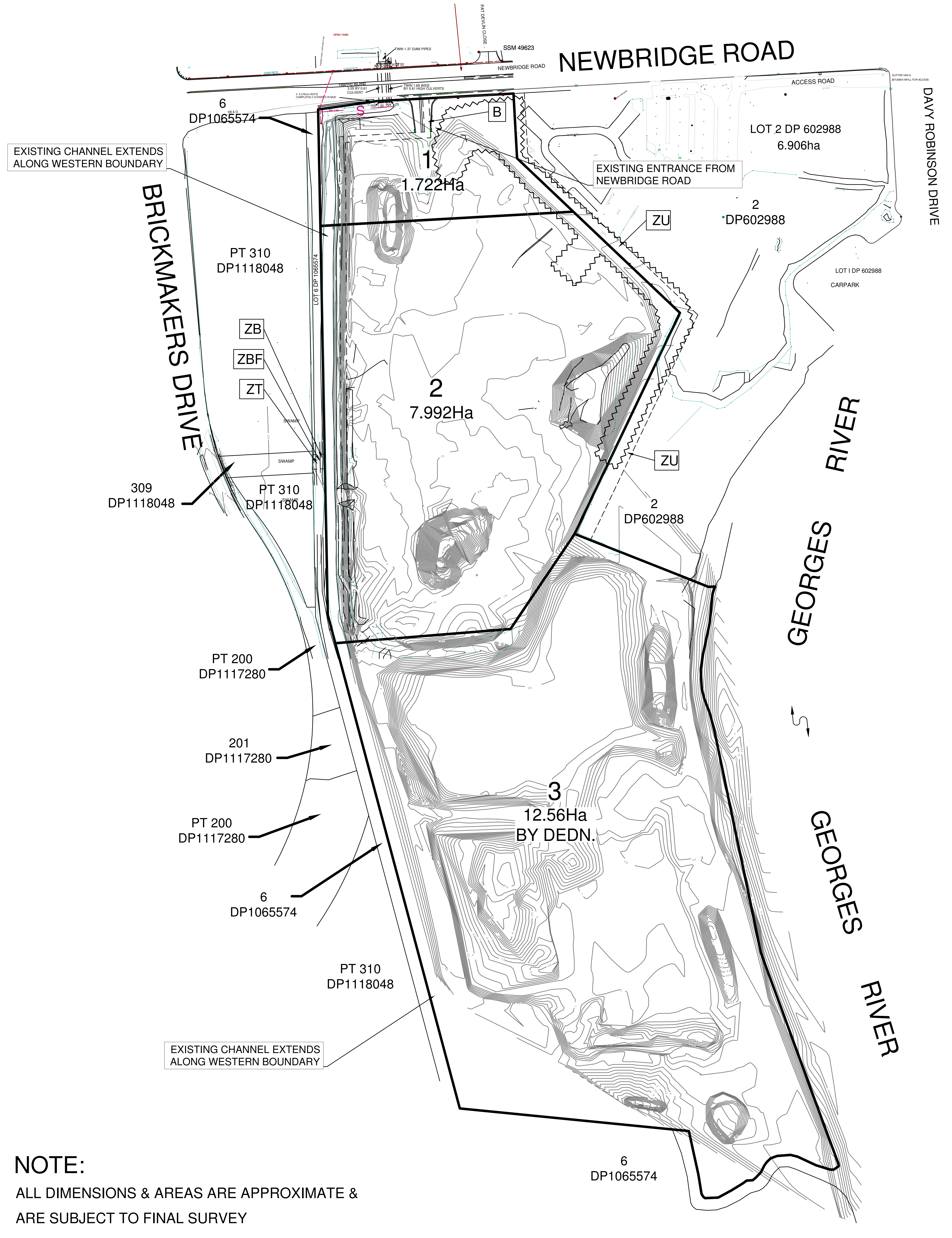
MGA

OFFICE: Sydney
DRAWN BY: MJC
DATE: 13.11.2015

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.04
DRAWING No: 2
REVISION: A
SCALE: As shown

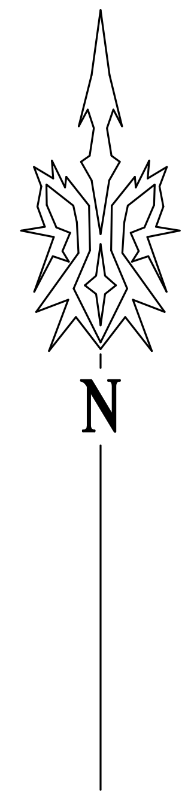
Appendix B

Drawings of the Proposed Development



NOTE:

ALL DIMENSIONS & AREAS ARE APPROXIMATE &
ARE SUBJECT TO FINAL SURVEY



AN EXISTING SURFACE MODEL WAS CREATED USING A COMPILATION OF VARIOUS TOPOGRAPHIC SURVEYS OF THE SUBJECT SITE BY JMD INCLUDING MATERIAL STOCKPILES WHICH WERE COMPLETED FOR BENEDICT IN 2014, 2015 AND 2016 AS WELL AS A DETAIL SURVEY BY FREEBURN SURVEYORS 23-10-2013.

SMALLER TEMPORARY STOCKPILES HAVE NOT BEEN SHOWN HOWEVER THE AREA BENEATH A NUMBER OF THE TEMPORARY STOCKPILES WAS ASSUMED TO GRADE CONSISTENTLY BETWEEN THE BOTTOM OF THE STOCKPILES. THE THREE LARGER STOCKPILES HAVE BEEN SHOWN.

NOTES:

1. THESE NOTES AND LEGEND (IF SHOWN) FORM PART OF THE PLAN AND SURVEY AND MUST REMAIN WITH THE PLAN IN ANY REPRODUCTION IN WHOLE OR PART.
2. THE SURVEY INFORMATION SHOWN HERE WAS PREPARED FOR A SPECIFIC PURPOSE FOR THE CLIENT SHOWN. THE INFORMATION IS NOT TO BE USED FOR ANY OTHER PURPOSE OR BY ANYONE NOT AUTHORISED BY THIS CLIENT.
3. IF THIS PLAN HAS BEEN PROVIDED IN ELECTRONIC FORMAT, BE ADVISED THAT THE POSITION OF SOME DETAIL IS SHOWN DIAGRAMMATICALLY ONLY, IN ORDER TO PROVIDE CLARITY ON THE HARD COPY PLAN. SOME TEXT AND LINESTYLES MAY BE SHOWN IN INCORRECT POSITIONS OR DIFFERENTLY TO THAT INTENDED, AS YOU MAY BE VIEWING THE DRAWING IN AN INCOMPATIBLE PROGRAM OR VERSION. THE HARD COPY PLAN IS TO BE USED TO CHECK TEXT AND LINESTYLES.
4. THIS PLAN HAS BEEN PREPARED FOR HARD COPY (OR PDF) FORMAT ONLY AND IF PROVIDED IN CAD FORMAT ALL DIMENSIONS HEREON TAKE PRECEDENCE OVER ANY INTERROGATION OF LINEWORKS IN THE CAD FILE.
5. THE PROPOSED BOUNDARY DIMENSIONS SHOWN ARE APPROXIMATE ONLY. THEY HAVE BEEN COMPILED FROM TITLE DIAGRAMS AND ADJOINING DEPOSITED PLANS AND ARE SUBJECT TO SURVEY

6. B DENOTES PROPOSED RIGHT OF CARRIAGEWAY (5 WIDE)

ZB DENOTES EXISTING RIGHT OF CARRIAGEWAY (12 WIDE - LIMITED IN HEIGHT TO RL7.2)

ZBF DENOTES EXISTING RIGHT OF FOOTWAY (12 WIDE - LIMITED IN HEIGHT TO RL7.2)

ZT DENOTES EXISTING EASEMENT FOR CONSTRUCTION, MAINTENANCE & REPAIR OF A ROAD BRIDGE (12 WIDE)

ZU DENOTES EXISTING EASEMENT FOR BATTER (9 & 14 WIDE)

0 10 20 40 60 80 100 200
SCALE :- 1 : 2000 Metres (A1)

Issue	App	Date	Description
A	S.G.	24-01-2017	ISSUED FOR DA

Client: MIRVAC HOMES (NSW) PTY LTD.
Designed by : S.G.
Date of Drawing : 24-01-2017
Ratio (A1) : 1:2000

Datum : AHD
Origin of Levels :
Date of Survey : N/A

JMD Development Consultants

John M. Daly & Associates PTY LTD
A.B.N. 88051977989
Surveying
Engineering
Project Management
Licensed Water Service Co ordinators
32 Iolanthe Street
P.O. BOX 25
CAMPBELLTOWN N.S.W. 2560
PH. (02) 4625 5055
FAX (02) 4628 2013
email: admin@jmd.com.au

Project : MOOREBANK COVE - STAGE 2
NEWBRIDGE ROAD, MOOREBANK

PLAN OF EXISTING FEATURES OVER STAGE 1

Locality : MOOREBANK
L.G.A. : LIVERPOOL

Sheet 1 of 4 sheets
Ref: 14005-DS1
CAD Ref: S:\DATA\14\14005\14005 EMW\ENG\CAD\E6-RESI DA PLANS\14005E6-ADD1

The ratio shown on this plan relates to the original plan, produced by JMD only. Any photocopying or printing from digital files provided (particularly PDF files) may significantly alter the ratio of the plan.

AS DIRECTED BY BENEDICT, AN EXISTING SURFACE MODEL WAS CREATED USING A COMPILATION OF VARIOUS TOPOGRAPHIC SURVEYS OF THE STOCKPILES COMPLETED FOR BENEDICT IN 2014, 2015 & 2016.

THE AREA BENEATH A NUMBER OF THE MINOR STOCKPILES WAS ASSUMED TO GRADE CONSISTENTLY BETWEEN THE BOTTOM OF THE MINOR STOCKPILES.

MAJOR STOCKPILES ARE SHOWN. STOCKPILES No.1 AND No.2 ARE EXPECTED TO BE USED IN FILLING OPERATIONS.STOCKPILE No.3 IS EXPECTED TO BE REMOVED FROM SITE.

CUT/FILL DEPTHS AT THE FRINGES CAN BE ASSUMED TO BE INCORRECT AS MORE SURVEY IS REQUIRED TO CONFIRM HOW THE NEIGHBOURING LAND TIES IN.

PRELIMINARY FILL PLAN BASED ON A FINISHED SURFACE THAT IS 3m BELOW THE FINISHED SURFACE LEVEL MODEL (i.e. BOTTOM OF THE CAPPING LAYER) PREPARED BY JMD FOR THE RESIDENTIAL DEVELOPMENT APPLICATION.

THE FINISHED SURFACE LEVEL USED IN THIS MODEL INCLUDES PRELIMINARY BULK EARTHWORKS LEVELS ALONG THE WESTERN RETAINING WALL.

Issue	App	Date	Description
A	T.H.	01-09-2016	PRELIMINARY FOR REVIEW

Client: MIRVAC HOMES (NSW) PTY LTD.
Designed by : S.G.
Date of Drawing : 01-09-2016
Ratio (A1) : 1:750

Datum : AHD
Origin of Levels :
Date of Survey : VARIOUS

JMD
Development Consultants

John M. Daly & Associates PTY LTD
A.B.N. 88051977989
Surveying
Engineering
Project Management
Licensed Water Service Co ordinators
32 Iolanthe Street
P.O. BOX 25
CAMPBELLTOWN N.S.W. 2560
PH. (02) 4625 5055
FAX (02) 4628 2013
email: admin@jmd.com.au

Project :
MOOREBANK COVE DEVELOPMENT
NEWBRIDGE ROAD, MOOREBANK

PRELIMINARY FILL PLAN OF THE RESIDENTIAL PORTION OF LOT 7 DP1065574
ABOVE THE BOTTOM OF THE CAPPING LAYER (i.e. 3m BELOW PROPOSED FSL)

Locality : MOOREBANK
L.G.A. : LIVERPOOL
CAD Ref: C:\USERS\SGRAY\DESKTOP\14005\14005FILL2

Sheet 1 of 1 sheets
Ref: 14005-FILL2

The ratio shown on this plan relates to the original plan, produced by JMD only. Any photocopying or printing from digital files provided (particularly PDF files) may significantly alter the ratio of the plan.

RAINGARDEN No.1 (NORTHERN RAINGARDEN)

LOT 1 CREATED UNDER STAGE 1 IS TO BE DEVELOPED AS COMMERCIAL DEVELOPMENT

12m (RADIUS) TEMPORARY CUL-DE-SAC TO BE CONSTRUCTED UNTIL WHICH TIME THE FUTURE COLLECTOR ROAD IS CONSTRUCTED

SUPERLOTS 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 & 16 ARE TO BE FURTHER DEVELOPED INTO RESIDENTIAL LOTS.

LOT 17 MAY BE USED AS A FUTURE ROAD CONNECTION OR BE DEVELOPED INTO RESIDENTIAL LOTS.

LOT 18 IS TO BE A DEDICATED AS A DRAINAGE RESERVE

LOT 19 IS TO BE DEDICATED AS A DRAINAGE RESERVE

LOT 20 IS TO BE DEDICATED AS A PUBLIC RESERVE

NORTHERN CATCHMENT AREA OF THE RESIDENTIAL DEVELOPMENT DRAINING TO RAINGARDEN No.2

CATCHMENT BOUNDARY

SOUTHERN CATCHMENT AREA OF THE RESIDENTIAL DEVELOPMENT DRAINING TO RAINGARDEN No.2

BRIDGE TO BE CONSTRUCTED UNDER DA1552/2006B

PROPOSED DRAINAGE EASEMENT TO DRAIN MAJOR FLOWS TO RIVER

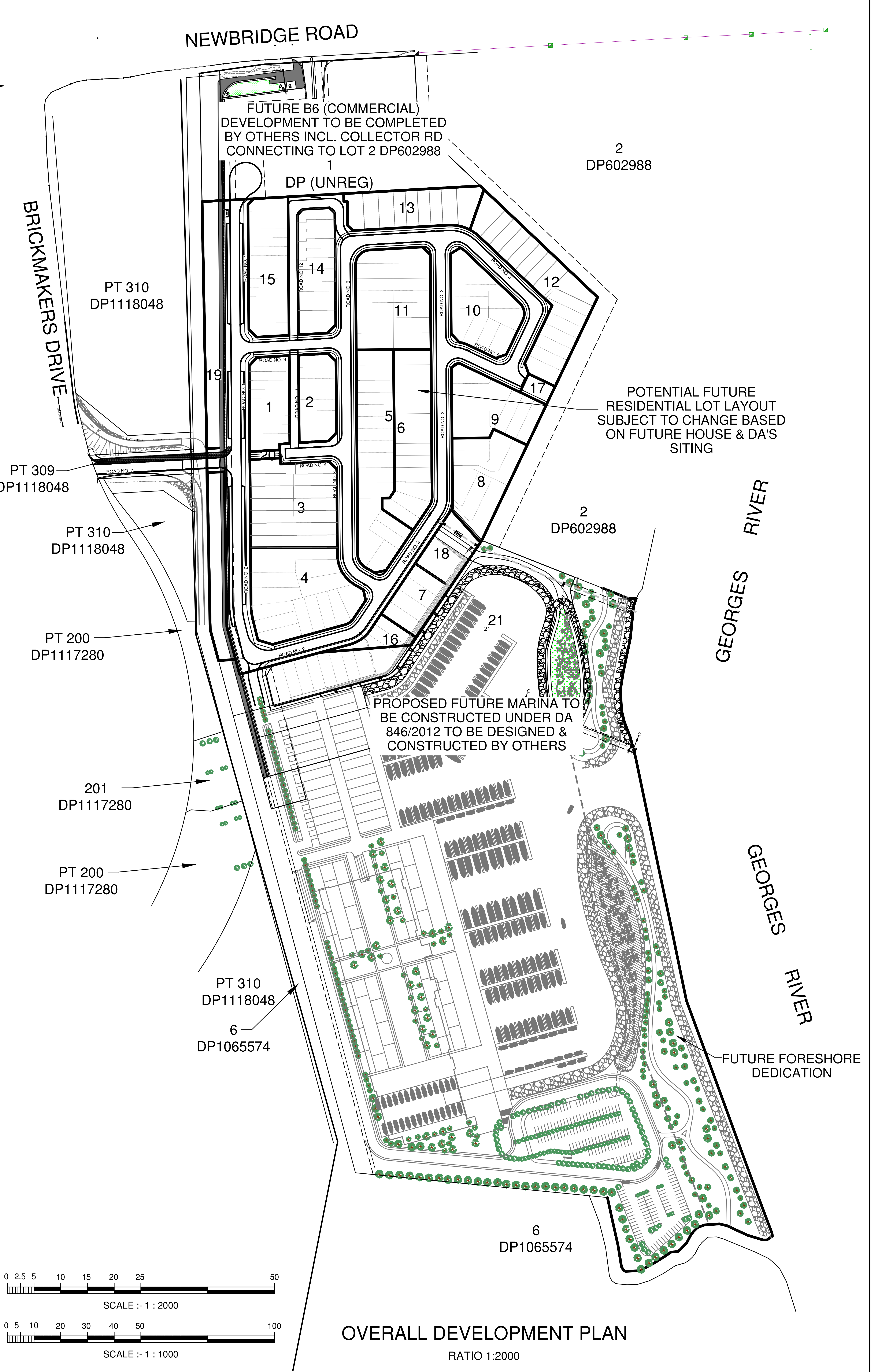
RAINGARDEN No.2 (SOUTHERN RAINGARDEN)

PROPOSED DRAINAGE EASEMENT TO DRAIN LOW FLOWS FROM RAINGARDEN TO RIVER

LOT 3 CREATED UNDER STAGE 1 IS TO BE SUBDIVIDED TO ALLOW THE CREATION OF ROAD No.2. RESIDUE LOT (LOT 21) IS TO BE DEVELOPED INTO A MARINA

PROPOSED STAGE 2 WORKS

RATIO 1:1000



FUTURE B6 (COMMERCIAL) DEVELOPMENT TO BE COMPLETED BY OTHERS INCL. COLLECTOR RD CONNECTING TO LOT 2 DP602988

POTENTIAL FUTURE RESIDENTIAL LOT LAYOUT SUBJECT TO CHANGE BASED ON FUTURE HOUSE & DA'S SITING

PROPOSED FUTURE MARINA TO BE CONSTRUCTED UNDER DA 846/2012 TO BE DESIGNED & CONSTRUCTED BY OTHERS

FUTURE FORESHORE DEDICATION

OVERALL DEVELOPMENT PLAN

RATIO 1:2000

Issue	App	Date	Description
A	T.H.	20-11-2016	ISSUED FOR DA

Client: MIRVAC HOMES (NSW) PTY LTD.
Designed by : S.G.
Date of Drawing : 20-11-2016
Ratio (A1) : 1:1000/1:2000

Datum : AHD
Origin of Levels :
Date of Survey : N/A

JMD
Development Consultants

John M. Daly & Associates PTY LTD
A.B.N. 88051977989
Surveying
Engineering
Project Management
Licensed Water Service Co ordinators

32 Iolanthe Street
P.O. BOX 25
CAMPBELLTOWN N.S.W. 2560
PH. (02) 4625 5055
FAX (02) 4628 2013
email: admin@jmd.com.au

Project :
MOOREBANK COVE - STAGE 2
NEWBRIDGE ROAD, MOOREBANK

OVERALL PLAN SHOWING CATCHMENTS

Locality : MOOREBANK
L.G.A. : LIVERPOOL
CAD Ref:
S:\DATA\14\14005\14005 EMW\ENG\CAD\E10 RAINGARDEN SUPPORT\14005E10-PLAN

Sheet 1
of 3 sheets
Ref:
14005E10

The ratio shown on this plan relates to the original plan, produced by JMD only. Any photocopying or printing from digital files provided (particularly PDF files) may significantly alter the ratio of the plan.

TOTAL 179 LOTS

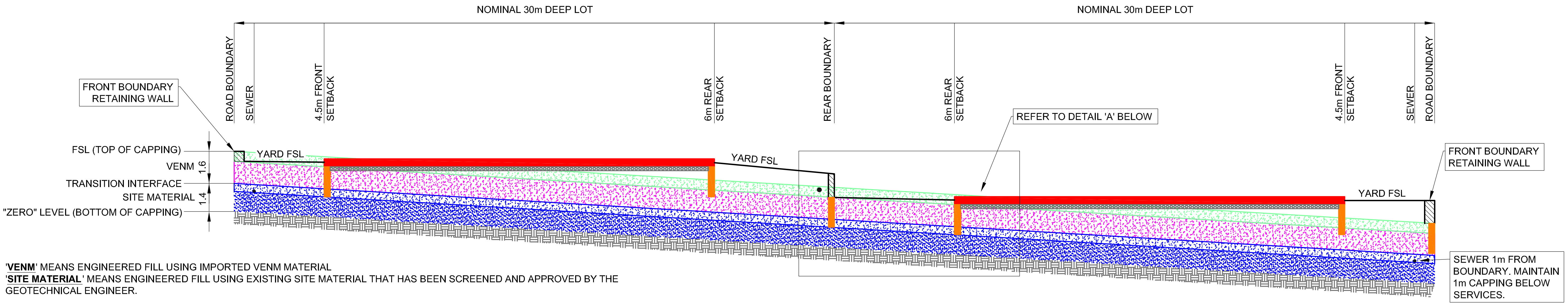
rev:	date:	amendment:
A	21.11.16	ISSUE FOR INFORMATION

project:
GEORGES COVE MARINA
Newbridge Road
Moorebank NSW 2170

architect:
MIRVAC DESIGN
architects
planners
interior designers
Level 26, 60 Margaret St.
Sydney, NSW, 2000
tel. 02 9080 8000
fax. 02 9080 8181
Mirvac Design Pty. Ltd.
ABN 78 003 359 153

title:
CONCEPT PLAN
Reduced Site Area
Option 20y

drawn:
approved:
job no: .....
lot no: 0
date: 21-11-2016
scale @ A0:1:500
drawing no: MP01-20y
rev: B

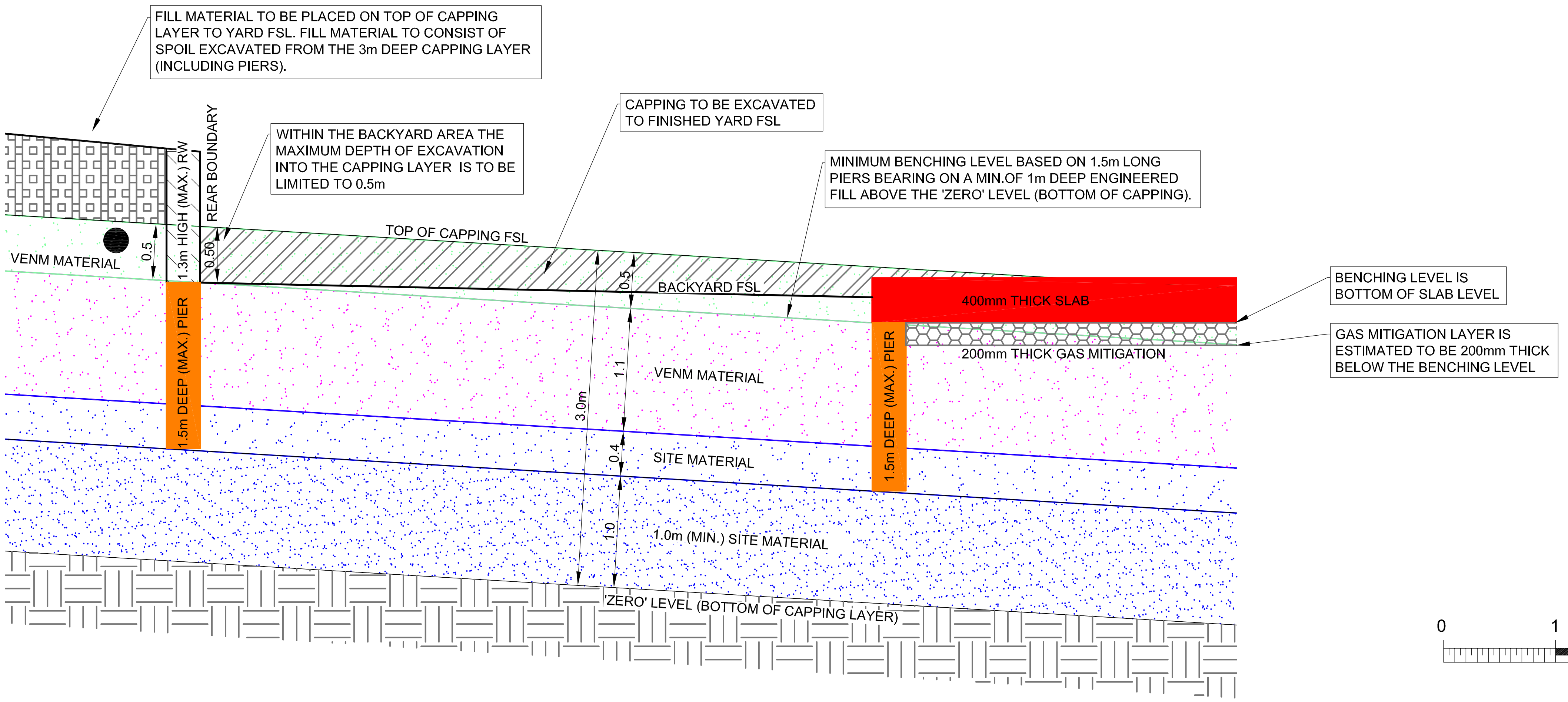


'**VENM**' MEANS ENGINEERED FILL USING IMPORTED VENM MATERIAL
'**SITE MATERIAL**' MEANS ENGINEERED FILL USING EXISTING SITE MATERIAL THAT HAS BEEN SCREENED AND APPROVED BY THE GEOTECHNICAL ENGINEER.

ALL ENGINEERED FILL TO BE PLACED UNDER LEVEL 1 GEOTECHNICAL SUPERVISION

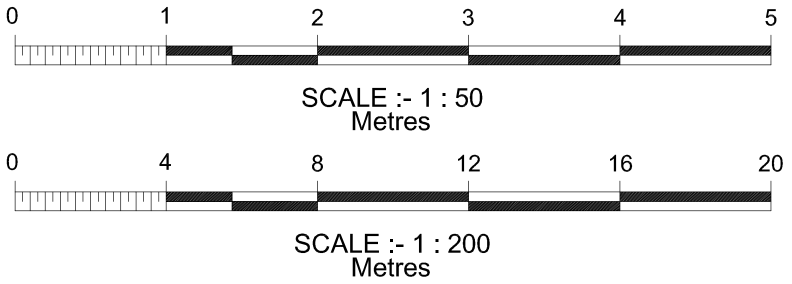
TYPICAL HOUSE BENCHING SECTION SHOWING CUT AND FILL WITHIN THE CAPPING LAYER

RATIO 1:200



DETAIL A - PIER, CUT AND FILL DETAILS

RATIO 1:50



B 13-03-2017 MINOR AMENDMENTS TO NOTES, SERVICES ADDED
A 09-03-2017 ORIGINAL ISSUE FOR COMMENT

Client: MIRVAC HOMES (NSW) PTY LTD.

Origin of Levels : N/A

Datum : AHD

Ratio (A3) : 1:200 & 1:50

Date of Survey :

Designed By : S.G.

Approved : T.H.

JMD
Development
Consultants

John M. Daly & Associates PTY LTD
A.B.N. 88051977989

Surveying
Engineering
Project Management
Licensed Water Service Co ordinators

32 Iolanthe Street
P.O. BOX 25
CAMPBELLTOWN N.S.W. 2560

PH. (02) 4625 5055
FAX (02) 4628 2013
email: admin@jmd.com.au

Project :

MOOREBANK COVE - NEWBRIDGE ROAD, MOOREBANK

TYPICAL HOUSE BENCHING SECTION
SHOWING CUT AND FILL WITHIN THE CAPPING LAYER

Locality : MOOREBANK

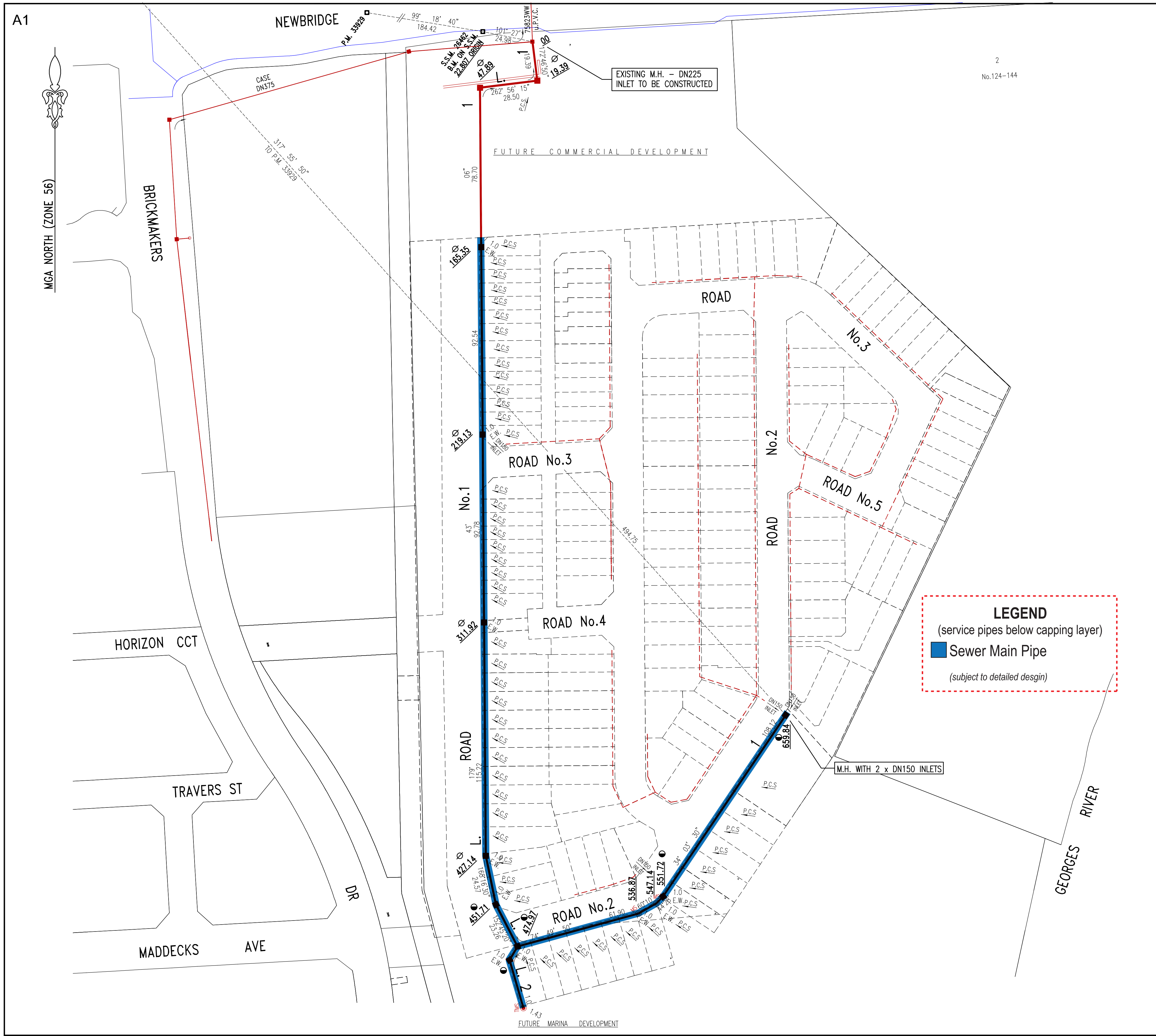
L.G.A. : LIVERPOOL

CAD Ref:
c:\users\sgray\desktop\14005\14005e15.dwg

Sheet 1
of 1 sheets

Ref:
14005E15

The ratio shown on this plan relates to the original plan, produced by JMD only. Any photocopying or printing from digital files provided (particularly PDF files) may significantly alter the ratio of the plan.



DEVELOPER CONTRACT PLAN
LEAK TIGHT SEWER SPECIFICATION

0 5 10 20 30 40 50 100 METRES

DATUM LINE OF AZIMUTH
P.M. 33929–SSM 26462 99°18'40" MGA
(ALL DISTANCES SHOWN ARE GROUND DISTANCES)

NOTES :

1. WATER SERVICING COORDINATOR & DESIGNER:
CALIBRE CONSULTING (NSW) PTY LTD
P.O. BOX 8300 BAULKHAM HILLS BC NSW 2153
Ph: (02) 8808 5000
FOR:
MIRVAC HOMES (NSW) PTY LTD
LEVEL 28 200 GEORGE ST, SYDNEY NSW 2000
Ph: (02) 9080 8848

2. THE WORKS AND MATERIAL ARE IN ACCORDANCE WITH THE SEWER RETICULATION CODE OF AUSTRALIA (WSA 02–2002–2.2 VERSION 3) INCLUDING THE SYDNEY WATER SUPPLEMENT AND APPENDICES AND THE TECHNICAL SPECIFICATION FOR LEAK TIGHT SEWER SYSTEMS (VERSION 8) 17/12/14.

3. ALL LOTS WERE VACANT AT TIME OF SURVEY.

4. ALL STRUCTURES TO BE CONSTRUCTED TO PROPOSED FINISHED SURFACE LEVELS. AS THE PFSL'S SHOWN ON THIS PLAN MAY BE SUBJECT TO CHANGE, THE CONSTRUCTOR IS TO LIAISE WITH THE SITE SUPERINTENDENT TO VERIFY ALL FINAL LEVELS AT TIME OF CONSTRUCTION. DEPTH TO INVERT SHOWN ON SECTIONS SHEETS 3 & 4 IS FROM EXISTING GROUND LEVEL.

5. PIPES CONCRETE ENCASED SHOWN ACCORDINGLY: SUPPORT TYPE 12U

6. ALL LEVELS ELECTRONICALLY GENERATED. NO LEVEL BOOK AVAILABLE.

7. ALL ROAD CROSSINGS TO BE BACKFILLED WITH 14:1 CEMENT STABILISED SAND.

8. CONCRETE BULKHEADS TO BE CONSTRUCTED AT REAR OF KERB FOR ALL ROAD CROSSINGS. REFER SEW–1206 & SEW–1207–V.

9. EXISTING & PROPOSED SERVICES ARE INDICATIVE ONLY. CURRENT SERVICES SEARCH & SITE CHECK OF ALL EXISTING SERVICES WILL BE NECESSARY PRIOR TO THE COMMENCEMENT OF WORK & APPROPRIATE PROCEDURES, PRECAUTIONS AND CARE NEED TO BE TAKEN BY THE CONSTRUCTOR WHEN WORKING IN CLOSE PROXIMITY TO SERVICES DURING CONSTRUCTION AND ANY DAMAGE TO EXISTING SERVICES IS TO BE RECTIFIED AT THE CONSTRUCTORS EXPENSE.

10. THE MINIMUM NUMBER OF FIELD COMPACTION TESTS REQUIRED TO SATISFY THE SEWERAGE CODE OF AUSTRALIA (CLAUSE 22.3.4.4) ARE:

PIPE EMBEDMENT ZONE: NIL (SEE NOTE 13)	TRENCH FILL ZONE – TRAFFICABLE: NIL (SEE NOTE 7)
	TRENCH FILL ZONE – NON–TRAFFICABLE: 10
	M.H. & M.S. ZONE: 18

11. PRECAUTIONS ARE NECESSARY IN THE VICINITY OF SUB–STATION & OTHER ELECTRICAL EARTHING.

12. CONSTRUCTOR TO PROVIDE WSC WITH CERTIFIED RED MARKED UP WAC DRAWINGS SHOWING ACCURATE DISTANCES OF PCS'S TO CENTRE OF DOWNSTREAM STRUCTURES & CHAINAGES OF CONCRETE ENCASED SECTIONS.

13. EMBEDMENT COMPACTION TESTING SUBJECT TO CLAUSE 22.3.3.1 OF SEWERAGE CODE OF AUSTRALIA. SELF COMPACTING METAL GRANULAR EMBEDMENT MAY BE USED

14. SUBSURFACE CONDITIONS, INCLUDING GROUNDWATER, INADEQUATE FOUNDATION CONDITIONS, CONTAMINATION, UNRECORDED BURIED MATERIAL OR OBJECTS, AND ARCHAEOLOGICALLY SIGNIFICANT ITEMS, MAY BE ENCOUNTERED DURING CONSTRUCTION, REQUIRING FURTHER ENVIRONMENTAL, GEOTECHNICAL OR ARCHAEOLOGICAL ASSESSMENT AND APPLICATION OF APPROPRIATE CONSTRUCTION METHODS AND STANDARDS.

15. MINIMUM ALLOWABLE BEARING PRESSURE FOR MAINTENANCE HOLES SHALL BE 100kPA. FOUNDATION MATERIAL TO BE INSPECTED BY A SUITABLY EXPERIENCED GEOTECHNICAL ENGINEER PRIOR TO PLACING BLINDING CONCRETE. CERTIFICATION TO BE PROVIDED TO WSC. ALSO REFER STD DWG SEW–1200

16. INVERT LEVEL OF EXISTING SEWER LINE 1–CH00 TO BE CONFIRMED PRIOR TO CONSTRUCTION. WSC TO BE ADVISED

◒ – DN1050 M.H. TO BE CONSTRUCTED IN ACCORDANCE WITH DTC–2203

Ø – DN1200 M.H. TO BE CONSTRUCTED IN ACCORDANCE WITH DTC–2200

PLAN DRAWN DATE: 29/11/16 VERSION: 01

SHEET 1 OF 1 SHEETS

PLAN TO BE READ IN CONJUNCTION
WITH CURRENT SYDNEY WATER STANDARDS
SYDNEY WATER CORPORATION

PRIOR TO COMMENCEMENT OF EXCAVATION FOR PROPOSED AND EXISTING SERVICES CONTACT :-
DIAL BEFORE YOU DIG .... Ph. 1100 ....
ELECTRICITY .... Ph. ....
GAS .... Ph. ....
TELECOMMUNICATIONS .... Ph. ....
.... Ph. ....
GIVING AT LEAST 48 HOURS NOTICE.

UTILITIES

TYPE	DATE	REF.	TYPE	DATE	REF.

WORK AS CONSTRUCTED CERTIFICATION

DEVELOPER ....
WATER SERVICE CO-ORDINATOR ....
CONSTRUCTOR ....
COMPLETED .... W.A.C. PREPARED ....

DESIGNER ....
I CERTIFY THAT THE WORKS HAVE BEEN CONSTRUCTED IN ACCORDANCE WITH THE WORK AS CONSTRUCTED DRAWINGS.

PIPE SCHEDULE

SIZE DN	TYPE	CLASS	LENGTH	PIPE JOINING METHOD / NOTES
150	U.P.V.C.	SN8	184.87	
225	u.P.V.C.	SN8	507.36	

DESIGN HEAD ......m

NO BOUNDARY TRAPS REQUIRED.

20m BELOW
AUSTRALIAN HEIGHT DATUM

SCALES
PLAN 1:1000 SECTION HOR. 1:1000 VERT. 1:250
CROSS SECTIONS — NATURAL
LENGTHS, DEPTHS & LEVELS ARE IN METRES.

NO AMENDMENTS ARE TO BE MADE TO THIS PLAN WITHOUT REFERENCE TO SYDNEY WATER. THIS PLAN IS NOT NECESSARILY UP TO DATE OR CORRECT AND SYDNEY WATER ACCEPTS NO RESPONSIBILITY.

U.B. DIRECTORY MAP 270 E8 (41st Ed.)

SHEET 1 OF 3 File No. N/A

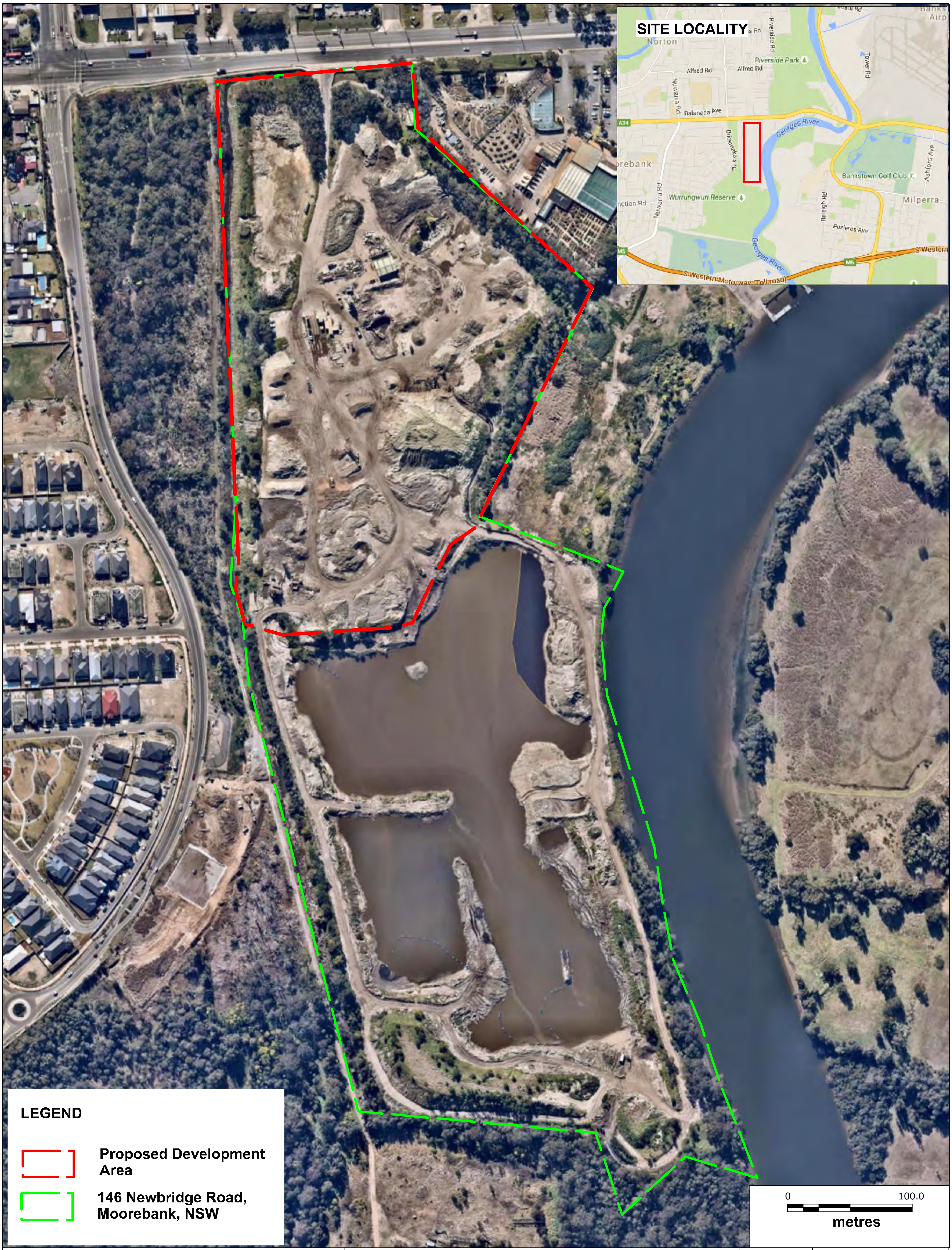
Sydney WATER SYDNEY WATER CORPORATION

Case No. 158048WW

LIVERPOOL SEWERAGE
DRAINS TO
MALABAR SEWAGE TREATMENT
SPO327

Appendix C

Drawings DP (2016)



LEGEND

🟥 Proposed Development Area

🟩 146 Newbridge Road, Moorebank, NSW

0 100.0
metres

Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Site Locality
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

N
MGA

OFFICE: Sydney
DRAWN BY: MJC
DATE: 14.10.2015

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.03
DRAWING No: 1
REVISION: A
SCALE: As shown

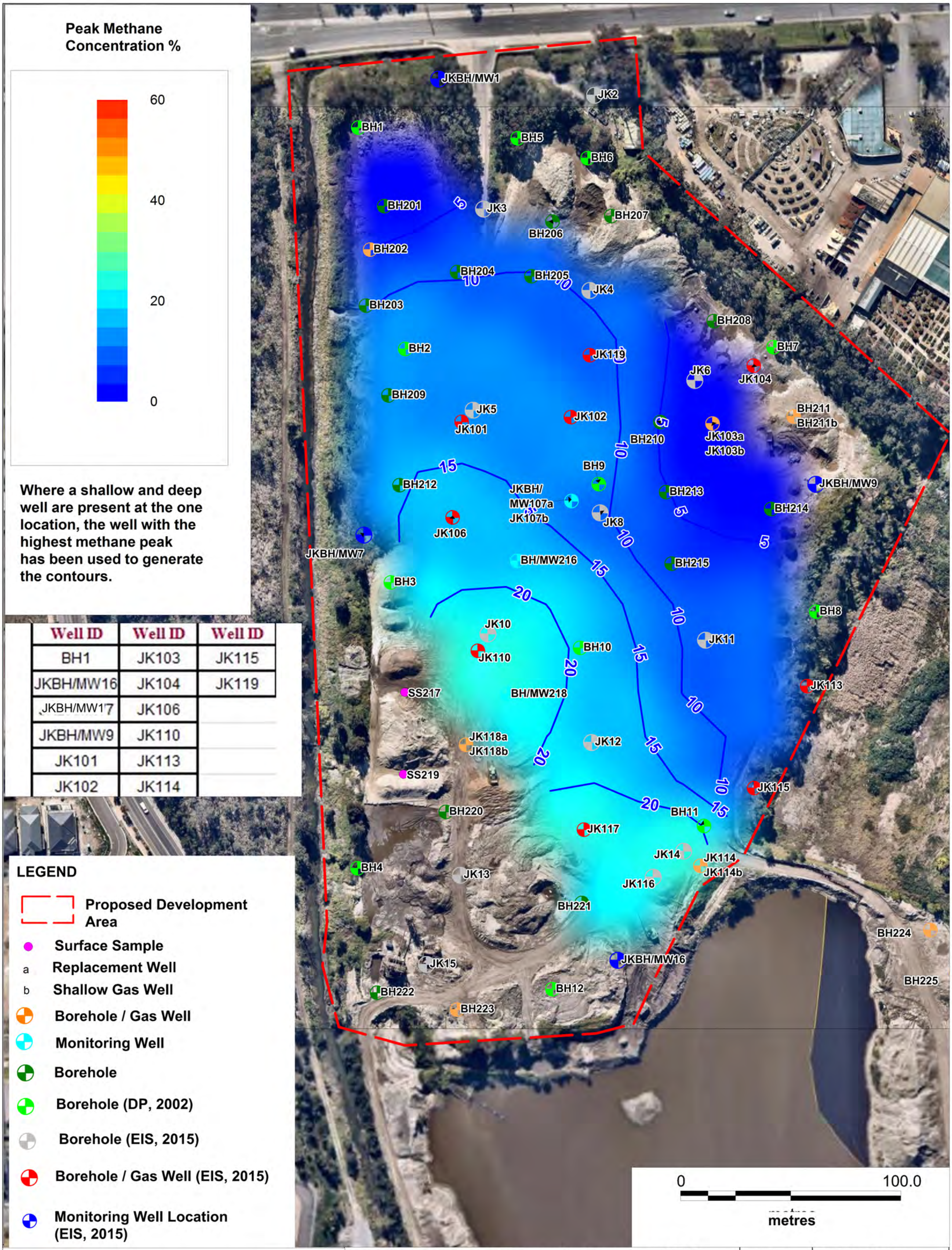
Douglas Partners
Geotechnics | Environment | Groundwater

TITLE: Test Locations
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

N
MGA

OFFICE: Sydney
DRAWN BY: MJC
DATE: 17.2.2016

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.03
DRAWING No: 2
REVISION: A
SCALE: As shown



Peak Methane Concentration %

Where a shallow and deep well are present at the one location, the well with the highest methane peak has been used to generate the contours.

Well ID	Well ID	Well ID
BH1	JK103	JK115
JKBH/MW16	JK104	JK119
JKBH/MW17	JK106	
JKBH/MW9	JK110	
JK101	JK113	
JK102	JK114	

LEGEND

- **Proposed Development Area**
- ● **Surface Sample**
- a **Replacement Well**
- b **Shallow Gas Well**
- **Borehole / Gas Well**
- **Monitoring Well**
- **Borehole**
- **Borehole (DP, 2002)**
- **Borehole (EIS, 2015)**
- **Borehole / Gas Well (EIS, 2015)**
- **Monitoring Well Location (EIS, 2015)**

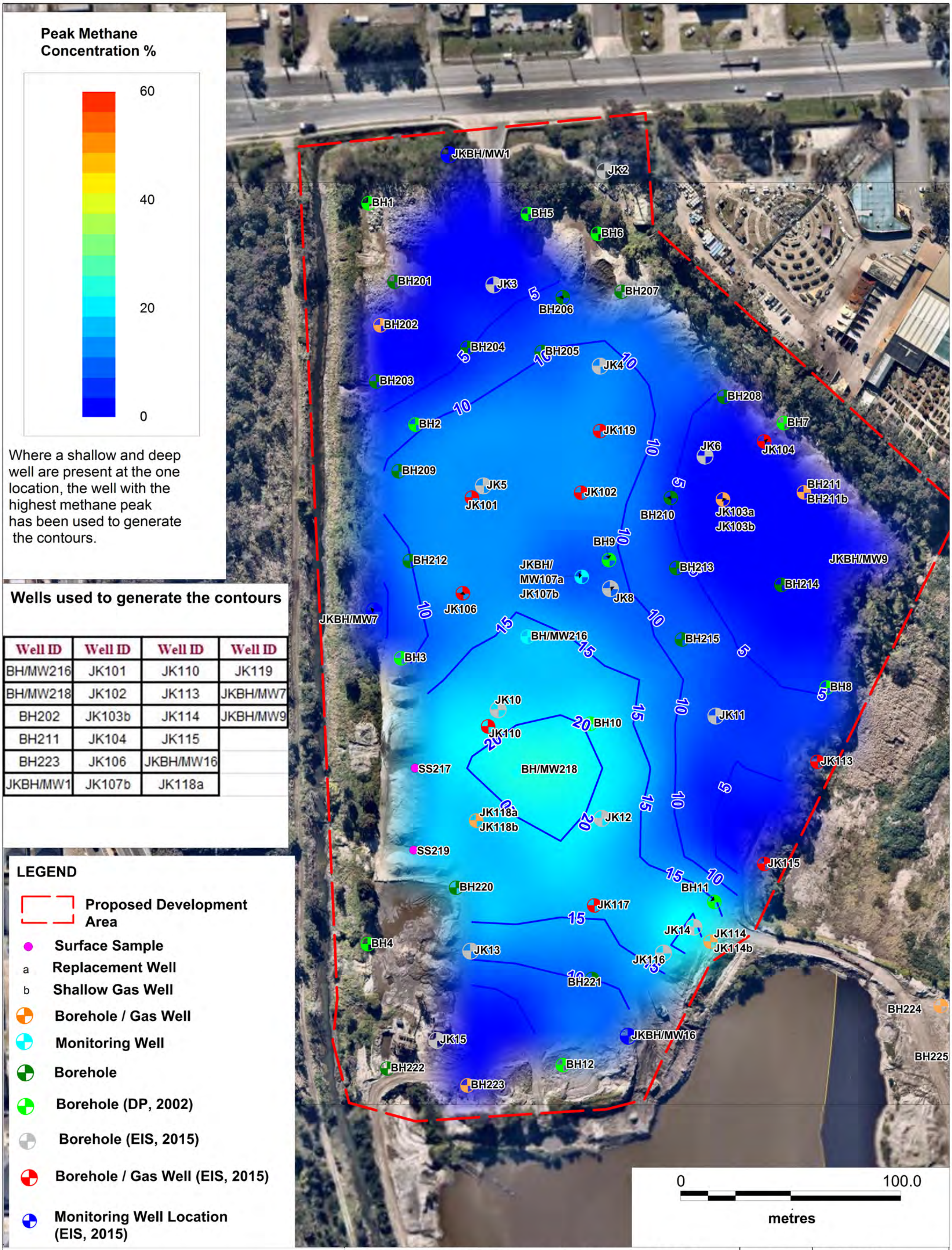
Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Peak Methane Concentration Contours 19/8/15
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

N
MGA

OFFICE: Sydney
DRAWN BY: MJC
DATE: 17.02.2016

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.03
DRAWING No: 3
REVISION: A
SCALE: As shown



Where a shallow and deep well are present at the one location, the well with the highest methane peak has been used to generate the contours.

Wells used to generate the contours

Well ID	Well ID	Well ID	Well ID
BH/MW216	JK101	JK110	JK119
BH/MW218	JK102	JK113	JKBH/MW7
BH202	JK103b	JK114	JKBH/MW9
BH211	JK104	JK115	
BH223	JK106	JKBH/MW16	
JKBH/MW1	JK107b	JK118a	

LEGEND

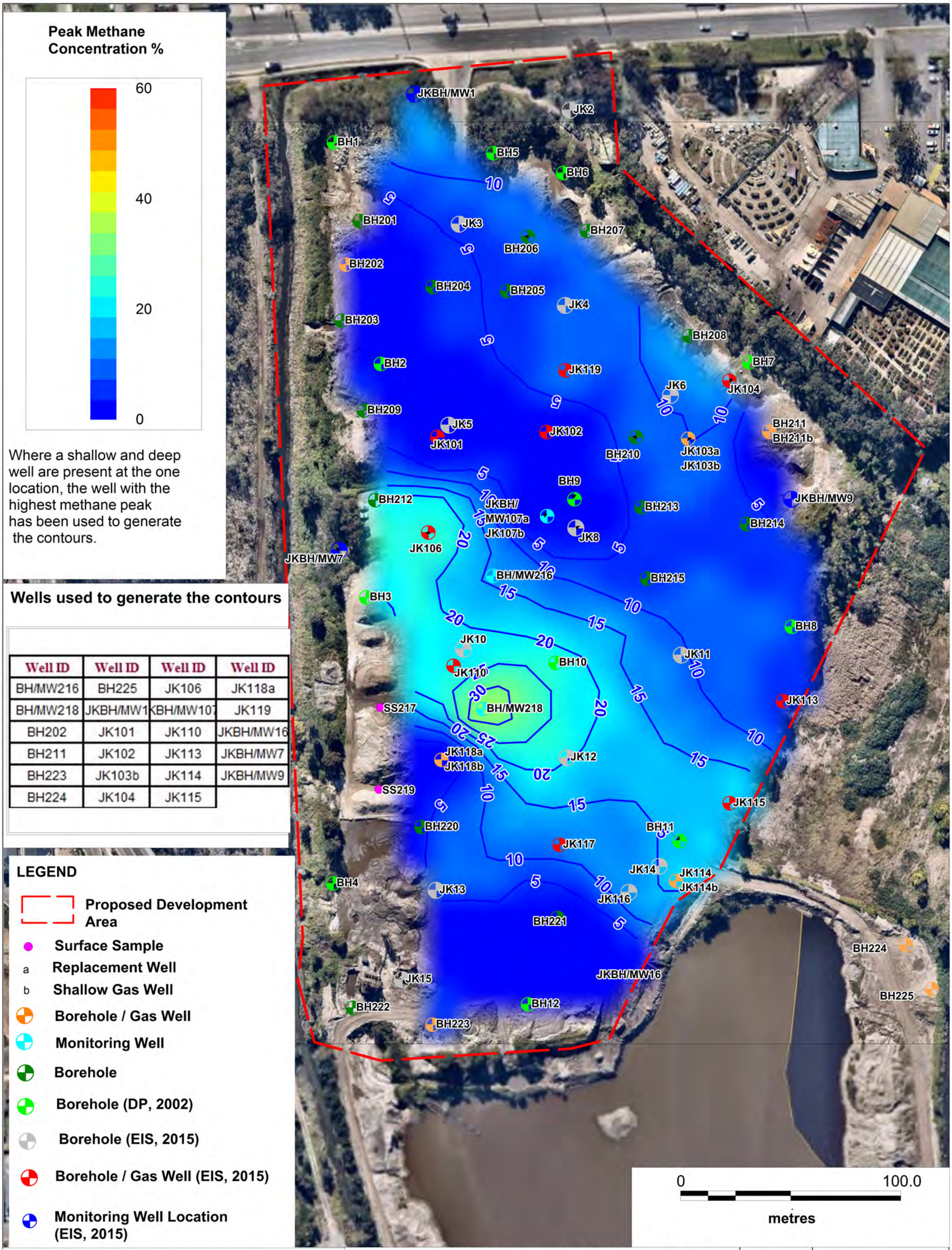
- Proposed Development Area
- ● Surface Sample
- a Replacement Well
- b Shallow Gas Well
- ⊕ Borehole / Gas Well
- ⊕ Monitoring Well
- ⊕ Borehole
- ⊕ Borehole (DP, 2002)
- ⊕ Borehole (EIS, 2015)
- ⊕ Borehole / Gas Well (EIS, 2015)
- ⊕ Monitoring Well Location (EIS, 2015)

Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Peak Methane Concentration Contours 1/10/15
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

OFFICE: Sydney
DRAWN BY: MJC
DATE: 17.02.2016

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.03
DRAWING No: 4
REVISION: A
SCALE: As shown



Peak Methane Concentration %

Where a shallow and deep well are present at the one location, the well with the highest methane peak has been used to generate the contours.

Wells used to generate the contours

Well ID	Well ID	Well ID	Well ID
BH/MW216	BH225	JK106	JK118a
BH/MW218	JKBH/MW1	KBH/MW107	JK119
BH202	JK101	JK110	JKBH/MW16
BH211	JK102	JK113	JKBH/MW7
BH223	JK103b	JK114	JKBH/MW9
BH224	JK104	JK115	

LEGEND

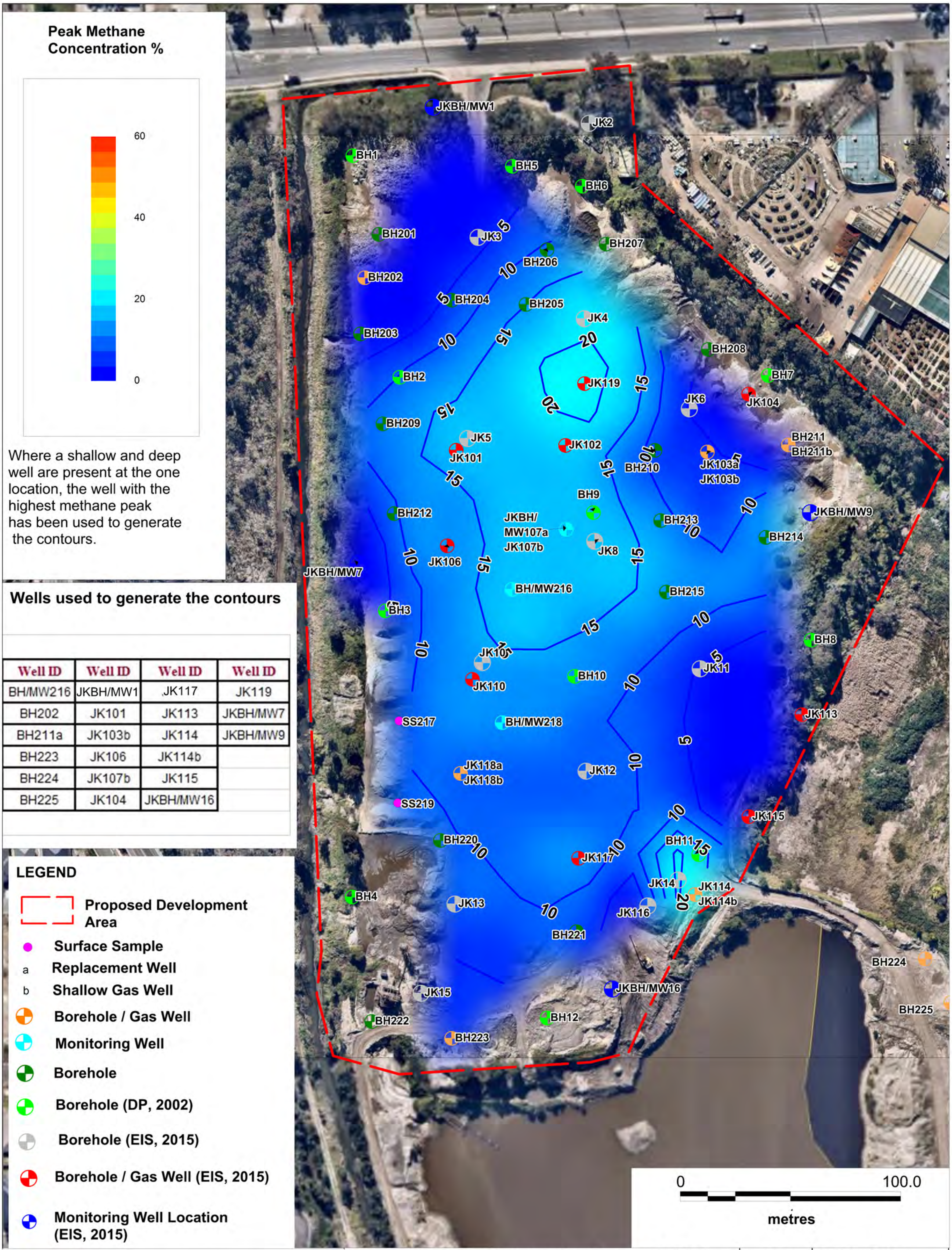
⌐ ¬	Proposed Development Area
●	Surface Sample
a	Replacement Well
b	Shallow Gas Well
⊕	Borehole / Gas Well
⊕	Monitoring Well
⊕	Borehole
⊕	Borehole (DP, 2002)
⊕	Borehole (EIS, 2015)
⊕	Borehole / Gas Well (EIS, 2015)
⊕	Monitoring Well Location (EIS, 2015)

Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Peak Methane Concentration Contours 27/10/15
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

OFFICE: Sydney
DRAWN BY: MJC
DATE: 17.02.2016

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.03
DRAWING No: 5
REVISION: A
SCALE: As shown



Peak Methane Concentration %

Where a shallow and deep well are present at the one location, the well with the highest methane peak has been used to generate the contours.

Wells used to generate the contours

Well ID	Well ID	Well ID	Well ID
BH/MW216	JKBH/MW1	JK117	JK119
BH202	JK101	JK113	JKBH/MW7
BH211a	JK103b	JK114	JKBH/MW9
BH223	JK106	JK114b	
BH224	JK107b	JK115	
BH225	JK104	JKBH/MW16	

LEGEND

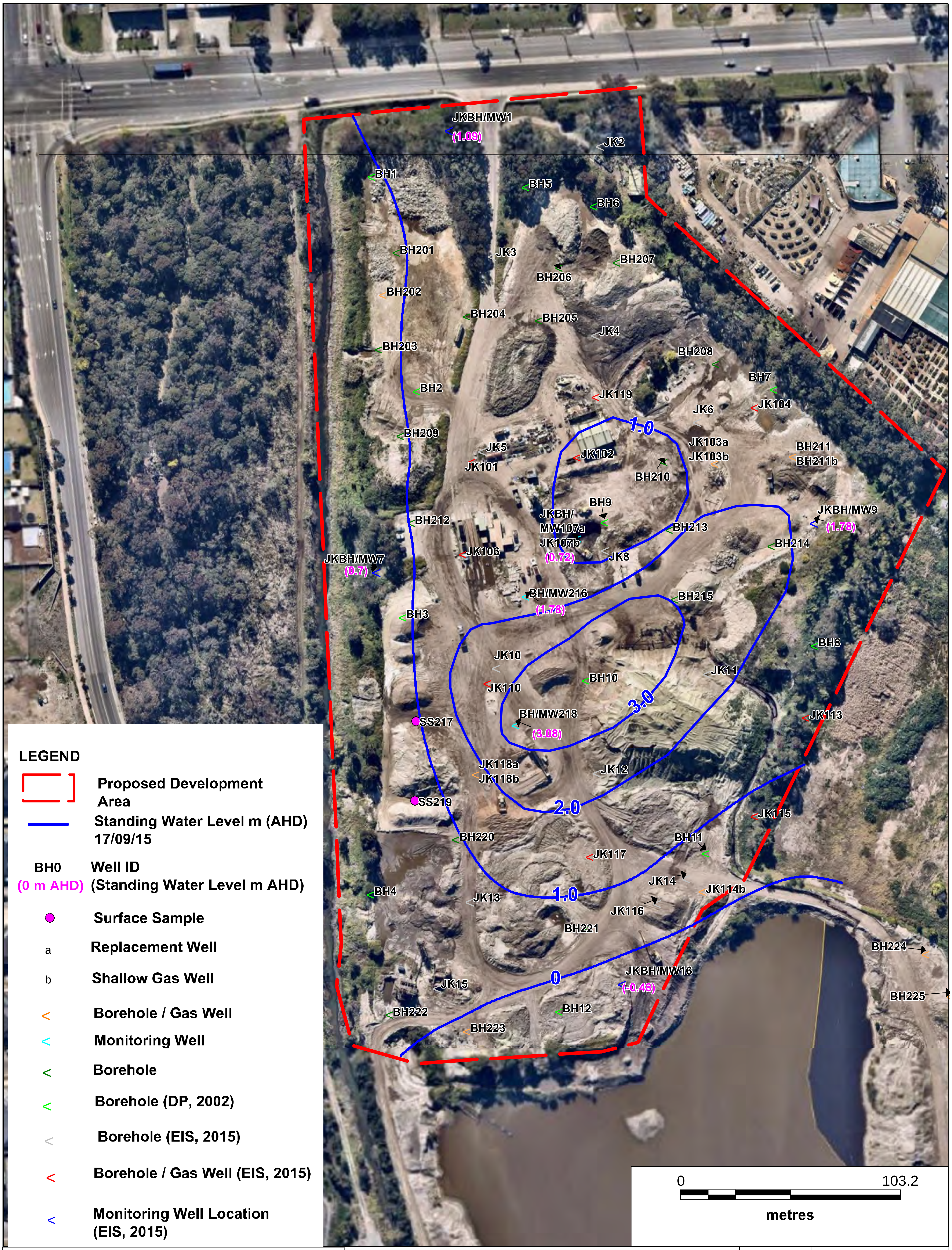
- ▭ Proposed Development Area
- ● Surface Sample
- a Replacement Well
- b Shallow Gas Well
- ⊕ Borehole / Gas Well
- ⊕ Monitoring Well
- ⊕ Borehole
- ⊕ Borehole (DP, 2002)
- ⊕ Borehole (EIS, 2015)
- ⊕ Borehole / Gas Well (EIS, 2015)
- ⊕ Monitoring Well Location (EIS, 2015)

Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Peak Methane Concentration Contours 10/2/16
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

OFFICE: Sydney
DRAWN BY: MJC
DATE: 17.02.2016

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.03
DRAWING No: 6
REVISION: A
SCALE: As shown

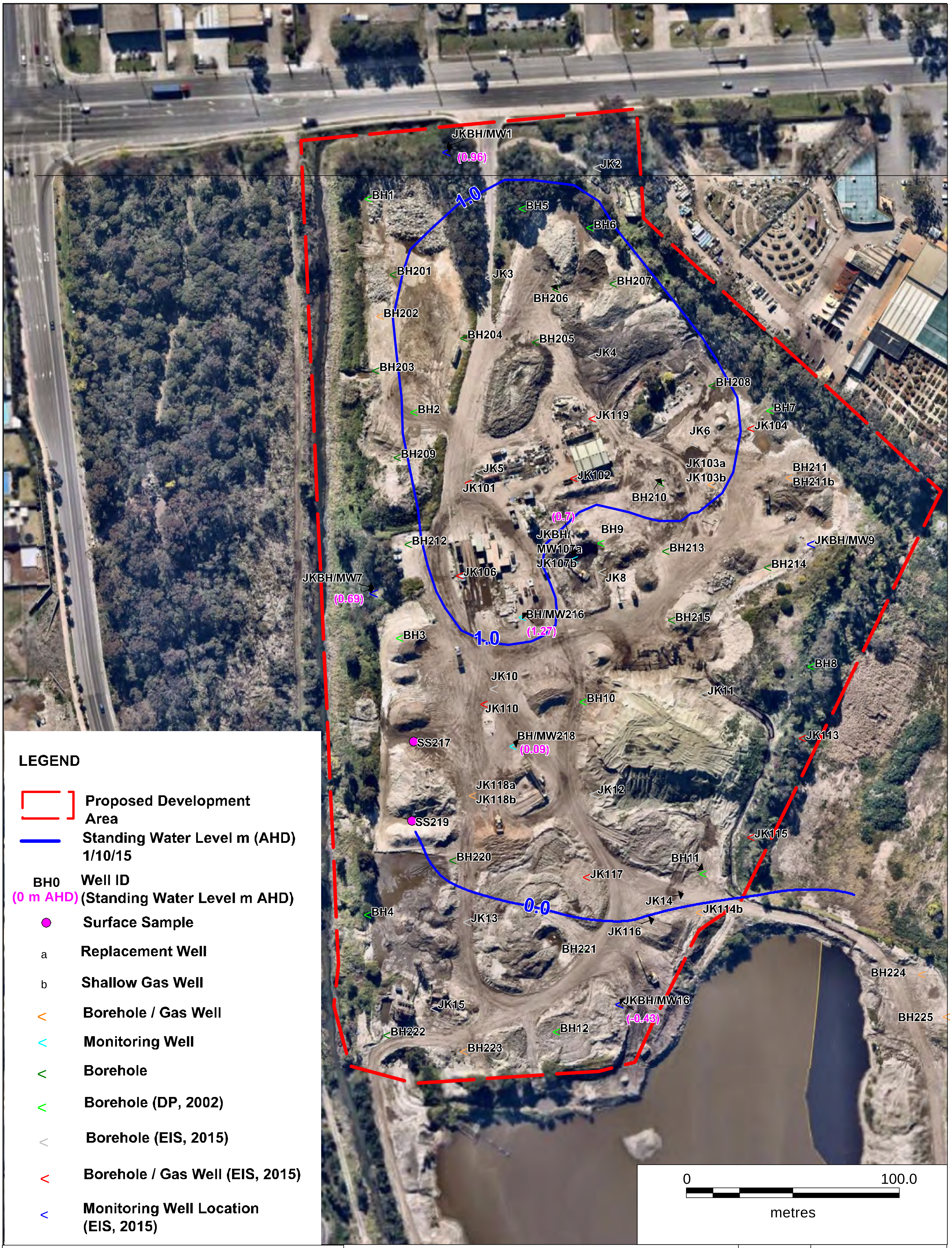


Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Standing Water Level (17.09.15)
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

OFFICE: Sydney
DRAWN BY: BAH
DATE: 19.02.16

CLIENT: Benedict Industries Pty Ltd	PROJECT No: 71459.03	DRAWING No: 7	REVISION: A	SCALE: As shown



Douglas Partners
Geotechnics | Environment | Groundwater

TITLE: Standing Water Level (1.10.15)
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

OFFICE: Sydney
DRAWN BY: BAH
DATE: 18.02.2016

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.03
DRAWING No: 8
REVISION: A
SCALE: As shown

Douglas Partners
Geotechnics | Environment | Groundwater

TITLE: Surface Water Sample Locations
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

N
MGA

OFFICE: Sydney
DRAWN BY: MJC
DATE: 19.02.2016

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.03
DRAWING No: 9
REVISION: A
SCALE: As shown

Appendix D

Summary of Soil Results (DP, 2016)

Table 1: Summary Results for Metals

Test Location ID	Depth (m)	As[3]	Cd	Cr	Cu	Pb[4]	Hg[5,6]	Ni	Zn	Mn
BH/MW216	0.1-0.2	<4	0.8	13	28	54	<0.1	9	130	200
BH/MW216	3.9-4.35	7	<0.4	21	26	66	0.1	11	83	230
BH/MW216	5.9-6.35	17	<0.4	21	23	51	<0.1	9	170	130
BH/MW218	0.9-1.35	<4	<0.4	4	2	4	<0.1	3	13	68
BH/MW218	2.9-2.35	5	<0.4	14	46	37	<0.1	13	64	110
BH/MW218	5.9-6.35	5	<0.4	15	7	11	<0.1	2	3	5
BH201	0.1-0.2	<4	0.4	7	32	56	<0.1	5	110	61
BH201	0.9-1.35	4	1	15	79	110	0.1	9	170	160
BH202	0.9-1.35	<4	<0.4	45	47	13	<0.1	11	32	1500
BH202	1.9-2.35	6	0.5	26	50	170	0.1	15	140	180
BH203	0.1-0.2	<4	<0.4	7	46	44	<0.1	5	100	87
BH203	0.9-1.35	7	<0.4	14	19	36	<0.1	6	70	40
BH203	2.9-3.35	7	0.5	15	160	860	0.2	14	380	150
BH204	0.1-0.2	<4	<0.4	5	24	47	<0.1	3	83	44
BH204	1.9-2.35	5	<0.4	15	56	72	<0.1	5	140	130
BH204	3.9-4.35	7	<0.4	11	64	150	0.1	16	210	80
BH205	0.9-1.35	<4	<0.4	46	15	12	<0.1	19	25	92
BH205	2.9-3.35	6	<0.4	9	7	13	<0.1	2	5	8
BH205	3.9-4.35	8	<0.4	15	15	15	<0.1	2	15	9
BH206	0.1-0.2	5	<0.4	17	30	140	0.2	15	140	160
BH206	0.9-1.35	8	<0.4	15	22	16	<0.1	11	30	450
BH206	2.35-2.9	<4	<0.4	16	8	25	<0.1	3	9	37
BH206	4.35-4.9	17	<0.4	19	10	32	<0.1	11	30	120
BH207	0.1-0.2	<4	<0.4	25	53	16	<0.1	26	40	490
BH207	0.9-1.35	5	<0.4	15	18	21	<0.1	6	55	73
BH208	1.9-2.35	<4	<0.4	18	21	55	<0.1	13	470	190
BH208	0.9-1.35	<4	<0.4	10	19	32	<0.1	5	44	42
BH208	3.9-4.35	7	<0.4	30	13	26	<0.1	5	16	6
BH209	0.1-0.2	6	<0.4	18	82	98	0.1	13	210	270
BH209	0.9-1.35	<4	<0.4	21	37	35	<0.1	10	75	450
BH209	1.9-2.35	5	<0.4	17	55	35	<0.1	9	66	150
BH209	3.9-4.35	7	0.4	19	25	150	<0.1	10	140	190
BH210	0.1-0.2	<4	<0.4	10	63	11	<0.1	14	33	280
BH210	2.0-2.45	5	<0.4	12	4	10	<0.1	2	5	15
BH211	0.1-0.2	<4	<0.4	12	19	21	<0.1	9	54	200
BH211	0.9-1.35	<4	<0.4	10	5	10	<0.1	2	4	18
BH211	2.9-2.35	4	<0.4	17	3	24	<0.1	4	6	42
BH212	0.1-0.2	<4	<0.4	28	67	16	<0.1	11	39	800
BH212	2.9-3.35	6	0.6	16	41	130	0.1	9	240	120
BH213	0.1-0.2	8	<0.4	19	21	19	<0.1	14	43	200
BH213	2.9-3.35	5	<0.4	13	4	18	<0.1	3	27	27
BH214	0.1-0.2	<4	<0.4	18	46	17	<0.1	11	48	240
BH214	2.2-2.65	<4	<0.4	6	14	54	<0.1	8	33	67
BH215	0.9-1.35	<4	<0.4	9	10	28	<0.1	4	50	61
BH215	1.9-2.35	<4	<0.4	4	17	19	<0.1	2	11	13
BH220	0.1-0.2	4	0.8	16	47	190	0.2	11	290	610
BH221	0.1-0.2	<4	<0.4	11	14	30	0.1	4	69	110
BH221	1.9-2.35	4	<0.4	14	16	92	<0.1	6	78	120
BH221	2.9-3.35	7	0.6	15	45	620	0.2	9	290	180
BH221	3.9-4.35	17	0.7	25	24	86	<0.1	8	150	130
BH222	0.1-0.2	<4	<0.4	16	32	22	<0.1	26	52	560
BH222	0.9-1.35	<4	<0.4	12	85	22	<0.1	12	77	220
BH223	2.0-2.45	5	<0.4	17	540	79	0.2	10	110	190
JK103a	0.1-0.2	<4	<0.4	73	78	6	<0.1	11	26	2300
JK103a	1.9-2.35	<4	<0.4	4	18	31	<0.1	1	14	51
JK103a	2.9-3.35	<4	<0.4	12	22	49	<0.1	9	66	170
JK103a	5.9-6.35	<4	<0.4	3	3	3	<0.1	<1	1	1
JK107a	0.1-0.2	<4	<0.4	9	19	38	<0.1	5	79	87
JK107a	1.9-2.35	10	<0.4	17	29	98	<0.1	10	110	89
JK107a	7.9-8.35	<4	<0.4	5	5	6	<0.1	1	2	2
JK107a	8.9-9.35	<4	<0.4	3	3	6	<0.1	<1	4	3
JK118a	0.1-0.2	<4	<0.4	4	17	15	<0.1	5	25	110
JK118a	1.9-2.35	<4	<0.4	9	12	63	<0.1	6	87	120
JK118a	4.9-5.35	<4	<0.4	15	15	10	<0.1	2	9	9
SS217	0.0-0.1	5	<0.4	9	18	25	<0.1	6	55	120
SS219	0.0-0.1	<4	<0.4	9	24	45	<0.1	7	80	120
BD1/070815	-	8	0.6	13	49	35	<0.1	43	160	340
BD2/080915	-	5	<0.4	9	42	90	0.1	6	75	79
BD3/090915	-	4	0.5	12	27	140	0.1	8	170	100
BD5/100915	-	6	<0.4	16	56	93	<0.1	10	250	85
BD4/100915	-	9	<1	18	23	25	<0.1	6	35	254
BD6/100915	-	6	<1	8	15	14	<0.1	7	15	152
BD7/100915	-	10	<1	30	13	27	<0.1	2	11	<5
BH222(T)	0.9-1.35	<4	<0.4	23	250	42	<0.1	16	160	270
BH204 (T)	3.9-4.35	6	<0.4	13	31	180	<0.1	8	150	110
BH206 (T)	2.35-2.9	<4	<0.4	16	10	35	<0.1	2	10	49
BH/MW216 (T)	5.9-6.35	14	<0.4	18	18	43	<0.1	7	210	74
Laboratory PQL		4	0.4	1	1	1	0.1	1	1	1
NEPM HIL A[1, 2]		100	20	100[7]	6000	300	40	400	7400	3800
EILs[8] - Urban residential/Public open space		100	NC	450	230	1100	NC	300	850	NC

Notes to Table:

All results in mg/kg on a dry weight basis

NA - Not Applicable

NC - No Criteria

NT - Not Tested

PQL - Practical Quantitation Limits

1 - Health Based Criteria for Residential with Accessible Soils Land Use

2- HIL generally applies to the top 3m of soil

3- HIL assumes 70% oral bioavailability. Site-specific bioavailability may be important and should be considered where appropriate (refer Schedule B7)

4- HIL is based on blood lead models (adult lead model where 50% bioavailability has been considered)
Site-specific bioavailability may be important and should be considered where appropriate (refer Schedule B7)

5- Assessment of methyl mercury should only be considered if there is evidence of its potential source

6- HIL does not address elemental mercury

7 - Chromium (VI)

8- EILs refer to contamination present in soil for at least two years

▨ exceeds NEPM Health-Based Criteria for Residential with accessible soil Landuse

Underlined results exceed NPEM Ecological Investigation Levels for Urban residential/Public open space

BD1/070815 is the replicate sample of JK107a/1.9-2.35 m (Envirolab)

BD2/080915 is the replicate sample of BH213/2.9-3.35 m (Envirolab)

BD3/090915 is the replicate sample of BH212/2.9-3.35 m (Envirolab)

BD5/100915 is the replicate sample of BH207/0.9-1.35 m (Envirolab)

BD4/100915 is the replicate sample of BH201/0.9-1.35 m (ALS)

BD6/100915 is the replicate sample of BH206/0.9-1.35 m (ALS)

BD7/100915 is the replicate sample of BH208/3.9-4.35 m (ALS)

Table 2: Summary Results for Hydrocarbons

Test Location ID	Depth (m)	TRH				TRH (NEPC, 2013)						BTEX				PAHs
		C_6 - C_9	C_{10} - C_{14}	C_{15} - C_{28}	C_{29} - C_{36}	F1 (C_6-C_{10}-BTEX)	F2 (>C_{10}-C_{16} - Napthalene)	C_6-C_{10}	>C_{10}-C_{16}	>C_{16}-C_{34}	>C_{34}-C_{40}	Benzene	Toluene	Ethyl Benzene	Xylenes	Naphthalene
BH/MW216	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH/MW216	3.9-4.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH/MW216	5.9-6.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH/MW218	0.9-1.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH/MW218	2.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH/MW218	5.9-6.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH202	0.9-1.35	<25	<50	<100	240	<25	<50	<25	<50	200	330	<0.5	<1	<2	<1	<1
BH201	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH201	0.9-1.35	<25	<50	<100	110	<25	<50	<25	<50	110	130	<0.5	<1	<2	<1	<1
BH202	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH203	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	110	<100	<0.5	<1	<2	<1	<1
BH203	0.9-1.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH203	2.9-3.35	<25	<50	<100	200	<25	<50	<25	<50	210	170	<0.5	<1	<2	<1	<1
BH204	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	110	<100	<0.5	<1	<2	<1	<1
BH204	1.9-2.35	<25	<50	<100	120	<25	<50	<25	<50	170	<100	<0.5	<1	<2	<1	<1
BH204	3.9-4.35	<25	<50	<100	140	<25	<50	<25	<50	150	130	<0.5	<1	<2	<1	<1
BH205	0.9-1.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH205	2.9-3.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH205	3.9-4.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH206	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	120	<100	<0.5	<1	<2	<1	<1
BH206	0.9-1.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH206	2.35-2.9	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH206	4.35-4.9	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH207	0.1-0.2	<25	<50	850	1200	<25	<50	<25	<50	1700	1300	<0.5	<1	<2	<1	<1
BH207	0.9-1.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH208	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH208	0.9-1.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH208	3.9-4.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH209	0.1-0.2	<25	<50	160	250	<25	<50	<25	<50	330	170	<0.5	<1	<2	<1	<1
BH209	0.9-1.35	<25	<50	370	910	<25	<50	<25	<50	990	1100	<0.5	<1	<2	<1	<1
BH209	1.9-2.35	<25	<50	<100	140	<25	<50	<25	<50	140	150	<0.5	<1	<2	<1	<1
BH209	3.9-4.35	<25	<50	<100	150	<25	<50	<25	<50	120	130	<0.5	<1	<2	<1	<1
BH210	0.1-0.2	<25	<50	260	570	<25	<50	<25	<50	680	580	<0.5	<1	<2	<1	<1
BH210	2.0-2.45	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH211	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH211	0.9-1.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH211	2.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH212	0.1-0.2	<25	<50	230	640	<25	<50	<25	<50	640	840	<0.5	<1	<2	<1	<1
BH212	2.9-3.35	<25	<50	100	250	<25	<50	<25	<50	280	160	<0.5	<1	<2	<1	<1
BH213	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH213	2.9-3.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH214	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH214	2.2-2.65	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH215	0.9-1.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH215	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH220	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	130	<100	<0.5	<1	<2	<1	<1
BH221	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH221	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH221	2.9-3.35	<25	<50	<100	<100	<25	<50	<25	<50	110	<100	<0.5	<1	<2	<1	<1
BH221	3.9-4.35	<25	<50	220	<100	<25	<50	<25	<50	270	<100	<0.5	<1	<2	<1	<1
BH222	0.1-0.2	<25	<50	400	590	<25	<50	<25	<50	890	340	<0.5	<1	<2	<1	<1
BH222	0.9-1.35	<25	<50	450	790	<25	<50	<25	<50	990	890	<0.5	<1	<2	<1	<1
BH223	2.0-2.45	<25	<50	<100	110	<25	<50	<25	<50	100	130	<0.5	<1	<2	<1	<1
JK103a	0.1-0.2	<25	<50	110	550	<25	<50	<25	<50	460	860	<0.5	<1	<2	<1	<1
JK103a	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK103a	2.9-3.35	<25	<50	460	360	<25	<50	<25	<50	720	240	<0.5	<1	<2	<1	<1
JK103a	5.9-6.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK107a	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK107a	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK107a	7.9-8.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK107a	8.9-9.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK118a	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK118a	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK118a	4.9-5.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
SS217	0.0-0.1	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
SS219	0.0-0.1	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BD1/070815	-	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BD2/080915	-	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BD3/090915	-	<25	<50	<100	<100	<25	<50	<25	<50	110	<100	<0.5	<1	<2	<1	<1
BD5/100915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD4/100915	-	<25	<50	<100	<100	<25	<50	<25	<50	110	<100	<0.5	<1	<2	<1	<1
BD6/100915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD7/100915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Laboratory PQL		25	50	100	100	25	50	25	50	100	100	0.2	0.5	1	1	1
NEPM HSL A [6] SAND		NC	NC			45/70/110/200 [1]	110/240/440/NL [1]	NC	NC	NC	NC	0.5/0.5/0.5/0.5 [1]	160/220/310/540 [1]	55/NL/NL/NL [1]	40/60/95/170 [1]	3/NL/NL/NL [1]
NEPM HSL A [6] SILT		NC	NC			40/65/100/190 [2]	230/NL/NL/NL [2]	NC	NC	NC	NC	0.6/0.7/1/2 [2]	390/NL/NL/NL [2]	NL/NL/NL/NL [2]	95/210/NL/NL [2]	4/NL/NL/NL [2]
NEPM HSL A [6] CLAY		NC	NC			50/90/150/290 [3]	280/NL/NL/NL [3]	NC	NC	NC	NC	0.7/1/2/3 [3]	480/NL/NL/NL [3]	NL/NL/NL/NL [3]	110/310/NL/NL [3]	5/NL/NL/NL [3]
CRC HSL for Intrusive Worker by Vapour Intrusion		NC	NC			NC	NC	NL	NL	NL	NL	77	NL	NL	NL	NL
CRC HSL A for Direct Contact - Resident		NC	NC			NC	NC	4400	3300	4500	6300	100	14000	4500	12000	1400
CRC HSL for Intrusive Worker by Direct Contact		NC	NC			NC	NC	82000	62000	85000	120000	1100	120000	85000	130000	29000
NEPM ESL Residential A,B,C [4,7] - Coarse Soils		NC	NC			180 *	NC	NC	120 *	300	2800	50	85	70	105	170 [8]
NEPM ESL Residential A,B,C [4,7] - Fine Soils		NC	NC			180 *	NC	NC	120 *	1300	5600	65	105	125	45	170 [8]
Management limits for TPH fractions in coarse soils - Residential A, B, C [5]		NC	NC			NC	NC	700	1000	2500	10000	NC	NC	NC	NC	NC
Management limits for TPH fractions in fine soils - Residential A, B, C [5]		NC	NC			NC	NC	800	1000	3500	10000	NC	NC	NC	NC	NC

Notes to Table:

All results in mg/kg on a dry weight basis

NC - No Criteria

PID - Photoionisation Detector

PQL - Practical Quantitation Limits

NL - Not Limiting

1- Soil HSLs for vapour intrusion (mg/kg) for SAND samples recovered from 0 m to <1 m / 1 m to <2 m / 2 m to <4 m / >=4 m

2- Soil HSLs for vapour intrusion (mg/kg) for SILT samples recovered from 0 m to <1 m / 1 m to <2 m / 2 m to <4 m / >=4 m

3- Soil HSLs for vapour intrusion (mg/kg) for CLAY samples recovered from 0 m to <1 m / 1 m to <2 m / 2 m to <4 m / >=4 m

4- ESLs are of low reliability except where indicated by * which indicates that the ESLs are of moderate reliability

5- Management limits are applied after consideration of relevant ESLs and HSLs

6- Multiplication factor may be applied (for depths >2m) subject to favourable biodegradation conditions - refer to 2.4.10 NEPC (2013)

7- ESLs apply from the surface to 2 m depth below finished surface/ground level

8- Ecological Investigation Level (EIL) - this value relates to fresh contamination.

▨ exceeds NEPM HSL Health-Based Criteria for Residential with accessible soils Landuse

🟦 exceeds NEPM management limits for TRH fractions in coarse/fine soils - Residential Landuse

Underlined results exceed the NEPM ESL guideline values for Residential with accessible Soils Landuse

Bold results exceed the CRC CARE guideline values for HSL

BD1/070815 is the replicate sample of JK107a/1.9-2.35 m (Envirolab)

BD2/080915 is the replicate sample of BH213/2.9-3.35 m (Envirolab)

BD3/090915 is the replicate sample of BH212/2.9-3.35 m (Envirolab)

BD5/100915 is the replicate sample of BH207/0.9-1.35 m (Envirolab)

BD4/100915 is the replicate sample of BH201/0.9-1.35 m (ALS)

BD6/100915 is the replicate sample of BH206/0.9-1.35 m (ALS)

BD7/100915 is the replicate sample of BH208/3.9-4.35 m (ALS)

Table 3: Summary Results for PAH, OCP, OPP, PCB, Phenols and Cyanide

Test Location ID	Depth (m)	Total PAH	Naphthalene	B(a)P	B(a)P TEQ	Total OCP	Aldrin + Dieldrin	Chlordane	DDT+DDE+DDD	Endosulfan	Endrin	Heptachlor	HCB	Methoxychlor	Total OPP	Chlorpyrifos	PCB [3]	Total Phenols	Total Cyanide
BH/MW216	0.1-0.2	2.6	<0.1	0.2	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH/MW216	3.9-4.35	0.53	<0.1	0.07	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH/MW216	5.9-6.35	0.47	<0.1	0.1	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH/MW218	0.9-1.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH/MW218	2.9-2.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	0.6
BH/MW218	5.9-6.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH201	0.1-0.2	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	0.6
BH201	0.9-1.35	0.28	<0.1	0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH202	0.9-1.35	4.5	<0.1	0.4	0.6	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH202	1.9-2.35	1.8	<0.1	0.2	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH203	0.1-0.2	1.6	<0.1	0.1	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH203	0.9-1.35	1.2	<0.1	0.1	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH203	2.9-3.35	17	<0.1	1.5	2.1	0.3	0.3	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH204	0.1-0.2	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH204	1.9-2.35	0.51	<0.1	0.08	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<1	<5	<0.5
BH204	3.9-4.35	1.9	<0.1	0.2	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<1	<5	<0.5
BH205	0.9-1.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH205	2.9-3.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH205	3.9-4.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH206	0.1-0.2	17	<0.1	1.1	1.7	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH206	0.9-1.35	<1.45	<0.1	<0.05	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH206	2.35-2.9	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH206	4.35-4.9	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	0.5
BH207	0.1-0.2	250	0.4	20	29	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	0.6	<0.1	<0.7	<5	<0.5
BH207	0.9-1.35	<1.45	<0.1	<0.05	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH208	1.9-2.35	8.5	<0.1	0.65	1	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH208	0.9-1.35	1.9	<0.1	0.2	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH208	3.9-4.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH209	0.1-0.2	13	<0.1	1.1	1.7	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH209	0.9-1.35	110	<0.1	9.5	14	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH209	1.9-2.35	10	<0.1	0.86	1.3	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	4.4
BH209	3.9-4.35	0.76	<0.1	0.1	<0.5	0.2	0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH210	0.1-0.2	28	<0.1	2.8	4.2	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH210	2.0-2.45	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH211	0.1-0.2	0.59	<0.1	0.07	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH211	0.9-1.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH211	2.9-2.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH212	0.1-0.2	7	<0.1	0.4	0.7	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH212	2.9-3.35	3.9	<0.1	0.4	0.7	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	0.5
BH213	0.1-0.2	3.6	<0.1	0.3	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH213	2.9-3.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH214	0.1-0.2	2.5	<0.1	0.2	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH214	2.2-2.65	0.3	<0.1	0.06	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH215	0.9-1.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH215	1.9-2.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH220	0.1-0.2	0.43	<0.1	0.1	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	3.7	<5	<0.5
BH221	0.1-0.2	0.36	<0.1	0.09	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH221	1.9-2.35	0.54	<0.1	0.09	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH221	2.9-3.35	2.9	<0.1	0.3	<0.5	0.1	0.1	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH221	3.9-4.35	0.49	<0.1	0.06	<0.5	0.3	<0.2	<0.2	0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH222	0.1-0.2	2.1	<0.1	0.1	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH222	0.9-1.35	46	2.5	3.6	5.4	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH223	2.0-2.45	6.9	<0.1	0.51	0.8	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK103a	0.1-0.2	5	<0.1	0.56	1	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK103a	1.9-2.35	0.38	<0.1	0.08	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK103a	2.9-3.35	150	0.6	13	17	1	<0.2	<0.2	0.7	0.1	0.2	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK103a	5.9-6.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK107a	0.1-0.2	2.8	<0.1	0.3	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK107a	1.9-2.35	0.33	<0.1	0.07	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK107a	7.9-8.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK107a	8.9-9.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK118a	0.1-0.2	1.9	<0.1	0.2	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK118a	1.9-2.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK118a	4.9-5.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
SS217	0.0-0.1	1.3	<0.1	0.1	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	-
SS219	0.0-0.1	3.4	<0.1	0.3	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	-
BD1/070815	-	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BD2/080915	-	7.5	<0.1	0.77	1.2	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BD3/090915	-	3.3	<0.1	0.4	0.6	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BD5/100915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD4/100915	-	<0.5	<0.1	<0.05	1.2	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.1	<5	<0.5
BD6/100915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD7/100915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Laboratory PQL		0.05/0.2	1	0.05	0.5	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	0.5
NEPM HIL A [1]		300	NC	NC	3	NC	6	50	240	270	10	6	10	300	NC	160	1	3000 [4]	250
NEPM EIL Residential A,B,C [2]		NC	170	NC	NC	NC	NC	NC	180 [5]	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
NEPM ESL Residential A,B,C [2] - Fine and Coarse Soils		NC	NC	0.7	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

Notes to Table:

All results in mg/kg on a dry weight basis

NC - No Criteria

NT - Not Tested

PQL - Practical Quantitation Limits

TEQ - Toxicity Equivalent Quotient

Total PAH - Sum of positive and PQL values

1 - Health Based Criteria for Residential with Accessible Soils Land Use

2- ESLs apply from the surface to 2 m depth below finished surface/ground level

3- PCB HILs relates to non-dioxin-like PCB only

4- Criterion based on phenol

5- Criterion is for DDT only

🟦 exceeds NEPM Health-Based Criteria for Residential with Accessible Soils Landuse

Underline results exceed NEPM EIL or ESL

BD1/070815 is the replicate sample of JK107a/1.9-2.35 m (Envirolab)

BD2/080915 is the replicate sample of BH213/2.9-3.35 m (Envirolab)

BD3/090915 is the replicate sample of BH212/2.9-3.35 m (Envirolab)

BD5/100915 is the replicate sample of BH207/0.9-1.35 m (Envirolab)

BD4/100915 is the replicate sample of BH201/0.9-1.35 m (ALS)

BD6/100915 is the replicate sample of BH206/0.9-1.35 m (ALS)

BD7/100915 is the replicate sample of BH208/3.9-4.35 m (ALS)

Table 4: Summary Results for TCLP Metals and PAH

Test Location ID	Depth (m)	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn	Total PAH
JK103a	2.9-3.35	-	-	-	-	-	-	-	-	0.029
BH221	2.9-3.35	<0.05	<0.01	<0.01	<0.01	0.2	<0.0005	<0.02	1.1	-
BH222	0.9-1.35	-	-	-	-	-	-	-	-	<0.016
BH209	0.9-1.35	-	-	-	-	-	-	-	-	<0.016
BH203	2.9-3.35	<0.05	0.01	<0.01	0.04	1	<0.0005	<0.02	1.8	-
BH207	0.1-0.2	-	-	-	-	-	-	-	-	<0.016

Notes to Table:

All results in mg/L

Appendix E

Summary of Landfill Gas Results (DP, 2016)

Summary of Non-Methane Organic Compound Results (DP, 2016)

Landfill Gas Sampling Results

Landfill gas monitoring was undertaken on 19 August 2015, 1 October 2015, 27 October 2015 and 10 February 2016. The results, along with the CSV and CGS are summarised in the following tables.

Table 1: Landfill Gas Sampling Results for 19/08/15

Well ID	Flow Rate Peak	Methane Peak %	GSV	CO_2 Peak %	GSV	CGS [1]
JKBH/MW1	0.2	1.3	<0.01	1.7	<0.01	2
JKBH/MW16	0.2	22	0.04	6.7	0.01	2
JKBH/MW7	0.2	14	0.03	9.6	0.02	2
JKBH/MW9	0.3	20.9	0.06	6.1	0.02	2
JK101	0.2	14	0.03	7.7	0.02	2
JK102	0.1	13.2	0.01	7.8	0.01	2
JK103	0.1	0.8	<0.01	1.9	<0.01	1
JK104	0.1	0.5	<0.01	3.1	<0.01	1
JK106	0.2	16.1	0.03	4.2	0.01	2
JK110	0.4	23.2	0.09	6.3	0.03	2
JK113	0.1	9.9	0.01	15.9	0.02	2
JK114	0.2	24.6	0.05	8	0.02	2
JK115	0.2	8.6	0.02	11.1	0.02	2
JK119	0.9	10.5	0.09	6.7	0.06	2
Max Value	**0.9**	**24.6**	**0.22**	**15.9**	**0.14**	**2**

Notes to Table 1:

1. Where methane >1% or CO_2 >5% CGS has been increased to Situation 2 as per Table 6 of NSW EPA (2012)

Atmospheric pressure start 1024 mb end 1024 mb – pressure steady

Table 2: Landfill Gas Sampling Results for 1/10/15

Well ID	Flow Rate Peak	Methane Peak %	GSV	CO_2 Peak %	GSV	CGS [1]
BH/MW216	0.2	16	0.03	6.3	0.01	2
BH/MW218	0.2	24.2	0.05	10.2	0.02	2
BH202	0.2	1.1	<0.01	12.4	0.02	2
BH211	0.3	0	<0.01	1.5	<0.01	1
BH211b	-	0	-	3.7	-	-
BH223	0.2	1.1	<0.01	3.4	0.01	2
JKBH/MW1	0.2	0	<0.01	2	<0.01	1
JKBH/MW7	0.2	4.1	0.01	7	0.01	2
JKBH/MW9	0.1	0	<0.01	2.9	<0.01	1
JK101	0.3	14.3	0.04	7.3	0.02	2
JK102	0.3	12	0.04	6.4	0.02	2
JK103a	0.7	0.7	<0.01	3.1	0.02	1
JK103b	0.3	1.4	<0.01	1.2	<0.01	2
JK104	0.2	0	<0.01	4	0.01	1
JK106	0.4	13.2	0.05	4.5	0.02	2
JKBH/MW107a	0.4	3	0.01	0.2	<0.01	2
JK107b	0.2	10.2	0.02	5.6	0.01	2
JK110	0.5	19	0.1	6.3	0.03	2
JK113	0.4	6	0.02	14.5	0.06	2
JK114	0.2	22.2	0.04	5.3	0.01	2
JK114b	0.2	20.2	0.04	7.2	0.01	2
JK115	0.2	0.6	<0.01	9.1	0.02	1
JKBH/MW16	0.3	8.5	0.03	6.5	0.02	2
JK118a	0.3	17.3	0.05	5.7	0.02	2
JK118b	0.2	12.9	0.03	4.5	0.01	2
JK119	0.7	11.9	0.08	3.1	0.02	2
Max Value	**0.7**	**24.2**	**0.17**	**14.5**	**0.10**	**2**

Notes to Table 2:

1. Where methane >1% or CO_2 >5% CGS has been increased to Situation 2 as per Table 6 of NSW EPA (2012)

Atmospheric pressure start 1023 end1032 mb – pressure increasing

Table 3: Landfill Gas Sampling Results for 27/10/15

Well ID	Flow Rate Peak	Methane Peak %	GSV	CO_2 Peak %	GSV	CGS [1]
BH/MW216	0.1	14.7	0.01	6.7	0.01	2
BH/MW218	-0.2	32.5	<0.01	13.8	<0.01	2
BH202	0.4	0.8	<0.01	13.2	0.05	2
BH211	0.4	0	<0.01	1.7	0.01	1
BH211b	0.3	0	<0.01	3.9	0.01	1
BH223	0.6	3.7	0.02	8.2	0.05	2
BH224	0.4	0	<0.01	10.3	0.04	2
BH225	0.2	0	<0.01	9.6	0.02	2
JKBH/MW1	0.2	0	<0.01	2.2	<0.01	1
JKBH/MW7	0.3	8.5	0.03	3.2	0.01	2
JKBH/MW9	0.2	0	<0.01	3.2	0.01	1
JKBH/MW16	0.2	2.8	0.01	8.3	0.02	2
JK101	0.3	14.1	0.04	10.2	0.03	2
JK102	0.2	13.2	0.03	6.6	0.01	2
JK103a	0.4	0	<0.01	1.7	0.01	1
JK103b	0.6	1.1	0.01	0.7	<0.01	2
JK104	0.5	0	<0.01	1.7	0.01	1
JK106	0.4	10	0.04	3.3	0.01	2
JKBH/MW107a	0.1	15	0.02	5.2	0.01	2
JK107b	0.2	14.4	0.03	2.9	0.01	2
JK110	0.1	25	0.03	6.4	0.01	2
JK113	0.2	1	<0.01	4.5	0.01	1
JK114	0.1	21.2	0.02	6.4	0.01	2
JK114b	0.3	19.1	0.06	7.5	0.02	2
JK115	0.3	7.2	0.02	7	0.02	2
JK118a	0.3	15.2	0.05	5.1	0.02	2
JK118b	0.3	14.5	0.04	4.8	0.01	2
JK119	0.6	16.2	0.1	5.8	0.03	2
Max Value	**0.6**	**32.5**	**0.20**	**13.8**	**0.08**	**2**

Notes to Table 3:

1. Where methane >1% or CO_2 >5% CGS has been increased to Situation 2 as per Table 6 of NSW EPA (2012)

Atmospheric pressure start 1022 mb to 1026 mb – pressure increasing

Table 4: Landfill Gas Sampling Results for 10/02/16

Well ID	Flow Rate Peak	Methane Peak %	GSV	CO$_2$ Peak %	GSV	CGS [1]
BH/MW216	0.3	16.1	0.05	5.2	0.02	2
BH202	0.2	1.1	<0.01	3.4	0.01	2
BH211a	0.1	1.1	<0.01	5	0.01	2
BH211b	0.2	0.5	<0.01	1.9	<0.01	1
BH223	0.1	3.7	<0.01	10	0.01	2
BH224	0.3	0.1	<0.01	14.4	0.04	2
BH225	0.3	0.2	<0.01	12.1	0.04	2
JKBH/MW1	0.1	0.2	<0.01	3.4	<0.01	1
JKBH/MW7	0	0.5	<0.01	6.8	<0.01	2
JKBH/MW9	0.2	17.5	0.04	23.8	0.05	2
JKBH/MW16	0.3	0.1	<0.01	9.7	0.03	2
JK101	0.3	15.7	0.05	11.4	0.03	2
JK103	6.8	1.7	0.12	0.6	0.04	2
JK103a	0.3	0.9	<0.01	0.2	<0.01	1
JK103b	0.3	5.1	0.02	2.6	0.01	2
JK106	0	14.2	<0.01	6.7	<0.01	2
JKBH/MW107a	0.3	16.4	0.05	0.9	<0.01	2
JK107b	0.2	17.3	0.03	3.8	0.01	2
JK104	0.2	0.5	<0.01	2.3	<0.01	1
JK113	0.1	0.1	<0.01	1	<0.01	1
JK114	0.2	25.3	0.05	4.7	0.01	2
JK114b	0.3	0.1	<0.01	0	<0.01	1
JK115	0.2	0.1	<0.01	0	<0.01	1
JK117*	0.6	11.7	0.07	6.8	0.04	2
JK119	0.4	21.3	0.09	6.9	0.03	2
Max Value	**6.8**	**25.3**	**1.72**	**23.8**	**1.62**	**3**

Notes to Table 4:

1. Where methane >1% or CO$_2$ >5% CGS has been increased to Situation 2 as per Table 6 of NSW EPA (2012)

*JK117 was inaccessible for previous monitoring events due to stockpile placement

Atmospheric pressure start 1016 mb end 1011 mb – pressure decreasing

The peak methane concentration data for each of the landfill gas monitoring events were used to generate concentration contours on the following drawings in Appendix C:

- Drawing 3 - Peak Methane Concentration Contours 19/08/15;
- Drawing 4 - Peak Methane Concentration Contours 1/10/15;
- Drawing 5 - Peak Methane Concentration Contours 27/10/15; and
- Drawing 6 - Peak Methane Concentration Contours 10/02/16.

Where a shallow and deep gas well is present at the one location, the well with the highest methane peak was used to generate the contours. It should also be noted that some wells have been destroyed due to the site owner undertaking a further trial remediation excavation at the south-western portion of the site.

Table 1: Summary Results of Soil Gas Analysis (NMOC)

								BTEX					MAH				Chlorinated Hydrocarbons																							Halo
				Freon 113	2-Propanol	Propene	1,2-Dichlorotetrafluoroethane	Benzene	Ethylbenzene	Toluene	Xylene (m & p)	Xylene (o)	1,2,4-trimethylbenzene	1,3,5-trimethylbenzene	1-methyl-4 ethyl benzene	Styrene	1,1,1-trichloroethane	1,1,2,2-tetrachloroethane	1,1,2-trichloroethane	1,1-dichloroethane	1,1-dichloroethene	1,2-dichloroethane	1,2-dichloropropane	Benzyl chloride	Bromodichloromethane	Bromoform	Carbon tetrachloride	Chlorodibromomethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-dichloroethene	cis-1,3-dichloropropene	Hexachlorobutadiene	Trichloroethene	Tetrachloroethene	trans-1,2-dichloroethene	trans-1,3-dichloropropene	Vinyl chloride	1,2-dibromoethane
				µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	ug/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3
PQL				**3.8**	**1**	**0.9**	**2.5**	**1.6**	**2**	**1.9**	**4**	**2**	**2.5**	**2.5**	**2.5**	**2**	**2.7**	**3**	**2.7**	**2**	**2**	**2**	**2**	**2.6**	**3**	**5**	**3**	**1.6**	**1**	**2**	**1**	**2**	**2**	**5**	**2.7**	**3**	**2**	**2**	**1**	**3.8**
NEPM 2013 Table 1A(2) Res A Soil Vap VOCC HILs																	60000															80			20	2000			30	
NEPM 2013 Table 1A(5) Res Soil Vapour HSL A/B for Vapour Intrusion, Sand																																								
0-1m								1000	330000	1300000																														
Field_ID	**LocCode**	**WellCode**	**Sampled_Date-Time**																																					
BH/MW216	BH/MW216		27/10/2015	<3.8	<1	<0.9	<2.5	**5**	**7**	**9**	**10**	**4**	**5**	<2.5	<2.5	**10**	<2.7	<3	<2.7	<2	<2	<2	<2	<2.6	<3	<5	<3	<1.6	**3**	<2	<1	**6**	<2	<5	**5**	<3	<2	<2	<1	<3.8
BD1	BH/MW216		27/10/2015	<3.8	<1	<0.9	<2.5	**6**	**7**	**8**	**9**	**3**	**5**	<2.5	<2.5	**10**	<2.7	<3	<2.7	<2	<2	<2	<2	<2.6	<3	<5	<3	<1.6	**4**	<2	<1	**7**	<2	<5	<2.7	<3	<2	<2	<1	<3.8
JK101	JK101		27/10/2015	<3.8	<1	<0.9	<2.5	**4**	**5**	**9**	**10**	**4**	**6**	<2.5	<2.5	<2	<2.7	<3	<2.7	<2	<2	<2	<2	<2.6	<3	<5	<3	<1.6	<1	<2	<1	<2	<2	<5	<2.7	<3	<2	<2	<1	<3.8
JK107B	JK107B		27/10/2015	<3.8	<1	<0.9	<2.5	**8**	**6**	**8**	**10**	**4**	**5**	<2.5	<2.5	**43**	<2.7	<3	<2.7	<2	<2	<2	<2	<2.6	<3	<5	<3	<1.6	**4**	<2	<1	<2	<2	<5	<2.7	<3	<2	<2	<1	<3.8

				genated Hydrocarbons			Halogenated Benzenes					VOCs			Solvents													PAH/Phenols
				Bromomethane	**Dichlorodifluoromethane**	**Trichlorofluoromethane**	**1,2,4-trichlorobenzene**	**1,2-dichlorobenzene**	**1,3-dichlorobenzene**	**1,4-dichlorobenzene**	**Chlorobenzene**	**1,3-Butadiene**	**Acrolein**	**Methyl Methacrylate**	**1,4-Dioxane**	**Methyl Ethyl Ketone**	**2-hexanone (MBK)**	**4-Methyl-2-pentanone**	**Carbon disulfide**	**Cyclohexane**	**Ethanol**	**Ethyl acetate**	**Heptane**	**Hexane**	**MTBE**	**Tetrahydrofuran**	**Vinyl acetate**	**Naphthalene**
				µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	ug/m3	µg/m3	µg/m3	µg/m3	µg/m3	ug/m3	µg/m3	µg/m3	µg/m3
PQL				**1.9**	**2.5**	**2.8**	**3.7**	**3**	**3**	**3**	**2**	**1**	**1**	**2**	**1.8**	**1.5**	**2**	**2**	**1.6**	**1.7**	**0.9**	**1.8**	**2**	**1.8**	**1.8**	**1.5**	**1.8**	**2.6**
NEPM 2013 Table 1A(2) Res A Soil Vap VOCC HILs																												
NEPM 2013 Table 1A(5) Res Soil Vapour HSL A/B for Vapour Intrusion, Sa																												
0-1m																												800
Field_ID	**LocCode**	**WellCode**	**Sampled_Date-Time**																									
BH/MW216	BH/MW216		27/10/2015	<1.9	**210**	<2.8	<3.7	<3	<3	<3	<2	<1	<1	<2	<1.8	<1.5	<2	<2	<1.6	**88**	**18**	<1.8	**4**	**47**	<1.8	<1.5	<1.8	**7**
BD1	BH/MW216		27/10/2015	<1.9	**230**	<2.8	<3.7	<3	<3	<3	<2	<1	<1	<2	<1.8	<1.5	<2	<2	<1.6	**98**	**19**	<1.8	**5**	**53**	<1.8	<1.5	<1.8	**4**
JK101	JK101		27/10/2015	<1.9	**20**	<2.8	<3.7	<3	<3	<3	<2	<1	<1	<2	<1.8	<1.5	<2	<2	**6**	**110**	**22**	<1.8	**30**	**100**	<1.8	<1.5	<1.8	**10**
JK107B	JK107B		27/10/2015	<1.9	**120**	<2.8	<3.7	<3	<3	<3	<2	<1	<1	<2	<1.8	<1.5	<2	<2	**2**	**130**	**17**	<1.8	**10**	**38**	<1.8	<1.5	<1.8	**10**

Appendix F

Summary of Groundwater and Surface Water Results (DP, 2016)

			Inorganics						Metals												
			Ammonia (as N)	Chloride	Nitrate (as N)	Nitrite (as N)	Nitrogen (Total Oxidised)	Sulphate	Arsenic (Filtered)	Cadmium (Filtered)	Chromium (III+VI) (Filtered)	Copper (Filtered)	Lead (Filtered)	Manganese (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Phosphorus	Zinc (Filtered)	C10-C16	C16-C34	C34-C40
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.005	1	0.005	0.005		1	0.001	0.0001	0.001	0.001	0.001	0.001	0.00005	0.001	0.01	0.001	0.05	0.1	0.1
ANZECC 2000, Marine Waters, 95% of Species			0.91							0.0007		0.0013	0.0044		0.0001	0.007		0.015			
ANZECC 2000 LOW RELIABILITY MW									0.0045					0.08							
ANZECC 2000 Fresh Waters GILs for 95% of Species			0.9		0.161					0.0002	0.0274	0.0014	0.0034	1.9	0.00006	0.011		0.008			
ANZECC 2000 LOW RELIABILITY FRESH WATER																					
ADWG 2011 Aesthetic			0.5					250				1		0.1				3			
ADWG 2011 Drinking Water					11.5	0.9		500	0.01	0.002		2	0.01	0.5	0.001	0.02					
ANZECC 2000 Recreational water quality and aesthetics			0.1	400	10	1		400	0.05	0.005	0.05	1	0.05	0.1	0.001	0.1		5			
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																					
2-4m																					
4-8m																					
>8m																					
Field_ID	**LocCode**	**Sampled_Date-Time**																			
BH/MW216	BH/MW216	1-Oct-15	20	2200	<0.005	<0.005	-	91	0.002	<0.0001	0.001	0.001	0.001	1.4	<0.00005	0.009	0.7	0.06	<0.05	<0.1	<0.1
BH/MW218	BH/MW218	1-Oct-15	30	2300	<0.25	<0.25	-	410	0.011	<0.0001	0.19	0.017	0.007	0.65	<0.00005	0.16	0.3	0.084	<0.05	<0.1	<0.1
JKBH/MW1	JKBH/MW1	2-Oct-15	3.2	750	0.01	<0.005	-	1100	0.001	0.0001	<0.001	0.005	<0.001	0.95	<0.00005	0.03	<0.05	0.097	<0.05	<0.1	<0.1
BD1/021015	BD1/021015	2-Oct-15	2.56	-	0.03	<0.01	0.03	-	0.003	<0.0001	<0.001	<0.001	<0.001	0.985	<0.0001	0.046	3.58	0.245	<0.1	<0.1	<0.1
JKBH/MW107A	JKBH/MW107A	1-Oct-15	10	700	0.006	<0.005	-	75	0.003	<0.0001	<0.001	0.007	<0.001	0.42	<0.00005	0.012	<0.05	0.079	<0.05	<0.1	<0.1
JKBH/MW16	JKBH/MW16	1-Oct-15	4.9	3400	0.02	<0.005	-	1700	<0.001	0.0001	<0.001	0.004	<0.001	4.4	<0.00005	0.02	<0.05	0.82	<0.05	<0.1	<0.1
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.005	<0.00005	<0.001	-	<0.001	<0.05	<0.1	<0.1
SW1	SW1	1-Oct-15	0.025	6900	0.29	0.006	-	890	<0.001	<0.0001	<0.001	0.002	<0.001	0.012	<0.00005	0.001	<0.05	0.006	<0.05	<0.1	<0.1
SW2	SW2	1-Oct-15	8.4	2700	0.11	0.08	-	590	0.002	<0.0001	<0.001	<0.001	<0.001	0.42	<0.00005	0.005	<0.05	0.005	<0.05	<0.1	<0.1
BD2/011015	SW2	1-Oct-15	8.2	-	0.16	0.083	-	-	0.002	<0.0001	<0.001	<0.001	<0.001	0.4	<0.00005	0.005	<0.05	0.005	<0.05	<0.1	<0.1
SW3	SW3	2-Oct-15	0.017	91	0.02	<0.005	-	12	<0.001	<0.0001	<0.001	<0.001	<0.001	0.1	<0.00005	0.002	<0.05	0.018	<0.05	<0.1	<0.1

			TRH									BTEX								
			F2-NAPHTHALENE	C6 - C9	C10 - C14	C15 - C28	C29-C36	+C10 - C36 (Sum of total)	C10 - C40 (Sum of total)	C6-C10 less BTEX (F1)	C6-C10	Benzene	Ethylbenzene	Toluene	Total BTEX	Xylene (m & p)	Xylene (o)	Xylene Total	1,2,4-trimethylbenzene	1,3,5-trimethylbenzene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.05	0.01	0.05	0.1	0.05			0.01	0.01	0.001	0.001	0.001		0.002	0.001		0.001	0.001
ANZECC 2000, Marine Waters, 95% of Species												0.5								
ANZECC 2000 LOW RELIABILITY MW													0.005	0.18				0.625		
ANZECC 2000 Fresh Waters GILs for 95% of Species												0.95					0.35			
ANZECC 2000 LOW RELIABILITY FRESH WATER																				
ADWG 2011 Aesthetic													0.003	0.025				0.02		
ADWG 2011 Drinking Water												0.001	0.3	0.8				0.6		
ANZECC 2000 Recreational water quality and aesthetics												0.01								
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																				
2-4m			1							1		0.8	NL	NL				NL		
4-8m			1							1		0.8	NL	NL				NL		
>8m			1							1		0.9	NL	NL				NL		
Field_ID	**LocCode**	**Sampled_Date-Time**																		
BH/MW216	BH/MW216	1-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
BH/MW218	BH/MW218	1-Oct-15	<0.05	<0.1	<0.05	<0.1	<0.1	-	-	<0.01	<0.1	<0.01	<0.01	<0.01	-	<0.02	<0.01	-	<0.01	<0.01
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
BD1/021015	BD1/021015	2-Oct-15	<0.1	<0.02	<0.05	<0.1	<0.05	<0.05	<0.1	<0.02	<0.02	<0.001	<0.002	<0.002	<0.001	<0.002	<0.002	<0.002	-	-
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
R1/021015	R1/021015	2-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	-	-
SW1	SW1	1-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
SW2	SW2	1-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
BD2/011015	SW2	1-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
SW3	SW3	2-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001

			MAH																	
			Isopropylbenzene	n-butylbenzene	n-propylbenzene	p-isopropyltoluene	sec-butylbenzene	Styrene	tert-butylbenzene	1,1,1,2-tetrachloroethane	1,1,1-trichloroethane	1,1,2,2-tetrachloroethane	1,1,2-trichloroethane	1,1-dichloroethane	1,1-dichloroethene	1,1-dichloropropene	1,2,3-trichloropropane	1,2-dibromo-3-chloropropane	1,2-dichloroethane	1,2-dichloropropane
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
ANZECC 2000, Marine Waters, 95% of Species													1.9							
ANZECC 2000 LOW RELIABILITY MW															0.7					
ANZECC 2000 Fresh Waters GILs for 95% of Species													6.5							
ANZECC 2000 LOW RELIABILITY FRESH WATER											0.27	0.4	1.9						1.9	0.9
ADWG 2011 Aesthetic								0.004												
ADWG 2011 Drinking Water								0.03							0.03				0.003	
ANZECC 2000 Recreational water quality and aesthetics															0.0003				0.01	
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																				
2-4m																				
4-8m																				
>8m																				
Field_ID	**LocCode**	**Sampled_Date-Time**																		
BH/MW216	BH/MW216	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BH/MW218	BH/MW218	1-Oct-15	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BD1/021015	BD1/021015	2-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW1	SW1	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SW2	SW2	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BD2/011015	SW2	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SW3	SW3	2-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Table 1: Summary Results for Groundwater and Surface Water

			Chlorinated Hydrocarbons																	
			1,3-dichloropropane	2,2-dichloropropane	Bromochloromethane	Bromodichloromethane	Bromoform	Carbon tetrachloride	Chlorodibromomethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-dichloroethene	cis-1,3-dichloropropene	Dibromomethane	Hexachlorobutadiene	Trichloroethene	Tetrachloroethene	trans-1,2-dichloroethene	trans-1,3-dichloropropene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.01	0.001	0.01	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
ANZECC 2000, Marine Waters, 95% of Species																				
ANZECC 2000 LOW RELIABILITY MW																				
ANZECC 2000 Fresh Waters GILs for 95% of Species																				
ANZECC 2000 LOW RELIABILITY FRESH WATER			1.1					0.24			0.37			0.0008			0.33	0.07		0.0008
ADWG 2011 Aesthetic																				
ADWG 2011 Drinking Water																0.0007		0.05		
ANZECC 2000 Recreational water quality and aesthetics								0.003									0.03	0.01		
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																				
2-4m																				
4-8m																				
>8m																				
Field_ID	**LocCode**	**Sampled_Date-Time**																		
BH/MW216	BH/MW216	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BH/MW218	BH/MW218	1-Oct-15	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BD1/021015	BD1/021015	2-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW1	SW1	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SW2	SW2	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BD2/011015	SW2	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SW3	SW3	2-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

				Halogenated Hydrocarbons				Halogenated Benzenes										Solvents	PA
			Vinyl chloride	1,2-dibromoethane	Bromomethane	Dichlorodifluoromethane	Trichlorofluoromethane	1,2,3-trichlorobenzene	1,2,4-trichlorobenzene	1,2-dichlorobenzene	1,3-dichlorobenzene	1,4-dichlorobenzene	2-chlorotoluene	4-chlorotoluene	Bromobenzene	Chlorobenzene	Hexachlorobenzene	Cyclohexane	7,12-dimethylbenz(a)anthracene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.01	0.001	0.01	0.01	0.01	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000001	0.001	
ANZECC 2000, Marine Waters, 95% of Species									0.02										
ANZECC 2000 LOW RELIABILITY MW			0.1																
ANZECC 2000 Fresh Waters GILs for 95% of Species								0.003	0.085	0.16	0.26	0.06							
ANZECC 2000 LOW RELIABILITY FRESH WATER								0.003		0.16	0.26	0.06							
ADWG 2011 Aesthetic										0.001	0.02	0.0003							
ADWG 2011 Drinking Water			0.0003	0.001	0.001					1.5		0.04							
ANZECC 2000 Recreational water quality and aesthetics																			
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																			
2-4m																			
4-8m																			
>8m																			
Field_ID	**LocCode**	**Sampled_Date-Time**																	
BH/MW216	BH/MW216	1-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
BH/MW218	BH/MW218	1-Oct-15	<0.1	<0.01	<0.1	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.000001	<0.01	-
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
BD1/021015	BD1/021015	2-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.00001	-	<0.0001
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.000001	-	-
SW1	SW1	1-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
SW2	SW2	1-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
BD2/011015	SW2	1-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
SW3	SW3	2-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-

			AH	PAH/Phenols															
			Benzo[b+j]fluoranthene	2,4-dimethylphenol	2-methylnaphthalene	2-methylphenol	2-nitrophenol	3-&4-methylphenol	3-methylcholanthrene	4-chloro-3-methylphenol	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	Benzo(b)&(k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL											0.0001	0.0001	0.0001	0.0001	0.00005	0.0002	0.0001	
ANZECC 2000, Marine Waters, 95% of Species																		
ANZECC 2000 LOW RELIABILITY MW													0.00001		0.0002			
ANZECC 2000 Fresh Waters GILs for 95% of Species																		
ANZECC 2000 LOW RELIABILITY FRESH WATER																		
ADWG 2011 Aesthetic																		
ADWG 2011 Drinking Water																		
ANZECC 2000 Recreational water quality and aesthetics															0.00001			
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																		
2-4m																		
4-8m																		
>8m																		
Field_ID	**LocCode**	**Sampled_Date-Time**																
BH/MW216	BH/MW216	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
BH/MW218	BH/MW218	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
JKBH/MW1	JKBH/MW1	2-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
BD1/021015	BD1/021015	2-Oct-15	<0.0001	<0.001	<0.0001	<0.001	<0.001	<0.002	<0.0001	<0.001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00005	-	<0.0001	<0.0001
JKBH/MW107A	JKBH/MW107A	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
JKBH/MW16	JKBH/MW16	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
SW1	SW1	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
SW2	SW2	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
BD2/011015	SW2	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
SW3	SW3	2-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-

														Halogenated Phenols					
			Chrysene	**Dibenz(a,h)anthracene**	**Fluoranthene**	**Fluorene**	**Indeno(1,2,3-c,d)pyrene**	**Naphthalene**	**PAHs (Sum of total)**	**Phenanthrene**	**Phenol**	**Phenolics Total**	**Pyrene**	**2,4,5-trichlorophenol**	**2,4,6-trichlorophenol**	**2,4-dichlorophenol**	**2,6-dichlorophenol**	**2-chlorophenol**	**Pentachlorophenol**
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.0001	0.0001	0.0001	0.0001	0.0001	0.0001		0.0001		0.05	0.0001						
ANZECC 2000, Marine Waters, 95% of Species								0.05			0.4								0.011
ANZECC 2000 LOW RELIABILITY MW					0.0014					0.002									
ANZECC 2000 Fresh Waters GILs for 95% of Species								0.016			0.32				0.003	0.12		0.34	0.0036
ANZECC 2000 LOW RELIABILITY FRESH WATER																			
ADWG 2011 Aesthetic															0.002	0.0003		0.0001	
ADWG 2011 Drinking Water									0.00001						0.02	0.2		0.3	0.01
ANZECC 2000 Recreational water quality and aesthetics														0.001	0.01				0.01
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																			
2-4m								NL											
4-8m								NL											
>8m								NL											
Field_ID	**LocCode**	**Sampled_Date-Time**																	
BH/MW216	BH/MW216	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
BH/MW218	BH/MW218	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
BD1/021015	BD1/021015	2-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00005	<0.0001	<0.001	-	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
R1/021015	R1/021015	2-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
SW1	SW1	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
SW2	SW2	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
BD2/011015	SW2	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
SW3	SW3	2-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-

			Polychlorinated Biphenyls								SVOCs				
			Arochlor 1016	Arochlor 1221	Arochlor 1232	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	PCBs (Sum of total)	Benzo(e)pyrene	Coronene	EPN	Perylene	4,4-DDE
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001					0.000001
ANZECC 2000, Marine Waters, 95% of Species															
ANZECC 2000 LOW RELIABILITY MW															
ANZECC 2000 Fresh Waters GILs for 95% of Species						0.0003		0.00001							
ANZECC 2000 LOW RELIABILITY FRESH WATER			0.000009	0.001	0.0003	0.0006	0.00003	0.00003	0.025						
ADWG 2011 Aesthetic															
ADWG 2011 Drinking Water															
ANZECC 2000 Recreational water quality and aesthetics															
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand															
2-4m															
4-8m															
>8m															
Field_ID	**LocCode**	**Sampled_Date-Time**													
BH/MW216	BH/MW216	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
BH/MW218	BH/MW218	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
BD1/021015	BD1/021015	2-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00005	<0.0001	<0.00001
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
R1/021015	R1/021015	2-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
SW1	SW1	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
SW2	SW2	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
BD2/011015	SW2	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
SW3	SW3	2-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001

Organochlorine Pesticide

			a-BHC	Aldrin	b-BHC	chlordane	Chlordane (cis)	Chlordane (trans)	d-BHC	DDD	DDT	DDT+DDE+DDD	Dieldrin	Endosulfan
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.000001	0.000001	0.000001		0.000001	0.000001	0.000001	0.000001	0.000001		0.000001	
ANZECC 2000, Marine Waters, 95% of Species														0.000005
ANZECC 2000 LOW RELIABILITY MW				0.000003			0.000001	0.000001			0.0000004	0.0000005	0.00001	
ANZECC 2000 Fresh Waters GILs for 95% of Species						0.00003					0.000006			0.00003
ANZECC 2000 LOW RELIABILITY FRESH WATER														
ADWG 2011 Aesthetic														
ADWG 2011 Drinking Water											0.009			0.02
ANZECC 2000 Recreational water quality and aesthetics				0.001		0.006					0.003		0.001	0.04
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand														
2-4m														
4-8m														
>8m														
Field_ID	**LocCode**	**Sampled_Date-Time**												
BH/MW216	BH/MW216	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000008	-
BH/MW218	BH/MW218	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000076	-
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000001	-
BD1/021015	BD1/021015	2-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000003	-
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000003	-
R1/021015	R1/021015	2-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	<0.000001	-
SW1	SW1	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000001	-
SW2	SW2	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000004	-
BD2/011015	SW2	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000004	-
SW3	SW3	2-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	<0.000001	-

			s											
			Endosulfan I	Endosulfan II	Endosulfan sulphate	Endrin	Endrin aldehyde	Endrin ketone	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Methoxychlor	Oxychlordane	Azinophos methyl
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.00001
ANZECC 2000, Marine Waters, 95% of Species						0.000004								
ANZECC 2000 LOW RELIABILITY MW			0.000005	0.000005						0.0000004		0.000004		
ANZECC 2000 Fresh Waters GILs for 95% of Species						0.00001			0.0002	0.00001				
ANZECC 2000 LOW RELIABILITY FRESH WATER														
ADWG 2011 Aesthetic														
ADWG 2011 Drinking Water									0.01	0.0003		0.3		0.03
ANZECC 2000 Recreational water quality and aesthetics						0.001			0.01	0.003				0.01
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand														
2-4m														
4-8m														
>8m														
Field_ID	**LocCode**	**Sampled_Date-Time**												
BH/MW216	BH/MW216	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
BH/MW218	BH/MW218	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
BD1/021015	BD1/021015	2-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.000005	<0.00001	<0.00001	<0.00001	<0.00002
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
R1/021015	R1/021015	2-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
SW1	SW1	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
SW2	SW2	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
BD2/011015	SW2	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
SW3	SW3	2-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001

			Bolstar (Sulprofos)	Bromophos-ethyl	Carbophenothion	Azinphos Ethyl	Chlorfenvinphos	Chlorfenvinphos E	Chlorfenvinphos Z	Chlorpyrifos	Chlorpyrifos-methyl	Coumaphos	Demeton-O	Demeton-S	Diazinon	Dichlorvos
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL						0.00001		0.00001	0.00001	0.00001	0.00001				0.00001	0.00001
ANZECC 2000, Marine Waters, 95% of Species										0.000009						
ANZECC 2000 LOW RELIABILITY MW																
ANZECC 2000 Fresh Waters GILs for 95% of Species										0.00001					0.00001	
ANZECC 2000 LOW RELIABILITY FRESH WATER																
ADWG 2011 Aesthetic																
ADWG 2011 Drinking Water			0.01	0.01						0.01					0.004	0.005
ANZECC 2000 Recreational water quality and aesthetics			0.02	0.02	0.001		0.01			0.002					0.01	0.02
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																
2-4m																
4-8m																
>8m																
Field_ID	**LocCode**	**Sampled_Date-Time**														
BH/MW216	BH/MW216	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
BH/MW218	BH/MW218	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
JKBH/MW1	JKBH/MW1	2-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
BD1/021015	BD1/021015	2-Oct-15	<0.00005	<0.0001	<0.00002	<0.00002	<0.00002	-	-	<0.00002	<0.0002	<0.00001	<0.00002	<0.00002	<0.00001	<0.0002
JKBH/MW107A	JKBH/MW107A	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
JKBH/MW16	JKBH/MW16	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
R1/021015	R1/021015	2-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
SW1	SW1	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
SW2	SW2	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
BD2/011015	SW2	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
SW3	SW3	2-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001

	Organophosphorous Pesticides													
	Dimethoate	**Disulfoton**	**Ethion**	**Ethoprop**	**Fenitrothion**	**Fensulfothion**	**Fenthion**	**Malathion**	**Methidathion**	**Methyl parathion**	**Mevinphos (Phosdrin)**	**Monocrotophos**	**Omethoate**	**Phorate**
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL	0.00001		0.00001		0.00001		0.00001	0.00001		0.00001				
ANZECC 2000, Marine Waters, 95% of Species														
ANZECC 2000 LOW RELIABILITY MW														
ANZECC 2000 Fresh Waters GILs for 95% of Species	0.00015				0.0002			0.00005						
ANZECC 2000 LOW RELIABILITY FRESH WATER														
ADWG 2011 Aesthetic														
ADWG 2011 Drinking Water	0.007	0.004	0.004	0.001	0.007	0.01	0.007	0.07	0.006	0.0007	0.005	0.002	0.001	
ANZECC 2000 Recreational water quality and aesthetics	0.1	0.006	0.006	0.001	0.02	0.02		0.1	0.06	0.006	0.006	0.002	0.0004	
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand														
2-4m														
4-8m														
>8m														

Field_ID	**LocCode**	**Sampled_Date-Time**	Dimethoate	Disulfoton	Ethion	Ethoprop	Fenitrothion	Fensulfothion	Fenthion	Malathion	Methidathion	Methyl parathion	Mevinphos (Phosdrin)	Monocrotophos	Omethoate	Phorate
BH/MW216	BH/MW216	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
BH/MW218	BH/MW218	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
BD1/021015	BD1/021015	2-Oct-15	<0.00002	<0.00005	<0.00002	<0.00001	<0.002	<0.00001	<0.00005	<0.00002	<0.0001	<0.0005	<0.00002	<0.00002	<0.00001	<0.0001
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
R1/021015	R1/021015	2-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
SW1	SW1	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
SW2	SW2	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
BD2/011015	SW2	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
SW3	SW3	2-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-

																	Pesticides	
			Prothiofos	Pyrazophos	Ronnel	Terbufos	Thiometon	Trichloronate	Tetrachlorvinphos	Acephate	Demeton-S-methyl	Fenamiphos	Formothion	Parathion	Pirimiphos-methyl	Pirimphos-ethyl	Profenofos
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL											0.00001			0.00001	0.00001	0.00001	
ANZECC 2000, Marine Waters, 95% of Species																	
ANZECC 2000 LOW RELIABILITY MW																	
ANZECC 2000 Fresh Waters GILs for 95% of Species														0.000004			
ANZECC 2000 LOW RELIABILITY FRESH WATER																	
ADWG 2011 Aesthetic																	
ADWG 2011 Drinking Water				0.02		0.0009	0.004		0.1	0.008		0.0005	0.05	0.02	0.09	0.0005	0.0003
ANZECC 2000 Recreational water quality and aesthetics				1	0.06		0.02			0.02			0.1	0.03	0.06	0.001	0.0006
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																	
2-4m																	
4-8m																	
>8m																	
Field_ID	**LocCode**	**Sampled_Date-Time**															
BH/MW216	BH/MW216	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
BH/MW218	BH/MW218	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
JKBH/MW1	JKBH/MW1	2-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
BD1/021015	BD1/021015	2-Oct-15	<0.0001	<0.0001	<0.01	<0.00001	<0.0005	<0.0005	<0.00001	<0.0005	<0.00002	<0.00001	<0.02	<0.0002	<0.00001	<0.00001	<0.00001
JKBH/MW107A	JKBH/MW107A	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
JKBH/MW16	JKBH/MW16	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
SW1	SW1	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
SW2	SW2	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
BD2/011015	SW2	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
SW3	SW3	2-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-

							Fungicides	Other
	Sulfotepp	Temephos	Trichlorfon	Bensulide	Demeton-O & Demeton-S	Naftalofos	Fosetyl-al	Triazophos
	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	mg/L	mg/L
PQL								
ANZECC 2000, Marine Waters, 95% of Species		0.00005						
ANZECC 2000 LOW RELIABILITY MW								
ANZECC 2000 Fresh Waters GILs for 95% of Species								
ANZECC 2000 LOW RELIABILITY FRESH WATER								
ADWG 2011 Aesthetic								
ADWG 2011 Drinking Water		0.4	0.007					
ANZECC 2000 Recreational water quality and aesthetics		0.03	0.01					
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand								
2-4m								
4-8m								
>8m								

Field_ID	LocCode	Sampled_Date-Time	Sulfotepp	Temephos	Trichlorfon	Bensulide	Demeton-O & Demeton-S	Naftalofos	Fosetyl-al	Triazophos
BH/MW216	BH/MW216	1-Oct-15	-	-	-	-	-	-	-	-
BH/MW218	BH/MW218	1-Oct-15	-	-	-	-	-	-	-	-
JKBH/MW1	JKBH/MW1	2-Oct-15	-	-	-	-	-	-	-	-
BD1/021015	BD1/021015	2-Oct-15	<0.000005	<0.00002	<0.00002	<0.1	<0.02	<1	<0.01	<0.000005
JKBH/MW107A	JKBH/MW107A	1-Oct-15	-	-	-	-	-	-	-	-
JKBH/MW16	JKBH/MW16	1-Oct-15	-	-	-	-	-	-	-	-
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	-	-
SW1	SW1	1-Oct-15	-	-	-	-	-	-	-	-
SW2	SW2	1-Oct-15	-	-	-	-	-	-	-	-
BD2/011015	SW2	1-Oct-15	-	-	-	-	-	-	-	-
SW3	SW3	2-Oct-15	-	-	-	-	-	-	-	-

Appendix G

Summary of EIS Soil and Groundwater Results (EIS, 2013)

REPORT TABLES

TABLE A-1
SOIL LABORATORY RESULTS COMPARED TO HIL

All data in mg/kg unless stated otherwise

			HEAVY METALS									PAHs		ORGANOCHLORINE PESTICIDES (OCPs)							OP PESTICIDES (OPPs)	TOTAL PCBs	ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Chromium VI	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	B(a)P TEQ [2]	HCB	Endosulfan	Methoxychlor	Aldrin & Dieldrin	Chlordane	DDT, DDD & DDE	Heptachlor	Chlorpyrifos		
PQL - Envirolab Services			4	0.5	1	1	1	1	0.1	1	1	-	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0,1	0.1	100
Site Assessment Criteria (SAC) [1]			100	20	nsl	100	6000	300	40	400	7400	300	3	10	270	300	6	50	240	6	160	1	Detect/Not Detect
Sample Reference	**Sample Depth**	**Sample Description**																					
JK1	0.0-0.2	Fill - Silty Sand Clay	8	0.4	31	NA	68	170	0.1	44	230	13.2	2	LPQL	LPQL	LPQL	0.1	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detected
JK1	1.3-1.5	Fill - Silty Clay	9	0.5	37	NA	74	200	0.1	41	220	5.57	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK1	2.7-3.0	Silty Clay	LPQL	LPQL	14	NA	11	16	LPQL	2	7	0.2	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK2	0.0-0.2	Fill - Silty Sand	5	LPQL	11	NA	36	45	LPQL	9	88	2.14	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detected
JK2	0.8-1.0	Silty Clay	5	LPQL	23	NA	10	30	LPQL	5	11	LPQL	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK3	0.3-0.5	Fill - Silty Sand	LPQL	LPQL	21	NA	76	60	LPQL	9	63	7.25	1	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detected
JK3	3.5-3.8	Fill - Silty Clay	8	LPQL	17	NA	44	96	0.1	7	250	0.69	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK3	4.3-4.5	Silty Clay	6	LPQL	10	NA	11	32	LPQL	3	470	LPQL	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK4	0.0-0.2	Fill - Silty Sand	5	LPQL	24	NA	34	46	LPQL	13	77	3.13	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detected
JK4	1.3-1.5	Fill - Silty Clay	10	LPQL	20	NA	110	68	0.2	13	100	3.18	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK5	0.0-0.2	Fill - Silty Sand	4	LPQL	15	NA	32	110	0.2	10	120	15.1	2	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detected
JK5	0.65-0.95	Fill - Silty Clay	4	0.5	19	NA	68	160	0.2	13	200	7.69	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK5	3.0-3.15	Fill - Silty Clay	7	LPQL	17	NA	30	83	0.1	9	150	8.95	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK5	6.0-6.2	Clayey Silt	5	LPQL	13	NA	15	24	LPQL	3	39	0.61	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK6	0.05-0.2	Fill - Gravelly Clayey Sand	LPQL	LPQL	28	NA	57	23	LPQL	28	42	21.1	3	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detected
JK6	1.3-1.5	Fill - Clayey Sand	6	LPQL	15	NA	32	46	LPQL	10	52	7.31	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK6	3.0-3.45	Fill - Silty Clay	6	LPQL	13	NA	25	37	LPQL	14	100	LPQL	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK7	0.0-0.2	Fill - Silty Clay	LPQL	LPQL	110	NA	56	9	LPQL	9	25	4.27	1	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detected
JK7[a]	2.7-3.0	Fill - Clayey Sandy Gravel	11	LPQL	2800	LPQL	91	97	0.1	59	130	3.2	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK7	5.8-6.0	Fill - Gravelly Sandy Clay	7	LPQL	33	NA	48	100	0.1	9	140	8.5	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK8	0.0-0.2	Fill - Silty Sand	LPQL	LPQL	11	NA	34	35	LPQL	7	100	3.39	1	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detected
JK8	2.7-3.0	Fill - Sandy Gravelly Clay	5	LPQL	33	NA	48	47	LPQL	19	120	0.27	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK8	4.3-4.5	Fill - Sandy Clay	7	LPQL	14	NA	38	27	LPQL	9	70	LPQL	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK9	0.0-0.2	Fill - Silty Sand	LPQL	LPQL	18	NA	29	29	LPQL	10	53	2.47	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detected
JK9	0.5-0.7	Fill - Silty Sandy Clay	7	LPQL	17	NA	150	86	0.2	8	270	2.22	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK9	2.6-2.8	Fill - Silty Sandy Clay	5	LPQL	16	NA	58	51	LPQL	6	81	7.25	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Number of Samples			26	26	26	1	26	26	26	26	26	26	26	9	9	9	9	9	9	9	9	9	9
Maximum Value			11	0.5	2800	LPQL	150	200	0.2	59	470	21.1	3	LPQL	LPQL	LPQL	0.1	LPQL	LPQL	LPQL	LPQL	LPQL	nc

Explanation:

1 - Site Assessment Criteria (SAC): NEPM 2013, HIL-A: 'Residential with garden/accessible soils; children's day care centers; preschools; and primary schools'

2 - B(a)P TEQ - Benzo(a)pyrene Toxicity Equivalence Quotient has been calculated based on 8 carcinogenic PAHs and their Toxic Equivalence Factors (TEFs) outlined in NEPM 2013

a - Hexavalent Chromium (Cr VI) results are presented in Envirolab Report 99558-A

Concentration above the SAC **VALUE**

Abbreviations:

PAHs: Polycyclic Aromatic Hydrocarbons
B(a)P: Benzo(a)pyrene
PQL: Practical Quantitation Limit
LPQL: Less than PQL
OPP: Organophosphorus Pesticides
OCP: Organochlorine Pesticides
PCBs: Polychlorinated Biphenyls

UCL: Upper Level Confidence Limit on Mean Value
HILs: Health Investigation Levels
NA: Not Analysed
nc: Not Calculated
nsl: No Set Limit
SAC: Site Assessment Criteria
NEPM: National Environmental Protection Measure

TABLE A-2
SOIL LABORATORY RESULTS COMPARED TO HIL
All data in mg/kg unless stated otherwise

			HEAVY METALS									PAHs		ORGANOCHLORINE PESTICIDES (OCPs)							OP PESTICIDES (OPPs)	TOTAL PCBs	ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Chromium VI	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	B(a)P TEQ[2]	HCB	Endosulfan	Methoxychlor	Aldrin & Dieldrin	Chlordane	DDT, DDD & DDE	Heptachlor	Chlorpyrifos		
PQL - Envirolab Services			4	0.5	1	1	1	1	0.1	1	1	-	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0,1	0.1	100
Site Assessment Criteria (SAC)[1]			100	20	nsl	100	6000	300	40	400	7400	300	3	10	270	300	6	50	240	6	160	1	Detect/Not Detect
Sample Reference	**Sample Depth**	**Sample Description**																					
JK10	0.0-0.2	Fill - Silty Gravelly Sand	LPQL	LPQL	6	NA	30	33	LPQL	4	68	0.5	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detect
JK10	1.3-1.5	Fill - Clayey Sand	LPQL	LPQL	10	NA	17	34	0.1	6	44	3.87	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK10	2.7-3.0	Fill - Silty Sandy Gravel	8	0.4	22	NA	64	270	0.6	12	230	1.35	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	Not Detect
JK10	5.7-6.0	Fill - Sandy Clay	5	0.6	17	NA	120	170	0.4	11	400	8.11	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK10	7.3-7.5	Fill - Sandy Clay	9	LPQL	20	NA	57	140	0.2	6	220	3.82	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	**Chrysotile & Crocidolite Asbestos**
JK11	0.0-0.2	Fill - Gravelly Clayey Sand	5	LPQL	19	NA	150	68	0.1	14	150	2.25	LPQL	LPQL	LPQL	LPQL	5.2	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detect
JK11	4.0-4.5	Fill - Clayey Gravelly Sand	LPQL	LPQL	18	NA	8	11	LPQL	6	32	LPQL	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK11	6.0-6.45	Silty Clay	LPQL	LPQL	7	NA	9	8	LPQL	1	5	LPQL	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK12	0.0-0.2	Fill - Silty Gravelly Sand	LPQL	LPQL	10	NA	31	43	LPQL	5	96	2.65	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK12	0.5-0.7	Fill - Silty Gravelly Sand	LPQL	LPQL	68	NA	56	11	LPQL	6	27	10.12	1	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detect
JK12	1.3-1.5	Fill - Silty Gravelly Sand	LPQL	LPQL	7	NA	47	81	LPQL	4	57	139.1	**13**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK12	4.3-4.5	Fill - Silty Sand	15	3.2	25	NA	190	270	0.1	42	640	1.55	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK13	0.0-0.2	Fill - Silty Sand	LPQL	LPQL	9	NA	34	38	LPQL	5	120	2.74	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detect
JK13	0.8-1.0	Fill - Sandy Clay	4	LPQL	9	NA	25	75	LPQL	4	97	2.17	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK13	2.7-3.0	Fill - Sandy Clayey Gravel	10	3.5	26	NA	43	180	0.1	10	250	2.3	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK14	0.0-0.2	Fill - Silty Sand	5	LPQL	14	NA	46	93	0.1	9	220	3.87	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detect
JK14	2.7-3.0	Fill - Silty Clay	6	LPQL	17	NA	54	71	0.1	11	230	6.96	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK14	7.3-7.5	Fill - Silty Sand	5	LPQL	11	NA	30	89	0.2	6	260	1.24	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK14	8.7-9.0	Fill - Silty Sand	6	LPQL	12	NA	41	190	0.1	8	230	2.65	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK15	0.0-0.2	Fill - Silty Sand	LPQL	LPQL	5	NA	40	12	0.3	6	37	2.13	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detect
JK15	0.3-0.5	Fill - Silty Sand	6	LPQL	3	NA	12	26	LPQL	2	52	LPQL	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK15	2.8-3.0	Fill - Silty Clayey Sand	8	LPQL	18	NA	83	110	0.1	13	170	12.6	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK15	5.7-6.0	Fill - Silty Sand	LPQL	LPQL	4	NA	4	9	LPQL	8	21	LPQL	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK16	0.0-0.2	Fill - Silty Sand	5	LPQL	15	NA	36	**350**	0.1	14	250	14.7	1	LPQL	LPQL	LPQL	0.4	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detect
JK16	1.3-1.5	Fill - Silty Sand	LPQL	LPQL	26	NA	26	24	LPQL	22	80	6.27	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK16	2.7-3.0	Fill - Clayey Sand	9	LPQL	16	NA	15	25	LPQL	11	64	4.01	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Number of Samples			26	26	26	0	26	26	26	26	26	26	26	7	7	7	7	7	7	7	7	7	9
Maximum Value			15	3.5	68	0	190	350	0.6	42	640	139.1	13	LPQL	LPQL	LPQL	5.2	LPQL	LPQL	LPQL	LPQL	LPQL	nc

Explanation:

1 - Site Assessment Criteria (SAC): NEPM 2013, HIL-A: 'Residential with garden/accessible soils; children's day care centers; preschools; and primary schools'

2 - B(a)P TEQ - Benzo(a)pyrene Toxicity Equivalence Quotient has been calculated based on 8 carcinogenic PAHs and their Toxic Equivalence Factors (TEFs) outlined in NEPM 2013

Concentration above the SAC **VALUE**

Abbreviations:

PAHs: Polycyclic Aromatic Hydrocarbons
B(a)P: Benzo(a)pyrene
PQL: Practical Quantitation Limit
LPQL: Less than PQL
OPP: Organophosphorus Pesticides
OCP: Organochlorine Pesticides
PCBs: Polychlorinated Biphenyls

UCL: Upper Level Confidence Limit on Mean Value
HILs: Health Investigation Levels
NA: Not Analysed
nc: Not Calculated
nsl: No Set Limit
SAC: Site Assessment Criteria
NEPM: National Environmental Protection Measure

TABLE B-1
SOIL LABORATORY RESULTS COMPARED TO HSL
All data in mg/kg unless stated otherwise

				C_6-C_{10} (F1)	$>C_{10}$-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	PID [2]
PQL - Envirolab Services				25	50	0.2	0.5	1	3	1	
HSL Land Use Category [1]				**RESIDENTIAL WITH ACCESSIBLE SOIL**							
Sample Reference	**Sample Depth**	**Depth Category**	**Soil Category**								
JK1	0.0-0.2	0m to < 1m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK1	1.3-1.5	1m to <2m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK1	2.7-3.0	2m to <4m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK2	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK2	0.8-1.0	0m to < 1m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK3	0.3-0.5	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK3	3.5-3.8	2m to <4m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK3	4.3-4.5	4m+	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK4	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK4	1.3-1.5	1m to <2m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK5	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK5	0.65-0.95	0m to < 1m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK5	3.0-3.15	2m to <4m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK5	6.0-6.2	4m+	Silt	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK6	0.05-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0.5
JK6	1.3-1.5	1m to <2m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK6	3.0-3.45	2m to <4m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0.4
JK7	0.0-0.2	0m to < 1m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK7	2.7-3.0	2m to <4m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK7	5.8-6.0	4m+	Clay	LPQL	240	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK8	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK8	2.7-3.0	2m to <4m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK8	4.3-4.5	4m+	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK9	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK9	0.5-0.7	0m to < 1m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK9	2.6-2.8	2m to <4m	Clay	LPQL	53	LPQL	LPQL	LPQL	LPQL	LPQL	0
Total Number of Samples [3]				26	26	26	26	26	26	26	26
Maximum Value				LPQL	240	LPQL	LPQL	LPQL	LPQL	LPQL	0.5

Explanation:

1 - Site Assessment Criteria (SAC): NEPM 2013
2 - Field PID values obtained during the investigation

Concentration above the SAC VALUE

Abbreviations:

UCL: Upper Level Confidence Limit on Mean Value	PQL: Practical Quantitation Limit
HSLs: Health Screening Levels	LPQL: Less than PQL
na: Not Analysed	SAC: Site Assessment Criteria
nc: Not Calculated	NEPM: National Environmental Protection Measure
NL: Not Limiting	

SITE ASSESSMENT CRITERIA

				C_6-C10 (F1)	$>C_{10}$-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene
PQL - Envirolab Services				25	50	0.2	0.5	1	3	1
HSL Land Use Category [1]				**RESIDENTIAL WITH ACCESSIBLE SOIL**						
Sample Reference	**Sample Depth**	**Depth Category**	**Soil Category**							
JK1	0.0-0.2	0m to < 1m	Clay	50	280	0.7	480	NL	110	5
JK1	1.3-1.5	1m to <2m	Clay	90	NL	1	NL	NL	310	NL
JK1	2.7-3.0	2m to <4m	Clay	150	NL	2	NL	NL	NL	NL
JK2	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK2	0.8-1.0	0m to < 1m	Clay	50	280	0.7	480	NL	110	5
JK3	0.3-0.5	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK3	3.5-3.8	2m to <4m	Clay	150	NL	2	NL	NL	NL	NL
JK3	4.3-4.5	4m+	Clay	290	NL	3	NL	NL	NL	NL
JK4	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK4	1.3-1.5	1m to <2m	Clay	90	NL	1	NL	NL	310	NL
JK5	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK5	0.65-0.95	0m to < 1m	Clay	50	280	0.7	480	NL	110	5
JK5	3.0-3.15	2m to <4m	Clay	150	NL	2	NL	NL	NL	NL
JK5	6.0-6.2	4m+	Silt	190	NL	2	NL	NL	NL	NL
JK6	0.05-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK6	1.3-1.5	1m to <2m	Sand	70	240	0.5	220	NL	60	NL
JK6	3.0-3.45	2m to <4m	Clay	150	NL	2	NL	NL	NL	NL
JK7	0.0-0.2	0m to < 1m	Clay	50	280	0.7	480	NL	110	5
JK7	2.7-3.0	2m to <4m	Sand	110	440	0.5	310	NL	95	NL
JK7	5.8-6.0	4m+	Clay	290	NL	3	NL	NL	NL	NL
JK8	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK8	2.7-3.0	2m to <4m	Clay	150	NL	2	NL	NL	NL	NL
JK8	4.3-4.5	4m+	Clay	290	NL	3	NL	NL	NL	NL
JK9	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK9	0.5-0.7	0m to < 1m	Clay	50	280	0.7	480	NL	110	5
JK9	2.6-2.8	2m to <4m	Clay	150	NL	2	NL	NL	NL	NL

TABLE B-2
SOIL LABORATORY RESULTS COMPARED TO HSL

All data in mg/kg unless stated otherwise

				C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	PID [2]
PQL - Envirolab Services				25	50	0.2	0.5	1	3	1	
HSL Land Use Category [1]				**RESIDENTIAL WITH ACCESSIBLE SOIL**							
Sample Reference	**Sample Depth**	**Depth Category**	**Soil Category**								
JK10	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK10	1.3-1.5	1m to <2m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK10	2.7-3.0	2m to <4m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK10	5.7-6.0	4m+	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK10	7.3-7.5	4m+	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK11	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0.4
JK11	4.0-4.5	4m+	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	1.9
JK11	6.0-6.45	4m+	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0.4
JK12	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK12	0.5-0.7	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK12	1.3-1.5	1m to <2m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK12	4.3-4.5	4m+	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK13	0.0-0.2	0m to < 1m	Sand	LPQL	190	LPQL	LPQL	LPQL	LPQL	LPQL	1
JK13	0.8-1.0	0m to < 1m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK13	2.7-3.0	2m to <4m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK14	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK14	2.7-3.0	2m to <4m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK14	7.3-7.5	4m+	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK14	8.7-9.0	4m+	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK15	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK15	0.3-0.5	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK15	2.8-3.0	2m to <4m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK15	5.7-6.0	4m+	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK16	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK16	1.3-1.5	1m to <2m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK16	2.7-3.0	2m to <4m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
Total Number of Samples [3]				26	26	26	26	26	26	26	26
Maximum Value				LPQL	190	LPQL	LPQL	LPQL	LPQL	LPQL	1.9

Explanation:

1 - Site Assessment Criteria (SAC): NEPM 2013
2 - Field PID values obtained during the investigation

Concentration above the SAC VALUE

Abbreviations:

UCL: Upper Level Confidence Limit on Mean Value	PQL: Practical Quantitation Limit
HSLs: Health Screening Levels	LPQL: Less than PQL
na: Not Analysed	SAC: Site Assessment Criteria
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NL: Not Limiting	

SITE ASSESSMENT CRITERIA

				C_6-C10 (F1)	>C_{10}-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene
PQL - Envirolab Services				25	50	0.2	0.5	1	3	1
HSL Land Use Category [1]				**RESIDENTIAL WITH ACCESSIBLE SOIL**						
Sample Reference	**Sample Depth**	**Depth Category**	**Soil Category**							
JK10	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK10	1.3-1.5	1m to <2m	Sand	70	240	0.5	220	NL	60	NL
JK10	2.7-3.0	2m to <4m	Sand	110	440	0.5	310	NL	95	NL
JK10	5.7-6.0	4m+	Clay	290	NL	3	NL	NL	NL	NL
JK10	7.3-7.5	4m+	Clay	290	NL	3	NL	NL	NL	NL
JK11	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK11	4.0-4.5	4m+	Sand	200	NL	0.5	540	NL	170	NL
JK11	6.0-6.45	4m+	Clay	290	NL	3	NL	NL	NL	NL
JK12	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK12	0.5-0.7	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK12	1.3-1.5	1m to <2m	Sand	70	240	0.5	220	NL	60	NL
JK12	4.3-4.5	4m+	Sand	200	NL	0.5	540	NL	170	NL
JK13	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK13	0.8-1.0	0m to < 1m	Clay	50	280	0.7	480	NL	110	5
JK13	2.7-3.0	2m to <4m	Sand	110	440	0.5	310	NL	95	NL
JK14	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK14	2.7-3.0	2m to <4m	Clay	150	NL	2	NL	NL	NL	NL
JK14	7.3-7.5	4m+	Sand	200	NL	0.5	540	NL	170	NL
JK14	8.7-9.0	4m+	Sand	200	NL	0.5	540	NL	170	NL
JK15	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK15	0.3-0.5	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK15	2.8-3.0	2m to <4m	Sand	110	440	0.5	310	NL	95	NL
JK15	5.7-6.0	4m+	Sand	200	NL	0.5	540	NL	170	NL
JK16	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK16	1.3-1.5	1m to <2m	Sand	70	240	0.5	220	NL	60	NL
JK16	2.7-3.0	2m to <4m	Sand	110	440	0.5	310	NL	95	NL

TABLE C
SUMMARY OF LABORATORY RESULTS - VOLATILE ORGANIC COMPOUNDS (VOCs)

Sample Reference	Sample Depth (m)	Sample Description	Total VOCs
JK12[a]	0.5-0.7	Fill - Silty Gravelly Sand	ALPQL
JK6[b]	0.05-0.2	Fill - Gravelly Clayey Sand	ALPQL
JK7[b]	0.0-0.2	Fill - Silty Clay	ALPQL
JK7[b]	5.8-6.0	Fill - Gravelly Sandy Clay	ALPQL
JK9[b]	0.5-0.7	Fill - Silty Sandy Clay	ALPQL
JK13[b]	0.0-0.2	Fill - Silty Sand	ALPQL
Total Number of Samples			6
Minimum Value			ALPQL
Maximum Value			ALPQL

EXPLANATION:

a - Reference should be made to Envirolab Report 99467-A for more information on individual values

b - Reference should be made to Envirolab Report 99558-A for more information on individual values

Values Exceeding Action Criteria — **VALUE**

Abbreviations:

ALPQL: All Values Less than PQL

PQL: Practical Quantitation Limit

TABLE D
SUMMARY OF LABORATORY RESULTS - ASBESTOS IN MATERIAL

Sample Reference	Sample Depth (m)	Sample Description	Asbestos
JK5	5.7	Material	**Chrysotile asbestos detected, Amosite asbestos detected**
JK10	4.3-4.5	Material	**Chrysotile asbestos detected, Amosite asbestos detected**
JK10	7.3-7.5	Material	**Chrysotile asbestos detected, Crocidolite asbestos detected**
JK10	11	Material	**Chrysotile asbestos detected, Crocidolite asbestos detected**
JK14	1.3-1.5	Material	No asbestos detected
JK14	7.3-7.5	Material	**Chrysotile asbestos detected**
S1	-	Material	**Chrysotile asbestos detected, Amosite asbestos detected, Crocidolite asbestos detected**
Total Number of Samples			7

EXPLANATION:

a - Reference should be made to Envirolab Report 99467-A for more information on individual values

Values Exceeding Action Criteria **VALUE**

Abbreviations:

ALPQL: All Values Less than PQL

PQL: Practical Quantitation Limit

TABLE E
SUMMARY OF LABORATORY RESULTS - ACID SULFATE SOILS ANALYSIS (POCAS)

Sample Reference	Sample Depth (m)	Sample Description	pH_{KCL}	TAA	pH_{ox}	TPA	TSA	S_{POS}	Ca A	Mg A	Liming Rate
				pH 6.5		pH 6.5	pH 6.5	%w/w	%w/w	%w/w	kg $CaCO_3$/tonne
JK1	1.3-1.5	Fill - Silty Clay	6.1	5	**4.5**	**30**	**25**	**0.08**	0.017	LPQL	4.2
JK3	3.5-3.8	Fill - Silty Clay	8.8	LPQL	7	LPQL	LPQL	**0.2**	0.55	0.025	LPQL
JK3	5.7-6.0	Silty Clay	6.5	LPQL	**3**	**170.0**	**170**	**0.4**	0.05	LPQL	15
JK5	6.3-6.5	Clayey Silt	6.4	LPQL	**4.9**	LPQL	LPQL	0.03	LPQL	0.006	1.7
JK15	2.8-3.0	Fill - Silty Clayey Sand	8.3	LPQL	7.4	LPQL	LPQL	**0.06**	0.72	0.013	LPQL
JK15	4.3-4.5	Fill - Silty Sand	6.2	LPQL	**3.3**	**65**	**62**	**0.13**	LPQL	LPQL	6.4
JK16	1.8-2.0	Fill - Silty Sand	10.1	LPQL	8	LPQL	LPQL	0.01	0.48	0.027	LPQL
JK16	4.3-4.5	Silty Sand	5.6	5	**2.6**	**85**	**80**	**0.31**	0.008	LPQL	15
Total Number of Samples			8	8	8	8	8	8	8	8	8
Minimum Value			5.6	5	2.6	30	25	0.01	0.008	0.006	1.7
Maximum Value			10.1	5	8	170	170	0.4	0.72	0.027	15

EXPLANATION:

Action criteria are defined as follows:

- coarse textured soils (sands to loamy sands):

$pH < 5$

TAA/TSA/TPA (pH 5.5) > 18mol H^+/tonne

S_{pos} > 0.03% sulfure oxidisable

Values Exceeding Action Criteria **VALUE**

Abbreviations:

pH_{KCL} : pH of filtered 1:20, 1M KCL extract, shaken overnight

TAA pH 6.5 : Total Actual Acidity in 1M KCL extract titrated to pH6.5

pH_{ox} : pH filtered 1:20 1M KCl after peroxide digestion

TPA : Total Potential Acidity, 1M KCL peroxide digest titrated to pH6.5

TSA: Total Sulfide Acidity

S_{POS}: Peroxide oxidisable Sulfur (SP - SKCL)

Ca $_A$/Mg $_A$: Calcium/Magnesium reacted with acid generated by peroxide digest

Calcium and Magnesium values used to estimate additional Ca/Mg from acid-shell/carbonate/dolomite reaction

Reference: ASSMAC (Acid Sulfate Soils management Advisory Committee - Acid Sulfate Soil Manual, August 1998).

TABLE F
SUMMARY OF GROUNDAWATER LABORATORY RESULTS
All results in μg/L unless stated otherwise.

	PQL Envirolab Services	GIL - ANZECC 2000 [1] Fresh Waters	GIL - US EPA[3]	GIL - Drinking Water[2]	SAMPLES			
					MW1	MW7	MW9	MW16
Field Measurements [4]								
Dissolved oxygen (ppm)	-	nsl	-	>85%[d]	0.5	0.5	0.6	1.6
Redox potential (mV)	-	nsl	-	nsl	-77.2	151.7	250.5	-8
pH	-	6.5 - 8.5[i]	-	6.5 - 8.5[d]	**6.45**	6.96	**4.25**	6.72
Conductivity (μS/cm)	-	nsl	-	nsl	3,092	6,447	2,225	12,535
Temperature °C	-	nsl	-	nsl	19.6	20.7	25.5	20.3
Inorganic Compounds and Parameters								
pH	0.1	6.5 - 8.5[i]	-	6.5 - 8.5[d]	7.6	8	**4.8**	7.4
Electrical Conductivity (μS/cm)	1	nsl	-	nsl	3,500	7,100	2,300	14,000
Hardness (mgCaCo3/L)	3	nsl	-	200[d]	**800**	**1400**	110	**3400**
Heavy Metals								
Arsenic (As III)	1	24	-	10	2	2	**33**	1
Cadmium	0.1	0.2	-	2	LPQL	LPQL	LPQL	LPQL
Chromium (total)	2	3.3[a#]	-	nsl	LPQL	LPQL	2	1
Copper	1	1.4	-	2000	LPQL	LPQL	**12**	**2**
Lead	1	3.4	-	10	LPQL	LPQL	**4**	LPQL
Mercury (inorganic)	0.05	0.6	-	1	LPQL	LPQL	LPQL	LPQL
Nickel	1	11	-	20	4	5	**120**	**26**
Zinc	1	8	-	3000[d]	6	3	**200**	**39**
Monocyclic Aromatic Hydrocarbons (BTEX Compounds)								
Benzene	1	950[a]	-	1	LPQL	LPQL	LPQL	LPQL
Toluene	1	180[a]	-	800	LPQL	LPQL	LPQL	LPQL
Ethylbenzene	1	80[a]	-	300	LPQL	LPQL	LPQL	LPQL
m+p-xylene	2	75[m]	-	nsl	LPQL	LPQL	LPQL	LPQL
o-xylene	1	350[a]	-	nsl	LPQL	LPQL	LPQL	LPQL
Total xylenes	3	nsl	-	600	LPQL	LPQL	LPQL	LPQL
Volatile Organic Compounds (VOCs)								
Total VOCs	-	nsl	-	-	ALPQL	ALPQL	ALPQL	ALPQL
Polycyclic Aromatic Hydrocarbons (PAHs)								
Naphthalene	0.1	16[a]	0.14	nsl	LPQL	LPQL	LPQL	**0.2**
Acenaphthylene	0.1	nsl	nsl	nsl	LPQL	LPQL	LPQL	LPQL
Acenaphthene	0.1	nsl	400	nsl	LPQL	LPQL	LPQL	LPQL
Fluorene	0.1	nsl	220	nsl	LPQL	LPQL	LPQL	LPQL
Phenanthrene	0.1	0.6[c]	nsl	nsl	LPQL	LPQL	LPQL	LPQL
Anthracene	0.1	0.01[c]	1300	nsl	LPQL	LPQL	LPQL	LPQL
Fluoranthene	0.1	1[c]	630	nsl	LPQL	LPQL	LPQL	LPQL
Pyrene	0.1	nsl	87	nsl	LPQL	LPQL	LPQL	LPQL
Benzo(a)anthracene	0.1	nsl	0.029	nsl	LPQL	LPQL	LPQL	LPQL
Chrysene	0.1	nsl	2.9	nsl	LPQL	LPQL	LPQL	LPQL
Benzo(b,k)fluoranthene	0.2	nsl	0.029[r]	nsl	LPQL	LPQL	LPQL	LPQL
Benzo(a)pyrene	0.1	0.1[c]	0.003	0.01	LPQL	LPQL	LPQL	LPQL
Indeno(1,2,3-c,d)pyrene	0.1	nsl	0.029	nsl	LPQL	LPQL	LPQL	LPQL
Dibenzo(a,h)anthracene	0.1	nsl	0.003	nsl	LPQL	LPQL	LPQL	LPQL
Benzo(g,h,i)perylene	0.1	nsl	nsl	nsl	LPQL	LPQL	LPQL	LPQL
Total PAHs	-	nsl	nsl	nsl	LPQL	LPQL	LPQL	0.2
Organochlorine Pesticides (OCPs)								
Aldrin	0.001	0.001[a]	-	0.3	LPQL	LPQL	LPQL	LPQL
Chlordane	0.001	0.03[c]	-	1	LPQL	LPQL	LPQL	LPQL
DDE	0.001	0.03[a]	nsl	nsl	0.001	LPQL	LPQL	LPQL
DDT	0.001	0.006[c]	-	9	0.001	LPQL	LPQL	LPQL
Dieldrin	0.001	0.01[a]	-	0.3	0.004	0.005	LPQL	0.004
Endosulfan	0.001	0.03[c]	-	20	LPQL	LPQL	LPQL	LPQL
Endrin	0.001	0.01[c]	11	nsl	LPQL	LPQL	LPQL	LPQL
Heptachlor	0.001	0.01[c]	-	0.3	LPQL	LPQL	LPQL	LPQL
Methoxychlor	0.001	0.005[c]	-	300	LPQL	LPQL	LPQL	LPQL
Organophosphate Pesticides (OPPs)								
Dichlorovos	0.001	nsl	-	5	LPQL	LPQL	LPQL	LPQL
Mevinphos (Phesdrin)	0.001	nsl	-	5	LPQL	LPQL	LPQL	LPQL
Naled	0.001	nsl	73	nsl	LPQL	LPQL	LPQL	LPQL
Phorate	0.001	nsl	7.3	nsl	LPQL	LPQL	LPQL	LPQL
Dimethoate	0.001	0.15[a]	-	7	LPQL	LPQL	LPQL	LPQL
Diazinon	0.001	0.01[a]	-	4	LPQL	LPQL	LPQL	LPQL
Disulfoton	0.001	nsl	-	4	LPQL	LPQL	LPQL	LPQL
Chlorpyriphos-methyl	0.001	nsl	370	nsl	LPQL	LPQL	LPQL	LPQL
Methyl Parathion	0.001	nsl	-	nsl	LPQL	LPQL	LPQL	LPQL
Ronnel (fenchlorphos)	0.001	nsl	1800	nsl	LPQL	LPQL	LPQL	LPQL
Fenitrothion	0.001	0.2[a]	-	10	LPQL	LPQL	LPQL	LPQL
Malathion	0.001	0.05[a]	730	70	LPQL	LPQL	LPQL	LPQL
Chlorpyriphos	0.001	0.01	-	10	**0.014**	**0.02**	**0.023**	LPQL
Bromophos-ethyl	0.001	nsl	-	10	LPQL	LPQL	LPQL	LPQL
Methidathion	0.001	nsl	-	6	LPQL	LPQL	LPQL	LPQL
Phenamiphos	0.001	nsl	nsl	nsl	LPQL	LPQL	LPQL	LPQL
Ethion	0.001	nsl	-	4	LPQL	LPQL	LPQL	LPQL
Phosalone	0.001	nsl	nsl	nsl	LPQL	LPQL	LPQL	LPQL
Azinphos-methyl	0.001	0.01[c]	-	3	LPQL	LPQL	LPQL	LPQL
Coumaphos	0.001	nsl	nsl	nsl	LPQL	LPQL	LPQL	LPQL
Polychlorinated Biphenyls (PCBs)								
Total PCBs	0.01	nsl	nsl	nsl	ALPQL	ALPQL	ALPQL	ALPQL

EXPLANATION:

1 - ANZECC Australian Water Quality Guidelines for Fresh Waters, 2000 - Trigger Values for protection of 95% of species
2 - NHMRC Australian Drinking Water Guidelines (2011)
3 - In the absence of Australian guidelines, the USEPA (2010) Region 9 Screening Levels for tapwater have been adopted as a preliminary screening tool
4 - Field Measurements obtained during sampling on 6-11-13

a - In the absence of a high reliability guideline concentration, the moderate or low reliability guideline concentration has been quoted
c - 99% trigger values adopted due to the potential for bioaccumulation effects
d - In the absence of a health guideline the aesthetic guideline concentration has been quoted
i - ANZECC 2000 - Level for NSW Lowland Rivers.
m - Guideline value adopted for m-Xylene. We note that the m-Xylene guideline value is 75ug/L and the p-Xylene guideline value is 200ug/L.
However these two isomers cannot be distinguished analytically. Therefore EIS have adopted the more conservative guideline value
r - The more conservative value for Benzo(b)fluoranthene has been adopted
a# - The GIL for Cr III has been adopted as Cr VI is relatively unstable and breakdown rapidly

Concentration above the GIL **VALUE**

ABBREVIATIONS:

na: Not Analysed
nsl: No Set Limit
GIL - Groundwater Investigation Levels
PQL: Practical Quantitation Limit
LPQL: Less than Practical Quantitation Limit
ALPQL: All results less than the PQL
(-) : Not Applicable

TABLE G
GROUNDWATER LABORATORY RESULTS COMPARED AGAINST THE HSLs
All data in µg/L unless stated otherwise

				C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	PID [2]
PQL - Envirolab Services				10	50	1	1	1	3	1	
Land Use Category [1]				LOW DENSITY RESIDENTIAL							
Sample Reference	**Water Depth**	**Depth Category**	**Soil Category**								
MW1	1.65	0m to <2m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	NA
MW7	4.58	4m to <8m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	NA
MW9	5.75	4m to <8m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	NA
MW16	4.49	4m to <8m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	NA
Total Number of Samples				4	4	4	4	4	4	4	0
Maximum Value				LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0

Explanation:

1 - Groundwater Investigation Levels (GILs): NEPM 2013
2 - Field PID values obtained during the investigation

Concentration above the SAC	VALUE
Site specific assesment required	VALUE

Abbreviations:

UCL: Upper Level Confidence Limit on Mean Value
HSLs: Health Screening Levels
NA: Not Analysed
nc: Not Calculated
NL: Not Limiting

PQL: Practical Quantitation Limit
LPQL: Less than PQL
SAC: Site Assessment Criteria
NEPM: National Environmental Protection Measure
SSA: Site Specific Assessment

HSL GROUNDWATER ASSESSMENT CRITERIA

				C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene
PQL - Envirolab Services				10	50	1	1	1	3	1
Land Use Category [1]				LOW DENSITY RESIDENTIAL						
Sample Reference	**Water Depth**	**Depth Category**	**Soil Category**							
MW1	1.65	0m to <2m	Clay	SSA	SSA	SSA	SSA	SSA	SSA	SSA
MW7	4.58	4m to <8m	Clay	NL	NL	5000	NL	NL	NL	NL
MW9	5.75	4m to <8m	Clay	NL	NL	5000	NL	NL	NL	NL
MW16	4.49	4m to <8m	Sand	1000	1000	800	NL	NL	NL	NL

TABLE H-1
SOIL LABORATORY RESULTS COMPARED AGAINST THE EILs and ESLs
All data in mg/kg unless stated otherwise

Land Use Category [1]			URBAN RESIDENTIAL AND PUBLIC OPEN SPACE																			
						AGED HEAVY METALS-EILs						EILs		ESLs								
			pH	CEC (cmol$_c$/kg)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	>C_6-C_{10}	>C_{10}-C_{16}	>C_{16}-C_{34}	>C_{34}-C_{40}	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
PQL - Envirolab Services			-	1	-	4	1	1	1	1	1	0.05	0.1	25	50	100	100	0.2	0.5	1	3	0.05
Ambient Background Concentration (ABC) [2]			-	-	-	nsl	13	28	nsl	5	122	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl
Sample Reference	**Sample Depth**	**Soil Texture**	**Average Values from Table I[3]**																			
JK1	0.0-0.2	Fine	8.64	25.43	13.75	8	31	68	170	44	230	LPQL	LPQL	LPQL	LPQL	240	180	LPQL	LPQL	LPQL	LPQL	1.2
JK1	1.3-1.5	Fine	8.64	25.43	13.75	9	37	74	200	41	220	LPQL	NA	LPQL	LPQL	300	190	LPQL	LPQL	LPQL	LPQL	0.47
JK1	2.7-3.0	Fine	8.64	25.43	13.75	LPQL	14	11	16	2	7	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL
JK2	0.0-0.2	Coarse	8.64	25.43	13.75	5	11	36	45	9	88	LPQL	LPQL	LPQL	LPQL	220	LPQL	LPQL	LPQL	LPQL	LPQL	0.24
JK2	0.8-1.0	Fine	8.64	25.43	13.75	5	23	10	30	5	11	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL
JK3	0.3-0.5	Coarse	8.64	25.43	13.75	LPQL	21	76	60	9	63	LPQL	LPQL	LPQL	LPQL	120	140	LPQL	LPQL	LPQL	LPQL	0.75
JK3	3.5-3.8	Fine	8.64	25.43	13.75	8	17	44	96	7	250	LPQL	NA	LPQL	LPQL	180	160	LPQL	LPQL	LPQL	LPQL	0.09
JK3	4.3-4.5	Fine	8.64	25.43	13.75	6	10	11	32	3	470	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL
JK4	0.0-0.2	Coarse	8.64	25.43	13.75	5	24	34	46	13	77	LPQL	LPQL	LPQL	LPQL	170	230	LPQL	LPQL	LPQL	LPQL	0.33
JK4	1.3-1.5	Fine	8.64	25.43	13.75	10	20	110	68	13	100	LPQL	NA	LPQL	LPQL	150	140	LPQL	LPQL	LPQL	LPQL	0.28
JK5	0.0-0.2	Coarse	8.64	25.43	13.75	4	15	32	110	10	120	LPQL	LPQL	LPQL	LPQL	110	LPQL	LPQL	LPQL	LPQL	LPQL	1.4
JK5	0.65-0.95	Fine	8.64	25.43	13.75	4	19	68	160	13	200	LPQL	NA	LPQL	LPQL	170	110	LPQL	LPQL	LPQL	LPQL	0.79
JK5	3.0-3.15	Fine	8.64	25.43	13.75	7	17	30	83	9	150	LPQL	NA	LPQL	LPQL	290	120	LPQL	LPQL	LPQL	LPQL	0.85
JK5	6.0-6.2	Fine	8.64	25.43	13.75	5	13	15	24	3	39	LPQL	NA	LPQL	LPQL	140	LPQL	LPQL	LPQL	LPQL	LPQL	0.11
JK6	0.05-0.2	Coarse	8.64	25.43	13.75	LPQL	28	57	23	28	42	LPQL	LPQL	LPQL	LPQL	490	750	LPQL	LPQL	LPQL	LPQL	2.4
JK6	1.3-1.5	Coarse	8.64	25.43	13.75	6	15	32	46	10	52	LPQL	NA	LPQL	LPQL	220	340	LPQL	LPQL	LPQL	LPQL	0.81
JK6	3.0-3.45	Fine	8.64	25.43	13.75	6	13	25	37	14	100	LPQL	NA	LPQL	LPQL	140	230	LPQL	LPQL	LPQL	LPQL	LPQL
JK7	0.0-0.2	Fine	8.64	25.43	13.75	LPQL	110	56	9	9	25	LPQL	LPQL	LPQL	LPQL	320	690	LPQL	LPQL	LPQL	LPQL	0.57
JK7	2.7-3.0	Coarse	8.64	25.43	13.75	11	2800	91	97	59	130	LPQL	NA	LPQL	LPQL	210	240	LPQL	LPQL	LPQL	LPQL	0.3
JK7	5.8-6.0	Fine	8.64	25.43	13.75	7	33	48	100	9	140	LPQL	NA	LPQL	240	700	340	LPQL	LPQL	LPQL	LPQL	0.7
JK8	0.0-0.2	Coarse	8.64	25.43	13.75	LPQL	11	34	35	7	100	LPQL	LPQL	LPQL	LPQL	240	150	LPQL	LPQL	LPQL	LPQL	0.39
JK8	2.7-3.0	Fine	8.64	25.43	13.75	5	33	48	47	19	120	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0.07
JK8	4.3-4.5	Fine	8.64	25.43	13.75	7	14	38	27	9	70	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL
JK9	0.0-0.2	Coarse	8.64	25.43	13.75	LPQL	18	29	29	10	53	LPQL	LPQL	LPQL	LPQL	220	240	LPQL	LPQL	LPQL	LPQL	0.18
JK9	0.5-0.7	Fine	8.64	25.43	13.75	7	17	150	86	8	270	LPQL	NA	LPQL	LPQL	2300	700	LPQL	LPQL	LPQL	LPQL	0.22
JK9	2.6-2.8	Fine	8.64	25.43	13.75	5	16	58	51	6	81	LPQL	NA	LPQL	53	470	160	LPQL	LPQL	LPQL	LPQL	0.65
Total Number of Samples			26	26	23	26	26	26	26	26	26	26	9	26	26	26	26	26	26	26	26	26
Maximum Value			8.64	25.43	13.75	11	2800	150	200	59	470	LPQL	LPQL	LPQL	240	2300	750	LPQL	LPQL	LPQL	LPQL	2.4

Explanation:

1 - Site Assessment Criteria (SAC): NEPM 2013

2 - ABC Values for selected metals has been adopted from the published background concentrations presented in Olszowy et al (1995), Trace Element Concentrations in Soils from Rural and Urban New South Wales (old/new Suburbs high traffic 25th percentile values quoted)

3 - The average values for pH, % Clay and CEC are presented in Table I

Concentration above the SAC **VALUE**

Abbreviations:

EILs: Ecological Investigation Levels	UCL: Upper Level Confidence Limit on Mean Value	PQL: Practical Quantitation Limit	SAC: Site Assessment Criteria	NA: Not Analysed
B(a)P: Benzo(a)pyrene	ESLs: Ecological Screening Levels	LPQL: Less than PQL	NEPM: National Environmental Protection Measure	nc: Not Calculated
nsl: No Set Limit				

EIL AND ESL ASSESSMENT CRITERIA

Land Use Category [1]			URBAN RESIDENTIAL AND PUBLIC OPEN SPACE																			
						AGED HEAVY METALS-EILs						EILs		ESLs								
			pH	CEC (cmol$_c$/kg)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	>C_6-C_{10}	>C_{10}-C_{16}	>C_{16}-C_{34}	>C_{34}-C_{40}	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
PQL - Envirolab Services			-	1	-	4	1	1	1	1	1	0.05	0.1	25	50	100	100	0.2	0.5	1	3	0.05
Ambient Background Concentration (ABC) [2]			-	-	-	nsl	13	28	nsl	5	122	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl
Sample Reference	**Sample Depth**	**Soil Texture**	**Average Values from Table I**																			
JK1	0.0-0.2	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	1300	5600	60	105	125	45	0.7
JK1	1.3-1.5	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK1	2.7-3.0	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK2	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK2	0.8-1.0	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK3	0.3-0.5	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK3	3.5-3.8	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK3	4.3-4.5	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK4	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK4	1.3-1.5	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK5	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK5	0.65-0.95	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK5	3.0-3.15	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK5	6.0-6.2	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK6	0.05-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK6	1.3-1.5	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK6	3.0-3.45	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK7	0.0-0.2	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	1300	5600	60	105	125	45	0.7
JK7	2.7-3.0	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK7	5.8-6.0	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK8	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK8	2.7-3.0	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK8	4.3-4.5	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK9	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK9	0.5-0.7	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK9	2.6-2.8	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7

TABLE H-2
SOIL LABORATORY RESULTS COMPARED AGAINST THE EILs and ESLs
All data in mg/kg unless stated otherwise

Land Use Category [1]			URBAN RESIDENTIAL AND PUBLIC OPEN SPACE																			
						AGED HEAVY METALS-EILs						EILs		ESLs								
			pH	CEC (cmol$_c$/kg)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	>C_6-C_{10}	>C_{10}-C_{16}	>C_{16}-C_{34}	>C_{34}-C_{40}	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
PQL - Envirolab Services			-	1	-	4	1	1	1	1	1	0.05	0.1	25	50	100	100	0.2	0.5	1	3	0.05
Ambient Background Concentration (ABC) [2]			-	-	-	nsl	13	28	nsl	5	122	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl
Sample Reference	**Sample Depth**	**Soil Texture**	**Average Values from Table I[3]**																			
JK10	0.0-0.2	Coarse	8.64	25.43	13.75	LPQL	6	30	33	4	68	LPQL	LPQL	LPQL	LPQL	130	LPQL	LPQL	LPQL	LPQL	LPQL	0.1
JK10	1.3-1.5	Coarse	8.64	25.43	13.75	LPQL	10	17	34	6	44	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0.37
JK10	2.7-3.0	Coarse	8.64	25.43	13.75	8	22	64	270	12	230	LPQL	NA	LPQL	LPQL	160	LPQL	LPQL	LPQL	LPQL	LPQL	0.15
JK10	5.7-6.0	Fine	8.64	25.43	13.75	5	17	120	170	11	400	LPQL	NA	LPQL	LPQL	410	LPQL	LPQL	LPQL	LPQL	LPQL	0.81
JK10	7.3-7.5	Fine	8.64	25.43	13.75	9	20	57	140	6	220	LPQL	NA	LPQL	LPQL	220	110	LPQL	LPQL	LPQL	LPQL	0.32
JK11	0.0-0.2	Coarse	8.64	25.43	13.75	5	19	150	68	14	150	LPQL	LPQL	LPQL	LPQL	260	150	LPQL	LPQL	LPQL	LPQL	0.25
JK11	4.0-4.5	Coarse	8.64	25.43	13.75	LPQL	18	8	11	6	32	LPQL	NA	LPQL	LPQL	120	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL
JK11	6.0-6.45	Fine	8.64	25.43	13.75	LPQL	7	9	8	1	5	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL
JK12	0.0-0.2	Coarse	8.64	25.43	13.75	LPQL	10	31	43	5	96	LPQL	NA	LPQL	LPQL	160	LPQL	LPQL	LPQL	LPQL	LPQL	0.25
JK12	0.5-0.7	Coarse	8.64	25.43	13.75	LPQL	68	56	11	6	27	LPQL	LPQL	LPQL	LPQL	500	900	LPQL	LPQL	LPQL	LPQL	0.72
JK12	1.3-1.5	Coarse	8.64	25.43	13.75	LPQL	7	47	81	4	57	LPQL	NA	LPQL	LPQL	360	LPQL	LPQL	LPQL	LPQL	LPQL	8.6
JK12	4.3-4.5	Coarse	8.64	25.43	13.75	15	25	190	270	42	640	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0.15
JK13	0.0-0.2	Coarse	8.64	25.43	13.75	LPQL	9	34	38	5	120	LPQL	LPQL	LPQL	190	890	280	LPQL	LPQL	LPQL	LPQL	0.24
JK13	0.8-1.0	Fine	8.64	25.43	13.75	4	9	25	75	4	97	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0.17
JK13	2.7-3.0	Coarse	8.64	25.43	13.75	10	26	43	180	10	250	LPQL	NA	LPQL	LPQL	450	240	LPQL	LPQL	LPQL	LPQL	0.2
JK14	0.0-0.2	Coarse	8.64	25.43	13.75	5	14	46	93	9	220	LPQL	LPQL	LPQL	LPQL	110	LPQL	LPQL	LPQL	LPQL	LPQL	0.37
JK14	2.7-3.0	Coarse	8.64	25.43	13.75	6	17	54	71	11	230	LPQL	NA	LPQL	LPQL	170	LPQL	LPQL	LPQL	LPQL	LPQL	0.36
JK14	7.3-7.5	Coarse	8.64	25.43	13.75	5	11	30	89	6	260	LPQL	NA	LPQL	LPQL	150	LPQL	LPQL	LPQL	LPQL	LPQL	0.14
JK14	8.7-9.0	Coarse	8.64	25.43	13.75	6	12	41	190	8	230	LPQL	NA	LPQL	LPQL	130	LPQL	LPQL	LPQL	LPQL	LPQL	0.25
JK15	0.0-0.2	Coarse	8.64	25.43	13.75	LPQL	5	40	12	6	37	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0.13
JK15	0.3-0.5	Coarse	8.64	25.43	13.75	6	3	12	26	2	52	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL
JK15	2.8-3.0	Coarse	8.64	25.43	13.75	8	18	83	110	13	170	LPQL	NA	LPQL	LPQL	260	170	LPQL	LPQL	LPQL	LPQL	1.1
JK15	5.7-6.0	Coarse	8.64	25.43	13.75	LPQL	4	4	9	8	21	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL
JK16	0.0-0.2	Coarse	8.64	25.43	13.75	5	15	36	350	14	250	LPQL	LPQL	LPQL	LPQL	140	LPQL	LPQL	LPQL	LPQL	LPQL	1.1
JK16	1.3-1.5	Coarse	8.64	25.43	13.75	LPQL	26	26	24	22	80	LPQL	NA	LPQL	LPQL	170	200	LPQL	LPQL	LPQL	LPQL	0.37
JK16	2.7-3.0	Coarse	8.64	25.43	13.75	9	16	15	25	11	64	LPQL	NA	LPQL	LPQL	120	160	LPQL	LPQL	LPQL	LPQL	0.31
Total Number of Samples			26	26	23	26	26	26	26	26	26	26	7	26	26	26	26	26	26	26	26	26
Maximum Value			8.64	25.43	13.75	15	68	190	350	42	640	LPQL	LPQL	LPQL	190	890	900	LPQL	LPQL	LPQL	LPQL	8.6

Explanation:

1 - Site Assessment Criteria (SAC): NEPM 2013

2 - ABC Values for selected metals has been adopted from the published background concentrations presented in Olszowy et al (1995), Trace Element Concentrations in Soils from Rural and Urban New South Wales (old/new Suburbs high traffic 25th percentile values quoted)

3 - The average values for pH, % Clay and CEC are presented in Table I

Concentration above the SAC **VALUE**

Abbreviations:

EILs: Ecological Investigation Levels	UCL: Upper Level Confidence Limit on Mean Value	PQL: Practical Quantitation Limit	SAC: Site Assessment Criteria	NA: Not Analysed
B(a)P: Benzo(a)pyrene	ESLs: Ecological Screening Levels	LPQL: Less than PQL	NEPM: National Environmental Protection Measure	nc: Not Calculated
nsl: No Set Limit				

EIL AND ESL ASSESSMENT CRITERIA

Land Use Category [1]			URBAN RESIDENTIAL AND PUBLIC OPEN SPACE																			
						AGED HEAVY METALS-EILs						EILs		ESLs								
			pH	CEC (cmol$_c$/kg)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	>C_6-C_{10}	>C_{10}-C_{16}	>C_{16}-C_{34}	>C_{34}-C_{40}	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
PQL - Envirolab Services			-	1	-	4	1	1	1	1	1	0.05	0.1	25	50	100	100	0.2	0.5	1	3	0.05
Ambient Background Concentration (ABC) [2]			-	-	-	nsl	13	28	nsl	5	122	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl
Sample Reference	**Sample Depth**	**Soil Texture**	**Average Values from Table I[3]**																			
JK10	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK10	1.3-1.5	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK10	2.7-3.0	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK10	5.7-6.0	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK10	7.3-7.5	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK11	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK11	4.0-4.5	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK11	6.0-6.45	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK12	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK12	0.5-0.7	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK12	1.3-1.5	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK12	4.3-4.5	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK13	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK13	0.8-1.0	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK13	2.7-3.0	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK14	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK14	2.7-3.0	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK14	7.3-7.5	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK14	8.7-9.0	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK15	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK15	0.3-0.5	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK15	2.8-3.0	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK15	5.7-6.0	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK16	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK16	1.3-1.5	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK16	2.7-3.0	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7

TABLE I
SUMMARY OF LABORATORY RESULTS - ECOLOGY PARAMETERS

Sample Reference	Sample Depth (m)	Sample Description	pH	Clay	Ca	K	Mg	Na	CEC
			(1:5 soil:water)	(% w/w)	(meq/100g)	(meq/100g)	(meq/100g)	(meq/100g)	(med/100g)
JK1	0.0-0.2	Fill - Silty Sand Clay	7.1	24	12	1	2.6	0.32	16
JK7	0.0-0.2	Fill - Silty Clay	10.7	4	22	0	1	0.27	23
JK9	0.5-0.7	Fill - Silty Sand Clay	9.4	21	37	0.8	0.61	0.42	39
JK13	0.0-0.2	Fill - Silty Sand	8.1	11	16.0	0	0.42	0.2	17
JK16	0.0-0.2	Fill - Silty Sand	8.4	16	31	0	1	0.56	33
JK2	0.0-0.2	Fill - Silty Sand	7.9	10	22	0	1	0.26	24
JK3	0.3-0.5	Fill - Silty Sand	9.8	8	NA	NA	NA	NA	NA
JK5	0.65-0.95	Fill - Silty Clay	7.7	16	25	0.3	0.31	0.22	26
Total Number of Samples			8	8	7	7	7	7	7
Minimum Value			7.1	4	12	0	0	0.2	16
Maximum Value			10.7	24	37	1	3	0.56	39
Average Value			8.64	13.75	23.57	0.41	0.98	0.32	25.43

EXPLANATION:

The average values of the ecological parameters have been used in calcualting the EILs in Table H.

ABBREVIATIONS:

Ca - Calcium
K - Potassium
Mg - Magnesium
Na - Sodium
CEC - Cation Exchange Capacity

TABLE J-1
SOIL INTRA-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS
All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	INITIAL	REPEAT	MEAN	RPD %
Primary Sample: JK5 (0-0.2)	Arsenic	4	4	LPQL	4	NC
Dup Ref = Dup A	Cadmium	0.5	LPQL	LPQL	NC	NC
	Chromium	1	15	12	13.5	22.2
Envirolab Report: 99467	Copper	1	32	34	33	6.1
	Lead	1	110	90	100	20.0
	Mercury	0.1	0.2	0.1	0.15	66.7
	Nickel	1	10	9	9.5	10.5
	Zinc	1	120	110	115	8.7
	Naphthalene	0.1	LPQL	LPQL	NC	NC
	Acenaphthylene	0.1	0.1	0.1	0.1	0.0
	Acenaphthene	0.1	0.2	LPQL	0.2	NC
	Fluorene	0.1	0.1	LPQL	0.1	NC
	Phenanthrene	0.1	1.1	1.3	1.2	16.7
	Anthracene	0.1	0.4	0.4	0.4	0.0
	Fluoranthene	0.1	2.6	2.8	2.7	7.4
	Pyrene	0.1	2.5	2.8	2.65	11.3
	Benzo(a)anthracene	0.1	1.3	1.3	1.3	0.0
	Chrysene	0.1	1.1	1.2	1.15	8.7
	Benzo(b)&(k)fluorant	0.2	2.2	2.1	2.15	4.7
	Benzo(a)pyrene	0.05	1.4	1.4	1.4	0.0
	Indeno(123-cd)pyrene	0.1	1	0.8	0.9	22.2
	Dibenzo(ah)anthracene	0.1	0.2	0.2	0.2	0.0
	Benzo(ghi)perylene	0.1	0.9	0.7	0.8	25.0
	TRH >C6-C9 (F1)	25	LPQL	LPQL	NC	NC
	TRH >C10 - C16 (F2)	50	LPQL	LPQL	NC	NC
	TRH >C16-C34	100	110	150	130	30.8
	TRH >C34-C40	100	LPQL	LPQL	NC	NC
	Benzene	0.5	LPQL	LPQL	NC	NC
	Toluene	0.5	LPQL	LPQL	NC	NC
	Ethylbenzene	1	LPQL	LPQL	NC	NC
	m+p-xylene	2	LPQL	LPQL	NC	NC
	o-xylene	1	LPQL	LPQL	NC	NC

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value <= 50% are acceptable
Results between 5 & 10 times PQL = RPD value <= 75% are acceptable
Results < 5 times PQL = RPD value <= 100% are acceptable

RPD Results Above the Acceptance Criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit
LPQL: Less than PQL
na: Not Analysed
nc: Not Calculated

OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PCBs: Polychlorinated Biphenyls
TPH: Total Petroleum Hydrocarbons

TABLE J-2
SOIL INTRA-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS
All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	INITIAL	REPEAT	MEAN	RPD %
Primary Sample: JK10 (0-0.2)	Arsenic	4	LPQL	LPQL	NC	NC
Dup Ref = Dup B	Cadmium	0.5	LPQL	LPQL	NC	NC
	Chromium	1	6	8	7	28.6
Envirolab Report: 99467	Copper	1	30	24	27	22.2
	Lead	1	33	37	35	11.4
	Mercury	0.1	LPQL	0.1	0.1	NC
	Nickel	1	4	5	4.5	22.2
	Zinc	1	68	92	80	30.0
	Naphthalene	0.1	LPQL	LPQL	NC	NC
	Acenaphthylene	0.1	LPQL	LPQL	NC	NC
	Acenaphthene	0.1	LPQL	LPQL	NC	NC
	Fluorene	0.1	LPQL	LPQL	NC	NC
	Phenanthrene	0.1	LPQL	LPQL	NC	NC
	Anthracene	0.1	LPQL	LPQL	NC	NC
	Fluoranthene	0.1	0.2	0.2	0.2	0.0
	Pyrene	0.1	0.2	0.2	0.2	0.0
	Benzo(a)anthracene	0.1	LPQL	0.1	0.1	NC
	Chrysene	0.1	LPQL	0.1	0.1	NC
	Benzo(b)&(k)fluorant	0.2	LPQL	0.2	0.2	NC
	Benzo(a)pyrene	0.05	0.1	0.13	0.115	26.1
	Indeno(123-cd)pyrene	0.1	LPQL	LPQL	NC	NC
	Dibenzo(ah)anthracene	0.1	LPQL	LPQL	NC	NC
	Benzo(ghi)perylene	0.1	LPQL	LPQL	NC	NC
	TRH >C6-C9 (F1)	25	LPQL	LPQL	NC	NC
	TRH >C10 - C16 (F2)	50	LPQL	LPQL	NC	NC
	TRH >C16-C34	100	130	140	135	7.4
	TRH >C34-C40	100	LPQL	LPQL	NC	NC
	Benzene	0.5	LPQL	LPQL	NC	NC
	Toluene	0.5	LPQL	LPQL	NC	NC
	Ethylbenzene	1	LPQL	LPQL	NC	NC
	m+p-xylene	2	LPQL	LPQL	NC	NC
	o-xylene	1	LPQL	LPQL	NC	NC

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value <= 50% are acceptable
Results between 5 & 10 times PQL = RPD value <= 75% are acceptable
Results < 5 times PQL = RPD value <= 100% are acceptable

RPD Results Above the Acceptance Criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit	OCP: Organochlorine Pesticides
LPQL: Less than PQL	OPP: Organophosphorus Pesticides
na: Not Analysed	PCBs: Polychlorinated Biphenyls
nc: Not Calculated	TPH: Total Petroleum Hydrocarbons

TABLE J-3
SOIL INTRA-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS
All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	INITIAL	REPEAT	MEAN	RPD %
Primary Sample: JK12 (1.3-1.5)	Arsenic	4	LPQL	LPQL	NC	NC
Dup Ref = Dup C	Cadmium	0.5	LPQL	LPQL	NC	NC
	Chromium	1	7	6	6.5	15.4
Envirolab Report: 99467	Copper	1	47	45	46	4.3
	Lead	1	81	73	77	10.4
	Mercury	0.1	LPQL	LPQL	NC	NC
	Nickel	1	4	6	5	40.0
	Zinc	1	57	52	54.5	9.2
	Naphthalene	0.1	LPQL	LPQL	NC	NC
	Acenaphthylene	0.1	0.1	LPQL	NC	NC
	Acenaphthene	0.1	1.5	0.7	1.1	72.7
	Fluorene	0.1	1	0.5	0.75	66.7
	Phenanthrene	0.1	14	6.8	10.4	69.2
	Anthracene	0.1	4.3	1.9	3.1	77.4
	Fluoranthene	0.1	32	18	25	56.0
	Pyrene	0.1	29	16	22.5	57.8
	Benzo(a)anthracene	0.1	12	6.6	9.3	58.1
	Chrysene	0.1	11	6.2	8.6	55.8
	Benzo(b)&(k)fluorant	0.2	16	8.6	12.3	60.2
	Benzo(a)pyrene	0.05	8.6	4.6	6.6	60.6
	Indeno(123-cd)pyrene	0.1	4.8	2.5	3.65	63.0
	Dibenzo(ah)anthracene	0.1	0.9	0.4	0.65	76.9
	Benzo(ghi)perylene	0.1	3.9	2.1	3	60.0
	TRH >C6-C9 (F1)	25	LPQL	LPQL	NC	NC
	TRH >C10 - C16 (F2)	50	LPQL	LPQL	NC	NC
	TRH >C16-C34	100	360	290	325	21.5
	TRH >C34-C40	100	LPQL	120	NC	NC
	Benzene	0.5	LPQL	LPQL	NC	NC
	Toluene	0.5	LPQL	LPQL	NC	NC
	Ethylbenzene	1	LPQL	LPQL	NC	NC
	m+p-xylene	2	LPQL	LPQL	NC	NC
	o-xylene	1	LPQL	LPQL	NC	NC

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value <= 50% are acceptable
Results between 5 & 10 times PQL = RPD value <= 75% are acceptable
Results < 5 times PQL = RPD value <= 100% are acceptable

RPD Results Above the Acceptance Criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit	OCP: Organochlorine Pesticides
LPQL: Less than PQL	OPP: Organophosphorus Pesticides
na: Not Analysed	PCBs: Polychlorinated Biphenyls
nc: Not Calculated	TPH: Total Petroleum Hydrocarbons

TABLE J-4
SOIL INTRA-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS

All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	INITIAL	REPEAT	MEAN	RPD %
Primary Sample: JK1 (0.0-0.2)	Arsenic	4	8	9	8.5	11.8
Dup Ref = Dup F	Cadmium	0.5	0.4	0.4	0.4	0.0
	Chromium	1	31	31	31	0.0
Envirolab Report: 99558	Copper	1	68	62	65	9.2
	Lead	1	170	140	155	19.4
	Mercury	0.1	0.1	0.1	0.1	0.0
	Nickel	1	44	42	43	4.7
	Zinc	1	230	200	215	14.0
	Naphthalene	0.1	LPQL	LPQL	NC	NC
	Acenaphthylene	0.1	LPQL	LPQL	NC	NC
	Acenaphthene	0.1	LPQL	LPQL	NC	NC
	Fluorene	0.1	LPQL	LPQL	NC	NC
	Phenanthrene	0.1	1.3	0.7	1	60.0
	Anthracene	0.1	0.3	0.2	0.25	40.0
	Fluoranthene	0.1	2.4	2.5	2.45	4.1
	Pyrene	0.1	2.3	2.5	2.4	8.3
	Benzo(a)anthracene	0.1	0.9	0.9	0.9	0.0
	Chrysene	0.1	0.9	0.8	0.85	11.8
	Benzo(b)&(k)fluorant	0.2	1.8	1.8	1.8	0.0
	Benzo(a)pyrene	0.05	1.2	1.2	1.2	0.0
	Indeno(123-cd)pyrene	0.1	1	0.7	0.85	35.3
	Dibenzo(ah)anthracene	0.1	0.1	LPQL	0.1	NC
	Benzo(ghi)perylene	0.1	1	0.7	0.85	35.3
	TRH >C6-C9 (F1)	25	LPQL	LPQL	NC	NC
	TRH >C10 - C16 (F2)	50	LPQL	LPQL	NC	NC
	TRH >C16-C34	100	240	230	235	4.3
	TRH >C34-C40	100	180	180	180	0.0
	Benzene	0.5	LPQL	LPQL	NC	NC
	Toluene	0.5	LPQL	LPQL	NC	NC
	Ethylbenzene	1	LPQL	LPQL	NC	NC
	m+p-xylene	2	LPQL	LPQL	NC	NC
	o-xylene	1	LPQL	LPQL	NC	NC

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value <= 50% are acceptable
Results between 5 & 10 times PQL = RPD value <= 75% are acceptable
Results < 5 times PQL = RPD value <= 100% are acceptable

RPD Results Above the Acceptance Criteria 🟨 VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit	OCP: Organochlorine Pesticides
LPQL: Less than PQL	OPP: Organophosphorus Pesticides
na: Not Analysed	PCBs: Polychlorinated Biphenyls
nc: Not Calculated	TPH: Total Petroleum Hydrocarbons

TABLE J-5
SOIL INTRA-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS
All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	INITIAL	REPEAT	MEAN	RPD %
Primary Sample: JK6 (0.05-0.2)	Arsenic	4	LPQL	LPQL	NC	NC
Dup Ref = Dup I	Cadmium	0.5	LPQL	LPQL	NC	NC
	Chromium	1	28	62	45	75.6
Envirolab Report: 99558	Copper	1	57	76	66.5	28.6
	Lead	1	23	26	24.5	12.2
	Mercury	0.1	LPQL	LPQL	NC	NC
	Nickel	1	28	34	31	19.4
	Zinc	1	42	47	44.5	11.2
	Naphthalene	0.1	LPQL	LPQL	NC	NC
	Acenaphthylene	0.1	LPQL	LPQL	NC	NC
	Acenaphthene	0.1	LPQL	LPQL	NC	NC
	Fluorene	0.1	LPQL	LPQL	NC	NC
	Phenanthrene	0.1	0.4	0.5	0.45	22.2
	Anthracene	0.1	0.2	0.2	0.2	0.0
	Fluoranthene	0.1	3.5	3.4	3.45	2.9
	Pyrene	0.1	3.6	3.5	3.55	2.8
	Benzo(a)anthracene	0.1	1.7	1.7	1.7	0.0
	Chrysene	0.1	1.6	1.6	1.6	0.0
	Benzo(b)&(k)fluorant	0.2	4.1	3.7	3.9	10.3
	Benzo(a)pyrene	0.05	2.4	2.1	2.25	13.3
	Indeno(123-cd)pyrene	0.1	1.6	1.5	1.55	6.5
	Dibenzo(ah)anthracene	0.1	0.3	0.2	0.25	40.0
	Benzo(ghi)perylene	0.1	1.7	1.5	1.6	12.5
	TRH >C6-C9 (F1)	25	LPQL	LPQL	NC	NC
	TRH >C10 - C16 (F2)	50	LPQL	LPQL	NC	NC
	TRH >C16-C34	100	490	490	490	0.0
	TRH >C34-C40	100	750	900	825	18.2
	Benzene	0.5	LPQL	LPQL	NC	NC
	Toluene	0.5	LPQL	LPQL	NC	NC
	Ethylbenzene	1	LPQL	LPQL	NC	NC
	m+p-xylene	2	LPQL	LPQL	NC	NC
	o-xylene	1	LPQL	LPQL	NC	NC

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value <= 50% are acceptable
Results between 5 & 10 times PQL = RPD value <= 75% are acceptable
Results < 5 times PQL = RPD value <= 100% are acceptable

RPD Results Above the Acceptance Criteria	VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit	OCP: Organochlorine Pesticides
LPQL: Less than PQL	OPP: Organophosphorus Pesticides
na: Not Analysed	PCBs: Polychlorinated Biphenyls
nc: Not Calculated	TPH: Total Petroleum Hydrocarbons

TABLE K-1
SOIL INTER-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS
All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	Envirolab (VIC) PQL	INITIAL	REPEAT	MEAN	RPD %
Primary Sample: JK8 (0.0-0.2)	Arsenic	4	4	LPQL	LPQL	NC	NC
Dup Ref = Dup D	Cadmium	0.4	0.4	LPQL	LPQL	NC	NC
	Chromium	1	1	9	15	12	50.0
Envirolab Report: 99467 (Primary)	Copper	1	1	34	42	38	21.1
Environlab VIC QA Report: 2762	Lead	1	1	25	39	32	43.8
	Mercury	0.1	0.1	LPQL	LPQL	NC	NC
	Nickel	1	1	7	13	10	60.0
	Zinc	1	1	79	100	89.5	23.5
	Naphthalene	0.1	0.1	LPQL	LPQL	NC	NC
	Acenaphthylene	0.1	0.1	LPQL	LPQL	NC	NC
	Acenaphthene	0.1	0.1	LPQL	LPQL	NC	NC
	Fluorene	0.1	0.1	LPQL	LPQL	NC	NC
	Phenanthrene	0.1	0.1	0.2	0.2	0.2	0.0
	Anthracene	0.1	0.1	LPQL	LPQL	NC	NC
	Fluoranthene	0.1	0.1	0.6	0.7	0.65	15.4
	Pyrene	0.1	0.1	0.6	0.6	0.6	0.0
	Benzo(a)anthracene	0.1	0.1	0.3	0.3	0.3	0.0
	Chrysene	0.1	0.1	0.3	0.2	0.25	40.0
	Benzo(b)&(k)fluorant	0.2	0.2	0.6	0.6	0.6	0.0
	Benzo(a)pyrene	0.05	0.05	0.39	0.4	0.395	2.5
	Indeno(123-cd)pyrene	0.1	0.1	0.2	0.2	0.2	0.0
	Dibenzo(ah)anthracene	0.1	0.1	LPQL	LPQL	NC	NC
	Benzo(ghi)perylene	0.1	0.1	0.2	0.2	0.2	0.0
	TRH >C6-C9 (F1)	25	25	LPQL	LPQL	NC	NC
	TRH >C10 - C16 (F2)	50	50	LPQL	LPQL	NC	NC
	TRH >C16-C34	100	100	240	230	235	4.3
	TRH >C34-C40	100	100	150	180	165	18.2
	Benzene	0.2	0.2	LPQL	LPQL	NC	NC
	Toluene	0.5	0.5	LPQL	LPQL	NC	NC
	Ethylbenzene	1	1	LPQL	LPQL	NC	NC
	m+p-xylene	2	2	LPQL	LPQL	NC	NC
	o-xylene	1	1	LPQL	LPQL	NC	NC

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value <= 50% are acceptable
Results between 5 & 10 times PQL = RPD value <= 75% are acceptable
Results < 5 times PQL = RPD value <= 100% are acceptable

RPD Results Above the Acceptance Criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit
LPQL: Less than PQL
na: Not Analysed
nc: Not Calculated

OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PCBs: Polychlorinated Biphenyls
TPH: Total Petroleum Hydrocarbons

TABLE K-2
SOIL INTER-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS
All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	Envirolab (VIC) PQL	INITIAL	REPEAT	MEAN	RPD %
Primary Sample: JK2 (0.8-1)	Arsenic	4	4	5	4	4.5	22.2
Dup Ref = Dup E	Cadmium	0.4	0.4	LPQL	LPQL	NC	NC
	Chromium	1	1	23	21	22	9.1
Envirolab Report: 99467 (Primary)	Copper	1	1	10	10	10	0.0
Environlab VIC QA Report: 2762	Lead	1	1	30	29	29.5	3.4
	Mercury	0.1	0.1	LPQL	LPQL	NC	NC
	Nickel	1	1	5	4	4.5	22.2
	Zinc	1	1	11	12	11.5	8.7
	Naphthalene	0.1	0.1	LPQL	LPQL	NC	NC
	Acenaphthylene	0.1	0.1	LPQL	LPQL	NC	NC
	Acenaphthene	0.1	0.1	LPQL	LPQL	NC	NC
	Fluorene	0.1	0.1	LPQL	LPQL	NC	NC
	Phenanthrene	0.1	0.1	LPQL	LPQL	NC	NC
	Anthracene	0.1	0.1	LPQL	LPQL	NC	NC
	Fluoranthene	0.1	0.1	LPQL	LPQL	NC	NC
	Pyrene	0.1	0.1	LPQL	LPQL	NC	NC
	Benzo(a)anthracene	0.1	0.1	LPQL	LPQL	NC	NC
	Chrysene	0.1	0.1	LPQL	LPQL	NC	NC
	Benzo(b)&(k)fluorant	0.2	0.2	LPQL	LPQL	NC	NC
	Benzo(a)pyrene	0.05	0.05	LPQL	LPQL	NC	NC
	Indeno(123-cd)pyrene	0.1	0.1	LPQL	LPQL	NC	NC
	Dibenzo(ah)anthracene	0.1	0.1	LPQL	LPQL	NC	NC
	Benzo(ghi)perylene	0.1	0.1	LPQL	LPQL	NC	NC
	TRH >C6-C9 (F1)	25	25	LPQL	LPQL	NC	NC
	TRH >C10 - C16 (F2)	50	50	LPQL	LPQL	NC	NC
	TRH >C16-C34	100	100	LPQL	LPQL	NC	NC
	TRH >C34-C40	100	100	LPQL	LPQL	NC	NC
	Benzene	0.2	0.2	LPQL	LPQL	NC	NC
	Toluene	0.5	0.5	LPQL	LPQL	NC	NC
	Ethylbenzene	1	1	LPQL	LPQL	NC	NC
	m+p-xylene	2	2	LPQL	LPQL	NC	NC
	o-xylene	1	1	LPQL	LPQL	NC	NC

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value <= 50% are acceptable
Results between 5 & 10 times PQL = RPD value <= 75% are acceptable
Results < 5 times PQL = RPD value <= 100% are acceptable

RPD Results Above the Acceptance Criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit
LPQL: Less than PQL
na: Not Analysed
nc: Not Calculated

OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PCBs: Polychlorinated Biphenyls
TPH: Total Petroleum Hydrocarbons

TABLE K-3
SOIL INTER-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS

All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	Envirolab (VIC) PQL	INITIAL	REPEAT	MEAN	RPD %
Primary Sample: JK15 (2.8-3)	Arsenic	4	4	8	6	7	28.6
Dup Ref = Dup H	Cadmium	0.4	0.4	LPQL	LPQL	NC	NC
	Chromium	1	1	18	17	17.5	5.7
Envirolab Report: 99558 (Primary)	Copper	1	1	83	71	77	15.6
Environlab VIC QA Report: 2762	Lead	1	1	110	100	105	9.5
	Mercury	0.1	0.1	0.1	0.1	0.1	0.0
	Nickel	1	1	13	12	12.5	8.0
	Zinc	1	1	170	140	155	19.4
	Naphthalene	0.1	0.1	0.2	LPQL	0.2	NC
	Acenaphthylene	0.1	0.1	0.2	0.3	0.25	40.0
	Acenaphthene	0.1	0.1	LPQL	LPQL	NC	NC
	Fluorene	0.1	0.1	0.2	LPQL	0.2	NC
	Phenanthrene	0.1	0.1	1.6	2.1	1.85	27.0
	Anthracene	0.1	0.1	0.4	0.4	0.4	0.0
	Fluoranthene	0.1	0.1	2	2	2	0.0
	Pyrene	0.1	0.1	2.1	2.1	2.1	0.0
	Benzo(a)anthracene	0.1	0.1	1.1	1	1.05	9.5
	Chrysene	0.1	0.1	0.9	1	0.95	10.5
	Benzo(b)&(k)fluorant	0.2	0.2	1.6	1.8	1.7	11.8
	Benzo(a)pyrene	0.05	0.05	1.1	1.1	1.1	0.0
	Indeno(123-cd)pyrene	0.1	0.1	0.6	0.6	0.6	0.0
	Dibenzo(ah)anthracene	0.1	0.1	0.1	0.1	0.1	0.0
	Benzo(ghi)perylene	0.1	0.1	0.5	0.7	0.6	33.3
	TRH >C6-C9 (F1)	25	25	LPQL	LPQL	NC	NC
	TRH >C10 - C16 (F2)	50	50	LPQL	LPQL	NC	NC
	TRH >C16-C34	100	100	260	270	265	3.8
	TRH >C34-C40	100	100	170	120	145	34.5
	Benzene	0.2	0.2	LPQL	LPQL	NC	NC
	Toluene	0.5	0.5	LPQL	LPQL	NC	NC
	Ethylbenzene	1	1	LPQL	LPQL	NC	NC
	m+p-xylene	2	2	LPQL	LPQL	NC	NC
	o-xylene	1	1	LPQL	LPQL	NC	NC

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value <= 50% are acceptable
Results between 5 & 10 times PQL = RPD value <= 75% are acceptable
Results < 5 times PQL = RPD value <= 100% are acceptable

RPD Results Above the Acceptance Criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit
LPQL: Less than PQL
na: Not Analysed
nc: Not Calculated

OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PCBs: Polychlorinated Biphenyls
TPH: Total Petroleum Hydrocarbons

TABLE L
GROUNDWATER INTRA-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS
All results in μg/L unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	INITIAL	REPEAT	MEAN	RPD %
Primary Sample = MW9	Arsenic	1	33	32	32.5	3.1
Dup Ref = Dup GF2	Cadmium	0.1	LPQL	LPQL	NC	NC
	Chromium	1	2	1	1.5	66.7
Envirolab Report: 100418	Copper	1	12	12	12	0.0
	Lead	1	4	4	4	0.0
	Mercury	0.5	LPQL	LPQL	NC	NC
	Nickel	1	120	120	120	0.0
	Zinc	1	200	210	205	4.9
	Naphthalene	0.1	LPQL	LPQL	NC	NC
	Acenaphthylene	0.1	LPQL	LPQL	NC	NC
	Acenaphthene	0.1	LPQL	LPQL	NC	NC
	Fluorene	0.1	LPQL	LPQL	NC	NC
	Phenanthrene	0.1	LPQL	LPQL	NC	NC
	Anthracene	0.1	LPQL	LPQL	NC	NC
	Fluoranthene	0.1	LPQL	LPQL	NC	NC
	Pyrene	0.1	LPQL	LPQL	NC	NC
	Benzo(a)anthracene	0.1	LPQL	LPQL	NC	NC
	Chrysene	0.1	LPQL	LPQL	NC	NC
	Benzo(b)&(k)fluorant	0.2	LPQL	LPQL	NC	NC
	Benzo(a)pyrene	0.1	LPQL	LPQL	NC	NC
	Indeno(123-cd)pyrene	0.1	LPQL	LPQL	NC	NC
	Dibenzo(ah)anthracene	0.1	LPQL	LPQL	NC	NC
	Benzo(ghi)perylene	0.1	LPQL	LPQL	NC	NC
	TRH >C6-C9 (F1)	10	LPQL	LPQL	NC	NC
	TRH >C10 - C16 (F2)	50	LPQL	LPQL	NC	NC
	TRH >C16-C34	100	LPQL	LPQL	NC	NC
	TRH >C34-C40	100	LPQL	LPQL	NC	NC
	Benzene	1	LPQL	LPQL	NC	NC
	Toluene	1	LPQL	LPQL	NC	NC
	Ethylbenzene	1	LPQL	LPQL	NC	NC
	m+p-xylene	2	LPQL	LPQL	NC	NC
	o-xylene	1	LPQL	LPQL	NC	NC

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value <= 50% are acceptable
Results between 5 & 10 times PQL = RPD value <= 75% are acceptable
Results < 5 times PQL = RPD value <= 100% are acceptable

RPD Results Above the Acceptance Criteria — VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit	OCP: Organochlorine Pesticides
LPQL: Less than PQL	OPP: Organophosphorus Pesticides
na: Not Analysed	PCBs: Polychlorinated Biphenyls
nc: Not Calculated	TPH: Total Petroleum Hydrocarbons

TABLE M
GROUNDWATER INTER-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS

All results in μg/L unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	Envirolab (VIC) PQL	INITIAL	REPEAT	MEAN	RPD %
Primary Sample: MW7	Arsenic	1	1	2	2	2	0.0
Dup Ref = DupGF1	Cadmium	0.1	0.1	LPQL	LPQL	NC	NC
	Chromium	1	1	LPQL	1	1	NC
Envirolab Report: 100418 (Primary)	Copper	1	1	LPQL	LPQL	NC	NC
Environlab VIC QA Report: 2831	Lead	1	1	LPQL	LPQL	NC	NC
	Mercury	0.05	0.05	LPQL	LPQL	NC	NC
	Nickel	1	1	5	5	5	0.0
	Zinc	1	1	3	7	5	80.0
	Naphthalene	0.1	0.1	LPQL	LPQL	NC	NC
	Acenaphthylene	0.1	0.1	LPQL	LPQL	NC	NC
	Acenaphthene	0.1	0.1	LPQL	LPQL	NC	NC
	Fluorene	0.1	0.1	LPQL	LPQL	NC	NC
	Phenanthrene	0.1	0.1	LPQL	LPQL	NC	NC
	Anthracene	0.1	0.1	LPQL	LPQL	NC	NC
	Fluoranthene	0.1	0.1	LPQL	LPQL	NC	NC
	Pyrene	0.1	0.1	LPQL	LPQL	NC	NC
	Benzo(a)anthracene	0.1	0.1	LPQL	LPQL	NC	NC
	Chrysene	0.1	0.1	LPQL	LPQL	NC	NC
	Benzo(b)&(k)fluorant	0.2	0.2	LPQL	LPQL	NC	NC
	Benzo(a)pyrene	0.1	0.1	LPQL	LPQL	NC	NC
	Indeno(123-cd)pyrene	0.1	0.1	LPQL	LPQL	NC	NC
	Dibenzo(ah)anthracene	0.1	0.1	LPQL	LPQL	NC	NC
	Benzo(ghi)perylene	0.1	0.1	LPQL	LPQL	NC	NC
	TRH >C6-C9 (F1)	10	10	LPQL	LPQL	NC	NC
	TRH >C10 - C16 (F2)	50	50	LPQL	LPQL	NC	NC
	TRH >C16-C34	100	100	LPQL	740	740	NC
	TRH >C34-C40	100	100	LPQL	LPQL	NC	NC
	Benzene	1	1	LPQL	LPQL	NC	NC
	Toluene	1	1	LPQL	LPQL	NC	NC
	Ethylbenzene	1	1	LPQL	LPQL	NC	NC
	m+p-xylene	2	2	LPQL	LPQL	NC	NC
	o-xylene	1	1	LPQL	LPQL	NC	NC

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value <= 50% are acceptable
Results between 5 & 10 times PQL = RPD value <= 75% are acceptable
Results < 5 times PQL = RPD value <= 100% are acceptable

RPD Results Above the Acceptance Criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit	OCP: Organochlorine Pesticides
LPQL: Less than PQL	OPP: Organophosphorus Pesticides
na: Not Analysed	PCBs: Polychlorinated Biphenyls
nc: Not Calculated	TPH: Total Petroleum Hydrocarbons

TABLE N
SUMMARY OF QA/QC - TRIP SPIKE AND TRIP BLANK RESULTS

ANALYSIS	**Envirolab PQL**		TB1^{S}	TB2^{S}	TB1^{S}	TB2^{S}	TS1^{S}	TS^{W}
			18/10/2013	21/10/2013	22/10/2013	23/10/2013	22/10/2013	6/11/2013
	mg/kg	**µg/L**	99467	99467	99558	99558	99467	100418
			mg/kg	mg/kg	mg/kg	mg/kg	% Recovery	% Recovery
Benzene	1	1	LPQL	LPQL	LPQL	LPQL	67%	105%
Toluene	1	1	LPQL	LPQL	LPQL	LPQL	87%	102%
Ethylbenzene	1	1	LPQL	LPQL	LPQL	LPQL	104%	104%
m+p-xylene	2	2	LPQL	LPQL	LPQL	LPQL	104%	108%
o-xylene	1	1	LPQL	LPQL	LPQL	LPQL	104%	108%

EXPLANATION:

^{W} Sample type (water)
^{S} Sample type (sand)
BTEX concentrations in trip spikes are presented as % recovery

Values above PQLs/Acceptance criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit	TB: Trip Blank
LPQL: Less than PQL	TS: Trip Spike
(-) : Not Applicable / Not Analysed	RS: Rinsate Sample
OPP: Organophosphorus Pesticides	na: Not Analysed
OCP: Organochlorine Pesticides	nc: Not Calculated
PCBs: Polychlorinated Biphenyls	TPH: Total Petroleum Hydrocarbons

Appendix E: Statistical Calculation Sheets

General UCL Statistics for Full Data Sets

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

TRH F2

General Statistics

Number of Valid Observations	47	Number of Distinct Observations	4
Raw Statistics		Log-transformed Statistics	
Minimum	25	Minimum of Log Data	3.219
Maximum	240	Maximum of Log Data	5.481
Mean	33.68	Mean of log Data	3.326
Median	25	SD of log Data	0.448
SD	39.2		
Std. Error of Mean	5.718		
Coefficient of Variation	1.164		
Skewness	4.741		

Warning: There are only 4 Distinct Values in this data
There are insufficient Distinct Values to perform some GOF tests and bootstrap methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values to compute bootstrap methods.
However, results obtained using 4 to 9 distinct values may not be reliable.
It is recommended to have 10-15 or more observations for accurate and meaningful bootstrap results.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.245	Shapiro Wilk Test Statistic	0.265
Shapiro Wilk Critical Value	0.946	Shapiro Wilk Critical Value	0.946
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	43.28	95% H-UCL	34.78
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	39.81
95% Adjusted-CLT UCL (Chen-1995)	47.31	97.5% Chebyshev (MVUE) UCL	43.75
95% Modified-t UCL (Johnson-1978)	43.94	99% Chebyshev (MVUE) UCL	51.5
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	2.613	Data do not follow a Discernable Distribution (0.05)	
Theta Star	12.89		
MLE of Mean	33.68		
MLE of Standard Deviation	20.84		
nu star	245.6		
Approximate Chi Square Value (.05)	210.3	Nonparametric Statistics	
Adjusted Level of Significance	0.0449	95% CLT UCL	43.09
Adjusted Chi Square Value	209.3	95% Jackknife UCL	43.28
		95% Standard Bootstrap UCL	42.44
Anderson-Darling Test Statistic	16.34	95% Bootstrap-t UCL	85.07
Anderson-Darling 5% Critical Value	0.757	95% Hall's Bootstrap UCL	84.65
Kolmogorov-Smirnov Test Statistic	0.542	95% Percentile Bootstrap UCL	43.15
Kolmogorov-Smirnov 5% Critical Value	0.13	95% BCA Bootstrap UCL	46.34
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	58.61
		97.5% Chebyshev(Mean, Sd) UCL	69.39
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	90.58
95% Approximate Gamma UCL	39.33		
95% Adjusted Gamma UCL	39.52		
Potential UCL to Use		**Use 95% Student's-t UCL**	**43.28**
		or 95% Modified-t UCL	**43.94**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

B(a)P TEQ

General Statistics

Number of Valid Observations	47	Number of Distinct Observations	5
Raw Statistics		Log-transformed Statistics	
Minimum	0.25	Minimum of Log Data	-1.386
Maximum	13	Maximum of Log Data	2.565
Mean	0.899	Mean of log Data	-0.733
Median	0.25	SD of log Data	0.929
SD	1.904		
Std. Error of Mean	0.278		
Coefficient of Variation	2.119		
Skewness	5.843		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.351	Shapiro Wilk Test Statistic	0.704
Shapiro Wilk Critical Value	0.946	Shapiro Wilk Critical Value	0.946
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	1.365	95% H-UCL	1.007
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	1.227
95% Adjusted-CLT UCL (Chen-1995)	1.609	97.5% Chebyshev (MVUE) UCL	1.443
95% Modified-t UCL (Johnson-1978)	1.405	99% Chebyshev (MVUE) UCL	1.865
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.884	Data do not follow a Discernable Distribution (0.05)	
Theta Star	1.017		
MLE of Mean	0.899		
MLE of Standard Deviation	0.956		
nu star	83.11		
Approximate Chi Square Value (.05)	63.1	Nonparametric Statistics	
Adjusted Level of Significance	0.0449	95% CLT UCL	1.356
Adjusted Chi Square Value	62.55	95% Jackknife UCL	1.365
		95% Standard Bootstrap UCL	1.345
Anderson-Darling Test Statistic	6.282	95% Bootstrap-t UCL	2.299
Anderson-Darling 5% Critical Value	0.782	95% Hall's Bootstrap UCL	3.06
Kolmogorov-Smirnov Test Statistic	0.358	95% Percentile Bootstrap UCL	1.41
Kolmogorov-Smirnov 5% Critical Value	0.133	95% BCA Bootstrap UCL	1.67
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	2.11
		97.5% Chebyshev(Mean, Sd) UCL	2.634
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	3.663
95% Approximate Gamma UCL	1.184		
95% Adjusted Gamma UCL	1.194		
Potential UCL to Use		**Use 95% Chebyshev (Mean, Sd) UCL**	**2.11**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Lead

General Statistics

Number of Valid Observations	47	Number of Distinct Observations	40
Raw Statistics		Log-transformed Statistics	
Minimum	9	Minimum of Log Data	2.197
Maximum	350	Maximum of Log Data	5.858
Mean	86.13	Mean of log Data	4.076
Median	68	SD of log Data	0.926
SD	76.42		
Std. Error of Mean	11.15		
Coefficient of Variation	0.887		
Skewness	1.599		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.833	Shapiro Wilk Test Statistic	0.967
Shapiro Wilk Critical Value	0.946	Shapiro Wilk Critical Value	0.946
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	104.8	95% H-UCL	123.1
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	150
95% Adjusted-CLT UCL (Chen-1995)	107.2	97.5% Chebyshev (MVUE) UCL	176.2
95% Modified-t UCL (Johnson-1978)	105.3	99% Chebyshev (MVUE) UCL	227.7
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.383	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	62.28		
MLE of Mean	86.13		
MLE of Standard Deviation	73.24		
nu star	130		
Approximate Chi Square Value (.05)	104.7	Nonparametric Statistics	
Adjusted Level of Significance	0.0449	95% CLT UCL	104.5
Adjusted Chi Square Value	103.9	95% Jackknife UCL	104.8
		95% Standard Bootstrap UCL	104.6
Anderson-Darling Test Statistic	0.357	95% Bootstrap-t UCL	109.2
Anderson-Darling 5% Critical Value	0.768	95% Hall's Bootstrap UCL	108.4
Kolmogorov-Smirnov Test Statistic	0.0933	95% Percentile Bootstrap UCL	104.3
Kolmogorov-Smirnov 5% Critical Value	0.132	95% BCA Bootstrap UCL	107.1
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	134.7
		97.5% Chebyshev(Mean, Sd) UCL	155.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	197
95% Approximate Gamma UCL	107		
95% Adjusted Gamma UCL	107.7		
Potential UCL to Use		**Use 95% Approximate Gamma UCL**	**107**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Appendix E: HGG Monitoring Data Sheets

E26930KB
146 Newbridge Road, Moorebank

Date: 18/10/2013
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By: GF

BH	Depth	Pressure	CH4	CO2	O2	CO	H2S
JK5	0.5	1026	0.00	0.00	21.0	1	0.0
	1.5	1026	0.01	0.00	21.1	4	0.0
	3.0	1026	0.00	0.00	21.3	0	0.0
	4.5	1026	1.30	0.05	19.3	6	0.0
	6.0	1026	0.30	0.10	20.9	2	0.0
	7.5	1026	0.30	0.10	20.9	2	0.0
JK10	0.5	1026	0.00	0.00	20.9	1	0.0
	1.5	1026	0.00	0.00	20.5	0	0.0
	3.0	1026	2.80	0.30	18.9	1	0.0
	4.5	1026	3.10	0.40	18.8	0	0.0
	6.0	1026	2.70	0.30	17.6	0	0.0
	7.5	1026	3.20	0.60	18.1	0	0.0
	7.0	1026	16.60	4.40	6.1	0	0.0
	10.5	1025	7.10	2.30	17.5	1	0.0
JK12	0.5	1023	0.20	0.00	20.3	0	0.0
	1.5	1023	0.10	0.00	20.1	0	0.0
	3.0	1023	0.10	0.00	20.6	0	0.0
	4.5	1023	0.10	0.00	20.7	0	0.0
	6.0	1023	0.30	0.00	20.7	0	0.0
	7.5	1023	0.10	0.00	20.8	0	0.0
JK14	1.5	1024	0.60	0.10	30.6	1	0.0
	3.0	1024	0.70	0.50	20.0	2	0.0
	4.5	1024	22.60	9.40	3.4	0	0.0
	6.0	1024	20.80	10.10	11.5	1	0.0
	7.5	1024	19.30	9.50	7.8	0	0.0
Min	**0.5**	**1023**	**0.00**	**0.00**	**3.4**	**0**	**0.0**
Max	**10.5**	**1026**	**22.60**	**10.10**	**30.6**	**6**	**0.0**

Notes:

Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 21/10/2013
Page: 1 of 1
By: GF

BH	Depth	Pressure	CH4	CO2	O2	CO	H2S
JK8	0.5	1017	0.0	0.0	20.0	2	0
	1.5	1017	1.7	0.1	20.0	3	0
	3.0	1017	21.9	1.9	20.0	1	0
	4.5	1017	2.2	0.1	9.4	1	0
	6.0	1017	0.1	0.0	19.7	2	0
	7.5	1017	0.1	0.0	20.6	2	0
JK3	0.5	1015	0.1	0.0	20.5	2	0
	1.5	1015	0.1	0.0	20.5	1	0
	4.5	1012	0.4	11.6	6.5	1	0
	6.0	1012	0.2	11.6	6.4	1	0
JK2	0.5	1010	0.2	0.0	20.0	2	0
Min	**0.5**	**1010**	**0**	**0**	**6.4**	**1**	**0**
Max	**7.5**	**1017**	**21.9**	**11.6**	**20.6**	**3**	**0**

Notes:
Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 22/10/2013
Page: 1of1
By: GF

BH	Depth	Pressure	CH4	CO2	O2	CO	H2S
JK1	0.5	1017	0	0.2	20.6	1	0
	1.5	1017	0	0.2	20.5	1	0
	3	1017	0	0.1	20.5	0	0
JK16	0.5	1015	0.1	0	20.7	0	0
	1.5	1015	0.1	0	20.6	0	0
	3	1015	0.1	0	20.7	0	0
	4.5	1015	0.1	0	20.7	1	0
	6	1015	0.1	0	20.7	1	0
	7.5	1015	0.1	0	20.5	1	0
JK15	0.5	1012	0.1	0	20.6	0	0
	1.5	1012	0.1	0	20.6	0	0
	2	1012	0.1	0	20.5	1	0
	4.5	1012	0.1	0	20.6	0	0
	6	1012	0.1	0	20.5	0	0
	7.5	1012	0.1	0	20.6	0	0
JK13	0.5	1012	0.1	0.1	20.3	0	0
	1.5	1012	0.1	0	20.7	0	0
	3	1012	0.1	0	20.1	0	0
	4.5	1011	0.9	0.4	18.7	2	0
	6	1011	1	0.4	18.2	0	0
	7.5	1011	0.3	0.1	20.4	0	0
Min	**0.5**	**1011**	**0.00**	**0.00**	**18.20**	**0**	**0**
Max	**7.5**	**1017**	**1.00**	**0.40**	**20.70**	**2**	**0**

Notes:
Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 23/10/2013
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By: GF

BH	Depth	Pressure	CH4	CO2	O2	CO	H2S
JK11	0.5	1003	0.1	0	19.9	0	0
	1.5	1003	0.1	0	20	1	0
	3	1003	0.1	0	20.1	0	0
	4.5	1003	0.1	0	20	1	0
	6	1003	0.1	0	19.9	1	0
	7.5	1003	0.1	0	20	1	0
JK9	9	1010	0.1	0	20.5	0	0
JK7	9	1007	0.1	0	20.4	0	0
JK4	0.5	1000	0.1	0	20.6	0	0
	1.5	1000	0.1	0	20.7	0	0
	3	1000	0.2	0	20.6	0	0
	4.5	1000	0.2	0	20	0	0
	6	1000	0.2	0	20	0	0
	7.5	1000	0.2	0	20.1	0	0
JK6	7.95	1008	0.1	0	20.5	0	0
Min	**0.5**	**1000**	**0.1**	**0**	**19.9**	**0**	**0**
Max	**9**	**1010**	**0.2**	**0**	**20.7**	**1**	**0**

Notes:

Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 25/10/2013
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By: MD

BH	Depth	Pressure	CH4	CO2	O2	CO	H2S
1	NA	1024	0	1.50	20.40	2	0
9	NA	-	0.1	0.8	20.1	0	0
7	NA	1023	4.5	9.6	0.02	0	2
4	NA	1023	0.06	3.6	15	1	0
16	NA	1022	0.1	4.9	14.1	8	0
Min	**-**	**1022**	**0**	**0.8**	**0.02**	**0**	**0**
Max	**-**	**1024**	**4.5**	**9.6**	**20.4**	**8**	**2**

Notes:

Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 6/11/2013
Page: 1 of 1
By: GF

BH	Depth	Pressure	CH4	CO2	O2	CO	H2S
MW7	-	1017	1	2.4	15.5	0	0
MW9	-	1017	16.8	16.1	9.1	0	0
MW16	-	1017	0.1	14.9	14.1	1	0
MW1	-	1017	0	1.5	20.4	0	0
Min	**-**	**1017**	**0**	**1.5**	**9.1**	**0**	**0**
Max	**-**	**1017**	**16.8**	**16.1**	**20.4**	**1**	**0**

Notes:

Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 17/12/2013
Page: 1 of 1
By: JDC

BH	Depth	Fill Inclusions	Pressure	CH4	CO2	O2	CO	H2S
JK101	1.5	Wood Chips	1022	9.8	10.2	16.9	3	6
	3.0	-	1022	0.0	0.0	16.1	0	2
	4.5	-	1022	0.0	0.0	16.0	0	2
	6.0	-	1022	0.0	0.0	15.9	0	2
at 15.20	-	-	1022	0.1	0.2	14.5	11	9
on 18-12-13	-	-	1023	10.2	2.2	2.7	1.03	37
JK119	1.5	-	1022	0.0	1.0	20.1	0	0
	3.0	-	1022	0.0	0.0	19.6	0	0
	4.5	-	1022	0.0	0.0	19.5	0	0
	6.0	-	1022	0.0	0.0	20.4	0	1
	7.5	-	1022	0.0	0.0	20.2	0	1
	9.0	-	1022	0.0	1.0	20.1	0	1
at 15.30	-	-	1022	0.0	0.0	14.8	1	6
on 18-12-13	-	-	1023	1.4	1.8	12.6	61	34
Min	**-**	**-**	**1022**	**0.0**	**0.0**	**2.7**	**0.0**	**0.0**
Max	**-**	**-**	**1023**	**10.2**	**10.2**	**20.4**	**61.0**	**37.0**

Notes:
Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 18/12/2013
Page: 1 of 1
By: JDC

BH	Depth	Fill Inclusions	Pressure	CH4	CO2	O2	CO	H2S
JK116	1.5	-	1023	0.0	0.0	20.3	0	1
	3.0	-	1023	0.0	0.0	20.4	0	1
JK113	1.5	-	1023	0.0	0.0	14.5	0	3
	3.0	-	1023	0.0	0.0	14.7	1	2
	9.0	-	1023	0.1	1.2	14.5	3	6
JK106	1.5	-	1023	0.0	0.2	14.5	0	4
	3.0	-	1023	3.1	1.7	10.9	20	17
Min	**-**	**-**	**1023**	**0.0**	**0.0**	**10.9**	**0.0**	**1.0**
Max	**-**	**-**	**1023**	**3.1**	**1.7**	**20.4**	**20.0**	**17.0**

Notes:

Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 19/12/2013
Page: 1 of 1
By: JDC

BH	Depth	Fill Inclusions	Pressure	CH4	CO2	O2	CO	H2S
JK104	1.5	-	1022	0.1	0.1	20.8	0	0
	3.0	-	1022	0.4	1.0	19.7	4	3
	9.0	-	1022	0.0	0.1	20.6	1	2
JK102	1.5	-	1022	0.0	0.0	14.3	1	4
	3.0	-	1022	0.0	0.0	14.4	0	4
JK16	-	-	1022	0.0	1.5	11.3	1	4
JK113	-	-	1022	0.3	2.8	10.6	16	19
JK9	-	-	1022	15.5	14.7	5.5	1	14
JK104	-	-	1022	0.0	0.0	13.7	4	7
JK119	-	-	1022	2.3	1.7	10.4	117	40
JK101	-	-	1022	14.8	2.5	0.6	44	20
JK7	-	-	1022	2.5	8.3	1.1	1	7
JK1	-	-	1022	0.0	8.9	8.4	1	5
Min	**-**	**-**	**1022**	**0.0**	**0.0**	**0.6**	**0.0**	**0.0**
Max	**-**	**-**	**1022**	**15.5**	**14.7**	**20.8**	**117.0**	**40.0**

Notes:
Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 20/01/2014
Page: 1 of 1
By: JDC

BH	Depth	Fill Inclusions	Pressure	CH4	CO2	O2	CO	H2S
BH106	4.5	Timber	1009	1.7	0.1	16.0	29	32
	6.0	Timber	1009	11.7	8.2	1.9	0	8
	7.5	-	1009	11.7	8.1	2.7	0	4
JK103	1.5	-	1009	0.0	0.0	19.6	2	2
	4.5	-	1009	0.0	0.0	19.8	0	2
	6.0	-	1009	0.0	0.1	19.6	0	2
	7.5	-	1009	0.0	0.0	20.1	1	2
JK102	4.5	Timber	1009	24.5	5.4	1.9	2	2
	6.0	-	1009	24.8	5.1	1.2	8	4
	7.5	-	1009	25.6	5.1	1.2	0	4
Min	**-**		**1009**	**0.0**	**0.0**	**1.2**	**0.0**	**2.0**
Max	**-**		**1009**	**25.6**	**8.2**	**20.1**	**29.0**	**32.0**

Notes:

Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 22/01/2014
Page: 1 of 1
By: JDC

BH	Depth	Fill Inclusions	Pressure	CH4	CO2	O2	CO	H2S
JK115	0.5	-	1017	0.0	0.1	20.8	0	0
	1.5	-	1017	0.0	0.2	20.6	0	0
	3.0	-	1017	0.0	0.1	20.7	0	0
	4.5	-	1017	0.0	0.1	20.6	1	0
	6.0	Timber/wood	1017	0.0	0.5	20.0	1	0
	7.5	-	1017	0.0	1.6	19.5	0	0
JK107	1.5	Timber	1019	0.0	0.0	20.9	0	0
	3.0	-	1019	0.5	0.1	21.1	1	0
	4.5	-	1019	5.2	0.1	18.0	7	1
	6.0	-	1019	15.5	0.5	21.2	0	0
	7.5		1019	8.6	0.1	20.5	1	0
JK114	0.5	-	1017	0.0	0.1	20.9	0	0
	1.5	-	1019	0.0	0.7	20.2	1	0
	3.0	-	1019	0.0	0.9	19.7	1	0
	4.5	Timber	1019	1.4	2.0	17.4	3	0
	6.0	Timber	1019	20.4	10.5	9.1	1	0
	7.5	Timber	1019	19.2	0.2	15.5	1	0
Min	**-**		**1017**	**0**	**0**	**9.1**	**0**	**0**
Max	**-**		**1019**	**20.4**	**10.5**	**21.2**	**7**	**1**

Notes:

Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 24/01/2014
Page: 1 of 1
By: GF

BH	Depth	Pressure	CH4	CO2	O2	CO	H2S
MW1	-	1013	0.0	15.0	7.8	1	0
JK101	-	1013	16.4	7.4	2.7	0	0
JK106	-	1013	13.0	0.0	1.0	7	5
MW7	-	1013	12.5	0.1	0.4	0	5
JK107	-	1013	30.0	0.4	0.0	0	7
JK102	-	1013	25.4	5.7	0.0	0	3
JK119	-	1013	3.5	7.9	0.0	0	2
JK103	-	1013	0.6	0.1	19.6	0	1
JK104	-	1013	0.0	20.4	0.6	0	1
MW9	-	1013	24.2	31.2	0.8	1	1
JK115	-	1013	0.0	2.3	14.5	5	1
JK114	-	1013	24.1	10.3	0.0	0	1
MW116	-	1013	0.0	8.9	2.8	1	1
JK113	-	1013	0.0	0.9	19.0	0	0
Min	**-**	**1013**	**0**	**0**	**0**	**0**	**0**
Max	**-**	**1013**	**30**	**31.2**	**19.6**	**7**	**7**

Notes:

Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 28/01/2014
Page: 1 of 1
By: GF

BH	Depth	Fill Inclusions	Pressure	CH4	CO2	O2	CO	H2S
JK110	1.0	-	1020	0.0	0.0	20.0	0	0
	3.0	Timber	1020	15.4	6.3	0.1	0	4
	4.5	Timber	1020	14.6	6.2	1.4	2	2
	6.0	Timber	1020	14.5	6.2	1.0	2	3
	7.5	Timber	1020	15.1	6.1	0.1	2	3
JK118	0.5	-	1020	0.0	0.0	12.3	7	4
	1.5	-	1020	0.0	0.0	13.0	83	18
	3.0	Timber	1020	0.0	0.0	12.9	7	21
	4.5	Timber	1020	11.9	3.7	3.5	5	10
	6.0	Timber	1020	7.9	2.8	6.0	2	6
	7.5	Timber	1020	1.1	0.4	10.6	6	6
Min	**-**		**1020**	**0**	**0**	**0.1**	**0**	**0**
Max	**-**		**1020**	**15.4**	**6.3**	**20**	**83**	**21**

Notes:
Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

REPORT TABLES

Job No: E26930KB
Address: 146 Newbridge Road, Moorebank
Recorded by: VB/JDC

Date: 21/02/2014
Page: 1 of 1

Site Conditions: Sunny with light winds and some cloud cover

BH	Pressure	CH4	CH4	CO2	O2	CO	H2S	SWL	Flow Measurements			
		%v/v	%LEL	%v/v	%v/v	%v/v	%v/v	m	Average	Peak	Snapshot	Duration
MW1	1016	0.00	-	14.20	6.4	2	0	1.59	-	0.00	-	3
JK119	1018	6.10	-	11.90	0.7	1	0	6.50	-	4.70	-	3
JK102	1018	23.80	-	5.80	0.3	0	2	4.76	-	0.10	-	3
JK103	1018	0.60	-	0.60	18.7	0	1	3.10	-	0.00	-	3
JK104	1017	0.00	-	27.40	0.8	1	1	5.72	-	2.00	-	3
MW9	1018	21.50	-	31.30	0.3	1	2	5.82	-	0.20	-	3
JK107	1018	28.40	-	0.50	0.2	0	2	-	-	0.10	-	3
JK101	1018	14.70	-	7.40	0.0	0	2	5.59	-	0.10	-	3
MW7	1018	2.10	-	9.90	1.2	1	2	2.76	-	0.00	-	3
JK106	1019	13.00	-	1.70	0.2	0	2	4.94	-	0.20	-	3
JK113	1019	0.00	-	0.70	13.0	0	3	5.89	-	0.30	-	3
JK110	1019	15.40	-	6.40	0.3	1	2	5.24	-	0.40	-	3
JK118	1019	15.60	-	1.70	0.2	1	4	5.28	-	0.40	-	3
JK117	1019	12.10	-	1.30	0.2	1	2	6.80	-	0.20	-	3
JK114	1019	24.50	-	8.00	0.2	1	3	6.55	-	0.20	-	3
JK115	1019	0.00	-	7.70	6.7	1	2	5.70	-	0.00	-	3
MW16	1019	0.00	-	8.40	1.8	2.00	3.00	2.63	-	0.50	-	3
Min	**1016**	**0**	**-**	**0.5**	**0**	**0**	**0**	**1.59**	**-**	**0**	**-**	**3**
Max	**1019**	**28.4**	**-**	**31.3**	**18.7**	**2**	**4**	**6.8**	**-**	**4.7**	**-**	**3**

Notes:
SWL is in meters below ground level
Pressure is in mb
Gases are in %v/v
Flow in L/h

Duration is in minutes

Job No: E26930KB
Address: 146 Newbridge Road, Moorebank
Recorded by: GF/JDC

Date: 6/02/2014
Page: 1 of 1

BH	Pressure	CH4	CO2	O2	CO	H2S	Flow Measurements			
							Average	Peak	Snapshot	Duration
JK/MW1	1018	0.00	14.80	7.4	1	0	-	-	-	-
JK101	1018	15.40	7.70	1.1	0	0	-	0.3	-	1
JK119	1018	4.70	10.30	0.1	0	1	-	0.3	-	1
JK107	1017	29.30	0.30	0.0	0	1	-	0.5	-	1
JK106	1017	13.10	0.40	0.1	0	0	-	0.1	-	1
JK/MW7	1017	0.50	8.60	4.7	0	0	-	0.1	-	1
JK110	1017	14.60	6.30	0.1	0	1	-	0.1	-	1
JK118	1017	13.00	5.60	0.0	0	1	-	0.0	-	1
JK117	1017	12.30	1.10	0.2	0	1	-	0.2	-	1
JK/MW16	1017	0.00	6.70	4.4	1	1	-	-	-	
JK114	1017	23.50	9.70	0.0	0	2	-	0.1	-	1
JK115	1017	0.00	6.00	12.9	0	1	-	-	-	
JK113	1017	0.00	2.60	16.6	0	1	-	-	-	
MW9	1017	23.10	29.30	0.2	1	1	-	0.1	-	1
JK104	1017	0.00	24.30	0.2	1	1	-	-	-	
JK103	1017	1.50	0.70	18.2	2	2	-	0.1	-	1
JK102	1017	23.80	5.60	0.0	0	4	-	0.2	-	1
Min	**1017**	**0**	**0.3**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Max	**1018**	**29.3**	**29.3**	**18.2**	**2**	**4**	**0**	**0.5**	**0**	**1**

Notes:

Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v
Flow in L/h
Duration in minutes

REPORT TABLES

Job No: E26930KB
Address: 146 Newbridge Road, Moorebank
Recorded by: GF/JDC

Date: 7/03/2014
Page: 1 of 1

Site Conditions: Sunny with some cloud cover

BH	Pressure	CH4	CH4	CO2	O2	CO	H2S	SWL	Flow Measurements			
		%v/v	%LEL	%v/v	%v/v	%v/v	%v/v	m	Average	Peak	Snapshot	Duration
MW1	1018	0.10	-	13.90	1.1	2	0	1.63	-	0.40	-	3
JK119	1018	10.80	-	13.90	0.1	1	0	6.48	-	3.70	-	3
JK102	1018	29.60	-	6.10	0.1	1	3	4.73	-	0.10	-	3
JK103	1018	0.10	-	0.10	20.2	1	0	3.90	-	0.00	-	3
JK104	1018	0.00	-	31.60	0.2	1	1	5.64	-	7.30	-	3
MW9	1018	26.60	-	33.10	0.1	1	1	5.72	-	0.00	-	3
JK107	1018	35.00	-	0.20	0.1	1	1	-	-	0.10	-	3
JK101	1018	19.80	-	8.30	0.0	1	0	5.49	-	0.10	-	3
MW7	1021	5.00	-	10.90	0.5	1	2	4.50	-	0.00	-	3
JK106	1021	16.50	-	2.40	0.1	1	2	4.90	-	0.10	-	3
JK113	1021	0.00	-	0.10	19.0	0	1	5.80	-	0.10	-	3
JK110	1021	19.80	-	6.60	0.4	1	2	5.18	-	0.00	-	3
JK118	1021	15.20	-	1.10	0.3	1	18	5.22	-	0.10	-	3
JK117	1021	16.10	-	1.10	0.1	1	2	6.75	-	0.20	-	3
JK114	1021	30.60	-	7.60	0.1	1	2	6.65	-	0.10	-	3
JK115	1021	0.00	-	9.90	5.8	1	2	5.55	-	0.10	-	3
MW16	1021	0.00	-	9.40	2.1	1.00	2.00	2.73	-	-0.10	-	3
Min	**1018**	**0**	**-**	**0.1**	**0**	**0**	**0**	**1.63**	**-**	**-0.1**	**-**	**3**
Max	**1021**	**35**	**-**	**33.1**	**20.2**	**2**	**18**	**6.75**	**-**	**7.3**	**-**	**3**

Notes:
SWL is in meters below ground level
Duration is in minutes
Pressure is in mb
Gases are in %v/v
Flow in L/h

REPORT TABLES

Job No: E26930KB
Address: 146 Newbridge Road, Moorebank
Recorded by: GF/JDC

Date: 1/04/2014
Page: 1 of 1

Site Conditions: Sunny with some cloud cover

BH	Pressure	CH4	CH4	CO2	O2	CO	H2S	SWL	Flow Measurements			
		%v/v	%LEL	%v/v	%v/v	%v/v	%v/v	m	Peak (1)	Peak (2)	Peak (3)	Duration
MW1	1020	0.30	-	15.50	0.0	1	1	1.63	0.00	-	-	3
JK119	1020	13.40	-	14.20	0.1	1	1	6.36	4.50	3.60	1.65	3
JK102	1020	29.70	-	5.90	0.0	0	3	4.69	0.10	-	-	3
JK103	1020	31.00	-	2.30	2.2	1	1	4.12	0.00	-	-	3
JK104	1020	0.10	-	35.20	0.1	1	1	5.59	0.40	0.30	0.13	3
MW9	1020	26.10	-	33.90	0.0	1	1	5.68	0.10	-	-	3
JK107	1020	37.20	-	0.30	0.1	1	1	-	0.10	0.00	0.68	3
JK101	1020	23.80	-	12.00	0.0	0	1	5.39	0.10	-	-	3
MW7	1020	6.40	-	11.20	0.0	1	1	4.43	0.00	-	-	3
JK106	1020	17.40	-	3.20	0.1	1	2	4.76	0.10	-	-	3
JK113	No Access	-	-	-	-	-	-	-	-	-	-	3
JK110	1020	19.60	-	7.00	0.0	1	1	6.05	0.10	-	-	3
JK118	1020	16.80	-	0.80	0.1	1	177	5.10	0.10	-	-	3
JK117	1020	16.60	-	1.60	0.0	1	5	6.65	0.00	-	-	3
JK114	1020	4.70	-	4.10	5.0	1	2	6.70	0.10	-	-	3
JK115	No Access	-	-	-	-	-	-	-	-	-	-	3
MW16	1020	0.30	-	8.00	0.7	1	2	4.02	0.00	-	-	3
Min	**1020**	**0.10**	**-**	**0.3**	**0**	**0**	**1**	**1.63**	**-**	**0**	**-**	**3**
Max	**1020**	**37.2**	**-**	**35.2**	**5**	**1**	**177**	**6.7**	**-**	**3.6**	**-**	**3**

Notes:

SWL is in meters below ground level
Pressure is in mb
Gases are in %v/v
Flow in L/h

Duration is in minutes
Peak 1 - Measured using the GA5000
Peak 2 - Measured using the GFM unit
Peak 3 - Measured using Risiteck Solid State Flow unit

REPORT TABLES

Job No: E26930KB
Address: 146 Newbridge Road, Moorebank
Recorded by: GF/JDC

Date: 11/04/2014
Page: 1 of 1

Site Conditions: Storm Conditions, Cloud Cover and Rain

BH	Pressure	CH4	CH4	CO2	O2	CO	H2S	SWL	Flow Measurements			
		%v/v	%LEL	%v/v	%v/v	ppm	ppm	m	Peak (1)	Peak (2)	DP	Duration
MW1	1003	0.00	-	0.00	21.2	0	0	-	0.00	-	-	3
JK119	1003	13.30	-	13.90	0.0	3	0	-	-5.40	-	-55	3
JK102	1003	27.50	-	6.00	0.0	3	1	-	1.60	-	5	3
JK103	1003	65.40	-	2.10	0.0	6	9	-	1.40	-	4	3
JK104	1003	0.00	-	34.50	0.0	1	1	-	0.50	-	1	3
MW9	1003	23.40	-	32.80	0.0	1	0	-	0.30	-	1	3
JK107	1003	36.20	-	0.40	0.0	-	-	-	0.00	-	-	3
JK101	1003	18.90	-	7.90	0.0	1	1	-	0.60	-	2	3
MW7	1003	5.70	-	11.00	0.0	1	0	-	0.00	-	0	3
JK106	1003	15.50	-	3.40	0.0	3	0	-	0.70	-	1	3
JK113	1003	0.00	-	0.00	20.3	0	2	-	0.00	-	0	3
JK110	1003	21.70	-	7.20	0.0	3	0	-	1.10	-	2	3
JK118	1003	16.20	-	0.70	0.0	1	206	-	0.10	-	1	3
JK117	1003	14.60	-	0.60	0.0	0	1	-	0.80	-	3	3
JK114	1003	29.30	-	7.30	0.0	3	1	-	2.30	-	7	3
JK115	1003	0.00	-	0.00	12.7	3	0	-	0.00	-	0	3
MW16	1003	0.00	-	7.50	0.0	1	0	-	-0.90	-	-2	3
Min	**1003**	**0.00**	**-**	**0**	**0**	**0**	**0**	**0**	**-5.4**	**-**	**-55**	**3**
Max	**1003**	**65.4**	**-**	**34.5**	**21.2**	**6**	**206**	**0**	**2.3**	**-**	**7**	**3**

Notes:

SWL is in meters below ground level
Pressure is in hPa
Gases are in %v/v
Flow in L/h

Duration is in minutes
Peak 1 - Measured using the GFM430
DP - Differential Pressure

Appendix H

Reports on Validation of the Screening Process

Current Trial Remediation Excavation

Douglas Partners
Geotechnics / Environment / Groundwater

Douglas Partners Pty Ltd
ABN 75 053 980 117
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96 Hermitage Road
West Ryde NSW 2114
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West Ryde NSW 1685
Phone (02) 9809 0666
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Memorandum

To	Benedict Industries Pty Ltd (Ernest Dupere)		
cc	Ian Swane and Associates P/L (Ian Swane)		
From	John Russell	**Date**	05 Oct 2016
Subject	Validation of Screening Process	**Project No.**	71459.07

Dear Sirs

In June 2016, Douglas Partners Pty Ltd (DP) undertook soil and water sampling of the following areas within 146 Newbridge Road, Moorebank (the 'site') with reference to our Remediation Action Plan (RAP):

- Approximately 4400 m^3 of <16 mm denoted as 'screened stockpile 1' SSP1; and
- Base of the excavation (acid sulphate soil sample and dewater sample).

A copy of DP's test results are attached.

The SSP1 material had gone through the screening process as described in the RAP. The following summary has been provided by Benedict Industries Pty Ltd (Benedict) in relation to the screening process:

- *Prior to processing the material is dampened or is damp due to the nature of the material and the location it has been removed from;*
- *Whilst screening the material to remove timber and other contaminants no asbestos pieces are or have been picked/removed during the screening process;*
- *All pickers (labourers) on the conveyer wear PPE gear which includes eye, hearing, hard hats, gloves and P2 respirator masks;*
- *Since commencing screening operations on 3 March 2016 and 14 June 2016, Presna (NATA accredited environmental consultants) have been contracted to carry out airborne asbestos monitoring on site at Moorebank whilst screening operations are active;*
- *237 individual monitor samples have been tested;*
- *The airborne asbestos monitors are placed on picking platforms adjacent to pickers and inside earthmoving equipment such as excavators and wheel loaders which are working on the screening process;*
- *Of the 237 individual monitor samples, no asbestos fibres have been recorded in the samples;*
- *During the placement of the screened material, which has recently commenced, airborne asbestos monitoring has been conducted and a water cart has been used to dampen the material (if required); and*

- *Benedict will continue to monitor for the duration of the screening and placing of site materials at Moorebank.*

The following general comments are made in relation to DP's test results:

- The acid sulphate soil results indicated that one of the two samples is potential acid sulphate soil (PASS). The water sample (field filtered) collected from the ponded water at the base of excavation had relatively low concentrations of dissolved metals compared to those detected in groundwater wells in the vicinity of the excavation;
- Organic matter results on soil ranged from 18,000 mg/kg to 23,000 mg/kg suggesting on the micro to macro scale that organic matter in the screened soil is 1.8% to 2.3%;
- The foreign materials content test on soil (bulk >10L sample) ranged from 1% to 2.4% (i.e. <5% which was the nominal target set by the RAP);
- A grid-based walkover over accessible areas of the northern 'raw feed' stockpile was undertaken and four fragments of asbestos containing material (ACM) were observed. The southern 'raw feed' stockpile was inaccessible due to steep stockpile walls;
- Asbestos (ACM or fibrous asbestos (FA) and asbestos fines (AF)) was detected in five of the eight 500 ml samples and the concentration of FA and AF in one sample exceeded the NEPC (2013) residential land use criterion of 0.001% w/w; and
- PCB was recorded in all soil samples, however, at concentrations that were below the adopted remediation acceptance criteria (RAC) of 1 mg/kg.

The acid sulphate soil and water sample test results indicate that PASS may be exposed at the base of the excavation, however, it appears unlikely to be having a significantly adverse effect (i.e. mobilisation of dissolved metals) on water quality. Moreover, a significant component of the coarse material used to backfill the base of the excavation contains crushed concrete (which contains lime) that would assist to buffer any acid generation that may occur whilst the excavation remains temporarily dewatered.

The test results indicate that a component of organic matter remains in the <16 mm screened fraction following the screening process meaning that ongoing landfill gas monitoring will be required following placement of the fill back into the excavation to evaluate residual landfill gas levels. We anticipate a reasonable period of time (i.e. several months) following placement of the fill will be required for methanogenic conditions to return / re-establish.

The asbestos walkover inspection results indicate that some ACM fragments are present in the fill. The asbestos testing results on the 500 ml samples suggests that the screening process may be generating FA and AF in the screened material. Testing 500 ml soil samples for FA and AF from the 'raw feed' stockpiles would be required to confirm whether the FA and AF is already present in the fill or if it is being generated by the partial pulverisation of ACM fragments as a result of the screening process. We note that should the additional testing of screened material indicate further FA and AF, the screening operation generally, may constitute 'friable' asbestos works requiring appropriately licences contractor(s), an asbestos management plan (AMP) and associated controls.

Detectable concentrations of PCB were recorded in one soil sample during the Detailed Site Investigation (DSI) and the concentration of PCB Aroclor 1254 was 3.7 mg/kg. The fact that PCB Aroclor 1254 was detected in all samples suggests a source of PCB is present in the waste mass that has been screened. Whether the source is a spill of PCB oil affecting soil (e.g. as was detected at the one location BH220/0.1-0.2) or a small drum(s) or capacitor(s) that has been crushed resulting in leakage of PCB that was subsequently mixed through screened soil as a result of the screening process, is not known. Further testing of screened soil will provide additional data by which to assess a potential point-source (or diffuse source) of PCB.

The PCB results do suggest a relatively uniform distribution of PCB (Aroclor 1254) in the initial 4400 m^3 quantity of screened material that will be used to backfill the excavation. In this regard, the potential impacts on groundwater will warrant further consideration. Prior to the screening process, the PCB may have been confined to a small drum(s) and/or capacitor(s) which after screening may present a different risk profile with regard to potential impacts to groundwater beneath the site.

All the screened soil will be placed back in the excavation and will be below the 3 m thick engineered cap, of which the upper 1.6 m will comprise VENM, which will be placed across the site. It is understood from the client that the tested batch of screened soil will be placed above the water table thereby minimising the likelihood of migration of PCB to groundwater. The placement of the screened soil will be documented by photographic record and geotechnical earthworks records.

Limitations

Douglas Partners Pty Ltd (DP) has prepared this memorandum for this project at 146 Newbridge Road, Moorebank in accordance with DP's proposal SYD160677 dated 27 May 2016 and acceptance received from Ernest Dupere dated 27 May 2016. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Benedict Industries 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.

Yours faithfully
Douglas Partners Pty Ltd

Reviewed by

John Russell
Associate

J M Nash
Principal

Attachments: About this Report
Laboratory Certificate of Analysis

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.

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This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

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.

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.

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email: sydney@envirolab.com.au
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Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 147393

Client:

Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: Richard Lamont

Sample log in details:

Your Reference:	**71459.07, Proposed Residential Development**
No. of samples:	13 Soils, 1 Water
Date samples received / completed instructions received	26/05/16 / 26/05/16

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: / Issue Date:	2/06/15 / 2/06/16
Date of Preliminary Report:	Not Issued

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

Results Approved By:

Jacinta Hurst
Laboratory Manager

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	147393-1	147393-2	147393-3	147393-4	147393-5
Your Reference	------------ -	SP1/1	SP1/2	BD1/260516	SP1/3	SP1/4
Date Sampled	------------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
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
Surrogate aaa-Trifluorotoluene	%	103	93	98	93	80

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	147393-6	147393-7	147393-8	147393-9	147393-13
Your Reference	------------ -	SP1/5	SP1/6	SP1/7	SP1/8	TRIPSPIKE
Date Sampled	------------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	[NA]
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	[NA]
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	[NA]
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	96%
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	95%
Ethylbenzene	mg/kg	<1	<1	<1	<1	107%
m+p-xylene	mg/kg	<2	<2	<2	<2	105%
o-Xylene	mg/kg	<1	<1	<1	<1	95%
naphthalene	mg/kg	<1	<1	<1	<1	[NA]
Surrogate aaa-Trifluorotoluene	%	99	98	87	86	88

vTRH(C6-C10)/BTEXN in Soil		
Our Reference:	UNITS	147393-14
Your Reference	------------ -	TRIP BLANK
Date Sampled	------------	26/05/2016
Type of sample		Soil
Date extracted	-	27/05/2016
Date analysed	-	27/05/2016
Benzene	mg/kg	<0.2
Toluene	mg/kg	<0.5
Ethylbenzene	mg/kg	<1
m+p-xylene	mg/kg	<2
o-Xylene	mg/kg	<1
Surrogate aaa-Trifluorotoluene	%	104

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	147393-1	147393-2	147393-3	147393-4	147393-5
Your Reference	-------------	SP1/1	SP1/2	BD1/260516	SP1/3	SP1/4
Date Sampled	------------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	30/05/2016	30/05/2016	30/05/2016	30/05/2016	30/05/2016
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100	<100	<100	<100
TRHC$_{29}$ - 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
Surrogate o-Terphenyl	%	83	81	81	80	81

svTRH (C10-C40) in Soil					
Our Reference:	UNITS	147393-6	147393-7	147393-8	147393-9
Your Reference	-------------	SP1/5	SP1/6	SP1/7	SP1/8
Date Sampled	------------	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	30/05/2016	30/05/2016	30/05/2016	30/05/2016
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100	<100	<100	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	<100	<100	<100	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	<100	<100	<100	<100
Surrogate o-Terphenyl	%	80	82	80	80

PAHs in Soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- ------------	147393-1 SP1/1 26/05/2016 Soil	147393-2 SP1/2 26/05/2016 Soil	147393-3 BD1/260516 26/05/2016 Soil	147393-4 SP1/3 26/05/2016 Soil	147393-5 SP1/4 26/05/2016 Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
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	0.2	0.1	0.2	0.2	0.2
Anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.4	0.3	0.5	0.5	0.4
Pyrene	mg/kg	0.4	0.3	0.5	0.5	0.4
Benzo(a)anthracene	mg/kg	0.2	0.2	0.2	0.2	0.2
Chrysene	mg/kg	0.2	0.1	0.2	0.2	0.2
Benzo(b,j+k)fluoranthene	mg/kg	0.4	0.2	0.4	0.4	0.3
Benzo(a)pyrene	mg/kg	0.3	0.1	0.2	0.2	0.2
Indeno(1,2,3-c,d)pyrene	mg/kg	0.2	<0.1	0.1	0.1	0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	0.3	0.1	0.2	0.2	0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total Positive PAHs	mg/kg	2.7	1.4	2.6	2.5	2.2
Surrogate p-Terphenyl-d14	%	111	103	105	104	115

PAHs in Soil Our Reference:	UNITS	147393-6	147393-7	147393-8	147393-9
Your Reference	------------- -	SP1/5	SP1/6	SP1/7	SP1/8
Date Sampled	------------	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.2	0.2	0.2	0.2
Anthracene	mg/kg	<0.1	0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.5	0.5	0.3	0.5
Pyrene	mg/kg	0.6	0.6	0.3	0.6
Benzo(a)anthracene	mg/kg	0.2	0.3	0.2	0.3
Chrysene	mg/kg	0.2	0.2	0.2	0.2
Benzo(b,j+k)fluoranthene	mg/kg	0.4	0.4	0.3	0.4
Benzo(a)pyrene	mg/kg	0.2	0.2	0.1	0.2
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	0.1	<0.1	0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	0.2	0.2	0.1	0.2
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5
Total Positive PAHs	mg/kg	2.7	2.9	1.7	2.8
Surrogate p-Terphenyl-d14	%	104	110	106	110

Organochlorine Pesticides in soil Our Reference:	UNITS	147393-1	147393-2	147393-3	147393-4	147393-5
Your Reference	-------------	SP1/1	SP1/2	BD1/260516	SP1/3	SP1/4
Date Sampled	------------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	92	94	125	94	127

Organochlorine Pesticides in soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- ------------	147393-6 SP1/5 26/05/2016 Soil	147393-7 SP1/6 26/05/2016 Soil	147393-8 SP1/7 26/05/2016 Soil	147393-9 SP1/8 26/05/2016 Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	114	96	92	100

Organophosphorus Pesticides Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- --------------	147393-1 SP1/1 26/05/2016 Soil	147393-2 SP1/2 26/05/2016 Soil	147393-3 BD1/260516 26/05/2016 Soil	147393-4 SP1/3 26/05/2016 Soil	147393-5 SP1/4 26/05/2016 Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	92	94	125	94	127

Organophosphorus Pesticides Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- --------------	147393-6 SP1/5 26/05/2016 Soil	147393-7 SP1/6 26/05/2016 Soil	147393-8 SP1/7 26/05/2016 Soil	147393-9 SP1/8 26/05/2016 Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	114	96	92	100

PCBs in Soil						
Our Reference:	UNITS	147393-1	147393-2	147393-3	147393-4	147393-5
Your Reference	--------------	SP1/1	SP1/2	BD1/260516	SP1/3	SP1/4
Date Sampled	------------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	0.5	0.6	0.4	0.6	0.9
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	92	94	125	94	127

PCBs in Soil					
Our Reference:	UNITS	147393-6	147393-7	147393-8	147393-9
Your Reference	--------------	SP1/5	SP1/6	SP1/7	SP1/8
Date Sampled	------------	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	0.5	0.5	0.5	0.5
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	114	96	92	100

Acid Extractable metals in soil						
Our Reference:	UNITS	147393-1	147393-2	147393-3	147393-4	147393-5
Your Reference	-------------	SP1/1	SP1/2	BD1/260516	SP1/3	SP1/4
Date Sampled	------------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Arsenic	mg/kg	6	7	5	6	6
Cadmium	mg/kg	0.9	0.6	0.6	0.6	0.7
Chromium	mg/kg	14	22	14	18	16
Copper	mg/kg	39	47	40	37	49
Lead	mg/kg	120	100	100	95	120
Mercury	mg/kg	0.1	0.1	0.1	0.1	0.1
Nickel	mg/kg	11	11	10	14	13
Zinc	mg/kg	180	220	200	200	590

Acid Extractable metals in soil					
Our Reference:	UNITS	147393-6	147393-7	147393-8	147393-9
Your Reference	-------------	SP1/5	SP1/6	SP1/7	SP1/8
Date Sampled	------------	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Arsenic	mg/kg	6	6	4	7
Cadmium	mg/kg	0.7	0.8	0.6	0.6
Chromium	mg/kg	14	22	13	14
Copper	mg/kg	48	54	47	45
Lead	mg/kg	110	130	110	120
Mercury	mg/kg	0.2	0.2	<0.1	0.2
Nickel	mg/kg	10	12	9	11
Zinc	mg/kg	240	470	210	230

Misc Soil - Inorg						
Our Reference:	UNITS	147393-1	147393-2	147393-3	147393-4	147393-5
Your Reference	------------- -	SP1/1	SP1/2	BD1/260516	SP1/3	SP1/4
Date Sampled	------------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg					
Our Reference:	UNITS	147393-6	147393-7	147393-8	147393-9
Your Reference	------------- -	SP1/5	SP1/6	SP1/7	SP1/8
Date Sampled	------------	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5

Moisture Our Reference:	UNITS	147393-1	147393-2	147393-3	147393-4	147393-5
Your Reference	-------------	SP1/1	SP1/2	BD1/260516	SP1/3	SP1/4
Date Sampled	------------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Moisture	%	10	10	13	12	12

Moisture Our Reference:	UNITS	147393-6	147393-7	147393-8	147393-9
Your Reference	-------------	SP1/5	SP1/6	SP1/7	SP1/8
Date Sampled	------------	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Moisture	%	13	7.9	11	8.0

Misc Inorg - Soil						
Our Reference:	UNITS	147393-1	147393-2	147393-3	147393-4	147393-5
Your Reference	-------------	SP1/1	SP1/2	BD1/260516	SP1/3	SP1/4
Date Sampled	------------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	30/05/2016	30/05/2016	30/05/2016	30/05/2016	30/05/2016
Date analysed	-	31/05/2016	31/05/2016	31/05/2016	31/05/2016	31/05/2016
Organic Matter, Walkely Black	mg/kg	18,000	19,000	18,000	22,000	21,000

Misc Inorg - Soil					
Our Reference:	UNITS	147393-6	147393-7	147393-8	147393-9
Your Reference	-------------	SP1/5	SP1/6	SP1/7	SP1/8
Date Sampled	------------	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	30/05/2016	30/05/2016	30/05/2016	30/05/2016
Date analysed	-	31/05/2016	31/05/2016	31/05/2016	31/05/2016
Organic Matter, Walkely Black	mg/kg	23,000	23,000	23,000	21,000

sPOCAS			
Our Reference:	UNITS	147393-10	147393-11
Your Reference	-------------	ASS1	ASS2
Date Sampled	------------	26/05/2016	26/05/2016
Type of sample		Soil	Soil
Date prepared	-	30/05/2016	30/05/2016
Date analysed	-	30/05/2016	30/05/2016
pH$_{kcl}$	pH units	8.3	8.6
TAA pH 6.5	moles H$^+$/t	<5	<5
s-TAA pH 6.5	%w/w S	<0.01	<0.01
pH$_{Ox}$	pH units	8.2	7.6
TPA pH 6.5	moles H$^+$/t	<5	<5
s-TPA pH 6.5	%w/w S	<0.01	<0.01
TSA pH 6.5	moles H$^+$/t	<5	<5
s-TSA pH 6.5	%w/w S	<0.01	<0.01
ANC$_E$	% CaCO$_3$	3.2	0.49
a-ANC$_E$	moles H$^+$/t	630	99
s-ANC$_E$	%w/w S	1.0	0.16
S$_{KCl}$	%w/w S	<0.005	0.02
S$_P$	%w/w	0.02	0.1
S$_{POS}$	%w/w	0.01	0.07
a-S$_{POS}$	moles H$^+$/t	9	46
Ca$_{KCl}$	%w/w	0.15	0.18
Ca$_P$	%w/w	0.35	0.40
Ca$_A$	%w/w	0.19	0.22
Mg$_{KCl}$	%w/w	0.019	0.021
Mg$_P$	%w/w	0.043	0.062
Mg$_A$	%w/w	0.025	0.041
Fineness Factor	-	1.5	1.5
a-Net Acidity	moles H$^+$/t	<10	<10
Liming rate	kg CaCO$_3$/t	<0.75	<0.75
a-Net Acidity without ANCE	moles H$^+$/t	<10	46
Liming rate without ANCE	kg CaCO$_3$/t	<0.75	3.5

Asbestos ID - soils NEPM						
Our Reference:	UNITS	147393-1	147393-2	147393-4	147393-5	147393-6
Your Reference	------------ -	SP1/1	SP1/2	SP1/3	SP1/4	SP1/5
Date Sampled	------------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	31/05/2016	31/05/2016	31/05/2016	31/05/2016	31/05/2016
Sample mass tested	g	1112.91	937.35	926.62	846.92	915.14
Sample Description	-	Grey coarse-grained soil & rocks	Grey coarse-grained soil & rocks	Grey coarse-grained soil & rocks	Grey coarse-grained soil & rocks	Grey coarse-grained soil & rocks
Asbestos ID in soil (as per AS4964)	-	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	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	No asbestos detected	No asbestos detected
Total Asbestos#1	g/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Asbestos ID in soil <0.1g/kg*	-	Chrysotile Amosite Crocidolite	Not applicable	Not applicable	Not applicable	Chrysotile
ACM >7mm Estimation*	g	0.0489	0.0000	0.0000	0.0000	0.0000
FA and AF Estimation*	g	0.0000	0.0000	0.0000	0.0000	0.0595
FA and AF Estimation*#2	%(w/w)	<0.001	<0.001	<0.001	<0.001	0.0065

Asbestos ID - soils NEPM				
Our Reference:	UNITS	147393-7	147393-8	147393-9
Your Reference	------------ -	SP1/6	SP1/7	SP1/8
Date Sampled	------------	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil
Date analysed	-	31/05/2016	31/05/2016	31/05/2016
Sample mass tested	g	1009.87	971.96	1085.67
Sample Description	-	Grey coarse-grained soil & rocks	Grey coarse-grained soil & rocks	Grey coarse-grained soil & rocks
Asbestos ID in soil (as per AS4964)	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	Chrysotile asbestos detected Organic fibres detected	Chrysotile asbestos detected Amosite asbestos detected Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected
Total Asbestos#1	g/kg	<0.1	0.5605	1.2369
Asbestos ID in soil <0.1g/kg*	-	Chrysotile	Chrysotile	Chrysotile Amosite
ACM >7mm Estimation*	g	0.0000	0.5448	1.3428
FA and AF Estimation*	g	0.0016	0.0000	0.0000
FA and AF Estimation*#2	%(w/w)	<0.001	<0.001	<0.001

HM in water - dissolved		
Our Reference:	UNITS	147393-12
Your Reference	------------- -	DW1
Date Sampled	------------	26/05/2016
Type of sample		Water
Date prepared	-	27/05/2016
Date analysed	-	27/05/2016
Arsenic-Dissolved	µg/L	1
Cadmium-Dissolved	µg/L	<0.1
Chromium-Dissolved	µg/L	<1
Copper-Dissolved	µg/L	<1
Lead-Dissolved	µg/L	<1
Mercury-Dissolved	µg/L	<0.05
Nickel-Dissolved	µg/L	1
Zinc-Dissolved	µg/L	9

Miscellaneous Inorganics		
Our Reference:	UNITS	147393-12
Your Reference	------------- -	DW1
Date Sampled	------------	26/05/2016
Type of sample		Water
Date prepared	-	27/05/2016
Date analysed	-	27/05/2016
Total Alkalinity as $CaCO_3$	mg/L	670
Acidity as $CaCO_3$	mg/L	110

Method ID	Methodology Summary
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-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
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.
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. 'TEQ 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. 'TEQ 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. 'TEQ 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-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Inorg-008	Moisture content determined by heating at 105+/-5 deg C for a minimum of 12 hours.
Inorg-036	Total Organic Matter - A titrimetric method that measures the oxidisable organic content of soils. Based upon Rayment and Lyons 2011 where TOM is estimated as = TOC * 1.724.
Inorg-064	sPOCAS determined using titrimetric and ICP-AES techniques. Based on Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 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)

Method ID	Methodology Summary
	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.
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.
Metals-022 ICP-MS	Determination of various metals by ICP-MS.
Inorg-006	Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.
Inorg-005	Acidity - determined titrimetrically in accordance with APHA latest Edition, 2310-B.

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Date analysed	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
TRHC_6 - C_9	mg/kg	25	Org-016	<25	147393-1	<25 || <25	LCS-2	104%
TRHC_6 - C_{10}	mg/kg	25	Org-016	<25	147393-1	<25 || <25	LCS-2	104%
Benzene	mg/kg	0.2	Org-016	<0.2	147393-1	<0.2 || <0.2	LCS-2	95%
Toluene	mg/kg	0.5	Org-016	<0.5	147393-1	<0.5 || <0.5	LCS-2	100%
Ethylbenzene	mg/kg	1	Org-016	<1	147393-1	<1 || <1	LCS-2	105%
m+p-xylene	mg/kg	2	Org-016	<2	147393-1	<2 || <2	LCS-2	110%
o-Xylene	mg/kg	1	Org-016	<1	147393-1	<1 || <1	LCS-2	105%
naphthalene	mg/kg	1	Org-014	<1	147393-1	<1 || <1	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%		Org-016	92	147393-1	103 || 95 || RPD: 8	LCS-2	103%

QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Date analysed	-			30/05/2016	147393-1	30/05/2016 || 30/05/2016	LCS-2	30/05/2016
TRHC_{10} - C_{14}	mg/kg	50	Org-003	<50	147393-1	<50 || <50	LCS-2	107%
TRHC_{15} - C_{28}	mg/kg	100	Org-003	<100	147393-1	<100 || <100	LCS-2	85%
TRHC_{29} - C_{36}	mg/kg	100	Org-003	<100	147393-1	<100 || <100	LCS-2	123%
TRH>C_{10}-C_{16}	mg/kg	50	Org-003	<50	147393-1	<50 || <50	LCS-2	107%
TRH>C_{16}-C_{34}	mg/kg	100	Org-003	<100	147393-1	<100 || <100	LCS-2	85%
TRH>C_{34}-C_{40}	mg/kg	100	Org-003	<100	147393-1	<100 || <100	LCS-2	123%
Surrogate o-Terphenyl	%		Org-003	87	147393-1	83 || 83 || RPD: 0	LCS-2	98%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Date analysed	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Naphthalene	mg/kg	0.1	Org-012	<0.1	147393-1	<0.1 || <0.1	LCS-2	118%
Acenaphthylene	mg/kg	0.1	Org-012	<0.1	147393-1	0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	0.1	Org-012	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	0.1	Org-012	<0.1	147393-1	<0.1 || <0.1	LCS-2	124%
Phenanthrene	mg/kg	0.1	Org-012	<0.1	147393-1	0.2 || 0.1 || RPD: 67	LCS-2	126%
Anthracene	mg/kg	0.1	Org-012	<0.1	147393-1	0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	0.1	Org-012	<0.1	147393-1	0.4 || 0.3 || RPD: 29	LCS-2	127%
Pyrene	mg/kg	0.1	Org-012	<0.1	147393-1	0.4 || 0.3 || RPD: 29	LCS-2	121%
Benzo(a)anthracene	mg/kg	0.1	Org-012	<0.1	147393-1	0.2 || 0.1 || RPD: 67	[NR]	[NR]
Chrysene	mg/kg	0.1	Org-012	<0.1	147393-1	0.2 || 0.1 || RPD: 67	LCS-2	102%
Benzo(b,j +k)fluoranthene	mg/kg	0.2	Org-012	<0.2	147393-1	0.4 || 0.3 || RPD: 29	[NR]	[NR]

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Benzo(a)pyrene	mg/kg	0.05	Org-012	<0.05	147393-1	0.3 || 0.1 || RPD: 100	LCS-2	127%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	<0.1	147393-1	0.2 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	<0.1	147393-1	0.3 || 0.1 || RPD: 100	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012	113	147393-1	111 || 100 || RPD: 10	LCS-2	106%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Date analysed	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
HCB	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	LCS-2	108%
gamma-BHC	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	LCS-2	98%
Heptachlor	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	LCS-2	95%
delta-BHC	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	LCS-2	106%
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	LCS-2	100%
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	LCS-2	106%
Dieldrin	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	LCS-2	108%
Endrin	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	LCS-2	99%
pp-DDD	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	LCS-2	92%
Endosulfan II	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	LCS-2	96%
Methoxychlor	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%		Org-005	101	147393-1	92 || 96 || RPD: 4	LCS-2	116%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Date analysed	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	LCS-2	88%
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Diazinon	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Dichlorvos	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	LCS-2	85%
Dimethoate	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	LCS-2	97%
Fenitrothion	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	LCS-2	79%
Malathion	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	LCS-2	78%
Parathion	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	LCS-2	89%
Ronnel	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	LCS-2	96%
Surrogate TCMX	%		Org-008	101	147393-1	92 || 96 || RPD: 4	LCS-2	97%

QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Date analysed	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Aroclor 1016	mg/kg	0.1	Org-006	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Aroclor 1221	mg/kg	0.1	Org-006	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Aroclor 1232	mg/kg	0.1	Org-006	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Aroclor 1242	mg/kg	0.1	Org-006	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Aroclor 1248	mg/kg	0.1	Org-006	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Aroclor 1254	mg/kg	0.1	Org-006	<0.1	147393-1	0.5 || 0.4 || RPD: 22	LCS-2	116%
Aroclor 1260	mg/kg	0.1	Org-006	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		Org-006	101	147393-1	92 || 96 || RPD: 4	LCS-2	97%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Date analysed	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Arsenic	mg/kg	4	Metals-020	<4	147393-1	6 || 6 || RPD: 0	LCS-2	107%
Cadmium	mg/kg	0.4	Metals-020	<0.4	147393-1	0.9 || 1 || RPD: 11	LCS-2	104%
Chromium	mg/kg	1	Metals-020	<1	147393-1	14 || 15 || RPD: 7	LCS-2	105%
Copper	mg/kg	1	Metals-020	<1	147393-1	39 || 47 || RPD: 19	LCS-2	107%
Lead	mg/kg	1	Metals-020	<1	147393-1	120 || 160 || RPD: 29	LCS-2	104%
Mercury	mg/kg	0.1	Metals-021	<0.1	147393-1	0.1 || 0.1 || RPD: 0	LCS-2	85%
Nickel	mg/kg	1	Metals-020	<1	147393-1	11 || 11 || RPD: 0	LCS-2	100%
Zinc	mg/kg	1	Metals-020	<1	147393-1	180 || 240 || RPD: 29	LCS-2	102%

QUALITY CONTROL Misc Soil - Inorg	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-1	27/05/2016
Date analysed	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-1	27/05/2016
Total Phenolics (as Phenol)	mg/kg	5	Inorg-031	<5	147393-1	<5 || <5	LCS-1	102%

QUALITY CONTROL Misc Inorg - Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			30/05/2016	147393-1	30/05/2016 || 30/05/2016	LCS-1	30/05/2016
Date analysed	-			31/05/2016	147393-1	31/05/2016 || 31/05/2016	LCS-1	31/05/2016
Organic Matter, Walkely Black	mg/kg	1000	Inorg-036	<1000	147393-1	18000 || 19000 || RPD: 5	LCS-1	98%

QUALITY CONTROL sPOCAS	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			30/05/2016	[NT]	[NT]	LCS-1	30/05/2016
Date analysed	-			30/05/2016	[NT]	[NT]	LCS-1	30/05/2016
pH $_{kcl}$	pH units		Inorg-064	[NT]	[NT]	[NT]	LCS-1	98%
TAA pH 6.5	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	LCS-1	71%
s-TAA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NR]	[NR]
pH $_{Ox}$	pH units		Inorg-064	[NT]	[NT]	[NT]	LCS-1	102%
TPA pH 6.5	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	LCS-1	74%
s-TPA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NR]	[NR]
TSA pH 6.5	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NR]	[NR]

QUALITY CONTROL sPOCAS	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
s-TSA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NR]	[NR]
ANC_E	% $CaCO_3$	0.05	Inorg-064	<0.05	[NT]	[NT]	[NR]	[NR]
a-ANC_E	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NR]	[NR]
s-ANC_E	%w/w S	0.05	Inorg-064	<0.05	[NT]	[NT]	[NR]	[NR]
S_{KCl}	%w/w S	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
S_P	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
S_{POS}	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
a-S_{POS}	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NR]	[NR]
Ca_{KCl}	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
Ca_P	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
Ca_A	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
Mg_{KCl}	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
Mg_P	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
Mg_A	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
S_{HCl}	%w/w S	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
S_{NAS}	%w/w S	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
a-S_{NAS}	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NR]	[NR]
s-S_{NAS}	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NR]	[NR]
Fineness Factor	-	1.5	Inorg-064	<1.5	[NT]	[NT]	[NR]	[NR]
a-Net Acidity	moles H^+/t	10	Inorg-064	<10	[NT]	[NT]	[NR]	[NR]
Liming rate	kg $CaCO_3$ /t	0.75	Inorg-064	<0.75	[NT]	[NT]	[NR]	[NR]
a-Net Acidity without ANCE	moles H^+/t	10	Inorg-064	<10	[NT]	[NT]	[NR]	[NR]
Liming rate without ANCE	kg $CaCO_3$ /t	0.75	Inorg-064	<0.75	[NT]	[NT]	[NR]	[NR]

QUALITY CONTROL HM in water - dissolved	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			27/05/2016	[NT]	[NT]	LCS-W1	27/05/2016
Date analysed	-			27/05/2016	[NT]	[NT]	LCS-W1	27/05/2016
Arsenic-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W1	99%
Cadmium-Dissolved	µg/L	0.1	Metals-022 ICP-MS	<0.1	[NT]	[NT]	LCS-W1	99%

QUALITY CONTROL HM in water - dissolved	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Chromium-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W1	93%
Copper-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W1	100%
Lead-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W1	103%
Mercury-Dissolved	µg/L	0.05	Metals-021	<0.05	[NT]	[NT]	[NR]	[NR]
Nickel-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W1	98%
Zinc-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W1	98%

QUALITY CONTROL Miscellaneous Inorganics	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			27/05/2016	[NT]	[NT]	LCS-1	27/05/2016
Date analysed	-			27/05/2016	[NT]	[NT]	LCS-1	27/05/2016
Total Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	[NT]	[NT]	LCS-1	109%
Acidity as $CaCO_3$	mg/L	5	Inorg-005	<5	[NT]	[NT]	LCS-1	104%

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	147393-2	27/05/2016
Date analysed	-	[NT]	[NT]	147393-2	27/05/2016
TRH C_6 - C_9	mg/kg	[NT]	[NT]	147393-2	102%
TRH C_6 - C_{10}	mg/kg	[NT]	[NT]	147393-2	102%
Benzene	mg/kg	[NT]	[NT]	147393-2	92%
Toluene	mg/kg	[NT]	[NT]	147393-2	96%
Ethylbenzene	mg/kg	[NT]	[NT]	147393-2	104%
m+p-xylene	mg/kg	[NT]	[NT]	147393-2	108%
o-Xylene	mg/kg	[NT]	[NT]	147393-2	104%
naphthalene	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%	[NT]	[NT]	147393-2	99%

QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	147393-2	27/05/2016
Date analysed	-	[NT]	[NT]	147393-2	30/05/2016
TRHC$_{10}$ - C$_{14}$	mg/kg	[NT]	[NT]	147393-2	108%
TRHC$_{15}$ - C$_{28}$	mg/kg	[NT]	[NT]	147393-2	100%
TRHC$_{29}$ - C$_{36}$	mg/kg	[NT]	[NT]	147393-2	122%
TRH>C$_{10}$-C$_{16}$	mg/kg	[NT]	[NT]	147393-2	108%
TRH>C$_{16}$-C$_{34}$	mg/kg	[NT]	[NT]	147393-2	100%
TRH>C$_{34}$-C$_{40}$	mg/kg	[NT]	[NT]	147393-2	122%
Surrogate o-Terphenyl	%	[NT]	[NT]	147393-2	81%

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	147393-2	27/05/2016
Date analysed	-	[NT]	[NT]	147393-2	27/05/2016
Naphthalene	mg/kg	[NT]	[NT]	147393-2	107%
Acenaphthylene	mg/kg	[NT]	[NT]	[NR]	[NR]
Acenaphthene	mg/kg	[NT]	[NT]	[NR]	[NR]
Fluorene	mg/kg	[NT]	[NT]	147393-2	110%
Phenanthrene	mg/kg	[NT]	[NT]	147393-2	107%
Anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Fluoranthene	mg/kg	[NT]	[NT]	147393-2	113%
Pyrene	mg/kg	[NT]	[NT]	147393-2	108%
Benzo(a)anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Chrysene	mg/kg	[NT]	[NT]	147393-2	85%
Benzo(b,j+k)fluoranthene	mg/kg	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene	mg/kg	[NT]	[NT]	147393-2	98%
Indeno(1,2,3-c,d)pyrene	mg/kg	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d14	%	[NT]	[NT]	147393-2	113%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	147393-2	27/05/2016
Date analysed	-	[NT]	[NT]	147393-2	27/05/2016
HCB	mg/kg	[NT]	[NT]	[NR]	[NR]
alpha-BHC	mg/kg	[NT]	[NT]	147393-2	97%
gamma-BHC	mg/kg	[NT]	[NT]	[NR]	[NR]
beta-BHC	mg/kg	[NT]	[NT]	147393-2	85%
Heptachlor	mg/kg	[NT]	[NT]	147393-2	81%
delta-BHC	mg/kg	[NT]	[NT]	[NR]	[NR]
Aldrin	mg/kg	[NT]	[NT]	147393-2	92%
Heptachlor Epoxide	mg/kg	[NT]	[NT]	147393-2	91%
gamma-Chlordane	mg/kg	[NT]	[NT]	[NR]	[NR]
alpha-chlordane	mg/kg	[NT]	[NT]	[NR]	[NR]
Endosulfan I	mg/kg	[NT]	[NT]	[NR]	[NR]
pp-DDE	mg/kg	[NT]	[NT]	147393-2	96%
Dieldrin	mg/kg	[NT]	[NT]	147393-2	98%
Endrin	mg/kg	[NT]	[NT]	147393-2	89%
pp-DDD	mg/kg	[NT]	[NT]	147393-2	83%
Endosulfan II	mg/kg	[NT]	[NT]	[NR]	[NR]
pp-DDT	mg/kg	[NT]	[NT]	[NR]	[NR]
Endrin Aldehyde	mg/kg	[NT]	[NT]	[NR]	[NR]
Endosulfan Sulphate	mg/kg	[NT]	[NT]	147393-2	85%
Methoxychlor	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCMX	%	[NT]	[NT]	147393-2	104%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	147393-2	27/05/2016
Date analysed	-	[NT]	[NT]	147393-2	27/05/2016
Azinphos-methyl (Guthion)	mg/kg	[NT]	[NT]	[NR]	[NR]
Bromophos-ethyl	mg/kg	[NT]	[NT]	[NR]	[NR]
Chlorpyriphos	mg/kg	[NT]	[NT]	147393-2	88%
Chlorpyriphos-methyl	mg/kg	[NT]	[NT]	[NR]	[NR]
Diazinon	mg/kg	[NT]	[NT]	[NR]	[NR]
Dichlorvos	mg/kg	[NT]	[NT]	147393-2	82%
Dimethoate	mg/kg	[NT]	[NT]	[NR]	[NR]
Ethion	mg/kg	[NT]	[NT]	147393-2	94%
Fenitrothion	mg/kg	[NT]	[NT]	147393-2	80%
Malathion	mg/kg	[NT]	[NT]	147393-2	72%
Parathion	mg/kg	[NT]	[NT]	147393-2	78%
Ronnel	mg/kg	[NT]	[NT]	147393-2	96%
Surrogate TCMX	%	[NT]	[NT]	147393-2	92%

QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	147393-2	27/05/2016
Date analysed	-	[NT]	[NT]	147393-2	27/05/2016
Aroclor 1016	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1221	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1232	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1242	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1248	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1254	mg/kg	[NT]	[NT]	147393-2	124%
Aroclor 1260	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%	[NT]	[NT]	147393-2	92%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	[NT]	[NT]	147393-2	27/05/2016
Date analysed	-	[NT]	[NT]	147393-2	27/05/2016
Arsenic	mg/kg	[NT]	[NT]	147393-2	91%
Cadmium	mg/kg	[NT]	[NT]	147393-2	95%
Chromium	mg/kg	[NT]	[NT]	147393-2	86%
Copper	mg/kg	[NT]	[NT]	147393-2	90%
Lead	mg/kg	[NT]	[NT]	147393-2	##
Mercury	mg/kg	[NT]	[NT]	147393-2	96%
Nickel	mg/kg	[NT]	[NT]	147393-2	92%
Zinc	mg/kg	[NT]	[NT]	147393-2	#

Report Comments:

METALS_S: ## Percent recovery is not possible to report due to the inhomogeneous nature of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

METALS_S: # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

Asbestos ID-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.

Asbestos ID was analysed by Approved Identifier:	Matt Mansfield
Asbestos ID was authorised by Approved Signatory:	Paul Ching

INS: Insufficient sample for this test
NR: Test not required
<: Less than
PQL: Practical Quantitation Limit
RPD: Relative Percent Difference
>: Greater than
NT: Not tested
NA: Test not required
LCS: Laboratory Control Sample

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.

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.

CHAIN OF CUSTODY

Douglas Partners
Geotechnics / Environment / Groundwater

ENVIROLAB
Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Client: Douglas Partners
Contact Person: Richard Lamont
Project Mgr: JRR
Sampler: RJL
Address: 96 Hermitage Road
West Ryde NSW 2114
Phone: 9809 0666 **Mob:** 0434 561 888
Email: richard.lamont@douglaspartners.com.au
john.russell@douglasparnters.com.au

Project Number 71459.07
Project Name: Proposed Residential Development
PO No.:
lab Quote No. :
Date results required: *standard*
Or choose: standard / same day / 1 day / 2 day / 3 day
Note: Inform lab in advance if urgent turnaround is required - surcharges apply
Report format: esdat / PDF / Excel
Comments

To: Envirolab Services
Contact Person: Aileen Hie
Address: 12 Ashley Street
Chatswood NSW 2068
Phone: 02 9910 6200
Fax: 02 9910 6201
Email: ahie@envirolab.com.au
Laboratory Report No:
Lab Comments:

~~Job No:~~ 147393
Date Received: 26.5.16
Time Received: 11-30
Received by: PL
Temp: [✓ Cool]/Ambient 15.1.
Cooling: Ice/[✓ Icepack]
Security: [✓ Intact]/Broken/None

Sample information						Tests Required											Comments
Lab Sample ID	**Field Sample ID**	**Depth**	**Date sampled**	**Container Type**	**Type of sample**	heavy metals	TRH	BTEX	PAH	OCP/OPP/PCB	Phenols	asbestos AF & FA	organic matter by titration	total alkalinity & acidity	SPOCAS	**Combo**	**Provide as much information about the sample as you can**
	SP1/1	1	26-May	P;G	S	X	X	X	X	X	X	X	X			8	
	SP1/2	2	26-May	P;G	S	X	X	X	X	X	X	X	X			8	
	BD1/260516	3	26-May	P	S	X	X	X	X	X	X	X	X			8	
	SP1/3	4	26-May	P;G	S	X	X	X	X	X	X	X	X			8	
	SP1/4	5	26-May	P;G	S	X	X	X	X	X	X	X	X			8	
	SP1/5	6	26-May	P;G	S	X	X	X	X	X	X	X	X			8	
	SP1/6	7	26-May	P;G	S	X	X	X	X	X	X	X	X			8	
	SP1/7	8	26-May	P;G	S	X	X	X	X	X	X	X	X			8	
	SP1/8	9	26-May	P;G	S	X	X	X	X	X	X	X	X			8	
	ASS1	10	26-May	P	S										X		
	ASS2	11	26-May	P	W										X		
	DW1	12	26-May	P	W	X								X JYH			
	TRIP SPIKE	13	26-May	G	S			X						~~X~~			
	TRIP BLANK	14	26-May	G	S			X									

Relinquished by: Douglas Partners
Hand delivered / Courier (by whom)
Condition of Sample at dispatch Cool or Ambient (circle)
Temperature (if Applicable):
Print Name: Richard Lamont
Date & Time: 26/05/2016
Signature: RLam

Sample Receipt
Received by (Company): EVS.
Print Name: P.Rey
Date & Time: 26.5.16 11.30.
Signature:

Lab use only:
Samples Received: Cool or Ambient (circle one)
Temperature Received at: (if applicable)
Transported by: Hand delivered / courier

Page______of ______.

Douglas Partners
Geotechnics / Environment / Groundwater

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Memorandum

To	Benedict Industries Pty Ltd (Ernest Dupere)		Ref: 71459.R.002.Rev0
cc	Ian Swane and Associates P/L (Ian Swane)		
From	John Russell	**Date**	13 Oct 2016
Subject	Validation of Screening Process	**Project No.**	71459.07

Dear Sirs

On 20 September 2016, Douglas Partners Pty Ltd (DP) completed a site inspection and sampling at 146 Newbridge Road, Moorebank (the 'site') to undertake sampling with reference to our Remediation Action Plan (RAP), dated 19 May 2016. Based on the inspection and discussions with site staff, the activities occurring at the site are summarised as follows:

- The screening operation had generated a further approximately 2000 m^3 of <16 mm material denoted as 'screened stockpile 1' SSP1, representing an extension of the previously sampled SSP1. The screening operation had generated a further approximately 5000 m^3 stockpile of blended fraction material, including 16 – 40 mm, denoted as 'screened stockpile 2' SSP2.
- One 'raw feed' stockpile was present at the northern end of the excavation and what appears to be another 'raw feed' stockpile was present as the southern end of the excavation.
- According to the Benedict Industries Pty Ltd (Benedict) Group Operations Manager, material from SSP1 and/or SSP2 was being loaded and spread at the northern portion of the site to assist with drying the material prior to placement and compaction back in the excavation.
- The excavation was being backfilled and, according to the Benedict Group Operations Manager, the re-compacted fill was at approximately 1.6 m AHD.

During the site inspection:

- The excavation walls were inspected. The northern wall was observed to contain a comparatively high component of timber relative to the north-eastern wall.
- Soil samples were collected from SSP1 and SSP2.

A copy of DP's test results from samples collected from SSP1 and SSP2 are attached.

The following general comments are made in relation to DP's test results:

- Organic matter results on soil ranged from 15,000 mg/kg to 33,000 mg/kg suggesting on the micro to macro scale that organic matter in the screened soil is 1.5% to 3.3%;
- Many (>100) fragments of asbestos containing material (ACM) were observed in stockpiles SSP1 and SSP2;

- Asbestos (ACM or fibrous asbestos (FA) and asbestos fines (AF)) was detected in all 14 of the 500 ml samples analysed and concentration of FA and AF in five of the samples exceeded the NEPC (2013) residential land use criterion of 0.001% w/w;
- PCB was recorded in the majority of soil samples with several recording concentrations that were marginally above the adopted remediation acceptance criteria (RAC) of 1 mg/kg. All detectable concentrations were below 2 mg/kg; and
- TCLP testing indicated that a component of some of the detected metals is likely to leach from the screened soil over time and impact underlying groundwater. The TCLP testing also indicated that the leachability of the PAH and PCB present in the screened soil is low (i.e. <PQL).

The test results indicate that a component of organic matter remains in the screened material following the screening process meaning that ongoing landfill gas monitoring will be required following placement of the fill back into the excavation to evaluate residual landfill gas levels. We anticipate that methanogenic conditions will take a period of up to several months, to re-establish following re-placement of the fill.

Inspection of the stockpiles indicates that ACM fragments are present throughout the fill. The asbestos testing results on the 500 ml samples suggests that the screening process being undertaken on site may actually be generating FA and AF (as ACM is broken down in the screened material). Testing 500 ml soil samples for FA and AF from the ‘raw feed’ stockpiles would be required to confirm whether the FA and AF is already present in the fill, or if it is being generated by the partial pulverisation of ACM fragments as a result of the screening process.

As flagged in our previous memo dated 5 October 2016, the current results confirm that the screening operation and associated earthworks (i.e. backfilling the excavation) generally, constitutes ‘friable’ asbestos works requiring appropriately licenced contractor(s), an asbestos management plan (AMP) and associated controls. In this regard, DP recommends that **all works are immediately halted** until a suitable AMP is put in place and an appropriately licenced contractor(s) is appointed to undertake the remainder of the works that involve handling of the FA and AF impacted soils. Relevant notifications to SafeWork NSW must also be issued prior to the resumption of works.

In summary, the current results have triggered Section 16.5 of the RAP - *Contingencies for Unexpected Finds*. Section 16.5 of the RAP is also relevant where “significant quantities of bonded ACM or FA and AF are encountered”. The recent site inspection and test results reported herein are considered to meet the aforementioned threshold of “significant quantities”.

The AMP must include a process to verify timber recovered from the waste mass is free of asbestos prior to any form of re-use (e.g. recycling for mulch). Alternatively, recovered timber should be assumed to contain asbestos and be disposed of accordingly.

Further to our meeting on 30 September 2016, we understand the following from Benedict’s Director and Group Operations Manager:

- No further screening of soil is to be undertaken;
- All the residual fine sand / crushed glass from across the site will be excavated, stockpiled and processed (if required) prior to being sold;

- A 22,000 m^3 stockpile of ‘pond fill’ (i.e. soil dredged from the ponds located at the southern portion of the site) will be screened to separate fines from clay. The clay will be retained for backfill into the excavation and the fine grained sands will be sold; and
- Two additional areas with historically elevated concentrations of landfill gas will be excavated with a view to removing some of the gas-generating fill. Additional landfill gas wells will be installed at these locations by DP to increase the resolution of landfill gas data in these areas. Following the additional landfill gas monitoring, Benedict propose to excavate targetted gas generating fill (to be determined by Benedict) and take the excavated fill to their Chipping Norton facility for disposal / processing.

In relation to the items above and in the context of the current available data, DP provides the following comments:

- Two ‘raw feed’ stockpiles are still present at the northern and southern end of the excavation, respectively. DP’s understanding was that the ‘raw feed’ stockpiles were to undergo screening to a) remove a component of organic landfill gas generating material, and b) allow their backfilling and compaction under geotechnical supervision;
- Residual fine sand / crushed glass across the site also includes material that is within the trial remediation areas which is now inclusive of all areas used to spread and dry FA and AF impacted screened soil;
- The contamination status of the ‘pond fill’ stockpile is not known to DP as it has not been tested by DP and we can therefore make no comment on the suitability for the re-use and sale of this material. DP assumes that this stockpile has been generated under the conditions of the current licence of the facility. DP also understands that Benedict may have their own testing data on samples collected from this stockpile; and
- DP cannot provide commentary on whether excavation and transport of fill from this site to Benedict’s Chipping Norton facility for disposal / processing is compliant with relevant legislation and regulations including the POEO Act. It should be assumed, in the absence of a robust programme of testing proving otherwise, that the excavated material will contain asbestos.

Figures 1 and 2 below, shows the areas within the site relevant to the items discussed above.

Figure 1: **Aerial photograph showing SSP1, SSP2, 'pond fill', 'raw feed' stockpiles and the excavation (Source, NearMap flown 9 September 2016)**

Figure 2: Aerial photograph showing northern portion of the site used to dry material from SSP1 and SSP2 (Source, NearMap flown 9 September 2016)

In order to provide clarification of some of the items raised above, DP requests the following information from Benedict:

- We understand that the excavation at the central portion of the site was surveyed prior to commencement of backfilling. Please request from the surveyors the calculated volume of the void such that reconciliation between the void and screened material can be made. The area of the excavation as shown on Figure 2 in the RAP is approximately 4500 m^2 and assuming an average depth of 7 m would yield a volume of 31,500 m^3. Based on estimates to date, the total volume of screened soil that has been tested is approximately 11,500 m^3 (noting estimates of stockpiles are based on visual observation only, and not survey, and could therefore involve a high margin of error);

- A plan which clearly depicts those areas of the site that have been used for trial remediation excavation activities (e.g. stockpiling and spreading / drying of FA and AF impacted soil from SSP1 and SSP2). This plan should form the basis of the clear separation of trial remediation activities and the ongoing operational activities of the site;
- Material tracking information for all material that has been excavated and screened, specifically, components of the fill that have been segregated for off-site disposal (e.g. timber waste, metal waste, other deleterious materials such as rubber, plastics, vegetation, asbestos, bitumen, drums/containers); and
- Clarification of intention of what will be done to the 'raw feed' stockpiles identified on Figure 1. DP understands that these stockpiles are not suitable for backfilling in the excavation without undergoing screening as occurred with material which comprised stockpiles SSP1 and SSP2.

DP is of the opinion that all the residual fine sand / crushed glass from across the site that Benedict propose to excavate, stockpile and process (if required) and sell is not suitable for use for this purpose. This is because DP has not had a full time presence at the site during the trial remediation process and therefore cannot verify exactly where asbestos impacted fill from the trial remediation excavation has been stockpiled, screened or spread on areas of the site to dry. Given the potential for cross-contamination of residual fine sand / crushed glass by asbestos impacted fill, it is DP's opinion that only some of the residual fine sand / crushed glass may not have been impacted by the trial remediation activities (i.e. fine sand / crushed glass at areas where no stockpiling or vehicle movements associated with the trial remediation activities has occurred).

In working through the audit comments on the RAP, we also seek input from the geotechnical consultant on Audit Comment 47:

- *Sections 6 & 7 of the J&K (2016) report advise that excavations should be backfilled under the supervision of the geotechnical consultant (J&K). J&K should specify, in a letter to be included in the RAP, the likely frequency of these inspections and the competency of the person/s undertaking the inspection. These inspections should be undertaken by geotechnical professionals who are also experienced in identifying contamination. The RAP should require the geotechnical consultant to inspect the backfill material not only for geotechnical characteristics, but also for physical evidence of contamination that should include, but not be limited to, asbestos fragments, industrial waste (e.g. slag, ash), stained / odorous material, types and proportions of anthropogenic material present, proportion of timber and degradable material present. A detailed record of each inspection should be prepared and a copy provided to the environmental consultant for their review and inclusion in the validation report. A copy of a pro-forma inspection record should be provided in the J&K letter, so it can be included in the RAP*.

We trust that the foregoing will provide a framework for addressing the key issues that require immediate attention (i.e. implementation of an AMP and notification to SafeWork NSW) and moving forward with the trial remediation excavation(s) more generally.

Limitations

Douglas Partners Pty Ltd (DP) has prepared this memorandum for this project at 146 Newbridge Road, Moorebank in accordance with DP's proposal SYD160677 dated 27 May 2016 and acceptance received from Ernest Dupere dated 27 May 2016. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Benedict Industries 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.

Yours faithfully
Douglas Partners Pty Ltd

John Russell
Associate

Reviewed by

J M Nash
Principal

Attachments: About this Report
Laboratory Certificate of Analysis

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.

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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.

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.

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Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 154059

Client:
Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: John Russell

Sample log in details:

Your Reference:	**71459.07, Moorebank**		
No. of samples:	16 soils		
Date samples received / completed instructions received	22/09/2016	/	22/09/2016

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: / Issue Date:	29/09/16	/	28/09/16
Date of Preliminary Report:	Not Issued		

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

Results Approved By:

David Springer
General Manager

vTRH(C6-C10)/BTEXN in Soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- ------------	154059-1 SSP1/9 20/09/2016 Soil	154059-2 SSP1/10 20/09/2016 Soil	154059-3 SSP1/11 20/09/2016 Soil	154059-4 SSP1/12 20/09/2016 Soil	154059-5 SSP2/1 20/09/2016 Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	24/09/2016	24/09/2016	24/09/2016	24/09/2016	24/09/2016
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
Surrogate aaa-Trifluorotoluene	%	95	106	103	107	112

vTRH(C6-C10)/BTEXN in Soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- ------------	154059-6 SSP2/2 20/09/2016 Soil	154059-7 SSP2/3 20/09/2016 Soil	154059-8 SSP2/4 20/09/2016 Soil	154059-9 SSP2/5 20/09/2016 Soil	154059-10 SSP2/6 20/09/2016 Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	24/09/2016	24/09/2016	24/09/2016	24/09/2016	24/09/2016
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
Surrogate aaa-Trifluorotoluene	%	111	108	113	112	110

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	154059-11	154059-12	154059-13	154059-14	154059-15
Your Reference	-------------	SSP2/7	SSP2/8	SSP2/9	SSP2/10	BD1/200916
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	24/09/2016	24/09/2016	24/09/2016	24/09/2016	24/09/2016
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
Surrogate aaa-Trifluorotoluene	%	115	109	60	112	113

vTRH(C6-C10)/BTEXN in Soil		
Our Reference:	UNITS	154059-16
Your Reference	-------------	BD2/200916
Date Sampled	------------	20/09/2016
Type of sample		Soil
Date extracted	-	23/09/2016
Date analysed	-	24/09/2016
TRH C_6 - C_9	mg/kg	<25
TRH C_6 - C_{10}	mg/kg	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25
Benzene	mg/kg	<0.2
Toluene	mg/kg	<0.5
Ethylbenzene	mg/kg	<1
m+p-xylene	mg/kg	<2
o-Xylene	mg/kg	<1
naphthalene	mg/kg	<1
Surrogate aaa-Trifluorotoluene	%	108

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	154059-1	154059-2	154059-3	154059-4	154059-5
Your Reference	------------- -	SSP1/9	SSP1/10	SSP1/11	SSP1/12	SSP2/1
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	24/09/2016	24/09/2016	24/09/2016	24/09/2016	24/09/2016
TRHC $_{10}$ - C $_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC $_{15}$ - C $_{28}$	mg/kg	<100	<100	<100	<100	<100
TRHC $_{29}$ - C $_{36}$	mg/kg	<100	<100	<100	<100	110
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	110
TRH>C $_{34}$-C $_{40}$	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	81	88	84	85	86

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	154059-6	154059-7	154059-8	154059-9	154059-10
Your Reference	------------- -	SSP2/2	SSP2/3	SSP2/4	SSP2/5	SSP2/6
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	24/09/2016	24/09/2016	24/09/2016	24/09/2016	24/09/2016
TRHC $_{10}$ - C $_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC $_{15}$ - C $_{28}$	mg/kg	<100	<100	<100	<100	<100
TRHC $_{29}$ - 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	110	<100	<100	<100	<100
TRH>C $_{34}$-C $_{40}$	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	84	77	88	83	75

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	154059-11	154059-12	154059-13	154059-14	154059-15
Your Reference	------------- -	SSP2/7	SSP2/8	SSP2/9	SSP2/10	BD1/200916
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	24/09/2016	24/09/2016	24/09/2016	26/09/2016	26/09/2016
TRHC $_{10}$ - C $_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC $_{15}$ - C $_{28}$	mg/kg	<100	<100	<100	<100	<100
TRHC $_{29}$ - 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
Surrogate o-Terphenyl	%	76	83	76	80	77

svTRH (C10-C40) in Soil		
Our Reference:	UNITS	154059-16
Your Reference	------------- -	BD2/200916
Date Sampled	------------	20/09/2016
Type of sample		Soil
Date extracted	-	23/09/2016
Date analysed	-	26/09/2016
TRHC $_{10}$ - C $_{14}$	mg/kg	<50
TRHC $_{15}$ - C $_{28}$	mg/kg	<100
TRHC $_{29}$ - C $_{36}$	mg/kg	120
TRH>C $_{10}$-C $_{16}$	mg/kg	<50
TRH>C $_{10}$ - C $_{16}$ less Naphthalene (F2)	mg/kg	<50
TRH>C $_{16}$-C $_{34}$	mg/kg	160
TRH>C $_{34}$-C $_{40}$	mg/kg	<100
Surrogate o-Terphenyl	%	86

PAHs in Soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- ------------	154059-1 SSP1/9 20/09/2016 Soil	154059-2 SSP1/10 20/09/2016 Soil	154059-3 SSP1/11 20/09/2016 Soil	154059-4 SSP1/12 20/09/2016 Soil	154059-5 SSP2/1 20/09/2016 Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
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	0.2	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1
Phenanthrene	mg/kg	0.3	0.1	0.2	2.0	0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	0.6	<0.1
Fluoranthene	mg/kg	0.4	0.3	0.3	2.0	0.3
Pyrene	mg/kg	0.4	0.3	0.4	1.8	0.4
Benzo(a)anthracene	mg/kg	0.2	0.1	0.1	0.7	0.2
Chrysene	mg/kg	0.2	0.1	0.2	0.6	0.2
Benzo(b,j+k)fluoranthene	mg/kg	0.3	0.2	0.3	0.8	0.4
Benzo(a)pyrene	mg/kg	0.1	0.1	0.2	0.4	0.2
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	0.1	0.3	0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	0.1	0.1	0.2	0.2
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	0.6	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	0.6	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	0.6	<0.5
Total Positive PAHs	mg/kg	1.9	1.5	1.8	9.8	2.1
Surrogate p-Terphenyl-d14	%	89	97	94	97	92

PAHs in Soil Our Reference: Your Reference	UNITS	154059-6 SSP2/2	154059-7 SSP2/3	154059-8 SSP2/4	154059-9 SSP2/5	154059-10 SSP2/6
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample	-------------	Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
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	0.9	1.9	0.1	<0.1	0.1
Anthracene	mg/kg	0.2	0.4	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	1.9	2.6	0.3	0.2	0.3
Pyrene	mg/kg	1.8	2.6	0.3	0.2	0.3
Benzo(a)anthracene	mg/kg	0.8	0.9	0.1	<0.1	0.1
Chrysene	mg/kg	0.8	0.9	0.1	0.1	0.1
Benzo(b,j+k)fluoranthene	mg/kg	1	1	0.2	<0.2	0.3
Benzo(a)pyrene	mg/kg	0.72	0.75	0.1	0.09	0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	0.4	0.4	0.1	<0.1	0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	0.4	0.5	0.1	<0.1	0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	1	1.1	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	1	1.1	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	1	1.1	<0.5	<0.5	<0.5
Total Positive PAHs	mg/kg	9.1	12	1.6	0.61	1.7
Surrogate p-Terphenyl-d14	%	92	92	100	60	96

PAHs in Soil Our Reference: Your Reference	UNITS --------------	154059-11 SSP2/7	154059-12 SSP2/8	154059-13 SSP2/9	154059-14 SSP2/10	154059-15 BD1/200916
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
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	0.6	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1
Fluoranthene	mg/kg	0.3	0.3	0.2	0.9	0.1
Pyrene	mg/kg	0.3	0.3	0.2	0.8	0.1
Benzo(a)anthracene	mg/kg	0.1	0.1	<0.1	0.3	<0.1
Chrysene	mg/kg	0.1	0.2	<0.1	0.3	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	0.3	0.3	<0.2	0.5	<0.2
Benzo(a)pyrene	mg/kg	0.1	0.1	0.06	0.3	0.06
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	0.1	<0.1	0.2	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	0.1	0.1	<0.1	0.2	<0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total Positive PAHs	mg/kg	1.6	1.8	0.41	4.3	0.35
Surrogate p-Terphenyl-d14	%	90	92	92	92	106

PAHs in Soil		
Our Reference:	UNITS	154059-16
Your Reference	------------- -	BD2/200916
Date Sampled	------------	20/09/2016
Type of sample		Soil
Date extracted	-	23/09/2016
Date analysed	-	23/09/2016
Naphthalene	mg/kg	<0.1
Acenaphthylene	mg/kg	<0.1
Acenaphthene	mg/kg	<0.1
Fluorene	mg/kg	<0.1
Phenanthrene	mg/kg	0.1
Anthracene	mg/kg	<0.1
Fluoranthene	mg/kg	0.4
Pyrene	mg/kg	0.5
Benzo(a)anthracene	mg/kg	0.2
Chrysene	mg/kg	0.2
Benzo(b,j+k)fluoranthene	mg/kg	0.3
Benzo(a)pyrene	mg/kg	0.2
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1
Benzo(g,h,i)perylene	mg/kg	0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5
Total Positive PAHs	mg/kg	2.1
Surrogate p-Terphenyl-d14	%	94

Organochlorine Pesticides in soil						
Our Reference:	UNITS	154059-1	154059-2	154059-3	154059-4	154059-5
Your Reference	-------------	SSP1/9	SSP1/10	SSP1/11	SSP1/12	SSP2/1
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	98	98	115	98	100

Organochlorine Pesticides in soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- ------------	154059-6 SSP2/2 20/09/2016 Soil	154059-7 SSP2/3 20/09/2016 Soil	154059-8 SSP2/4 20/09/2016 Soil	154059-9 SSP2/5 20/09/2016 Soil	154059-10 SSP2/6 20/09/2016 Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	96	96	96	96	98

Organochlorine Pesticides in soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- ------------	154059-11 SSP2/7 20/09/2016 Soil	154059-12 SSP2/8 20/09/2016 Soil	154059-13 SSP2/9 20/09/2016 Soil	154059-14 SSP2/10 20/09/2016 Soil	154059-15 BD1/200916 20/09/2016 Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	96	98	126	94	98

Organochlorine Pesticides in soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- ------------- 	154059-16 BD2/200916 20/09/2016 Soil
Date extracted	-	23/09/2016
Date analysed	-	23/09/2016
HCB	mg/kg	<0.1
alpha-BHC	mg/kg	<0.1
gamma-BHC	mg/kg	<0.1
beta-BHC	mg/kg	<0.1
Heptachlor	mg/kg	<0.1
delta-BHC	mg/kg	<0.1
Aldrin	mg/kg	<0.1
Heptachlor Epoxide	mg/kg	<0.1
gamma-Chlordane	mg/kg	<0.1
alpha-chlordane	mg/kg	<0.1
Endosulfan I	mg/kg	<0.1
pp-DDE	mg/kg	<0.1
Dieldrin	mg/kg	<0.1
Endrin	mg/kg	<0.1
pp-DDD	mg/kg	<0.1
Endosulfan II	mg/kg	<0.1
pp-DDT	mg/kg	<0.1
Endrin Aldehyde	mg/kg	<0.1
Endosulfan Sulphate	mg/kg	<0.1
Methoxychlor	mg/kg	<0.1
Surrogate TCMX	%	127

Organophosphorus Pesticides Our Reference:	UNITS	154059-1	154059-2	154059-3	154059-4	154059-5
Your Reference	------------- -	SSP1/9	SSP1/10	SSP1/11	SSP1/12	SSP2/1
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	98	98	115	98	100

Organophosphorus Pesticides Our Reference:	UNITS	154059-6	154059-7	154059-8	154059-9	154059-10
Your Reference	------------- -	SSP2/2	SSP2/3	SSP2/4	SSP2/5	SSP2/6
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	96	96	96	96	98

Organophosphorus Pesticides Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- ------------	154059-11 SSP2/7 20/09/2016 Soil	154059-12 SSP2/8 20/09/2016 Soil	154059-13 SSP2/9 20/09/2016 Soil	154059-14 SSP2/10 20/09/2016 Soil	154059-15 BD1/200916 20/09/2016 Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	96	98	126	94	98

Organophosphorus Pesticides Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- ------------	154059-16 BD2/200916 20/09/2016 Soil
Date extracted	-	23/09/2016
Date analysed	-	23/09/2016
Azinphos-methyl (Guthion)	mg/kg	<0.1
Bromophos-ethyl	mg/kg	<0.1
Chlorpyriphos	mg/kg	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1
Diazinon	mg/kg	<0.1
Dichlorvos	mg/kg	<0.1
Dimethoate	mg/kg	<0.1
Ethion	mg/kg	<0.1
Fenitrothion	mg/kg	<0.1
Malathion	mg/kg	<0.1
Parathion	mg/kg	<0.1
Ronnel	mg/kg	<0.1
Surrogate TCMX	%	127

PCBs in Soil						
Our Reference:	UNITS	154059-2	154059-3	154059-9	154059-10	154059-12
Your Reference	-------------	SSP1/10	SSP1/11	SSP2/5	SSP2/6	SSP2/8
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.2
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.2
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.2
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.2
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.2
Aroclor 1254	mg/kg	0.6	0.3	0.6	0.8	<0.2
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.2
Surrogate TCLMX	%	98	115	96	98	98

PCBs in Soil				
Our Reference:	UNITS	154059-13	154059-14	154059-16
Your Reference	-------------	SSP2/9	SSP2/10	BD2/200916
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	0.4	1.2	0.7
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1
Surrogate TCLMX	%	126	94	127

Acid Extractable metals in soil						
Our Reference:	UNITS	154059-1	154059-2	154059-3	154059-4	154059-5
Your Reference	-------------	SSP1/9	SSP1/10	SSP1/11	SSP1/12	SSP2/1
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	26/09/2016	26/09/2016	26/09/2016	26/09/2016	26/09/2016
Arsenic	mg/kg	9	8	9	9	9
Cadmium	mg/kg	0.6	0.7	<0.4	0.8	0.7
Chromium	mg/kg	14	19	16	17	16
Copper	mg/kg	34	51	41	62	52
Lead	mg/kg	93	140	100	150	130
Mercury	mg/kg	<0.1	0.2	0.2	0.1	0.2
Nickel	mg/kg	7	12	13	13	11
Zinc	mg/kg	170	270	210	360	340

Acid Extractable metals in soil						
Our Reference:	UNITS	154059-6	154059-7	154059-8	154059-9	154059-10
Your Reference	-------------	SSP2/2	SSP2/3	SSP2/4	SSP2/5	SSP2/6
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	26/09/2016	26/09/2016	26/09/2016	26/09/2016	26/09/2016
Arsenic	mg/kg	11	11	8	7	5
Cadmium	mg/kg	1	1	0.7	0.7	<0.4
Chromium	mg/kg	24	28	16	15	13
Copper	mg/kg	58	120	55	95	48
Lead	mg/kg	190	590	140	120	93
Mercury	mg/kg	0.2	0.2	0.2	0.1	<0.1
Nickel	mg/kg	13	17	20	9	10
Zinc	mg/kg	350	430	290	210	180

Acid Extractable metals in soil						
Our Reference:	UNITS	154059-11	154059-12	154059-13	154059-14	154059-15
Your Reference	-------------	SSP2/7	SSP2/8	SSP2/9	SSP2/10	BD1/200916
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	26/09/2016	26/09/2016	26/09/2016	26/09/2016	26/09/2016
Arsenic	mg/kg	7	5	39	6	7
Cadmium	mg/kg	0.5	<0.4	0.7	0.6	2
Chromium	mg/kg	18	12	14	14	23
Copper	mg/kg	52	29	51	44	45
Lead	mg/kg	110	63	110	110	90
Mercury	mg/kg	0.1	<0.1	0.2	0.1	<0.1
Nickel	mg/kg	12	7	11	9	26
Zinc	mg/kg	210	190	270	220	330

Acid Extractable metals in soil			
Our Reference:	UNITS	154059-16	154059-17
Your Reference	-------------	BD2/200916	SSP1/9 - [TRIPLICATE]
Date Sampled	------------	20/09/2016	20/09/2016
Type of sample		Soil	Soil
Date prepared	-	23/09/2016	23/09/2016
Date analysed	-	26/09/2016	26/09/2016
Arsenic	mg/kg	9	14
Cadmium	mg/kg	0.8	0.8
Chromium	mg/kg	22	18
Copper	mg/kg	56	59
Lead	mg/kg	130	110
Mercury	mg/kg	0.1	<0.1
Nickel	mg/kg	11	8
Zinc	mg/kg	250	190

Misc Soil - Inorg						
Our Reference:	UNITS	154059-1	154059-2	154059-3	154059-4	154059-5
Your Reference	-------------	SSP1/9	SSP1/10	SSP1/11	SSP1/12	SSP2/1
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	27/09/2016	27/09/2016	27/09/2016	27/09/2016	27/09/2016
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg						
Our Reference:	UNITS	154059-6	154059-7	154059-8	154059-9	154059-10
Your Reference	-------------	SSP2/2	SSP2/3	SSP2/4	SSP2/5	SSP2/6
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	27/09/2016	27/09/2016	27/09/2016	27/09/2016	27/09/2016
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg						
Our Reference:	UNITS	154059-11	154059-12	154059-13	154059-14	154059-15
Your Reference	-------------	SSP2/7	SSP2/8	SSP2/9	SSP2/10	BD1/200916
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	27/09/2016	27/09/2016	27/09/2016	27/09/2016	27/09/2016
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg		
Our Reference:	UNITS	154059-16
Your Reference	-------------	BD2/200916
Date Sampled	------------	20/09/2016
Type of sample		Soil
Date prepared	-	23/09/2016
Date analysed	-	27/09/2016
Total Phenolics (as Phenol)	mg/kg	<5

Moisture						
Our Reference:	UNITS	154059-1	154059-2	154059-3	154059-4	154059-5
Your Reference	-------------	SSP1/9	SSP1/10	SSP1/11	SSP1/12	SSP2/1
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	24/09/2016	24/09/2016	24/09/2016	24/09/2016	24/09/2016
Moisture	%	18	14	15	17	5.9

Moisture						
Our Reference:	UNITS	154059-6	154059-7	154059-8	154059-9	154059-10
Your Reference	-------------	SSP2/2	SSP2/3	SSP2/4	SSP2/5	SSP2/6
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	24/09/2016	24/09/2016	24/09/2016	24/09/2016	24/09/2016
Moisture	%	9.1	18	5.3	9.1	6.5

Moisture						
Our Reference:	UNITS	154059-11	154059-12	154059-13	154059-14	154059-15
Your Reference	-------------	SSP2/7	SSP2/8	SSP2/9	SSP2/10	BD1/200916
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	24/09/2016	24/09/2016	24/09/2016	24/09/2016	24/09/2016
Moisture	%	9.0	14	16	14	14

Moisture		
Our Reference:	UNITS	154059-16
Your Reference	-------------	BD2/200916
Date Sampled	------------	20/09/2016
Type of sample		Soil
Date prepared	-	23/09/2016
Date analysed	-	24/09/2016
Moisture	%	8.1

Misc Inorg - Soil						
Our Reference:	UNITS	154059-1	154059-2	154059-3	154059-4	154059-5
Your Reference	-------------	SSP1/9	SSP1/10	SSP1/11	SSP1/12	SSP2/1
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/09/2016	27/09/2016	27/09/2016	27/09/2016	27/09/2016
Date analysed	-	27/09/2016	27/09/2016	27/09/2016	27/09/2016	27/09/2016
Organic Matter, Walkely Black	mg/kg	32,000	22,000	20,000	33,000	22,000

Misc Inorg - Soil						
Our Reference:	UNITS	154059-6	154059-7	154059-8	154059-9	154059-10
Your Reference	-------------	SSP2/2	SSP2/3	SSP2/4	SSP2/5	SSP2/6
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/09/2016	27/09/2016	27/09/2016	27/09/2016	27/09/2016
Date analysed	-	27/09/2016	27/09/2016	27/09/2016	27/09/2016	27/09/2016
Organic Matter, Walkely Black	mg/kg	29,000	30,000	25,000	22,000	16,000

Misc Inorg - Soil						
Our Reference:	UNITS	154059-11	154059-12	154059-13	154059-14	154059-15
Your Reference	-------------	SSP2/7	SSP2/8	SSP2/9	SSP2/10	BD1/200916
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/09/2016	27/09/2016	27/09/2016	27/09/2016	27/09/2016
Date analysed	-	27/09/2016	27/09/2016	27/09/2016	27/09/2016	27/09/2016
Organic Matter, Walkely Black	mg/kg	20,000	16,000	18,000	20,000	19,000

Misc Inorg - Soil		
Our Reference:	UNITS	154059-16
Your Reference	-------------	BD2/200916
Date Sampled	------------	20/09/2016
Type of sample		Soil
Date prepared	-	27/09/2016
Date analysed	-	27/09/2016
Organic Matter, Walkely Black	mg/kg	25,000

Asbestos ID - soils NEPM Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- ------------	154059-1 SSP1/9 20/09/2016 Soil	154059-2 SSP1/10 20/09/2016 Soil	154059-3 SSP1/11 20/09/2016 Soil	154059-4 SSP1/12 20/09/2016 Soil	154059-5 SSP2/1 20/09/2016 Soil
Date analysed	-	27-28/09/2016	27-28/09/2016	27-28/09/2016	27-28/09/2016	27-28/09/2016
Sample mass tested	g	916.01	996.11	1015.76	884.47	1217.33
Sample Description	-	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks
Asbestos ID in soil (as per AS4964)	-	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	Chrysotile asbestos detected Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	Chrysotile asbestos detected Amosite asbestos detected Crocidolite asbestos detected Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected
Total Asbestos[#1]	g/kg	<0.1	<0.1	0.1174	<0.1	0.6516
Asbestos ID in soil <0.1g/kg*	-	Chrysotile	Chrysotile	Not applicable	Chrysotile Amosite	Not applicable
ACM >7mm Estimation*	g	0.0000	0.0000	0.1183	0.0000	0.7343
FA and AF Estimation*	g	0.0025	0.0190	0.0010	0.0051	0.0590
FA and AF Estimation*[#2]	%(w/w)	<0.001	0.0019	<0.001	<0.001	0.0048

Asbestos ID - soils NEPM Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- ------------	154059-6 SSP2/2 20/09/2016 Soil	154059-7 SSP2/3 20/09/2016 Soil	154059-8 SSP2/4 20/09/2016 Soil	154059-9 SSP2/5 20/09/2016 Soil	154059-10 SSP2/6 20/09/2016 Soil
Date analysed	-	27-28/09/2016	27-28/09/2016	27-28/09/2016	27-28/09/2016	27-28/09/2016
Sample mass tested	g	1155.1	908.23	1130.16	1000.79	994.25
Sample Description	-	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks
Asbestos ID in soil (as per AS4964)	-	Chrysotile asbestos detected Amosite asbestos detected Crocidolite asbestos detected Organic fibres detected	Chrysotile asbestos detected Amosite asbestos detected Crocidolite asbestos detected Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	Chrysotile asbestos detected Amosite asbestos detected Crocidolite asbestos detected 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	No asbestos detected	No asbestos detected
Total Asbestos[#1]	g/kg	0.8930	10.4556	<0.1	0.1764	<0.1
Asbestos ID in soil <0.1g/kg*	-	Not applicable	Not applicable	Chrysotile Amosite	Not applicable	Chrysotile
ACM >7mm Estimation*	g	0.8290	9.1191	0.0000	0.1685	0.0000
FA and AF Estimation*	g	0.2025	0.3770	0.0045	0.0081	0.0048
FA and AF Estimation*[#2]	%(w/w)	0.0175	0.0415	<0.001	<0.001	<0.001

Asbestos ID - soils NEPM Our Reference:	UNITS	154059-11	154059-12	154059-13	154059-14
Your Reference	--------------	SSP2/7	SSP2/8	SSP2/9	SSP2/10
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil
Date analysed	-	27-28/09/2016	27-28/09/2016	27-28/09/2016	27-28/09/2016
Sample mass tested	g	1196.82	1136.86	1037.47	968.64
Sample Description	-	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks
Asbestos ID in soil (as per AS4964)	-	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	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected
Total Asbestos[#1]	g/kg	<0.1	<0.1	<0.1	<0.1
Asbestos ID in soil <0.1g/kg*	-	Chrysotile Crocidolite	Chrysotile	Chrysotile Amosite	Chrysotile
ACM >7mm Estimation*	g	0.0000	0.0000	0.0000	0.0000
FA and AF Estimation*	g	0.0047	0.0005	0.0296	0.0050
FA and AF Estimation*[#2]	%(w/w)	<0.001	<0.001	0.0029	<0.001

Total PCBs in Soil Our Reference: Your Reference	UNITS	154059-1	154059-4	154059-5	154059-6	154059-7
Your Reference	------------- -	SSP1/9	SSP1/12	SSP2/1	SSP2/2	SSP2/3
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Total PCB (Arochlor 1016-1260)	mg/kg	1.5	1.8	1.3	1.4	0.8
Surrogate TCLMX	%	98	98	100	96	96

Total PCBs in Soil Our Reference:	UNITS	154059-8	154059-11	154059-15
Your Reference	------------- -	SSP2/4	SSP2/7	BD1/200916
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016
Total PCB (Arochlor 1016-1260)	mg/kg	0.8	0.6	0.8
Surrogate TCLMX	%	96	96	98

Method ID	Methodology Summary
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-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
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.
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. 'TEQ 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. 'TEQ 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. 'TEQ 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-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Inorg-008	Moisture content determined by heating at 105+/-5 deg C for a minimum of 12 hours.
Inorg-036	Total Organic Matter - A titrimetric method that measures the oxidisable organic content of soils. Based upon Rayment and Lyons 2011 where TOM is estimated as = TOC * 1.724.
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.

Method ID	Methodology Summary
ASB-001	Estimation = Estimated asbestos weight Results reported with "--" is equivalent to no visible asbestos identified using Polarised Light microscopy and Dispersion Staining Techniques. 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.

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
Date analysed	-			24/09/2016	154059-1	24/09/2016 || 24/09/2016	LCS-8	24/09/2016
TRHC$_{6}$ - C$_{9}$	mg/kg	25	Org-016	<25	154059-1	<25 || <25	LCS-8	123%
TRHC$_{6}$ - C$_{10}$	mg/kg	25	Org-016	<25	154059-1	<25 || <25	LCS-8	123%
Benzene	mg/kg	0.2	Org-016	<0.2	154059-1	<0.2 || <0.2	LCS-8	118%
Toluene	mg/kg	0.5	Org-016	<0.5	154059-1	<0.5 || <0.5	LCS-8	119%
Ethylbenzene	mg/kg	1	Org-016	<1	154059-1	<1 || <1	LCS-8	124%
m+p-xylene	mg/kg	2	Org-016	<2	154059-1	<2 || <2	LCS-8	126%
o-Xylene	mg/kg	1	Org-016	<1	154059-1	<1 || <1	LCS-8	126%
naphthalene	mg/kg	1	Org-014	<1	154059-1	<1 || <1	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%		Org-016	109	154059-1	95 || 110 || RPD: 15	LCS-8	116%

QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
Date analysed	-			26/09/2016	154059-1	24/09/2016 || 24/09/2016	LCS-8	26/09/2016
TRHC$_{10}$ - C$_{14}$	mg/kg	50	Org-003	<50	154059-1	<50 || <50	LCS-8	126%
TRHC$_{15}$ - C$_{28}$	mg/kg	100	Org-003	<100	154059-1	<100 || <100	LCS-8	126%
TRHC$_{29}$ - C$_{36}$	mg/kg	100	Org-003	<100	154059-1	<100 || <100	LCS-8	129%
TRH>C$_{10}$-C$_{16}$	mg/kg	50	Org-003	<50	154059-1	<50 || <50	LCS-8	126%
TRH>C$_{16}$-C$_{34}$	mg/kg	100	Org-003	<100	154059-1	<100 || <100	LCS-8	126%
TRH>C$_{34}$-C$_{40}$	mg/kg	100	Org-003	<100	154059-1	<100 || <100	LCS-8	129%
Surrogate o-Terphenyl	%		Org-003	80	154059-1	81 || 78 || RPD: 4	LCS-8	97%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
Date analysed	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
Naphthalene	mg/kg	0.1	Org-012	<0.1	154059-1	<0.1 || <0.1	LCS-8	104%
Acenaphthylene	mg/kg	0.1	Org-012	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	0.1	Org-012	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	0.1	Org-012	<0.1	154059-1	<0.1 || <0.1	LCS-8	106%
Phenanthrene	mg/kg	0.1	Org-012	<0.1	154059-1	0.3 || 0.1 || RPD: 100	LCS-8	127%
Anthracene	mg/kg	0.1	Org-012	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	0.1	Org-012	<0.1	154059-1	0.4 || 0.2 || RPD: 67	LCS-8	110%
Pyrene	mg/kg	0.1	Org-012	<0.1	154059-1	0.4 || 0.2 || RPD: 67	LCS-8	111%
Benzo(a)anthracene	mg/kg	0.1	Org-012	<0.1	154059-1	0.2 || <0.1	[NR]	[NR]
Chrysene	mg/kg	0.1	Org-012	<0.1	154059-1	0.2 || 0.1 || RPD: 67	[NR]	[NR]
Benzo(b,j+k) fluoranthene	mg/kg	0.2	Org-012	<0.2	154059-1	0.3 || <0.2	[NR]	[NR]

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Benzo(a)pyrene	mg/kg	0.05	Org-012	<0.05	154059-1	0.1 || 0.06 || RPD: 50	LCS-8	111%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012	97	154059-1	89 || 94 || RPD: 5	LCS-8	111%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
Date analysed	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
HCB	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	LCS-8	117%
gamma-BHC	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	LCS-8	90%
Heptachlor	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	LCS-8	98%
delta-BHC	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	LCS-8	95%
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	LCS-8	94%
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	LCS-8	89%
Dieldrin	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	LCS-8	96%
Endrin	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	LCS-8	98%
pp-DDD	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	LCS-8	91%
Endosulfan II	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	LCS-8	88%
Methoxychlor	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%		Org-005	121	154059-1	98 || 98 || RPD: 0	LCS-8	119%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
Date analysed	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	LCS-8	94%
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Diazinon	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Dichlorvos	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	LCS-8	96%
Dimethoate	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	LCS-8	96%
Fenitrothion	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	LCS-8	110%
Malathion	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	LCS-8	74%
Parathion	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	LCS-8	109%
Ronnel	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	LCS-8	101%
Surrogate TCMX	%		Org-008	121	154059-1	98 || 98 || RPD: 0	LCS-8	98%

QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			23/09/2016	[NT]	[NT]	LCS-8	23/09/2016
Date analysed	-			23/09/2016	[NT]	[NT]	LCS-8	23/09/2016
Aroclor 1016	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Aroclor 1221	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Aroclor 1232	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Aroclor 1242	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Aroclor 1248	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Aroclor 1254	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	LCS-8	96%
Aroclor 1260	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%		Org-006	121	[NT]	[NT]	LCS-8	98%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
Date analysed	-			26/09/2016	154059-1	26/09/2016 || 26/09/2016	LCS-8	26/09/2016
Arsenic	mg/kg	4	Metals-020	<4	154059-1	9 || 7 || RPD: 25	LCS-8	110%
Cadmium	mg/kg	0.4	Metals-020	<0.4	154059-1	0.6 || 0.9 || RPD: 40	LCS-8	106%
Chromium	mg/kg	1	Metals-020	<1	154059-1	14 || 16 || RPD: 13	LCS-8	107%
Copper	mg/kg	1	Metals-020	<1	154059-1	34 || 56 || RPD: 49	LCS-8	109%
Lead	mg/kg	1	Metals-020	<1	154059-1	93 || 170 || RPD: 59	LCS-8	104%
Mercury	mg/kg	0.1	Metals-021	<0.1	154059-1	<0.1 || 0.1	LCS-8	92%
Nickel	mg/kg	1	Metals-020	<1	154059-1	7 || 14 || RPD: 67	LCS-8	101%
Zinc	mg/kg	1	Metals-020	<1	154059-1	170 || 290 || RPD: 52	LCS-8	103%

QUALITY CONTROL Misc Soil - Inorg	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD
Date prepared	-			27/09/2016	154059-1	23/09/2016 || 23/09/2016
Date analysed	-			27/09/2016	154059-1	27/09/2016 || 27/09/2016
Total Phenolics (as Phenol)	mg/kg	5	Inorg-031	<5	154059-1	<5 || <5

QUALITY CONTROL Misc Inorg - Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD
Date prepared	-			27/09/2016	154059-1	27/09/2016 || 27/09/2016
Date analysed	-			27/09/2016	154059-1	27/09/2016 || 27/09/2016
Organic Matter, Walkely Black	mg/kg	1000	Inorg-036	<1000	154059-1	32000 || 29000 || RPD: 10

QUALITY CONTROL Total PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
Date analysed	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
Total PCB (Arochlor 1016-1260)	mg/kg	0.6	Org-006	<0.6	154059-1	1.5 || 0.7 || RPD: 73	LCS-8	103%
Surrogate TCLMX	%		Org-006	121	154059-1	98 || 98 || RPD: 0	LCS-8	96%

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	154059-11	23/09/2016 || 23/09/2016	154059-2	23/09/2016
Date analysed	-	154059-11	24/09/2016 || 24/09/2016	154059-2	24/09/2016
TRHC$_6$ - C$_9$	mg/kg	154059-11	<25 || <25	154059-2	114%
TRHC$_6$ - C$_{10}$	mg/kg	154059-11	<25 || <25	154059-2	114%

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Benzene	mg/kg	154059-11	<0.2 || <0.2	154059-2	103%
Toluene	mg/kg	154059-11	<0.5 || <0.5	154059-2	101%
Ethylbenzene	mg/kg	154059-11	<1 || <1	154059-2	113%
m+p-xylene	mg/kg	154059-11	<2 || <2	154059-2	127%
o-Xylene	mg/kg	154059-11	<1 || <1	154059-2	128%
naphthalene	mg/kg	154059-11	<1 || <1	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%	154059-11	115 || 111 || RPD: 4	154059-2	106%

QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	154059-11	23/09/2016 || 23/09/2016	154059-2	23/09/2016
Date analysed	-	154059-11	24/09/2016 || 24/09/2016	154059-2	24/09/2016
TRHC $_{10}$ - C $_{14}$	mg/kg	154059-11	<50 || <50	154059-2	118%
TRHC $_{15}$ - C $_{28}$	mg/kg	154059-11	<100 || <100	154059-2	108%
TRHC $_{29}$ - C $_{36}$	mg/kg	154059-11	<100 || <100	154059-2	119%
TRH>C $_{10}$-C $_{16}$	mg/kg	154059-11	<50 || <50	154059-2	118%
TRH>C $_{16}$-C $_{34}$	mg/kg	154059-11	<100 || <100	154059-2	108%
TRH>C $_{34}$-C $_{40}$	mg/kg	154059-11	<100 || <100	154059-2	119%
Surrogate o-Terphenyl	%	154059-11	76 || 77 || RPD: 1	154059-2	88%

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	154059-11	23/09/2016 || 23/09/2016	154059-2	23/09/2016
Date analysed	-	154059-11	23/09/2016 || 23/09/2016	154059-2	23/09/2016
Naphthalene	mg/kg	154059-11	<0.1 || <0.1	154059-2	107%
Acenaphthylene	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	154059-11	<0.1 || <0.1	154059-2	116%
Phenanthrene	mg/kg	154059-11	0.1 || <0.1	154059-2	129%
Anthracene	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	154059-11	0.3 || 0.2 || RPD: 40	154059-2	111%
Pyrene	mg/kg	154059-11	0.3 || 0.2 || RPD: 40	154059-2	108%
Benzo(a)anthracene	mg/kg	154059-11	0.1 || 0.1 || RPD: 0	[NR]	[NR]
Chrysene	mg/kg	154059-11	0.1 || 0.1 || RPD: 0	[NR]	[NR]
Benzo(b,j+k)fluoranthene	mg/kg	154059-11	0.3 || <0.2	[NR]	[NR]
Benzo(a)pyrene	mg/kg	154059-11	0.1 || 0.1 || RPD: 0	154059-2	123%
Indeno(1,2,3-c,d)pyrene	mg/kg	154059-11	0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	154059-11	0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d14	%	154059-11	90 || 95 || RPD: 5	154059-2	104%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	154059-11	23/09/2016 || 23/09/2016	154059-2	23/09/2016
Date analysed	-	154059-11	23/09/2016 || 23/09/2016	154059-2	23/09/2016
HCB	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	154059-11	<0.1 || <0.1	154059-2	119%
gamma-BHC	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	154059-11	<0.1 || <0.1	154059-2	92%
Heptachlor	mg/kg	154059-11	<0.1 || <0.1	154059-2	99%
delta-BHC	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	154059-11	<0.1 || <0.1	154059-2	89%
Heptachlor Epoxide	mg/kg	154059-11	<0.1 || <0.1	154059-2	93%
gamma-Chlordane	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	154059-11	<0.1 || <0.1	154059-2	89%
Dieldrin	mg/kg	154059-11	<0.1 || <0.1	154059-2	96%
Endrin	mg/kg	154059-11	<0.1 || <0.1	154059-2	98%
pp-DDD	mg/kg	154059-11	<0.1 || <0.1	154059-2	92%
Endosulfan II	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	154059-11	<0.1 || <0.1	154059-2	93%
Methoxychlor	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%	154059-11	96 || 98 || RPD: 2	154059-2	118%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	154059-11	23/09/2016 || 23/09/2016	154059-2	23/09/2016
Date analysed	-	154059-11	23/09/2016 || 23/09/2016	154059-2	23/09/2016
Azinphos-methyl (Guthion)	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Bromophos-ethyl	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	154059-11	<0.1 || <0.1	154059-2	88%
Chlorpyriphos-methyl	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Diazinon	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Dichlorvos	mg/kg	154059-11	<0.1 || <0.1	154059-2	92%
Dimethoate	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	154059-11	<0.1 || <0.1	154059-2	97%
Fenitrothion	mg/kg	154059-11	<0.1 || <0.1	154059-2	110%
Malathion	mg/kg	154059-11	<0.1 || <0.1	154059-2	77%
Parathion	mg/kg	154059-11	<0.1 || <0.1	154059-2	115%
Ronnel	mg/kg	154059-11	<0.1 || <0.1	154059-2	101%
Surrogate TCMX	%	154059-11	96 || 98 || RPD: 2	154059-2	96%

QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	154059-2	23/09/2016
Date analysed	-	[NT]	[NT]	154059-2	23/09/2016
Aroclor 1016	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1221	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1232	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1242	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1248	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1254	mg/kg	[NT]	[NT]	154059-2	103%
Aroclor 1260	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%	[NT]	[NT]	154059-2	96%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	154059-11	23/09/2016 || 23/09/2016	154059-2	23/09/2016
Date analysed	-	154059-11	26/09/2016 || 26/09/2016	154059-2	26/09/2016
Arsenic	mg/kg	154059-11	7 || 6 || RPD: 15	154059-2	101%
Cadmium	mg/kg	154059-11	0.5 || 0.7 || RPD: 33	154059-2	98%
Chromium	mg/kg	154059-11	18 || 16 || RPD: 12	154059-2	102%
Copper	mg/kg	154059-11	52 || 49 || RPD: 6	154059-2	116%
Lead	mg/kg	154059-11	110 || 120 || RPD: 9	154059-2	105%
Mercury	mg/kg	154059-11	0.1 || 0.1 || RPD: 0	154059-2	99%
Nickel	mg/kg	154059-11	12 || 12 || RPD: 0	154059-2	98%
Zinc	mg/kg	154059-11	210 || 240 || RPD: 13	154059-2	#

QUALITY CONTROL Misc Soil - Inorg	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	154059-11	23/09/2016 || 23/09/2016	154059-2	27/09/2016
Date analysed	-	154059-11	27/09/2016 || 27/09/2016	154059-2	27/09/2016
Total Phenolics (as Phenol)	mg/kg	154059-11	<5 || <5	154059-2	98%

QUALITY CONTROL Total PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date extracted	-	154059-11	23/09/2016 || 23/09/2016
Date analysed	-	154059-11	23/09/2016 || 23/09/2016
Total PCB (Arochlor 1016-1260)	mg/kg	154059-11	0.6 || 0.8 || RPD: 29
Surrogate TCLMX	%	154059-11	96 || 98 || RPD: 2

QUALITY CONTROL Misc Soil - Inorg	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	[NT]	[NT]	LCS-1	27/09/2016
Date analysed	-	[NT]	[NT]	LCS-1	27/09/2016
Total Phenolics (as Phenol)	mg/kg	[NT]	[NT]	LCS-1	103%

QUALITY CONTROL Misc Inorg - Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	154059-12	27/09/2016 || 27/09/2016	LCS-1	27/09/2016
Date analysed	-	154059-12	27/09/2016 || 27/09/2016	LCS-1	27/09/2016
Organic Matter, Walkely Black	mg/kg	154059-12	16000 || 15000 || RPD: 6	LCS-1	96%

Report Comments:

Acid Extractable Metals in Soil: The laboratory RPD acceptance criteria
has been exceeded for 154059-1 for Pb, Ni and Zn. Therefore a triplicate result has
been issued as laboratory sample number 154059-17.

METALS_S: # Percent recovery is not possible to report due to the high concentration
of the element/s in the sample/s. However an acceptable recovery was
obtained for the LCS.

PCB_S:
PQL has been raised due to interference from analytes(other than those being tested)
in the sample/s.

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.

Asbestos ID was analysed by Approved Identifier:	Matt Mansfield
Asbestos ID was authorised by Approved Signatory:	Matt Mansfield

INS: Insufficient sample for this test
NR: Test not required
<: Less than
PQL: Practical Quantitation Limit
RPD: Relative Percent Difference
>: Greater than
NT: Not tested
NA: Test not required
LCS: Laboratory Control Sample

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.

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.

CHAIN OF CUSTODY

Douglas Partners
Geotechnics / Environment / Groundwater

Client: Douglas Partners
Contact Person: John Russell
Project Mgr: JRR
Address: 96 Hermitage Road
West Ryde NSW 2114
Phone: 9809 0666 Mob: 0422 000 434
Email: john.russell@douglaspartners.com.au

Project Number 71459.07
Project Name: Moorebank
PO No.:
lab Quote No. :
Date results required:
Or choose: standard
Note: Inform lab in advance if urgent turnaround is required - surcharges apply
Report format: esdat / PDF / Excel
Comments:

To: Envirolab Services
Contact Person: Aileen Hie
Address: 12 Ashley Street
Chatswood NSW 2068
Phone: 02 9910 6200
Fax: 02 9910 6201
Email: ahie@envirolab.com.au
Laboratory Report No:
Lab Comments:

Sample information						Tests Required												Comments
Lab Sample ID	Field Sample ID	Depth	Date sampled	Container Type	Type of sample	metals	TRH/BTEX	PAH	OCP/OPP/PCB	Phenols	asbestos FA/AF	organic matter by titration					Combo	Provide as much information about the sample as you can
1	SSP1/9		20/09/2016	P/G	soil	X	X	X	X	X	X	X					8	
2	SSP1/10		20/09/2016	P/G	soil	X	X	X	X	X	X	X					8	
3	SSP1/11		20/09/2016	P/G	soil	X	X	X	X	X	X	X					8	
4	SSP1/12		20/09/2016	P/G	soil	X	X	X	X	X	X	X					8	
5	SSP2/1		20/09/2016	P/G	soil	X	X	X	X	X	X	X					8	
6	SSP2/2		20/09/2016	P/G	soil	X	X	X	X	X	X	X					8	
7	SSP2/3		20/09/2016	P/G	soil	X	X	X	X	X	X	X					8	
8	SSP2/4		20/09/2016	P/G	soil	X	X	X	X	X	X	X					8	
9	SSP2/5		20/09/2016	P/G	soil	X	X	X	X	X	X	X					8	
10	SSP2/6		20/09/2016	P/G	soil	X	X	X	X	X	X	X					8	
11	SSP2/7		20/09/2016	P/G	soil	X	X	X	X	X	X	X					8	
12	SSP2/8		20/09/2016	P/G	soil	X	X	X	X	X	X	X					8	
13	SSP2/9		20/09/2016	P/G	soil	X	X	X	X	X	X	X					8	
14	SSP2/10		20/09/2016	P/G	soil	X	X	X	X	X	X	X					8	
15	BD1/200916		20/09/2016	P/G	soil	X	X	X	X	X	X	X					8	
16	BD2/200916		20/09/2016	P/G	soil	X	X	X	X	X	X	X					8	

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200
Job No: 154059
Date Received: 22/09/16
Time Received: 13:00
Received by: D.F
Temp: [✓ Cool]/Ambient
Cooling: Ice/[✓ Icepack]
Security: [✓ Intact]/Broken/None

Relinquished by: Douglas Partners
Courier (by whom)
Condition of Sample at dispatch Cool or Ambient (circle)
Temperature (if Applicable):
Print Name: John Russell
Date & Time: 22/09/16
Signature:

Sample Receipt
Received by (Company): ELS
Print Name: Daniel Ford
Date & Time: 22/09/16 @ 13:00
Signature:

Lab use only:
Samples Received: Cool or Ambient (circle one)
Temperature Received at: (if applicable)
Transported by: Hand delivered / courier

Envirolab Services Pty Ltd
ABN 37 112 535 645
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SAMPLE RECEIPT ADVICE

Client Details	
Client	Douglas Partners Pty Ltd
Attention	John Russell

Sample Login Details	
Your Reference	71459.07, Moorebank
Envirolab Reference	**154059**
Date Sample Received	22/09/2016
Date Instructions Received	22/09/2016
Date Results Expected to be Reported	**29/09/2015**

Sample Condition	
Samples received in appropriate condition for analysis	YES
No. of Samples Provided	16 soils
Turnaround Time Requested	Standard
Temperature on receipt (°C)	12.6
Cooling Method	Ice Pack
Sampling Date Provided	YES

Comments
Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples

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@envirolabservices.com.au	Email: jhurst@envirolabservices.com.au

Sample and Testing Details on following page

Sample Id	*vTRH(C6-C10)/BTEXN in Soil*	*svTRH (C10-C40) in Soil*	*PAHs in Soil*	*Organochlorine Pesticides in soil*	*Organophosphorus Pesticides*	*PCBs in Soil*	*Acid Extractable metals in soil*	*Total Phenolics (as Phenol)*	*Organic Matter, Walkely Black*	*Asbestos ID - soils NEPM*
SSP1/9	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP1/10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP1/11	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP1/12	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP2/1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP2/2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP2/3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP2/4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP2/5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP2/6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP2/7	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP2/8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP2/9	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP2/10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BD1/200916	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BD1/200916	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 154059-A

Client:
Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: John Russell

Sample log in details:

Your Reference:	**71459.07, Moorebank**
No. of samples:	Additional Testing on 16 Soils
Date samples received / completed instructions received	22/09/2016 / 30/09/16

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: / Issue Date:	10/10/16 / 10/10/16
Date of Preliminary Report:	Not Issued

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

Results Approved By:

David Springer
General Manager

Metals in TCLP USEPA1311 Our Reference:	UNITS	154059-A-1	154059-A-2	154059-A-3	154059-A-4	154059-A-5
Your Reference	------------- -	SSP1/9	SSP1/10	SSP1/11	SSP1/12	SSP2/1
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	04/10/2016	04/10/2016	04/10/2016	04/10/2016	04/10/2016
Date analysed	-	04/10/2016	04/10/2016	04/10/2016	04/10/2016	04/10/2016
pH of soil for fluid# determ.	pH units	6.6	6.7	6.4	6.4	6.7
pH of soil TCLP (after HCl)	pH units	1.6	1.6	1.5	1.5	1.6
Extraction fluid used	-	1	1	1	1	1
pH of final Leachate	pH units	5.1	5.2	5.2	5.2	5.2
Arsenic in TCLP	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium in TCLP	mg/L	0.01	0.01	<0.01	0.01	0.01
Chromium in TCLP	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Copper in TCLP	mg/L	0.04	0.04	0.04	0.05	0.04
Lead in TCLP	mg/L	0.2	0.2	0.2	0.2	0.2
Mercury in TCLP	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Nickel in TCLP	mg/L	0.03	0.04	0.04	0.05	0.05
Zinc in TCLP	mg/L	2.9	3.1	2.5	3.8	3.6

Metals in TCLP USEPA1311 Our Reference:	UNITS	154059-A-6	154059-A-7	154059-A-8	154059-A-9	154059-A-10
Your Reference	------------- -	SSP2/2	SSP2/3	SSP2/4	SSP2/5	SSP2/6
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	04/10/2016	04/10/2016	04/10/2016	04/10/2016	04/10/2016
Date analysed	-	04/10/2016	04/10/2016	04/10/2016	04/10/2016	04/10/2016
pH of soil for fluid# determ.	pH units	6.5	6.4	6.6	6.6	6.6
pH of soil TCLP (after HCl)	pH units	1.6	1.5	1.6	1.6	1.6
Extraction fluid used	-	1	1	1	1	1
pH of final Leachate	pH units	5.3	5.3	5.6	5.2	5.1
Arsenic in TCLP	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium in TCLP	mg/L	0.01	0.01	0.01	0.01	<0.01
Chromium in TCLP	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Copper in TCLP	mg/L	0.04	0.04	0.04	0.03	0.03
Lead in TCLP	mg/L	0.3	0.2	0.1	0.09	0.07
Mercury in TCLP	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Nickel in TCLP	mg/L	0.04	0.04	0.05	0.04	0.03
Zinc in TCLP	mg/L	3.1	4.0	5.4	2.6	1.5

Metals in TCLP USEPA1311						
Our Reference:	UNITS	154059-A-11	154059-A-12	154059-A-13	154059-A-14	154059-A-15
Your Reference	------------- -	SSP2/7	SSP2/8	SSP2/9	SSP2/10	BD1/200916
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	04/10/2016	04/10/2016	04/10/2016	04/10/2016	04/10/2016
Date analysed	-	04/10/2016	04/10/2016	04/10/2016	04/10/2016	04/10/2016
pH of soil for fluid# determ.	pH units	6.6	6.6	6.5	6.7	6.6
pH of soil TCLP (after HCl)	pH units	1.6	1.5	1.5	1.5	1.5
Extraction fluid used	-	1	1	1	1	1
pH of final Leachate	pH units	5.4	5.2	5.2	5.3	5.2
Arsenic in TCLP	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium in TCLP	mg/L	0.01	<0.01	<0.01	<0.01	<0.01
Chromium in TCLP	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Copper in TCLP	mg/L	0.04	0.03	0.04	0.05	0.05
Lead in TCLP	mg/L	0.1	0.08	0.1	0.2	0.2
Mercury in TCLP	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Nickel in TCLP	mg/L	0.04	0.03	0.04	0.04	0.05
Zinc in TCLP	mg/L	2.9	1.5	2.3	2.2	2.7

Metals in TCLP USEPA1311		
Our Reference:	UNITS	154059-A-16
Your Reference	------------- -	BD2/200916
Date Sampled	------------	20/09/2016
Type of sample		Soil
Date extracted	-	04/10/2016
Date analysed	-	04/10/2016
pH of soil for fluid# determ.	pH units	6.8
pH of soil TCLP (after HCl)	pH units	1.6
Extraction fluid used	-	1
pH of final Leachate	pH units	5.3
Arsenic in TCLP	mg/L	<0.05
Cadmium in TCLP	mg/L	<0.01
Chromium in TCLP	mg/L	<0.01
Copper in TCLP	mg/L	0.03
Lead in TCLP	mg/L	0.2
Mercury in TCLP	mg/L	<0.0005
Nickel in TCLP	mg/L	0.04
Zinc in TCLP	mg/L	3.6

PAHs in TCLP (USEPA 1311)						
Our Reference:	UNITS	154059-A-1	154059-A-2	154059-A-3	154059-A-4	154059-A-5
Your Reference	-------------	SSP1/9	SSP1/10	SSP1/11	SSP1/12	SSP2/1
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/10/2016	05/10/2016	05/10/2016	05/10/2016	05/10/2016
Date analysed	-	05/10/2016	05/10/2016	05/10/2016	05/10/2016	05/10/2016
Naphthalene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Acenaphthylene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Acenaphthene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Fluorene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Phenanthrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Fluoranthene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Pyrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(a)anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Chrysene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(bjk)fluoranthene in TCLP	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Benzo(a)pyrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Indeno(1,2,3-c,d)pyrene - TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Dibenzo(a,h)anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(g,h,i)perylene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Total +ve PAH's	mg/L	NIL (+)VE	NIL (+)VE	NIL (+)VE	NIL (+)VE	NIL (+)VE
Surrogate p-Terphenyl-d14	%	123	100	115	119	116

PAHs in TCLP (USEPA 1311) Our Reference:	UNITS	154059-A-6	154059-A-7	154059-A-8	154059-A-9	154059-A-10
Your Reference	------------- -	SSP2/2	SSP2/3	SSP2/4	SSP2/5	SSP2/6
Date Sampled	------------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/10/2016	05/10/2016	05/10/2016	05/10/2016	05/10/2016
Date analysed	-	05/10/2016	05/10/2016	05/10/2016	05/10/2016	05/10/2016
Naphthalene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Acenaphthylene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Acenaphthene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Fluorene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Phenanthrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Fluoranthene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Pyrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(a)anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Chrysene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(bjk)fluoranthene in TCLP	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Benzo(a)pyrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Indeno(1,2,3-c,d)pyrene - TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Dibenzo(a,h)anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(g,h,i)perylene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Total +ve PAH's	mg/L	NIL (+)VE	NIL (+)VE	NIL (+)VE	NIL (+)VE	NIL (+)VE
Surrogate p-Terphenyl-d14	%	118	107	126	124	130

PAHs in TCLP (USEPA 1311) Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- ------------	154059-A-11 SSP2/7 20/09/2016 Soil	154059-A-12 SSP2/8 20/09/2016 Soil	154059-A-13 SSP2/9 20/09/2016 Soil	154059-A-14 SSP2/10 20/09/2016 Soil	154059-A-15 BD1/200916 20/09/2016 Soil
Date extracted	-	05/10/2016	05/10/2016	05/10/2016	05/10/2016	05/10/2016
Date analysed	-	05/10/2016	05/10/2016	05/10/2016	05/10/2016	05/10/2016
Naphthalene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Acenaphthylene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Acenaphthene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Fluorene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Phenanthrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Fluoranthene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Pyrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(a)anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Chrysene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(bjk)fluoranthene in TCLP	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Benzo(a)pyrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Indeno(1,2,3-c,d)pyrene - TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Dibenzo(a,h)anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(g,h,i)perylene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Total +ve PAH's	mg/L	NIL (+)VE	NIL (+)VE	NIL (+)VE	NIL (+)VE	NIL (+)VE
Surrogate p-Terphenyl-d14	%	124	104	106	108	104

PAHs in TCLP (USEPA 1311) Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------ - ------------	154059-A-16 BD2/200916 20/09/2016 Soil
Date extracted	-	05/10/2016
Date analysed	-	05/10/2016
Naphthalene in TCLP	mg/L	<0.001
Acenaphthylene in TCLP	mg/L	<0.001
Acenaphthene in TCLP	mg/L	<0.001
Fluorene in TCLP	mg/L	<0.001
Phenanthrene in TCLP	mg/L	<0.001
Anthracene in TCLP	mg/L	<0.001
Fluoranthene in TCLP	mg/L	<0.001
Pyrene in TCLP	mg/L	<0.001
Benzo(a)anthracene in TCLP	mg/L	<0.001
Chrysene in TCLP	mg/L	<0.001
Benzo(bjk)fluoranthene in TCLP	mg/L	<0.002
Benzo(a)pyrene in TCLP	mg/L	<0.001
Indeno(1,2,3-c,d)pyrene - TCLP	mg/L	<0.001
Dibenzo(a,h)anthracene in TCLP	mg/L	<0.001
Benzo(g,h,i)perylene in TCLP	mg/L	<0.001
Total +ve PAH's	mg/L	NIL (+)VE
Surrogate p-Terphenyl-d14	%	126

PCBs in TCLP Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- ------------	154059-A-1 SSP1/9 20/09/2016 Soil	154059-A-2 SSP1/10 20/09/2016 Soil	154059-A-3 SSP1/11 20/09/2016 Soil	154059-A-4 SSP1/12 20/09/2016 Soil	154059-A-5 SSP2/1 20/09/2016 Soil
Date extracted	-	05/10/2016	05/10/2016	05/10/2016	05/10/2016	05/10/2016
Date analysed	-	06/10/2016	06/10/2016	06/10/2016	06/10/2016	06/10/2016
Aroclor 1016	µg/L	<2	<2	<2	<2	<2
Aroclor 1221	µg/L	<2	<2	<2	<2	<2
Aroclor 1232	µg/L	<2	<2	<2	<2	<2
Aroclor 1242	µg/L	<2	<2	<2	<2	<2
Aroclor 1248	µg/L	<2	<2	<2	<2	<2
Aroclor 1254	µg/L	<2	<2	<2	<2	<2
Aroclor 1260	µg/L	<2	<2	<2	<2	<2
Surrogate TCLMX	%	134	128	135	138	129

PCBs in TCLP Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- ------------	154059-A-6 SSP2/2 20/09/2016 Soil	154059-A-7 SSP2/3 20/09/2016 Soil	154059-A-8 SSP2/4 20/09/2016 Soil	154059-A-9 SSP2/5 20/09/2016 Soil	154059-A-10 SSP2/6 20/09/2016 Soil
Date extracted	-	05/10/2016	05/10/2016	05/10/2016	05/10/2016	05/10/2016
Date analysed	-	06/10/2016	06/10/2016	06/10/2016	06/10/2016	06/10/2016
Aroclor 1016	µg/L	<2	<2	<2	<2	<2
Aroclor 1221	µg/L	<2	<2	<2	<2	<2
Aroclor 1232	µg/L	<2	<2	<2	<2	<2
Aroclor 1242	µg/L	<2	<2	<2	<2	<2
Aroclor 1248	µg/L	<2	<2	<2	<2	<2
Aroclor 1254	µg/L	<2	<2	<2	<2	<2
Aroclor 1260	µg/L	<2	<2	<2	<2	<2
Surrogate TCLMX	%	130	126	129	137	132

PCBs in TCLP Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- ------------	154059-A-11 SSP2/7 20/09/2016 Soil	154059-A-12 SSP2/8 20/09/2016 Soil	154059-A-13 SSP2/9 20/09/2016 Soil	154059-A-14 SSP2/10 20/09/2016 Soil	154059-A-15 BD1/200916 20/09/2016 Soil
Date extracted	-	05/10/2016	05/10/2016	05/10/2016	05/10/2016	05/10/2016
Date analysed	-	06/10/2016	06/10/2016	06/10/2016	06/10/2016	06/10/2016
Aroclor 1016	µg/L	<2	<2	<2	<2	<2
Aroclor 1221	µg/L	<2	<2	<2	<2	<2
Aroclor 1232	µg/L	<2	<2	<2	<2	<2
Aroclor 1242	µg/L	<2	<2	<2	<2	<2
Aroclor 1248	µg/L	<2	<2	<2	<2	<2
Aroclor 1254	µg/L	<2	<2	<2	<2	<2
Aroclor 1260	µg/L	<2	<2	<2	<2	<2
Surrogate TCLMX	%	118	126	123	135	137

PCBs in TCLP Our Reference:	UNITS	154059-A-16
Your Reference	------------- -	BD2/200916
Date Sampled	------------	20/09/2016
Type of sample		Soil
Date extracted	-	05/10/2016
Date analysed	-	06/10/2016
Aroclor 1016	µg/L	<2
Aroclor 1221	µg/L	<2
Aroclor 1232	µg/L	<2
Aroclor 1242	µg/L	<2
Aroclor 1248	µg/L	<2
Aroclor 1254	µg/L	<2
Aroclor 1260	µg/L	<2
Surrogate TCLMX	%	133

Method ID	Methodology Summary
Inorg-004	Toxicity Characteristic Leaching Procedure (TCLP) using in house method INORG-004.
EXTRACT.7	Toxicity Characteristic Leaching Procedure (TCLP).
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.
Metals-021 CV-AAS	Determination of Mercury by Cold Vapour AAS.
Org-012	Leachates are extracted with Dichloromethane and analysed by GC-MS.
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.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.

QUALITY CONTROL Metals in TCLP USEPA1311	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			04/10/2016	154059-A-1	04/10/2016 || 04/10/2016	LCS-W1	04/10/2016
Date analysed	-			04/10/2016	154059-A-1	04/10/2016 || 04/10/2016	LCS-W1	04/10/2016
Arsenic in TCLP	mg/L	0.05	Metals-020 ICP-AES	<0.05	154059-A-1	<0.05 || <0.05	LCS-W1	116%
Cadmium in TCLP	mg/L	0.01	Metals-020 ICP-AES	<0.01	154059-A-1	0.01 || 0.01 || RPD: 0	LCS-W1	109%
Chromium in TCLP	mg/L	0.01	Metals-020 ICP-AES	<0.01	154059-A-1	<0.01 || <0.01	LCS-W1	108%
Copper in TCLP	mg/L	0.01	Metals-020 ICP-AES	<0.01	154059-A-1	0.04 || 0.04 || RPD: 0	LCS-W1	115%
Lead in TCLP	mg/L	0.03	Metals-020 ICP-AES	<0.03	154059-A-1	0.2 || 0.2 || RPD: 0	LCS-W1	107%
Mercury in TCLP	mg/L	0.0005	Metals-021 CV-AAS	<0.0005	154059-A-1	<0.0005 || <0.0005	LCS-W1	116%
Nickel in TCLP	mg/L	0.02	Metals-020 ICP-AES	<0.02	154059-A-1	0.03 || 0.03 || RPD: 0	LCS-W1	106%
Zinc in TCLP	mg/L	0.02	Metals-020 ICP-AES	<0.02	154059-A-1	2.9 || 2.8 || RPD: 4	LCS-W1	117%

QUALITY CONTROL PAHs in TCLP (USEPA 1311)	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			05/10/2016	[NT]	[NT]	LCS-W1	05/10/2016
Date analysed	-			05/10/2016	[NT]	[NT]	LCS-W1	05/10/2016
Naphthalene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	LCS-W1	78%
Acenaphthylene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Acenaphthene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Fluorene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	LCS-W1	94%
Phenanthrene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	LCS-W1	108%
Anthracene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Fluoranthene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	LCS-W1	90%
Pyrene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	LCS-W1	90%
Benzo(a)anthracene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Chrysene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Benzo(bjk)fluoranthene in TCLP	mg/L	0.002	Org-012	<0.002	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	LCS-W1	90%
Indeno(1,2,3-c,d)pyrene - TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012	126	[NT]	[NT]	LCS-W1	97%

QUALITY CONTROL PCBs in TCLP	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			05/10/2016	[NT]	[NT]	LCS-W1	05/10/2016
Date analysed	-			06/10/2016	[NT]	[NT]	LCS-W1	06/10/2016
Aroclor 1016	µg/L	2	Org-006	<2	[NT]	[NT]	[NR]	[NR]
Aroclor 1221	µg/L	2	Org-006	<2	[NT]	[NT]	[NR]	[NR]
Aroclor 1232	µg/L	2	Org-006	<2	[NT]	[NT]	[NR]	[NR]
Aroclor 1242	µg/L	2	Org-006	<2	[NT]	[NT]	[NR]	[NR]
Aroclor 1248	µg/L	2	Org-006	<2	[NT]	[NT]	[NR]	[NR]
Aroclor 1254	µg/L	2	Org-006	<2	[NT]	[NT]	LCS-W1	82%
Aroclor 1260	µg/L	2	Org-006	<2	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%		Org-006	71	[NT]	[NT]	LCS-W1	123%

QUALITY CONTROL Metals in TCLP USEPA1311	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	154059-A-13	04/10/2016 || 04/10/2016	154059-A-2	04/10/2016
Date analysed	-	154059-A-13	04/10/2016 || 04/10/2016	154059-A-2	04/10/2016
Arsenic in TCLP	mg/L	154059-A-13	<0.05 || <0.05	154059-A-2	113%
Cadmium in TCLP	mg/L	154059-A-13	<0.01 || <0.01	154059-A-2	101%
Chromium in TCLP	mg/L	154059-A-13	<0.01 || <0.01	154059-A-2	101%
Copper in TCLP	mg/L	154059-A-13	0.04 || 0.04 || RPD: 0	154059-A-2	110%
Lead in TCLP	mg/L	154059-A-13	0.1 || 0.1 || RPD: 0	154059-A-2	100%
Mercury in TCLP	mg/L	154059-A-13	<0.0005 || <0.0005	154059-A-2	122%
Nickel in TCLP	mg/L	154059-A-13	0.04 || 0.04 || RPD: 0	154059-A-2	98%
Zinc in TCLP	mg/L	154059-A-13	2.3 || 2.4 || RPD: 4	154059-A-2	102%

Report Comments:

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NR: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

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.

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.

Aileen Hie

From: John Russell <John.Russell@douglaspartners.com.au>
Sent: Friday, 30 September 2016 10:59 AM
To: Ken Nguyen
Cc: Samplereceipt
Subject: RE: Results for Registration 154059 71459.07, Moorebank

Ken,

1-16

Can we please get the following additional testing done:

- TCLP for metals, PAH and PCB on all samples.

Envirolab Ref. 154059A
Due: 10/10/16
Std +1A.

Thanks,

John Russell | Associate
Douglas Partners Pty Ltd | ABN 75 053 980 117 | www.douglaspartners.com.au
96 Hermitage Road West Ryde NSW 2114 | PO Box 472 West Ryde NSW 1685
P: 02 9809 0666 | F: 02 9809 4095 | M: 0422 000 434 | E: John.Russell@douglaspartners.com.au

FINANCIAL REVIEW
CLIENT CHO
FINALIS

From: Ken Nguyen [mailto:KNguyen@envirolab.com.au]
Sent: Wednesday, 28 September 2016 6:56 PM
To: John Russell
Subject: Results for Registration 154059 71459.07, Moorebank

Please refer to attached for:
a copy of the Certificate of Analysis
a copy of the COC
an excel file containing the results

Please note that a hard copy will not be posted.

Enquiries should be made directly to:
sydney@envirolab.com.au

Regards

Envirolab Services
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
www.envirolabservices.com.au

Regards

Ken Nguyen | Chemist | Envirolab Services Pty Ltd

12 Ashley Street, Chatswood, NSW 2067
tel: +61 2 9910 6200

email: sydney@envirolab.com.au
envirolab.com.au

Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 158762

Client:

Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: John Russell

Sample log in details:

Your Reference:	**71459.07, Stockpile Sampling**	
No. of samples:	12 soils	
Date samples received / completed instructions received	08/12/2016	/ 08/12/2016

This report replaces R00 due to the addition of report comments.

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: / Issue Date:	12/12/16	/ 12/12/16
Date of Preliminary Report:	Not Issued	

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

Results Approved By:

David Springer
General Manager

RTA276 ENM* Foreign Material						
Our Reference:	UNITS	158762-1	158762-2	158762-3	158762-4	158762-5
Your Reference	-------------	SSP1-B1	SSP1-B2	SSP2-1	SSP2-2	SSP2-3
Type of sample	------------	material	material	material	material	material
Date prepared	-	12/12/2016	12/12/2016	12/12/2016	12/12/2016	12/12/2016
Date analysed	-	12/12/2016	12/12/2016	12/12/2016	12/12/2016	12/12/2016
Sample Mass Tested	g	6,800	5,900	6,900	7,400	6,400
Foreign Material	%	1.3#	0.90#	0.74#	0.33#	0.95#

RTA276 ENM* Foreign Material						
Our Reference:	UNITS	158762-6	158762-7	158762-8	158762-9	158762-10
Your Reference	-------------	SSP2-4	SSP2-5	SSP2-6	SSP2-7	SSP2-8
Type of sample	------------	material	material	material	material	material
Date prepared	-	12/12/2016	12/12/2016	12/12/2016	12/12/2016	12/12/2016
Date analysed	-	12/12/2016	12/12/2016	12/12/2016	12/12/2016	12/12/2016
Sample Mass Tested	g	5,700	6,700	6,300	7,100	5,400
Foreign Material	%	0.35#	0.36#	0.72#	0.31#	0.73#

RTA276 ENM* Foreign Material			
Our Reference:	UNITS	158762-11	158762-12
Your Reference	-------------	SSP2-9	SSP2-10
Type of sample	------------	material	material
Date prepared	-	12/12/2016	12/12/2016
Date analysed	-	12/12/2016	12/12/2016
Sample Mass Tested	g	6,100	6,800
Foreign Material	%	0.54#	0.45#

Method ID	Methodology Summary
RTA276	RTA 276 - Modified to Environmental Operations (Waste) - 2005 General Exemption under Part 6, Clause 51A.
Inorg-080 ENM	This method is based on RTA T276 and as per NSW DECC Resource Recovery Exemption Guidelines and correspondence. It includes rubber, plastic, bitumen, paper, cloth, paint and wood (Note wood is construction timber only, naturally occuring wood/twigs/roots are excluded). RTA T276 requires at least 6kg of sample for this test.

Report Comments:

Foreign Material: #Indicates asbestos found, see below:

SSP1-B1(158762-1) Asphalt (including bitumen)plastic, timber.
57g Asbestos detected.

SSP1-B2(158762-2) plastic, timber and cloth
42g Asbestos detected.

SSP2-1(158762-3) plastic, timber and cloth
26g Asbestos detected.

SSP1-B2(158762-4) plastic, timber and cloth
55g Asbestos detected.

SSP2-3(158762-5) plastic, timber and cloth
19g Asbestos detected.

SSP2-4(158762-6) plastic, timber.
34g Asbestos detected.

SSP2-5(158762-7) plastic, timber and cloth
67g Asbestos detected.

SSP2-6(158762-8) plastic, timber,Asphalt (including bitumen)
12g Asbestos detected.

SSP7-7(158762-9) plastic, timber and cloth

SSP2-8(158762-10) plastic, timber and cloth
10g Asbestos detected.

SSP2-9(158762-11) plastic, timber.
34g Asbestos detected.

SSP2-10(158762-12) plastic, timber, cloth, Asphalt (including bitumen)
13g Asbestos detected.

Asbestos ID was analysed by Approved Identifier: Not applicable for this job
Asbestos ID was authorised by Approved Signatory: Not applicable for this job

Quality Control Definitions

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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.

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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.

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.
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Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

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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.

CHAIN OF COUSTODY

Douglas Partners
Geotechnics | Environment | Groundwater

Client: Douglas Partners
Contact Person: John Russell
Project Mgr: John Russell

Address: 96 Hermitage Road
West Ryde NSW 2114

Phone: 9809 0666 **Mob:** 0422 000 434
Email: John.Russell @douglaspartners.com.au
Chris.Bagia @douglaspartners.com.au

Project Number 71459.07
Project Name: Stockpile Sampling
PO No.:
lab Quote No. :
Date results required: Standard
Or choose: 24h
Note: Inform lab in advance if urgent turnaround is required - surcharges apply
Report format: esdat / PDF / Excel
Comments: Samples already held by Envirolab

To: Envirolab Services
Contact Person: Aileen Hie
Address: 12 Ashley Street
Chatswood NSW 2068
Phone: 02 9910 6200
Fax: 02 9910 6201
Email: ahie@envirolab.com.au
Laboratory Report No:
Lab Comments:

Sample information						Tests Required		
Lab Sample ID	Field Sample ID	Depth	Date sampled	Container Type	Type of sample	Foreign Materials (Aggregates)	Combo	Comments Provide as much information about the sample as you can
1	SSP1-B1	-	23/09/2016	BULKBAG	S	X		
2	SSP1-B2	-	23/09/2016	BULKBAG	S	X		
3	SSP2-1	-	23/09/2016	BULKBAG	S	X		
4	SSP2-2	-	23/09/2016	BULKBAG	S	X		
5	SSP2-3	-	23/09/2016	BULKBAG	S	X		
6	SSP2-4	-	23/09/2016	BULKBAG	S	X		
7	SSP2-5	-	23/09/2016	BULKBAG	S	X		
8	SSP2-6	-	23/09/2016	BULKBAG	S	X		
9	SSP2-7	-	23/09/2016	BULKBAG	S	X		
10	SSP2-8	-	23/09/2016	BULKBAG	S	X		
11	SSP2-9	-	23/09/2016	BULKBAG	S	X		
12	SSP2-10	-	23/09/2016	BULKBAG	S	X		

ENVIROLAB GROUP
Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200
Job No: 158762
Date Received: 8/12/16.
Time Received: 16:00
Received by: 8Z
Temp: Cool/[✓ Ambient]
Cooling: Ice/Icepack
Security: [✓ Intact]/Broken/None

Relinquished by: Douglas Partners
Hand delivered / Courier (by whom)
Condition of Sample at dispatch Cool or Ambient (circle)
Temperature (if Applicable):
Print Name: Christopher Bagia
Date & Time:
Signature:

Sample Receipt
Received by (Company): ELS
Print Name: Kevin [illegible]
Date & Time: 8/12/16 16
Signature: 8Z

Lab use only:
Samples Received: Cool or Ambient (circle one)
Temperature Received at: (if applicable)
Transported by: Hand delivered / courier

Page 1 of 1

Appendix I

J&K (2016b)

J&K (2017)

EMAIL

JK Geotechnics
GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

PO Box 976, North Ryde BC NSW 1670
115 Wicks Rd, Macquarie Park NSW 2113
Tel: 02 9888 5000 Fax: 02 9888 5003
www.jkgeotechnics.com.au

To: **Ern Dupere**

Of: **Benedict**

Email: **ern@benedict.com.au**

Ref No: **26903Zemail3** **Date:** **22 August 2016**

From: **Agi Zenon**

Cc: **John.Russell@douglas.com.au**

Re: **Response to RAP Comments**

We refer to the geotechnical comments made by Dr Ian Swane in his review of the RAP (prepared by Douglas Partners) and comment as follows:

Item 13 (Section 11: Geotechnical Improvement)

Rereading our report in light of the comments has indicated that the intent of our recommendations is not clear.

As stated in Section 7.4.3 *"Site Classification of Footings"* of our report, following the recommended geotechnical site improvement/remediation works, we expect that differential movements across individual residential lots will be no higher than those associated with a 'Class H1' or possibly 'Class H2' site.

The final design classification will depend on the nature and composition of the 'engineered fill' earthworks.

Although crushed sandstone has been recommended for the engineered fill, material breakdown can sometimes occur, which affects shrink-swell properties. The further geotechnical investigation is required following completion of the engineered fill, to confirm whether material breakdown has occurred to the extent that the site classification has increased from the predicted 'H1' to 'H2'. This further investigation would be limited to the upper 2m to 2.5m of the engineered fill.

The further geotechnical investigation will also allow sampling for laboratory CBR testing of the upper engineered fill to confirm the parameters for final pavement design.

Item 27 (New Section 15.4: Remediation Acceptance Criteria – Geotechnical)

The following are the acceptance criteria for the geotechnical operations which are required on the site:

(i) Proof-roll the base of the proposed ‘backfill’ areas in accordance with the criteria indicated in AS2798 (Section 5.5: Test Rolling).

(ii) ‘Backfill’ to be carried out as follows:

- The excavated material can be used as backfill subject to approval by the geotechnical engineer prior to, and on completion of, sorting to remove deleterious matter and to remove particle sizes greater than 75mm. The approved material can then be placed in layers not greater than 200mm loose thickness and compacted to a density between 95% and 97% of SMDD. If clayey materials are used, the compacted moisture content should be within 2% of SOMC. Compaction may be carried out in thicker layers using larger particle sizes, subject to confirmation that the required density can be achieved through the full layer thickness. Over compaction should be avoided as this would result in too much of a contrast between the ‘existing fill’ and the ‘backfill’ with associated large differential settlements over short horizontal distances. Similarly, under-compaction is undesirable as the creep settlement within the ‘backfill’ will increase and may also result in larger differential settlements.
- Particular care is required to achieve edge compaction where access for rollers is difficult. Benching the sides of the excavation will facilitate edge compaction.
- The backfill must be subjected to Level 1 testing, carried out at the frequency indicated in AS32798 for the volume of fill involved. The Geotechnical Testing Authority should be engaged directly on behalf of the client and not as part of the earthworks contractor.

(iii) High Energy Impact Compaction (HEIC) acceptance criteria, based on initial field trials:

Settlement: average compaction settlement 3mm or less.

Uniformity: Soil response based on Continuous Impact Response technology (medium or better).

(iv) ‘Engineered Fill’ to be carried out as follows:

- The site should be backfilled using select material to achieve the design surface grades, with an ‘engineered fill’ blanket being no less than 3m thick. The ‘engineered fill’ should comprise a well graded granular material (such as ripped or crushed sandstone), which is free of deleterious substances, and has a maximum particle size of 75mm. The fill should be compacted in layers of not greater than 200mm loose thickness, to a minimum density of 98% SMDD. Compaction may be carried out in thicker layers using larger particle sizes, subject to confirmation that the required density can be achieved through the full layer thickness.

- Level 1 density testing should be carried out at the frequency indicated in AS3798 to confirm that the above specifications have been achieved. Preferably the Geotechnical Technical Authority should be engaged directly on behalf of the client and not as part of the earthworks contract.

Item 11 (Section 11: Geotechnical Site Improvements)

a) The value of 1.8% creep settlement rate which was adopted is based on information available in the literature, taking into account the age of the fill. Douglas Partners in their report dated November 2015, adopted a similar creep settlement rate value of 2%.

b) Based on the borehole logs which were presented in our report, materials in sufficient quantity were not identified, to indicate that degradation of waste, material collapse or liquidation would be an issue. Also, the infiltration of surface water would be minimal if at all, due to the presence of the 3m thick 'engineered fill' capping layer.

c) The surcharge value of 70kPa was estimated by assessing the volume and load spread of existing stockpiles on site as shown on the survey plan and examination of a number of historical aerial photographs.

d) The effects of creep settlements from two types of fill (ie. existing fill and backfill) settling at different rates, could not be modelled directly by a computer analysis. In order to model the differential settlements across the site, we estimated the creep settlement of the two fills at regular time intervals using the relationship presented in our report. For each time interval, we then adopted a modulus value for each of the fills which would result in the same settlement as that estimated for the creep. These moduli were then used in a computer analysis. The differential settlements between the two fills were then estimated at each time interval, taking the 'bridging effect' of the 'engineered fill' capping layer into account. The maximum differential settlement across an individual lot was selected on this basis.

The reference in our report to parameters being adjusted until the settlements were with 10% of those expected, refers to expected settlements based on analysis and adjustment of parameters in order to model the differential settlements between two fills in different stages of their settlement cycles as indicated above.

e) The section shown in Figure 3 is the 'existing fill' and 'engineered fill' capping layer. Although the 'backfill' areas are not shown, they were analysed. Figure 3 will be updated to show the 'backfill' areas.

f) We note that the prediction of creep settlements for both the 'existing fill' and the 'backfill' adopted the same methodology as that used by Douglas Partners in their report dated November 2015. The total settlement was different as we considered any elastic or consolidation settlements to have already occurred due to the applied stockpile loads and that the stockpile loads will in effect be replaced by the ‘engineered fill’ capping layer, thus not increasing the overall applied loads.

We can revise the relevant sections of our report to more clearly reflect the actual analyses carried out and the intent of the provided recommendations.

Should you require further information please do not hesitate to contact the undersigned.

Regards
For and on behalf of
JK GEOTECHNICS

Agi Zenon
Principal I Geotechnical Engineer

REPORT

TO
BENEDICT INDUSTRIES PTY LTD

ON
GEOTECHNICAL EVALUATION

FOR
PROPOSED RESIDENTIAL SUBDIVISION

AT
146 NEWBRIDGE ROAD, MOOREBANK, NSW

22 March 2017
Ref: 26930Zrpt Rev5

AS/NZS ISO 9001 certified
AS/NZS 4801 certified

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Revision No: 5

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1 INTRODUCTION

This report presents the results of a geotechnical evaluation of 146 Newbridge Road, Moorebank for residual subdivision purposes. This evaluation has been carried out for Benedict Industries Pty Ltd and supersedes our earlier report (Ref 26930Zrpt Rev3) dated 22 April 2016.

We understand that the site has been rezoned from rural to medium density residential (R3). We have been provided with preliminary unreferenced civil drawings prepared by John Daly & Associates including sewer and road plans and long sections.

The purpose of the evaluation was to obtain geotechnical information on subsurface conditions as a basis for remediation/improvement options, footings, pavements and buried services.

2 BACKGROUND

A study of aerial photographs indicates that the site was previously a low lying bushland area prone to flooding. The photographs since 1943 indicate that the area was used for grazing and was occupied at various stages by small isolated sheds. We understand that between about 1980 and 1990, the site levels were raised using 'non putrefiable' waste. From 1991 to 2016, the site had been used as a sand washing and inert waste processing facility which included some buildings, sheds and a weighbridge. Aerial photographs between 1991 and 2015 (copies presented in Appendix A) indicate that many stockpiles occupied different portions of the site at various times.

3 SITE DESCRIPTION

The site is located in the relatively flat alluvial topography associated with the Georges River. The site itself has an irregular plan shape, covers an area of approximately 9.5 hectares, and has a northern frontage onto Newbridge Road.

At the time of the investigation, the site was occupied by numerous stockpiles. The stockpiles were of varying size and mainly consisted of sand, but also gravel and glass. The provided survey plan (Ref 32825, dated 22/08/13) prepared by Matthew Freeburn, shows that the stockpiles at the time of the survey were up to 16m high. A fibro house and shed were located over the north-eastern portion of the site adjacent to Newbridge Road. Over the centre of the site were two, two storey metal sheds, several containers, and a weighbridge with an adjacent office.

The site appeared to have been built up from natural, with the access road ramping up off Newbridge Road, and batters along the southern, eastern and western site boundaries sloping at between approximately 25° and 40° down to the neighbouring ground.

The Georges River is located a short distance to the east and Governor Macquarie Drive is located a short distance to the west. Immediately beyond the western site boundary is a creek containing standing water. A lake or dam is located immediately to the south. Vacant land is located to the east.

4 EVALUATION METHODOLOGY

Our geotechnical evaluation of the site has been based on investigations carried out by us (JKG) and complemented by work carried out by EIS, Douglas Partners (DP) and Landpac, all working for Benedicts.

4.1 JKG Investigation

The fieldwork for the subsurface investigation was carried out between 18 and 25 October 2012, and comprised the auger drilling of 16 boreholes (JK1 to JK16) to depths between 7.95m and 12m, using our truck mounted JK350 and JK500, and our track mounted JK305 rigs. In addition, three Electrical Friction Cone Penetrometer (EFCP) tests (2, 8 and 14) were carried out at the JK2, JK8 and JK14 locations, to depths between 5.55m and 22.27m. The test locations, as indicated on attached Figure 1, were set out using hand held GPS instrumentation, and are therefore approximate. The surface reduced levels (RLs) at the test locations, were estimated by interpolation between spot heights and ground contours shown on the provided survey plan, and are therefore also approximate. The survey datum is the Australian Height Datum (AHD).

The nature and composition of the subsoils were assessed by logging the materials recovered during drilling and by interpretation of the EFCP test results. The strength/density of the subsoils was assessed from the Standard Penetration Test (SPT) ‘N’ number augmented by hand penetrometer readings on clayey samples recovered from the SPT split tube sampler, and by interpretation of the EFCP test results. Groundwater observations were made during, on completion, and a short period after completion of drilling individual boreholes. Standpipes or monitoring wells were installed into JK1, JK7, JK9 and JK16, and allowed longer term groundwater monitoring.

Our geotechnical engineers were present full time on site during the fieldwork and set out the test locations, nominated sampling and testing, and logged the subsurface profile. The borehole logs and EFCP test results are attached to this report together with a glossary of logging terms and symbols used.

Selected soil samples were recovered from the boreholes and submitted to a NATA registered laboratory (Soil Test Services Pty Ltd) for moisture content, Atterberg Limits, linear shrinkage, Standard compaction, four-day soaked CBR testing, and particle size distribution testing. The test results are summarised in attached STS Tables A to C.

4.2 DP Investigation

The fieldwork for the subsurface investigation was undertaken in September 2015 and included Cone Penetration Tests (same as the JKG EFCP test) at 10 locations (CPT301 to CPT310) to maximum depths of approximately 20m. Most of the CPTs encountered obstructions in the filling at shallow depths. When an obstruction was encountered, the test location was generally moved slightly and repeated. In total, there were 28 attempts to penetrate the filling at 10 locations. Only two CPTs penetrated through the filling and tested the underlying material, which is a 7% success rate.

The depths to groundwater were recorded upon extraction of the CPT rods.

The test locations and test results are presented in Appendix B.

4.3 Landpac High Energy Impact Compaction

It was fairly obvious and was also recommended in our earlier report dated 17 December 2013, that some form of structural remediation of the site would be required.

To this end, a trial of high energy impact compaction (HEIC) was carried out on the site by Landpac. Two trial areas were selected, referred to as Area A near Newbridge Road where the filling was relatively shallow, and Area B near the south-western corner of the site where the filling was significantly deeper.

Trial Areas A and B were subjected to 40 passes of a three sided roller. The methodology and evaluation of results is presented in the Landpac report included in Appendix C.

DP carried out CPTs in the test areas following completion of the HEIC in an attempt to assess the depth of improvement. These tests were of limited use due to premature refusal.

5 INVESTIGATION RESULTS

5.1 Subsurface Conditions

The 1:100,000 geological map of Penrith indicates that the site is underlain by fluvial deposits possibly over Ashfield Shales. Reference should be made to the attached borehole logs and EFCP logs for detailed subsurface conditions at specific locations. A summary of the subsurface conditions as encountered is presented below:

- Asphaltic concrete (AC) paving 150mm and 160mm thick was encountered at the surface of JK3 and JK7, respectively. A concrete pavement 50mm thick was encountered at the surface of JK6.
- Fill underlies the site to depths between 0.5m and 11.5m. A plan showing contours of fill depth is presented in Figure 2. These contours are not dissimilar to the contours determined by DP following inclusion of their investigation results. The fill varied erratically in composition (silty sand, silty clay, sandy clay, clayey sand, gravel, etc) and density (from poorly to well compacted), and contained inclusions of gravel and concrete, brick, plastic, ash, metal and timber fragments. The compaction of the fill generally appeared to reduce with depth.
- Natural silty and sandy clays underlay the fill. These clays were generally of high plasticity and varied in strength from stiff to hard. However, soft clays were also encountered.
- Sand deposits often underlay the clays and were loose to dense. However, very dense sand and very loose sand was also encountered.
- Based on the EFCP refusals at JK2 and JK8, bedrock has been inferred at depths of 17.2m and 22.3m, respectively.
- A few hours to several days following completion of drilling individual boreholes, groundwater levels were measured at depths between 1.5m (JK1) and 5.6m (JK9). The groundwater surface varied between RL0.5m (JK1) and RL2.7m (JK7). The groundwater surface appeared to slope down towards the north-east.
- The laboratory Atterberg Limits and particle size distribution tests confirmed the field classification of the soils. The plastic limit and linear shrinkage test results indicated that the sampled silty clays generally had a moderate shrink-swell reactivity.

- Four day soaked CBR values of 5% and 8% are indicated, based on the samples being compacted to 98% Standard Maximum Dry Density (SMDD) and within 2% of Standard Optimum Moisture Content (SOMC).

5.2 Results of HEIC

The results of the HEIC trial indicated that after 40 passes of HEIC, the near surface profile appeared to have been compacted in both areas based on the low to medium results of the ‘continuous impact response’. Landpac’s report is included in Appendix C.

The measured settlements (obtained by GPS methods) indicate an average settlement of 63mm for Area A and 60mm for Area B. The range of settlement, however, indicated that the settlement for Area A ranged from less than 20mm to 200mm with some minor areas up to 300mm. Area B had a similar range of settlement. The difference in settlements was often over a short distance and was not ‘uniform’ across the trial area.

HEIC is generally effective for a depth of about 1m to 2m for clayey material which appears to make up most of the filling material. Therefore, it could be expected that HEIC has created a compacted layer of approximately 1m to 2m thick across the trial area. However, the filling beneath the ‘compacted layer’ is expected to have not been noticeably affected by the HEIC. This was confirmed to a certain extent by the post HEIC CPT attempted by DP.

Landpac concluded that the HEIC provided a relatively uniform subgrade over the trial areas, except for one localised area in Area A.

6 COMPUTER MODELLING AND ANALYSES

Finite element (FE) analyses were carried out in an attempt to estimate the settlements which will affect the buildings and structures associated with the proposed subdivision as a result of the existing fill and the proposed remediation/improvement operations.

During discussions with the project civil and structural engineers, it was agreed that a blanket 3m deep of engineered fill is required across the entire site to allow for the laying of buried services and the installation of shallow piles in ‘stable’ material.

Further, methane ‘hotspots’ have been detected by the project environmentalists and these are being treated by excavating down into or through the fill to remove organics (generally buried timber) to the extent that methane is no longer an issue.

We have recommend that excavations be backfilled under our direction. Details on the backfill methodology for both the excavations and the blanket are provided in Section 7 below.

In the following sections of this report, we have distinguished the different fills by referring to the original fill as ‘existing fill’. The fill used to backfill excavations following the removal of organic material as ‘backfill’ and the 3m blanket of fill to be placed over the site as ‘engineered fill’.

The FE analyses were carried out using a two dimensional (2D) computer program PLAXIS. A typical long section through the site was prepared from the results of the survey, subsurface investigation results and the latest civil drawings, and staged 2D modelling was completed as detailed in Section 6.4 below. The estimated total settlements and differential settlements are reported in Section 6.5 below.

6.1 Settlement of Deep Fill

6.1.1 Sources of Settlement

The sources that contribute to the total long term settlement of deep fills include consolidation, creep, inundation (also known as hydro-consolidation or collapse) and elastic settlements. In the case of landfill, total settlement may also include decomposition. These different sources are discussed below.

Consolidation

Consolidation settlements result from the self-weight of the fill, and any subsequent surcharge loads, and occur in fine grained soils due to dissipation of excess pore pressures. This settlement will effectively be complete a relatively short period following fill placement and/or surcharge application.

Creep Settlement

Creep settlement is a long term settlement which occurs over the life of the fill, even under constant stress (surcharge load) and moisture content. Creep settlements occur due to the gradual rearrangement of the soil particles as a result of failure of their contact points both in granular and clayey soils. The magnitude of creep settlements is a function of the composition, thickness, compaction, and stress history of the fill.

Although they continue over the long term, creep settlements reduce with time relative to a log cycle of time, as follows:

$$\textit{Creep settlement} = \alpha \textit{ x fill thickness (m) x log} \left(\frac{t_2}{t_1}\right)$$

Where α = *creep settlement rate*

Time $t_2 > t_1$

Based on available literature, the creep settlement rate (α) for landfill material is in the order of 1% to 15% of the fill thickness per log cycle of time. However, based on the age of the subject landfill of about 30 years, the surcharge to which it has been subjected during the operation of the washing and processing facility over the last about 20 years, and the nature of fill encountered during the investigations, we have adopted a creep settlement rate for the ‘existing fill’ of 3% of the fill thickness per log cycle of time. The creep settlement rate was reduced by 40 percent to 1.8% to take into account the effect of surcharge, as suggested in the literature. This 1.8% creep settlement rate is consistent with the 2% creep settlement rate adopted by DP in their estimation of fill settlement.

For compacted clay fill, the literature indicates that creep settlement rate is generally in the range of 0.2% to 0.5% of the fill thickness per log cycle of time. Therefore, on this basis and considering the nature of the proposed ‘backfill’ and ‘engineered fill’, we have adopted a creep settlement rate for these more recent fills to be in the order of 0.5% of fill thickness over a log cycle of time.

Inundation Settlement

Additional settlement of deep fill can occur when the fill is inundated from a rise in the groundwater table. Given the site setting and the period of about 30 years since the fill was placed, inundation settlement is not considered to be applicable.

Elastic Settlement

The proposed ‘engineered fill’ surcharge and the proposed subdivision loads would cause the ‘existing fill’ and ‘backfill’ to settle elastically (ie. shortly after the load is applied).

Decomposition Settlement

Settlement due to decomposition of organics present in subsoils can occur.

Although significant organics were removed from the ‘existing fill’ in the methane hotspot areas, we consider that it is those very organics causing the high methane. In the overall ‘existing fill’, we have assumed an organic content of about 5% (ie. higher than the organics measured by DP (the project environmentalist) in the ‘existing fill’ after selection and blending for use as ‘backfill’. As the organics are expected to be spread throughout the ‘existing fill’ mass and given their age, we do not expect that they will be significant relative to the ongoing creep settlement of the ‘existing fill’ nor are they expected to affect likely differential settlements. Further, we anticipate that the creep settlement recommended for landfills includes an element of decomposition.

The presence of organics has therefore been ignored in our analyses.

6.1.2 Total and Different Settlement

Based on the aerial photographs, we have estimated that the average load applied to the ‘existing fill’ over the last 20 years by the stockpiles associated with the washing and processing operations to be about 70kPa.

The loads imposed by the proposed 3m thick ‘engineered fill’ and the proposed subdivision have been estimated to be 60kPa and 5kPa, respectively.

Based on the above, therefore, the surcharge (ie. past and future) on the ‘existing fill’ for the purposes of our analyses has been assumed to be constant, other than for the construction period. The construction period includes the period during which the stockpiles are removed, the ‘engineered fill’ is placed, and the subdivision (including buildings and structures) completed. During the construction period, the surcharge load is reduced and gradually reapplied. This will have the effect of stiffening the ‘existing fill’ or reducing the magnitude of total settlement (due to rebound), but has been ignored in the analyses.

The proposed ‘backfill’ will be placed immediately prior to the construction period.

It can thus be seen from the above that the total settlement which occurs in the ‘existing fill’ will be due to the assumed constant surcharge load, with the period of interest being from the end of the construction period, say, year 2019 and, say, a 50 year life of the buildings (ie. to the year 2069). With respect to the age of the ‘existing fill’, 2019 corresponds to t_1=28, and 2069 corresponds to t_2=78 in the equation presented in Section 6.1.1 above.

The total settlement which will occur in the ’backfill’ will be due to the same loads and time period described above, but at a different stage of the time cycle relative to the age of the ‘backfill’. The year 2019 will correspond with t_1=0.5, and year 2069 will correspond with t_2=50.

Settlement of the natural soils underlying the ‘existing fill’ will be minor as the settlement would have taken place not long after the surcharge due to the stockpiles was placed and the surcharge has remained, for all intense and purposes, constant since and going forward. However, for the sake of completeness, we have taken elastic settlement of the natural sand and creep settlement of the natural clay into account. There will be some minor elastic settlement of the ‘engineered fill’ due to the self-weight and subdivision surcharge. However, given the relatively light subdivision load, the shallow depth of the ‘engineered fill’ and the relatively high compacted density of the engineered fill, the resulting settlements are insignificant relative to the creep settlement of the underlying ‘existing fill’ and ‘backfill’.

6.2 Geotechnical Model

In order to assess the total and differential settlement at the surface of the subdivision site, a geotechnical model was prepared. A long section through the site (refer Figure 3, Appendix D) presents a summary of the geotechnical model assumed, based on borehole and CPT information. This geotechnical model was used in our numerical analysis.

The model divides the subsurface profile into a number of soil units. Geotechnical parameters were selected for each unit based on the borehole and CPT information, available literature and case studies.

Groundwater has been included in our analysis and was assumed to be between RL0.5m to RL3.0m along the length of the analysed section. This is based on the standing water levels encountered during our investigation.

6.3 Applied Loads

As stated above, we have used the aerial photographs to roughly estimate that a surcharge load of 70kPa was applied at the surface of the landfill for a period of 20 years due to the presence of the stockpiles during the operational life of the site.

The surcharge of 60kPa due to the ‘engineered fill’ was then applied following by a residential surcharge of 5kPa for a period of 50 years.

6.4 Model Parameters and Stages

In our selection of parameters, consideration was given to the inherent uncertainty associated with natural, non-engineered materials and anisotropy. In this regard, we consider that conservative geotechnical parameters have been adopted. The adopted geotechnical parameters for each geotechnical unit are presented in the following table:

Parameters	**Engineering Fill (crushed sandstone)**	**Engineering Fill (clayey material)**	**Backfill**	**Existing Fill**	**Natural Clay**	**Natural Sand**
Unsaturated Unit Weight (kN/m^3)	22	18	20	16	18	18
Saturated Unit Weight (kN/m^3)	24	20	20	18	18	20
Cohesion (c') (kPa)	0.3	3	0	0	19	0
Internal Angle of Friction (ϕ) (°)	35	28	30	28	28	33
Modified Swelling Index (κ*)	–	–	0.017	$6x5x10^{3-}$	0.02	–
Modified Compression Index (λ*)	–	–	0.06	0.047	0.07	–
Modified Creep Index (μ*)	–	–	$1.3x10^{-3}$	$3.7x10^{-3}$	$0.6x10^{-3}$	–
Modulus (E_{50}) (MPa)	50	30	–	–	–	60
Modulus (E_{oed}) (MPa)	–	–	–	–	–	60
Unload/Reload Modulus (E_{ur}) (MPa)	–	–	–	–	–	240
Poisson's Ratio (v)	0.25	0.3	–	–	–	–
Unload/Reload Poisson's Ratio (V_{ur})	–		–	–	–	0.2

The geotechnical units 'existing fill', 'backfill' and 'natural clay' were modelled using the soft soil creep constitutive model to predict the time dependent behaviour. The 'engineering fill' units were modelled using the Mohr-Coulomb model and the 'natural sand' was modelled using the hardening soil model.

The initial stress field has been modelled by the adoption of K_o values relating horizontal and vertical stresses for specific units. K_o within the natural sand and clay profile has been calculated on the basis of the relationship $K_o = 1–\sin\Phi$.

The model was run through a number of stages in an attempt to simulate the stress history followed by the remediation and construction procedure. The stages are presented below:

1 Initial phase.
2 Place ‘existing fill’ and leave for 10 years.
3 Apply 70kPa surcharge for 20 years.
4 Replace ‘existing fill’ with ‘backfill’ locally.
5 Place 1.4m thick ‘engineered fill’ capping layer comprising clayey material.
6 Place 1.6m thick ‘engineered fill’ capping layer comprising crushed sandstone.
7 Apply 5kPa residential surcharge.

Our analyses also addressed the situation of up to 1m of the ‘engineered fill’ being stripped locally as part of forming the final building platform. Although such stripping did not have a measurable effect on the analyses results, there may be impacts with respect to shrink-swell as the underlying compacted engineered fill consisting of clayey material will be closer to surface (refer Sections 7.2 and 7.4.3 below).

6.5 Analyses Results

A printout showing the predicted settlements from our FE analyses is presented in Figure 4, Appendix D. The maximum settlement of about 60mm after 50 years occurs in the area of deeper ‘existing fill’, to the north of the area which was excavated and backfilled for environmental reasons. Over the remainder of the site, the total settlement varies between about 10mm (over the north) and 40mm (towards the south) depending on the depth of ‘existing fill’.

However, a maximum differential settlement over a distance of 30m of about 40mm is indicated. This differential settlement occurs in an area which straddles the ‘existing fill’-‘backfill’ interface.

The above differential settlement will probably occur as a tilt and is consistent with differential movements associated with a ‘Class H1’ site in accordance with AS2870–2011.

We note that a 60 tonne weighbridge on site was operational for many years and was supported by concrete pad footings founded in the ‘existing fill’. The weighbridge was calibrated every year and apparently no problems due to differential settlement have been experienced, bearing in mind that weighbridges are sensitive to such movement.

Given the above, we consider that our settlement predictions are probably conservative (ie. higher than will likely be experienced). However, we recommend that the predicted settlements be adopted for design.

7 COMMENTS AND RECOMMENDATIONS

7.1 Geotechnical Issue

The principal geotechnical issue associated with the proposed residential subdivision of the subject site is the presence of uncontrolled fill ('existing fill') to significant depth. As a result, the site currently would classify as 'Class P' in accordance with AS2870.

However, given that the site has effectively been preloaded over many years by the extensive stockpiles, our numerical analyses have indicated that the site can be improved to the extent that the proposed residential buildings and associated infrastructure will be subjected to differential settlements which can be accommodated using engineering principles.

7.2 Site Improvement

In order to achieve the conditions modelled in our analyses so as to control the long term settlements of the site and maintain them within acceptable limits, the following process is recommended:

- All existing buildings, structures and pavements must be demolished and, together with all existing stockpiles, removed from site.
- The excavation of 'hotspots' must be completed as required by the environmentalist and the lateral extent and depth recorded by survey. These excavations must then be backfilled using well compacted fill. Prior to backfilling, the base of the excavations must be proof-rolled. It will probably be necessary in areas to form a stable platform and this can be achieved by punching cobble sized fragments into the subgrade.
- The excavated material can be used as backfill subject to approval by the geotechnical engineer prior to, and on completion of, sorting to remove deleterious matter and to remove particle sizes greater than 75mm. The approved material can then be placed in layers not greater than 200mm loose thickness and compacted to a target density between 95% and 97% of SMDD. If clayey materials are used, the compacted moisture content should be within 2% of SOMC. Compaction may be carried out in thicker layers using larger particle sizes, subject to confirmation that the required density can be achieved through the full layer

thickness. Extensive over compaction is undesirable as this would result in too much of a contrast between the 'existing fill' and the 'backfill' with associated large differential settlements over short horizontal distances. Similarly, under-compaction is undesirable as the creep settlement within the 'backfill' will increase and also result in larger differential settlements.

- Particular care is required to achieve edge compaction of the backfill in areas where access for rollers is difficult. Benching the sides of the excavation will facilitate edge compaction. The backfill must be subjected to Level 1 testing, carried out at the frequency indicated in AS32798 for the volume of fill involved.
- The entire site should be excavated down to 3m below design bulk subgrade level.
- The exposed subgrade should then be subjected to HEIC. The purpose of HEIC is to improve the density of the upper fill materials, particularly those areas of inferior compaction, and to provide a relatively uniform platform onto which to place the 'engineered fill'.
- A specification for HEIC should be prepared based on the results of an initial trial. The HEIC must be accompanied by survey levelling and possibly testing. The extent of testing and survey levelling will depend on the performance of HEIC at specific locations.
- Once the entire site area has been successfully subjected to HEIC, the site should be backfilled using select material to achieve the design bulk surface grades, with an 'engineered fill' blanket being no less than 3m thick. The upper 'engineered fill' should comprise a well graded granular material (such as crushed sandstone), which is free of deleterious substances, and has a maximum particle size of 75mm. Site won clayey material which has been certified by the project environmentalist as being suitable for the intended purpose may also be used as engineered fill over the lower capping, subject to approval by the geotechnical engineer. The clayey fill should be compacted in layers of not greater than 200mm loose thickness to a density strictly between 98% and 102% SMDD and within 2% of SOMC. The granular fill should be compacted in layers of not greater than 200mm loose thickness, to a minimum density of 98% SMDD. Compaction may be carried out in thicker layers using larger particle sizes, subject to confirmation that the required density can be achieved through the full layer thickness.
- Level 1 density testing of the 'engineered fill' should be carried out at the frequency indicated in AS3798 to confirm that the above specifications have been achieved. Preferably the Geotechnical Technical Authority should be engaged directly on behalf of the client and not as part of the earthworks contract.

The earthworks recommendations provided above should be complemented to reference to AS3798 and will need to be integrated with any environmental remediation which may be required.

As stated in Section 6.4 above, detailed local excavations into the upper ‘engineered fill’ will be carried out in areas to form level building platforms. This may expose such areas to shrink-swell movements as the clays will be within the shrink-swell zone.

In order to limit shrink-swell, it must be ensured that the final building platforms are underlain by at least 1.5m of ‘engineered fill’ comprising granular material. Particular care is therefore required to ensure that the areas of detailed excavation are clearly demarcated so as to allow the required material making up the ‘engineered fill’ to be used.

7.3 Batter Slopes

The existing batters along the southern, eastern and western site boundaries should be cleared of vegetation and ‘tidied up’ so that even side slopes no steeper than 1 Vertical (V) in 1.5 Horizontal (H) are achieved. The batters to the proposed ‘engineered fill’ embankments should also be no steeper than 1V on 1.5H. Batter slopes higher than a total of, say 3m, should incorporate a horizontal bench at least 2m wide. The batters should be protected from erosion by providing a rapidly growing vegetation cover or by structural means (eg. stone pitching, shotcreting, etc). A drain should be constructed at the crest of the batters to collect surface water runoff and direct it to the base of the embankment in a controlled manner.

Alternatively, the batters may be supported by engineered retaining walls or engineered embankment slopes.

7.4 Proposed Subdivision Works

Once the improvement/remediation detailed in Section 7.2 above has been completed, we would consider that the site is suitable for subdivision works.

7.4.1 Buried Services and Detailed Excavations

The proposed buried services should be flexible to the extent that the predicted differential settlements can be accommodated, and should be laid in trenches which are underlain by at least 1m of ‘engineered fill’. If deeper services are required, the trenches may encounter difficult excavation conditions, and provision will need to be made for removal of concrete, boulders, timber, etc and for the provision of adequate service support in the form of deeper ‘engineered fill’, etc. If such a situation exists, further geotechnical advice should be sought.

The backfill of trenches requires particular attention so as to maintain the properties of the ‘engineered fill’. A similar specification to that proposed engineered fill must be adopted, except that the maximum particle size and the maximum loose thickness of the material placed must reflect the likely smaller compaction equipment which will be used.

Detailed excavations into the ‘engineered fill’ up to 1m to form individual building platforms will not have a measurable effect on the predicted total and differential settlements, however, there may be other impacts as detailed in Section 7.4.3 below.

7.4.2 Pavements

The design of the proposed pavements will depend on the nature and composition of the fill materials imported to site for the ‘engineered fill’. However, where ripped or crushed sandstone is used as the upper ‘engineered fill’, design CBR values for the proposed roads should be tentatively assumed as 15%. Once the ‘engineered fill’ has been completed, additional sampling should be carried out and four day CBR tests completed to obtain final pavement design parameters.

The proposed pavement subbase and basecourse layers should avoid the use of cemented materials, given the anticipated differential settlements which may cause the cemented layers to crack, with the cracks propagating to the surface.

7.4.3 Site Classification and Footings

We note that currently a ‘Class P’ classification is applicable with very difficult founding conditions, which will require extensive footing designs. However, following the geotechnical site improvement/remediation works detailed above, we consider that differential movements across individual residential lots will be no higher than those associated with a ‘Class H1’ site. The ‘Class H1’ will apply in the area of, and adjacent to, the deeper ‘existing fill’, to the north of the area which was excavated and backfilled for environmental reasons. ‘Class M’ sites will apply to the area radiating out from the above with ‘Class S’ over the extreme north, where the ‘existing fill’ is shallowest.

The above assumes that each individual building platform is underlain by at least 1.5m of ‘engineered fill’ comprising granular material. Should the proposed ‘engineered fill’ which comprises clayey material be present within 1.5m of the individual building platform surface, the clayey material will be subject to shrink-swell movements which will adversely affect the above site classifications.

On this basis, conventional high level footings are appropriate. We note that the design classification will, to some extent, depend on the nature and composition of the engineered fill, and will have to be confirmed following completion of the earthworks. For design purposes, we recommend that a ‘Class H1-D’ be tentatively adopted throughout.

The use of piles as settlement reduces and to reduce issues associated with buried services being surcharged or undermining high level footings, are acceptable, provided they are founded no deeper than 1m above the ‘existing fill’.

7.5 Further Geotechnical Investigation

Further geotechnical investigations are required once the site remediation has been completed. The geotechnical investigation should target the upper 2m of the site (ie. the ‘engineered fill’) to confirm its nature and composition for site classification purposes as well as the pavement design CBR values.

7.6 Further Geotechnical Input

The following summarises the further geotechnical input which is required and which has been detailed in the preceding sections of this report:

- Survey of the lateral extent and depth of ‘backfill’ excavations.
- Preparation of a specification for HEIC the remainder of the site.
- Ongoing levelling, survey and possible testing for the HEIC.
- Level 1 density testing of ‘backfill’ and ‘engineered fill’.
- Geotechnical investigation of the ‘engineered fill’ to confirm the site classification and subgrade CBR values.

8 GENERAL COMMENTS

The recommendations presented in this report include specific issues to be addressed during the construction phase of the project. In the event that any of the construction phase recommendations presented in this report are not implemented, the general recommendations may become inapplicable and JK Geotechnics accept no responsibility whatsoever for the performance of the structure where recommendations are not implemented in full and properly tested, inspected and documented.

Occasionally, the subsurface conditions between the completed boreholes may be found to be different (or may be interpreted to be different) from those expected. Variation can also occur with groundwater conditions, especially after climatic changes. If such differences appear to exist, we recommend that you immediately contact this office.

This report provides advice on geotechnical aspects for the proposed civil and structural design. As part of the documentation stage of this project, Contract Documents and Specifications may be prepared based on our report. However, there may be design features we are not aware of or have not commented on for a variety of reasons. The designers should satisfy themselves that all the necessary advice has been obtained. If required, we could be commissioned to review the geotechnical aspects of contract documents to confirm the intent of our recommendations has been correctly implemented.

This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose. If there is any change in the proposed development described in this report then all recommendations should be reviewed. Copyright in this report is the property of JK Geotechnics. We have used a degree of care, skill and diligence normally exercised by consulting engineers in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this report. The report shall not be reproduced except in full.

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SOIL TEST SERVICES
ABN 43 002 145 173

TABLE A
MOISTURE CONTENT, ATTERBERG LIMITS AND LINEAR SHRINKAGE TEST REPORT

Client: JK Geotechnics
Project: Proposed Residential Development
Location: 146 Newbridge Road, Moorebank, NSW

Ref No: 26930Z
Report: A
Report Date: 18/11/2013
Page 1 of 1

AS 1289	TEST METHOD	2.1.1	3.1.2	3.2.1	3.3.1	3.4.1
BOREHOLE NUMBER	DEPTH m	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	PLASTICITY INDEX %	LINEAR SHRINKAGE %
JK1	3.00-3.45	N/A	60	18	42	15.0
JK3	5.50-6.00	27.0				
JK4	4.50-4.95	26.8	67	21	46	15.0
JK6	4.50-4.95	14.0	51	15	36	15.0
JK9	3.00-3.45	19.1	64	26	38	12.0
JK15	7.50-7.95	33.8				
JK16	7.50-7.95	29.0				

Notes:

- The test sample for liquid and plastic limit was air-dried & dry-sieved
- The linear shrinkage mould was 125mm
- Refer to appropriate notes for soil descriptions
- Date of receipt of sample: 04/11/2013
- N/A denotes not applicable

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SOIL TEST SERVICES
ABN 43 002 145 173

TABLE B
FOUR DAY SOAKED CALIFORNIA BEARING RATIO TEST REPORT

Client: JK Geotechnics
Project: Proposed Residential Development
Location: 146 Newbridge Road, Moorebank, NSW

Ref No: 26930Z
Report: B
Report Date: 18/11/2013
Page 1 of 1

BOREHOLE NUMBER	JK2	JK8	JK14
DEPTH (m)	0.50 - 1.30	0.00 - 0.50	0.50 - 1.00
Surcharge (kg)	9.0	9.0	9.0
Maximum Dry Density (t/m^3)	1.57 STD	1.90 STD	1.83 STD
Optimum Moisture Content (%)	24.9	13.9	14.0
Moulded Dry Density (t/m^3)	1.54	1.86	1.79
Sample Density Ratio (%)	98	98	98
Sample Moisture Ratio (%)	98	100	101
Moisture Contents			
Insitu (%)	20.7	18.3	12.3
Moulded (%)	24.5	13.8	14.2
After soaking and After Test, Top 30mm(%)	32.5	17.7	17.4
Remaining Depth (%)	27.1	14.5	16.4
Material Retained on 19mm Sieve (%)	0	7*	10*
Swell (%)	1.0	1.0	0.5
C.B.R. value: @5.0mm penetration	5	5	8

NOTES:

- Refer to appropriate Borehole logs for soil descriptions
- Test Methods :
  - (a) Soaked C.B.R. : AS 1289 6.1.1
  - (b) Standard Compaction : AS 1289 5.1.1
  - (c) Moisture Content : AS 1289 2.1.1
- Date of receipt of sample: 04/11/2013
- * Denotes not used in test sample

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Number:1327

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Authorised Signature / Date
(A. Tatikonda) 18/11/13

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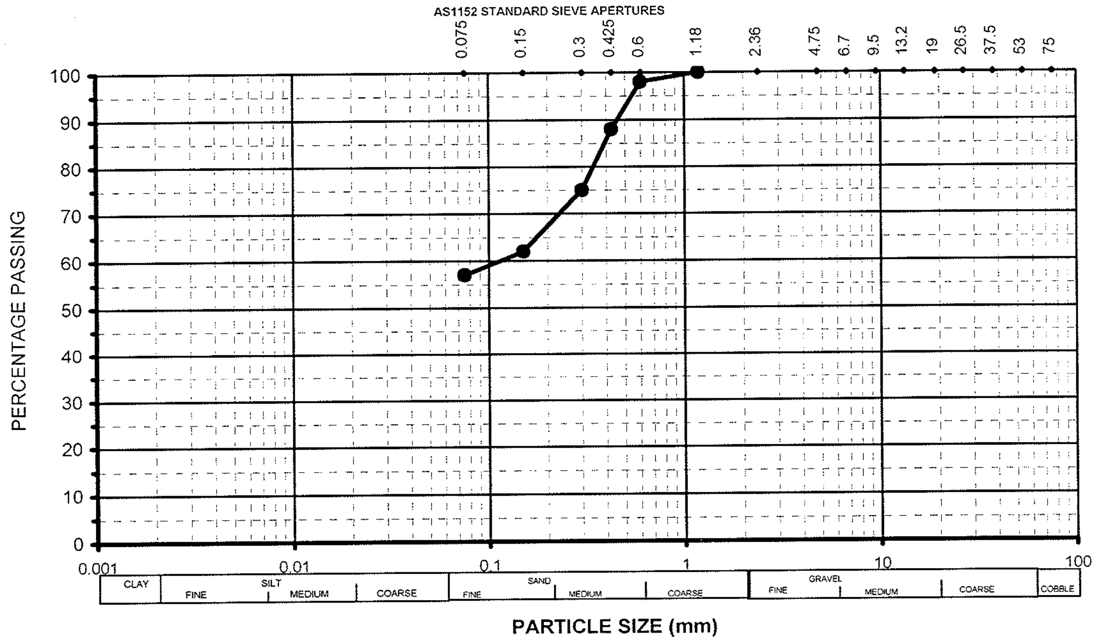
SOIL TEST SERVICES
ABN 43 002 145 173

TABLE C
PARTICLE SIZE DISTRIBUTION TEST REPORT

Client: JK Geotechnics
Project: Proposed Residential Development
Location: 146 Newbridge Road, Moorebank, NSW

Ref No: 26930Z
Report No: C
Report Date: 18/11/2003
Page 1 of 2

Borehole No:JK1
Depth (m): 6.00-6.45



SIEVE ANALYSIS RESULTS

SIEVE SIZE	% PASSING
1.18 mm	100
600 um	98
425 um	88
300 um	75
150 um	62
75 um	57

Test Method: AS1289.3.6.1 Dry Sieve(washed)

• Notes:

- Please refer to appropriate notes for soil descriptions

NATA

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Number:1327

Approved Signatory / Date
18/11/13
(A. Tatikonda)

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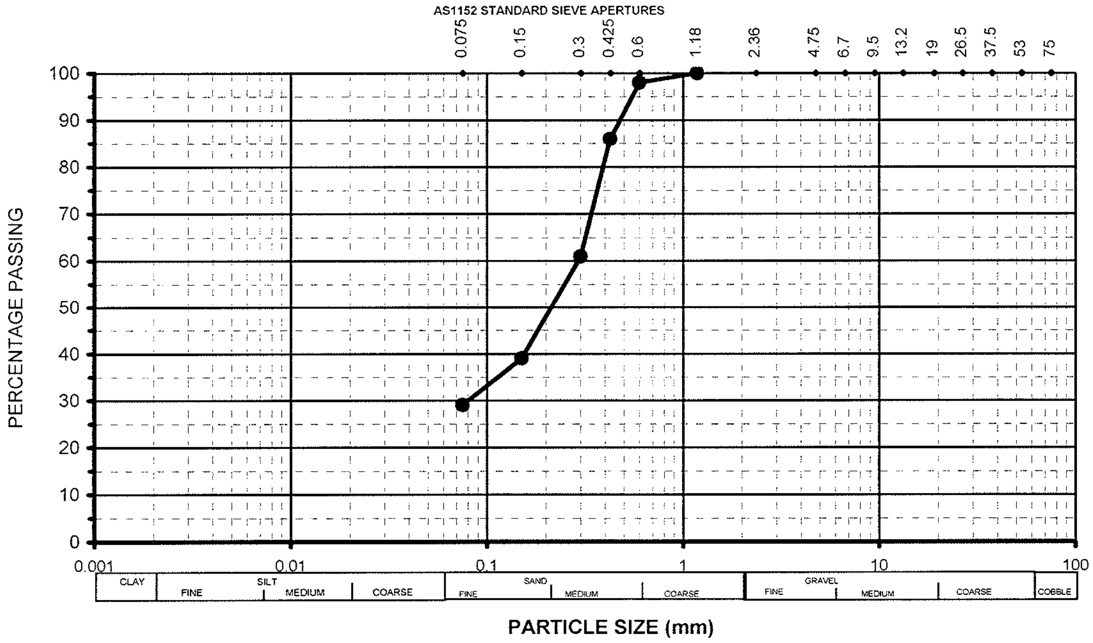
SOIL TEST SERVICES
ABN 43 002 145 173

TABLE C
PARTICLE SIZE DISTRIBUTION TEST REPORT

Client:	JK Geotechnics	**Ref No:**	26930Z
Project:	Proposed Residential Development	**Report No:**	C
Location:	146 Newbridge Road, Moorebank, NSW	**Report Date:**	18/11/2003
		Page 2 of 2	

Borehole No:JK9
Depth (m): 6.00-6.45



SIEVE ANALYSIS RESULTS

SIEVE SIZE	% PASSING
1.18 mm	100
600 um	98
425 um	86
300 um	61
150 um	39
75 um	29

Test Method: AS1289.3.6.1 Dry Sieve(washed)

• Notes:

• Please refer to appropriate notes for soil descriptions

NATA
NATA Accredited Laboratory
Number:1327

Approved Signatory / Date
18/11/13
(A. Tatikonda)

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK1
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
Method: SPIRAL AUGER
R.L. Surface: ~2.0 m
Date: 22/10/13
Datum: AHD
Plant Type: JK305
Logged/Checked By: D.S.

Groundwater Record	ES	U50	DB	DS	Field Tests	RL (m AHD)	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	■								FILL: Silty sandy clay, low plasticity, red brown, with fine grained ironstone gravel, trace of concrete fragments, ash and root fibres.	MC<PL			GRASS COVER APPEARS POORLY COMPACTED
				■	N = 8 5,4,4								
						1	1						
ON 25/10/13	■								FILL: Silty clay, mediium plasticity, brown and ligth grey, with timber fragments, trace of fine to medium grained sand.	MC>PL			
				■	N=0 0,0,0							40 40 40	
						0	2						
	■												
								CH	SILTY CLAY: high plasticity, light grey, trace of fine to medium grained ironstone gravel.	MC>PL	St		
	■												
				■	N = 11 4,4,7	-1	3					150 170 180	
						-2	4						
				■	N = 15 4,7,8				as above, but trace of fine to medium grained sand.		VSt	330 350 350	
						-3	5						
ON COMPLETION & AFTER 24 HRS								CL	SANDY CLAY: low plasticity, light grey.				
	■							SM	SILTY SAND: fine to medium grained, light grey and brown.	W	MD		
				■	N = 22 9,12,10	-4	6						

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK1
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
Method: SPIRAL AUGER
R.L. Surface: ~2.0 m
Date: 22/10/13
Datum: AHD
Plant Type: JK305
Logged/Checked By: D.S.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
								▨		SILTY SAND: fine to medium grained, light grey and brown.	W	MD		
				■	N = 21 5,10,11			▨						
						-6	8	▨						
						-7	9			END OF BOREHOLE AT 9.00 m				50mm DIA. CLASS 18 PVC STANDPIPE INSTALLED TO 7.5m DEPTH. MACHINE SLOTTED FROM 7.5m TO 1.5m DEPTH, CASING FROM 1.5m TO SURFACE, 2mm SAND FILTER PACK FROM 7.5m TO 1.0m, BENTONITE SEAL FROM 1.0m TO 0.5m, BACKFILLED WITH SAND AND CUTTINGS FINISHED AS MONUMENT.
						-8	10							
						-9	11							
						-10	12							
						-11	13							

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

BOREHOLE LOG

Borehole No.
JK2
1 / 2

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~2.5 m
Date: 21/10/13 **Datum:** AHD
Plant Type: JK350 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES				Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	ES	U50	DB	DS										
	■							▨		FILL: Silty sand, fine to medium grained, brown, with fine to coarse grained igneous gravel and clay nodules.	D			GRASS COVER
	■		■	■	N = 7 2,3,4	2		▨	CL	SILTY CLAY: medium plasticity, orange brown, trace of root fibres.	MC>PL	VSt	250 270 300	
							1							
				■	N = 13 4,6,7	1		▨	CH	SILTY CLAY: high plasticity, ligth grey, trace of fine to medium grained ironstone gravel and root fibres.			350 350 350	
							2							
ON COMPLETION ▼						0								
▶				■	N = 35 7,17,18	-1	3	▨	SC	CLAYEY SAND: fine to medium grained, light grey.	D	D		
							4							
				■	N = 57 6,27,30	-2		▨	SP	SAND: fine to medium grained, light brown.	W	VD		
						-3	5							
				■	N = 44 6,22,22	-4	6					D		

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Borehole No.
JK2
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
Method: SPIRAL AUGER
R.L. Surface: ~2.5 m
Date: 21/10/13
Datum: AHD
Plant Type: JK350
Logged/Checked By: D.S.

Groundwater Record	SAMPLES				Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	ES	U50	DB	DS										
									SM	SILTY SAND: fine to medium grained, light grey and light brown.	W	VD		
				■	N = 50 7,20,30	-5								
							8			END OF BOREHOLE AT 7.95 m				
						-6								
							9							
						-7								
							10							
						-8								
							11							
						-9								
							12							
						-10								
							13							
						-11								

Borehole No.
JK3
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~4.0 m
Date: 21/10/13 **Datum:** AHD
Plant Type: JK350 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										ASPHALTIC CONCRETE: 160mm.t				
										FILL: Silty sandy gravel, fine to medium grained igneous, dark grey, fine to medium grained sand.	D	-		APPEARS MODERATELY COMPACTED
					N = 14 8,7,7					FILL: Silty sand, fine to medium grained, brown, with fine to medium grained ironstone gravel, concrete and brick fragments, trace of ash.				
						3	1							
					N = 15 1,2,13					FILL: Silty sand, fine to medium grained brown, with fine to medium grained sandstone gravel, trace of plastic and fibre glass.				
ON COMPLETION						2	2							
					SPT 2/ 0mm REFUSAL	1	3			FILL: Silty clay, medium plasticity, dark grey, with fine to coarse grained sandstone gravel, trace of fine to medium grained sand.	MC>>PL			
						0	4		CL	SILTY CLAY: medium plasticity, dark grey, trace of fine to medium grained sand.	MC>>PL	S		
					N = 2 1,1,1								40 40 30	
						-1	5							
												VS		
						-2	6							

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JK Geotechnics

GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK3
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~4.0 m
Date: 21/10/13 **Datum:** AHD
Plant Type: JK350 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	■			■				▨	CH	SILTY CLAY: high plasticity, brown.	MC>PL	St	150 120 140	
						-4	8			END OF BOREHOLE AT 8.00 m				
						-5	9							
						-6	10							
						-7	11							
						-8	12							
						-9	13							

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BOREHOLE LOG

Borehole No.
JK4
1 / 2

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~6.5 m
Date: 23/10/13 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	■									FILL: Silty sand, fine to medium grained, brown, trace of fine to coarse grained igneous gravel.	D			APPEARS MODERATELY AND WELL COMPACTED
				■	N = 24 7,12,12	6	1			FILL: Silty sand, fine to medium grained, brown, trace of fine to medium grained ironstone gravel and clay fines.				
	■			■	N = 5 2,3,2	5 4	2			FILL: Silty clay, medium plasticity, brown, with fine to medium grained sand, trace of fine to emdium grained sandstone gravel and root fibres.	MC>PL		320 120 120	
	■			■	N = 2 2,1,1	3	3		CL	SILTY SANDY CLAY: low plasticity, dark grey.	MC>PL	S	40 40 50	
	■			■	N = 14 4,6,8	2 1	4 5		CH	SILTY CLAY: high plasticity, light grey and brown.		St	160 160 190	
	■			■	N = 14 5,7,7	0	6		CL	SILTY CLAY: medium plasticity, light grey.			120 120 150	

Borehole No.
JK4
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
Method: SPIRAL AUGER
R.L. Surface: ~6.5 m
Date: 23/10/13
Datum: AHD
Plant Type: JK500
Logged/Checked By: D.S.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
								▨		SILTY CLAY: medium plasticity, light grey.	MC>PL	VSt		
				■	N = 15 7,7,8	-1		▨					340 350 340	
							8			END OF BOREHOLE AT 7.95 m				
						-2								
							9							
						-3								
							10							
						-4								
							11							
						-5								
							12							
						-6								
							13							
						-7								

Borehole No.
JK5
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~7.0 m
Date: 18/10/13 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	■									FILL: Silty sand, fine to medium grained, brown, with fine to mediun grained quartz gravel and concrete and glass fragments.	D			APPEARS POORLY TO MODERATELY COMPACTED
	■			■	N = 16 4,4,12	6	1			FILL: Silty clay, medium plasticity, brown, with fine to medium grained sand, concrete and brick fragments.	MC>PL		200 200 150	
	■				SPT 5/ 20mm REFUSAL	5	2			FILL: Silty clayey sand, fine to coarse grained, dark brown, with concrete and metal fragments.				
	■			■	SPT 19/ 150mm REFUSAL	4	3			FILL: Silty clay, medium plasticity, brown, with fine to medium grained quartz and ironstone gravel, and timber, slag and brick fragments.			100 120 100	
ON COMPLETION						3	4			FILL: Silty gravelly sand, fine to medium grained, light grey and brown, fine to coars grianed concrete and brick fragments.	W			
	■			■	N = 7 1,2,5	2	5			FILL: Silty sandy clay, low plasticity, light grey and orange brown.	MC>PL		150 150 150	
AFTER 6.5 HRS				■						FILL: Silty sandy clay, low plasticity, dark brown, with fine to medum grained ironstone gravel and concrete fragments.			100 100 100	
	■			■	N = 13 0,5,8	1	6		ML	CLAYEY SILT: low plasticity, light grey.	MC<PL	VSt - H	300 400 300	

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Borehole No.
JK5
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
Method: SPIRAL AUGER
R.L. Surface: ~7.0 m
Date: 18/10/13
Datum: AHD
Plant Type: JK500
Logged/Checked By: D.S.

Groundwater Record	SAMPLES				Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	ES	U50	DB	DS										
	■			■	N = 10 3,4,6			▨	CL	SILTY CLAY: medium plasticity, light grey and orange brown.	MC>PL	VSt - H		
						-1	8			END OF BOREHOLE AT 7.95 m				
						-2	9							
						-3	10							
						-4	11							
						-5	12							
						-6	13							

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Borehole No.
JK6
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
Method: SPIRAL AUGER
R.L. Surface: ~6.8 m
Date: 23/10/13
Datum: AHD
Plant Type: JK305
Logged/Checked By: G.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	■								-	CONCRETE: 50mm.t	M	-		APPEARS MODERATELY TO POORLY COMPACTED
										FILL: Gravelly clayey sand, fine to medium grained, brown, fine to coarse grained igneous, trace of ash, slag, glass and metal fragments.				
	■			■	N = 12 6,6,6	6	1			FILL: Silty clay, high plasticity, light grey, grey and brown, trace of fine to medium grained ironstone, sandstone and shale gravel.	MC>PL		300 250 120	
	■ ■			■	N = 9 7,6,3	5 4	2			FILL: Clayey sand, fine to medium grained, grey, light grey and brown, trace of timber, fine to medium grained sandstone gravel and ash.	M			
	■			■	N = 6 4,3,3		3			FILL: Silty clay, high plasticity, grey brown and orange brown, trace of fine to medium grained ironstone gravel and ash.	MC>PL		100 110 90	
	■ ■			■	N = 19 6,8,11	3 2	4 5		CH	SILTY CLAY: high plasticity, grey mottled red brown.	MC>PL	H	500 550 580	
				■	N = 17 5,7,10	1	6			SILTY CLAY: high plasticity, light grey mottled orange brown, trace of fine grained sand.		VSt - H	350 410 440	
▼ ON COMPLETION						0			SM	SILTY SAND: fine to medium grained, grey.	W	(MD)		

BOREHOLE LOG

Borehole No.
JK6
2 / 2

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
Method: SPIRAL AUGER
R.L. Surface: ~6.8 m
Date: 23/10/13
Datum: AHD
Plant Type: JK305
Logged/Checked By: G.F.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
				■	N = 26 8,11,15	-1		░		SILTY SAND: fine to medium grained, grey.	W	(MD)		
							8			END OF BOREHOLE AT 7.95 m				
						-2	9							
						-3	10							
						-4	11							
						-5	12							
						-6	13							
						-7								

Borehole No.
JK7
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
Method: SPIRAL AUGER
R.L. Surface: ~7.2 m
Date: 23/10/13
Datum: AHD
Plant Type: JK500
Logged/Checked By: D.S.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
								■		ASPHALTIC CONCRETE: 150mm.t				
	■			■	N = 44 27,22,22	7 6	1	▨	-	FILL: Silty clay, medium plasticity, brown, with fine to medium grained ironstone gravel, fine grained sand, trace of root fibres.	MC>PL	-		APPEARS WELL COMPACTED
	■			■	N > 10 8,10/ 100mm REFUSAL	5	2	▨		FILL: Silty sandy clay, low plasticity, brown, fine to medium grained sand, with fine to medium grained sandstone and igneous gravel, concrete, timber and brick fragments.			100 100 100	
	■			■	N = 16 8,7,9	4	3	▨		FILL: Clayey sandy gravel, fine to coarse grained sized concrete, grey, fine to medium grained sand, trace of timber fragments.	D			
ON COMPLETION & AFTER 2 HRS	■			■	N = 5 4,2,3	3 2	4 5	▨		FILL: Gravelly sandy clay, low plasticity, brown, fine to medium grained sand, with concrete fragments.	MC>PL			TOO GRAVELLY FOR HP TESTING APPEARS POORLY COMPACTED
	■							▨		as above, but with plastic and metal fragments and fabric.				
	■			■	N=0 0,0,0	1	6	▧	CH	SILTY CLAY: high plasticity, light grey and brown.	MC>PL	S	40 40 50	

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Borehole No.
JK7
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~7.2 m
Date: 23/10/13 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
						0		▨	CH	SILTY CLAY: high plasticity, light grey and brown. *(continued)*	MC>PL	VSt		
				■	N = 14 4,6,8			▨					250 280 280	
						-1	8	▨						
						-2	9			END OF BOREHOLE AT 9.00 m				50mm DIA. CLASS 18 PVC STANDPIPE INSTALLED TO 8.6m DEPTH. MACHINE SLOTTED FROM 8.6m TO 2.6m, CASING 2.6m TO SURFACE, 2mm SAND FILTER PACK FROM 8.6m TO 1.5m, BENTONITE SEAL BETWEEN 1.5m & 0.5m, BACKFILLED WITH SAND AND CUTTINGS, FINISHED AS MONUMENT
						-3	10							
						-4	11							
						-5	12							
						-6	13							

Borehole No.
JK8
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~7.0 m
Date: 21/10/13 **Datum:** AHD
Plant Type: JK350 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES U50 DB DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
▶						-	FILL: Silty sand, fine to medium grained, brown, with glass, plastic, metal, timber and concrete fragments.	D			APPEARS WELL COMPACTED
			6	1			FILL: Silty sandy gravel, fine to medium grained sized glass, brown, fine to medium grained sand.	W			
		N = 24 5,10,14	5	2			FILL: Silty sand, fine to medium grained, light brown and dark brown, trace of fine to coarse grained sandstone gravel.	(D)			
▼ ON COMPLETION		N > 16 1,5,11/ 100mm REFUSAL	4 3	3 4			FILL: Sandy gravelly clay, low plasticity, brown and dark brown, fine to medium grained sandstone and concrete gravel, trace of glass fragments.	MC>PL			TOO GRAVELLY FOR HP TESTING APPEARS MODERATELY COMPACTED
		N = 6 2,3,3	2	5			FILL: Sandy clay, medium plasticity, brown, fine to medium grained sand, trace of ironstone gravel and root fibres.			120 140 150	
		N = 22 10,11,11	1	6		SM	SILTY SAND: fine to medium grained, light grey, with clay fines.	W	MD		

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No.
JK8
2 / 2

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
Method: SPIRAL AUGER
R.L. Surface: ~7.0 m
Date: 21/10/13
Datum: AHD
Plant Type: JK350
Logged/Checked By: D.S.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
								░		SILTY SAND: fine to medium grained, light grey, with clay fines.	W	MD		
				■	N = 43 4,20,23			░				D		
						-1	8			END OF BOREHOLE AT 7.95 m				
						-2	9							
						-3	10							
						-4	11							
						-5	12							
						-6	13							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No.
JK9
1 / 2

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
Method: SPIRAL AUGER
R.L. Surface: ~6.8 m
Date: 23/10/13
Datum: AHD
Plant Type: JK500
Logged/Checked By: D.S.

Groundwater Record	Field Tests	RL (m AHD)	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
				-	FILL: Silty sand, fine to medium grained, brown, trace of fine to medium grained igneous gravel.	D			APPEARS MODERATELY TO WELL COMPACTED
	N = 12 9,6,6	6	1		FILL: Silty sandy clay, low plasticity, brown, fine to medium grained sand, with fine to medium grained sandstone, ironstone and igneous gravel.	MC>PL		220 210 200	
	N = 7 6,3,4	5	2		as above, but with timber fragments.			210 220 210	
	N = 8 3,4,4	4 3	3	CH	SILTY CLAY: high plasticity, brown mottled dark brown.	MC>PL	VSt	300 300 300	
	N = 20 4,9,11	2	4 5		SILTY CLAY: high plasticity, light grey and red brown.	MC<PL	H	580 290 >600	
5/10/1 AFTER 4 HRS ON COMPLETION		1		CL	SANDY CLAY: low plasticity, ligth grey, fine to coarse grained sand.	MC>PL	(St)		
	N = 20 8,8,12	0	6	SM	SILTY CLAYEY SAND: fine to coarse grained, ligth grey and brown, with clay fines.	M	MD		

SAMPLES: ES, U50, DB, DS

Borehole No.
JK9
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~6.8 m
Date: 23/10/13 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES				Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	ES	U50	DB	DS										
										SILTY CLAYEY SAND: fine to coarse grained, ligth grey and brown, with clay fines.	W	MD		
				■ ■	N = 14 1,4,10	-1 -2	8			SILTY SAND: fine to medium grained, light grey.				
						-3 -4 -5 -6 -7	9 10 11 12 13			END OF BOREHOLE AT 9.00 m				CLASS 18 PVC STANDPIPE INSTALLED TO 8.4m DEPTH. SLOTTED BETWEEN 2.4m AND 8.4m, CASING 2.4m TO SURFACE, BACKFILLED WITH 2mm FILTER SAND, BENTONITE SEAL BETWEEN 1.5m & 0.5m, MONUMENT COMPLETED AT SURFACE

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No.
JK10
1 / 2

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
Method: SPIRAL AUGER
R.L. Surface: ~7.0 m
Date: 18/10/13
Datum: AHD
Plant Type: JK500
Logged/Checked By: D.S.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	■									FILL: Silty gravelly sand, fine to medium grained, brown, fine to medium grained quartz and bitumen gravel, crushed concrete and brick fragments.	D			
	■				SPT 10/ 20mm REFUSAL									
						6	1							
	■									FILL: Clayey sand, fine to coarse grained, yellow brown, with fine to medium grained quartz gravel.				
				■	SPT 17/ 100mm REFUSAL					FILL: Silty sandy gravel, fine to medium grained sandstone, dark brown, fine to medium grained sand, with concrete and brick fragments, timber, metal and plastic fragments.				
	■					5	2							
				■	N = 7 4,5,2	4	3			FILL: Silty sand, fine to coarse grained, grey, trace of fine to coarse grained sandtone gravel and timber fragments.				
						3	4							
	■			■	N = 4 2,2,2					FILL; Silty clay, medium plasticity, orange brown, with fine to medium grained sand, concrete and brick fragments.	MC>PL		50 50 80	APPEARS POORLY COMPACTED
AFTER 4 HRS						2	5							
	■									FILL: Sandy clay, low plasticity, dark grey, fine to medium grained sand, with timber, concrete and brick fragments and plastic bags.				
				■	N = 13 3,8,5	1	6							TOO GRAVELLY FOR HP TESTING

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No.
JK10
2 / 2

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
Method: SPIRAL AUGER
R.L. Surface: ~7.0 m
Date: 18/10/13
Datum: AHD
Plant Type: JK500
Logged/Checked By: D.S.

RL (m AHD)	Depth (m)	Field Tests	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
-1 -2 -3 -4	8 9 10 11	N = 9 3,6,3		FILL: Sandy clay, low plasticity, dark grey, fine to medium grained sand, with timber, concrete and brick fragments and plastic bags.	MC>PL		50 50 80 50 50 80	TOO GRAVELLY FOR HP TESTING APPEARS POORLY COMPACTED
			SM	SILTY SAND: fine to coarse grained, light brown, trace of clay fines.	W	-		ALLUVIAL
-5 -6	12 13			END OF BOREHOLE AT 12.00 m				

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Borehole No.
JK11
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
Method: SPIRAL AUGER
R.L. Surface: ~7.0 m
Date: 23/10/13
Datum: AHD
Plant Type: JK305
Logged/Checked By: G.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	■							▨		FILL: Gravelly clayey sand, fine to medium grained, dark brown and grey, fine to coarse grained igneous, trace of glass, steel and ash fragments.	M			
	■			■	N = 20 10,10,10			▨		FILL: Silty clay, medium to high plasticity, brown and grey, trace of fine to medium grained ironstone and shale gravel.	MC>PL		220 100 190	
	■			■	N = 8 7,4,4	6	1	▨		FILL: Sandy clay, low plasticity, brown and grey, trace of fine to medium grained sandstone, ironstone and shale gravel and ash.	MC<PL		100 120 90	APPEARS WELL TO POORLY COMPACTED
	■			■	SPT 10/ 50mm REFUSAL	5 4	2 3	▨						
	■			■	SPT 5/ 0mm REFUSAL	3	4	▨		FILL: Clayey gravelly sand, fine to medium grained, brown and light brown, fine to medium grained ironstone and concrete fragments.	M			
	■			■	N = 19 8,9,10	2 1	5 6	▧	CH	SILTY CLAY: high plasticity, light grey.	MC>PL	H	500 580 550	
▼ ON COMPLETION								░	SM	SILTY SAND: fine to medium grained, grey.	W	MD		

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK11
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
Method: SPIRAL AUGER
R.L. Surface: ~7.0 m
Date: 23/10/13
Datum: AHD
Plant Type: JK305
Logged/Checked By: G.F.

Groundwater Record	SAMPLES				Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	ES	U50	DB	DS										
				■	N = 22 10,10,12			▨		SILTY SAND: fine to medium grained, grey.	W	MD		
						-1	8			END OF BOREHOLE AT 7.95 m				
						-2	9							
						-3	10							
						-4	11							
						-5	12							
						-6	13							

Borehole No.
JK12
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
Method: SPIRAL AUGER
R.L. Surface: ~7.0 m
Date: 18/10/13
Datum: AHD
Plant Type: JK500
Logged/Checked By: D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	■ ■ ■			■	SPT 13/ 50mm REFUSAL	6	1	▨		FILL: Silty gravelly sand, fine to coarse grained, grey, with fine to medium grained igneous gravel and concrete and glass fragments.	D			
	■			■	SPT 6/ 50mm REFUSAL	5	2	▨		as above, but with metal and brick fragments, trace of clay fines.				
	■			■	N = 11 11,7,4	4	3	▨		FILL: Silty clay, medium plasticity, brown, with fine to medium grained ironstone gravel, trace of brick and timber fragments and ash.	MC>PL		100 100 100	APPEARS WELL TO POORLY COMPACTED
ON COMPLETION & AFTER 2 HRS								▨						
	■ ■			■	N = 2 1,1,1	3 2	4 5	▨		FILL: Silty sand, fine to coarse grained, dark grey, with fine to medium grained igneous gravel and slag.	W			
				■	N = 26 3,10,16	1	6	▧	CH	SILTY CLAY: high plasticity, orange brown mottled light grey.	MC<PL	H	450 480 520	

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Borehole No.
JK12
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
Method: SPIRAL AUGER
R.L. Surface: ~7.0 m
Date: 18/10/13
Datum: AHD
Plant Type: JK500
Logged/Checked By: D.S.

Groundwater Record	SAMPLES				Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	ES	U50	DB	DS										
	■							▨	SC	CLAYEY SAND: fine to medium grained, light grey and orange brown.	W	MD		
				■	N = 11 7,6,5									
						-1	8			END OF BOREHOLE AT 7.95 m				
						-2	9							
						-3	10							
						-4	11							
						-5	12							
						-6	13							

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Borehole No.
JK13
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BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~7.0 m
Date: 22/10/13 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										FILL: Silty sand, fine to medium grained, light brown.	D			
										FILL: Silty sand, fine to medium grained, brown.				
					N > 32 15,32/ 150mm REFUSAL	6	1			FILL: Sandy clay, low plasticity, brown, fine to medium grained sand, with fine to medium grained igneous gravel, brick and glass fragments, trace of ash.	MC>PL			SLIGHT HYDROCARBON ODOUR TOO GRAVELLY FOR HP TESTING
					N = 29 9,19,10	5	2			FILL: Sandy clayey gravel, fine to coarse grained sized brick and concrete gravel.	D			APPEARS WELL COMPACTED
ON COMPLETION					N = 29 5,1,28	4 3	3 4			as above, but with timber fragments, trace of plastic and metal fragments.	W			
					N = 16 4,8,8	2	5			FILL: Silty gravel, fine to coarse grained sied brick ad concrete gravel, trace of fine to medium grained igneous gravel and tile fragments.				
					N = 2 3,1,1	1	6		SC	SILTY CLAYEY SAND: fine to medium grained, light grey and brown.	W	VL		
									CL	SILTY SANDY CLAY: low plasticity, orange brown and light grey, fine grained sand.	MC>PL	VSt		

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK13
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~7.0 m
Date: 22/10/13 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES				Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	ES	U50	DB	DS										
	■			■	N = 12 2,6,6			▨		SILTY SANDY CLAY: low plasticity, orange brown and light grey.	MC>PL	VSt	250 250 250	
						-1	8			END OF BOREHOLE AT 7.95 m				
						-2	9							
						-3	10							
						-4	11							
						-5	12							
						-6	13							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK14
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
Method: SPIRAL AUGER
R.L. Surface: ~6.0 m
Date: 18/10/13
Datum: AHD
Plant Type: JK500
Logged/Checked By: D.S.

Groundwater Record	Field Tests	RL (m AHD)	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
					FILL:Silty sand, fine to medium grained, dark grey, with fine to medium grained igneous gravel, concrete and timber fragments.	D			
					FILL: Silty sandy clay, low plasticity, dark brown, with fine to medium grained igneous gravel, concrete, glass and timber fragments.	MC<PL			NO SPT DUE TO OBSTRUCTION IN FILL
		5	1						
					FILL: Silty clay, medium plasticity, brown, trace of fine to medium grained sand, fine grained igneous gravel and timber fragments.	MC>PL			
	N = 3 1,1,2							100 100 120	
		4	2						
	N > 12 15,12/ 150mm REFUSAL	3	3		FILL: Gravel, fine to coarse grained sized bricks.	D			APPEARS POORLY COMPACTED
					FILL: Gravelly clay, low plasticity, brown, fine to coarse grained sand, concrete and brick fragments.	MC>PL			
		2	4						TOO GRAVELLY FOR HP TESTING
	N = 7 2,4,3								
		1	5						
	N = 3 17,1,2	0	6						
ON COMPLETION					FILL: Silty sand, fine to medium grained, light grey.	W			
					FILL: Silty sand, fine to medium grained, dark grey, with timber fragments.				

Borehole No.
JK14
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~6.0 m
Date: 18/10/13 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	■			■	SPT 10/ 10mm REFUSAL	-2	8	▨		FILL: Silty sand, fine to medium grained, dark grey, with timber fragments.	W			
	■			■		-3	9	▨		as above, but with metal fragments.				
⊖	■			■		-4 -5	10 11	▧	CL	SILTY CLAY: low plasticity, dark grey, with fine grained sand.	MC>PL	F	50 50 50	
	■			■				▧				St	100 120 100	
						-6	12			END OF BOREHOLE AT 12.00 m				
						-7	13							

Borehole No.
JK15
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
Method: SPIRAL AUGER
R.L. Surface: ~8.5 m
Date: 22/10/13
Datum: AHD
Plant Type: JK305
Logged/Checked By: D.S.

Groundwater Record	Field Tests	RL (m AHD)	Depth (m)	DESCRIPTION	Moisture Condition/ Weathering	Remarks
				FILL: Silty sand, fine to medium grained, brown, with fine to medium grained quartz gravel, concrete, glass and tile fragments and slag.	D	
	N = 40 15,18,22	8		FILL: Clayey sand, fine to coarse grained, brown, with fine to medium grained quartz and ironstone gravel, tile fragments, trace of ash.		
	N = 11 7,5,6	7 6	1 2	FILL: Gravelly clayey sand, fine to coarse grained, dark grey (black), with fin eto medium grained sandstone and ironstone gravel, concrete, tile and plastic fragments, trace of timber.		APPEARS MODERATELY TO POORLY COMPACTED
	N = 8 2,2,6	5	3	FILL: Silty clayey sand, fine to medium grained, fine to medium grained, brown, with fine to medium grained quartz gravel, concrete and timber fragments, trace of ash.		
	N = 5 4,2,3	4	4 5	FILL: Silty sand, fine to medium grained, brown grey, trace of fine to medium grained quartz gravel.	W	
ON COMPLETION	N = 3 1,1,2	3 2	6	FILL: Silty sand, fine to medium grained, grey.		POSSIBLY NATURAL

Borehole No.
JK15
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~8.5 m
Date: 22/10/13 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	■			■	N=0 0,0,0	1		▨	CH	SILTY CLAY: high plasticity, dark grey.	MC>PL	VS		
							8			END OF BOREHOLE AT 7.95 m				
						0								
							9							
						-1								
							10							
						-2								
							11							
						-3								
							12							
						-4								
							13							
						-5								

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No.
JK16
1 / 2

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~5.0 m
Date: 22/10/13 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	■ ■			■	SPT 20/ 150mm REFUSAL	4	1	▨		FILL: Silty sand, fine to medium grained, brown, with fine to medium grained igneous gravel, concrete and brick fragments, trace of slag.	D			APPEARS POORLY COMPACTED
	■			■	N = 7 4,3,4	3	2	▨		as above, but with fine to medium grained sandstone gravel, trace of ash.				
▶	■			■	N = 4 1,2,2	2	3	▨		FILL: Clayey sand, fine to coarse grained, brown, with fine to medium grained quartz and ironstone gravel, trace of glass fragments and slag.	W			
ON 25/10/13 AFTER 4 HRS ON COMPLETION	■ ■			■ ■	N = 2 1,1,1 N = 2 1,1,1	1 0 -1	4 5 6	⁚	SM	SILTY SAND: fine to medium grained, dark brown, with clay fines.	W	VL		

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No.
JK16
2 / 2

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
Method: SPIRAL AUGER
R.L. Surface: ~5.0 m
Date: 22/10/13
Datum: AHD
Plant Type: JK305
Logged/Checked By: D.S.

Groundwater Record	SAMPLES				Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	ES	U50	DB	DS										
	■			■	N=0 0,0,0			▨	CL	SILTY CLAY: medium plasticity, grey, with fine to medium grained sand.	MC>>PL	VS		TOO SOFT FOR HP TESTING
						-3	8	▨						
						-4	9			END OF BOREHOLE AT 9.00 m				CLASS 18 PVC STANDPIPE INSTALLED TO 8.4m DEPTH. SLOTTED BETWEEN 2.4m AND 8.4m, CASING 2.4m TO SURFACE, BACKFILLED WITH 2mm FILTER SAND AND CUTTINGS TO SURFACE, BENTONITE SEAL BETWEEN 2m & 1m, MONUMENT COMPLETED AT SURFACE
						-5	10							
						-6	11							
						-7	12							
						-8	13							

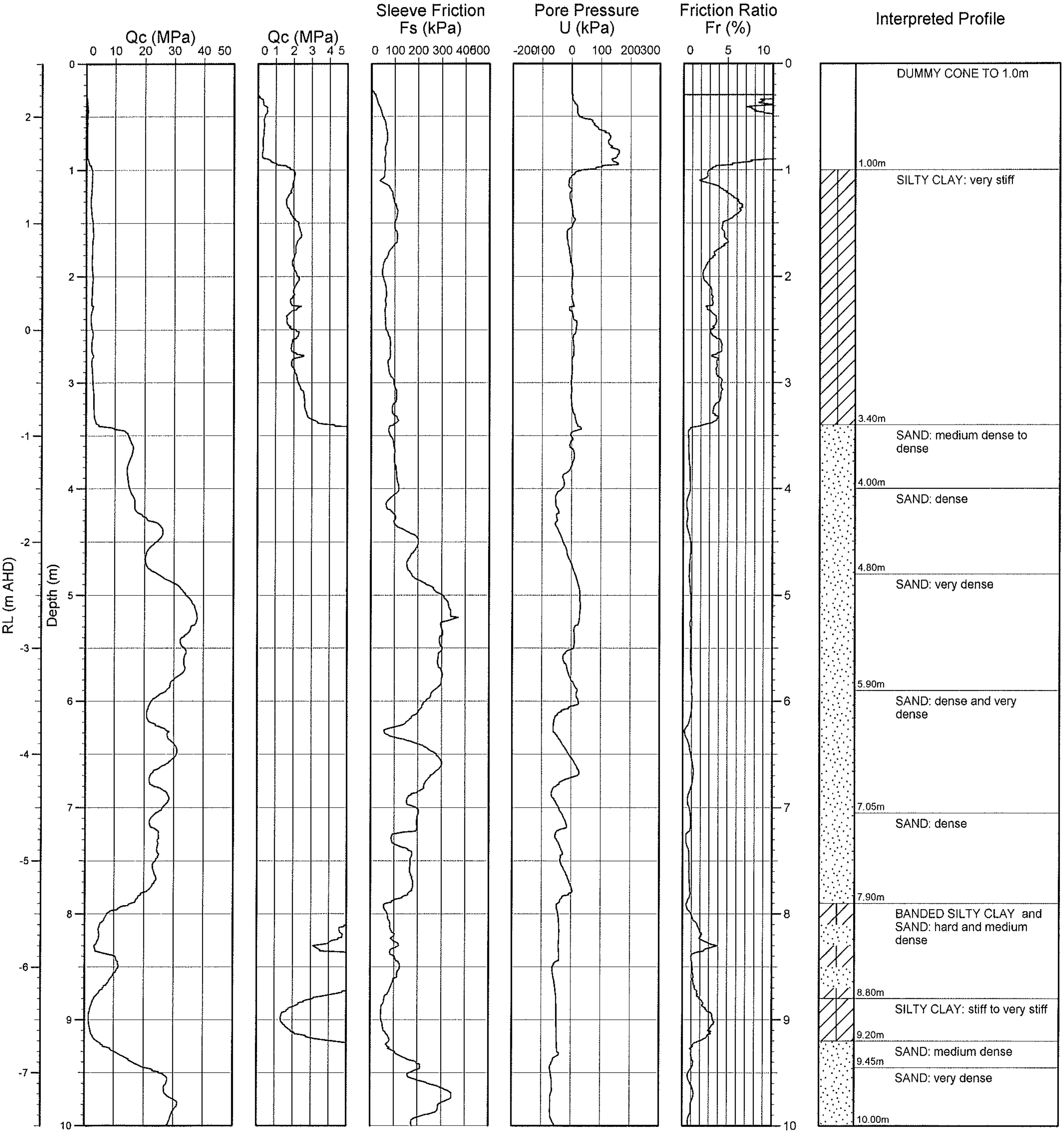
JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

EFCP No.
2
1 / 2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
Date: 25/10/13
R.L. Surface: ~2.5 m
Datum: AHD
Data File: 26930Z_2.GEF
Operator: D.W.



Interpreted by: D.W.
Checked by:

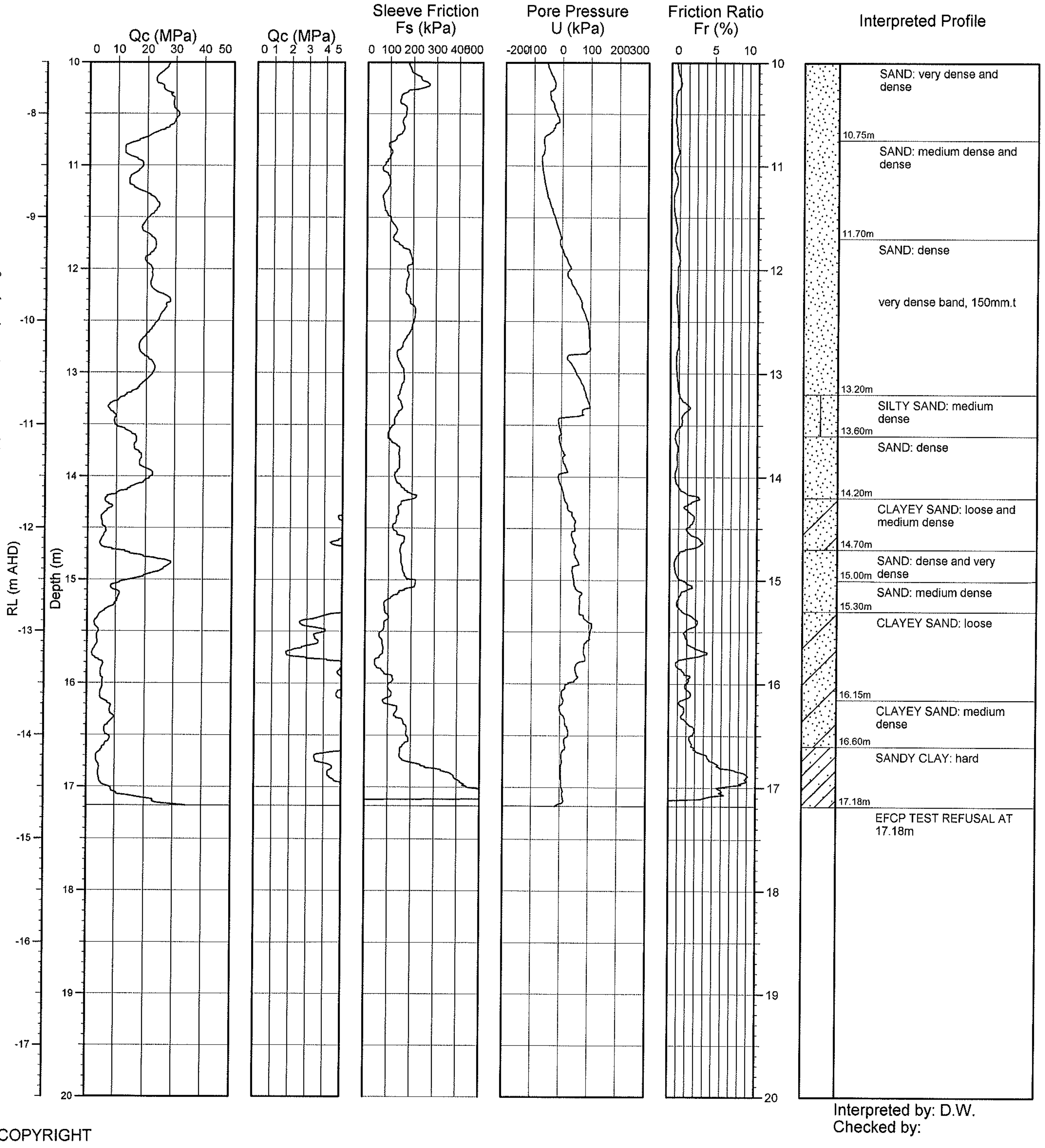
JK_LIB_CURRENT - V7.1.GLB Log J & K CPTU MATERIAL - MASTER 26930Z MOOREBANK.GPJ DWG28132.GDW 17/12/2013 10:37 Produced by gINT Professional, Developed by Datgel

EFCP No.
2
2 / 2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
R.L. Surface: ~2.5 m
Data File: 26930Z_2.GEF
Date: 25/10/13
Datum: AHD
Operator: D.W.



JK_LIB_CURRENT - V7.1.GLB Log J & K CPTU MATERIAL - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:39 Produced by gINT Professional, Developed by Datgel

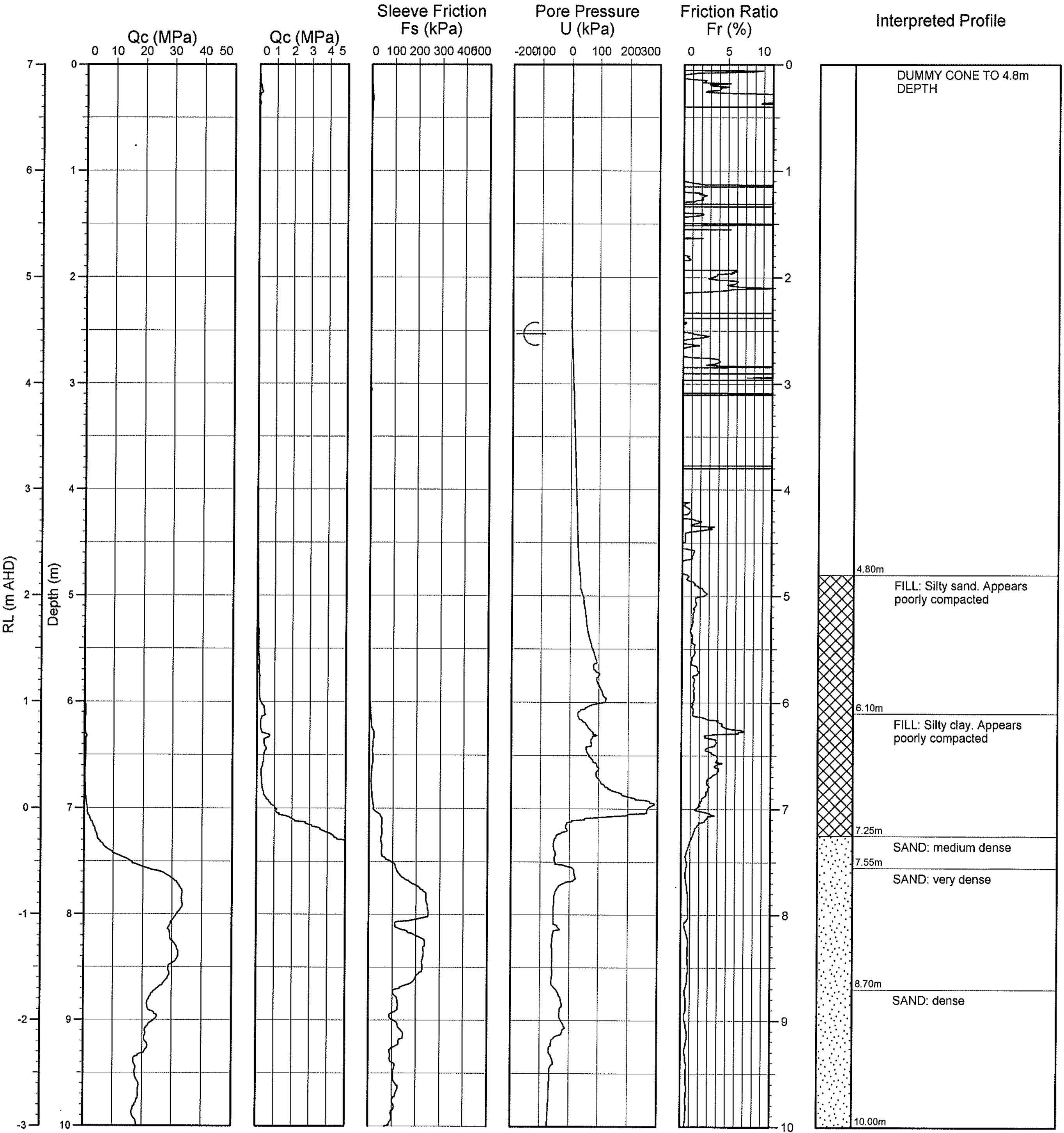
Interpreted by: D.W.
Checked by:

EFCP No.
8
1 / 3

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z	**R.L. Surface:** ~7.0 m	**Data File:** 26930Z_8.GEF
Date: 25/10/13	**Datum:** AHD	**Operator:** D.W.



Interpreted by: D.W.
Checked by:

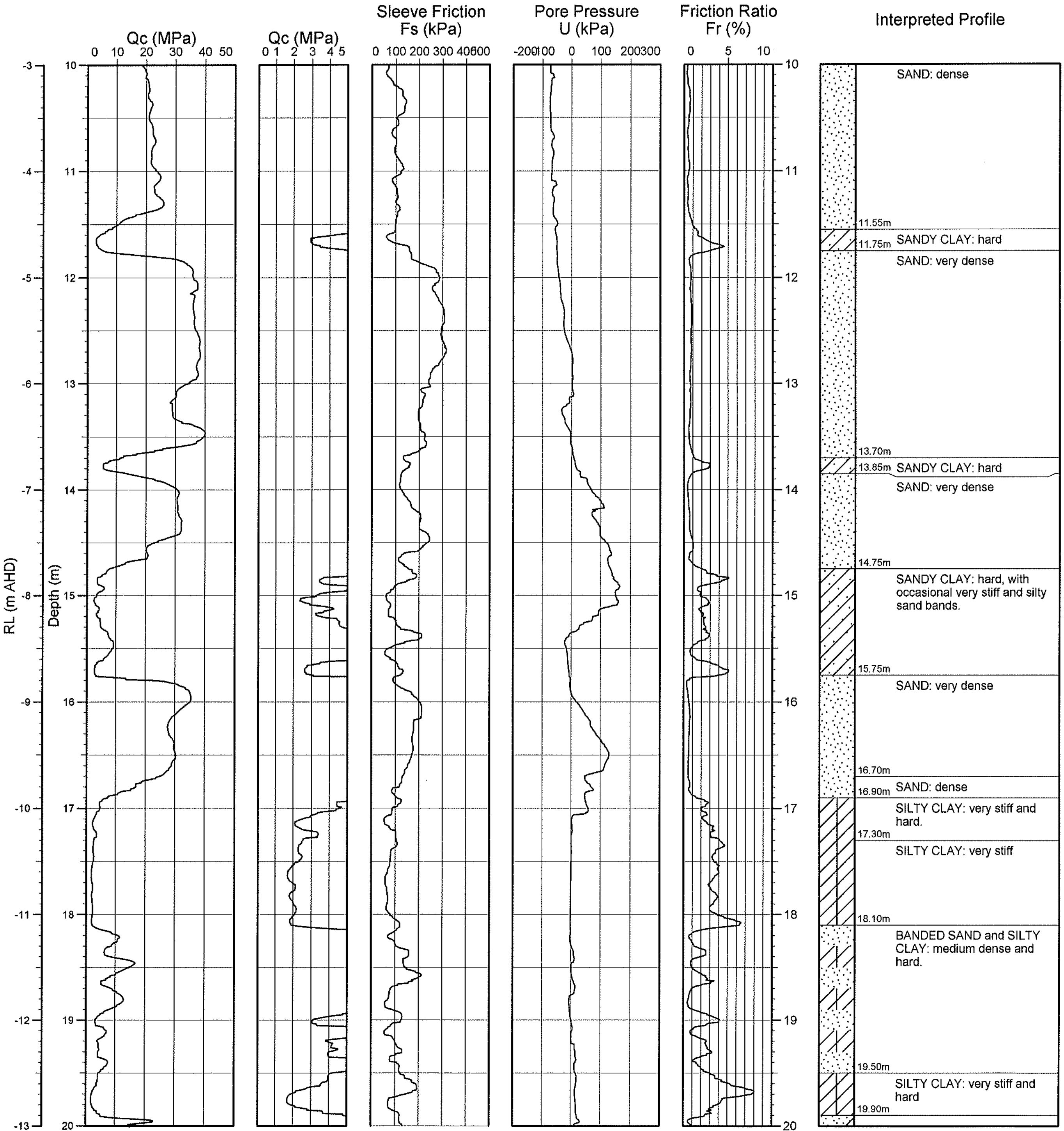
JK_LIB_CURRENT - V7.1.GLB Log J & K CPTU MATERIAL - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:40 Produced by gINT Professional, Developed by Datgel

EFCP No.
8
2 / 3

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
R.L. Surface: ~7.0 m
Data File: 26930Z_8.GEF
Date: 25/10/13
Datum: AHD
Operator: D.W.



Interpreted by: D.W.
Checked by:

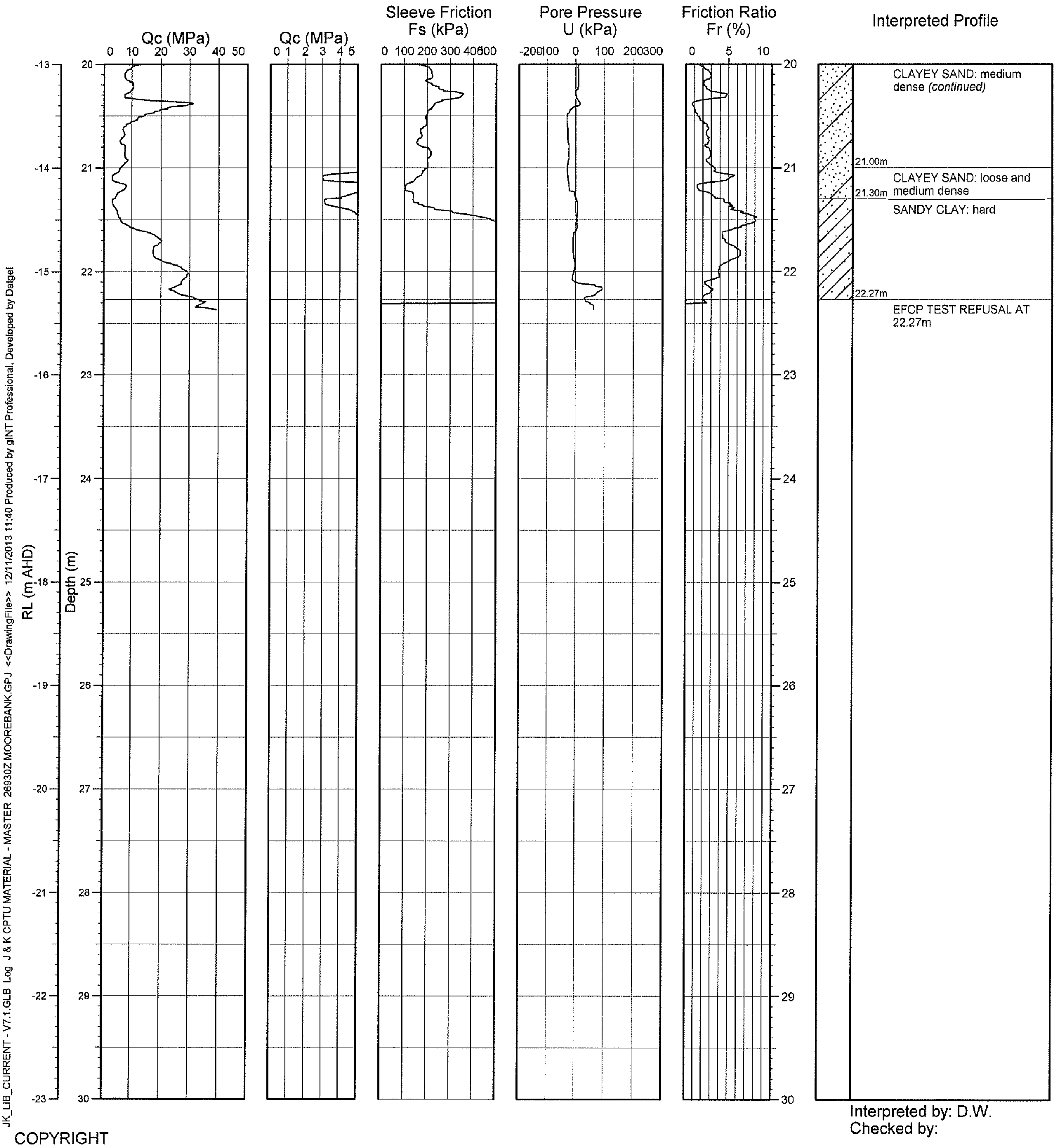
JK_LIB_CURRENT - V7.1.GLB Log J & K CPTU MATERIAL - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:40 Produced by gINT Professional, Developed by Datgel

EFCP No.
8
3 / 3

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
R.L. Surface: ~7.0 m
Data File: 26930Z_8.GEF
Date: 25/10/13
Datum: AHD
Operator: D.W.



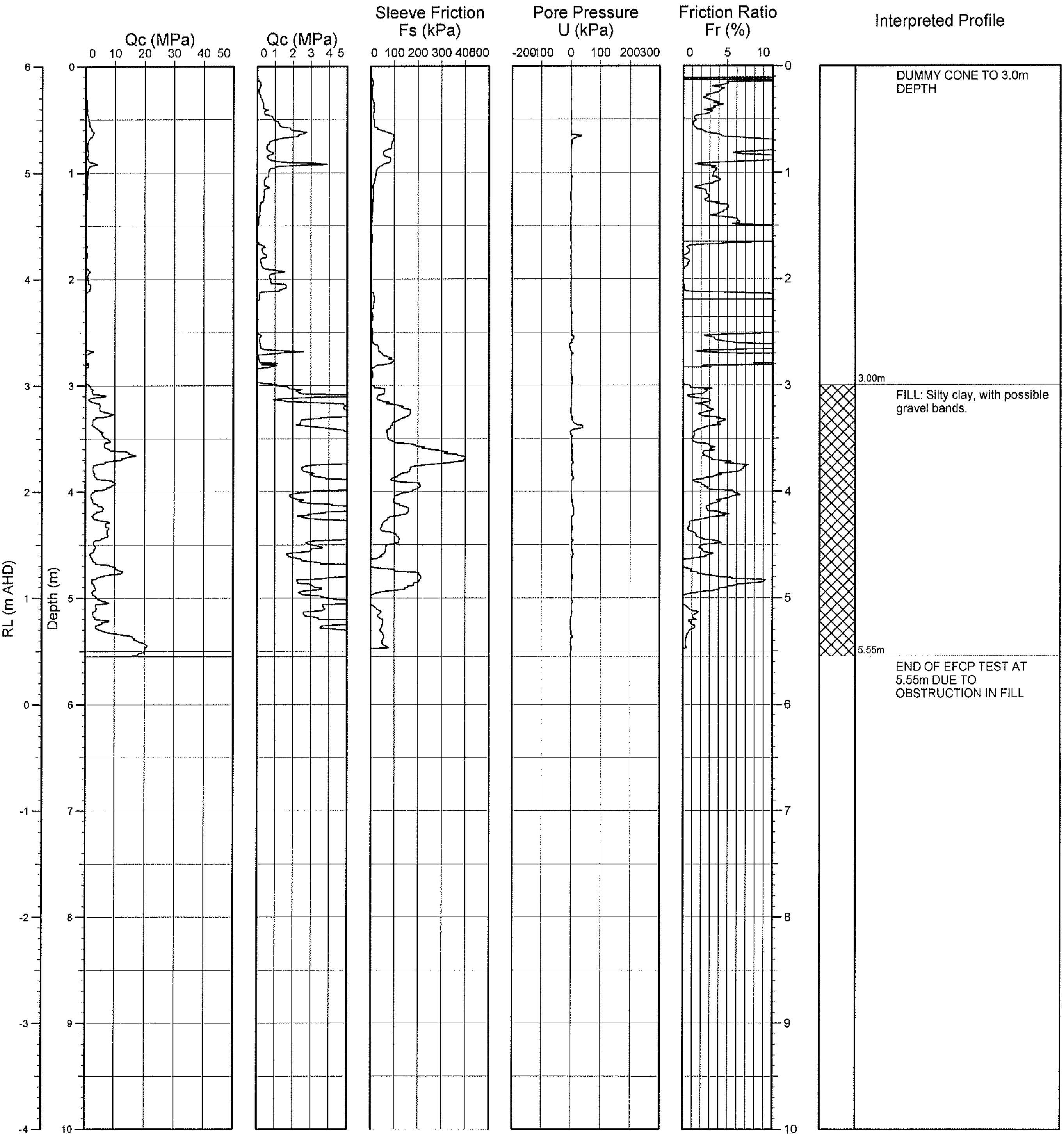
Interpreted by: D.W.
Checked by:

EFCP No.
14
1 / 1

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z
R.L. Surface: ~6.0 m
Data File: 26930Z_14_2.GEF
Date: 25/10/13
Datum: AHD
Operator: D.W.



Interpreted by: D.W.
Checked by:

JK_LIB_CURRENT - V7.1.GLB Log J & K CPTU MATERIAL - MASTER 26930Z MOOREBANK.GPJ DWG00471.GDW 18/12/2013 10:16 Produced by gINT Professional, Developed by Datgel

NOTES:
Figure 1 has been recreated from the survey plan prepared by Freeburn Surveying Pty Ltd (Ref: 32825, dated 22/8/13).

The borehole locations presented on this plan have been established using a hand held GPS unit with an accuracy of +/- 5m.

Reference should be made to the report text for a full understanding of this plan.

Approximate Scale (m):

0 10 20 30 40 50

BOREHOLE LOCATION PLAN

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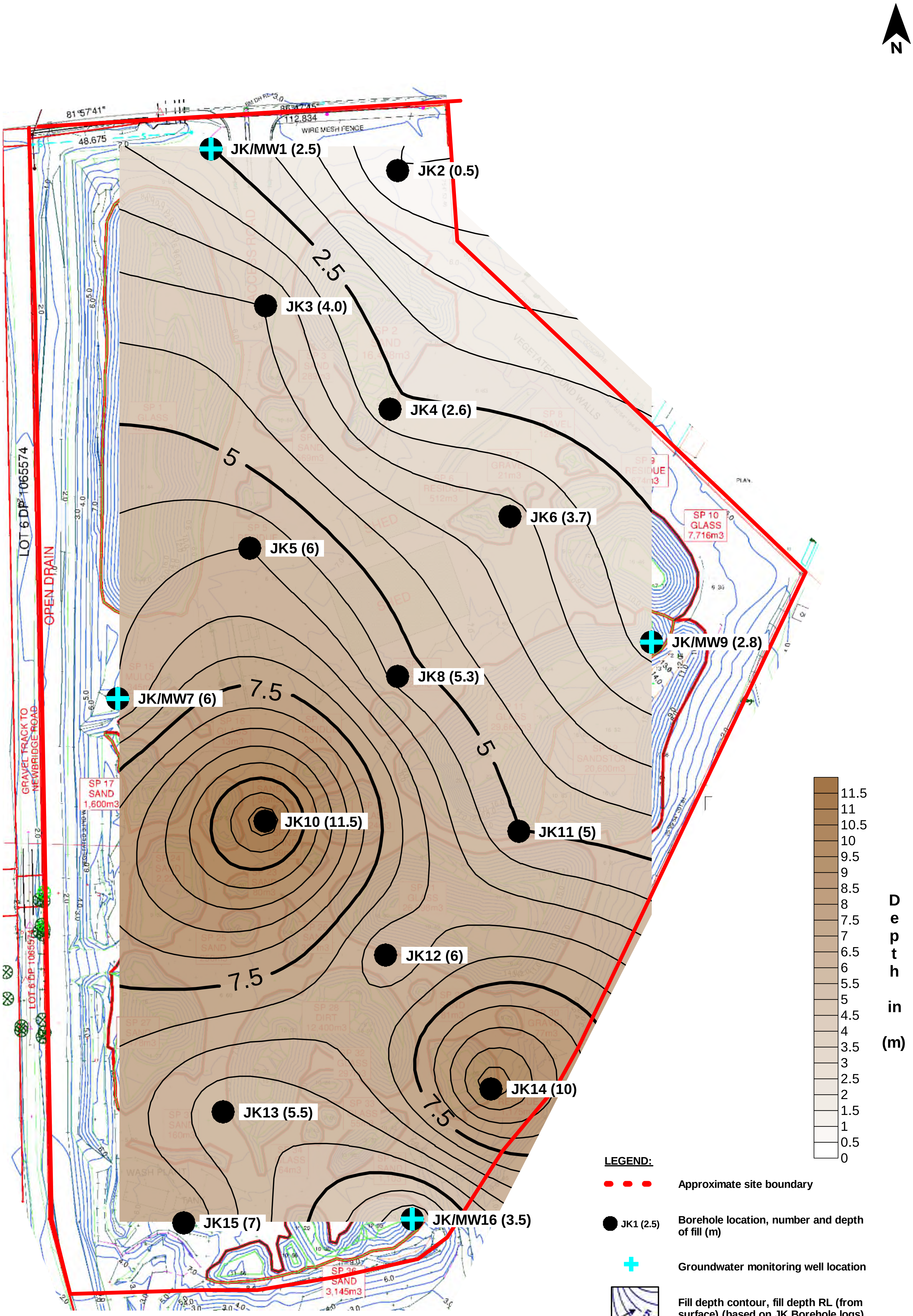
Report No. 26930Z Figure No. 1



LEGEND:

▬ ▬ ▬	Approximate site boundary
● JK1 (2.5)	Borehole location, number and depth of fill (m)
✚	Groundwater monitoring well location
▨	Fill depth contour, fill depth RL (from surface) (based on JK Borehole logs)

NOTES:
Figure 2 has been recreated from the survey plan prepared by Freeburn Surveying Pty Ltd (Ref: 32825, dated 22/8/13).

The borehole locations presented on this plan have been established using a hand held GPS unit with an accuracy of +/- 5m.

Reference should be made to the report text for a full understanding of this plan.

Approximate Scale (m):
0 10 20 30 40 50

FILL DEPTH CONTOUR PLAN

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Report No. 26930Z

Figure No. 2

REPORT EXPLANATION NOTES

REPORT EXPLANATION NOTES

INTRODUCTION

These notes have been provided to amplify the geotechnical report in regard to classification methods, field procedures and certain matters relating to the Comments and Recommendations section. Not all notes are necessarily relevant to all reports.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, the SAA Site Investigation Code. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geotechnical practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached Unified Soil Classification Table qualified by the grading of other particles present (e.g. sandy clay) as set out below:

Soil Classification	Particle Size
Clay	less than 0.002mm
Silt	0.002 to 0.075mm
Sand	0.075 to 2mm
Gravel	2 to 60mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT ‘N’ Value (blows/300mm)
Very loose	less than 4
Loose	4 – 10
Medium dense	10 – 30
Dense	30 – 50
Very Dense	greater than 50

Cohesive soils are classified on the basis of strength (consistency) either by use of hand penetrometer, laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength kPa
Very Soft	less than 25
Soft	25 – 50
Firm	50 – 100
Stiff	100 – 200
Very Stiff	200 – 400
Hard	Greater than 400
Friable	Strength not attainable – soil crumbles

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, ‘Shale’ is used to describe thinly bedded to laminated siltstone.

SAMPLING

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

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content, minor constituents and, depending upon the degree of disturbance, some information on strength and structure. Bulk samples are similar but of greater volume required for some test procedures.

Undisturbed samples are taken by pushing a thin-walled sample tube, usually 50mm diameter (known as a U50), into the soil and withdrawing it with a sample of the soil contained 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.

Details of the type and method of sampling used are given on the attached logs.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All except test pits, hand auger drilling and portable dynamic cone penetrometers require the use of a mechanical drilling rig which is commonly mounted on a truck chassis.

Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Premature refusal of the hand augers can occur on a variety of materials such as hard clay, gravel or ironstone, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

Rock Augering: Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock fragments. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is usually advanced by a rotary bit, with water 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 “feel” and rate of penetration.

Mud Stabilised Drilling: Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term ‘mud’ encompasses a range of products ranging from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, an NMLC triple tube core barrel, which gives a core of about 50mm diameter, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as CORE LOSS. The location of losses are determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the top end of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils as a means of indicating density or strength 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 F3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the ‘N’ value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm 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 150mm of, say, 4, 6 and 7 blows, as

  N = 13
  4, 6, 7

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

  N>30
  15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

Occasionally, the drop hammer is used to drive 50mm diameter thin walled sample tubes (U50) in clays. In such circumstances, the test results are shown on the borehole logs in brackets.

A modification to the SPT test is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as "N_c” on the borehole logs, together with the number of blows per 150mm penetration.

Static Cone Penetrometer Testing and Interpretation: Cone penetrometer testing (sometimes referred to as a Dutch Cone) described in this report has been carried out using an Electronic Friction Cone Penetrometer (EFCP). The test is described in Australian Standard 1289, Test F5.1.

In the tests, a 35mm diameter rod with a conical tip is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the frictional resistance on a separate 134mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are electrically connected by wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output as incremental digital records every 10mm. The results given in this report have been plotted from the digital data.

The information provided on the charts comprise:

- Cone resistance – the actual end bearing force divided by the cross sectional area of the cone – expressed in MPa.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio – the ratio of sleeve friction to cone resistance, expressed as a percentage.

  The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and occasionally very soft clays, rising to 4% to 10% in stiff clays and peats. Soil descriptions based on cone resistance and friction ratios are only inferred and must not be considered as exact.

Correlations between EFCP and SPT values can be developed for both sands and clays but may be site specific.

Interpretation of EFCP values can be made to empirically derive modulus or compressibility values to allow calculation of foundation settlements.

Stratification can be inferred from the cone and friction traces and from experience and information from nearby boreholes etc. Where shown, this information is presented for general guidance, but must be regarded as interpretive. The test method provides a continuous profile of engineering properties but, where precise information on soil classification is required, direct drilling and sampling may be preferable.

Portable Dynamic Cone Penetrometers: Portable Dynamic Cone Penetrometer (DCP) tests are carried out by driving a rod into the ground with a sliding hammer and counting the blows for successive 100mm increments of penetration.

Two relatively similar tests are used:

- Cone penetrometer (commonly known as the Scala Penetrometer) – a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (AS1289, Test F3.2). The 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.
- Perth sand penetrometer – a 16mm diameter flat ended rod is driven with a 9kg hammer, dropping 600mm (AS1289, Test F3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.

LOGS

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

The attached explanatory notes define the terms and symbols used in preparation of the logs.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than “straight line” variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

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

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it 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 and may not be the same at the time of construction.
- 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 be washed out of the hole or ‘reverted’ chemically if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read after stabilising at intervals ranging from several days to 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 perched water tables or surface water.

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg bricks, steel etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably determine the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse engineering characteristics or behaviour. If the volume and quality of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing is normally carried out in accordance with Australian Standard 1289 *'Methods of Testing Soil for Engineering Purposes'*. Details of the test procedure used are given on the individual report forms.

ENGINEERING REPORTS

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building) the information and interpretation may not be relevant if the design proposal is changed (eg to a twenty storey building). If this happens, the company 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 aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions – the potential for this will be partially dependent on borehole spacing and sampling frequency as well as investigation technique.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of persons or contractors responding to commercial pressures.

If these occur, the company will be pleased to assist with investigation or advice to resolve any problems occurring.

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, the company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed that at some later stage, well after the event.

REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES

Attention is drawn to the document *'Guidelines for the Provision of Geotechnical Information in Tender Documents'* , published by the Institution of Engineers, Australia. Where information obtained from this investigation 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. The company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Copyright in all documents (such as drawings, borehole or test pit logs, reports and specifications) provided by the Company shall remain the property of Jeffery and Katauskas Pty Ltd. Subject to the payment of all fees due, the Client alone shall have a licence to use the documents provided for the sole purpose of completing the project to which they relate. License to use the documents may be revoked without notice if the Client is in breach of any objection to make a payment to us.

REVIEW OF DESIGN

Where major civil or structural developments are proposed or where only a limited investigation has been completed or where the geotechnical conditions/ constraints are quite complex, it is prudent to have a joint design review which involves a senior geotechnical engineer.

SITE INSPECTION

The company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related.

Requirements could range from:

i) a site visit to confirm that conditions exposed are no worse than those interpreted, to

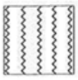
ii) a visit to assist the contractor or other site personnel in identifying various soil/rock types such as appropriate footing or pier founding depths, or

iii) full time engineering presence on site.

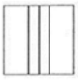
GRAPHIC LOG SYMBOLS FOR SOILS AND ROCKS

SOIL


FILL


TOPSOIL

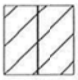

CLAY (CL, CH)

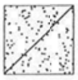

SILT (ML, MH)


SAND (SP, SW)


GRAVEL (GP, GW)

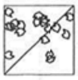

SANDY CLAY (CL, CH)

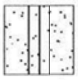

SILTY CLAY (CL, CH)


CLAYEY SAND (SC)


SILTY SAND (SM)


GRAVELLY CLAY (CL, CH)

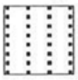

CLAYEY GRAVEL (GC)


SANDY SILT (ML)


PEAT AND ORGANIC SOILS

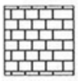
ROCK


CONGLOMERATE

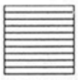

SANDSTONE


SHALE

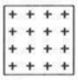

SILTSTONE, MUDSTONE, CLAYSTONE


LIMESTONE


PHYLLITE, SCHIST


TUFF

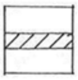

GRANITE, GABBRO

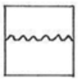

DOLERITE, DIORITE

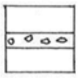

BASALT, ANDESITE


QUARTZITE

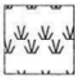
DEFECTS AND INCLUSIONS


CLAY SEAM

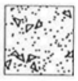

SHEARED OR CRUSHED SEAM


BRECCIATED OR SHATTERED SEAM/ZONE


IRONSTONE GRAVEL

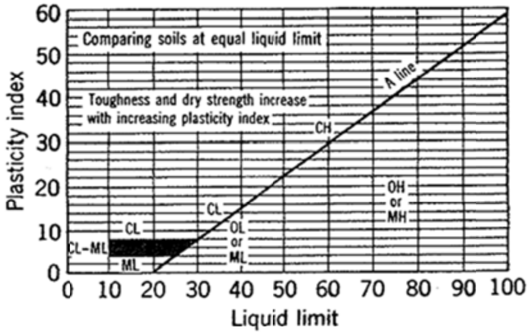

ORGANIC MATERIAL

OTHER MATERIALS


CONCRETE


BITUMINOUS CONCRETE, COAL


COLLUVIUM

Field Identification Procedures (Excluding particles larger than 75 µm and basing fractions on estimated weights)						Group Symbols[a]	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria			
Coarse-grained soils More than half of material is *larger* than 75 µm sieve size[b] (The 75 µm sieve size is about the smallest particle visible to naked eye)	Gravels More than half of coarse fraction is larger than 4 mm sieve size	Clean gravels (little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes			*GW*	Well graded gravels, gravel-sand mixtures, little or no fines	Give typical name; indicate approximate percentages of sand and gravel; maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics Example: *Silty sand*, gravelly; about 20% hard, angular gravel particles 12 mm maximum size; rounded and subangular sand grains coarse to fine, about 15% non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand; (*SM*)	Use grain size curve in identifying the fractions as given under field identification	Determine percentages of gravel and sand from grain size curve Depending on percentage of fines (fraction smaller than 75 µm sieve size) coarse grained soils are classified as follows: Less than 5% *GW, GP, SW, SP* More than 12% *GM, GC, SM, SC* 5% to 12% *Borderline* cases requiring use of dual symbols	$C_U = \frac{D_{60}}{D_{10}}$ Greater than 4 $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
			Predominantly one size or a range of sizes with some intermediate sizes missing			*GP*	Poorly graded gravels, gravel-sand mixtures, little or no fines				Not meeting all gradation requirements for *GW*	
		Gravels with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures see *ML* below)			*GM*	Silty gravels, poorly graded gravel-sand-silt mixtures				Atterberg limits below "A" line, or *PI* less than 4	Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
			Plastic fines (for identification procedures, see *CL* below)			*GC*	Clayey gravels, poorly graded gravel-sand-clay mixtures				Atterberg limits above "A" line, with *PI* greater than 7	
	Sands More than half of coarse fraction is smaller than 4 mm sieve size	Clean sands (little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes			*SW*	Well graded sands, gravelly sands, little or no fines				$C_U = \frac{D_{60}}{D_{10}}$ Greater than 6 $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
			Predominantly one size or a range of sizes with some intermediate sizes missing			*SP*	Poorly graded sands, gravelly sands, little or no fines				Not meeting all gradation requirements for *SW*	
		Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see *ML* below)			*SM*	Silty sands, poorly graded sand-silt mixtures				Atterberg limits below "A" line or *PI* less than 5	Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
			Plastic fines (for identification procedures, see *CL* below)			*SC*	Clayey sands, poorly graded sand-clay mixtures				Atterberg limits below "A" line with *PI* greater than 7	
	Identification Procedures on Fraction Smaller than 380 µm Sieve Size											
			Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)							
Fine-grained soils More than half of material is *smaller* than 75 µm sieve size	Silts and clays liquid limit less than 50		None to slight	Quick to slow	None	*ML*	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; colour in wet condition, odour if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions Example: *Clayey silt*, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (*ML*)		 Plasticity chart for laboratory classification of fine grained soils		
			Medium to high	None to very slow	Medium	*CL*	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays					
			Slight to medium	Slow	Slight	*OL*	Organic silts and organic silt-clays of low plasticity					
	Silts and clays liquid limit greater than 50		Slight to medium	Slow to none	Slight to medium	*MH*	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts					
			High to very high	None	High	*CH*	Inorganic clays of high plasticity, fat clays					
			Medium to high	None to very slow	Slight to medium	*OH*	Organic clays of medium to high plasticity					
Highly Organic Soils			Readily identified by colour, odour, spongy feel and frequently by fibrous texture			*Pt*	Peat and other highly organic soils					

Note: 1 Soils possessing characteristics of two groups are designated by combinations of group symbols (eg. GW-GC, well graded gravel-sand mixture with clay fines).
2 Soils with liquid limits of the order of 35 to 50 may be visually classified as being of medium plasticity.

LOG SYMBOLS

LOG COLUMN	SYMBOL	DEFINITION
Groundwater Record	▼	Standing water level. Time delay following completion of drilling may be shown.
	C	Extent of borehole collapse shortly after drilling.
	▶	Groundwater seepage into borehole or excavation noted during drilling or excavation.
Samples	ES	Soil sample taken over depth indicated, for environmental analysis.
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.
	DB	Bulk disturbed sample taken over depth indicated.
	DS	Small disturbed bag sample taken over depth indicated.
	ASB	Soil sample taken over depth indicated, for asbestos screening.
	ASS	Soil sample taken over depth indicated, for acid sulfate soil analysis.
	SAL	Soil sample taken over depth indicated, for salinity analysis.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'R' as noted below.
	N_c = 5 7 3R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60 degree solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25	Vane shear reading in kPa of Undrained Shear Strength.
	PID = 100	Photoionisation detector reading in ppm (Soil sample headspace test).
Moisture Condition (Cohesive Soils)	MC>PL	Moisture content estimated to be greater than plastic limit.
	MC≈PL	Moisture content estimated to be approximately equal to plastic limit.
	MC<PL	Moisture content estimated to be less than plastic limit.
(Cohesionless Soils)	D	DRY – Runs freely through fingers.
	M	MOIST – Does not run freely but no free water visible on soil surface.
	W	WET – Free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS	VERY SOFT – Unconfined compressive strength less than 25kPa
	S	SOFT – Unconfined compressive strength 25-50kPa
	F	FIRM – Unconfined compressive strength 50-100kPa
	St	STIFF – Unconfined compressive strength 100-200kPa
	VSt	VERY STIFF – Unconfined compressive strength 200-400kPa
	H	HARD – Unconfined compressive strength greater than 400kPa
	( )	Bracketed symbol indicates estimated consistency based on tactile examination or other tests.
Density Index/ Relative Density (Cohesionless Soils)		**Density Index (I_D) Range (%)** **SPT 'N' Value Range (Blows/300mm)**
	VL	Very Loose <15 0-4
	L	Loose 15-35 4-10
	MD	Medium Dense 35-65 10-30
	D	Dense 65-85 30-50
	VD	Very Dense >85 >50
	( )	Bracketed symbol indicates estimated density based on ease of drilling or other tests.
Hand Penetrometer Readings	300 250	Numbers indicate individual test results in kPa on representative undisturbed material unless noted otherwise.
Remarks	'V' bit	Hardened steel 'V' shaped bit.
	'TC' bit	Tungsten carbide wing bit.
	T_{60}	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.

LOG SYMBOLS continued

ROCK MATERIAL WEATHERING CLASSIFICATION

TERM	SYMBOL	DEFINITION
Residual Soil	RS	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely weathered rock	XW	Rock is weathered to such an extent that it has "soil" properties, ie it either disintegrates or can be remoulded, in water.
Distinctly weathered rock	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by ironstaining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Slightly weathered rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh rock	FR	Rock shows no sign of decomposition or staining.

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Journal of Rock Mechanics, Mining, Science and Geomechanics. Abstract Volume 22, No 2, 1985.

TERM	SYMBOL	Is (50) MPa	FIELD GUIDE
Extremely Low:	EL		Easily remoulded by hand to a material with soil properties.
-----------------------	--------------	0.03	
Very Low:	VL		May be crumbled in the hand. Sandstone is "sugary" and friable.
-----------------------	--------------	0.1	
Low:	L		A piece of core 150mm long x 50mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
-----------------------	--------------	0.3	
Medium Strength:	M		A piece of core 150mm long x 50mm dia. can be broken by hand with difficulty. Readily scored with knife.
-----------------------	--------------	1	
High:	H		A piece of core 150mm long x 50mm dia. core cannot be broken by hand, can be slightly scratched or scored with knife; rock rings under hammer.
-----------------------	---------------	3	
Very High:	VH		A piece of core 150mm long x 50mm dia. may be broken with hand-held pick after more than one blow. Cannot be scratched with pen knife; rock rings under hammer.
-----------------------	---------------	10	
Extremely High:	EH		A piece of core 150mm long x 50mm dia. is very difficult to break with hand-held hammer. Rings when struck with a hammer.

ABBREVIATIONS USED IN DEFECT DESCRIPTION

ABBREVIATION	DESCRIPTION	NOTES
Be	Bedding Plane Parting	Defect orientations measured relative to the normal to the long core axis (ie relative to horizontal for vertical holes)
CS	Clay Seam	
J	Joint	
P	Planar	
Un	Undulating	
S	Smooth	
R	Rough	
IS	Ironstained	
XWS	Extremely Weathered Seam	
Cr	Crushed Seam	
60t	Thickness of defect in millimetres	

APPENDIX A

Aerial Photographs
Between 1991 and 2015

20th September 1991

4th October 1994

29th September 1998

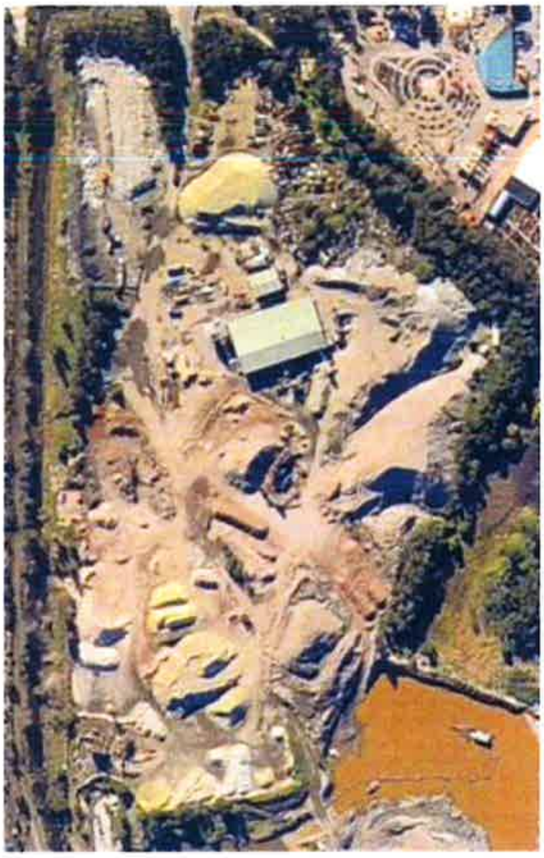
16th March 2002

10th December 2005

14th November 2009

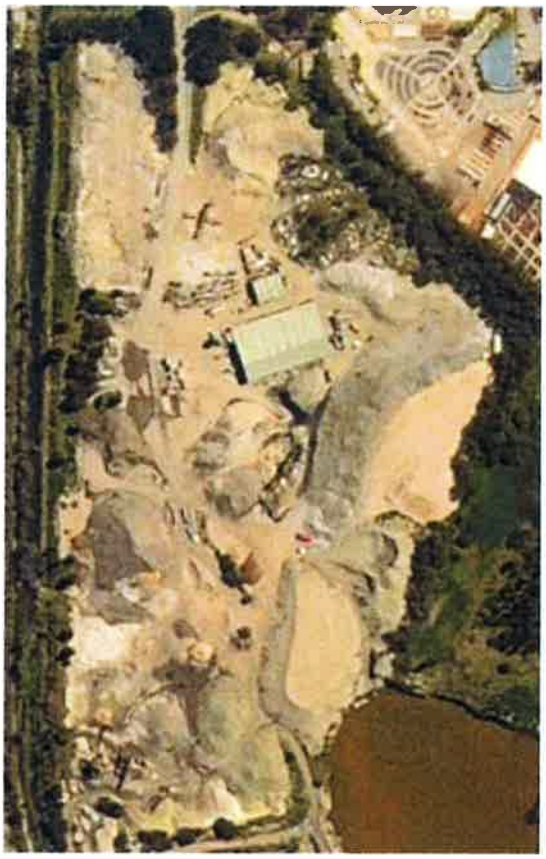
22nd April 2010

15th July 2010



3rd June 2011

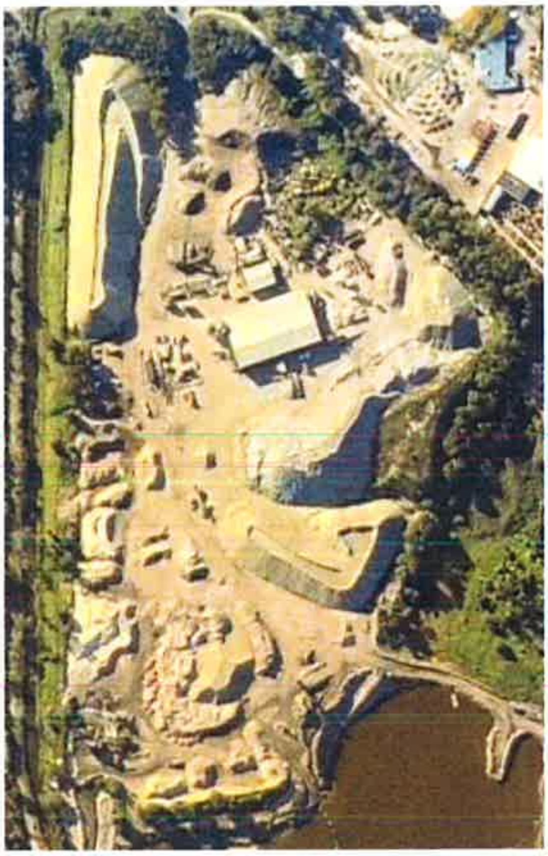
23rd October 2011



9th May 2012

24th October 2012

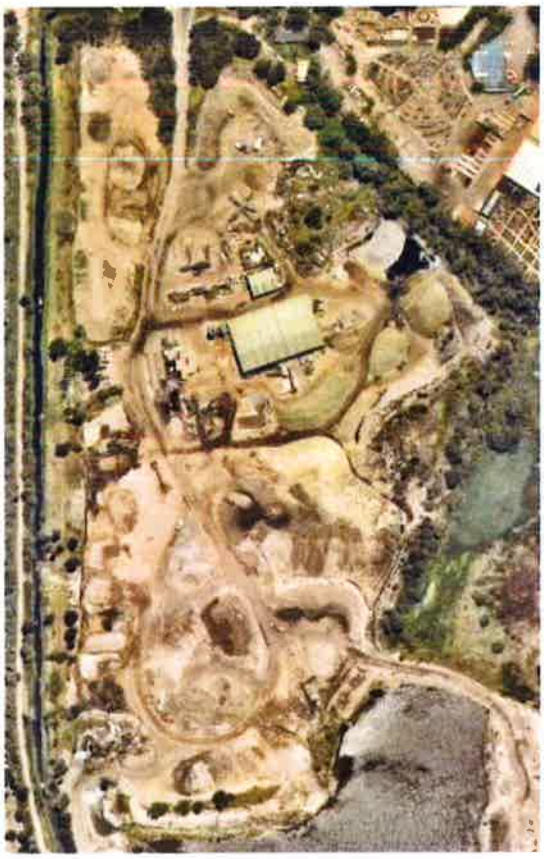
3rd May 2013



30th September 2013

8th February 2014

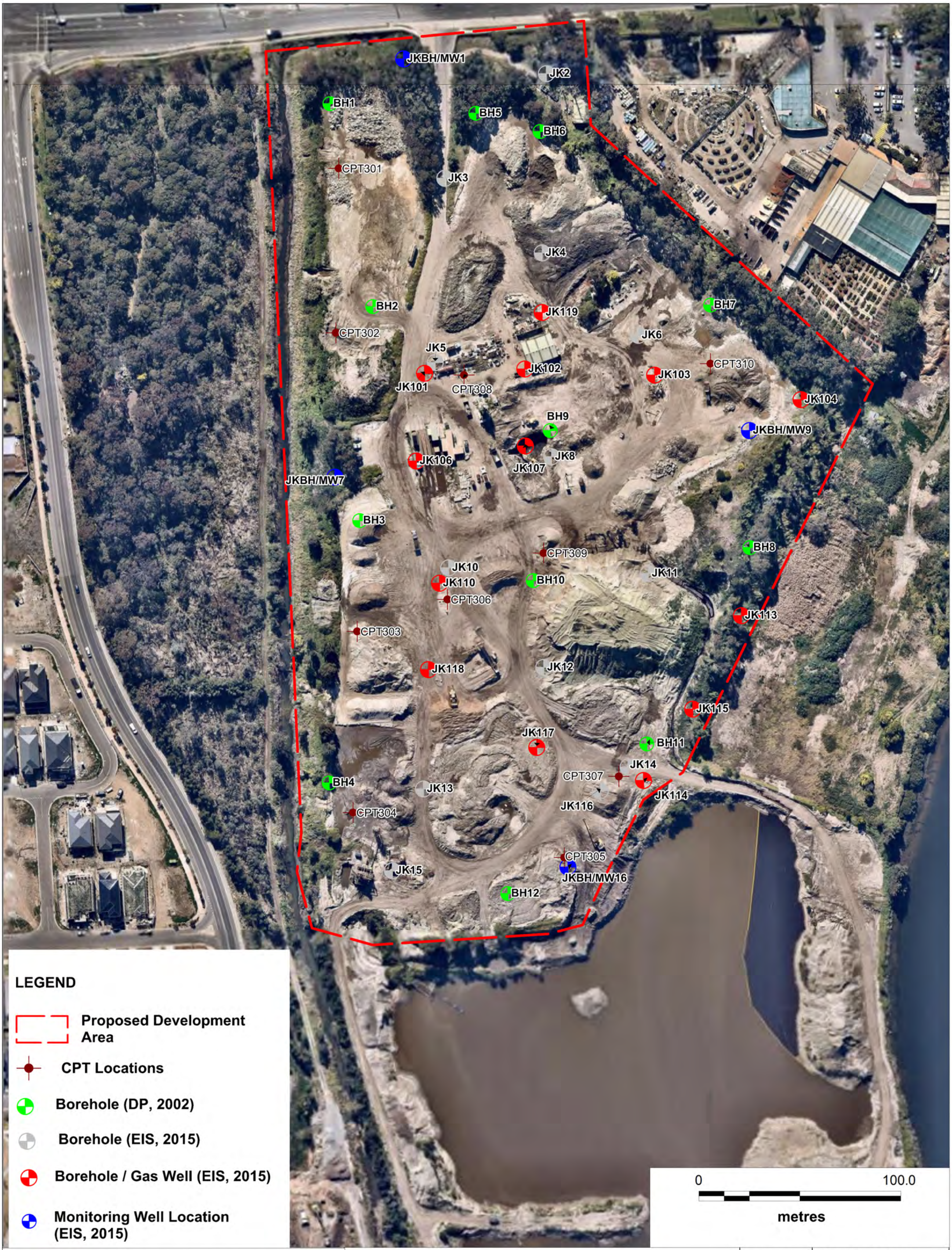
21st November 2014



6th May 2015

APPENDIX B

Douglas Partners
Test Locations and Test Results
(Project 30410, dated 30 May 2002)



Douglas Partners
Geotechnics | Environment | Groundwater

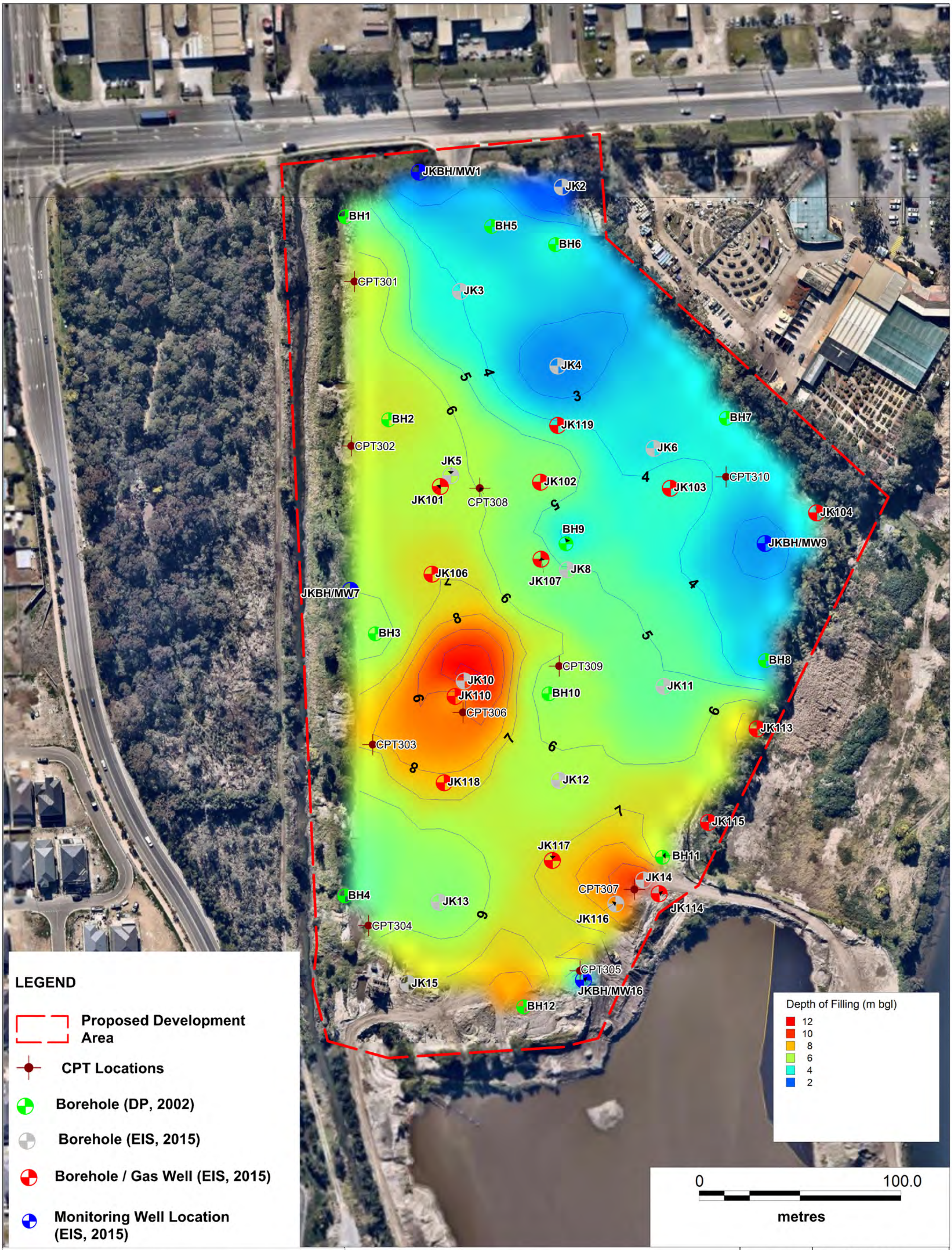
TITLE: Location of Tests

146 Newbridge Road, Moorebank, NSW

N
MGA

OFFICE: Sydney
DRAWN BY: MJC
DATE: 11.11.2015

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.04
DRAWING No: 1
REVISION: A
SCALE: As shown



Douglas Partners
Geotechnics | Environment | Groundwater

TITLE: Depth of Filling Contours

146 Newbridge Road, Moorebank, NSW

MGA

OFFICE: Sydney
DRAWN BY: MJC
DATE: 13.11.2015

CLIENT: Benedict Industries Pty Ltd	PROJECT No: 71459.04	DRAWING No: 2	REVISION: A	SCALE: As shown

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

COORDINATES:

CPT301

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04

REMARKS: HOLE DISCONTINUED DUE TO BENDING IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT201.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

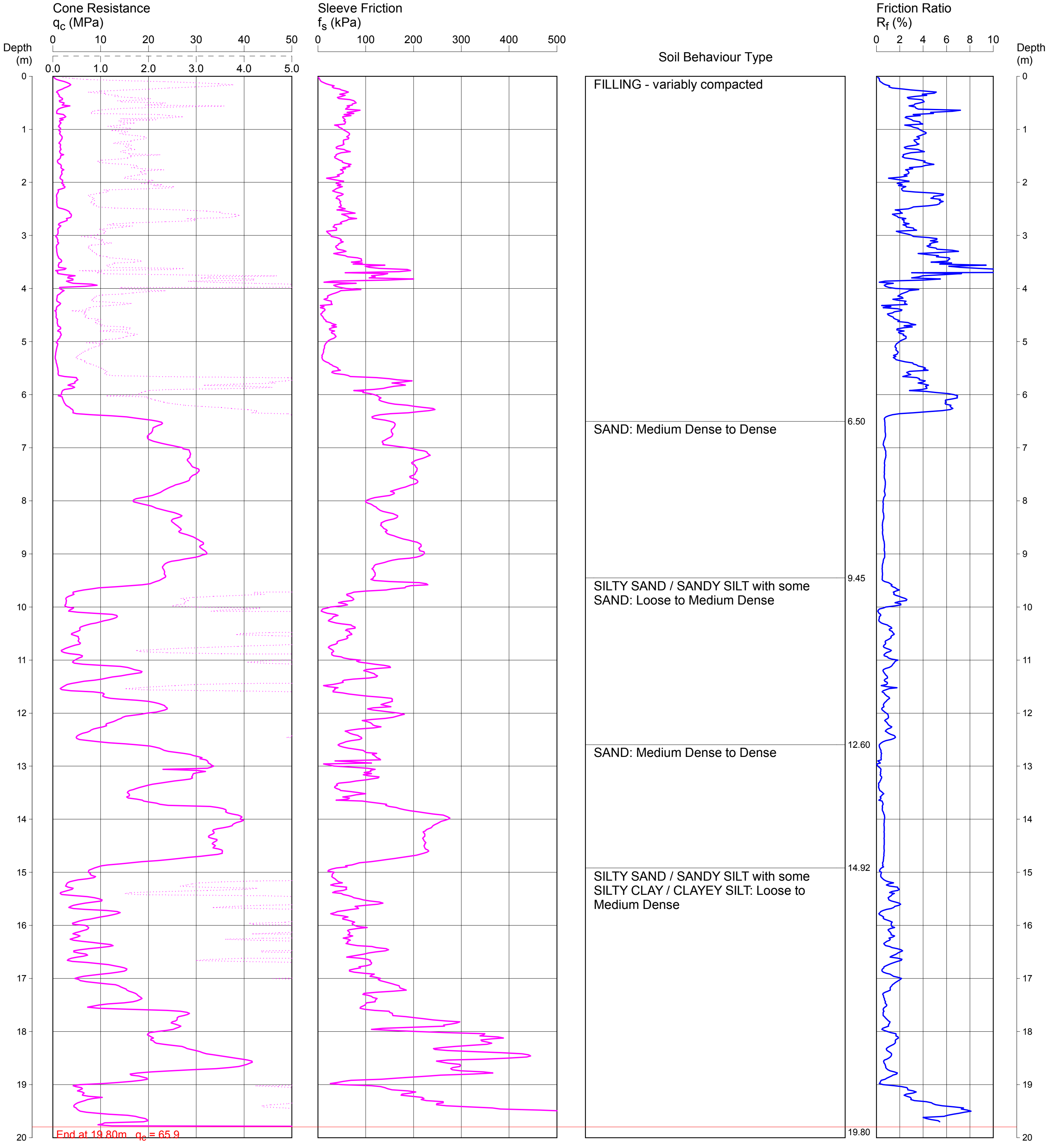
COORDINATES:

CPT301A

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



FILLING - variably compacted

6.50
SAND: Medium Dense to Dense

9.45
SILTY SAND / SANDY SILT with some SAND: Loose to Medium Dense

12.60
SAND: Medium Dense to Dense

14.92
SILTY SAND / SANDY SILT with some SILTY CLAY / CLAYEY SILT: Loose to Medium Dense

19.80

REMARKS: HOLE DISCONTINUED DUE TO CONE TIP REFUSAL.
HOLE COLLAPSE AT 4.9 m DEPTH AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT201A.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

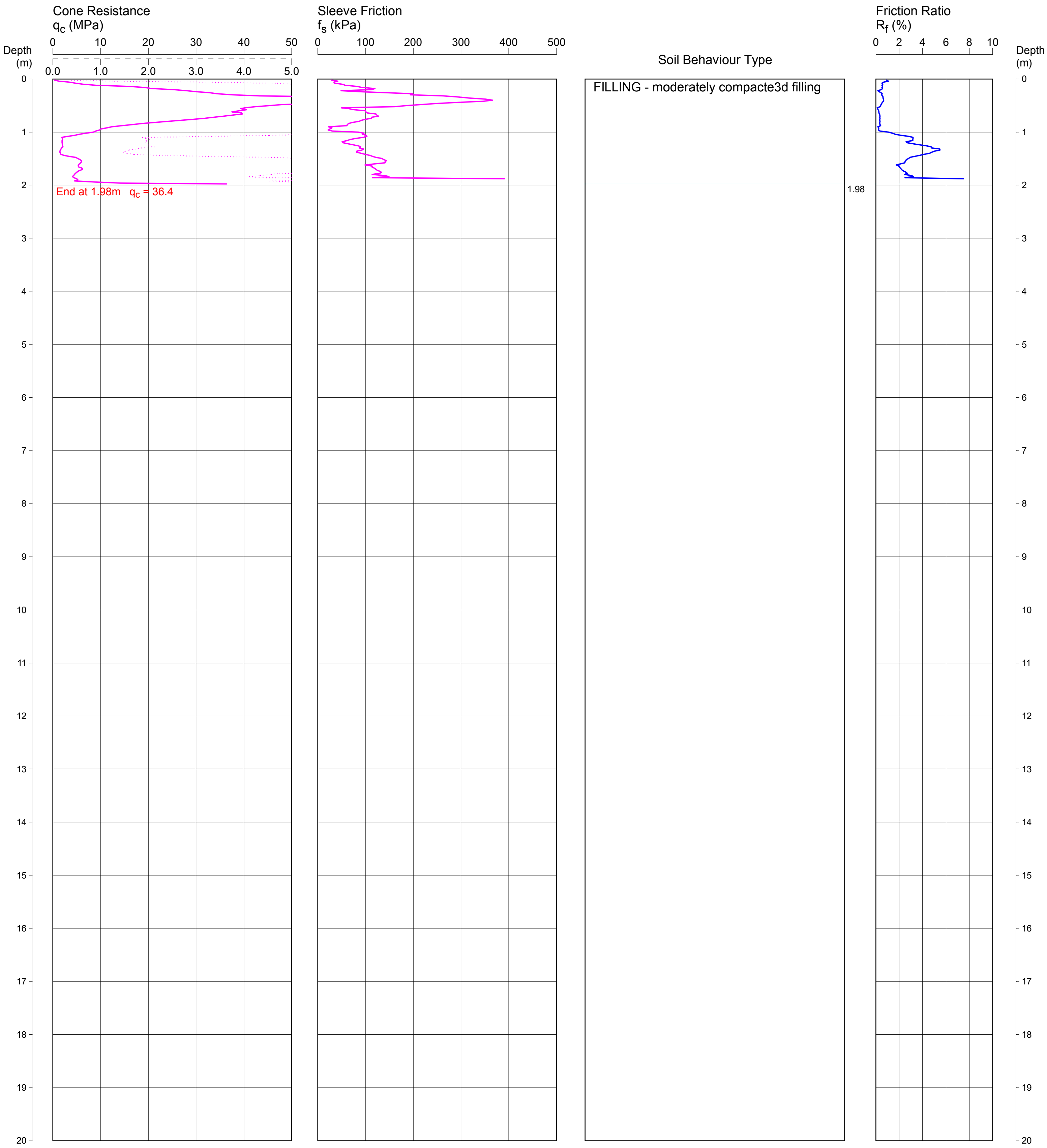
COORDINATES:

CPT302

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO BENDING IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT302.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

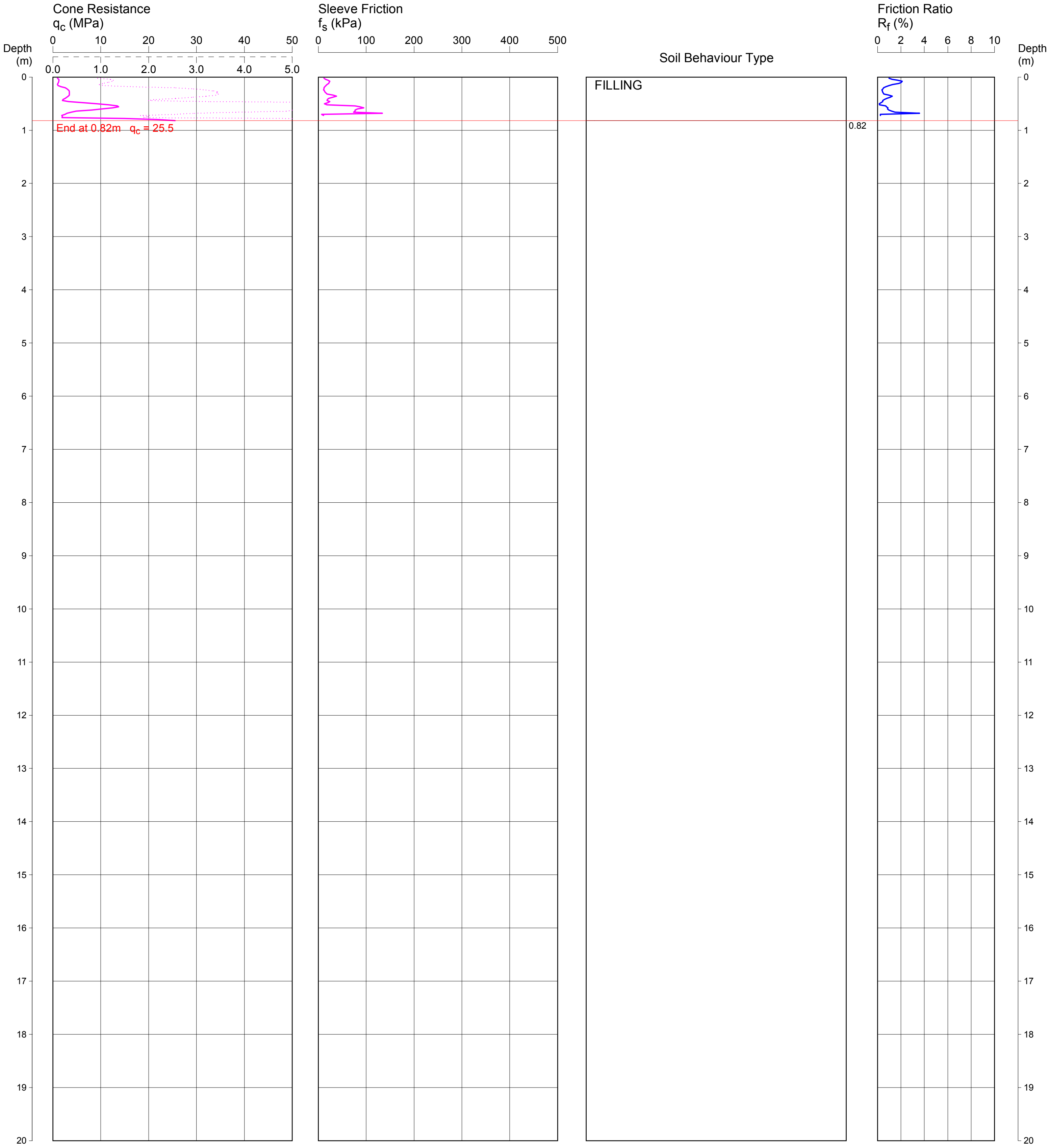
COORDINATES:

CPT302A

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO BENDING IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT302A.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

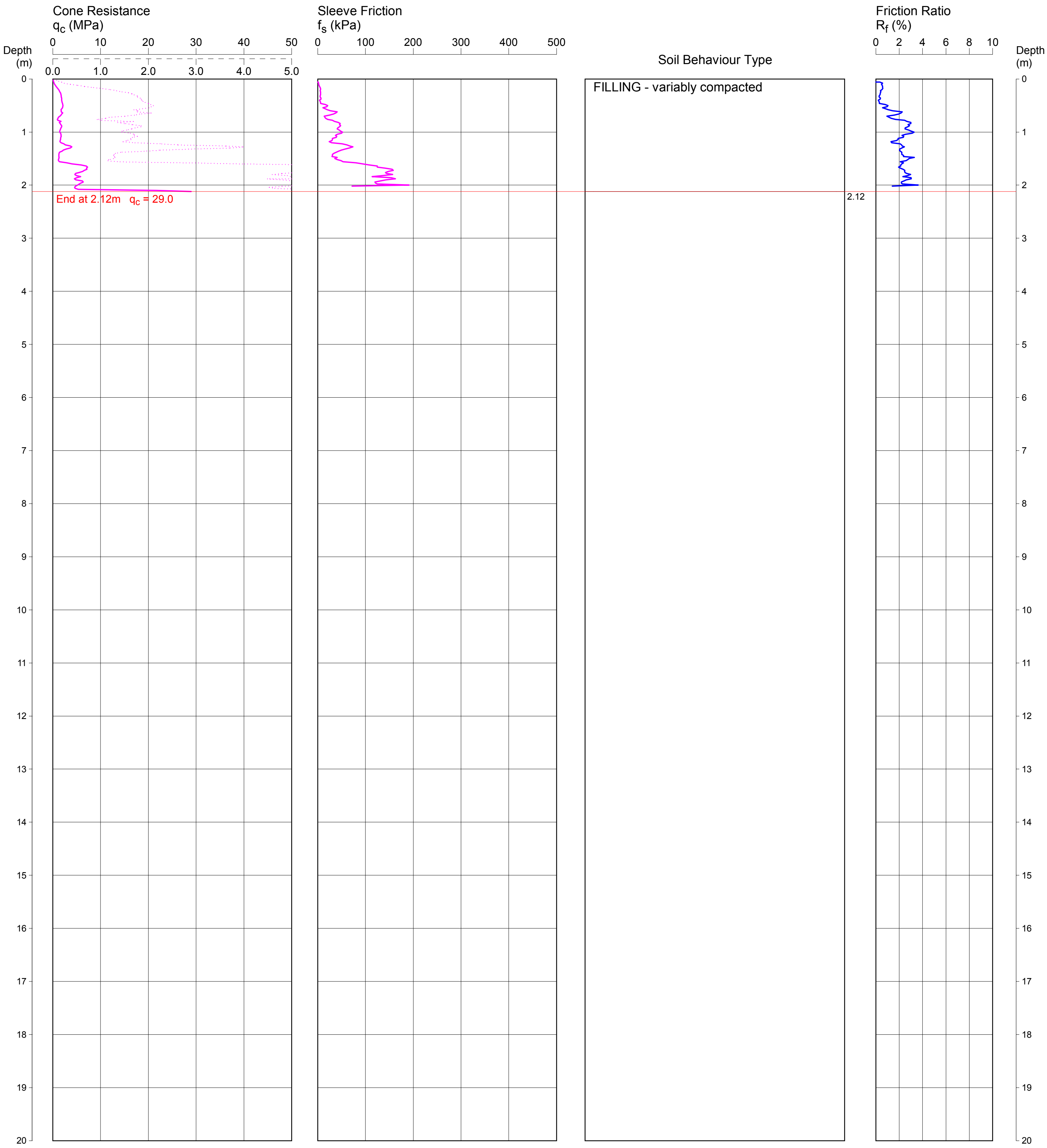
COORDINATES:

CPT302B

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO BENDING IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT302B.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
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CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

COORDINATES:

CPT302C

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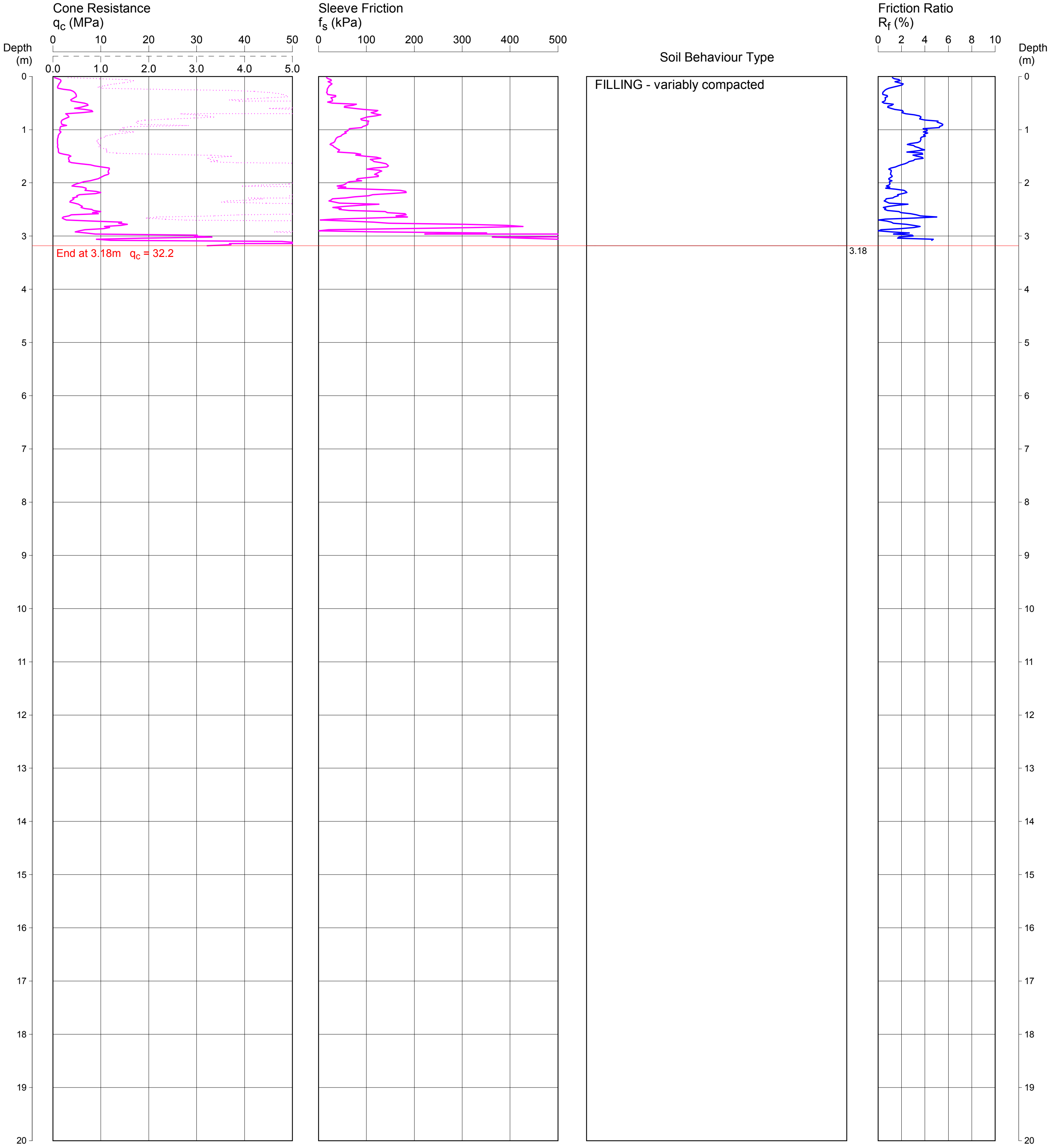
DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO HIGH CONE SLEEVE OFFSET.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT302C.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

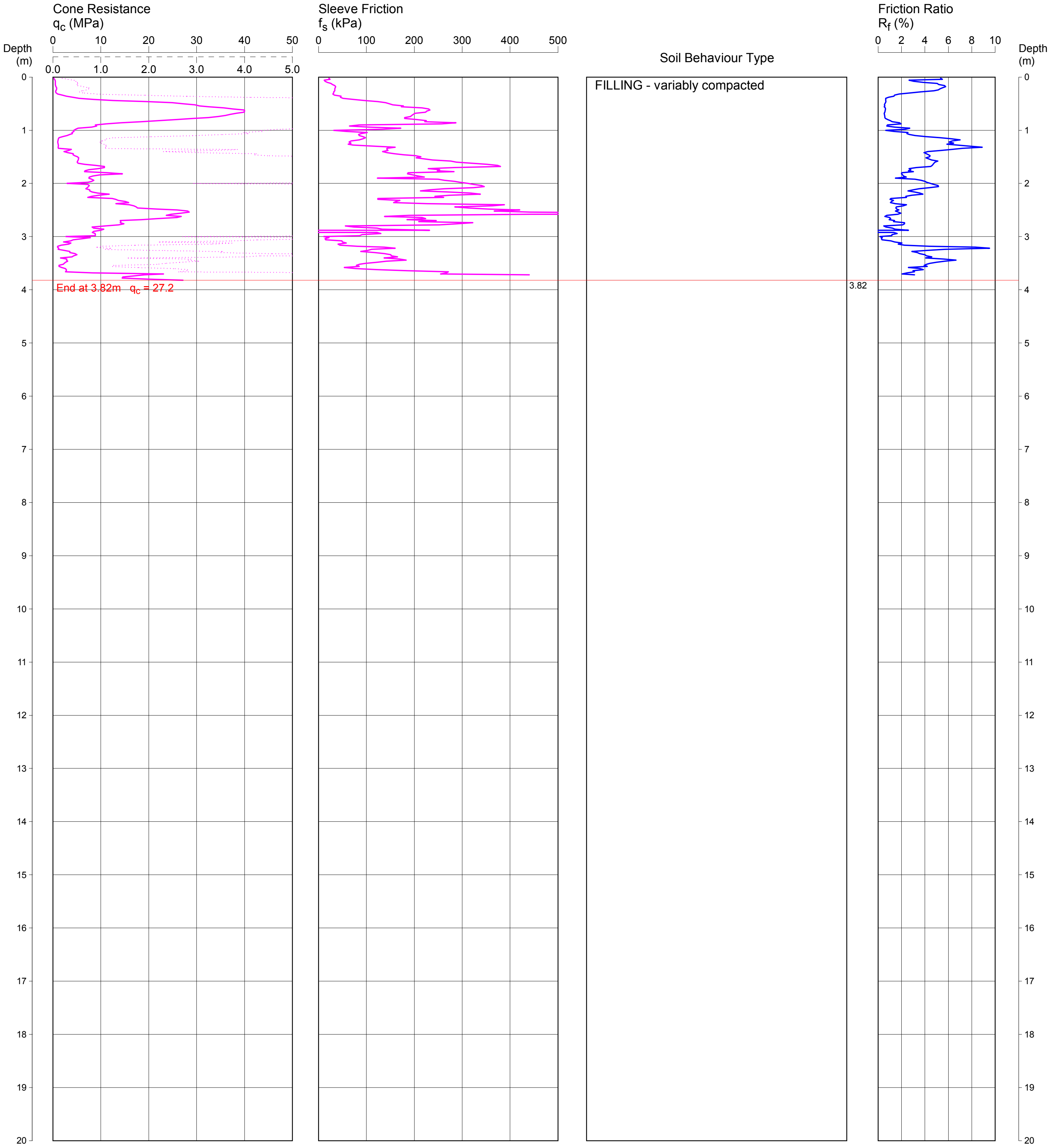
COORDINATES:

CPT302D

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO OBSTRUCTION IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT302D.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

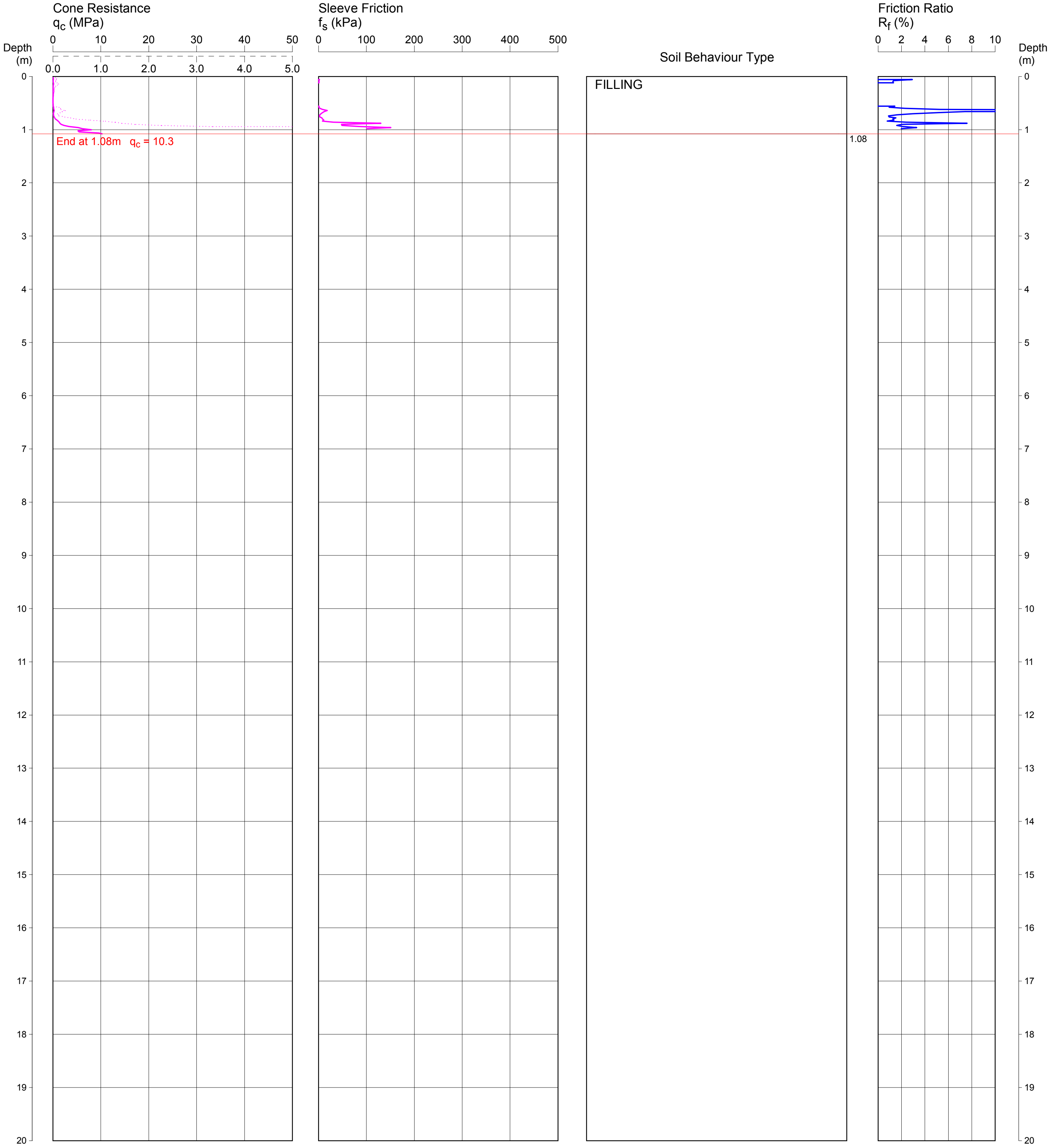
COORDINATES:

CPT303

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 0 m TO 1.0 m DEPTH TO PENETRATE FILLING; HOLE DISCONTINUED DUE TO BENDING IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT303.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

COORDINATES:

CPT303A

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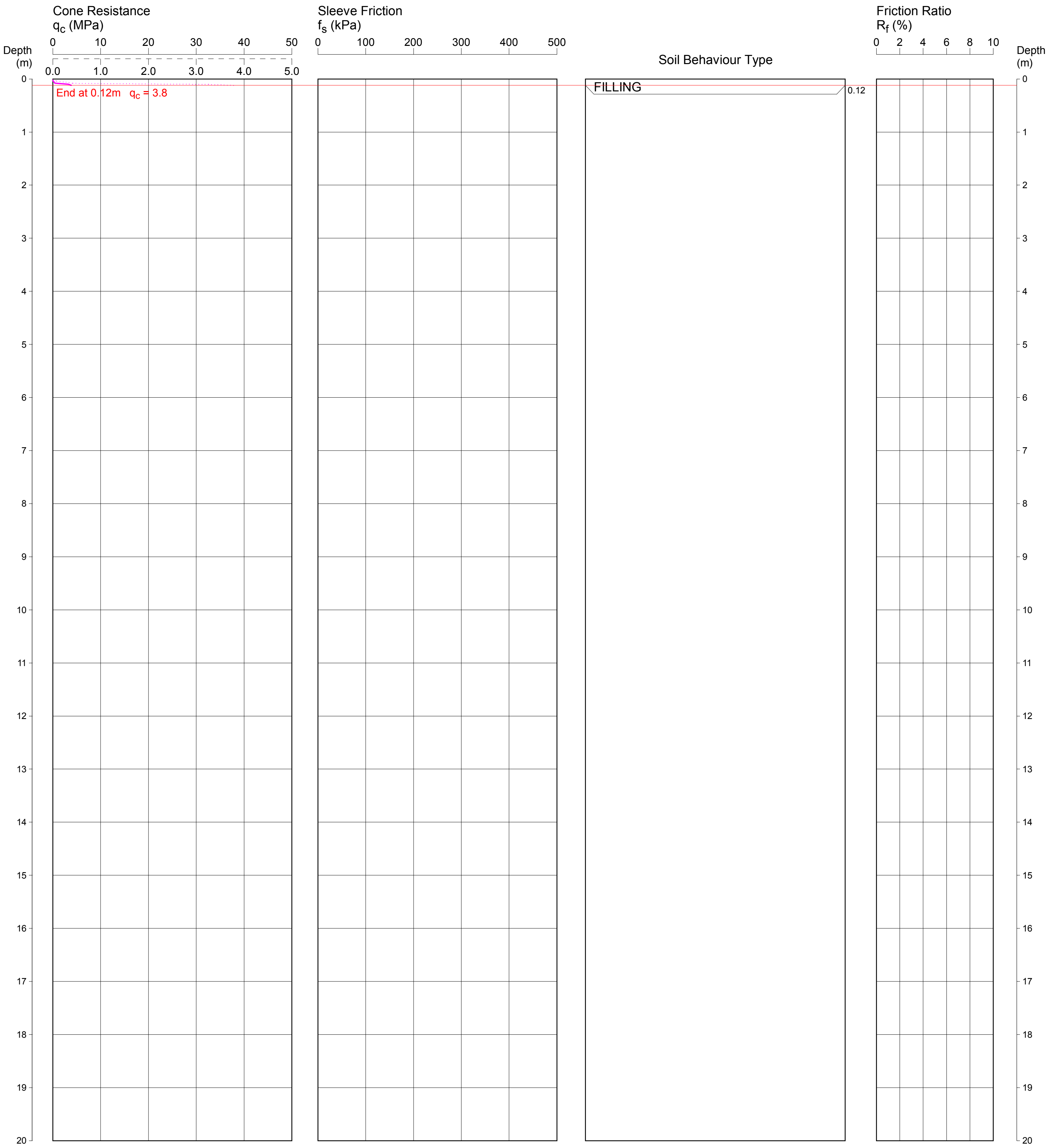
DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO OBSTRUCTION IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT303A.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

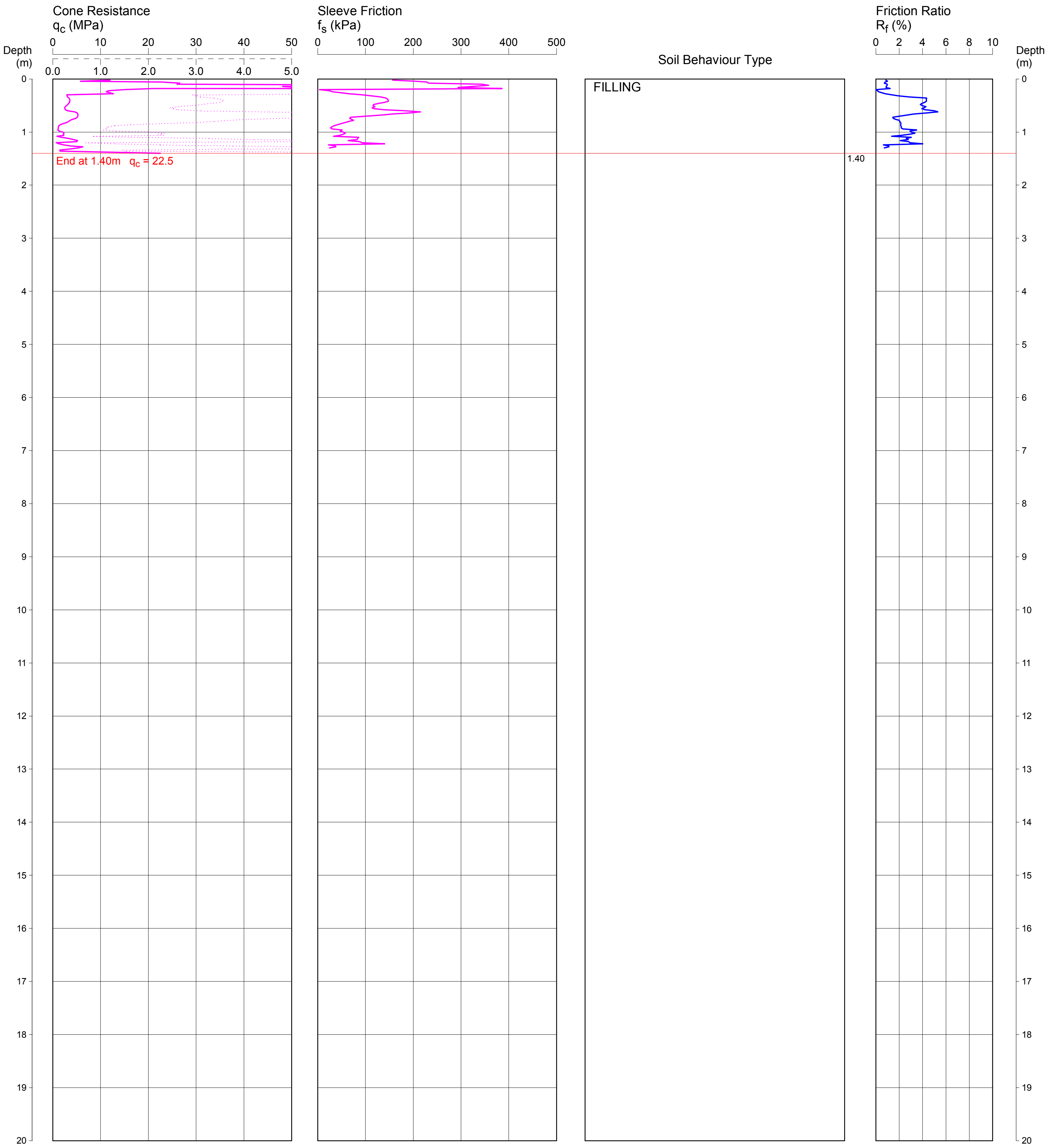
COORDINATES:

CPT303B

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO OBSTRUCTION IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT303B.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

COORDINATES:

CPT304

Page 1 of 1

DATE 2/9/2015

PROJECT No: 71459.04

REMARKS: HOLE DISCONTINUED DUE TO OBSTRUCTION IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT304.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

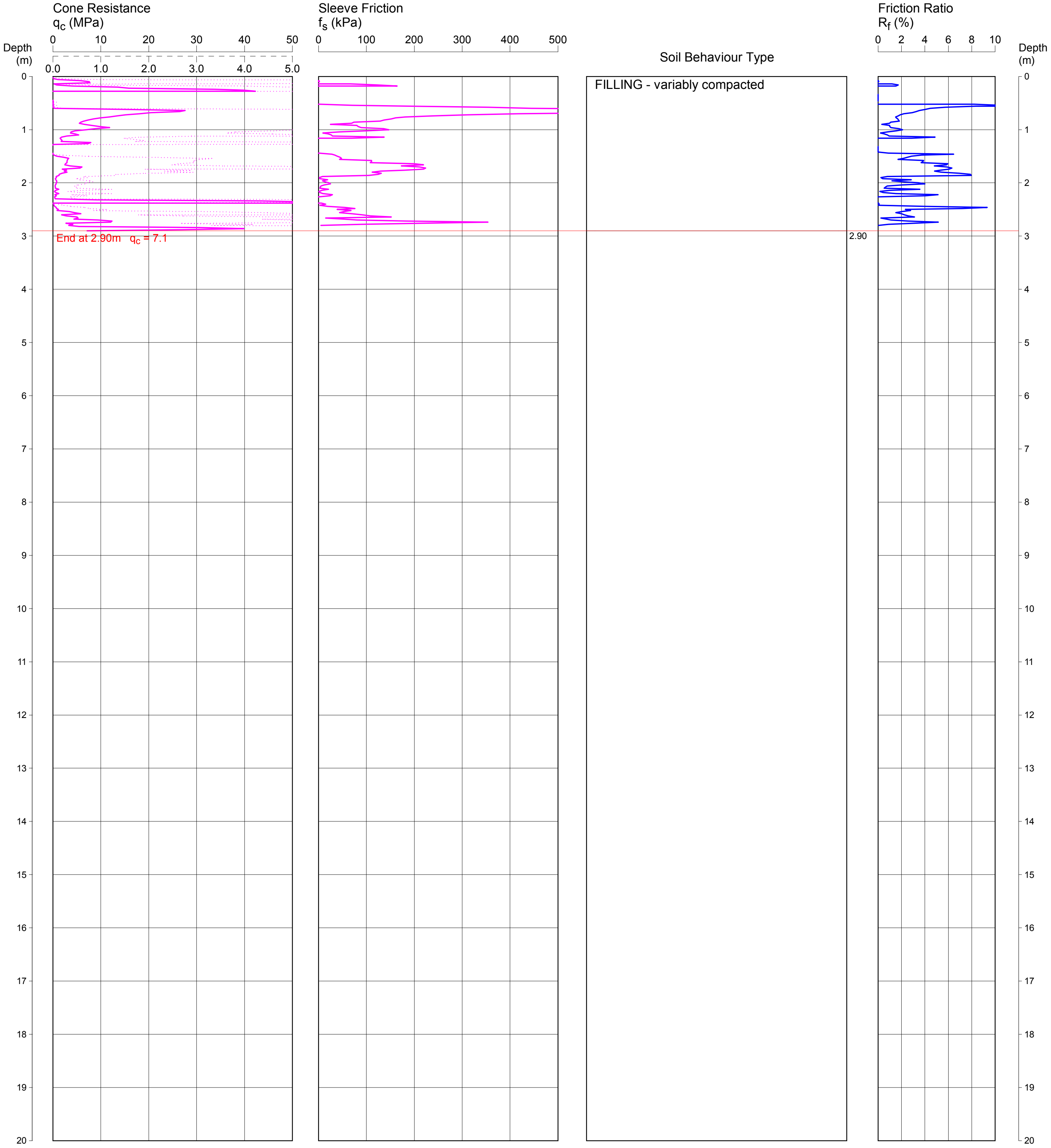
COORDINATES:

CPT304A

Page 1 of 1

DATE 2/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 0.28 m TO 0.60 m, 1.26 m TO 1.50 m, 2.36 m TO 2.50 m AND 2.88 m TO 4.10 m DEPTH TO PENETRATE FILLING.
HOLE DISCONTINUED DUE TO BENDING IN FILLING; NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT304A.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

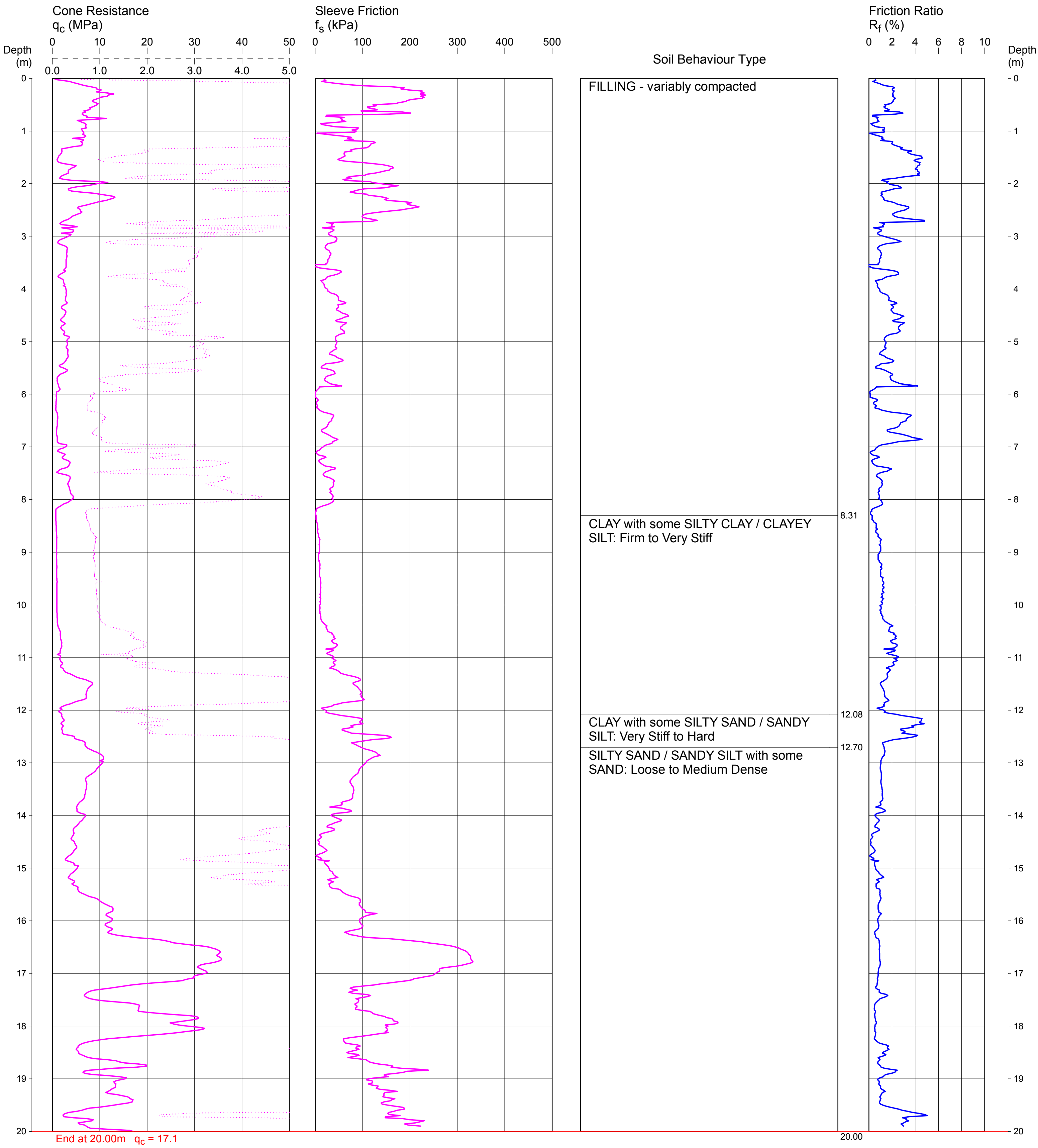
COORDINATES:

CPT305

Page 1 of 1

DATE 2/9/2015

PROJECT No: 71459.04



REMARKS: HOLE COLLAPSE AT 5.55 m DEPTH AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT305.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

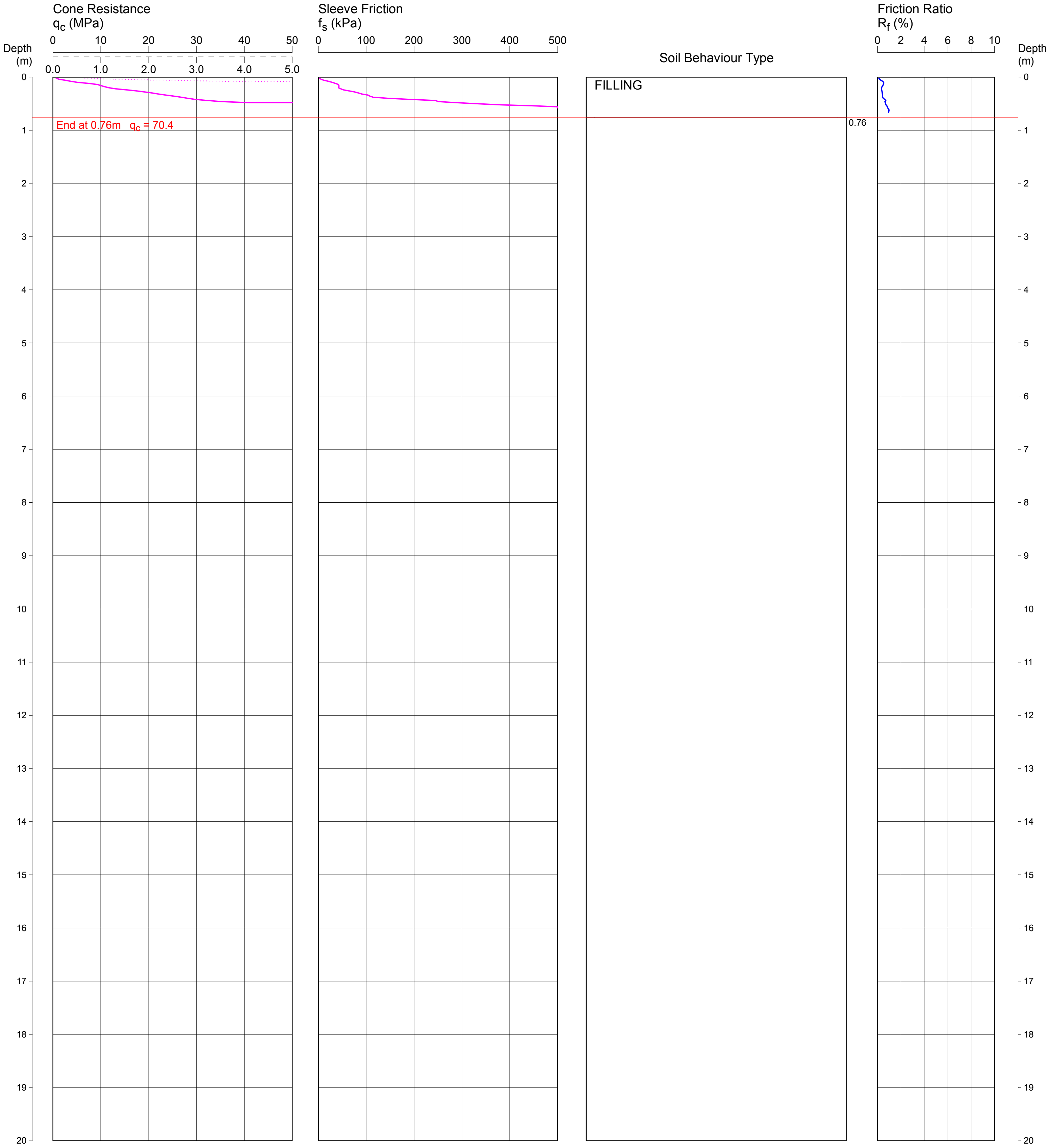
COORDINATES:

CPT306

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO OBSTRUCTION IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT306.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

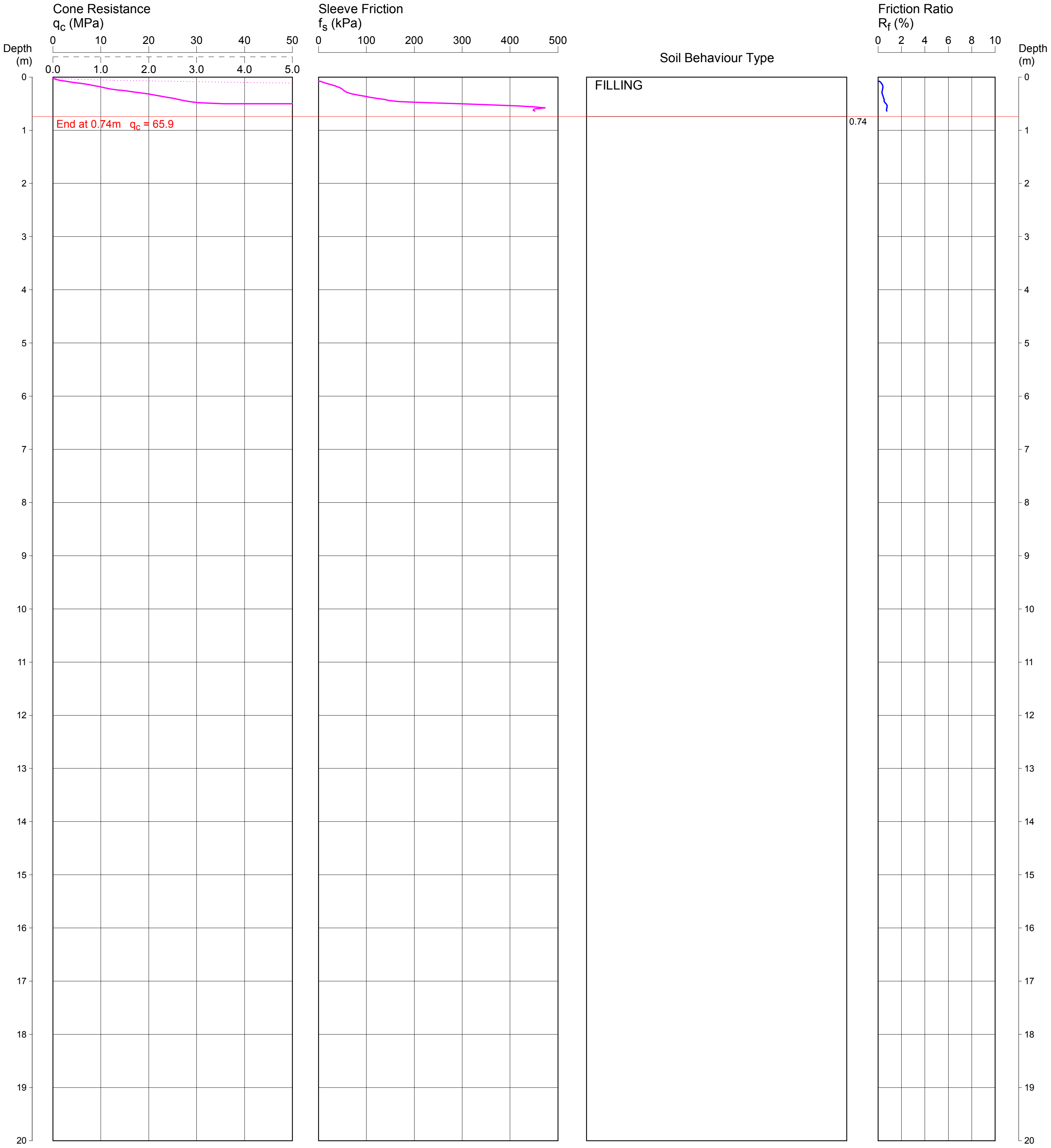
COORDINATES:

CPT306A

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO OBSTRUCTION IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT306A.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

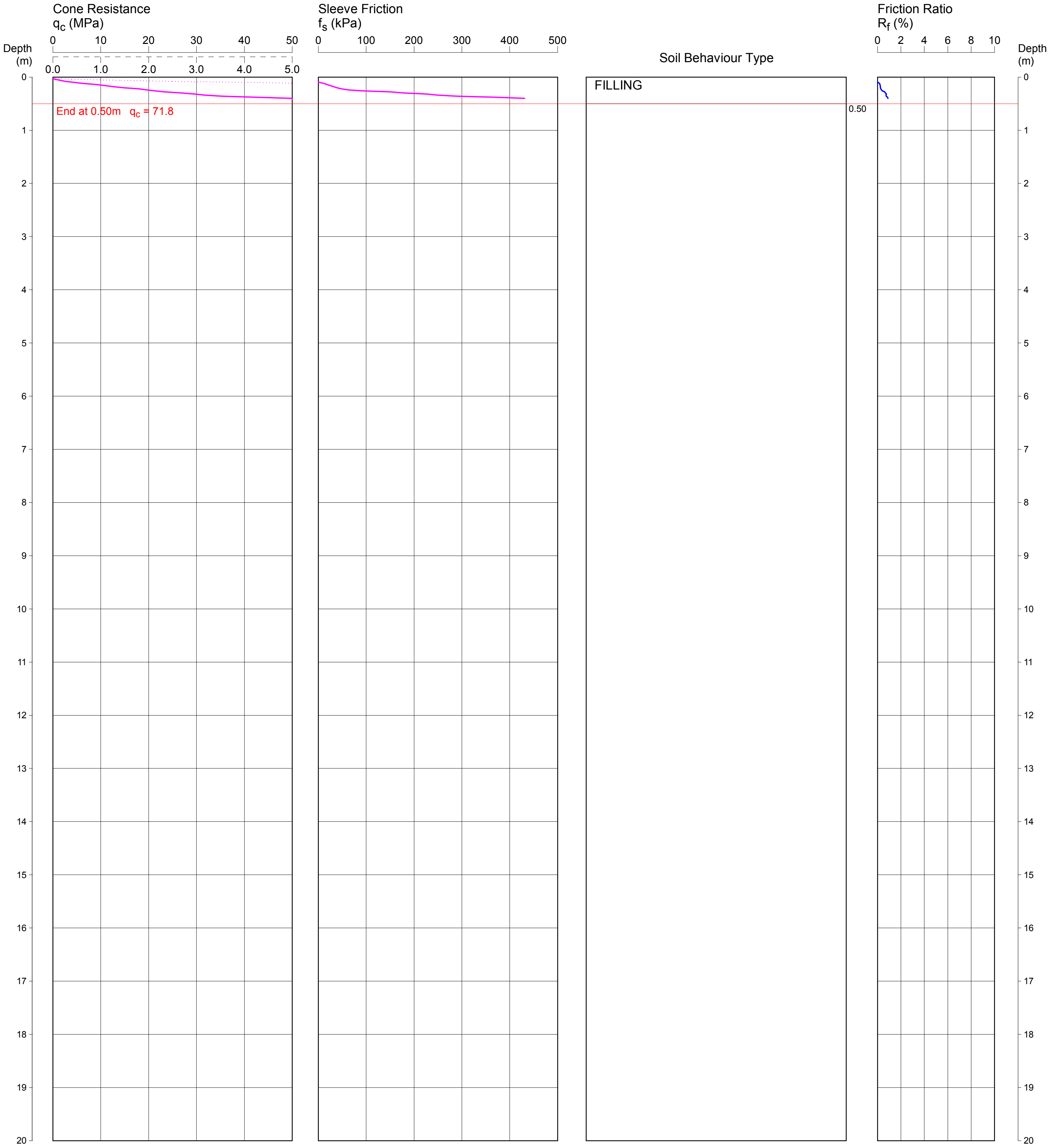
COORDINATES:

CPT306B

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 0.5 m TO 1.02 m DEPTH TO PENETRATE FILLING; HOLE DISCONTINUED DUE TO OBSTRUCTION IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT306B.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

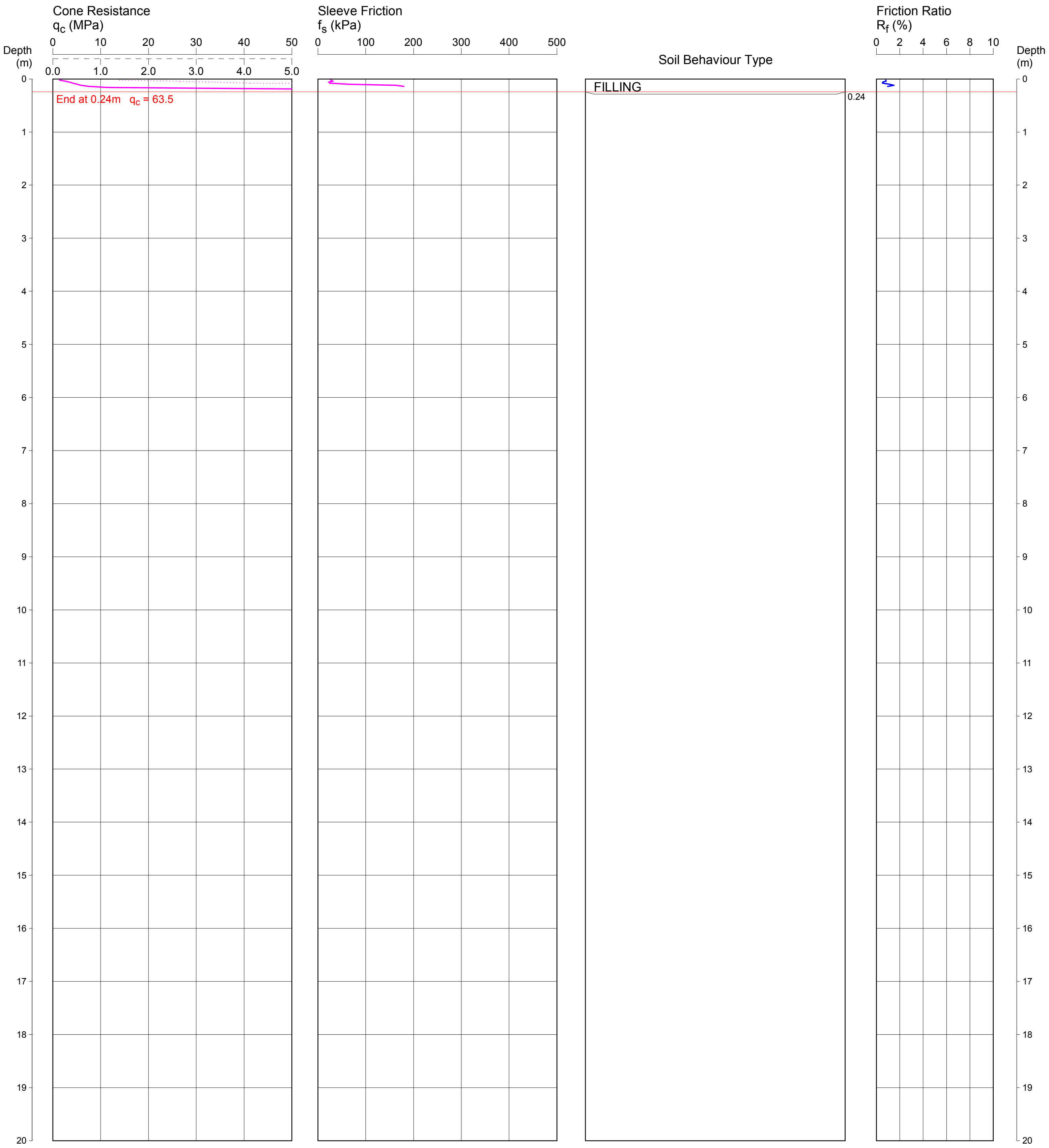
COORDINATES:

CPT306C

Page 1 of 1

DATE 3/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 0.24 m TO 0.66 m DEPTH TO PENETRATE FILLING; HOLE DISCONTINUED DUE TO BENDING IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT306C.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

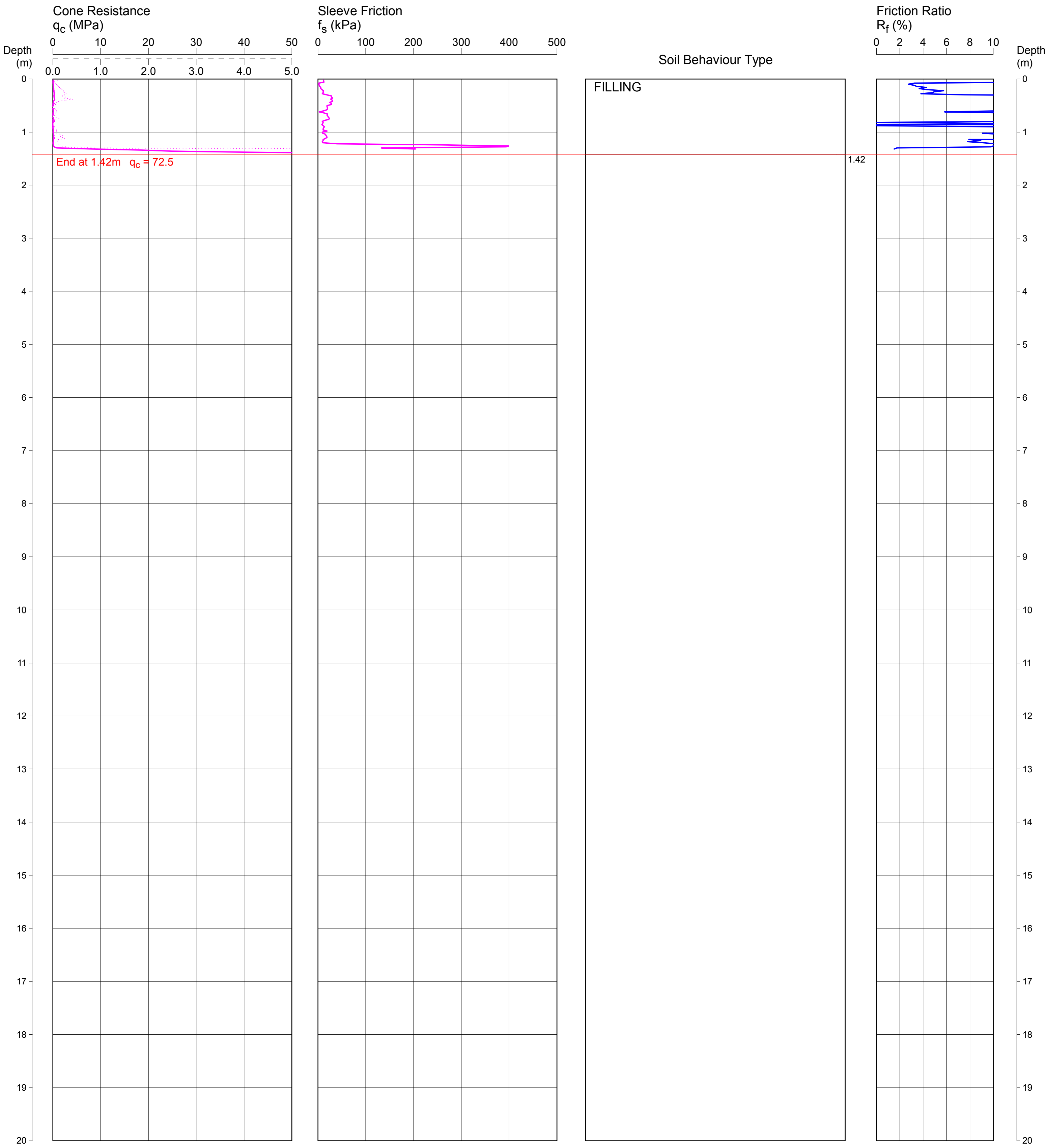
COORDINATES:

CPT306D

Page 1 of 1

DATE 3/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 0 m TO 1.5 m DEPTH TO PENETRATE FILLING; HOLE DISCONTINUED DUE TO BENDING IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT306D.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

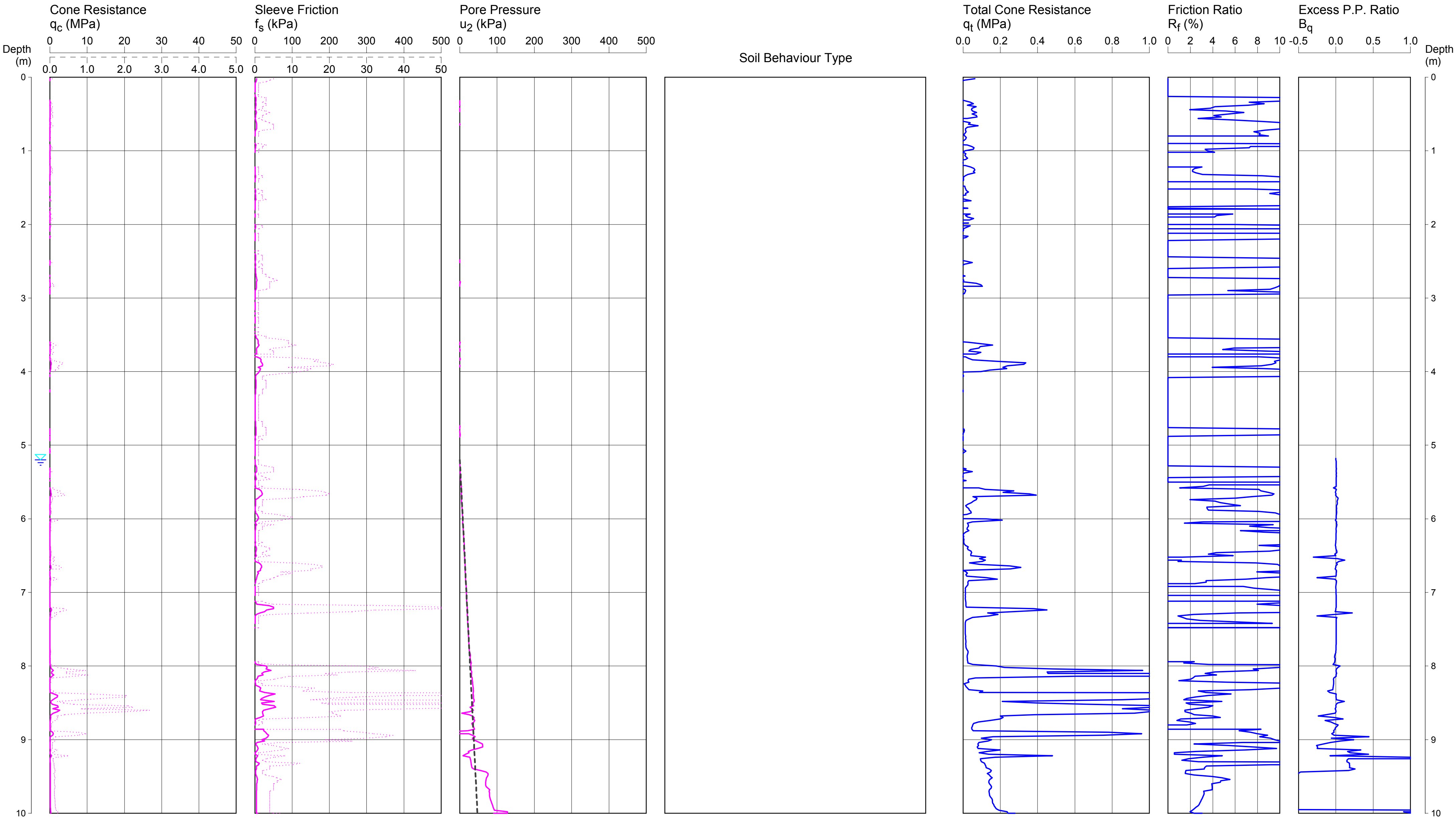
COORDINATES:

CPT306E PIEZO

Page 1 of 2

DATE 3/9/2015

PROJECT No: 71459.04



REMARKS: STANDARD CONE AND DUMMY CONE USED FROM 0 m TO 10.40 m DEPTH [illegible] DISCONTINUED DUE TO CONE TIP REFUSAL
GROUNDWATER OBSERVED AT 5.2 m DEPTH AFTER WITHDRAWAL OF RODS

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT306E PIEZO.CP5

Cone ID: 120509 **Type:** I-CFXYP20-10

Water depth after test: 5.20m depth (assumed)

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

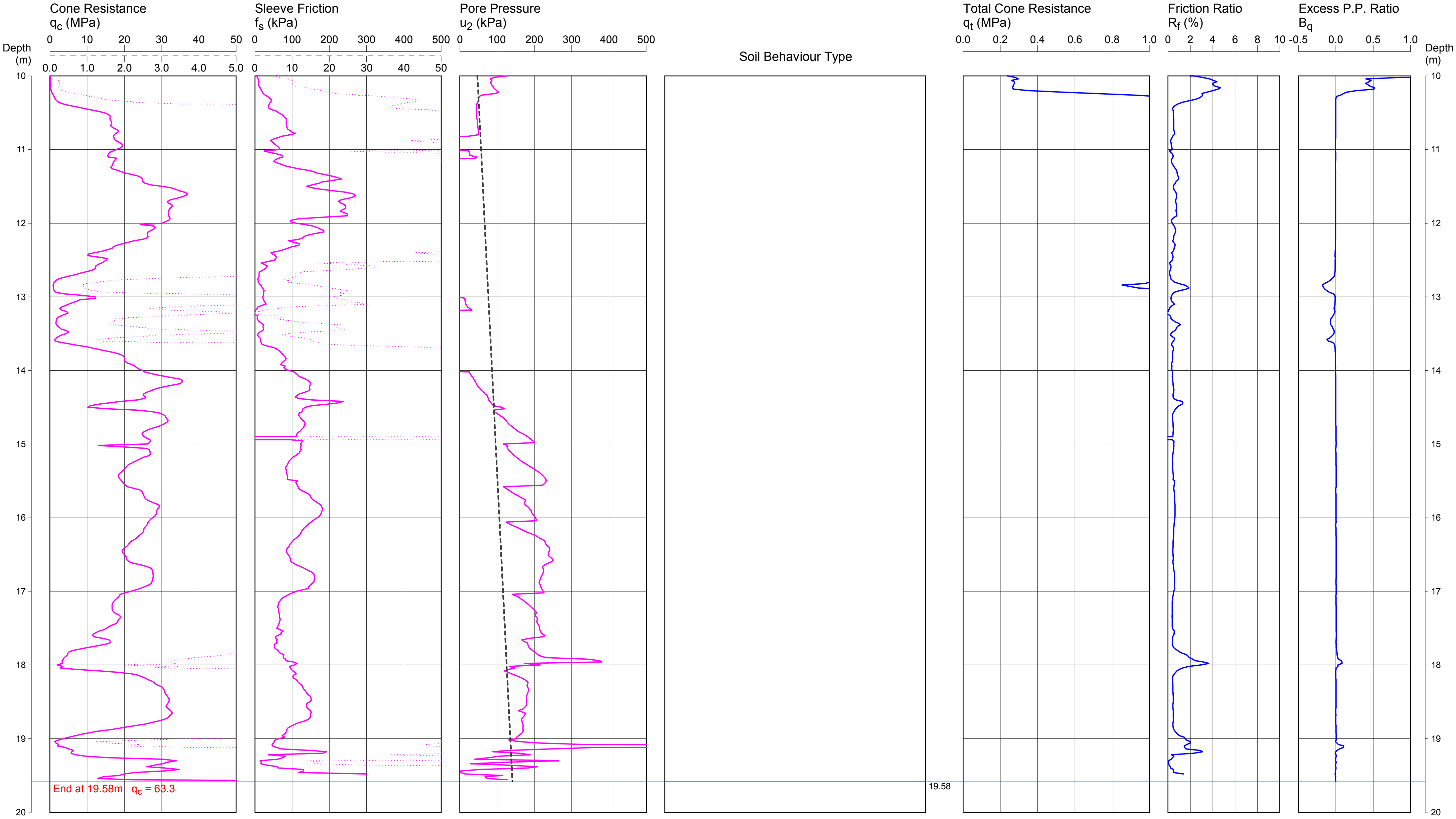
COORDINATES:

CPT306E PIEZO

Page 2 of 2

DATE 3/9/2015

PROJECT No: 71459.04



REMARKS: STANDARD CONE AND DUMMY CONE USED FROM 0 m TO 10.40 m DE[illegible] DISCONTINUED DUE TO CONE TIP REFUSAL
GROUNDWATER OBSERVED AT 5.2 m DEPTH AFTER WITHDRAWAL OF RODS

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT306E PIEZO.CP5

Cone ID: 120509 **Type:** I-CFXYP20-10

Water depth after test: 5.20m depth (assumed)

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

COORDINATES:

CPT306E

Page 1 of 1

DATE 3/9/2015

PROJECT No: 71459.04

REMARKS: DUMMY CONE USED FROM 1.60 m TO 2.00 m, 7.16 m TO 7.80 m AND 8.34 m TO 10.40 m DEPTH TO PENETRATE FILLING.
HOLE DISCONTINUED DUE TO REPLACEMENT WITH PIEZO-CONE; NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT306E.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

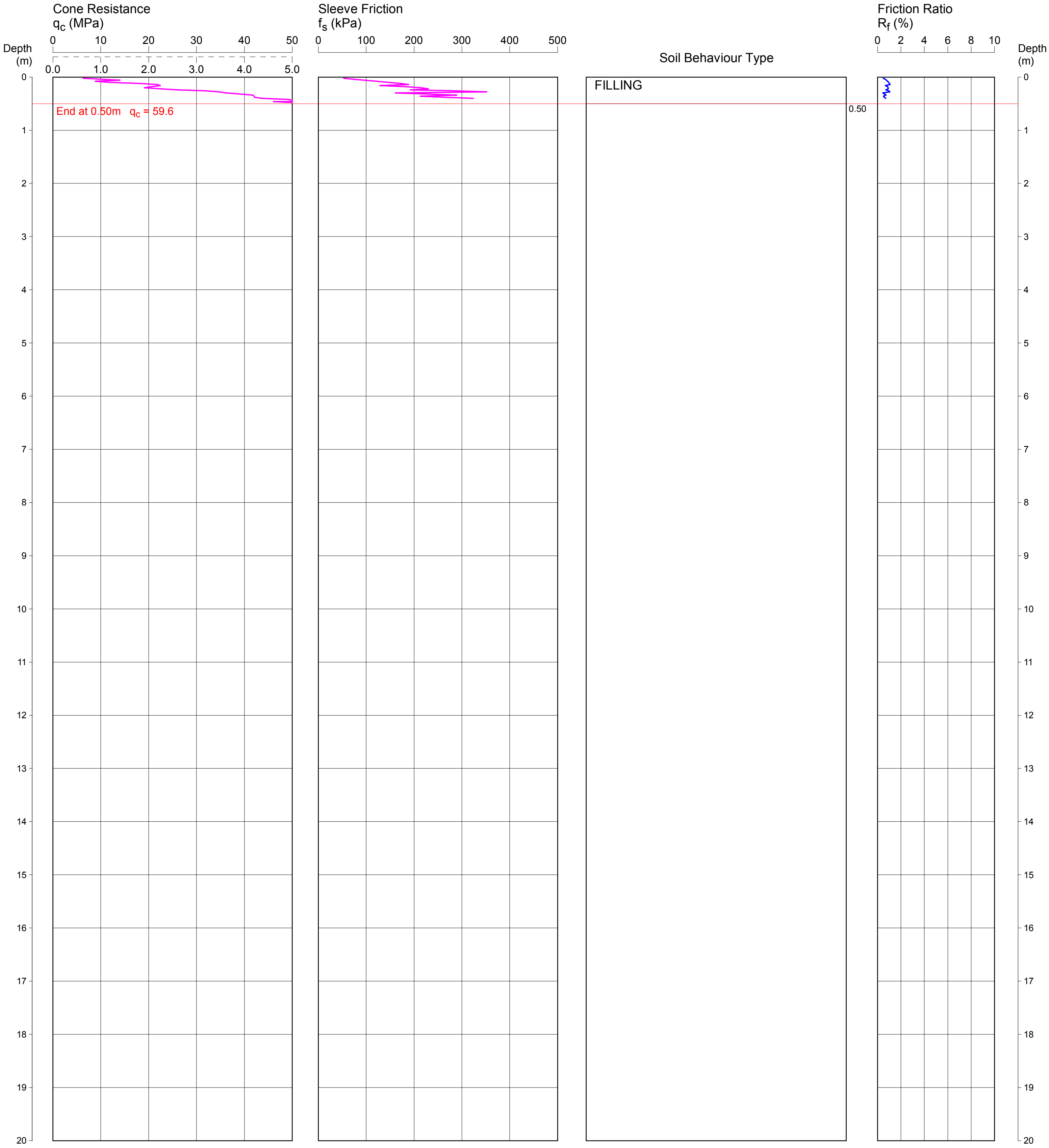
COORDINATES:

CPT307

Page 1 of 1

DATE 2/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO BENDING IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT307.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

COORDINATES:

CPT307A

Page 1 of 1

DATE 2/9/2015

PROJECT No: 71459.04

REMARKS: DUMMY CONE USED FROM 5.4 m TO 5.6 m DEPTH TO PENETRATE FILLING; HOLE DISCONTINUED DUE TO BENDING IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT307A.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

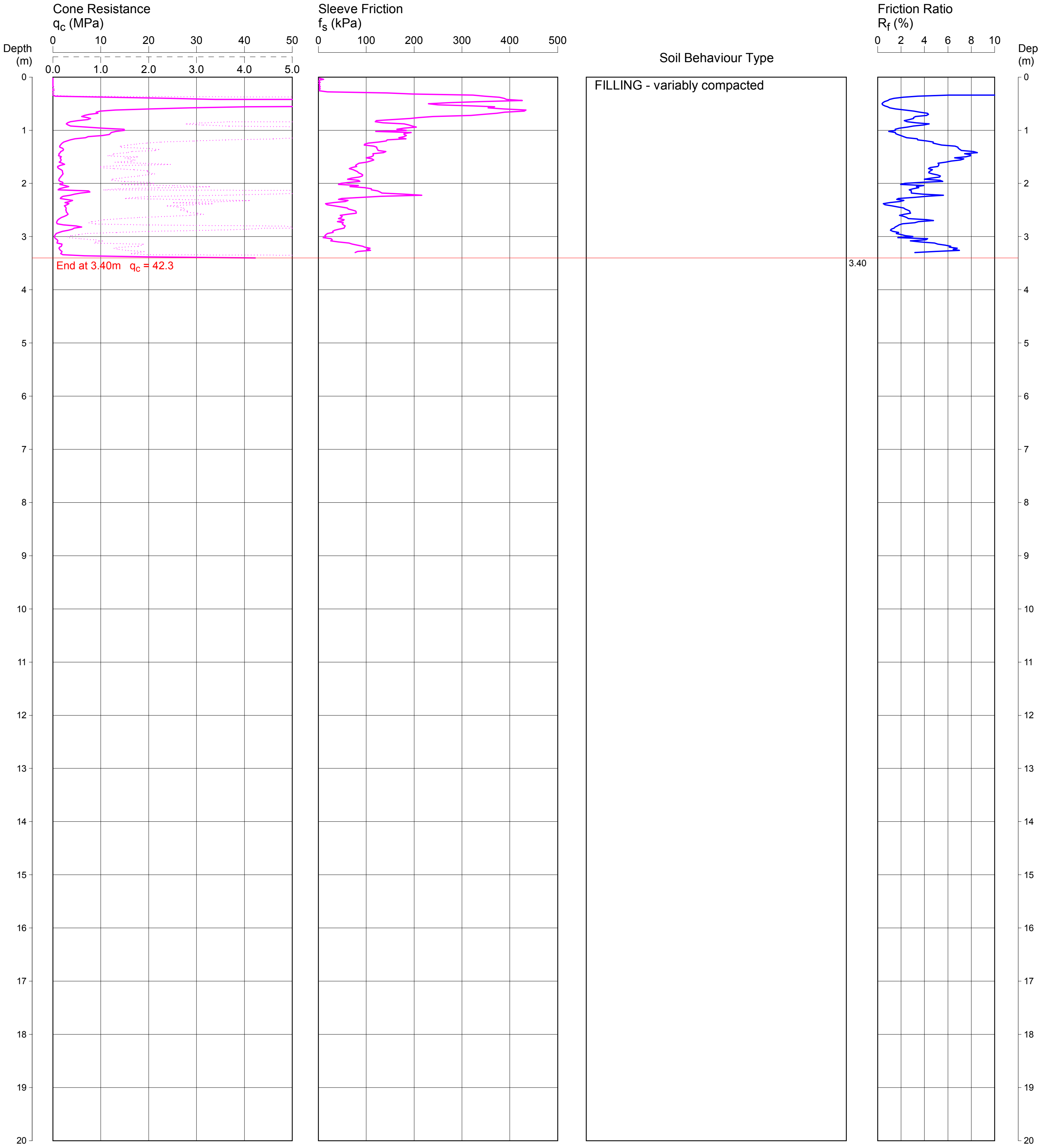
COORDINATES:

CPT308

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 0.02 m TO 0.40 m DEPTH TO PENETRATE FILLING; HOLE DISCONTINUED DUE TO OBSTRUCTION IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

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Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

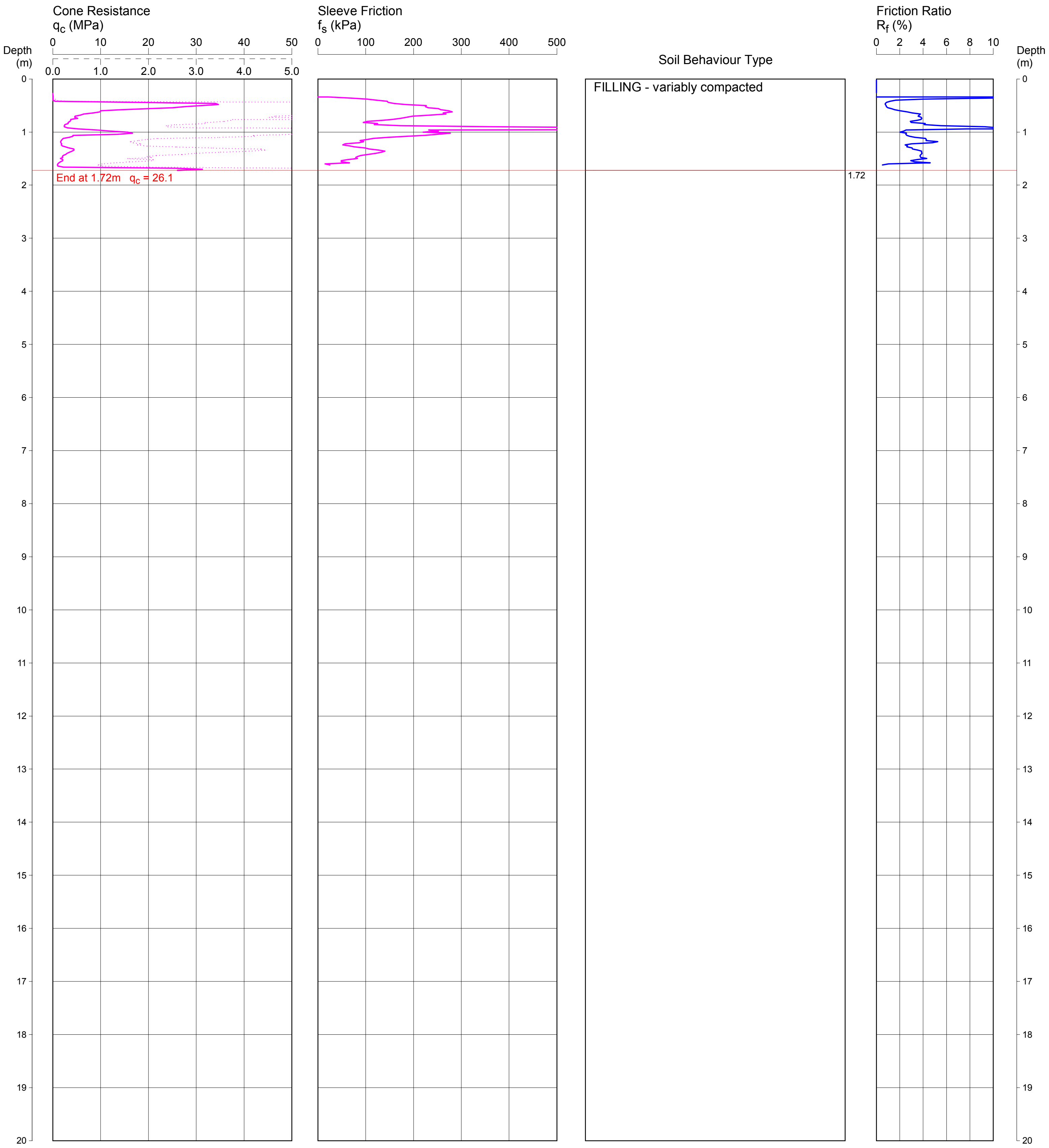
COORDINATES:

CPT308A

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 0 m TO 0.46 m DEPTH TO PENETRATE FILLING; HOLE DISCONTINUED DUE TO BENDING IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

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Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

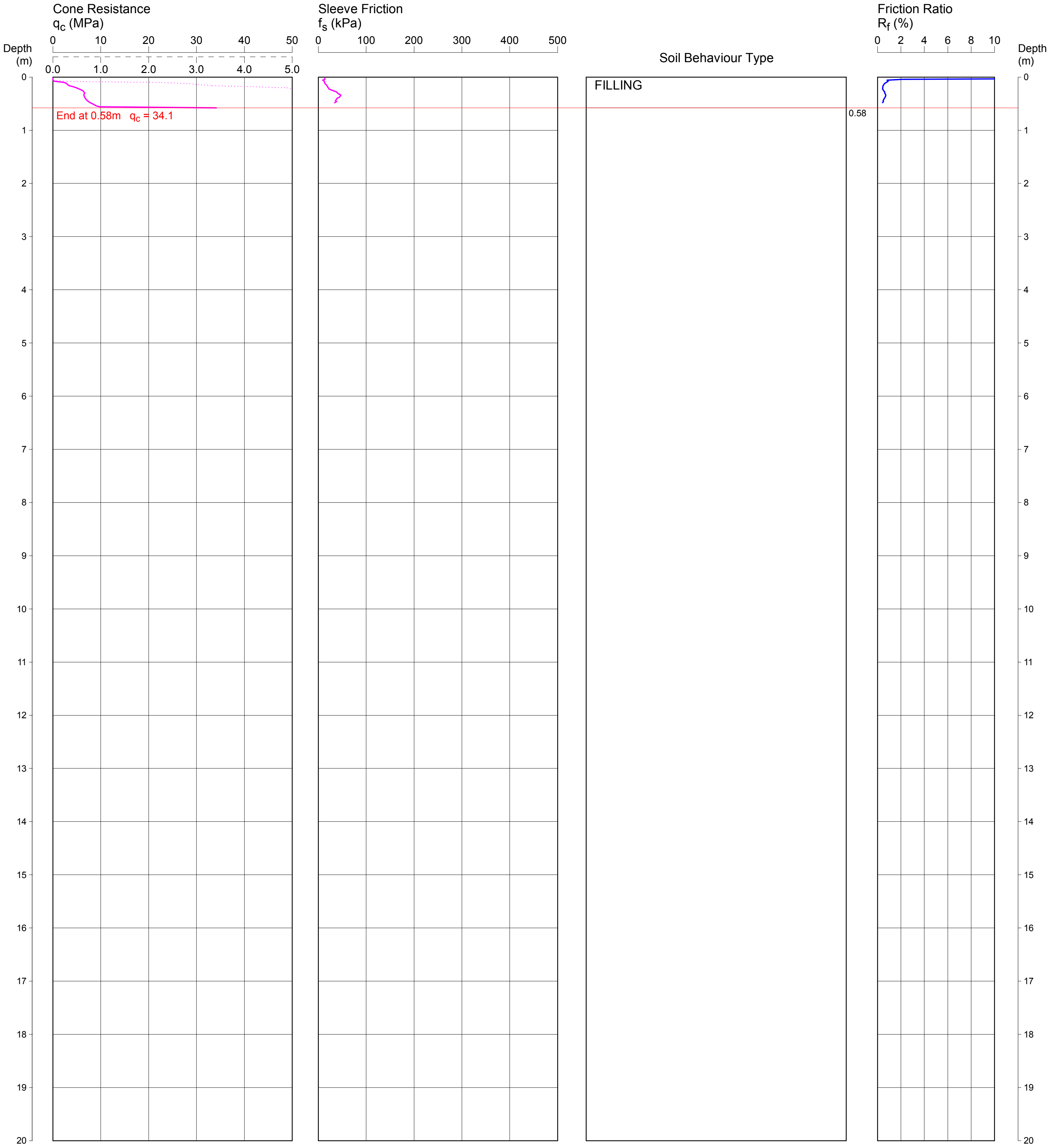
COORDINATES:

CPT309

Page 1 of 1

DATE 2/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO BENDING IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

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ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

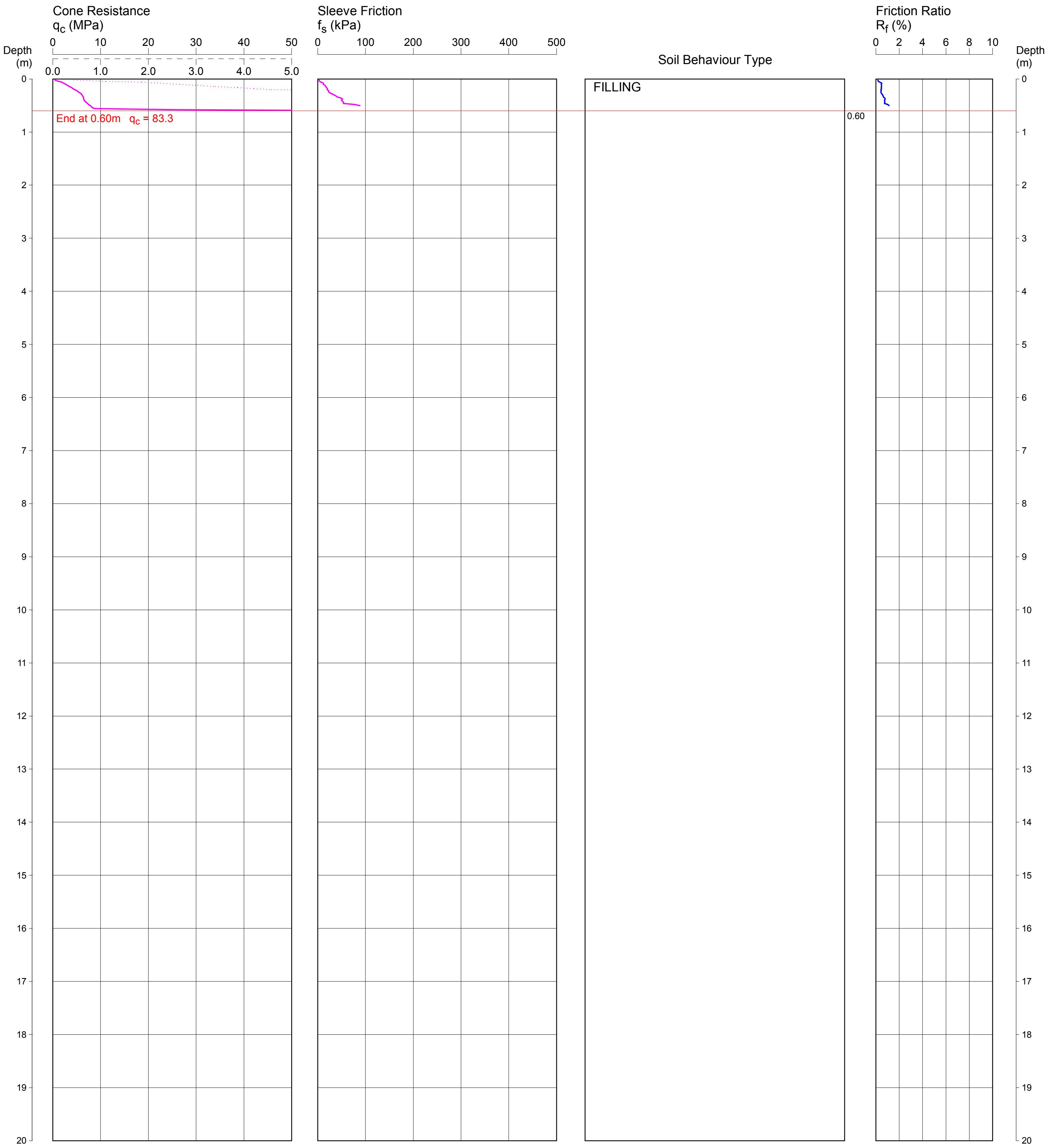
COORDINATES:

CPT309A

Page 1 of 1

DATE 2/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE ATTEMPTED TO PENETRATE FILLING AT 0.6 m DEPTH; HOLE DISCONTINUED DUE TO OBSTRUCTION IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

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Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

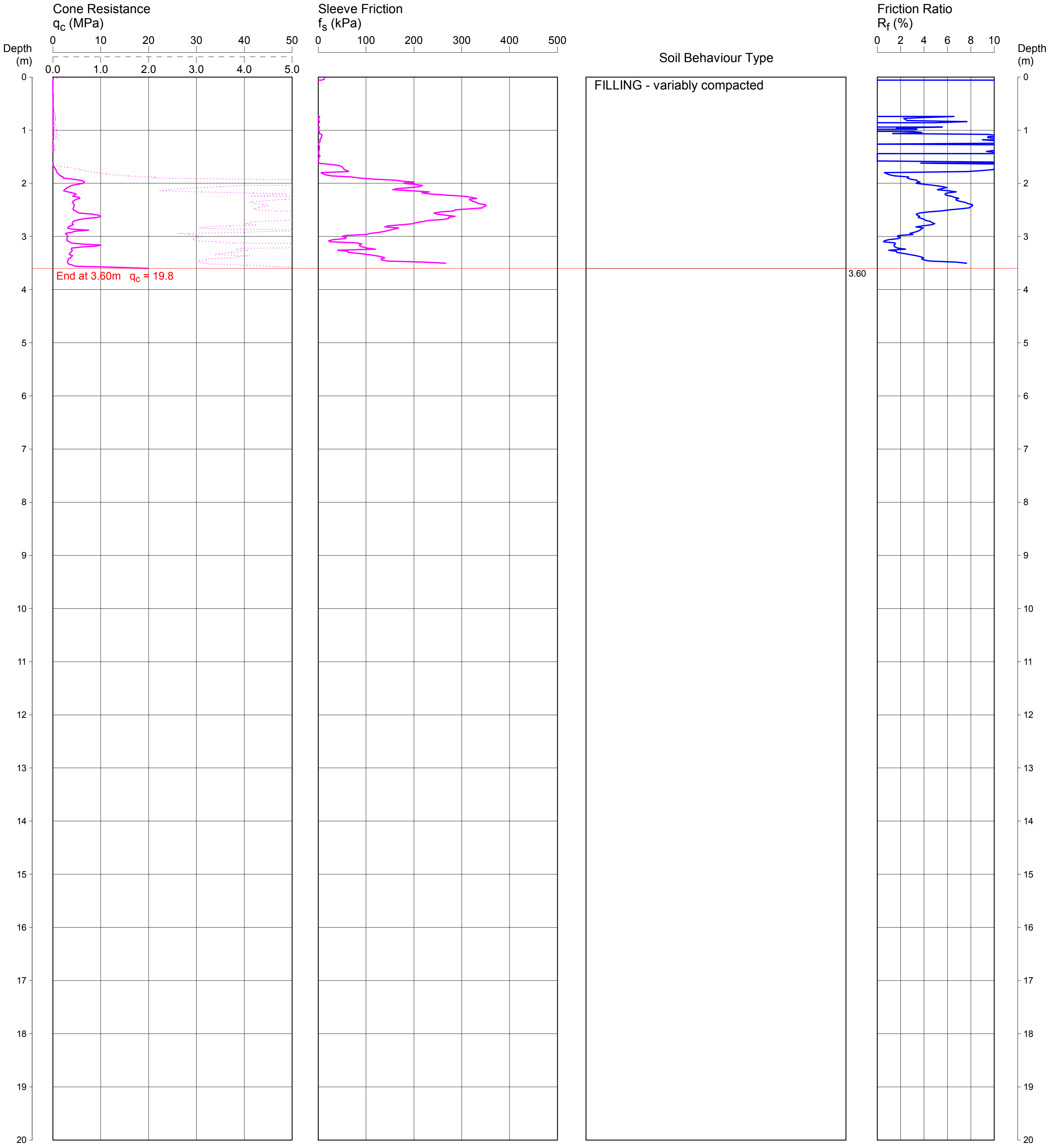
COORDINATES:

CPT309B

Page 1 of 1

DATE 2/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 0 m TO 2.0 m DEPTH TO PENETRATE FILLING; HOLE DISCONTINUED DUE TO BENDING IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

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Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

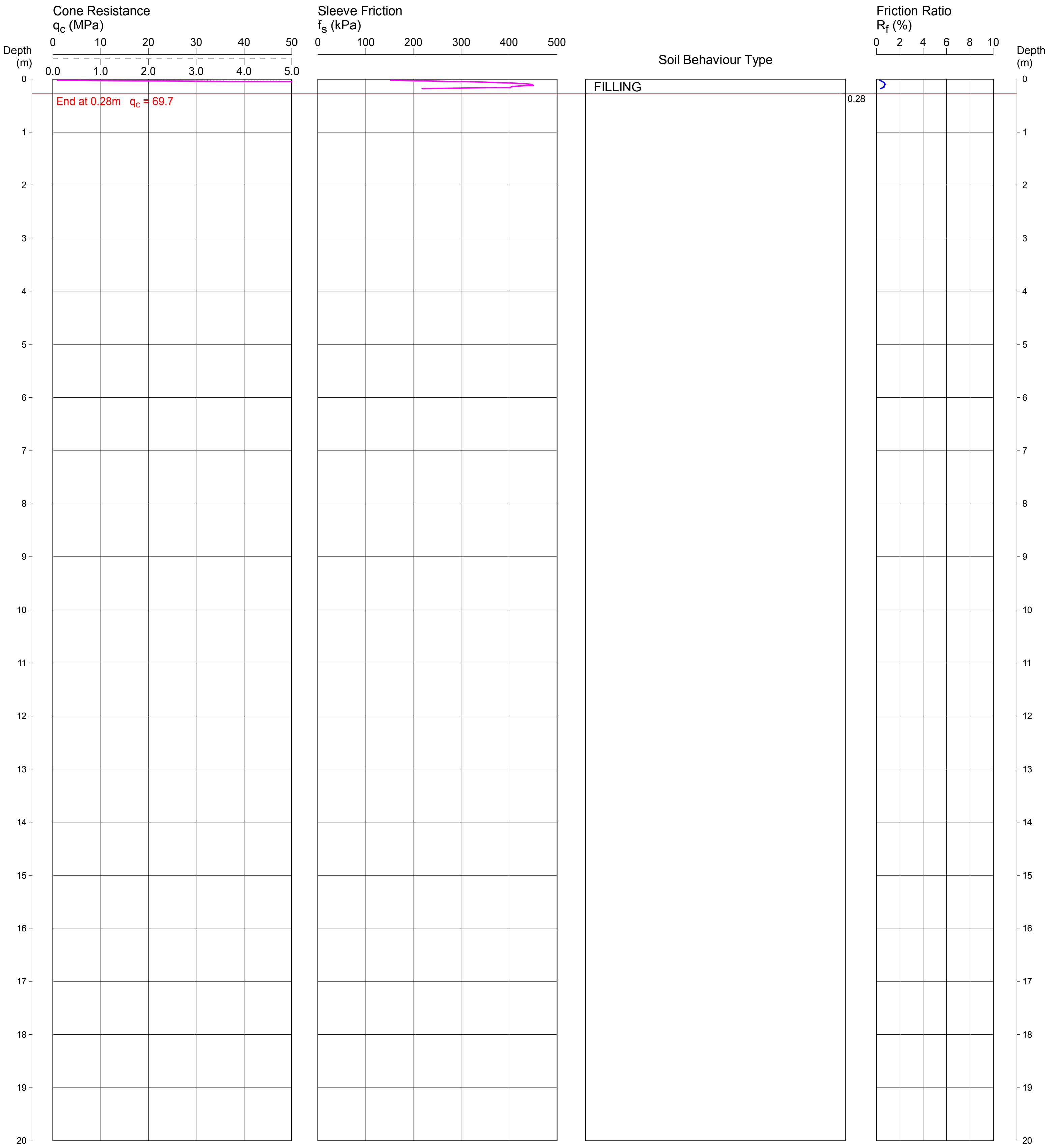
COORDINATES:

CPT310

Page 1 of 1

DATE 2/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 0.28 m TO 0.32 m DEPTH TO PENETRATE FILLING; HOLE DISCONTINUED DUE TO BENDING IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT310.CP5
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ConePlot Version 5.9.2

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

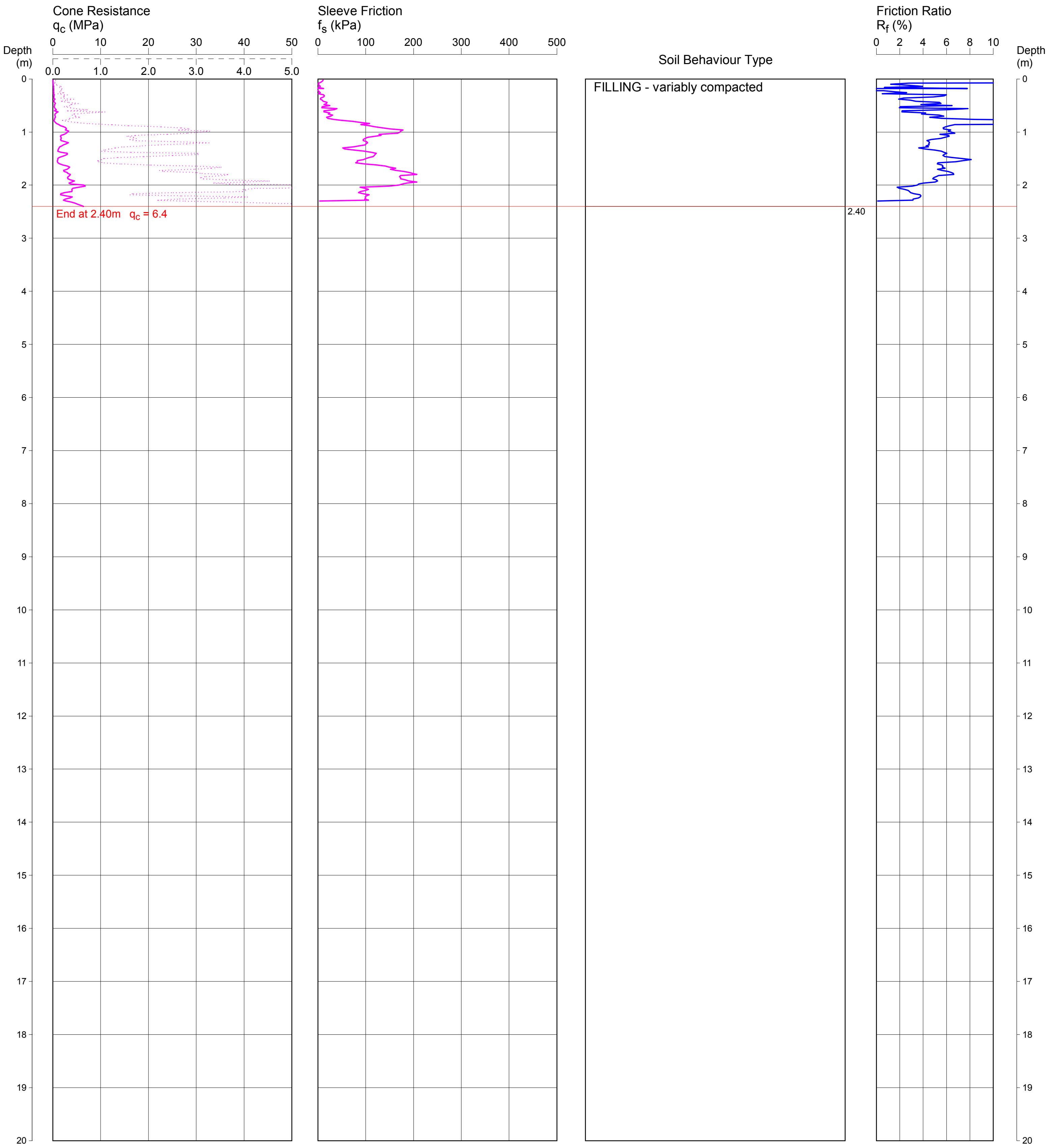
COORDINATES:

CPT310B

Page 1 of 1

DATE 2/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 0 m TO 1.0 m DEPTH TO PENETRATE FILLING; HOLE DISCONTINUED DUE TO BENDING IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

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Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics | Environment | Groundwater

APPENDIX C

Landpac HEIC Report

Landpac Technologies Pty Ltd ®

LAND PAC

Ground Engineering

AUSTRALIA – NEW ZEALAND – MALAYSIA - SOUTH AFRICA - EUROPE - USA - MIDDLE EAST

REPORT

Impact Compaction

Benedict Ground Improvement Trial
Moorebank, NSW.

October 2015

R1044-01 Issue C

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1. Summary
2. Introduction
3. Impact Compaction Methodology
4. Ground Improvement works
5. Soil Response and Induced Settlement Results
6. Geotechnical Testing
7. Conclusion and Discussion

APPENDICIES
1- CIS Plots
2- CIR Plots
3- DCP Results

Record of Amendments:

REV	DATE	COMMENTS	BY	CHKD	APPD
A	30th September 2015	1st Issue	MC	MC	KTM
B	30th September 2015	Cover page date correction	MC	MC	KTM
C	7th October 2015	DCP results appendix addition	MC	MC	KTM

1. SUMMARY

This report describes the Impact Compaction works conducted for the Ground Improvement Trial for Benedict Industries, and presents the methodology used and records of the controls and monitoring conducted by Landpac during the works.

The compaction settlement (CIS) monitoring indicated that the average compaction settlements on the in-situ fill area had been reduced to acceptable levels with 40 surface passes with a Landpac 3-sided Heavy Impact Compactor. The soil response (CIR) monitoring indicated that the sub-grade was relatively uniform at the completion of the Impact compaction works with the exception of a localised weaker zone identified in one of the trial areas during the impact compaction trial works.

It is understood that Douglas Partners Pty Ltd have been engaged by Benedict Industries Pty Ltd to provide sub-grade design recommendations following the completion of the impact compaction works.

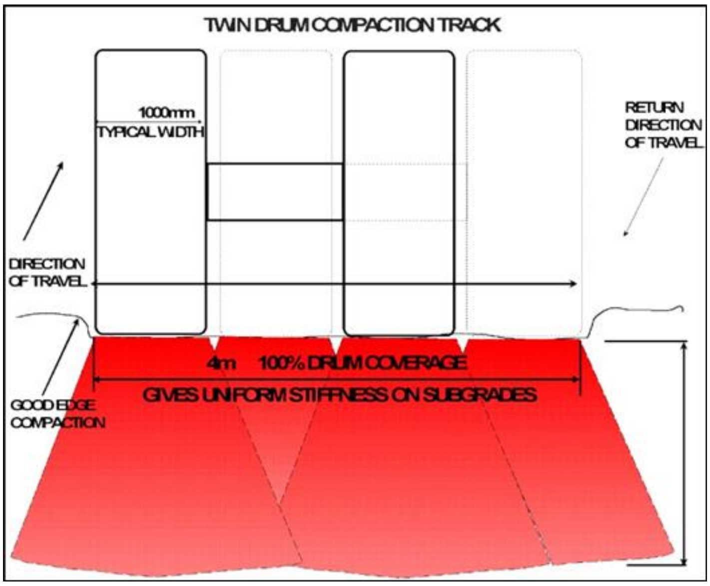
2. INTRODUCTION

Landpac was engaged by Benedict Industries Pty Ltd to undertake a Ground Improvement Trial on the existing in-situ fill using Impact Compaction. Douglas Partners were engaged by Benedict Industries to conduct pre and post compaction geotechnical testing.

Impact compaction was used as a ground improvement means to alleviate the differential settlement in in-situ fill. The Impact Compaction was carried out using Landpac's 3-Sided Heavy Impact Compactor. Landpac's 3-Sided Heavy Impact Compactor has a Kinetic Energy rating of 160 kJ.

The Impact Compactor was mobilised on to site on the 18th September '15 and works commenced on the 21st September '15. Works were completed on 24th September '15.

3. IMPACT COMPACTION METHODOLOGY



The compaction was applied with an interlocking drum pattern across the trial areas to ensure that the whole surface area was subject to a consistent number of impact blows. The application of a surface pass methodology as indicated is preferred to a conventional pass methodology. A characteristic of Impact Compactors is that the width of the drums whether twin drum or single drum does not cover the width of the machine. Therefore unlike conventional rollers the application of a pass methodology does not cover the whole surface leaving uncompacted strips. A surface pass methodology covers the whole width with approximately 50% greater compaction work done than that with a pass methodology.

The compaction works were carried out in an engineered manner with the monitoring of the sub-grade behaviour with the regular measurement compaction induced settlements and the soil response to the dynamic impact loads.

CIS (Continuous Impact Settlement) monitoring and CIR (Continuous Impact Response) monitoring was carried out to control the compaction process. CIS is used for monitoring settlement and CIR is used for monitoring soil response of the nominated sub-grade.

4. GROUND IMPROVEMENT TRIAL WORKS

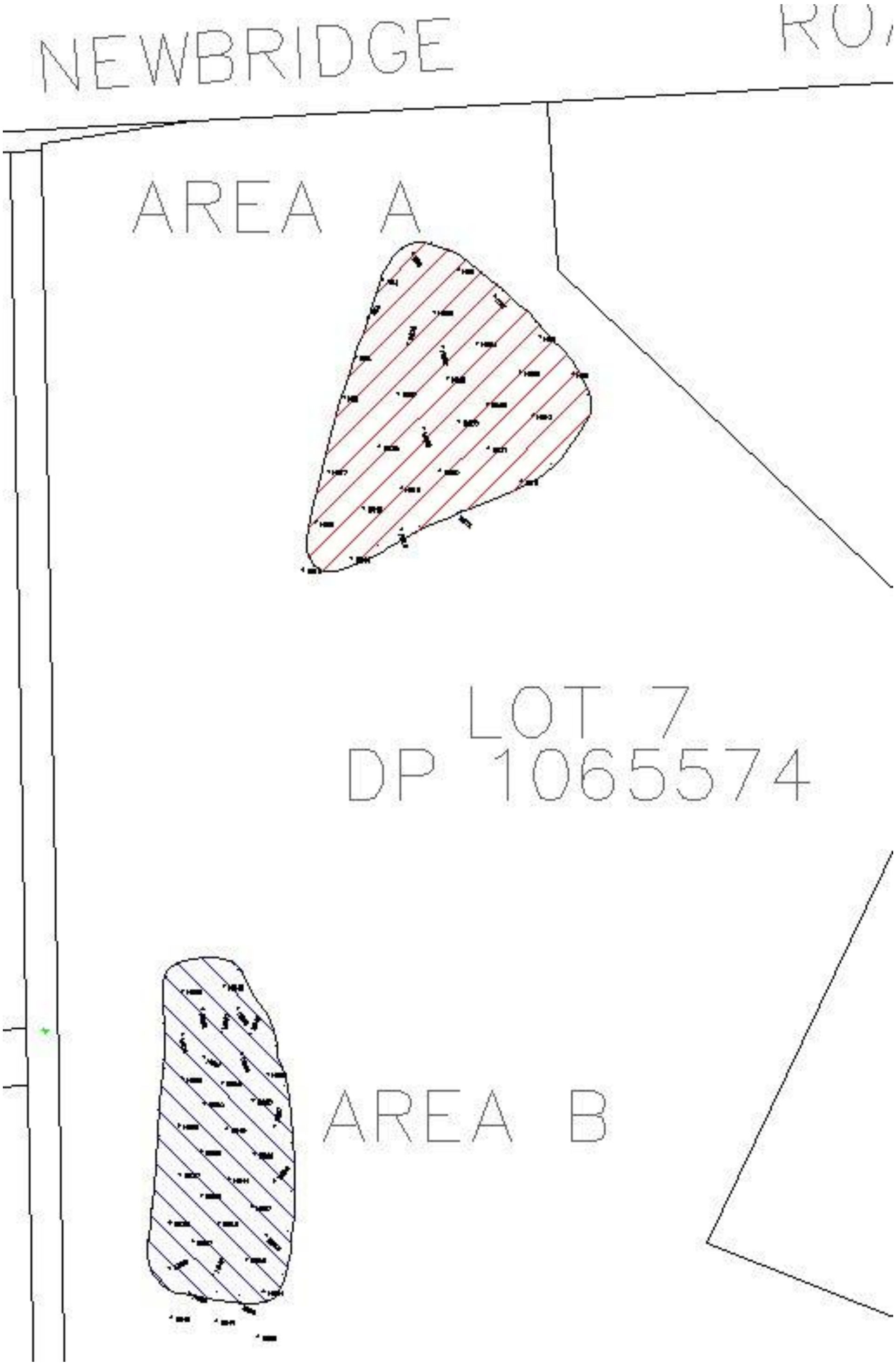
The trial works were carried out on two sections (Area A & Area B) as shown in diagram 1 with a Landpac 3-sided Heavy Impact Compactor until the average compaction settlements had been reduced to a ‘near zero’ condition.

The specifications of the 3-sideds Heavy Impact Compactor are shown in Table 1. The compactive effort imparted by Impact Compactors during compaction is primarily dependent on the weight of the impact drum assembly and the height the drum falls during rotation.

Table 1: Impact Roller Specifications

	Landpac- 3 sided (Heavy)
Impact Compactor Module Weight (without Tractor)	14 Tonne
Lift Height (h)	0.23 metre
Kinetic Energy	**160 kJ**

Diagram 1: Site Area



5. SOIL RESPONSE AND SETTLEMENT MONITORING RESULTS

Compaction settlements were measured from 0-40 passes (at 10 pass intervals) before a ‘near zero’ compaction settlement condition had been achieved.

The measured settlements (See Appendix 1) indicated that the average compaction settlements on the total area had been reduced to less than 3mm over the last ten surface passes thereby confirming that sufficient compaction work with a 3-sided heavy impact compactor had been applied.

The total settlements were an average of 60 to 63mm respectively across the trial areas, with localised settlements in excess of 250mm. A zone in trial area ‘A’ where a large stockpile was apparently located exhibited less settlement (about 20 to 60mm) than on areas outside of this where settlements ranged from about 100 to 250mm (See Appendix 1).

Continuous Impact Response (CIR) technology was used to measure and plot the relative soil response to the dynamic loads induced by the impact drums. The CIR plots shown in appendix 2 indicate the relative soil response to the dynamic loads imposed by the impact drums. The plot is derived from the recorded deceleration of the impact drums and the GPS locations of each impact point.

Low soil response are typically an indication of very weak near surface material (say <300mm depth) or deleterious or over wet material to about 1.5m or so depth. Low response areas would typically warrant some remediation if footings or pavements are located close to the weak soils. Medium response areas are typically an indication of near surface moist or loose material (say <300mm depth) or relatively lower strength material to 1.5m or so depth. The medium response values can be influenced by near surface soil conditions and do not necessarily indicate weaker sub-grade stiffness below the near surface material. Further inspection of the medium response areas is required to ascertain whether the response is simply weak or loose near surface material or lower strength material to a greater depth. High response values typically indicate the average sub-grade stiffness to a depth of 1.5 metres or so and under most circumstances consist of a compacted stiff sub-grade.

The final CIR (soil response monitoring) at the completion of the Impact Compaction works indicated a relatively uniform sub-grade with a portion in area ‘A’ that showed a lower response (See CIR Plot in Appendix 2).

6. GEOTECHNICAL TESTING

It is understood that the assessment of the in-situ compaction methodology and the verification of sub-grade design parameters will be carried out by independently by Douglas Partners who have been engaged by Benedict Industries.

7. CONCLUSION AND DISCUSSION

The measured compaction settlements over the last 10 surface passes indicated that sufficient impact compaction passes have been applied using Landpac’s 3-sided Heavy (160kJ Kinetic Energy) Impact Compactor. The variation in compaction settlements indicates the variability of the site and demonstrates the usefulness of heavy Impact Compaction in providing a more uniform sub-grade.

The final CIR (soil response monitoring) at the completion of the Impact Compaction works indicated a relatively uniform sub-grade over the impact compaction trial area. There was however, one weaker sub-grade zone in area “A” (See Appendix 2) identified during the compaction works with the CIR monitoring where a stockpile of material had been located prior to the trial. Eight DCP’s were conducted on this area (See DCP Results in Appendix 3) after the completion of the trial. DCP’s No’s 1, 2, 4 & 8 in the CIR medium response areas confirm weak subsurface soils most likely as a result of excess moisture infiltration into loose soils under the stockpile. Impact Compaction besides compacting soils at depth also provides an onerous proof roll of sub-grades, which is a useful means of identifying localised uncompacted soils (moist/wet clays; organic materials; non-soil matter; etc) that are sometimes evident on uncontrolled fill sites. Typically such areas identified during production works would be investigated further and subject to further treatment if necessary. This further treatment could involve additional compaction passes or removal, drying and replacement or exposing the moisture via ripping to dry and subsequent additional impact compaction. In this instance the treatment on the localised area (Approx 220m^2) identified in the trial area would require excavation (Approx 220m^3) and drying/replacement of the fill.

We would recommend a minimum of 40 surface passes with an impact compactor with Impact Drum module weight of 14 Tonne with a minimum kinetic energy rating of 160kJ. Where deeper fill is encountered additional surface passes may be required, this would be ascertained by on site by monitoring using Landpac’s settlement monitoring system and ground response monitoring system

This report has been provided for use by Benedict Industries and Douglas Partners and should only be used for purposes relating to this project and should not be copied in whole or part thereof for use by any other party or parties unless with written permission from Landpac.

Should you have any queries regarding this report or require further clarification of the findings please do not hesitate to contact the undersigned.

For and Behalf of
LANDPAC TECHNOLOGIES Pty Ltd

Matthew Clenton

Reviewed by

Kevin McCann

APPENDIX 1

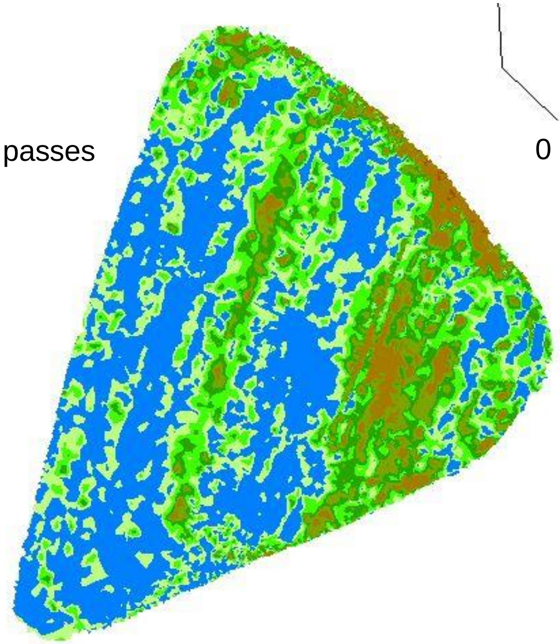
CIS (Continuous Induced Settlement)

Plots

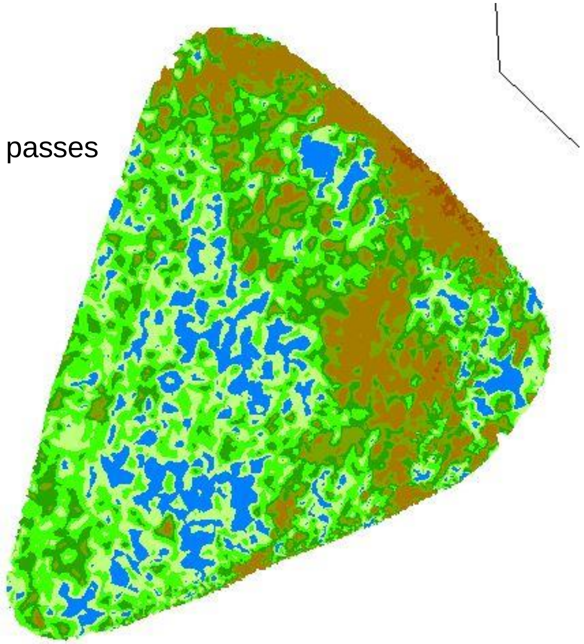
Project
Benedict Moorebank Ground Improvement Trial
Job No. P1044

Drawing Title
CIS COMPACTION SETTLEMENT PLOT
AREA A

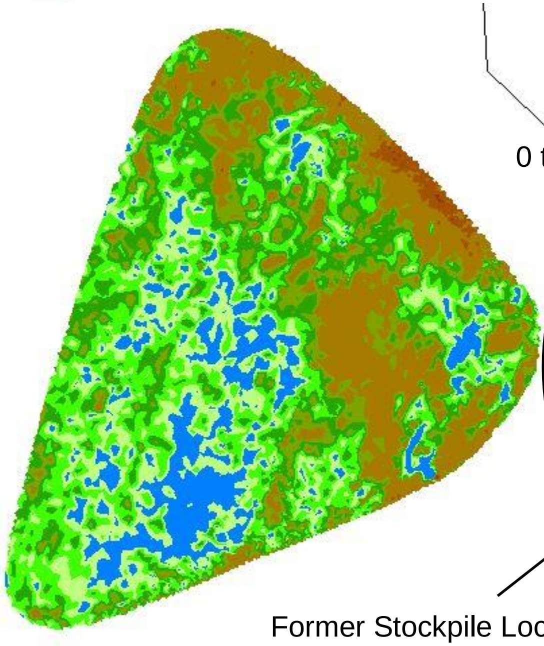
0 to 10 passes



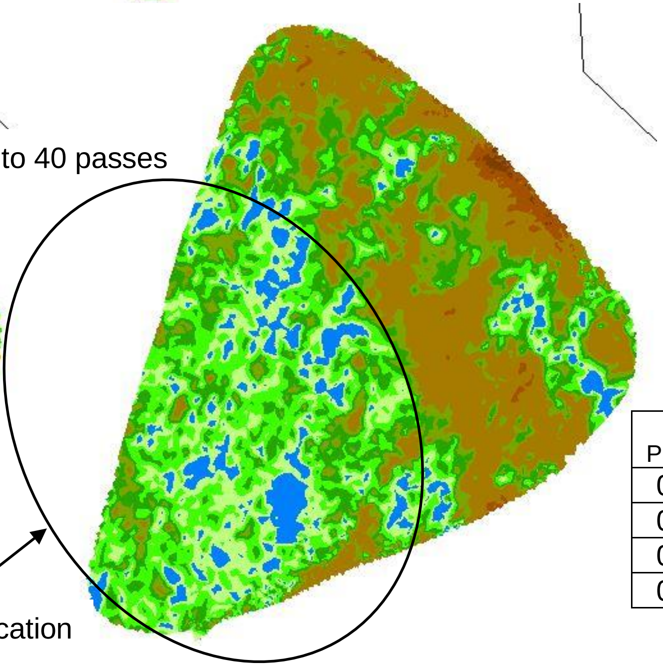
0 to 20 passes



0 to 30

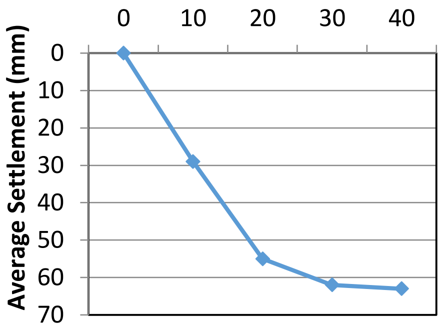


0 to 40 passes



Former Stockpile Location

No. Surface Passes



No. Passes	Average Settlement
0-10	29
0-20	55
0-30	62
0-40	63

CIS SETTLEMENT LEGEND
METERS

0.40	🟫
0.30	🟫
0.20	🟫
0.10	🟩
0.08	🟩
0.06	🟩
0.04	🟩
0.02	🟦
0.00	

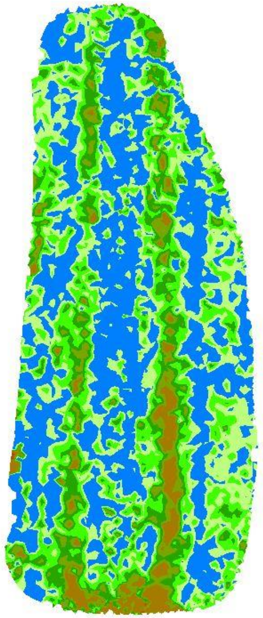
A.B.N. 12 069 528 696

LAND PAC

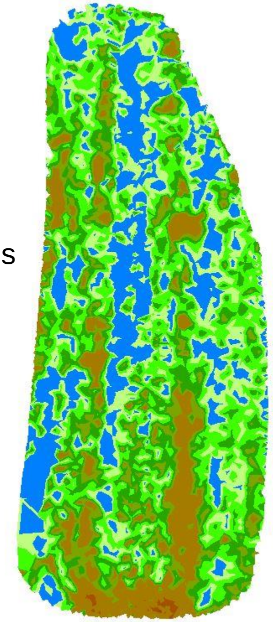
Project
Benedict Moorebank Ground Improvement Trial
Job No. P1044

Drawing Title
CIS COMPACTION SETTLEMENT PLOT
AREA B

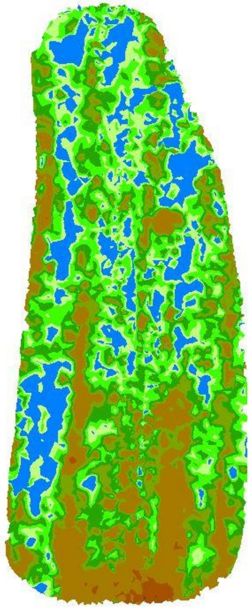
0 to 10 passes



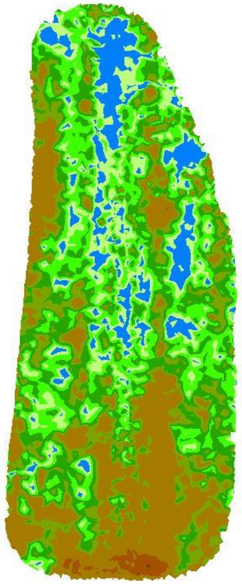
0 to 20 passes

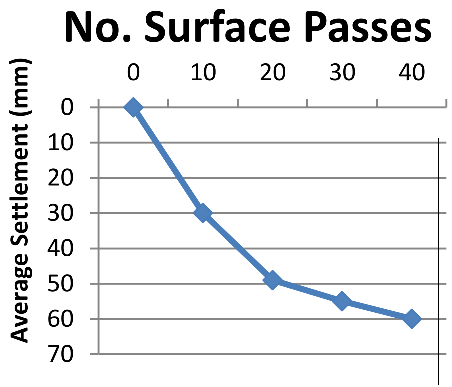


0 to 30 passes



0 to 40 passes





CIS SETTLEMENT LEGEND
METERS

0.40
🟫
0.30
🟫
0.20
🟫
0.10
🟩
0.08
🟩
0.06
🟩
0.04
🟩
0.02
🟦
0.00

No. Passes	Average Settlement
0-10	30
0-20	49
0-30	55
0-40	60

A.B.N. 12 069 528 696

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APPENDIX 2

CIR (Continuous Impact Response)

Plots

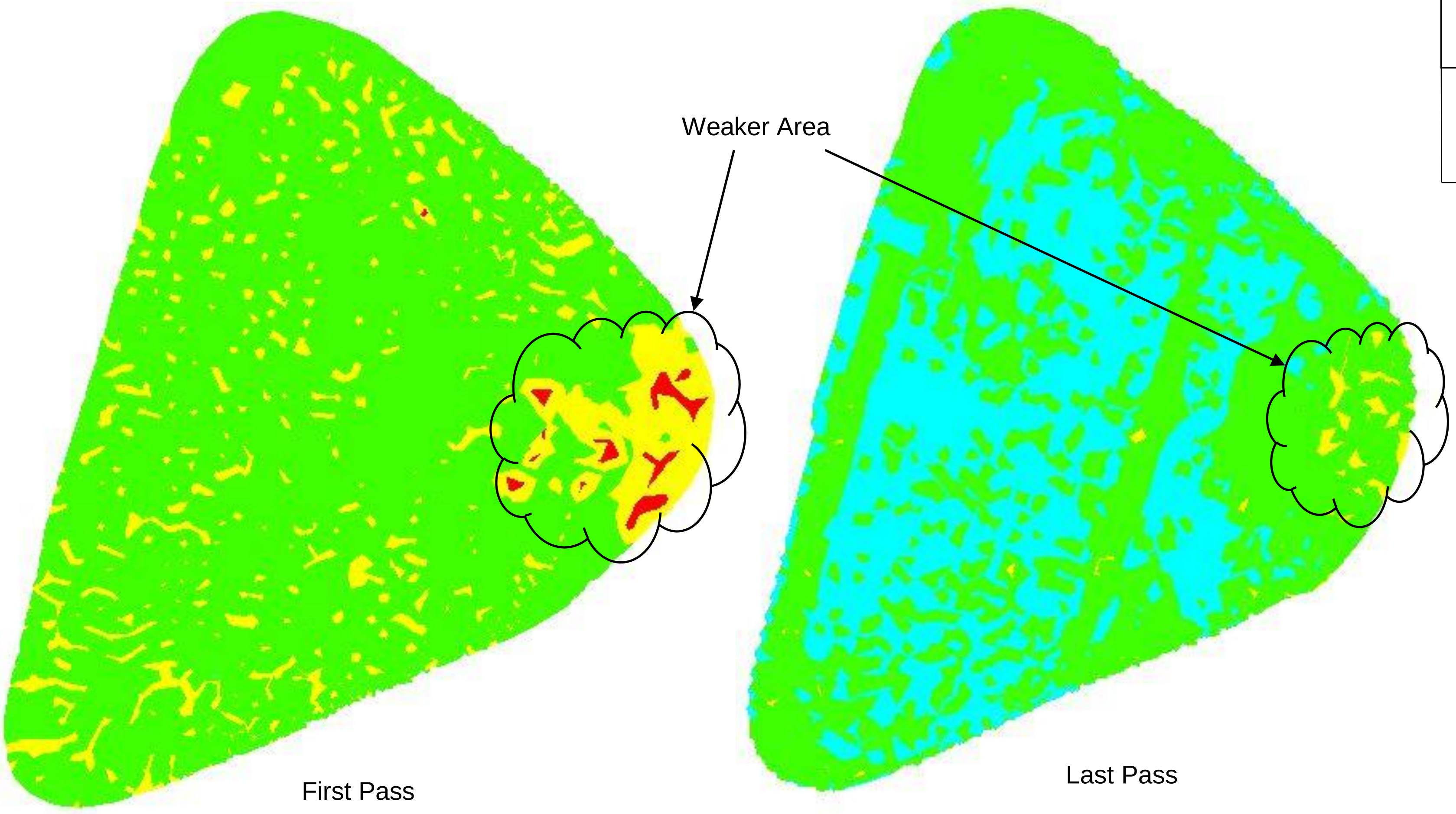
NOTE:
Soil Response is indicative only. Indicated **Low** and Medium soil response areas should be investigated further by a geotechnical engineer.

Project
Benedict Moorebank Ground Improvement Trial
Job No. P1044

Drawing Title
CIR Ground Response Monitoring Plot
AREA A

SOIL RESPONSE

🟥 Low
🟨 Medium
🟩 High
🟦 Very High



N

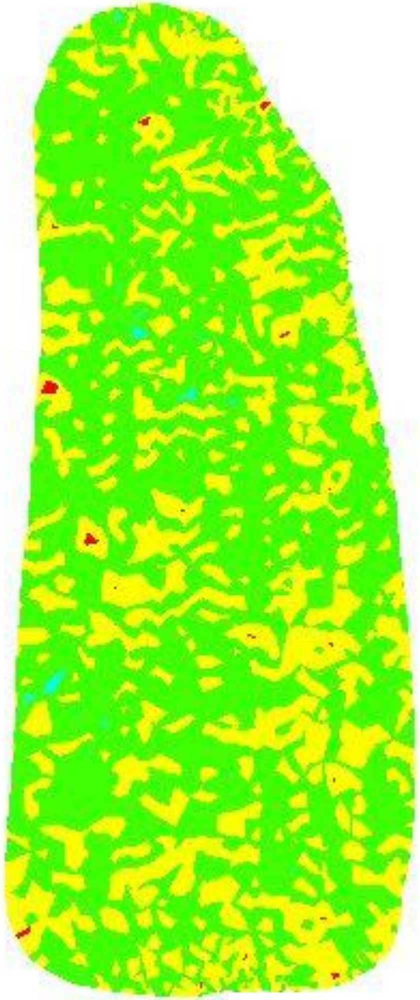
NOTE:
Soil Response is indicative only. Indicated **Low** and Medium soil response areas should be investigated further by a geotechnical engineer.

Project
Benedict Moorebank Ground Improvement Trial
Job No. P1044

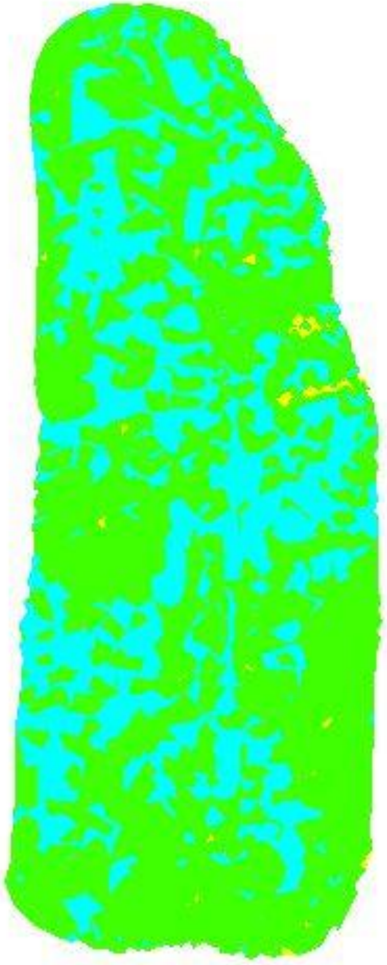
Drawing Title
CIR Ground Response Monitoring Plot
AREA B

SOIL RESPONSE

🟥	Low
🟨	Medium
🟩	High
🟦	Very High



First Pass



Last Pass

N

A.B.N. 12 069 528 696

LAND PAC

APPENDIX 3

DCP Results

DCP RECORD SHEET

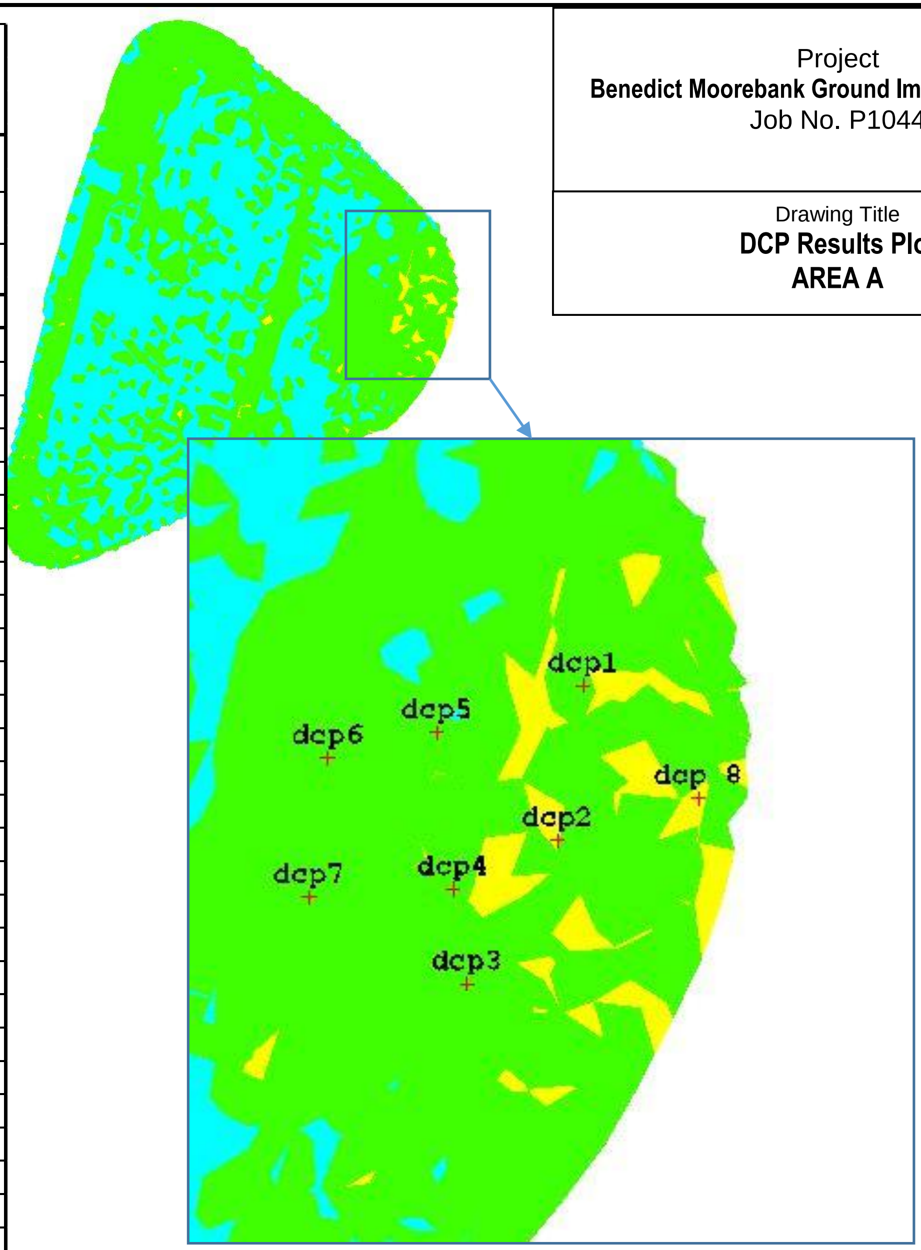
Landpac Technologies Pty Ltd
LAND PAC
Ground Engineering Contractors

PROJECT: Benedict Ground Improvement Trial		**REPORT NO:**	**LPDCPA1**
CLIENT: Benedict Industries		**DATE:**	**6/10/2015**
TYPE OF WORK: DCP Area A		**DAY:**	**Tuesday**

DCP #	1	2	3	4	5	6	7	8
100mm	10	5	15	6	6	15	20	5
200mm	9	4	3	2	6	9	19	3
300mm	3	2	6	2	4	5	11	5
400mm	8	5	12	3	4	5	20R	3
500mm	5	3	5	3	6	4		3
600mm	5	2	9	7	5	10		2
700mm	3	8	17	20R	5	7		3
800mm	4	16	19		5	5		3
900mm	3	16	22		6	6		3
1000mm	4	10	18		17	7		4
1100mm	6	5	16		9	7		3
1200mm	5	6			7	20R		4
1300mm	4	12			20R			20R
1400mm	2	8						
1500mm	3	5						
1600mm	3	5						
1700mm	5	5						
1800mm	4							
1900mm	5							
2000mm								
2100mm								
2200mm								
2300mm								
2400mm								
2500mm								
2600mm								
2700mm								
2800mm								
2900mm								

Project
Benedict Moorebank Ground Improvement Trial
Job No. P1044

Drawing Title
DCP Results Plot
AREA A



A.B.N. 12 069 528 696

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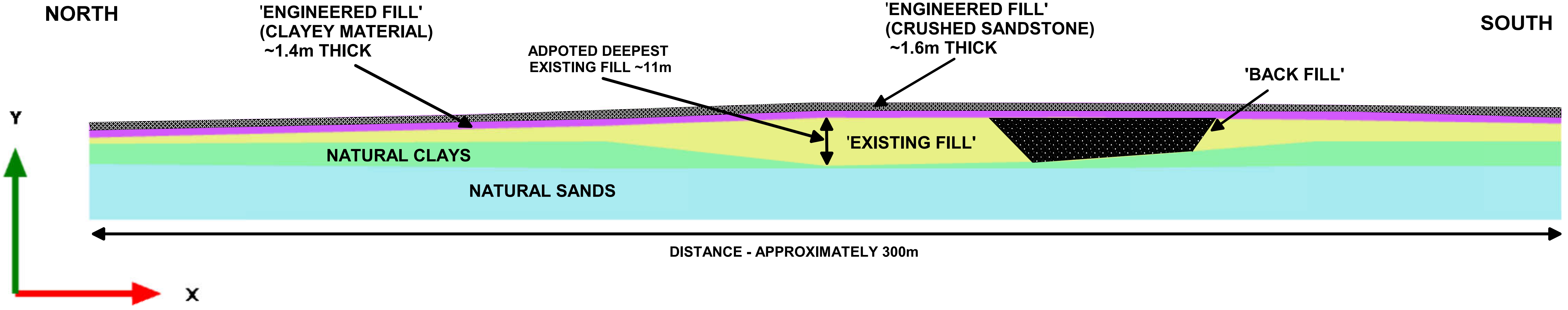
APPENDIX D

Numerical Analyses Output



NOTES:

- REFER TO TEXT OF REPORT

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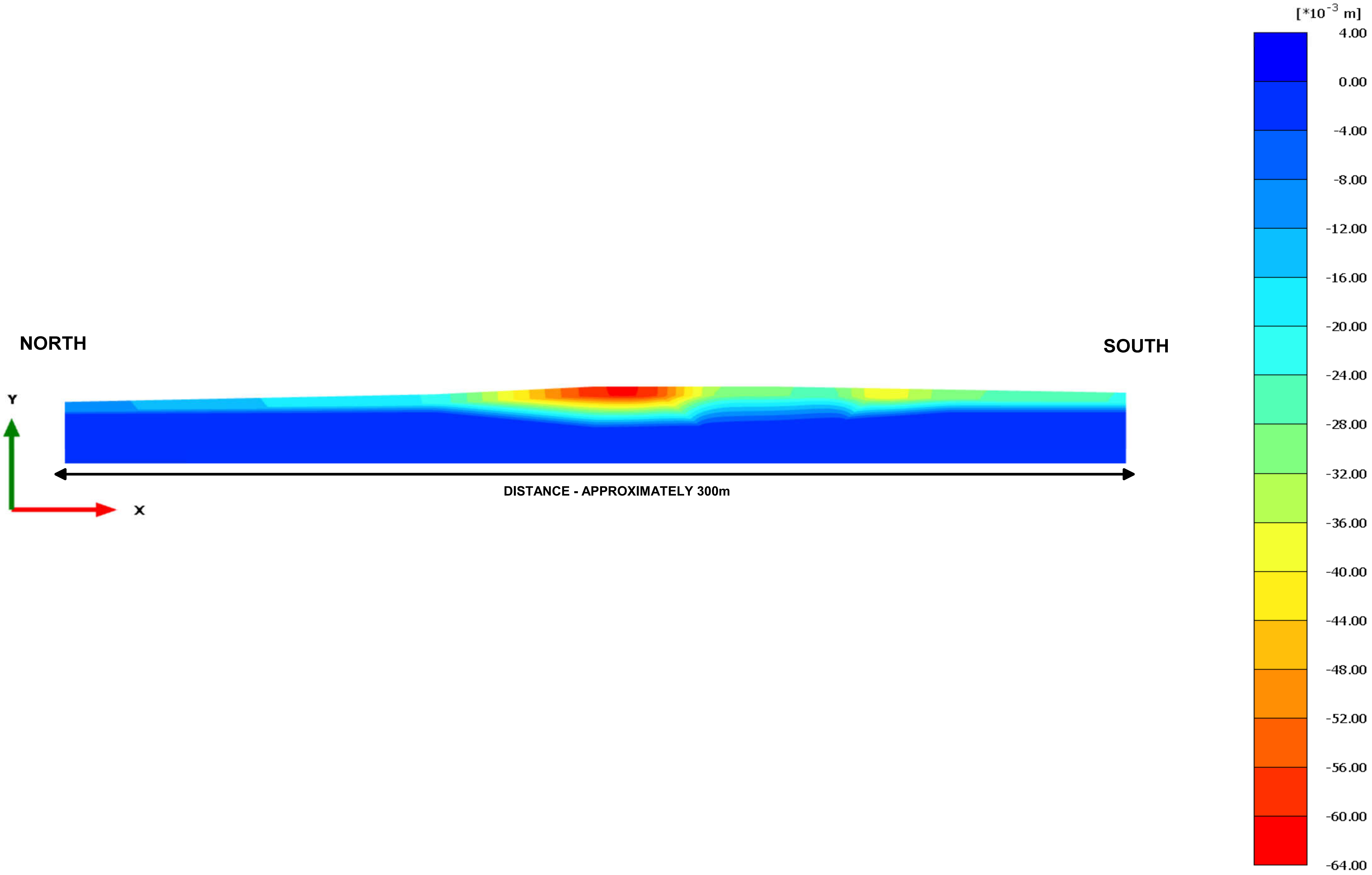
LONG SECTION THROUGH SITE
ADOPTED GEOTECHNICAL MODEL

JK Geotechnics
GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

Report No. 26930Z Figure No. 3



NOTES:

- REFER TO TEXT OF REPORT

NOT TO SCALE

LONG SECTION THROUGH SITE
ESTIMATED SETTLEMENTS - AT 50 YEARS

JK Geotechnics
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Report No. 26930Z Figure No. 4

Appendix J

Fill Management Protocol for Imported VENM Cap Construction

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Fill Management Protocol for Imported VENM Cap Construction

Proposed Residential Development
146 Newbridge Road, Moorebank

Prepared for
Benedict Industries Pty Ltd

Project 71459.07
April 2017

Integrated Practical Solutions

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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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Fill Management Protocol for Imported VENM Cap Construction
Proposed Residential Development
146 Newbridge Road, Moorebank

1. Introduction

Douglas Partners Pty Ltd (DP) was commissioned by Mr Ernest Dupere of Benedict Industries Pty Ltd (Benedict) to prepare this Fill Management Protocol (the FMP) to manage the importation of fill material during the bulk earthworks to be undertaken as part of the proposed developments at 146 Newbridge Road, Moorebank (the site).

DP understands that bulk earthworks will involve cut and fill of existing material with a net deficit of soil. The net deficit will require an average 1.6 m thickness of imported virgin excavated natural material (VENM) fill across the site.

This FMP details the requirements for assessing the VENM prior to importation to the site, with respect to contamination and (if required) salinity, and the procedures to be implemented during the course of VENM importation. A separate procedure will need to be adopted to cater for geotechnical aspects of fill suitability.

Application of the FMP to all soil and rock to be imported to the site will provide a consistent approach to the management of materials with respect to their suitability for use as the proposed cap.

The following should be considered with respect to the implementation of the FMP:

- The FMP is only for the materials imported for the bulk earthworks and does not apply to other materials imported to the site for the purpose of road construction or drainage works etc.;
- It is the responsibility of Benedict Industries Pty Ltd and its nominated qualified Geotechnical and Environmental Consultant to maintain compliance with the FMP; and
- The suppliers of the materials are required to provide the supporting documentation to verify that the subject material complies with the FMP. It is the suppliers' responsibility to ensure that the supporting documentation is complete and correct. In this regard, the suppliers of materials must be issued with a copy of the FMP.

The site is being audited by Dr Ian Swane, a NSW Environment Protection Authority (EPA) accredited site auditor, to facilitate the issue of a site audit statement (SAS) Part B confirming the land can be made suitable for the proposed development. The auditor has requested in auditors comments (26 July 2016) (comments 41, 47 and 52 that a Fill Management Protocol (FMP) be included in the RAP.

2. Site Information

The site comprises part (generally the northern half) Lot 7 in Deposited Plan 1065574. The street address is 146 Newbridge Road, Moorebank and the site has a total area of approximately 9 ha.

The site boundary is shown on Drawing 1, Appendix A. The drawing also shows land to the south of the 'site' which is the remainder of Lot 7 in Deposited Plan 1065574. It is understood that this southern portion is also proposed to be developed as a marina and that this development is the subject of a separate DA.

The site has been the subject of various previous reports including *inter alia*:

- Douglas Partners *Detailed Site Investigation 146 Newbridge Road, Moorebank NSW* Project 71459.03 dated March 2016 (DP, 2016); and
- Douglas Partners *Remediation Action Plan 146 Newbridge Road, Moorebank NSW* Project 71459.06 dated April 2017 (DP, 2017).

An extended list of references is provided in Section 10.

The proposed development of 180 residential dwellings will comprise a mix of terrace homes, duplex (semi-detached) homes and detached homes. The final lot layout may be subject to minor changes as detailed design progresses. The following drawings that depict the various aspects of the proposed development are provided in Appendix B:

- Drawing 14005-FILL2 Preliminary Fill Plan of the Residential Portion of Lot 7 DP1065574 Above the Bottom of the Capping Layer (i.e. 3 m below FSL), dated 1 September 2016;
- Drawing 14005E10 Overall Plan Showing Catchments, dated 20 November 2016; and
- Drawing MP01-B-01-12-2016 Concept Plan Reduced Site Area Option 20y, dated 21 November 2016.

3. Material Importation

The soil and rock materials to be imported to the site during bulk earthworks must satisfy the requirements detailed in Sections 4, 5 and 6 below. All materials to be imported must be accompanied by appropriate reports/ certifications from the qualified geo-environmental geotechnical consultants confirming the status of the material with respect to contamination, acid sulphate soils and salinity (and relevant geotechnical parameters where available). The materials to be imported should also be compatible with the salinity and aggressivity characteristic of the site.

4. Contamination Requirements

4.1 Regulatory Requirements and Applicable Guidelines

The NSW Department of Planning and Environment have outlined a list of Key Issues as part of the *Secretary's Environment Assessment Requirements (SEAR) 1102 (dated 16 November 2016)*. The relevant key issue is replicated below:

'Waste management – including:

- *Details of the type, quality and classification of waste to be received at the site;*

- *Details of the resource outputs and any additional processes for residual waste;*
- *Details of waste handling including transport, identification, receipt, stockpiling and quality control; and*
- *The measures that would be implemented to ensure that the proposed development is consistent with the aims, objectives and guidelines in the NSW Waste Avoidance and Resource Recovery Strategy 2014-21.'*

Liverpool Development Control Plan 2008 (DCP) Part 1 Section 10 outlines the requirements for the management of contaminated sites under the DCP. This has been addressed via the various site investigations and remediation action plan (RAP) (e.g. DP, 2016a; 2016b). Part 2.10 of the DCP is specific to the site and Section 3.5 of Part 2.10 is relevant to cut and fill works, specifically, Item 4. states that "*contaminated fill, either imported or found on site is not permitted*."

DP notes that in addition to satisfying the Council's requirements the importation of material onto the site must also comply with the provisions of relevant NSW environmental legislation, including, inter alia, the *Contaminated Land Management Act 1997* and *Protection of the Environment Operations Act 1997*. The following guidelines and documents are relevant for the purpose of material assessment for importation:

- NSW Environment Protection Authority (NSW EPA, 2014) *Waste Classification Guidelines: Part 1 Classifying Waste*;
- National Environment Protection Council (2013) *National Environment Protection (Assessment of Site Contamination) Measure* (NEPC, 2013);
- ANZECC/NHMRC (1992) *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites, Environmental Soil Quality Guidelines* - Background A (ANZECC, 1992); and
- Berkman (1989) *Field Geologists Manual* - Background Concentration Ranges for Metals.

For the purposes of this site materials classified under Resource Recovery Exemptions and Orders will not be accepted as imported bulk filling under this FMP.

4.2 Imported Material Acceptance Criteria – Contamination

The materials to be imported to the site must satisfy the following:

- All imported soil/rock materials must be geotechnically suitable as determined by a geotechnical engineer (refer to Section 0);
- All imported soil/rock materials must be VENM under the NSW EPA (2014) *Waste Classification Guidelines* and the *Protection of the Environment (POEO) Act*;
- No Excavated Natural Material (ENM) or other exempted waste material is to be accepted onto the site;
- No Acid Sulphate Soil / Potential Acid Sulphate Soil is to be accepted onto the site;
- As the NSW EPA has no specific VENM assessment criteria (in terms of contaminant thresholds), the VENM should be reviewed on the basis of the source site history, potential for acid sulphate soil conditions, material type and the site conditions observed during field assessment and the

assessment of VENM validation samples with reference to relevant guidelines/thresholds. The VENM validation assessment should include an appropriate number of sample analyses conducted for the analytes listed in Table D1, Appendix D at the sampling frequency as specified in Table E1, Appendix E. DP notes that the sampling frequencies to be adopted during VENM assessment are dependent on the past land use history of the source site and the potential for the contamination to be present at the source site. The supplier's Environmental Consultant should adopt the relevant sampling frequency (Criterion 1 or Criterion 2) as per Table E1, Appendix E based on the history of the source site and the potential for contamination when undertaking VENM assessment. If necessary, The Environmental Consultant should be contacted for advice in selecting the required sampling frequency for VENM assessment. The concentrations of heavy metals in the samples tested should be below the background ranges published in Berkman (1989) and/ or ANZECC (1992) for typical Australian soils, and the concentrations of organic analytes in the samples should be below the analytical practical quantitation limits (PQL). Similarly, the VENM should not contain any fill, anthropogenic material (including asbestos) or building demolition rubble;

- The imported VENM material must satisfy the requirements under section 4.3.7 of the NSW EPA *Contaminated Land Management – Draft Guidelines for the NSW Site Auditor Scheme (3rd Edition)* dated October 2016 or corresponding clause(s) in the final published version of this guideline;
- The thresholds to be adopted for VENM assessment are included in Table D1, Appendix D;
- All imported VENM must be placed in accordance with the Specification in J&K (2016) see Section 10). A separate procedure for verifying imported material from a geotechnical perspective is to be developed by the Geotechnical Consultant;
- All VENM to be imported must be accompanied by a VENM validation report (VENM certification) from a suitably qualified Environmental Consultant. The VENM validation report should include the following:
  - Details of the source site, past land use, site contamination history, surrounding land use and the potential for the occurrence of contamination and acid sulphate soil conditions;
  - Information on depth and the extent of excavation, geological profile at the source site and the VENM volume requiring disposal, including relevant test pit or borehole logs;
  - Site conditions at the time of validation assessment, a plan showing the proposed area of excavation and VENM sampling locations;
  - Site photographs showing the site conditions and geological profile within the test pits / investigation locations;
  - Analytical schedule (undertaken as per Table D1, Appendix D), the number of samples tested (as per the sampling frequency outlined in Table E1, Appendix E), sample collection depth and a summary table of laboratory analytical results compared against the criteria provided in Table D1, Appendix D;
  - A summary of recommendations/limitations of the VENM assessment (e.g. if VENM classification applies to certain soil strata or the *in-situ* soil throughout the site or to stockpiles only, if the segregation of material required etc.); and
  - The validity period (time frame) of the VENM report.

- In addition to the above, all VENM materials must also be validated to be suitable, from a contamination standpoint, for use on residential sites with access to soil. Whilst the proposed development at the site comprised residential dwellings with access to soil DP notes that the criteria for residential land use are the most conservative and protective of human health. In this regard, material to be imported to the site must also meet the assessment criteria specified in Schedule B1 of NEPC (2013) for residential land use as provided in Table D2, Appendix D; and
- With regard to the analytical testing, all laboratory analysis must be conducted by a laboratory that holds National Association of Testing Authorities (NATA) accreditation for the test methods performed.

Compliance with the above requirements must be met before VENM materials are imported to the site. Agreement of compliance by the Environmental Consultant represents a hold point on importation.

5. Salinity and Aggressivity Requirements

5.1 Applicable Guidelines

The following guidelines are considered relevant for the assessment of the suitability of material for importation with respect to their salinity and aggressivity-related properties:

- Department of Land and Water Conservation (DLWC, 2002) *Site Investigations for Urban Salinity*;
- *Western Sydney Salinity Code of Practice 2003;*
- Standards Australia (2009) *AS 2159 – 2009 Piling Design and Installation*;
- Standards Australia (2011) *AS 2870 – 2011 Residential Slabs and Footings*; and
- Standards Australia (2009) *AS 3600 – 2009 Concrete Structures*.

5.2 Background

According to the DIPNR (2002) *Salinity Potential in Western Sydney* map, the subject site is identified as having a moderate salinity potential. The site is covered by fill of varying thickness of up to approximately 11.5 m and the salinity potential of the fill is likely to be variable (i.e. consistent with the various sources of fill).

Establishing the salinity potential of the fill at the site has not been undertaken for the following reasons:

- The soils to be excavated largely comprise non-homogeneous fill and therefore establishing a salinity depth profile was not feasible;
- Soils that need to be excavated, screened and re-compacted as part of the as part of bulk earthworks will be such that their location / distribution will change from their current location / distribution; and
- The site will require final filling / capping involving a 1.6 m thick layer of VENM, likely to be crushed sandstone.

The most important aspect of any salinity management will be that any fill soils imported to form final design levels will ultimately be in contact with built infrastructure. This issue will be managed by implementing this Fill Management Protocol. This is on the premise that all foundations are high level footings founded in the imported fill layer. Should any structures involve piered foundations that contact the existing fill, then the salinity and aggressivity of the fill at the relevant area of the site should be confirmed to allow for appropriate design of those deep foundations.

5.3 Imported Material Acceptance Criteria – Salinity and Aggressivity

Crushed sandstone generally has characteristics of non-saline to slightly saline soil and therefore testing of crushed sandstone to confirm salinity characteristics is not required under this FMP.

Materials to be imported to the site must be assessed for salinity (excluding crushed sandstone) and aggressivity as per below:

- Analysis of the samples for the salinity and aggressivity related parameters (pH, EC, chloride, sulphate and texture) at the specified sampling frequency indicated in Table E2, Appendix E;
- Materials to be imported to the site should have a maximum salinity classification of non-saline to slightly saline salinity, based on EC, the electrical conductivity of saturated pore water. Refer to Table D3, Appendix D for the salinity scale; and
- Materials should be a maximum of mildly aggressive to concrete structures and non-aggressive to steel structures based on the aggressivity scale given in Tables D4 and D5, Appendix D.

The VENM reports provided to the Environmental Consultant for review must also include an assessment of salinity and aggressivity of VENM. The following information should be included in the VENM report in relation to salinity assessment:

- Visual clues of salinity potential at the site during site inspections (such as black greasy patches on the soil surface, salt crystals, scalds, stressed vegetation and salt damage to structures);
- Number of soil samples analysed for salinity and the depths of sample collection. Samples should be collected from various depths rather than just from the surface;
- A plan showing sample collection locations; and
- Comments on the soil salinity at the source site and the aggressivity of the soil to concrete and steel structures based on the analytical results of the samples tested.

Compliance with the above requirements must be met before VENM materials are imported to the site. Agreement of compliance by the Environmental Consultant represents a hold point on importation.

It is to be noted that the placement of imported materials may change the salinity and aggressivity characteristics of the site. Therefore, an assessment of site's salinity may be required post completion of bulk earthworks but prior to issuing of the subdivision certificates. The need for a post-earthworks salinity assessment shall be to be determined by the Environmental Consultant and be based on the number and nature of VENM source sites. The results of any the salinity mapping generated by a post-earthworks salinity assessment should be incorporated into the lot classifications.

6. Geotechnical Requirements

The materials to be imported to the site should have the following geotechnical characteristics:

- All imported soil/rock materials must be geotechnically suitable as determined by a geotechnical engineer;
- Materials should be free of topsoil, organic material, fill, refuse, building rubble and anthropogenic inclusions and should not be ASS/PASS;
- Materials should not contain particle sizes larger than 150 mm. If the materials contain particle sizes larger than 150 mm such materials should be breakable under the normal compaction conditions;
- Materials are not overly wet (greater than +4% of optimum moisture content) upon visual assessment; and
- All imported VENM must be placed in accordance with the Specification in J&K (2016) see Section 10).

Compliance with the above requirements and any other requirements and checking procedures imposed by the Geotechnical Consultant must be met before VENM materials are imported to the site. Agreement of compliance by the Environmental Consultant represents a hold point on importation.

7. Fill Management Protocol

The following procedures must be followed prior to and during the course of material importation:

- Prior to commencing construction of the 1.6 m capping in that area, the Environmental Consultant and the auditor should inspect the subgrade at an area;
- Prior to importation the suppliers must provide VENM validation reports to the site Environmental for review;
- The Environmental Consultant will review the VENM validation reports to assess the compliance of the VENM assessment with Sections 4, 5 and 6 of this FMP and the suitability of material for importation. Following review of the VENM validation reports, the Environmental Consultant will issue a memorandum for each source site with an approval for material importation and / or comments / recommendations that should be addressed before the material can be approved for importation. The Environmental Consultant, at its discretion, may approve the VENM reports (and the source sites) where the frequency of samples tested for contamination and salinity/aggressivity assessment varies from Tables E1 and / or E2 provided that the land use information is sufficiently robust and the analytical results indicate that the *in-situ* material at the source site has a low potential for contamination, is compatible with the salinity characteristic of the receiving site and all other requirements of this FMP have been complied with;
- An inspection of the source sites by the Environmental Consultant may be required (in the event of any dispute regarding the suitability or classification of the materials) on a case by case basis prior to material importation to assess the current conditions of the source site (i.e. absence of fill, topsoil, anthropogenic material or unassessed material stockpiles at the source sites). It is envisaged that under normal circumstances such inspections would not be required particular

under circumstances where the VENM was being imported from a single source site (e.g. tunnel construction);

- Provision of seven days' notice to the Auditor of the intention to import material to the site. Benedict (or nominated Contractor) must provide all supporting documents (e.g. VENM validation reports, salinity assessment reports, NATA endorsed laboratory certificates and the Environmental Consultant's report review memorandums) to the Auditor for approval to import and place the material at the site;
- The Suppliers (or nominated Contractor) must provide a list of source sites and the registration details of the trucks bringing materials into the site to the Environmental Consultant (and the Gate Keeper at the site) in advance;
- Provision of training to the Gate Keeper for the inspection of materials during the course of importation. The Environmental Consultant will provide information to the Gate Keeper in relation to the approved source sites and the volumes and descriptions of approved material for importation using Form F3 included in Appendix F;
- The Gate Keeper must verify the registration numbers of trucks bringing in the materials with the truck registration list provided by the Suppliers. The Gate Keeper should also cross-examine the imported material at the gate check point to ensure it matches with the description of the approved material and that it is free of visual / olfactory contamination and anthropogenic material;
- The Gate Keeper must keep records of trucks importing material to the site with a description of source site and material imported using Forms F1 and F2 included in Appendix F, and any loads rejected due to non-compliance using Form F4. Recording of the location of materials imported onto the site including photographs, and drawings are also required to be completed by the Gate Keeper in liaison with the earthworks contractor or field technician from the Environmental Consultant undertaking compaction test at the site. Refer to Section 8.2 for details on gate check;
- The Gate Keeper should provide a record of truck registrations and material imported to the site on a daily basis to the Environmental Consultant's project manager who will in turn provide this information to Benedict (or nominated Contractor) for record keeping purpose. Benedict (or nominated Contractor) should keep records of truck registrations and material imported to the site for future reference;
- The imported materials must be placed at the designated locations and compacted to the required standards as per the Council's Work Specification. Upon completion of material placement, Benedict's nominated Contractor should survey the depths and the extent of material placement at the site;
- All material imported to the site is tracked from cradle-to-grave;
- Material is only to be imported to the site when the Gate Keeper is present and certifies the loads being imported;
- The Gate Check Forms in Appendix F are to be completed by the Gate Keeper at the time the loads are received at the site and at a frequency not less than one per day;
- Inspection of the completed cap as soon as construction of the cap has been completed in an area by the Environmental Consultant and the auditor; and

- Preparation of a fill validation report by the Environmental Consultant for submission to the Council at the completion of material importation to the site. The report should be prepared with reference to Section 9 of this FMP.

Note: inspection by the Environmental Consultant does not constitute agreement of the geotechnical properties of the materials. Such inspections must be carried out by the Geotechnical Consultant.

Compliance with the approval for import of material must be met before further VENM materials are imported to the site. Agreement of compliance by the Environmental Consultant represents a hold point on importation.

8. Approval/ Assessment

8.1 Assessment/Approval of Source Sites

Prior to acceptance of material from an external source site, an assessment of the source site should be undertaken by the source site's consultant to determine the general acceptability of material from that site. Materials will be judged as suitable, or otherwise, by the Environmental Consultant based on the documentation provided by the source site's consultant, the apparent reliability, or otherwise, of the documentation and its conformance with this Protocol.

No material is to be imported to site that has not had prior written approval from the Environmental Consultant.

Compliance with the above requirements must be met before VENM materials are imported to the site. Agreement of compliance by the Environmental Consultant represents a hold point on importation.

The Environmental Consultant shall notify the Site Auditor of any non-compliant imported material without delay;

If the non-compliant material is found to be incompatible with the site requirements, no further material from that source is to be imported to the site until approved by the Environmental Consultant.

8.2 Gate Check

Material tracking and inspection should be undertaken to assess that the materials being imported are consistent with those approved for importation. The Gate Keeper must compare each load with the material description provided in the VENM validation report (and Environmental Consultant memorandum).

A record of truck movements providing the following information must be maintained by the Gate Keeper for trucks carrying material imported to the site:

- The date and time of truck arrival;
- The source location of the material;
- The truck registration details;

- Material type;
- Visual assessment of material at gate;
- Record of load acceptance/rejection; and
- The approximate location of material placement (on a daily basis not per truck load).

The Gate Keeper will reject any materials entering the site when:

- The registration numbers of trucks brining in the materials or the source site does not match up with the list of truck registrations provided by the Suppliers in advance and the approved source site lists;
- The material is deemed to be not consistent with that described in supporting documentation (and Environmental Consultant memorandum) based on a visual assessment of the material at the gate or the imported material contains unsuitable materials listed in Appendix G; or
- The supporting documentation has not been previously supplied and accepted.

Similarly, the Gate Keeper will reject materials from the source sites from which more material has been delivered than has been allowed for in the original assessment. A supplementary assessment may be undertaken by the source site's consultant to allow for importation of additional material, but the supplementary assessment report must be submitted to the Environmental Consultant for review in accordance with Section 4.2.

Compliance with the above requirements must be met before VENM materials are imported to the site. Agreement of compliance by the Environmental Consultant represents a hold point on importation.

8.3 Check Samples

As an additional level of control, check samples of imported material may be collected at the gate at the discretion of the Environmental Consultant if it is considered necessary. The check samples (if collected) will be assessed for contamination as per Table D1, Appendix D and for salinity and aggressivity parameters as per Table E2, Appendix E. As a minimum check samples will be collected in the following circumstances:

- The source sites had previous contamination history but have been remediated; and
- Contamination is suspected in the imported material based on visual/olfactory assessments.

Compliance with the above requirements must be met before VENM materials are imported to the site. Agreement of compliance by the Environmental Consultant represents a hold point on importation.

8.4 Non-conformance

The bulk earthworks contractors must notify the Environmental Consultant if contamination is suspected in the imported material during material placement. Such material should be segregated for assessment by the Environmental Consultant.

If the non-compliant material is found to be incompatible with the site requirements it will be removed at the cost of the Suppliers. A bond system is recommended to be put in place with the suppliers to address non-conformance matters.

Compliance with the above requirements must be met before VENM materials are imported to the site. Agreement of compliance by the Environmental Consultant represents a hold point on importation.

9. Final Validation Reporting

At the completion of importation of the materials to the site and prior to the commencement of construction the Environmental Consultant will prepare an imported fill validation report. The validation report should include the following:

- A review of source site documentation;
- Copies of Environmental Consultant memoranda (associated with reviews of VENM and salinity reports) for the approved source sites;
- A review of gate keeping records and the volumes of material imported from each source site;
- Site drawings/surveys identifying where the imported materials were placed within the site;
- A review of and discussion of check sampling (if undertaken);
- Records of non-conformances with this FMP; and
- An assessment of the overall compliance of imported material with the FMP.

The final imported fill validation report will also be submitted to Council to demonstrate compliance with the FMP.

10. References

DLWC (2002) Site Investigations for Urban Salinity

EPA (2014a) Waste Classification Guidelines, Part 1: Classifying Waste

EPA (2014b) Waste Classification Guidelines Part 2: Immobilisation of Waste

DEC (2006) Guidelines for the NSW Site Auditor Scheme

DIPNR (2002) Salinity Potential in Western Sydney

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

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

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

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

Standards Australia (2009) AS 2159 – 2009 Piling Design and Installation

Standards Australia (2011) AS 2870 – 2011 Residential Slabs and Footings

Standards Australia (2009) AS 3600 – 2009 Concrete Structures

Western Sydney Salinity Code of Practice 2003

11. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 146 Newbridge Road, Moorebank in accordance with DP's proposal dated 26 April 2016 and acceptance received from Mr Ernest Dupere dated 20 May 2016. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Benedict Industries 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.

Asbestos has previously been detected by observation or by laboratory analysis at the site, either on the surface of the site, or in filling materials at the test locations sampled and analysed. Building demolition materials, such as concrete, brick, tile, timber, plastic, are ubiquitous throughout the fill at the site, and these are considered as indicative of the possible presence of hazardous building materials (HBM), including asbestos. It is therefore considered possible that HBM, including asbestos, may be during bulk earthworks associated with the proposed development, and hence no warranty can be given that asbestos is not present.

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 associated with future design aspects relevant to our input to the project, 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

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

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

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.

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 and Proposed Fill Plan

Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Site Locality
Remediation Action Plan
146 Newbridge Road, Moorebank, NSW

N
MGA

OFFICE: Sydney
DRAWN BY: MJC
DATE: 29.04.2016

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.06
DRAWING No: 1
REVISION: A
SCALE: As shown

LEGEND

- ⬚ Proposed Development Area
- ● Surface Sample
- a Replacement Well
- b Shallow Gas Well
- ● Borehole / Gas Well
- ● Monitoring Well
- ● Borehole
- ● Borehole (DP, 2002)
- ● Borehole (EIS, 2015)
- ● Borehole / Gas Well (EIS, 2015)
- ● Monitoring Well Location (EIS, 2015)

Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Previous Test Locations
Remediation Action Plan
146 Newbridge Road, Moorebank, NSW

MGA N

OFFICE: Sydney
DRAWN BY: MJC
DATE: 29.04.2016

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.06
DRAWING No: 2
REVISION: A
SCALE: As shown

TOTAL 179 LOTS

rev:	date:	amendment:
A	21.11.16	ISSUE FOR INFORMATION

project:

GEORGES COVE MARINA
Newbridge Road
Moorebank NSW 2170

architect:

MIRVAC DESIGN
architects
planners
interior designers

Level 26, 60 Margaret St.
Sydney, NSW, 2000
tel. 02 9080 8000
fax. 02 9080 8181
Mirvac Design Pty. Ltd.
ABN 78 003 359 153

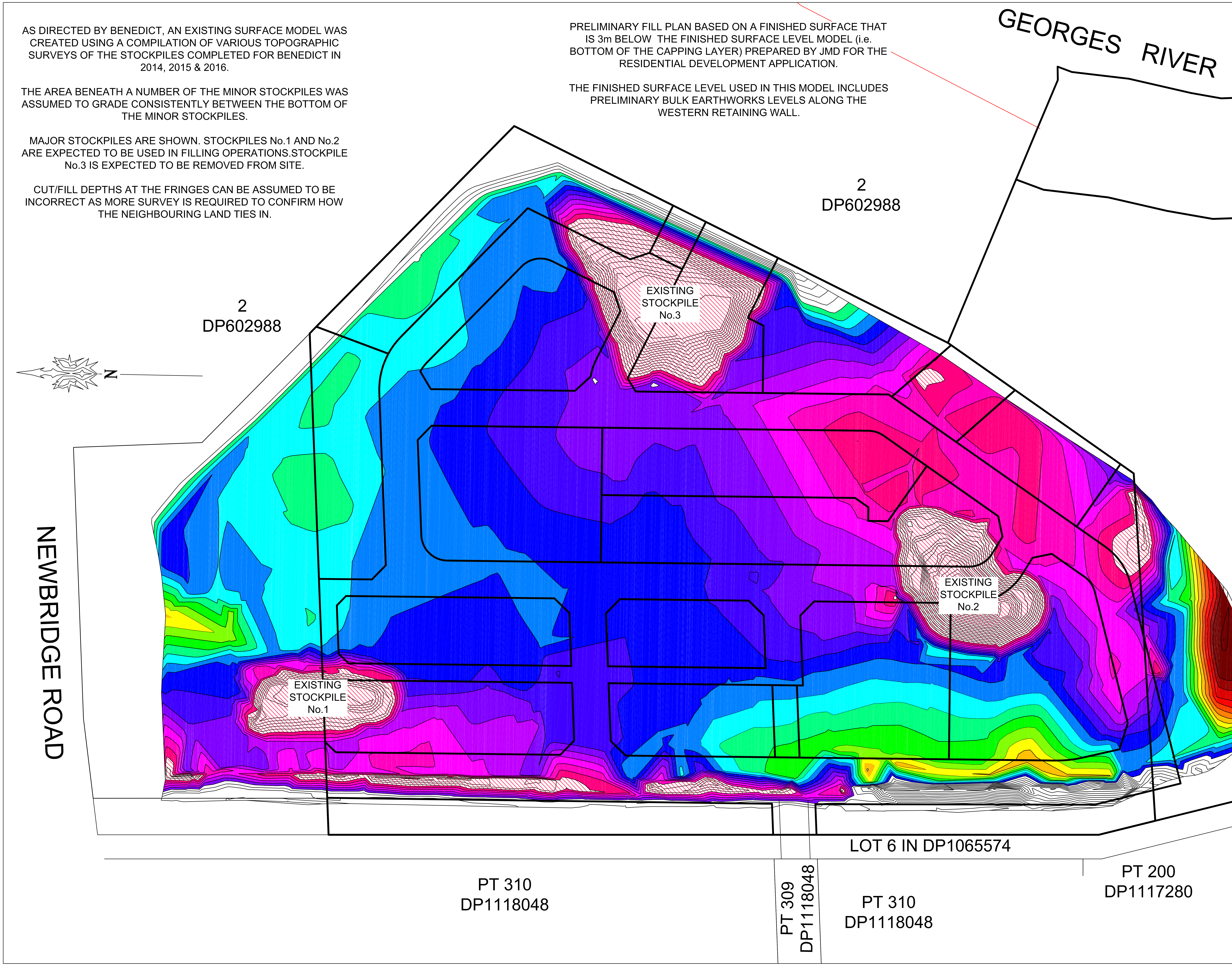
mirvac

title:

CONCEPT PLAN
Reduced Site Area
Option 20y

drawn:
approved:

job no: .....
date: 21-11-2016
scale @ A0:1:500
lot no: 0
drawing no: MP01-20y
rev: B



AS DIRECTED BY BENEDICT, AN EXISTING SURFACE MODEL WAS CREATED USING A COMPILATION OF VARIOUS TOPOGRAPHIC SURVEYS OF THE STOCKPILES COMPLETED FOR BENEDICT IN 2014, 2015 & 2016.

THE AREA BENEATH A NUMBER OF THE MINOR STOCKPILES WAS ASSUMED TO GRADE CONSISTENTLY BETWEEN THE BOTTOM OF THE MINOR STOCKPILES.

MAJOR STOCKPILES ARE SHOWN. STOCKPILES No.1 AND No.2 ARE EXPECTED TO BE USED IN FILLING OPERATIONS.STOCKPILE No.3 IS EXPECTED TO BE REMOVED FROM SITE.

CUT/FILL DEPTHS AT THE FRINGES CAN BE ASSUMED TO BE INCORRECT AS MORE SURVEY IS REQUIRED TO CONFIRM HOW THE NEIGHBOURING LAND TIES IN.

PRELIMINARY FILL PLAN BASED ON A FINISHED SURFACE THAT IS 3m BELOW THE FINISHED SURFACE LEVEL MODEL (i.e. BOTTOM OF THE CAPPING LAYER) PREPARED BY JMD FOR THE RESIDENTIAL DEVELOPMENT APPLICATION.

THE FINISHED SURFACE LEVEL USED IN THIS MODEL INCLUDES PRELIMINARY BULK EARTHWORKS LEVELS ALONG THE WESTERN RETAINING WALL.

▨	EXISTING SURFACE IS GREATER THAN 4.5m ABOVE THE PRELIMINARY DESIGN SURFACE
🟥	EXISTING SURFACE IS BETWEEN 4.0m AND 4.5m ABOVE THE PRELIMINARY DESIGN SURFACE
🟪	EXISTING SURFACE IS BETWEEN 3.5m AND 4.0m ABOVE THE PRELIMINARY DESIGN SURFACE
🟪	EXISTING SURFACE IS BETWEEN 3.0m AND 3.5m ABOVE THE PRELIMINARY DESIGN SURFACE
🟪	EXISTING SURFACE IS BETWEEN 2.5m AND 3.0m ABOVE THE PRELIMINARY DESIGN SURFACE
🟪	EXISTING SURFACE IS BETWEEN 2.0m AND 2.5m ABOVE THE PRELIMINARY DESIGN SURFACE
🟦	EXISTING SURFACE IS BETWEEN 1.5m AND 2.0m ABOVE THE PRELIMINARY DESIGN SURFACE
🟦	EXISTING SURFACE IS BETWEEN 1.0m AND 1.5m ABOVE THE PRELIMINARY DESIGN SURFACE
🟦	EXISTING SURFACE IS BETWEEN 0.5m AND 1.0m ABOVE THE PRELIMINARY DESIGN SURFACE
🟦	EXISTING SURFACE IS BETWEEN 0.0m AND 0.5m ABOVE THE PRELIMINARY DESIGN SURFACE
🟩	EXISTING SURFACE IS BETWEEN 0.0m AND 0.5m BELOW THE PRELIMINARY DESIGN SURFACE
🟩	EXISTING SURFACE IS BETWEEN 0.5m AND 1.0m BELOW THE PRELIMINARY DESIGN SURFACE
🟩	EXISTING SURFACE IS BETWEEN 1.0m AND 1.5m BELOW THE PRELIMINARY DESIGN SURFACE
🟨	EXISTING SURFACE IS BETWEEN 1.5m AND 2.0m BELOW THE PRELIMINARY DESIGN SURFACE
🟧	EXISTING SURFACE IS BETWEEN 2.0m AND 2.5m BELOW THE PRELIMINARY DESIGN SURFACE
🟧	EXISTING SURFACE IS BETWEEN 2.5m AND 3.0m BELOW THE PRELIMINARY DESIGN SURFACE
🟥	EXISTING SURFACE IS BETWEEN 3.0m AND 3.5m BELOW THE PRELIMINARY DESIGN SURFACE
🟥	EXISTING SURFACE IS BETWEEN 3.5m AND 4.0m BELOW THE PRELIMINARY DESIGN SURFACE
🟥	EXISTING SURFACE IS BETWEEN 4.0m AND 4.5m BELOW THE PRELIMINARY DESIGN SURFACE
🟫	EXISTING SURFACE IS BETWEEN 4.5m AND 5.0m BELOW THE PRELIMINARY DESIGN SURFACE
🟫	EXISTING SURFACE IS MORE THAN 5.0m BELOW THE PRELIMINARY DESIGN SURFACE

Issue	App	Date	Description
A	T.H.	01-09-2016	PRELIMINARY FOR REVIEW

Client: MIRVAC HOMES (NSW) PTY LTD.
Designed by : S.G.
Date of Drawing : 01-09-2016
Ratio (A1) : 1:750
Datum : AHD
Origin of Levels :
Date of Survey : VARIOUS

JMD
Development Consultants

John M. Daly & Associates PTY LTD
A.B.N. 88051977989
Surveying
Engineering
Project Management
Licensed Water Service Co ordinators

32 Iolanthe Street
P.O. BOX 25
CAMPBELLTOWN N.S.W. 2560
PH. (02) 4625 5055
FAX (02) 4628 2013
email: admin@jmd.com.au

Project : MOOREBANK COVE DEVELOPMENT
NEWBRIDGE ROAD, MOOREBANK

PRELIMINARY FILL PLAN OF THE RESIDENTIAL PORTION OF LOT 7 DP1065574
ABOVE THE BOTTOM OF THE CAPPING LAYER (i.e. 3m BELOW PROPOSED FSL)

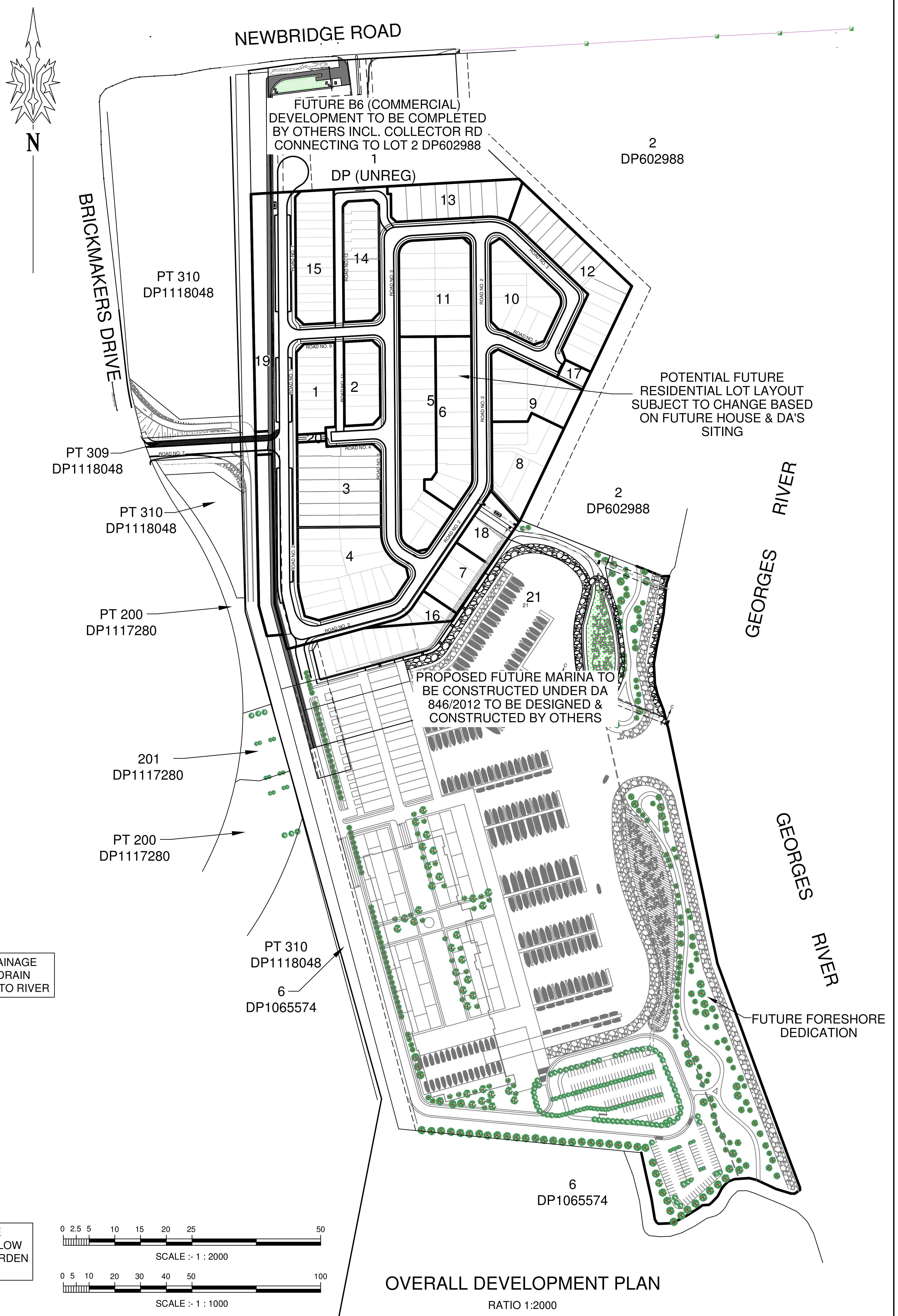
Sheet 1
of 1 sheets
Ref: 14005-FILL2

Locality : MOOREBANK
L.G.A. : LIVERPOOL
CAD Ref: C:\USERS\SGRAY\DESKTOP\14005\14005FILL2

The ratio shown on this plan relates to the original plan, produced by JMD only. Any photocopying or printing from digital files provided (particularly PDF files) may significantly alter the ratio of the plan.

PROPOSED STAGE 2 WORKS

RATIO 1:1000



OVERALL DEVELOPMENT PLAN

RATIO 1:2000

Issue	App	Date	Description
A	T.H.	20-11-2016	ISSUED FOR DA

Client: MIRVAC HOMES (NSW) PTY LTD.

Designed by : S.G.

Date of Drawing : 20-11-2016

Ratio (A1) : 1:1000/1:2000

Datum : AHD

Origin of Levels :

Date of Survey : N/A

JMD
Development Consultants

John M. Daly & Associates PTY LTD
A.B.N. 88051977989
Surveying
Engineering
Project Management
Licensed Water Service Co ordinators

32 Iolanthe Street
P.O. BOX 25
CAMPBELLTOWN N.S.W. 2560
PH. (02) 4625 5055
FAX (02) 4628 2013
email: admin@jmd.com.au

Project : MOOREBANK COVE - STAGE 2
NEWBRIDGE ROAD, MOOREBANK

OVERALL PLAN SHOWING CATCHMENTS

Locality : MOOREBANK

L.G.A. : LIVERPOOL

Sheet 1 of 3 sheets

Ref: 14005E10

CAD Ref: S:\DATA\14\14005\14005 EMW\ENG\CAD\E10 RAINGARDEN SUPPORT\14005E10-PLAN

Appendix C

NSW Department of Planning (SEAR 1102) November 2016

Mr Phillip Towler
EMM Consulting Pty Ltd
Suite 1, 20 Chandos Street
ST LEONARDS NSW 2065

16/13470
SEAR 1102

Dear Mr Towler

Secretary's Environmental Assessment Requirements (SEAR) 1102
Proposed Contaminated Soil Treatment Works, 146 Newbridge Road, Moorebank
Liverpool Local Government Area

Thank you for your request for the Secretary's Environmental Assessment Requirements (SEARs) for the preparation of an Environmental Impact Statement (EIS) for the above development proposal. I have attached a copy of these requirements.

These SEARs have been provided on the basis that the site is not declared 'significantly contaminated land' by the Environment Protection Authority (EPA) under Section 11 of the *Contaminated Land Management Act 1997*. If the site is declared 'significantly contaminated land' by the EPA and the remediation works are to be carried out by a management order, the proposal would be considered State Significant Development under Schedule 1, Clause 24 of *State Environmental Planning Policy (State and Regional Development) 2011* for remediation of contaminated land. In the event that the proposal is considered SSD, the Minister for Planning would be the consent authority for the proposed development and Liverpool City Council would not have jurisdiction to determine the Development Application (DA).

In support of your application, you indicated that your proposal is both designated and integrated development under Part 4 of the *Environmental Planning and Assessment Act 1979* and requires an approval under the *Protection of the Environment Operations Act 1997* and the *Rural Fires Act 1997*.

In preparing the SEARs, the Department has consulted with the Environment Protection Authority, Department of Primary Industries, Rural Fire Service and the Office of Environment and Heritage. A copy of their requirements for the EIS are attached.

If other integrated approvals are identified before the DA is lodged, you must undertake direct consultation with the relevant agencies, and address their requirements in the EIS.

If your proposal contains any actions that could have a significant impact on matters of National Environmental Significance, then it will require an additional approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This approval is in addition to any approvals required under NSW legislation. If you have any questions about the application of the EPBC Act to your proposal, you should contact the Commonwealth Department of the Environment on (02) 6274 1111.

Should you have any further enquiries regarding SEAR 1102, please contact Thomas Piovesan, Planning Services, at the Department on (02) 9274 6356.

Yours sincerely

C. Ritchie

Chris Ritchie 16/11/16.
Director
Industry Assessments
as delegate of the Secretary

Environmental Assessment Requirements

Section 78A (8) of the *Environmental Planning and Assessment Act 1979.*

Designated Development

SEAR Number	1102
Proposal	Staged subdivision and infrastructure works for a residential subdivision, including contaminated soil treatment works
Location	146 Newbridge Road, Moorebank, Liverpool Local Government Area (Lot 7 DP 1065574)
Applicant	Mirvac Homes (NSW) Pty Ltd
Date of Issue	November 2016
General Requirements	The Environmental Impact Statement (EIS) must meet the minimum form and content requirements in clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.*
Key Issues	The EIS must include an assessment of all potential impacts of the proposed development on the existing environment (including cumulative impacts if necessary) and develop appropriate measures to avoid, minimise, mitigate and/or manage these potential impacts. As part of the EIS assessment, the following matters must also be addressed: • **strategic context** – including: – a detailed justification for the proposal and suitability of the site for the development; – a demonstration that the proposal is consistent with all relevant planning strategies, environmental planning instruments, development control plans (DCPs), or justification for any inconsistencies; and – a list of any approvals that must be obtained under any other Act or law before the development may lawfully be carried out; and – a description of any additional licence(s) or approval(s) required to carry out the proposed development. • **remediation action plan** – including: – a site audit statement from a site auditor accredited under the *Contaminated Land Management Act 1997* determining the appropriateness of and approving the Remediation Action Plan; – details of the nature and extent of contaminated material; – comprehensive program of the works proposed, including estimation of the surface area to be disturbed and excavation of contaminated material proposed to be undertaken; – details of the proposed measures to manage any disturbance of contaminated material; – justification for the proposed remediation approach; – details of the proposed remediation process, including equipment to be used and measures to dispose of contaminated material; – justification of the remediation criteria and process for the cleaning/verification of all equipment leaving the site (including workers clothing); – a detailed site validation plan; and – details of the consistency of the Remediation Action Plan with the relevant NSW Government legislation, environmental planning instruments, guidelines and standards. • **air quality** – including: – a description of all potential sources of air and odour emissions; – an air quality impact assessment in accordance with relevant Environment

	Protection Authority Guidelines; and – a description and appraisal of air quality impact mitigation and monitoring measures. • **soil and water** – including: – a description of local soils, topography, drainage and landscapes; – details of water usage for the proposal including existing and proposed water licencing requirements in accordance with the *Water Act 1912* and/or the *Water Management Act 2000*; – an assessment of potential impacts on the quality and quantity of surface and groundwater resources; – details of sediment and erosion controls; – the potential for further soil and/or groundwater contamination; – details of the proposed stormwater and wastewater management systems and water monitoring program to mitigate surface and groundwater impacts; and – a description and appraisal of impact mitigation and monitoring measures. • **waste management** – including: – details of the type, quantity and classification of waste to be received at the site; – details of the resource outputs and any additional processes for residual waste; – details of waste handling including, transport, identification, receipt, stockpiling and quality control; and – the measures that would be implemented to ensure that the proposed development is consistent with the aims, objectives and guidelines in the *NSW Waste Avoidance and Resource Recovery Strategy 2014-21*. • **noise and vibration** – including: – a description of all potential noise and vibration sources during construction and operation, including road traffic noise; – a noise and vibration assessment in accordance with the relevant Environment Protection Authority Guidelines; and – a description and appraisal of noise and vibration mitigation and monitoring measures. • **traffic and transport** – including: – details of road transport routes and access to the site; – road traffic predictions for the development during construction and operation; and – an assessment of impacts to the safety and function of the road network; and the details of any road upgrades required for the development. • **hazards and risk** – including: – the Environmental Impact Statement must include a preliminary risk screening completed in accordance with State Environmental Planning Policy No. 33 – Hazardous and Offensive Development and Applying SEPP 33 (DoP, 2011). • **biodiversity** – including: – accurate predictions of any vegetation clearing on site or for any road upgrades; – an assessment of the potential impacts on any threatened species, populations, endangered ecological communities or their habitats, groundwater dependent ecosystems and any potential for offset requirements; and – a detailed description of the measures to avoid, minimise, mitigate and offset biodiversity impacts.
Environmental Planning Instruments and other policies	The EIS must assess the proposal against the relevant environmental planning instruments, including but not limited to: • *State Environmental Planning Policy (Infrastructure) 2007*; • *State Environmental Planning Policy No. 33 Hazardous and Offensive Development*; • *State Environmental Planning Policy No. 55 Remediation of Land*;

	• *Liverpool Local Environmental Plan 2008*; and • relevant development control plans and section 94 plans.
Guidelines	During the preparation of the EIS you should consult the Department's Register of Development Assessment Guidelines which is available on the Department's website at planning.nsw.gov.au under Development Proposals/Register of Development Assessment Guidelines. Whilst not exhaustive, this Register contains some of the guidelines, policies, and plans that must be taken into account in the environmental assessment of the proposed development.
Consultation	During the preparation of the EIS, you must consult the relevant local, State and Commonwealth government authorities, service providers and community groups, and address any issues they may raise in the EIS. In particular, you should consult with the: • Environment Protection Authority; • Office of Environment and Heritage; • Department of Primary Industries; • Roads and Maritime Services; • Department of Primary Industries; • NSW Rural Fire Service; • WaterNSW; • SafeWork; • Liverpool City Council; and • the surrounding landowners and occupiers that are likely to be impacted by the proposal. Details of the consultation carried out and issues raised must be included in the EIS.
Further consultation after 2 years	If you do not lodge an application under Section 78A (8) of the *Environmental Planning and Assessment Act 1979* within 2 years of the issue date of these SEARs, you must consult with the Secretary in relation to any further requirements for lodgement.

Locked Bag 5123, Parramatta NSW 2124
Level 11, 10 Valentine Ave
Parramatta NSW 2150
www.waternsw.com.au
ABN 21 147 934 787

Contact: Wayne Conners
Phone: 02 8838 7531
Fax: 02 8838 7554
Email: wayne.conners@waternsw.com.au

Your ref: SEAR 1102

Via email: thomas.piovesan@planning.nsw.gov.au

Department of Planning & Environment
Industry Assessments
GPO Box 39
SYDNEY NSW 2001

Attention: Mr Thomas Piovesan

Dear Mr Piovesan,

Request for Secretary's Environmental Assessment Requirements – SEAR 1102 – Soil Contamination Treatment Works - 146 Newbridge Road, Moorebank (Lot 7 DP 1065574)

Thank you for your email of 12 October 2016 concerning the request for Secretary's Environmental Assessment Requirements for the above project.

Water NSW on behalf of DPI Water has reviewed the supporting documentation accompanying the request for Secretary's Environmental Assessment Requirements (SEAR's) and provides the following comments below, and further detail in **Attachment A**.

It is recommended that the EIS be required to include, where applicable:

- Annual volumes of surface water and groundwater proposed to be taken by the activity (including through inflow and seepage) from each surface and groundwater source as defined by the relevant water sharing plan.
- Assessment of any volumetric water licensing requirements (including those for ongoing water take following completion of the project).
- The identification of an adequate and secure water supply for the life of the project. Confirmation that water can be sourced from an appropriately authorised and reliable supply. This is to include an assessment of the current market depth where water entitlement is required to be purchased.
- A detailed and consolidated site water balance.
- Assessment of impacts on surface and ground water sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts.
- Full technical details and data of all surface and groundwater modelling.

- Proposed surface and groundwater monitoring activities and methodologies.
- Assessment of any potential cumulative impacts on water resources, and any proposed options to manage the cumulative impacts.
- Consideration of relevant policies and guidelines.
- A statement of where each element of the SEARs is addressed in the EIS (i.e. in the form of a table).

Should you have any enquiries about this matter, please contact Wayne Conners at Water NSW's Parramatta office on (02) 8838-7531.

Yours sincerely

Wayne Conners

Wayne Conners
Senior Water Regulation Officer
Water Regulation Coastal
27 October, 2016

ATTACHMENT A

Water NSW General Assessment Requirements for general projects

The following detailed assessment requirements are provided to assist in adequately addressing the assessment requirements for this proposal.

For further information visit the DPI Water website, www.water.nsw.gov.au

Key Relevant Legislative Instruments

This section provides a basic summary to aid proponents in the development of an Environmental Impact Statement (EIS), and should not be considered a complete list or comprehensive summary of relevant legislative instruments that may apply to the regulation of water resources for a project.

The EIS should take into account the objects and regulatory requirements of the *Water Act 1912* (WA 1912) and *Water Management Act 2000* (*WMA 2000*), and associated regulations and instruments, as applicable.

Water Management Act 2000 (WMA 2000)
Key points:

- Volumetric licensing in areas covered by water sharing plans
- Works within 40m of waterfront land
- SSD & SSI projects are exempt from requiring water supply work approvals and controlled activity approvals as a result of the *Environmental Planning & Assessment Act 1979 (EP&A Act)*.
- No exemptions for volumetric licensing apply as a result of the *EP&A Act*.
- Basic landholder rights, including harvestable rights dams
- Aquifer interference activity approval and flood management work approval provisions have not yet commenced and are regulated by the *Water Act 1912*
- Maximum penalties of $2.2 million plus $264,000 for each day an offence continues apply under the *WMA 2000*

Water Act 1912 (WA 1912)
Key points:

- Volumetric licensing in areas where no water sharing plan applies
- Monitoring bores
- Aquifer interference activities that are not regulated as a water supply work under the *WMA 2000*.
- Flood management works
- No exemptions apply to licences or permits under the *WA 1912* as a result of the *EP&A Act*.
- Regulation of water bore driller licensing.

Water Management (General) Regulation 2011
Key points:

- Provides various exemptions for volumetric licensing and activity approvals
- Provides further detail on requirements for dealings and applications.

Water Sharing Plans – these are considered regulations under the *WMA 2000*

Access Licence Dealing Principles Order 2004

Harvestable Rights Orders

Water Sharing Plans

It is important that the proponent understands and describes the ground and surface water sharing plans, water sources, and management zones that apply to the project. The relevant water sharing plans can be determined spatially at www.ourwater.nsw.gov.au. Multiple water sharing plans may apply and these must all be described.

The *Water Act 1912* applies to all water sources not yet covered by a commenced water sharing plan.

The EIS is required to:

- Demonstrate how the proposal is consistent with the relevant rules of the Water Sharing Plan including rules for access licences, distance restrictions for water supply works and rules for the management of local impacts in respect of surface water and groundwater sources, ecosystem protection (including groundwater dependent ecosystems), water quality and surface-groundwater connectivity.
- Provide a description of any site water use (amount of water to be taken from each water source) and management including all sediment dams, clear water diversion structures with detail on the location, design specifications and storage capacities for all the existing and proposed water management structures.
- Provide an analysis of the proposed water supply arrangements against the rules for access licences and other applicable requirements of any relevant WSP, including:
    - Sufficient market depth to acquire the necessary entitlements for each water source.
    - Ability to carry out a "dealing" to transfer the water to relevant location under the rules of the WSP.
    - Daily and long-term access rules.
    - Account management and carryover provisions.
- Provide a detailed and consolidated site water balance.
- Further detail on licensing requirements is provided below.

Relevant Policies and Guidelines

The EIS should take into account the following policies (as applicable):

- State Environmental Policy (Sydney Drinking Water Catchment) 2011
- NSW Guidelines for Controlled Activities on Waterfront Land (NOW, 2012)
- NSW Aquifer Interference Policy (NOW, 2012)
- Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW, 2012)
- Australian Groundwater Modelling Guidelines (NWC, 2012)
- NSW State Rivers and Estuary Policy (1993)
- NSW Wetlands Policy (2010)

- NSW State Groundwater Policy Framework Document (1997)
- NSW State Groundwater Quality Protection Policy (1998)
- NSW State Groundwater Dependent Ecosystems Policy (2002)
- NSW Water Extraction Monitoring Policy (2007)

The EIS will need to ensure that the project is consistent with Controlled Activity Approval guidelines and that any Controlled Activity Approval requirements are addressed. Guidelines for instream works on waterfront land can be found at:

http://www.water.nsw.gov.au/__data/assets/pdf_file/0020/547040/licensing_approvals_controlled_activities_instream_works.pdf

DPI Water policies can be accessed at the following links:
http://www.water.nsw.gov.au/Water-management/Law-and-policy/Key-policies/default.aspx
http://www.water.nsw.gov.au/Water-licensing/Approvals/Controlled-activities/default.aspx

An assessment framework for the NSW Aquifer Interference Policy can be found online at: http://www.water.nsw.gov.au/Water-management/Law-and-policy/Key-policies/Aquifer-interference.

Licensing Considerations

The EIS is required to provide:

- Identification of water requirements for the life of the project in terms of both volume and timing (including predictions of potential ongoing groundwater take following the cessation of operations at the site – such as evaporative loss from open voids or inflows).
- Details of the water supply source(s) for the proposal including any proposed surface water and groundwater extraction from each water source as defined in the relevant Water Sharing Plan/s and all water supply works to take water.
- Explanation of how the required water entitlements will be obtained (i.e. through a new or existing licence/s, trading on the water market, controlled allocations etc.).
- Information on the purpose, location, construction and expected annual extraction volumes including details on all existing and proposed water supply works which take surface water, (pumps, dams, diversions, etc).
- Details on all bores and excavations for the purpose of investigation, extraction, dewatering, testing and monitoring. All predicted groundwater take must be accounted for through adequate licensing.
- Details on existing dams/storages (including the date of construction, location, purpose, size and capacity) and any proposal to change the purpose of existing dams/storages
- Details on the location, purpose, size and capacity of any new proposed dams/storages.
- Applicability of any exemptions under the *Water Management (General) Regulation 2011* to the project.

Water allocation account management rules, total daily extraction limits and rules governing environmental protection and access licence dealings also need to be considered.

The Harvestable Right gives landholders the right to capture and use for any purpose 10% of the average annual runoff from their property. The Harvestable Right has been defined in terms of an equivalent dam capacity called the Maximum Harvestable Right Dam Capacity (MHRDC). The MHRDC is determined by the area of the property (in hectares) and a site-specific run-off factor. The MHRDC includes the capacity of all existing dams on the property that do not have a current water licence. Storages capturing up to the harvestable right capacity are not required to be licensed but any capacity of the total of all storages/dams on the property greater than the MHRDC may require a licence.

For more information on Harvestable Right dams, including a calculator, visit:
http://www.water.nsw.gov.au/Water-licensing/Basic-water-rights/Harvesting-runoff/Harvesting-runoff

Dam Safety

Where new or modified dams are proposed, or where new development will occur below an existing dam, the NSW Dams Safety Committee should be consulted in relation to any safety issues that may arise. Conditions of approval may be recommended to ensure safety in relation to any new or existing dams.

See www.damsafety.nsw.gov.au for further information.

Surface Water Assessment

The predictive assessment of the impact of the proposed project on surface water sources should include the following:

- Identification of all surface water features including watercourses, wetlands and floodplains transected by or adjacent to the proposed project.
- Identification of all surface water sources as described by the relevant water sharing plan.
- Detailed description of dependent ecosystems and existing surface water users within the area, including basic landholder rights to water and adjacent/downstream licensed water users.
- Description of all works and surface infrastructure that will intercept, store, convey, or otherwise interact with surface water resources.
- Assessment of predicted impacts on the following:
    - flow of surface water, sediment movement, channel stability, and hydraulic regime,
    - water quality,
    - flood regime,
    - dependent ecosystems,
    - existing surface water users, and
    - planned environmental water and water sharing arrangements prescribed in the relevant water sharing plans.

Groundwater Assessment

To ensure the sustainable and integrated management of groundwater sources, the EIS needs to include adequate details to assess the impact of the project on all groundwater sources.

Where it is considered unlikely that groundwater will be intercepted or impacted (for example by infiltration), a brief site assessment and justification for the minimal impacts may be sufficient, accompanied by suitable contingency measures in place in the event that groundwater is intercepted, and appropriate measures to ensure that groundwater is not contaminated.

Where groundwater is expected to be intercepted or impacted, the following requirements should be used to assist the groundwater assessment for the proposal.

- The known or predicted highest groundwater table at the site.
- Works likely to intercept, connect with or infiltrate the groundwater sources.
- Identification of any predicted impacts on groundwater resulting from proposed earthworks at the construction phase.
- Any proposed groundwater extraction, including purpose, location and construction details of all proposed bores and expected annual extraction volumes.
- Bore construction information is to be supplied to DPI Water by submitting a “Form A” template. DPI Water will supply “GW” registration numbers (and licence/approval numbers if required) which must be used as consistent and unique bore identifiers for all future reporting.
- A description of the watertable and groundwater pressure configuration, flow directions and rates and physical and chemical characteristics of the groundwater source (including connectivity with other groundwater and surface water sources).
- Sufficient baseline monitoring for groundwater quantity and quality for all aquifers and GDEs to establish a baseline incorporating typical temporal and spatial variations.
- The predicted impacts of any final landform on the groundwater regime.
- The existing groundwater users within the area (including the environment), any potential impacts on these users and safeguard measures to mitigate impacts.
- An assessment of groundwater quality, its beneficial use classification and prediction of any impacts on groundwater quality.
- An assessment of the potential for groundwater contamination (considering both the impacts of the proposal on groundwater contamination and the impacts of contamination on the proposal).
- Measures proposed to protect groundwater quality, both in the short and long term.
- Measures for preventing groundwater pollution so that remediation is not required.
- Protective measures for any groundwater dependent ecosystems (GDEs).
- Proposed methods of the disposal of waste water and approval from the relevant authority.
- The results of any models or predictive tools used.

Where potential impact/s are identified the assessment will need to identify limits to the level of impact and contingency measures that would remediate, reduce or manage potential impacts to the existing groundwater resource and any dependent groundwater environment or water users, including information on:

- Any proposed monitoring programs, including water levels and quality data.
- Reporting procedures for any monitoring program including mechanism for transfer of information.
- An assessment of any groundwater source/aquifer that may be sterilised from future use as a water supply as a consequence of the proposal.
- Identification of any nominal thresholds as to the level of impact beyond which remedial measures or contingency plans would be initiated (this may entail water level triggers or a beneficial use category).
- Description of the remedial measures or contingency plans proposed.
- Any funding assurances covering the anticipated post development maintenance cost, for example on-going groundwater monitoring for the nominated period.

Groundwater Dependent Ecosystems

The EIS must consider the potential impacts on any Groundwater Dependent Ecosystems (GDEs) at the site and in the vicinity of the site and:

- Identify any potential impacts on GDEs as a result of the proposal including:
  - the effect of the proposal on the recharge to groundwater systems;
  - the potential to adversely affect the water quality of the underlying groundwater system and adjoining groundwater systems in hydraulic connections; and
  - the effect on the function of GDEs (habitat, groundwater levels, connectivity).
- Provide safeguard measures for any GDEs.

Watercourses, Wetlands and Riparian Land

The EIS should address the potential impacts of the project on all watercourses likely to be affected by the project, existing riparian vegetation and the rehabilitation of riparian land. It is recommended the EIS provides details on all watercourses potentially affected by the proposal, including:

- Scaled plans showing the location of:
  - wetlands/swamps, watercourses and top of bank;
  - riparian corridor widths to be established along the creeks;
  - existing riparian vegetation surrounding the watercourses (identify any areas to be protected and any riparian vegetation proposed to be removed);
  - the site boundary, the footprint of the proposal in relation to the watercourses and riparian areas; and
  - proposed location of any asset protection zones.
- Photographs of the watercourses/wetlands and a map showing the point from which the photos were taken.
- A detailed description of all potential impacts on the watercourses/riparian land.
- A detailed description of all potential impacts on the wetlands, including potential impacts to the wetlands hydrologic regime; groundwater recharge; habitat and any species that depend on the wetlands.
- A description of the design features and measures to be incorporated to mitigate potential impacts.

- Geomorphic and hydrological assessment of water courses including details of stream order (Strahler System), river style and energy regimes both in channel and on adjacent floodplains.

Landform rehabilitation

Where significant modification to landform is proposed, the EIS must include:

- Justification of the proposed final landform with regard to its impact on local and regional surface and groundwater systems;
- A detailed description of how the site would be progressively rehabilitated and integrated into the surrounding landscape;
- Outline of proposed construction and restoration of topography and surface drainage features if affected by the project; and
- An outline of the measures to be put in place to ensure that sufficient resources are available to implement the proposed rehabilitation.

Stream rehabilitation

The Environmental Impact Statement should include:

- A Stream Rehabilitation Plan and Vegetation Management Plan with details on how the watercourse and riparian corridor within the site would be progressively rehabilitated to mimic a natural system from the local area. The riparian corridor should be planted with suitable native species from the local vegetation community.
- An outline of measures to minimise erosion and sedimentation impacts to the local stream environment,
- An outline of measures to minimise impacts to bed and bank stability.
- An outline of measures to be put in place to ensure that sufficient resources are available to implement the proposed stream rehabilitation.
- Guidelines for Vegetation Management plans on waterfront land can be found at:

http://www.water.nsw.gov.au/__data/assets/pdf_file/0010/547219/licensing_approvals_controlled_activities_veg_mgt_plans.pdf

Consultation and general enquiries

General licensing enquiries can be made to Advisory Services: water.enquiries@dpi.nsw.gov.au, 1800 353 104.

Assessment or state significant development enquiries, or requests for review or consultation should be directed to the Strategic Stakeholder Liaison Unit, water.referrals@dpi.nsw.gov.au.

A consultation guideline and further information is available online at:
www.water.nsw.gov.au/water-management/law-and-policy/planning-and-assessment

End Attachment A

NSW GOVERNMENT
Department of
Primary Industries

RM8: OUT16/39132

Thomas Piovesan
Planning Officer Industry Assessment
Dept. of Planning and Environment
Level 22, 320 Pitt Street SYDNEY NSW 2000
GPO Box 39
SYDNEY NSW 2001
E thomas.piovesan@planning.nsw.gov.au

Dear Mr Piovesan

Request for Input - Secretary's Environmental Assessment Requirements 1102 - Soil Contamination Treatment Works - 146 Newbridge Road, Moorebank, Liverpool LGA

Thank you for your correspondence of the 12 October 2016. NSW Department of Primary Industries (DPI) - Agriculture has reviewed the proposal and provides the following advice.

The applicant should assess risk of spreading weeds particularly noxious weeds. The following text should be included in the SEARs:

- that weed management during construction and operation accord with existing State, regional or local weed management plans or strategies. Destruction or removal of Noxious Weeds may require a permit from Department of Primary Industries http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0015/170232/Application-for-noxious-weed-permit.pdf

Thank you for providing the opportunity to comment on the proposal. For further information contact Andrew Docking, Resource Management Officer, 98428607.

Yours sincerely

E Rogers

Liz Rogers
Manager Agricultural Land Use Planning
Department of Primary Industries
24 October 2016

NSW Department of Primary Industries, Agricultural Land Use Planning Unit
Locked Bag 21, Orange NSW 2800
Tel: 02 6391 3494 Fax: 02 6391 3551
Email: landuse.ag@dpi.nsw.gov.au
www.dpi.nsw.gov.au | ABN: 72 189 919 072

Transport
Roads & Maritime
Services

PCU067801

24 October 2016

Roads and Maritime Reference: SYD16/01378/01 (A14874940)
DP&E Reference: SEAR 1102

Director
Industry Assessments
Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

Attention: **Thomas Piovesan**

Dear Sir/Madam

SOIL CONTAMINATION TREATMENT WORKS
146 NEWBRIDGE ROAD, MOOREBANK

Reference is made to your email dated 12 October 2016 requesting Roads and Maritime Services (Roads and Maritime) to provide details of key issues and assessment requirements regarding the abovementioned development for inclusion in the Secretary's Environmental Assessment (EA) requirements.

Roads and Maritime require the following issues to be included in the transport and traffic impact assessment of the proposed development:

1. A strip of land has previously been resumed and dedicated as road along the Newbridge Road frontage of the subject property, as shown by grey colour on the attached Aerial – "X".

   All buildings and structure, together with any improvements integral to the future use of the site are to be wholly within the freehold property (unlimited in height or depth), along the Newbridge Road boundary.

2. Daily and peak traffic movements likely to be generated by the proposed development including the impact on nearby intersections and the need/associated funding for upgrading or road improvement works (if required).

3. Details of the proposed accesses and the parking provisions associated with the proposed development including compliance with the requirements of the relevant Australian Standards (ie: turn paths, sight distance requirements, aisle widths, etc).

4. Proposed number of car parking spaces and compliance with the appropriate parking codes.

5. Details of service vehicle movements (including vehicle type and likely arrival and departure times).

Any inquiries in relation to this Application can be directed to Malgy Coman on 8849 2413 or development.sydney@rms.nsw.gov.au.

Yours sincerely

Pahee Rathan
Senior Land Use Planner
Network and Safety Section

“X”


SP35737
12
DP17254
SP21647
101
DP864199
1
DP582009
NEWBRIDGE RD
NEWBRIDGE RD
310
DP1118048
6
DP1065574
7
DP1065574

NSW GOVERNMENT
Office of Environment & Heritage

DOC16/516094
SEARs ID No. 1102

Mr Thomas Piovesan
Planning Officer – Industry Assessments
NSW Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

Dear Mr Piovesan

Request for Input: Soil Contamination Treatment Works - 146 Newbridge Road, Moorebank, Liverpool LGA - SEAR 1102

I refer to your 12 October 2016 email requesting input from the Office of Environment and Heritage (OEH) on the Environmental Assessment Requirements (EARs) for the above designated development.

OEH data indicates Shale Gravel Transition Forest vegetation, a listed Endangered Ecological Community under the NSW *Threatened Species Conservation Act 1995*, may be present on the site. It is therefore recommended the EARs include a biodiversity assessment to be undertaken in accordance with the draft *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (November 2004)* and *The NSW Guide to Surveying Threatened Plants (February 2016).* These guidelines can be downloaded from the OEH website.

If you have any queries regarding this matter please contact Richard Bonner on 9995 6917 or richard.bonner@environment.nsw.gov.au.

Yours sincerely

26/10/16

SAM HIGGS
Acting Senior Team Leader Planning
Greater Sydney Region

Contact officer: RICHARD BONNER
9995 6917

PO Box 644 Parramatta NSW 2124
Level 6, 10 Valentine Ave Parramatta NSW 2150
Tel: (02) 9995 5000 Fax: (02) 9995 6900
ABN 30 841 387 271
www.environment.nsw.gov.au

NSW EPA

Our ref: DOC16/515581

Mr Thomas Piovesan
Planning Officer, Industry Assessments
NSW Department of Planning and Environment
thomas.piovesan@planning.nsw.gov.au

Dear Mr Piovesan

Request for Input: Staged Approval of works including Contaminated Soil Treatment Works – SEAR 1102

I refer to your email to the Environment Protection Authority (EPA) received 12 October 2016 requesting the EPA's input to the Secretary's Environmental Assessment Requirements (SEARs) in respect of the above proposal.

The EPA understands that the proposal involves the staged residential subdivision and development, including soil contamination treatment works at 146 Newbridge Road, Moorebank, Liverpool (Lot 7 DP 1065574).

The main issues of interest to the EPA are:

- suitability of the proposed remediation plan
- impacts on water quality and site water management
- waste management and disposal
- impacts on air quality and any potential odour emissions
- potential noise impacts.

The EPA has considered the details of the proposal. A summary of information to be included in the Environment Impact Statement has been outlined in Attachment A. If you require any further information regarding this matter please contact Tenille Lawrence on (02) 9995 6207.

Yours sincerely

25 October 2016

JAMES GOODWIN
Unit Head, Sydney Industry
NSW Environment Protection Authority

PO Box 668 Parramatta NSW 2124
Level 13, 10 Valentine Avenue Parramatta NSW 2150
Tel: (02) 9995 5000 Fax: (02) 9995 6900
ABN 43 692 285 758
www.epa.nsw.gov.au

ATTACHMENT A

ENVIRONMENT PROTECTION AUTHORITY – REQUEST FOR ENVIRONMENTAL ASSESSMENT REQUIREMENTS FOR A STATE SIGNIFICANT DEVELOPMENT

CONTAMINATED SOIL TREATMENT WORKS - SEARS 1102

GENERAL INFORMATION

The following information must be provided in the Environmental Impact Statement (EIS) to enable the EPA to accurately assess the environmental implications of the proposed activity. The EIS must adequately describe the development proposal and the existing environment including air, noise, water, soil, chemicals and waste.

EPA STATUTORY REQUIREMENTS

On review of the activities outlined within the proposal, it is likely the site will require an Environmental Protection Licence under s48 Protection of the Environment Operations Act (“POEO Act”) Schedule 1: Contaminated Soil Treatment where:

> *c15 (2) The activity to which this clause applies is declared to be a scheduled activity if:*
>
> *(b) where it treats contaminated soil originating exclusively on site, it has a capacity:*
>
> *(iii) to disturb more than an aggregate area of 3 hectares of contaminated soil.*

The NSW EPA will be the Appropriate Regulatory Authority for the premises if a licence is required.

THE PROPOSAL

The objectives of the proposal should be clearly stated and refer to:

- the size and type of the operation
- the nature of the processes and the products, by products and waste produced
- the use or disposal of products or wastes
- the anticipated level of performance in meeting required environmental standards and cleaner production principles
- the staging and timing of the proposal and
- the proposals relation to any other industry or facility.

THE PREMISES

The EIS will need to fully identify all of the processes and activities intended for the site and during the life of the project. This will include details of:

- a site plan prepared by a registered surveyor clearly showing the boundaries of any proposed premises that will be subject to an Environment Protection Licence (EPL) and the proposed location of any discharge points covered by an EPL

- ownership and/or land use details of any premises and land likely to be affected by the proposed development

- maps and/or aerial photographs showing:

  - the location of the proposed development and details of the surrounding environment
  - the proposed layout of the site
  - all equipment proposed for use at the site
  - the location of any environmentally sensitive areas such as conservation areas, wetland, creeks or streams, watercourses and stormwater systems
  - surface water management systems
  - chemicals, including fuel used on the site and proposed methods for their transportation, storage, use and energy management
  - methods to mitigate any expected environmental impacts of the development.

CONTAMINATION AND REMEDIATION

The EPA is not aware of any notices issued under the *Contaminated Land Management Act 1997* however the proponent must demonstrate that any potential land or groundwater contamination can be remediated to a level that preserves and protects the human health and the ecological value of the site.

A Stage 2 detailed site investigation must be conducted to adequately characterise all areas of the site. The detailed site investigation must provide certainty in relation to the suitability of the site for the intended purpose.

WATER MANAGEMENT

The EIS must provide sufficient information to demonstrate that the proposed development can be operated whilst complying with the POEO Act, in particular, the protection of water quality during construction and occupation of the area.

The methodology, data and assumptions used to design any pollution control works and assess the potential impact of the proposal on water quality (ground and surface waters), must be fully documented and justified.

The EIS must include an adequacy assessment of stormwater controls. This assessment must determine sediment basins are adequately sized based on relevant guidelines and that discharge to waters from any sediment basins or other treatment systems comply with the requirements of the POEO Act.

The EIS must identify any fuel or chemical storage areas to be established on the site and describe the measured proposed to minimise the potential for leakage or the migration of pollutants into the soil/waters or from the site.

NOISE AND VIBRATION IMPACTS

The EIS must include a noise assessment of the existing environment, potential impacts and proposed noise amelioration measures. The Noise Impact Assessment must take into consideration an:

- operational noise assessment from stationary aspects of the project (such as the staging area) in accordance with the *NSW Industrial Noise Policy* (EPA, 2000).
- construction noise associated with the project should be assessed using *the Interim Construction Noise Guideline* (EPA, 2009).

AIR QUALITY

The EIS must include an Air Quality Impact Assessment (AQIA). The AQIA must identify and describe in detail all possible sources of air pollution from any activities/processes, including those with the potential to cause odours and/or fugitive dust emissions beyond the boundary of any premises. The AQIA must cover both the construction and operational phases of the development. The AQIA must include the cumulative impacts associated with any existing development and any developments having been granted development consent but which have not commenced.

The EIS should demonstrate that the facility will operate within the EPA's objectives which are to minimise adverse effects on the amenity of local residents and sensitive land uses and to limit the effects of emissions on local, regional and interregional air quality.

The EIS must describe in detail the measures or controls proposed to mitigate air quality impacts and the extent to which the mitigation measures are likely to be effective in complying with the requirements specified in the *POEO Act* and the *Protection of the Environment Operations (Clean Air) Regulation 2010.*

The AQIA must be prepared in accordance with the EPA's Approved Methods and Guidance for the '*Modelling and Assessment of Air Pollutants in NSW'* and, with respect to the assessment of odour impacts, follow the principles outlined in the '*Technical framework for the assessment and management of odour from stationary sources in NSW* '. The AQIA must describe the methodology used and any assumption made to predict the impacts. Air pollutant emission rates, ambient air quality data and meteorological data used in the assessment must be clearly stated and justified.

DANGEROUS GOOD AND CHEMICAL TRANSPORT, STORAGE AND HANDLING

The EIS must outline all details regarding the transport, handling, storage and use of dangerous goods, chemicals and products, including fuel, both on-site and with ancillary activities and describe the measures proposed to minimise the potential for leakage or the migration of pollutants into the air, land or waters from the site.

MONITORING PROGRAMS

The EIS should include a detailed assessment of any noise, air quality, water quality or waste monitoring required during the on-going operation of the facility to ensure that the development achieves a satisfactory level of environmental performance and to demonstrate that any activity licenced by the EPA is carried out in an environmentally satisfactory manner. The evaluation should include a detailed description of any proposed monitoring locations, sample analysis methods and the level of reporting proposed.

WASTE FACILITIES

The EIS should include:

- details for the layout of any proposed waste facility, the treatment process and the environmental controls at the facility
- details of the quantity and type of liquid and/or liquid waste generated, handled, processed or disposed of at the premises. Waste must be classified according to EPA's *Waste Classification Guidelines*
- details of liquid waste and non-liquid waste management at the facility including:
    - the transportation, assessment and handling of waste arriving at or generated at the site
    - any stockpiling of waste or recovered materials at the site

    - any waste processing related to the facility including reuse, recycling, reprocessing or treatment both on-and off-site
    - the method for disposing of all wastes or recovered materials at the facility
    - the emissions arising from the handling, storage, processing and re-processing of waste at the facility
    - the proposed controls for managing the environmental impacts of these activities.
- details of procedures for the assessment, handling, storage, transport and disposal of all hazardous waste used, stored, processed or disposed of at the site, in addition to the requirement for liquid and non-liquid waste
- details of the quantity type and specification or all output products proposed to be produced at the facility. In documenting or describing the composition of the output products and/or wastes generated from the proposed facility reference should be made where relevant to the EPA resource recovery exemptions.
- details of the type and quantity of any chemical substances to be used or stored.

GENERAL WASTE

The EIS should:

- identify, characterise and classify all waste that will be generated on site through excavation, demolition or construction activities, including proposed quantities of waste

  Note: all waste must be classified in accordance with the EPA's *Waste Classification Guidelines*
- provide details on how waste will be handled and managed onsite to minimise pollution, including:
    - stockpile location and management
        - labelling of stockpiles for identification, ensuring that all waste is clearly identified and stockpiled separately from other types of material
        - proposed height limits for all waste to reduce the potential for dust and odour
        - procedures for minimising the movement of waste around the site and double handling
        - measures to minimise leaching from stockpiles into the surrounding environment
- erosion, sediment and leachate control including measures to be implemented to minimise erosion, leachate and sediment mobilisation at the site during works
- the proponent should provide detail how leachate from stockpiled waste will be kept separate from stormwater runoff
- any proposed transport and disposal of leachate off site

INCIDENT MANAGEMENT

The EIS should include a comprehensive assessment of the potential for incidents to occur at any stage of the project, the measures to be used to minimise the risk of incidents and the procedures to be employed in the event of an incident. In addition, information is required about contingency actions in the event that planned incident mitigation measures are inadequate.

COMMUNITY CONSULTATION

The EPA is not aware of community engagement activities for planning processes associated with the project to date. It is recommended that the proponent embark on a program of ongoing consultation throughout the project, from commencement until completion, and this should be detailed in the EIS.

NSW RURAL FIRE SERVICE

PCU067902

The Secretary
Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2000

Your reference: SEAR 1102
Our reference: D16/3430

25 October 2016

Attention: Thomas Piovesan

Dear Sir/Madam,

Proposed Staged Residential Subdivision Development – 146 Newbridge Road, Moorebank

Reference is made to your correspondence dated 12 October 2016 seeking input for the Secretary's Environmental Assessment Requirements (SEARs) for the subject proposal under Schedule 2 of the *Environmental Planning and Assessment Regulations 2000*.

The New South Wales Rural Fire Service (NSW RFS) recommends that the preparation of an Environmental Impact Statement (EIS) is to include a bush fire assessment report prepared by a suitably qualified bush fire consultant that addresses the requirements of *Planning for Bush Fire Protection 2006*.

If you have any queries regarding this advice, please contact Simon Derevnin, Development Assessment and Planning Officer, on 1300 NSW RFS.

Yours sincerely,

Nika Fomin
Manager Planning and Environment Services (East)

Department of Planning
Received
2 NOV 2016
Scanning Room

Postal address
NSW Rural Fire Service
Records Management
Locked Bag 17
GRANVILLE NSW 2141

Street address
NSW Rural Fire Service
Planning and Environment Services (East)
42 Lamb Street
GLENDENNING NSW 2761

T 1300 NSW RFS
F (02) 8741 5433
E csc@rfs.nsw.gov.au
www.rfs.nsw.gov.au

Appendix D

Threshold Values

Table D1 – Reference Contaminant Values for Virgin Excavated Natural Material (VENM)

Contaminants [1, 4]	Criteria To Be Adopted [5]	
	Berkman (1989) [2]	ANZECC [3]
Metals		
Arsenic (total)	1-50	0.2-30
Cadmium	1	0.04-2
Chromium (III)	5-1000	0.5-110
Copper	2-100	1-190
Lead	2-200	<2-200
Mercury	0.03	0.001-0.1
Nickel	5-500	2-400
Zinc	10-300	2-180
TRH	For all organic analytes, the analytical practical quantitation limits are used as the reference levels for VENM assessment. Special consideration may be given to low levels of naturally occurring TRH or PAH in shale.	
C_6 – C_{10}		
C_{10} – C_{16}		
C_{16} – C_{34}		
C_{34} – C_{40}		
BTEX		
Benzene		
Toluene		
Ethylbenzene		
Xylene		
Total Phenols		
PAH		
Benzo(a)Pyrene		
Benzo(a)Pyrene TEQ		
Naphthalene		
Total PAH		
PCB		
OPP		
OCP		
aldrin		
dieldrin		
aldrin + dieldrin		
chlordane		
DDT (including DDD, DDE, DDT)		
Heptachlor		
Asbestos	No asbestos present	

Notes:

1. Contaminant concentrations must also be evaluated against NEPC (2013) thresholds provided in Table D2 below.
2. Berkman (1989) Field Geologists Manual
3. Australian and New Zealand Environment and Conservation Council/National Health and Medical Research Council (ANZECC/NHMRC): Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (1992), Environmental Soil Quality Guidelines Background A [ANZECC A]
4. Threshold values in mg/kg
5. The threshold values should also not exceed the criteria given in Table 4 of the ENM Order 2014

Table D2 – Threshold Values Protective of Human Health and Ecology (NEPC, 2013)

Contaminants		Land Use Criteria HIL A	Vapour Intrusion Criteria HSL-A-B [2]	EIL / ESL Urban Residential and Public Open Space	Criteria To Be Adopted [6]
Metals	Arsenic	100	-	100	100
	Cadmium	20	-	-	20
	Chromium	100	-	450 [4]	100
	Copper	6000	-	230 [4]	230
	Mercury	40	-	-	40
	Nickel	400	-	300 [4]	300
	Lead	300	-	1100 [3]	300
	Zinc	7400	-	850 [4]	850
TRH	C_6 – C_{10} (less BTEX) [F1]	-	45[2]	180	45
	>C_6-C_{10}	-	-	-	
	>C_{10}-C_{16} (less Naphthalene) [F2]	-	110[2]	120	110
	>C_{10}-C_{16}	-	-	-	
	>C_{16}-C_{34}	-	-	300	300
	>C_{34}-C_{40}	-	-	2800	2800
PAHs	Benzo(a)pyrene TEQ1	3	-	-	3
	Benzo(a)pyrene	-	-	0.7	0.7
	Total PAH[1]	300	-	-	300
	Naphthalene	-	3 [2]	170	3
Phenols	Phenols	100 [5]	-	-	100
BTEX	Benzene	-	0.5 [2]	50	0.5
	Toluene	-	160 [2]	85	85
	Ethylbenzene	-	55	70	55
	Xylene	-	40 [2]	105	40
OPPs	Chlorpyrifos	160	-	-	160
PCB (total)	PCBs	1	-	-	1

Contaminants		Land Use Criteria HIL A	Vapour Intrusion Criteria HSL A &B [2]	EIL / ESL Urban Residential and Public Open Space	Criteria To Be Adopted
OCPs	DDT+DDE+DDD	240	-	180	180
	Aldrin+Dieldrin	6	-	-	6
	Chlordane	50	-	-	50
	Endosulfan (total)	270	-	-	270
	Endrin	10	-	-	10
	Heptachor	6	-	-	6
	HCB	10	-	-	10
	Methoxychor	300	-	-	300

Notes:

1 Sum of carcinogenic PAH.

2 HSL for sand 0 to <1 m have been adopted as a conservative screen.

3 The ACL for lead has been used as an initial conservative screen.

4 EIL derived using average pH, and CEC values reported during the DP (2016a) investigation.

5 HIL for pentachlorophenol has been adopted to screen for phenol.

6 Thresholds in mg/kg.

Table D3 – Salinity Scale

Salinity	Electrical conductivity (ECe)
Non Saline	<2 dS/m
Slightly Saline	2 – 4 dS/m
Moderately Saline	4 – 8 dS/m
Highly Saline	8 – 16 dS/m

Table D4 – Criteria for Aggressivity to Concrete

Sulphate as SO3* (mg/kg)	pH	Aggressivity To Concrete	
		High Permeability Soils Below Groundwater	Low Permeability Soils / All Soils Above Groundwater
<5,000	>5.5	Non-Aggressive	Non-Aggressive
5,000 – 10,000	4.5 – 5.5	Mild	Mild
10,000 – 20,000	4 – 4.5	Severe	Moderate
>20,000	<4	Very Severe	Severe

Source: AS 2159 2009

* Approximate 100 mg/kg of SO_4 = 80 mg/kg of SO_3

Table D5 – Criteria for Aggressivity to Steel

Chloride in Soil (mg/kg)	pH	Aggressivity To Steel	
		High Permeability Soils Below Groundwater	Low Permeability Soils / All Soils Above Groundwater
<5,000	>5	Non-Aggressive	Non-Aggressive
5,000 – 20,000	4 – 5	Mild	Non-Aggressive
20,000 – 50,000	3 – 4	Moderate	Mild
>50,000	<3	Severe	Moderate

Source: AS 2159 2009

Appendix E

Sampling Frequencies

Table E1 – Sampling and Analytical Requirements for VENM Validation

Natural Material	Material Quantity (m^3)	Minimum Sample Frequency for Source Site With Adequate Site History AND No Potential For Contamination (Criterion 1)	Minimum Sample Frequency for Source Site With Inadequate Site History and / or Potential for Contamination [2] (Criterion 2)	Analytical Suite [1, 2, 4, 5]
VENM	<5000	A minimum of three samples	One sample per 250 m^3	- Heavy metals - TRH - BTEX - PAH - Phenol - PCB - OPP - OCP - Asbestos
	5000-50,000	A minimum of three samples for the first 5000 m^3 and one additional sample per 5000 m^3 or part thereof	The minimum sampling frequency should vary from 20 samples plus one additional sample for each 1000 m^3 above 5000 m^3	
	>50,000	A minimum of 12 samples for the first 50,000 m^3 and one additional sample per 10,000 m^3 or part thereof	The minimum sampling frequency should vary from 65 samples plus one additional sample for each 2000 m^3 above 50000 m^3	

Notes:

1. Heavy metals = arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc. BTEX = benzene, toluene, ethylbenzene, total xylenes OCP = organochlorine pesticides (a scheduled chemical). PAH = polycyclic aromatic hydrocarbons. .PCB = polychlorinated biphenyls. TRH = total recoverable hydrocarbons (including total petroleum hydrocarbons).
2. Applicable for source sites with inadequate contamination history, or which have previously been remediated for contamination or have potential for contamination such as service stations, mechanical workshops, fuel depots, chemical storage facilities etc.
3. Environmental Consultant may request for testing of additional analytical suites as considered necessary based on the site history.
4. Selected hydrocarbon analytes can be eliminated if the site history showed there was no risk of contamination from that analyte.
5. The physical description and condition of each sample shall be documented.

VENM = Virgin Excavated Natural Material.

Table E2 – Sampling and Analytical Requirements for Salinity and Aggressivity Assessment

Assessment Type	Minimum Sample Frequency	Minimum Analyte Suite
Salinity and Aggressivity	A minimum of three samples for the first 5,000 m^3 and one additional sample per per 5000 m^3 or part thereof for material volume up to 50,000 m^3. A minimum of 12 samples and one additional sample per 10,000 m^3 for material volume greater than 50,000 m^3. A minimum of three samples or 25% of the samples, whichever is higher, to be analysed for chloride and sulphate.	EC, pH, sulphate, chloride, textural classification

Appendix F

Gate Check Forms and Material Acceptance Checklist

Table F1 – VENM Acceptance Checklist

VENM ACCEPTANCE CHECKLIST	Completed By:___________________________ Date:_____________
Material/ Suppliers Details Supplier's Name: Source Site Address:	
Materials described in application/ approval documentation:	
Description of materials arriving at site:	
Do material descriptions match?	Yes / No Accept / Reject
Location placed on-site: Sketch attached:	____________________ Yes / No
Number of loads received:	

Appendix G

Materials Giving Rise To Load Rejection

Unsuitable Materials List

The following list contains materials that are unsuitable for use as fill. Any materials containing the following will be rejected. The list is not exhaustive.

- Acid sulphate soils;
- Asbestos (friable and bonded);
- Biocides;
- Chemical storage containers;
- Contaminated material;
- Excessively wet soils (greater than 4% of optimum moisture content);
- Explosives;
- Food waste;
- Fungicides;
- Herbicides;
- Household domestic waste;
- Liquid waste;
- Non-validated materials;
- Oil filters and rags;
- Paint;
- Pesticides;
- Radioactive waste;
- Sanitary waste;
- Tyres;
- Vegetative waste;
- Any material not corresponding to the NSW EPA definition of VENM and no soil containing anthropogenic material, odorous or stained material; and
- All other potentially contaminating materials.

Appendix K

Moorebank East Development Proposal Fact Sheet

MOOREBANK EAST
DEVELOPMENT PROPOSAL FACTSHEET

Dear Resident,

Mirvac Homes (NSW) Pty Limited (Mirvac) proposes to develop a residential masterplanned community in the central portion of the site currently identified as Lot 7 in DP 1065574 (Lot 7) being No.146 Newbridge Road Moorebank. You have been sent this factsheet as your place of residence is within proximity to the subject site.

The site has most recently been used for the extraction of sand via dredging and dry extraction methods. These extractive industries are nearing the end of their economic life with final extraction operations due to be completed in the near future.

Mirvac's current intention is to develop the site in keeping with the surrounding residential area. The creation of a new residential community by Mirvac of approximately 180 future residential homes, is in accordance with Liverpool City Council's strategic planning framework and is consistent with the relevant objectives of the R3 Medium Density Residential zoning of the site.

Proposed Development

The development proposal will seek approval for the following works in two stages, including:

Stage One:

- Subdivision of Lot 7 into three lots that are consistent with the boundaries of the existing land use zones of the site being; Lot 1 - B6 Enterprise Corridor, Lot 2 - R3 Medium Denisty Residential and Lot 3 - RE1 & RE2 Public and Private Recreation.

Stage Two:

- Subdivision of Lot 2 created in Stage 1 into the following:
  a) residue lots for future residential development,
  b) drainage reserves that will be dedicated to Council, and
  c) open space that will be dedicated to Council,
- Lot 3 created in Stage 1 will form a residue lot for the future development of the proposed Georges Cove Marina (DA-781/2015),
- Bulk earthworks including:
  a) site remediation works consistent with the recommendations of the detailed contamination site investigation,
  b) cut and fill works,
  c) import and placement of virgin excavated natural material (VENM), and
  d) the extension of the retaining wall on the west of the site (DA-510/2016),
- Construction of roads to be dedicated to Council,
- Construction of stormwater infrastructure, including raingardens, in accordance with the Voluntary Planning Agreement already agreed with Liverpool City Council; and
- Construction of infrastructure and services.

Please note the development proposal may be subject to change, and both future residential subdivision and dwelling construction will be the subject to a further Development Application and do not form part of the scope of this proposal.

Environmental Impact Statement

The project has been classified under Schedule 3 of the EP&A Regulation 2000 as being 'designated development'. Accordingly, an Environmental Impact Statement (EIS) is being prepared to accompany the development application (DA) for the proposal under Part 4 of the NSW Environmental Planning and Assessment Act 1979. Liverpool City Council is the consent authority for the development application.

The EIS provides a comprehensive assessment of the subject proposal's impacts and addresses the requirements of Liverpool City Council and the relevant NSW government agencies, including the Secretary's Environmental Assessment Requirements (SEARs) issued by the Department of Planning and Infrastructure for the project.

Mirvac is working to ensure the project design and proposed environmental management measures will mitigate any adverse impacts to the subject and adjoining properties. The EIS and associated specialist studies will include detailed assessment of community matters raised during this consultation.

Want More Information?

If you would like additional information, provide comment on this proposal or register your interest regarding the development at Moorebank East by Mirvac, please contact by:

Email: moorebankeast@mirvac.com
Phone: (02) 9080 8848

MOOREBANK EAST
DEVELOPMENT PROPOSAL FACTSHEET

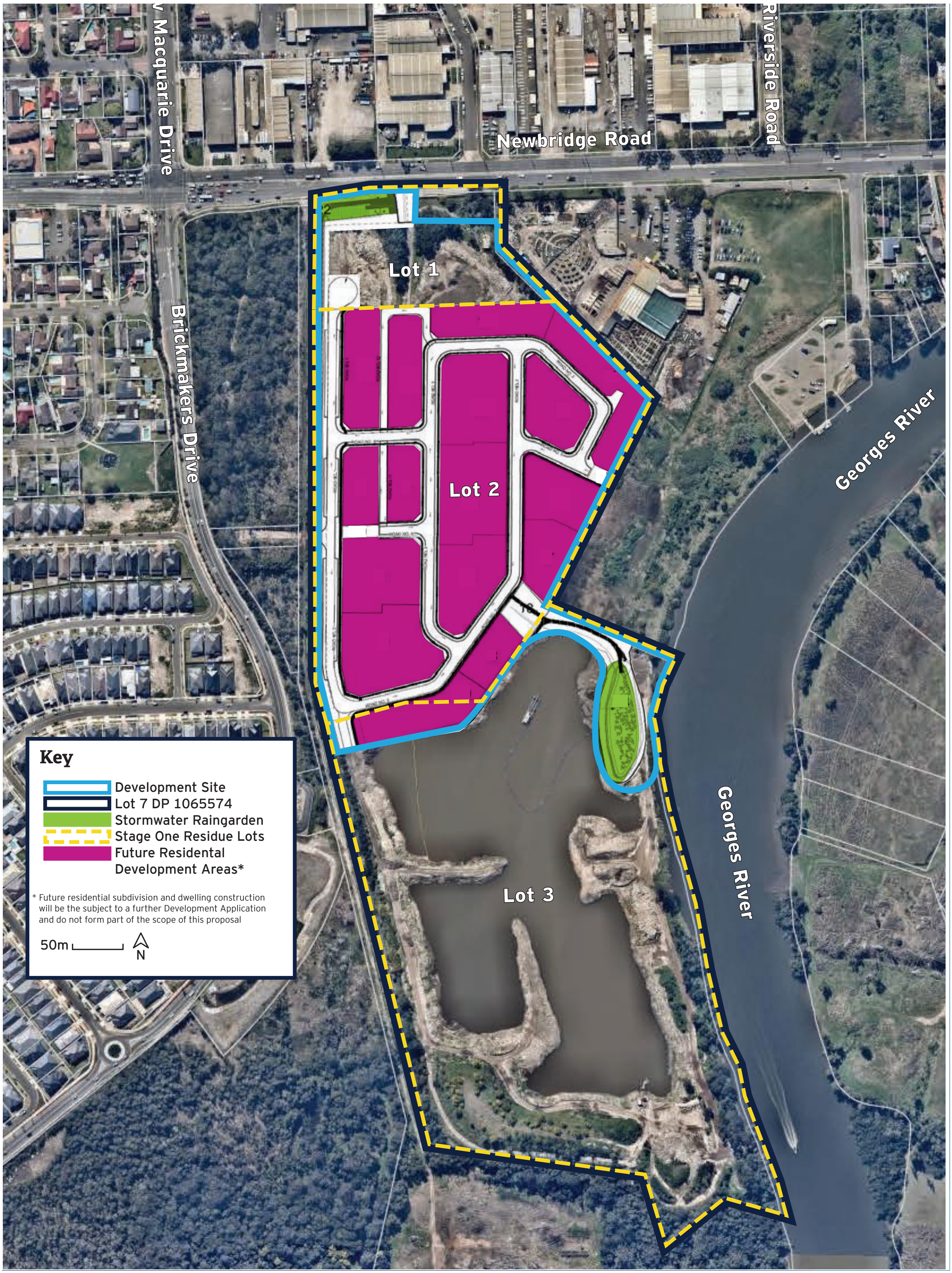


Figure 1: Indicative Site Plan of Moorebank East Development Proposal by Mirvac (Nearmap September 2016)

Mirvac Homes (NSW) Pty Limited
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