Douglas Partners
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Integrated Practical Solutions

Remediation Action Plan

North Ryde Station Precinct
M2 Site
State Significant Development

Prepared for
UrbanGrowth NSW

Project 73937
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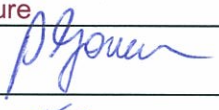
Author		23 May 2014
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NCS INTERNATIONAL CERTIFIED QUALITY MANAGEMENT SYSTEM

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
Phone (02) 9809 0666
Fax (02) 9809 4095

Table of Contents

Page

Page

Remediation Action Plan
North Ryde Station Precinct, M2 Site
State Significant Development

1. Introduction

1.1 General

This Remediation Action Plan (RAP) is a generic RAP which outlines the work potentially required to remediate the property known as the M2 Site, located at the corner of Delhi and Epping Roads, North Ryde, to a standard suitable for the proposed high density residential and mixed use development. The RAP was commissioned by UrbanGrowth NSW.

The M2 Site forms part of the North Ryde Station Precinct which was rezoned in July 2013 to facilitate high density residential development and mixed uses. UrbanGrowth NSW intends to lodge a State Significant Development Application (SSDA) for subdivision of the site into superlots, as shown on the subdivision drawing in Appendix A. A Geotechnical Investigation report and Phase 1 Contamination Assessment report have been prepared by Douglas Partners Pty Ltd (DP) and will be incorporated into the Environmental Impact Statement (EIS) to be submitted with the SSDA. This RAP will also be submitted with the SSDA to demonstrate that the M2 Site can be made suitable for the proposed development.

At the time of preparing this RAP the M2 Site was predominantly used by Leighton Contractors Pty Ltd (Leighton) and the Epping to Thornleigh Third Track (ETTT) Alliance as the site compound associated with the M2 Hills Motorway upgrade and the Epping to Thornleigh rail track works. As such, intrusive investigations recommended in the Phase 1 Contamination Assessment report could not be completed prior to preparing this RAP. This RAP, therefore, has been informed by the potential contamination issues outlined in the Phase 1 Contamination Assessment report which have not been ground-truthed to date. The remediation recommendations provided herein will require review once the SSDA subdivision application has been approved and intrusive investigations have been completed and the actual extent of contamination, if any, has been assessed. A revised RAP will then be prepared prior to construction certificate approval, providing remediation and validation details.

It is noted that previous investigations and validation of part of the M2 Site (as referenced in the Phase 1 Contamination Assessment report) were undertaken prior to the issue of the amended National Environment Protection Council *National Environment Protection (Assessment of Site Contamination) Measure* (NEPC 1999 as amended May 2013) and its approval by the NSW Environmental Protection Authority (EPA) on 11 June 2013. The NEPM 1999 as amended is referred to in this RAP as NEPC (2013). This RAP has been prepared with reference to NEPC (2013), including development of a conceptual site model and referencing appropriate contaminant threshold levels for future assessment and validation processes.

1.2 Site Identification

The M2 Site details are provided in Table 1, below and a site drawing showing the boundary and location is presented on Drawing 1, Appendix A.

Table 1: General Site Information

Item	Description
Site Owner	UrbanGrowth NSW
Lot and DP Number	Lots 100 and 101 in D.P. 1131776
Site Address	25-27 Epping Road (as per Section 149 Planning Certificates) cnr Epping, Delhi Roads and M2 Motorway
Local Government Authority	City of Ryde
Total Site Area	91,530 m^2
Current Zoning	Lot 101 is zoned 'B7 Business Park'; Lot 100 is zoned: 'Open Space – Recreation Existing', 'Reserved for Proposed County Road' and 'Reserved for County Open Space'; under the Ryde Planning Scheme. MD – SEPP (Major Development) 2005
Current Site Use	North – Wicks Park (reserve), undeveloped bushland, and part of Porters Creek, largely fenced from public access South and East – Leighton and ETTT works depot (majority of the M2 Site) West – sealed and unnamed access road, and fenced bushland
Proposed Future Land Use	High density residential and mixed use, including roads, public open space, commercial and childcare.

1.3 Proposed Development

The proposed development for the M2 Site comprises primarily a number of multi-storey residential and mixed use tower blocks linked by public roads, access drives and landscaping. There are a number of public open space areas as indicated on the proposed subdivision plan in Appendix A.

2. Objectives

The primary objective of the RAP is to demonstrate that the M2 Site can be made suitable for the proposed development. In this regard, the aligned objectives of the RAP are to:

- Develop a conceptual site model (CSM) on the basis of current information;
- Assess potential contamination issues based on the CSM;
- Establish a generic remedial and/or management strategy to address the potential contamination issues;
- Establish the remediation acceptance criteria to be adopted to confirm the successful implementation of the remediation strategy;
- Outline an investigation methodology to further assess the potential for contamination at the site, once the current active site uses cease and the M2 Site becomes available for intrusive investigations; and
- Outline the procedure for reviewing and amending the CSM and RAP on the basis of the investigations to be carried out.

This RAP was prepared with reference to the NSW Office of Environment and Heritage (2011) [now EPA] *Guidelines for Consultants Reporting on Contaminated Sites* (OEH 2011).

3. Site Information

3.1 Site Description

The M2 Site is an irregular shape occupying a total area of approximately 91,530 m^2. At the time of preparing this report, the majority of the M2 Site was occupied by Leighton's operational main M2 upgrade site compound, with approximately a third of this area leased to the ETTT Alliance (collectively referred to as the Leighton compound). The Leighton compound comprises portable offices, vehicle parking, equipment and materials storage, stockpiled sandstone and soil generated from the M2 upgrade and rail line works, and several sediment ponds. The northern portion of the M2 Site is bushland. The western portion of the M2 Site was occupied by an unnamed sealed access road and fenced bushland.

The main features of the M2 Site are indicated on Drawing 2, Appendix A.

3.2 Geology, Hydrogeology and Regional Groundwater

Reference to the Sydney 1:100,000 Geology Sheet Map indicates that the M2 Site is underlain by Ashfield Shale from the Wianamatta Group and from the Triassic period. The lithological description is that of black to dark-grey shale and laminite. The northern half of Lot 101 DP1131776 (part of the M2 Site), is underlain by Hawkesbury Sandstone from the Triassic period. The lithological description is that of medium to coarse grained quartz sandstone, very minor shale and laminite lenses.

Reference to the 1:100,000 Soils Landscape Map of Sydney indicates that the majority of the M2 Site is situated within the erosional soil group in the Glenorie landscape, and is typified by gently undulating to rolling low hills on Wianamatta Group shales. Limitations encountered in this landscape are high soil erosion hazard, localised impermeable highly plastic subsoil and moderate reactivity. The northern half of the M2 Site is situated within the residual soil group in the Lucas Heights landscape, and is typified by gently undulating crests and ridges on plateau surfaces of the Mittagong Formation (alternating bands of shale and fine-grained sandstones). Limitations encountered in this landscape are stony soil, low soil fertility and low available water capacity.

Porters Creek is located along the northern boundary of the M2 Site, and partially along the western boundary and flows into the Lane Cove River which is located approximately 1 km broadly east of the M2 Site. The local groundwater within the M2 Site is expected to flow in a northerly direction towards Porters Creek.

Reference to digital data of Acid Sulphate Soil Risk (supplied by NSW Department of Environment and Climate Change in 2008 based on published 1:25,000 Acid Sulfate Soils Risk Mapping, 1994-1998) indicates that the M2 Site is located outside areas known to contain acid sulphate soils.

A groundwater bore search of the NSW Office of Water website database was conducted in 2012. Sixteen groundwater bores were located within a 1 km radius around the M2 Site. One bore, located to the north of the M2 Site within the Eden Garden Centre was authorised for industrial use, with the remaining fifteen bores authorised as monitoring bores (located generally to the north and north-west of the M2 Site). Standing water level was only recorded at the bore within the Eden Garden Centre (GW107998) at a depth of 38 m. Water bearing zones were recorded in this bore within sandstone at depths of 108.70 m – 109 m and 158 m – 160 m. No groundwater zones were listed for any of the bores.

4. Background

The following relevant contamination investigations have previously been conducted, and were either prepared by DP or made available to DP for review as part of the Phase 1 contamination assessment:

- Parsons Brinckerhoff *Sampling and Validation Report ECRL M2 Worksite Closeout, Corner of Delhi and Lane Cove Roads, North Ryde, NSW*, May 2008 (PB, 2008); and
- DP Draft *Report on Phase 1 Contamination Assessment, M2 Site, Delhi Road, North Ryde*, prepared for UrbanGrowth NSW, Project 73927, 22 April 2014 (DP, 2014);

These reports are discussed in the following sub-sections.

4.1 Sampling and Validation Report – PB (2008)

PB prepared this report for the Thiess Hochtief Joint Venture (THJV) for the site which had been used as a worksite for approximately eight years at the time. The worksite had been used for storage of equipment and materials associated with the Epping to Chatswood Rail Link (ECRL) project which had involved tunnelling activities associated with the rail line. The report addressed the remedial works

that were carried out for the closing of the worksite (which had begun in mid-2007) which was said to have included "*the excavation and off-site disposal of bitumen, concrete and infrastructure in all areas of the worksite, the off-site disposal of contaminated material from various areas on site and the distribution of stockpiled material from tunnelling activities over the entire site after validation*". The validation works were carried out to determine if the site had been remediated to the most conservative level that would have existed prior to the commencement of works for the ECRL at the site – i.e. residential land use with soil access.

The report provided brief summaries of several previous investigations that where conducted at the site, none of which were provided to DP for review.

The earliest referenced report was in 1994, when Coffey Partners and Keown & Drummond Surveys were said to have assessed the quantity and geotechnical properties of fill that had been placed on the site which was understood at the time to be dated from the late 1970s and early 1980s. The central-western boundary of the site was found to comprise grey shale and building rubble fill (including concrete, metal pieces, timber, ceramic pipes, asphalt and bricks) in two locations to depths of up to 4.8 m, with fill up to 2 m deep in an area referenced as Area B.

PB (2008) also summarises a preliminary environmental assessment that was conducted in 2002 by PB "*along land adjacent to Epping Road/M2 Motorway, North Ryde*". It is unclear as to how much of the investigation area includes the subject M2 site, therefore the following low potential sources of contamination may not be wholly applicable, however no segregation of separate properties/areas was made. Potential sources of contamination included pesticides and other chemicals, contamination from "*previous storage of motor vehicle bodies and scrap metal*", lead contamination resulting from particulate matter from vehicle exhaust, "*likely potential for substantial quantities of fill material on site, low potential for contamination due to a number of damaged (crushed) lead acid batteries noted within the area*" at the time of the assessment and the potential of asbestos-containing materials to be found on the site. PB (2002) is said to have recommended that "*where significant quantities of fill materials were encountered during construction, they should be sampled and analysed with the laboratory results compared to the HILs for commercial/industrial land use as detailed in the NSW EPA (1998) Guidelines for the NSW Site Auditor Scheme*".

PB (2008) listed the main contaminants of concern based on previous investigations and site inspections in 2000, 2002 and 2007 which included TPH/benzene, toluene, ethyl benzene and xylene (BTEX), heavy metals, organochlorine pesticides (OCP), polychlorinated biphenyls (PCB) and asbestos across various areas of the site including the settlement pond, stockpiled material, electrical goods and chemical storage, wash bay area, tunnelling shaft, water treatment area, oils storage area, access road and general site coverage. The report stated that the land activities at the site prior to 2002 (when the site was used for the ECRL construction), involved grazing and farmland usage that would "*indicate negligible contamination*".

Seven areas were sampled as part of the validation assessment, with a total of 92 sampling locations across the site's 9.16 ha, which is relatively consistent with the EPA recommended number of sampling points for characterisation of a site that size. In addition, the material found at the base of the settlement pond was analysed for a range of common contaminants, as were three sampling locations near the overflow point of the settlement pond down the driveway towards Porters Creek (within the reserve to the north). The report also stated that "*bitumen, concrete, chemicals and general infrastructure from the site was disposed of off site from September 2007 to January 2008*".

PB validated clean fill material which was generated during site tunnelling activities as it was proposed to spread the material across the site once the site had been cleared. The report concluded that "*all infrastructure (with some exceptions) associated with the former worksite was demolished and removed. These exceptions included retention of the settlement pond on the northern boundary of the site in Area G, one transformer located in Area D and the access road to the site*." It is noted that a drawing was not provided in the copy of PB (2008) for DP's review therefore exact locations of the validation areas is not known. The report continued to conclude that "*all contaminated soils identified as exceeding adopted assessment criteria arising from the works have been removed off site, along with associated infrastructure*".

PB concluded that the site had been validated to the level required to be used as residential land with access to soil and that there were no issues on site that required ongoing management or institutional controls.

4.2 Phase 1 Contamination Assessment – DP (2014)

DP (2014) comprised a revision of an initial Phase 1 Contamination Assessment report prepared in 2012 for the whole of the North Ryde Station Precinct which incorporated the M2 Site. DP (2014) focussed solely on the M2 Site and included a desktop study of site history sources and information (including PB (2008)) provided by Transport for NSW (TfNSW) in 2011. In addition, an inspection of the M2 Site was conducted initially in August 2011, then again by the author of DP (2014) in April 2014.

In both 2011 and 2014 the majority of the M2 Site was being used as a works compound for construction on the M2 Hills Motorway upgrade and rail between Epping and Thornleigh.

The chronological history of the M2 Site, since about 1900, is summarised in the following Table 2.

Table 2: M2 Site History

Date	Site Use	Source
1889	Poultry farming (possibly)	PB (2008)
1900	Grazing (possibly)	PB (2008)
1901	Portion of the site subdivided for public road	PB (2008)
1915	Poultry farming (possibly)	PB (2008)
1930	Open fields, bushland (north) and three houses	Aerial photograph
1943	As in 1930, but apparent land cultivation in central portion	Aerial photograph
1961	As in 1943, mainly farming land	Aerial photograph
1970	Few additional sheds in the north, farm dam in the south. No evidence of land cultivation	Aerial photograph
1982	Fewer sheds and dwelling; farm dam appears to have been backfilled	Aerial photograph
1989-1994	Some areas of the site were covered with approximately	Coffey Partners (1994), as

Date	Site Use	Source
	60 tonnes of grey shale. Some building rubble was found in other portions of the site. Approximately 5100 m3 of fill in total was placed on the site during this period. The higher parts of the site were cleared for paddocks while the lower portion of the site remained covered in vegetation.	summarised in PB (2008)
1994	Western boundary appears disturbed through potential filling or excavation and minor road construction	Aerial photograph
1994-1995	The worksite (majority of M2 Site) was purchased by the Roads and Traffic Authority/Department of Urban Affairs and Planning/Department of School Education/Crown Reserve.	PB (2008)
2000	The majority of the site had been cleared with fencing and silt barriers erected around the site. Some building rubble had been uncovered including car batteries, fibrous cement sheeting and car bodies located in some areas.	PB (2002), as summarised in PB (2008)
2002-2007	The site was used as a worksite for the ECRL with workshops, chemical storage, water treatment plants, settlement ponds, transformers and site machinery.	PB (2008)
2004	No longer evidence of farming. Majority of the site was a construction site. Sealed road had been formed close to the western boundary. A large sediment pond was present to the south of the northern bushland area	Aerial photograph
2007-2008	Site buildings and storage areas were disassembled. On-site infrastructure was removed. Stockpiled soils were spread across site and into tunnelling shaft with some off-site disposal.	PB (2008)
2008	The sealed road and sediment pond remained. The construction activities had ceased. The site was largely cleared and obviously filled.	Aerial photograph
2009	The October 2009 aerial photograph shows that there was a significant square shaped excavation in the central southern portion of the site, with excavators working. The excavation had been backfilled prior to the November 2009 aerial photograph. The excavation was likely to have been associated with the rail tunnel beneath the site.	Aerial photograph DP (2014)
May 2011	The Leighton compound first appears in the May 2011 aerial photograph. The compound consisted of site sheds, parking areas, equipment and materials storage, and access roads.	Aerial photograph DP (2014)

Date	Site Use	Source
March 2012	Additional small detention basins were formed to the east and west of the stockpile storage areas in the Leighton compound. All basins are observed to have contained water.	Aerial photograph DP (2014)
Sep 2013	A vehicle parking and storage area was formed in the northern portion of the Leighton compound, to the south of the main detention basin. Conversely there were fewer stored items and parked cars in the southern portion, historically used as the main storage area.	Aerial photograph DP (2014)
Feb 2014	The northern vehicle parking and storage area noted above had been removed, with the majority of the Leighton compound cleared of stockpiles and detention basins. The main storage areas and buildings observed in November 2013 still remained.	Aerial photograph DP (2014)
April 2014	The Leighton compound had been split into the Leighton and ETTC Alliance lease areas.	Walkover

DP (2014) identified the following potential for contamination of the M2 Site:

- Agricultural chemical use. Considered to be a low potential based on the significant disturbance of the majority of the M2 Site since agricultural use;
- Fill used on the Leighton compound portion of the M2 Site, between 1989 and 1994, then again between 2002 and 2007 following the completion of the ECRL construction. Considered to be a low potential based on the validation works described in PB (2008);
- The use of part of the M2 Site as the Leighton compound, including:
  - The truck wash bay, and the surface drainage route from this location;
  - The sediment ponds, and the overflow drainage routes from these locations;
  - Car parking, materials storage and machinery movement areas; and
  - The general stockpiling areas.

  All considered to be a low potential for contamination based on the well maintained and managed site as observed by DP in 2011 and 2014.
- Fly tipping, sediment and soil contamination in the northern portion of the M2 Site, around Porters Creek. Considered to be a moderate potential for contamination since this area has had no known previous environmental assessment, is a magnet for unlawful fly tipping, and is a local stormwater runoff collection area (low point);
- Potential contamination of near surface soils impacted by hydrocarbons associated with vehicle movements, runoff from the Leighton compound, and/or the presence of bitumen. Considered to be a moderate potential given the age of the road construction, the damage to the road surface and the highly trafficked nature of the road, with construction and transport vehicles, since at least 2002;
- The bushland and Porters Creek area along the western boundary of the M2 Site may be impacted by fly tipping and adjoining industrial use. Considered to be a moderate potential for

contamination since the area has had no known previous environmental assessment, it adjoins a number of industrial premises, and is an easily accessible waste dumping area from the adjoining properties;

- The potential for groundwater contamination within the M2 Site is considered to be generally low, however, as the northern and western portions of the M2 Site are relatively low lying, associated with Porters Creek, there is a potential for perched or localised groundwater to be impacted by not only activities with the Leighton compound, but from off-site sources, notably industrial premises to the north and west. As noted in DP (2014), several groundwater monitoring wells were observed in the Wicks Road footpath at the northern boundary of the M2 Site. These may be associated with the monitoring of a groundwater contamination plume outside the M2 Site area, which may be impacting the northern portion of the M2 Site. Considered to be generally a low potential based on the elevation and generally low soil contamination nature of the majority of the M2 Site, however a moderate potential is identified in the northern and western portions of the M2 Site.

Based on the results of the Phase 1 contamination assessment, it was considered that the M2 Site has generally a low to moderate potential for contamination, and can be made suitable for the proposed high rise residential and mixed uses, subject to:

- A targeted Phase 2 (detailed) contamination assessment targeting the potential for contamination identified within this report;
- Appropriate remediation and/or management of any soil and/or groundwater contamination issues identified through the targeted Phase 2 contamination assessment; and
- Validation of completion of any remediation undertaken and/or development of an appropriate plan to implement recommended management measures.

5. 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. 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.

The CSM for the M2 Site has been prepared based on the information and findings presented in DP (2014).

5.1 Potential Contamination Sources

The potential contamination sources detailed in Table 3 have been identified on the basis of current information. These sources may not be present and require further investigation to confirm their existence, characteristics and extent. The proposed detailed site investigation (DSI) outlined in Section 8 is designed to assess the presence or absence of contamination at the site. Additional investigations beyond the DSI may be required for contaminant delineation purposes.

Table 3: Potential Contamination Sources and Contaminants of Concern

Potential Source	Description of Potential Contaminating Activity	Contaminants of Concern
Agricultural chemicals (low potential)	• Application of pesticides, fertilisers and/or herbicides during past agricultural activities up until about 1980	Heavy Metals (arsenic, boron, cadmium, copper, lead, zinc); Persistent Organochlorine Pesticides (OCP); Persistent Organophosphate Pesticides (OPP).
Fill (low potential)	• The Leighton compound was significantly filled between 1989 and 1994, then again between 2002 and 2007 (ECRL work site). • The Leighton compound was validated for residential use by PB post 2007.	Typical and commonly screened contaminants for fill of an unknown source include Heavy Metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc), total petroleum hydrocarbons (TPH), BTEX (benzene, toluene, ethyl benzene, xylene), polycyclic aromatic hydrocarbons (PAH), OCP, OPP, Polychlorinated Biphenyls (PCB), Phenols and Asbestos.
Leighton and ETTT Alliance lease areas (low potential)	• Truck wash bay • Sediment ponds and overflows • Car parking and vehicular routes • Materials and stockpile storage	Heavy Metals, TPH, BTEX, PAH, Asbestos
Fly tipping (moderate potential)	• Unlawful dumping of waste in the northern and western portions of the M2 Site	Asbestos
Unnamed access road in the west of the M2 Site (moderate potential)	• Degraded bitumen • Oil and fuel spills and leaks • Vehicle exhaust	Lead, TPH, BTEX, PAH
Adjoining industrial properties (moderate potential)	• Adjoins Porters Creek • Potential for waste disposal to creek area in the past	Various including Heavy Metals, TRH, BTEX, PAH, OCP, OPP, PCB, Phenols, Cyanide, volatile organic compounds (VOC).

To simplify the reference to the potential contamination sources in Table 4, Section 5.4, the following terminology has been used:

S1 Agricultural chemicals

S2 Fill

S3 Leighton and ETTT Alliance lease areas

S4 Fly tipping

S5 Unnamed access road

S6 Adjoining industrial properties

5.2 Potential Receptors

The potential receptors of contaminants that may be present on the site are both human and environmental (ecological). The identified receptors are as follows:

5.2.1 Human Health Receptors

R1 Construction workers during the development of the site

R2 Proposed site users once developed (residential, commercial, general public)

R3 Intrusive maintenance workers once developed

R4 Land users in adjacent areas (commercial/ industrial)

5.2.2 Environmental Receptors

R5 Groundwater

R6 Porters Creek and riparian corridor (ecology)

5.3 Potential Pathways

Potential pathways for contamination at the site to interact with the identified receptors include the following:

P1 Direct contact with soil or groundwater (ingestion and dermal)

P2 Inhalation of dust and/or vapours

P3 Leaching of contaminants and vertical mitigation into groundwater

P4 Surface water run-off

5.4 Summary of Preliminary CSM

A 'source–pathway–receptor' approach has been used to assess the potential risks of harm that could be caused to human, water or environmental receptors from potential contamination sources on or in the vicinity of the site, as shown in Table 4.

Table 4: Preliminary Conceptual Site Model

Potential Source	Transport Pathway	Receptors
S1 – Agricultural chemicals	P1 – Direct contact P2 – Inhalation P3 – Leaching and vertical migration P4 – Surface water runoff	R1 – Construction workers R2 – Site users R3 – Maintenance workers R5 – Groundwater R6 – Porters Creek
S2 - Fill	P1 – Direct contact P2 – Inhalation P3 – Leaching and vertical migration P4 – Surface water runoff	R1 – Construction workers R2 – Site users R3 – Maintenance workers R5 – Groundwater R6 – Porters Creek
S3 – Leighton and ETTT Alliance lease areas	P1 – Direct contact P2 – Inhalation P3 – Leaching and vertical migration P4 – Surface water runoff	R1 – Construction workers R2 – Site users R3 – Maintenance workers R5 – Groundwater R6 – Porters Creek
S4 – Fly tipping	P1 – Direct contact P3 – Leaching and vertical migration P4 – Surface water runoff	R1 – Construction workers R2 – Site users R5 – Groundwater R6 – Porters Creek
S5 – Unnamed access road	P1 – Direct contact P2 – Inhalation P3 – Leaching and vertical migration P4 – Surface water runoff	R1 – Construction workers R5 – Groundwater R6 – Porters Creek
S6 – Adjoining industrial	P2 – Inhalation P4 – Surface water runoff	R1 – Construction workers R2 – Site users R3 – Maintenance workers R5 – Groundwater R6 – Porters Creek

6. Remediation Strategy

6.1 Remediation Goal

The ultimate objective of the remedial works is to render the M2 Site suitable for the proposed high density residential and mixed use development and that the remediation will pose no unacceptable risk to human health or the environment.

6.2 Remediation Options

Based on the CSM and the identified contaminants associated with each potential contamination source (Table 3), Table 5 outlines the proposed remediation and/or management strategies to be considered to address contamination identified by the DSI outlined in Section 8.

A number of remediation and management options were reviewed. The suitability of the options was examined in accordance with a number of relevant documents, including, *inter alia*, the following:

- *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites* (ANZECC 1992);
- *NSW DEC, Contaminated Site: Guidelines for the NSW Site Auditor Scheme* (2006); and
- *Guidelines for the Assessment of On-site Containment of Contaminated Soil* (ANZECC, 1999).

Table 5: Proposed Remediation Options

Contamination	Remediation Option	Comments
Inorganic contaminants in soil	Excavation of impacted soil, waste classification and landfill disposal.	Completely removes the source from the site; May involve extensive truck movements on public roads; Expensive option; Does not conform to sustainability principals.
	Relocate and/or contain on site - capping - relocate based on proposed land use - place additional topsoil - landscaping - vegetation selections	Will retain contaminants on site, requiring a management plan and title notification; Can be a logistical exercise to prevent cross contamination and significant impacts to construction; May impact on future construction within the site; Removes the expense of landfill disposal; May require impermeable barriers if contaminants are leachable; Conforms to sustainability principals.

Contamination	Remediation Option	Comments
	Human health and/or ecological risk assessment	A risk assessment may be undertaken in lieu of active remediation. The risk assessment will utilise site specific information including characterisation, contaminant migration pathways and receptors to develop Tier 2 RAC. The risk assessment may determine that active remediation is not required.
Organic contaminants in soil	Excavation of impacted soil, waste classification and landfill disposal.	As above
	Relocate and/or contain on site - capping - relocate based on proposed land use - place additional topsoil - landscaping - vegetation selections	As above May require additional measures to manage vapours, such as vapour barriers beneath buildings, or ventilation systems
	Land farming / biodegradation	Can be undertaken on site; Requires available space and time to complete the process; Enables the soils to be re-used on site if concentration reduction is achieved; Conforms to sustainability principals.
	Human health and/or ecological risk assessment	As above
Fly tipping	Disposal to landfill	May require waste classification
	Re-use on site	Will require an assessment of suitability to remain on the site; May be subject to on-site management as outlined above
Porters Creek	Removal of any ongoing contaminant source (e.g. waste disposal from adjoining industrial properties).	
	Excavation, waste classification and landfill disposal of impacted sediment.	As above

Contamination	Remediation Option	Comments
	Pump and dispose of impacted stagnant water in the creek, if it is found that the source of contamination is within the site. If an external source is found the contamination will be managed within the site.	Expensive process
Groundwater	Management	If a source of groundwater contamination is determined to be off-site, groundwater within the site will be appropriately managed as required (e.g. appropriate disposal during dewatering).
	Monitored Natural Attenuation	To be considered if aquifer properties are determined to be conducive to natural attenuation and there are no immediate risks to identified receptors; Requires ongoing monitoring of groundwater to show that natural attenuation is occurring; Generally suitable for organic contaminants such as petroleum hydrocarbons, and also chlorinated hydrocarbons.
	Pump and treat	Relatively expensive process, likely to be repeated a number of times; Suitable for most contaminants.
	Enhanced biodegradation	Involves the injection of oxygen and/or chemicals and/or organisms to enhance the natural biodegradation properties of the aquifer; Generally only suitable for organic contaminants.
	Reactive barrier	Can be installed at the down-gradient end of a plume such that the contaminant(s) concentration is reduced to acceptable levels once passing through the barrier; Can be expensive particularly in rock aquifers.
	Human health and/or ecological risk assessment.	As above

6.3 Preferred Remediation

The selection of the most appropriate remediation method(s) will be governed by a number of factors including, but not limited to, the following:

- The nature of the contamination identified by the DSI;
- The extent (volume) of the impacted media;
- The concentrations of the contaminants identified;
- The details of the proposed development (e.g. basements);
- The remediation budget and timeframe; and
- Proximity of contaminated groundwater to potential receptors.

Upon completion of the DSI, and any subsequent investigations considered necessary to delineate areas of contamination, the RAP will be revised outlining the decision process and results in determining the preferred remediation method(s).

7. Remediation Acceptance Criteria

This section provides Remediation Acceptance Criteria (RAC), which will be used to judge the success or otherwise of the remediation, and are based on a variety of considerations, including field observations and laboratory results.

This section also provides soil and groundwater assessment criteria, which will be used in the investigation of soils and groundwater as outlined in Section 8, as well as RAC where appropriate.

7.1 Site Assessment Criteria

The SAC is informed by the CSM which identified human and ecological receptors to potential contamination on the site. Analytical results from the proposed DSI will be assessed (as a Tier 1 assessment) against the investigation and screening levels of Schedule B1, National Environment Protection Measure *National Environment Protection (Assessment of Site Contamination) Measure* 1999, as amended 2013 (NEPC, 2013). The NEPC guidelines are endorsed by the NSW EPA under the CLM Act 1997.

Petroleum based health screening levels for direct contact and vapour intrusion (where not available in NEPC, 2013) have been adopted from the *Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE) Technical Report no.10 Health screening levels for petroleum hydrocarbons in soil and groundwater* (2011) as referenced by NEPC (2013).

The investigation and screening levels are applicable to generic land use settings and include consideration of, where relevant, the soil type and the depth of contamination. The investigation and screening levels are not intended to be used as clean up levels. Rather, they establish concentrations

above which further appropriate investigation (e.g. Tier 2 assessment) should be undertaken. They are intentionally conservative and are based on a reasonable worst-case scenario.

The SAC will also be adopted as Tier 1 RAC. Exceedances of the SAC during and following remediation may trigger further remediation or an assessment of the significance of the remaining contaminants, i.e. through an appropriate Tier 2 / risk assessment.

7.1.1 Soils

7.1.1.1 Health Investigation and Screening Levels

The Health Investigation Levels (HIL) and Health Screening Levels (HSL) are scientifically-based, generic assessment criteria designed to be used in the first stage (Tier 1) of an assessment of potential human health risk from chronic exposure to contaminants.

HILs are applicable to assessing health risk arising *via* all relevant pathways of exposure for a range of metals and organic substances. The HIL are generic to all soil types and apply generally to a depth of 3 m below the surface for residential use. Site-specific conditions may determine the depth to which HILs apply for other land uses.

HSLs are applicable to selected petroleum compounds and fractions to assess the risk to human health via inhalation and direct contact pathways. HSL have been developed for different land uses, soil types and depths to contamination.

The generic HIL and HSL are considered to be appropriate for the assessment of contamination at the site. Given the proposed land use the adopted HIL and HSL will be:

- **HIL A / HSL A** – Residential A (child care centre);
- **HIL B / HSL B** – Residential B (high density residential areas);
- **HIL C / HSL C –** Recreational (parks, public open space and roads); and
- **HIL D / HSL D** – Commercial areas

In addition, the HSL adopted will be predicated on inputs such as soil type and depth to contamination, both of which will be determined by the proposed DSI. Based on the CSM, the HSL will also be considered for direct contact and vapour inhalation scenarios.

All appropriate HIL and HSL will be listed in the revised RAP following the completion of the proposed DSI, and any recommended subsequent investigations.

7.1.1.2 Ecological Investigation Levels

Ecological Investigation Levels (EIL) have been derived for selected metals and organic compounds and are applicable for assessing risk to terrestrial ecosystems (NEPC, 2013). EIL depend on specific soil physiochemical properties and land use scenarios and generally apply to the top 2 m of soil, which corresponds to the root zone and habitation zone of many species. The EIL is determined for a contaminant based on the sum of the ambient background concentration (ABC) and an added contaminant limit (ACL). The ABC of a contaminant is the soil concentration in a specific locality that

is the sum of naturally occurring background levels and the contaminants levels that have been introduced from diffuse or non-point sources (e.g. motor vehicle emissions). The ACL is the added concentration (above the ABC) of a contaminant above which further appropriate investigation and evaluation of the impact on ecological values is required.

The EIL is calculated using the following formula:

EIL = ABC + ACL,

The ABC is determined through direct measurement at an appropriate reference site (preferred) or through the use of methods defined by Olszowy et al *Trace element concentrations in soils from rural and urban areas of Australia*, Contaminated Sites monograph no. 4, South Australian Health Commission, Adelaide, Australia 1995 (Olszowy, 1995) or Hamon et al, *Geochemical indices allow estimation of heavy metal background concentrations in soils*, Global Biogeochemical Cycles, vol. 18, GB1014, (Hamon, 2004). ACL is based on the soil characteristics of pH, CEC and clay content.

EIL (and ACLs where appropriate) have been derived in NEPC (2013) for only a short list of contaminants comprising As, Cu, Cr (III), DDT, naphthalene, Ni, Pb and Zn. An *Interactive (Excel) Calculation Spreadsheet* may be used for calculating site-specific EIL for these contaminants, and has been provided in the ASC NEPM Toolbox available on the SCEW (Standing Council on Environment and Water) website (http://www.scew.gov.au/node/941).

The following site specific data and assumptions will be used to determine the EILs for the investigation and validation of the site:

- a protection level of 80% will be adopted;
- the EILs will apply to the top 2 m of the soil profile;
- any identified contaminant will be considered as “aged” (>2 years); and
- Site specific pH, cation exchange capacity (CEC) and clay content will be determined through the proposed investigations.

All appropriate EIL will be listed in the revised RAP following the completion of the proposed DSI and any recommended subsequent investigations.

7.1.1.3 Ecological Screening Levels – Petroleum Hydrocarbons

Ecological Screening Levels (ESL) are used to assess the risk of selected petroleum hydrocarbon compounds, BTEX and benzo(a)pyrene to terrestrial ecosystems. ESL apply to the top 2 m of the soil profile as for EIL.

ESL have been derived in NEPC (2013) for petroleum fractions F1 to F4 as well as BTEX and benzo(a)pyrene. The ESL adopted will be predicated on inputs such as soil type and depth to contamination, both of which will be determined by the proposed additional investigations.

All appropriate ESL will be listed in the revised RAP following the completion of the proposed DSI and any recommended subsequent investigations.

7.1.1.4 Management Limits – Petroleum Hydrocarbons

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

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

Management Limits to avoid or minimise these potential effects have been adopted in NEPC (2013) as interim Tier 1 guidance. Management Limits have been derived in NEPC (2013) for the same four petroleum fractions as the HSL (F1 to F4).

The Management Limits adopted will be predicated on inputs such as soil type, which will be determined by the proposed additional investigations.

All appropriate Management Limits will be listed in the revised RAP following the completion of the proposed DSI and any recommended subsequent investigations.

7.1.1.5 Asbestos in Soil

Bonded asbestos-containing material (ACM) is the most common form of asbestos contamination across Australia, generally arising from:

- Inadequate removal and disposal practices during demolition of buildings containing asbestos products;
- Widespread dumping of asbestos products and asbestos containing fill on vacant land and development sites; and
- Commonly occurring in historical fill containing unsorted demolition materials.

Mining, manufacturing or distribution of asbestos products may result in sites being contaminated by friable asbestos including free fibres. Severe weathering or damage to bonded ACM may also result in the formation of friable asbestos comprising fibrous asbestos (FA) and/or asbestos fines (AF).

Asbestos only poses a risk to human health when asbestos fibres are made airborne and inhaled. If asbestos is bound in a matrix such as cement or resin, it is not readily made airborne except through substantial physical damage. Bonded ACM in sound condition represents a low human health risk, whilst both FA and AF materials have the potential to generate, or be associated with, free asbestos fibres. Consequently, FA and AF must be carefully managed to prevent the release of asbestos fibres into the air.

NEPC (2013) defines the various asbestos types referred to above as follows:

Bonded ACM: Asbestos containing material which is in sound condition, bound in a matrix of cement or resin, and cannot pass a 7 mm x 7 mm sieve.

FA: Fibrous asbestos material including severely weathered cement sheet, insulation products and woven asbestos material. This material is typically unbonded or was previously bonded and is now significantly degraded and crumbling.

AF: Asbestos fines including free fibres, small fibre bundles and also small fragments of bonded ACM that pass through a 7 mm x 7 mm sieve.

Asbestos has not to date been identified as a significant contaminant of concern at the M2 Site, but may be associated with some imported fill and fly tipping. The proposed DSI will initially aim to identify the prevalence of ACM at the site. Based on that result, a more detailed assessment of asbestos concentrations may be undertaken over the whole or targeted parts of the site.

Health Screening Levels (HSL) for asbestos in soil, which are based on likely exposure levels for different scenarios, have been adopted in NEPC (2013) from the Western Australian Department of Health (WA DoH) publication *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia 2009* (WA DoH 2009).

On the basis of the proposed land use(s), and in accordance with Table 7, Schedule B1, NEPC (2013) the following asbestos HSL will be adopted for any detailed assessment of asbestos undertaken following the DSI:

Table 6: Health Screening Levels for Asbestos Contamination in Soil (% w/w)

Form of Asbestos	HSL			
	Residential A	Residential B	Recreational C	Commercial D
Bonded ACM	0.01%	0.04%	0.02%	0.05%
FA and AF	0.001 %			
All Forms of Asbestos	No visible asbestos for surface soil			

7.2 Groundwater

The Groundwater Investigation Levels (GIL) adopted in NEPC (2013) are based on:

- *Australian Drinking Water Guidelines* 2011 (ADWG);
- *Guidelines for Managing Risk in Recreational Waters* 2008 (GMRRW);
- *National water quality management strategy. Australian and New Zealand guidelines for fresh and marine water quality* 2000 (ANZECC & ARMCANZ).

The selection of the GIL is based on the CSM which identified Porters Creek and groundwater as potential receptors of site contamination. Although not confirmed, there is potentially a hydraulic link

between the groundwater and Porters Creek, and therefore the threshold levels for the protection of aquatic ecosystems are considered to be relevant GIL. Although no registered bores for domestic use were found in close proximity to the M2 Site (DP, 2014) there is a possibility that bore water is used in the area. The drinking water threshold levels will be used initially to assess the risk of exposure to bore water impacted by contaminants from the M2 Site.

The GIL to be adopted for the analytes to be included in the proposed DSI (where applicable), and the corresponding source documents, are shown in the following Table 7.

Table 7: Groundwater Investigation Levels (in µg/L unless otherwise stated)

Analyte		NEPC (2013) Fresh Waters [b]	NEPC (2013) Drinking Water	Comments
Metals	Arsenic (V)	13	10	
	Boron	370	4000	
	Cadmium	0.2	2	
	Chromium (VI)	1	50	
	Copper	1.4	2000	
	Lead	3.4	10	
	Mercury (total)	0.06	1	
	Nickel	11	20	
	Zinc	8	-	
PAH	Naphthalene	16	-	
	Benzo(a)pyrene	-	0.01	
BTEX	Benzene	950	1	
	Toluene	-	800	
	Ethylbenzene	-	300	
	Xylene (o)	350	-	
	Xylene (p)	200	-	
	Xylenes (Total)	-	600	
OCP	Chlordane	0.03	2	
	DDT	0.006	9	
	Endosulfan	0.03	20	
	Endrin	0.01	-	
	Heptachlor	0.01	-	
	Aldrin + Dieldrin	-	0.3	
	Lindane	0.2	10	
	Heptachlor Expoxide	-	0.3	
OPP	Chlorpyrifos	0.01	10	
	Diazinon	0.01	4	
	Dimethoate	0.15	7	
	Fenitrothion	0.2	7	
	Ethion	-	4	

Analyte		NEPC (2013) Fresh Waters [b]	NEPC (2013) Drinking Water	Comments
PCB	Aroclor 1242	0.3	-	
	Aroclor 1254	0.01	-	
Phenols	Phenol	320	-	
VOC	Chloroform	370[a]	-	ANZECC & ARMCANZ (2000)
	1,2-Dichloroethane	1900[a]	-	
	1,1,1-Trichloroethane	270[a]	-	
	Carbon Tetrachloride	240[a]	-	
	1,2-Dichloropropane	900[a]	-	
	Cis-1,3-Dichloropropene	0.8[a]	-	
	Trans-1,3-Dichloropropene	0.8[a]	-	
	1,1,2-Trichloroethane	1900[a]	-	
	1,3-Dichloropropane	1100[a]	-	
	1,1,2,2-Tetrachloroethane	400[a]	-	
	1,3-Dichlorobenzene	260[a]	-	
	1,4-Dichlorobenzene	60[a]	-	
	1,2-Dichlorobenzene	160[a]	-	
	1,2,3-Trichlorobenzene	3[a]	-	
	Tetrachlorethylene (PCE)	70[a]	-	
	Trichloroethylene (TCE)	330[a]	-	
	Dichloroethylene (1,1)	700[a]	-	
	Vinyl Chlorinde (VC)	100[a]	-	

Notes:

a in cases where no high reliability trigger values are provided, the low reliability trigger values provided in ANZECC & ARMCANZ (2000) have been listed as screening levels

b Investigation levels apply to typically slightly-moderately disturbed systems

7.2.1 Health Screening Levels – Petroleum Hydrocarbons

The generic HSL for groundwater are considered to be appropriate for the assessment of petroleum based contamination in groundwater at the site. Given the proposed land use the adopted HSL are:

- **HSL A** – Residential A (child care centre);
- **HSL B** – Residential B (high density residential areas);
- **HSL C –** Recreational (parks, public open space and roads); and
- **HSL D** – Commercial areas

In addition, the HSL adopted will be predicated on inputs such as soil type and depth to contamination, both of which will be determined by the proposed DSI. Based on the CSM, the HSL will also be considered for direct contact and vapour inhalation scenarios.

7.3 Porters Creek

7.3.1 Surface Water

The concentrations of analytes selected for the assessment of contamination in Porters Creek will be assessed against the trigger values for the protection of 95% of freshwater species, as stipulated in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* guidelines ANZECC & ARMCANZ (2000), as shown in Table 7 above.

7.3.2 Sediment

The concentrations of analytes selected for the assessment of contamination in the sediment of Porters Creek will be assessed against the interim Sediment Quality Guidelines specified in ANZECC & ARMCANZ (2000).

It is noted that the interim Sediment Quality Guideline (ISQG)-Low are screening /trigger levels for a "low effects" range. The ISQG-high refers to the "medium effects" range. The guidelines suggest that a concentration below ISQC-Low suggests a low risk, whilst a concentration exceeding ISQC-High triggers further assessment of parameters such as bioavailability and toxicity. For a concentration between ISQC-Low and ISQC-High it is recommended that background concentrations in the system be checked and if the concentration is within that range then there is a low risk. Exceedance will again trigger further assessment of other parameters. Moderate to high contamination risks will trigger a requirement for remediation.

The proposed sediment assessment levels are shown in Table 8.

Table 8: Assessment Criteria (mg/kg unless otherwise stated)

Analytic Parameter	ISQG-Low	ISQG-High
Arsenic	20	70
Cadmium	1.5	10
Chromium	80	370
Copper	65	270
Lead	50	220
Mercury	0.15	1
Nickel	21	52
Zinc	200	410
Acenaphthene	0.016	0.5
Acenaphthalene	0.044	0.64
Anthracene	0.085	1.1
Fluorene	0.019	0.54
Naphthalene	0.16	2.1
Phenanthrene	0.24	1.5

Analytic Parameter	ISQG-Low	ISQG-High
Benzo(a)anthracene	0.261	1.6
Benzo(a)pyrene	0.43	1.6
Dibenzo(a,h)anthracene	0.063	0.26
Chrysene	0.384	2.8
Fluoranthene	0.6	5.1
Pyrene	0.665	2.6
Total PAH	4	45
DDT	0.0016	0.046
p,p' DDE	0.0022	0.027
o,p' + p,p' DDD	0.002	0.02
Chlordane	0.0005	0.006
Dieldrin	0.00002	0.008
Endrin	0.00002	0.008
Lindane	0.00032	0.001
Total PCB	0.023	-

7.4 Imported Material

If any materials are required to be imported to the M2 Site for backfilling of remediation excavations, or for general site leveling, they must comprise:

- Virgin Excavated Natural Materials (VENM) as defined in the NSW Department of Environment Climate Change and Water *Waste Classification Guidelines (2009) 'Part 1 – Classifying Waste'* (DECCW, 2009); or
- Validated quarried materials; or
- A resource recovery exemption made under clauses 51 and 51A of the *Protection of the Environment Operations (Waste) Regulation* 2005, which is permitted for land application. Examples include excavated natural materials (ENM) and recovered aggregate.

Apart from complying with the relevant instruments used to define these materials, the analyte concentrations in the materials must meet the adopted SAC.

The validity of the materials classifications of any materials proposed to be imported to the site will be initially confirmed by the Environmental Consultant on the M2 Site prior to the materials being imported. The Environmental Consultant may require confirmatory sampling and testing of material before acceptance.

8. Proposed Detailed Site Investigation

8.1 Objectives

A DSI will be conducted at the M2 Site once the current active land uses cease and the site becomes readily accessible for sampling. The objectives of the DSI are as follows:

- To assess the presence or absence of contaminants in soil, groundwater, creek water and sediment at the M2 Site, with respect to the proposed development;
- To inform a revision to the CSM, if required;
- To assess the need for additional investigations to delineate areas of contamination; and
- To inform a revision to the RAP.

In determining the scope outlined in this section, it is presumed that the Leighton Compound would have some degree of post-use validation confirming the suitability of this part of the site for the proposed residential purposes. The scope outlined herein would essentially be a confirmation exercise.

8.2 Data Quality Objectives and Indicators

The DSI will be conducted in accordance with industry standard Data Quality Objectives (DQOs) and Quality Assurance/Quality Control (QA/QC) procedures such that the results are considered to be repeatable and reliable.

The DSI 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 Appendix V of the NSW EPA *Contaminated Sites Guidelines for the NSW Site Auditor Scheme* (2nd edition) [2006] will be completed as part of the DSI. 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 DSI report.

8.3 Reporting

The DSI will be undertaken in accordance with NEPC (2013) and the DSI report will be prepared by the Environmental Consultant in accordance with NSW Office of Environment and Heritage (OEH) *Contaminated Sites Guidelines for Consultants Reporting on Contaminated Sites* (reprinted 2011) and other appropriate guidance documentation. The DSI report will detail the methodology, results and conclusion of the investigation and make a clear statement regarding the suitability of the M2 Site for the proposed development. Recommendations for any additional assessment and/or remediation will be included in the report.

8.4 Scope

Given that the Leighton compound portion of the site was validated by PB in 2008, and that subsequent uses of this portion of the M2 Site are considered to have a low contamination potential, a targeted approach has been adopted for the DSI. The potential for contamination identified in Section 5 will be the focus of the DSI, with the proposed scope outlined in the following Table 9. The proposed sampling locations are shown on Drawing 3, Appendix A. Note that the majority of the bores are targeting multiple potential sources.

Table 9: Proposed DSI Scope

Potential for Contamination	Fieldwork	Analysis
Agricultural chemicals (low potential)	No specific target locations; Whole of site potential; Samples from bores described below will include analysis for potential contaminants.	Heavy Metals (arsenic, boron, cadmium, copper, lead, zinc); OCP / OPP.
Fill (low potential)	The M2 Site will be sampled through a combination of shallow and deep bores terminating below the base of the fill (if possible); A total of 16 bore locations will be positioned across the Leighton compound, including locations of current and former sediment ponds and surface drainage pathways, truck wash bay, car parking and storage areas; A total of four bores will be positioned along the unnamed access road; A total of 11 bores will be positioned at accessible locations in the western and	Heavy Metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc), total recoverable hydrocarbons (TRH), BTEX, PAH, OCP, OPP, PCB, Phenols, Asbestos, pH, clay content, CEC, iron.

Potential for Contamination	Fieldwork	Analysis
	northern bushland areas around Porters Creek; Samples will be selected for analysis on the basis of depth, composition and any visual or olfactory indicators of contamination.	
Leighton and ETTT Alliance lease areas (low potential)	One bore will be positioned at the location of the former truck wash bay; Nine bores will be positioned in locations of current and former sediment ponds and associated drainage pathways and overflows; Two bores will be positioned in current car parking areas; One bore will be positioned at the current location of the generators and diesel tank; Six bores will be positioned in the areas of materials and stockpile storage; Samples will be selected for analysis on the basis of depth, composition and any visual or olfactory indicators of contamination.	Heavy Metals, TPH, BTEX, PAH, Asbestos
Fly tipping (moderate potential)	An inspection of accessible areas will be undertaken by the Environmental Consultant to identify areas of fly tipping. If stockpiles of soil are identified, sampling will be carried out to assess suitability to retain on site, or waste classification for off-site disposal.	Heavy Metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc), total recoverable hydrocarbons (TRH), BTEX, PAH, OCP, OPP, PCB, Phenols and Asbestos.
Unnamed access road in the west of the M2 Site (moderate potential)	Four bores will be positioned along the route of the access road, with near surface samples recovered for analysis.	Lead, TPH, BTEX, PAH
Porters Creek water and sediment	An inspection will be carried out by the Environmental Consultant to assess the condition of Porters Creek water and sediment and determine potential points of exposure (if any) to contamination, including waste disposal; A minimum of three creek water and sediment samples will be recovered for	Heavy Metals, TRH, BTEX, PAH, OCP, OPP, PCB, Phenols, Cyanide, Asbestos, VOC.

Potential for Contamination	Fieldwork	Analysis
	analysis (not shown on Drawing 3). One set of samples will be recovered from the upstream end of the site to assess water quality coming into the site.	
Groundwater	A total of five groundwater monitoring wells will be installed to assess the groundwater condition. The wells will be a semi-permanent fixture to enable regular sampling when required.	Various including Heavy Metals, TRH, BTEX, PAH, OCP, OPP, PCB, Phenols, Cyanide, VOC.

Depending on the outcome of the proposed sampling and testing, recommendations may be provided to delineate the extent of any contamination found, prior to revising the RAP.

8.5 Field Methods

8.5.1 Soils

The following general sampling methodology is to be implemented for all sampling:

- Preparing record of samples, including sample date, location, description, signs of concern, and any field results;
- Sampling from surface or from the utilised plant using disposable sampling equipment or stainless steel hand tools;
- Decontaminating all re-useable sampling equipment prior to collecting each sample using a 3% solution of phosphate free detergent (Decon 90) and distilled water;
- Transferring samples into a sealable plastic bag, and then placement in a second plastic bag (i.e. double bagging) (for asbestos analysis);
- Transferring samples into laboratory-prepared glass jars with Teflon-lined lid, and capping immediately (for chemical analytes);
- Labelling sample containers with individual and unique identification, including project number and sample number;
- Placing the plastic bags for asbestos into a sealed container for transport to the laboratory;
- Placing the glass jars for chemical analysis into a cooled, insulated and sealed container for transport to the laboratory; and
- Use of chain-of-custody documentation to ensure that sample tracking and custody can be cross-checked at any point in the transfer of samples from the field to hand-over to the laboratory.

8.5.2 Water

The following general sampling methodology is to be implemented for all water sampling:

- Preparing record of samples, including sample date, location, description, signs of concern, and any field results;
- Decontaminating all re-useable sampling equipment prior to collecting each sample using a 3% solution of phosphate free detergent (Decon 90) and distilled water;
- Immediate placement of sample in laboratory prepared sample containers and capping;
- Labelling sample containers with individual and unique identification, including project number and sample number;
- Placing the samples into a cooled, insulated and sealed container for transport to the laboratory; and
- Use of chain-of-custody documentation to ensure that sample tracking and custody can be cross checked at any point in the transfer of samples from the field to hand-over to the laboratory.

For 'grab' creek water samples, the following additional sampling methodology is to be implemented for all sampling:

- Collection of sample from the depth of concern, which will be immediately under the water surface for petroleum contaminants; and
- Collection of samples directly into sampling containers, or sampling using disposable or decontaminated glass sampling equipment.

For samples from groundwater monitoring wells, the following additional sampling methodology is to be implemented for all sampling:

- Collection of sample from depth of concern, which will be the water surface for petroleum contaminants;
- Micro-purging of well using a low flow pump until field parameters (pH, temperature, dissolved oxygen, Ec and redox) have stabilised; and
- Once field parameters had stabilised the samples were collected using a low flow pump. Use of new disposable equipment (bladders and tubing) for each sample.

8.6 Laboratory Analysis

Laboratory analysis of samples will be undertaken by laboratories with NATA accreditation and NATA endorsement for the analytical method for the analytes being tested and with appropriate QA/QC assessment methods.

It is anticipated that at least two laboratories will be employed to undertake the testing, a primary laboratory and secondary laboratory, which will analyse inter-laboratory replicate samples.

Samples will be analysed for the contaminants of concern identified for the sampling purpose. These contaminants will be identified based on available laboratory results from previous testing, field observations and the objective of the analysis.

8.7 Quality Control and Quality Assurance

QA/QC procedures will be adopted to ensure the repeatability and reliability of the results.

Field QA/QC testing will include the following:

- 5% sample inter-laboratory analysis, analysed for the same suite as primary sample;
- 5% sample intra-laboratory analysis, analysed for the same suite as primary sample;
- Rinsate samples (where re-useable sampling equipment is used), analysed for the suite of analytes analysed by the majority of the primary samples;
- Trip spike samples (one per batch of samples tested for BTEX where volatile contaminants are of concern); and
- Trip blank samples (one per batch of samples tested for BTEX where volatile contaminants are of concern).

The laboratory will undertake analysis in accordance with its accreditation, including in-house QA/QC procedures. These may include:

- 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.

The quality control analytical results will be assessed using the following criteria:

- Sampling location rationale met the sampling objective;
- Standard operating procedures are followed;
- Appropriate QA/QC samples are collected/prepared 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;
- Conformance with specified holding times;
- Accuracy of spiked samples within the laboratory's acceptable range (typically 70-130% for inorganic contaminants and greater for some organic contaminants);

- Field and laboratory duplicates and replicate samples will have a precision average of +/- 30% relative percentage difference (RPD) for inorganic analytes and +/- 50% RPD for organic analytes; and
- Rinsate samples will show that the sampling equipment is free of introduced contaminants, i.e. the analytes show that the rinsate is within the normal range for deionised water.

9. RAP Revision

As stated throughout this report, the RAP will be subject to revision upon completion of the proposed DSI and any subsequent investigations deemed necessary to delineate and define the extent of remediation. The revised RAP will include the following:

- Background information as outlined in this current version;
- A summary of the results of the DSI and any subsequent investigations;
- An updated CSM, incorporating the results of the DSI;
- Development of Tier 2 RAC;
- Identification of areas / zones / media requiring remediation;
- A discussion on the remediation options;
- Decision process for determining the preferred remediation strategies;
- Remediation goal;
- The remediation process / sequence in detail;
- The remediation acceptance criteria and validation requirements;
- Waste classification process;
- An unexpected finds protocol;
- Contingency actions;
- A worker health and safety plan to be implemented during the remediation works;
- A construction environmental management plan (CEMP) to be implemented during the remediation works;
- A list of relevant persons and their role and responsibility during the remediation process; and
- Any legislative requirements that need to be met prior to or during the remediation process.

Should the DSI determine that no remediation is required for the M2 Site, a report titled “site works plan” or similar will be prepared by the Environmental Consultant as an alternative to the RAP. The report will include the following:

- Background information as outlined in this current version;
- A summary of the results of the DSI and any subsequent investigations;
- Waste classification process;

- An unexpected finds protocol; and
- Contingency actions.

10. Conclusions

Based on the information on the M2 Site outlined in this report, it is considered likely that the M2 Site can be rendered suitable for the proposed development. This RAP sets out generic remediation goals and processes that could be readily implemented to address any contamination issues that may be identified by the proposed DSI. Should the proposed DSI identify a requirement for remediation, this RAP will be revised with the necessary detail to enable its implementation and validation.

11. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report (or services) for this project at the M2 Site, located on Delhi Road, North Ryde, in accordance with DP's proposal SYD140339 dated 4 April 2014 and acceptance received from Mr Brian Reeves of National Projects Consultant (NPC) acting on behalf of UrbanGrowth NSW.

This report is provided for the exclusive use of UrbanGrowth NSW and NPC 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 assumptions made are based on a previous sampling program and sub-surface conditions can change abruptly due to variable geological processes and also as a result of anthropogenic influences.

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.

Douglas Partners Pty Ltd

Appendix A

About this Report

Site Drawings

About this Report

Douglas Partners

Introduction

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

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

Copyright

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

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

Douglas Partners Geotechnics / Environment / Groundwater	**Site Location** **Remediation Action Plan** **M2 Site, North Ryde**	PROJECT : 73937 DWG No: 1 REV: 0
	CLIENT: UrbanGrowth NSW	DATE: 14.4.14

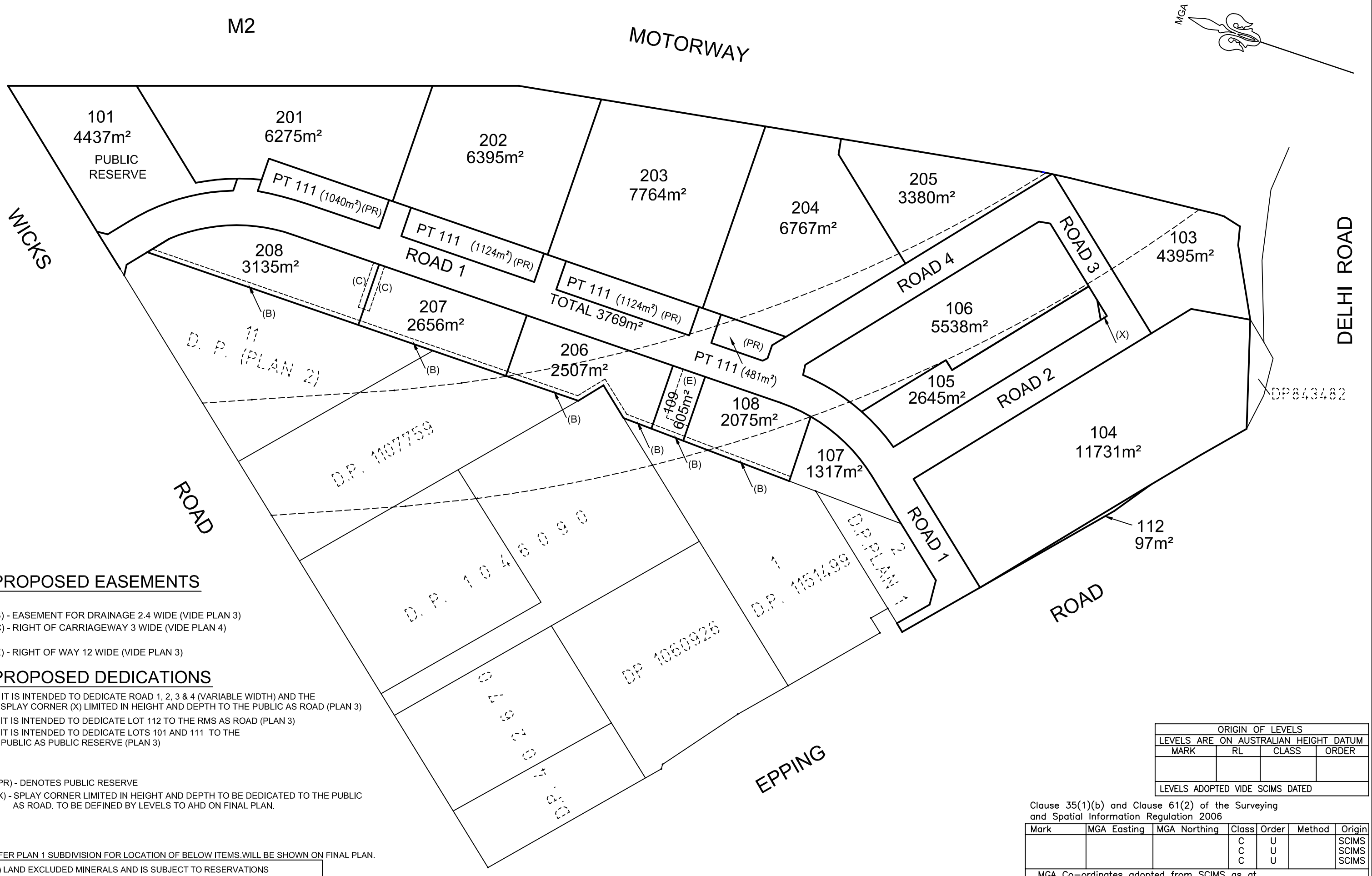
Douglas Partners Geotechnics / Environment / Groundwater	**M2 Site Features** **Remediation Action Plan** **M2 Site, North Ryde**	PROJECT : 73937 DWG No: 2 REV: 0
	CLIENT: UrbanGrowth NSW	DATE: 15.4.14

LEGEND

proposed bore

proposed groundwater well

Douglas Partners Geotechnics / Environment / Groundwater	**Proposed Bore Locations** **Remediation Action Plan** **M2 Site, North Ryde**	PROJECT : 73937 DWG No: 3 REV: 0
	CLIENT: UrbanGrowth NSW	DATE: 15.4.14



PROPOSED EASEMENTS

(B) - EASEMENT FOR DRAINAGE 2.4 WIDE (VIDE PLAN 3)
(C) - RIGHT OF CARRIAGEWAY 3 WIDE (VIDE PLAN 4)

(E) - RIGHT OF WAY 12 WIDE (VIDE PLAN 3)

PROPOSED DEDICATIONS

1. IT IS INTENDED TO DEDICATE ROAD 1, 2, 3 & 4 (VARIABLE WIDTH) AND THE SPLAY CORNER (X) LIMITED IN HEIGHT AND DEPTH TO THE PUBLIC AS ROAD (PLAN 3)
2. IT IS INTENDED TO DEDICATE LOT 112 TO THE RMS AS ROAD (PLAN 3)
3. IT IS INTENDED TO DEDICATE LOTS 101 AND 111 TO THE PUBLIC AS PUBLIC RESERVE (PLAN 3)

(PR) - DENOTES PUBLIC RESERVE
(X) - SPLAY CORNER LIMITED IN HEIGHT AND DEPTH TO BE DEDICATED TO THE PUBLIC AS ROAD. TO BE DEFINED BY LEVELS TO AHD ON FINAL PLAN.

REFER PLAN 1 SUBDIVISION FOR LOCATION OF BELOW ITEMS.WILL BE SHOWN ON FINAL PLAN.

(L) LAND EXCLUDED MINERALS AND IS SUBJECT TO RESERVATIONS AND CONDITIONS CONTAINED IN THE CROWN GRANT
(M) LAND EXCLUDED MINERALS VIDE DEALING T447400
(N) LAND EXCLUDED MINERALS VIDE DEALING V595431
(P) LAND EXCLUDED MINERALS VIDE CROWN GRANT
(C) PART LOT 100 DP 1131776 LIMITED IN HEIGHT TO RL 45 UNLIMITED IN DEPTH PART LOT 1 LIMITED IN DEPTH TO RL 45 UNLIMITED IN HEIGHT
(D) PART LOT 100 DP 1131776 LIMITED IN HEIGHT TO RL 40 UNLIMITED IN DEPTH PART LOT 1 LIMITED IN DEPTH TO RL 40 UNLIMITED IN HEIGHT

ORIGIN OF LEVELS			
LEVELS ARE ON AUSTRALIAN HEIGHT DATUM			
MARK	RL	CLASS	ORDER
LEVELS ADOPTED VIDE SCIMS DATED			

Clause 35(1)(b) and Clause 61(2) of the Surveying and Spatial Information Regulation 2006

Mark	MGA Easting	MGA Northing	Class	Order	Method	Origin
			C	U		SCIMS
			C	U		SCIMS
			C	U		SCIMS

MGA Co-ordinates adopted from SCIMS as at Combined Scale Factor = 0.999946 Zone 56

Surveyor: SCOTT DEVERIDGE
Date of Survey:
Surveyor's Ref: B1505-B1612-OVERALL-A

PLAN OF SUBDIVISION OF LOT 10 IN DP (PLAN 2)

NOTE:
1. DIMENSIONS AND AREA SUBJECT TO FINAL SURVEY.
2. EASEMENTS MAY BE CREATED AS REQUIRED

LGA: RYDE
Locality: MACQUARIE PARK
Subdivision No:
Lengths are in metres. Reduction Ratio 1: 1250

Registered

OVERALL - DRAFT
15/05/2014 - A

0 10 20 30 40 50 60 Table of mm 90 100 110 120 130 140 150