Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Remediation Action Plan

Proposed Residential Development
871 – 877 Pacific Highway, Chatswood

Prepared for
Megland Group Pty Ltd

Project 84722.03
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Douglas Partners
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Remediation Action Plan
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1. Introduction

Douglas Partners Pty Ltd (DP) has been commissioned by Megland Group Pty Ltd to prepare a Remediation Action Plan (RAP) for the above site. The objective of the RAP is to outline the methods and procedures necessary to remediate the subject site to a level suitable for the proposed development.

The project involves the construction of a six-storey residential unit building over a two level basement. The new building will cover the majority of the site and it is expected that there will be limited access to subsurface soils. The majority of the existing filling and soil will be excavated to form the basement, however small areas along the northern, western and eastern boundaries will remain.

This RAP details the methods and procedures by which the remediation and site validation will be achieved and has been prepared to address the requirements of *State Environmental Planning Policy No. 55 (SEPP 55) – Remediation of Land*. It is intended that following implementation of the RAP the site can be considered:

- appropriately remediated to a condition which would prevent unacceptable risks to human health and/or the environment; and
- suitable for the intended land-use.

It should be noted that this RAP does not form a detailed specification for the proposed site remediation works, but rather represents a planning document which outlines the means by which site remediation can render the site suitable for the intended land-use.

2. Methods and Objectives of this RAP

The objective of the RAP is to provide a mechanism by which the site can be remediated in an acceptable manner, with minimal environmental impact, and to a condition suitable for the proposed land-use. The main objective of this RAP is therefore to provide a strategy for site remediation which:

- minimises impacts from the site on the environment and on public health and safety during site demolition, remediation and construction;
- maximises the protection of workers involved with site remediation and construction;
- renders the site safe for the proposed high-density residential land-use and minimises potential exposure pathways to contaminants present in filling, soil and groundwater; and
- minimises impacts on the local environment during and following site remediation.

Additional objectives of the RAP are as follows:

- Set remediation goals that ensure the site is suitable for the proposed use and will not pose an unacceptable risk to human health or the environment;
- Document the remediation options that may be implemented to reduce risks to acceptable levels for the proposed site use;
- Provide information relating to a Construction Environmental Management Plan (CEMP) which will be required to detail the environmental safeguards necessary to complete the remediation in an environmentally acceptable manner;
- Identify the legislative requirements of the relevant regulatory authorities for the remediation works; and
- Comply with the relevant planning instruments and local government policies.

The general scope of work designed to achieve the RAP objectives stated above is described below:

- Provide an adequate description of the site, its history and available background information;
- Develop site remediation criteria by identifying the chemicals of concern;
- Provide a summary of the results of the previous site investigations and assess the contamination status of the site;
- Identify potential remediation options available for the site and nominate the preferred remediation strategy; and
- Highlight the requirement for the works to be undertaken in accordance with a CEMP and a Work Health and Safety Plan prepared for the remediation works.

Subject to concurrence by the approval authority, it is proposed that the remediation method will involve the removal of the majority of known/suspected contaminated filling/soil from within the basement excavation zone and in the small areas outside the proposed basement. Water and vapour-tight walls may also be required along the northern boundary if migration of contamination from the adjacent Shell service station is found to be occurring (see below).

3. Review of Site Information

3.1 Site Description

The site is irregular in plan and covers an area of approximately 1400 m^2. It is bounded by a service station to the north, Wilson Street to the south, a rail corridor to the east and the Pacific Highway to the west. The site is relatively flat, with surface levels in the vicinity of RL 108 m relative to the Australian Height Datum (AHD). The eastern boundary of the site is supported by a retaining wall approximately 6 m high, above the rail tracks which are at approximately RL 100 m AHD. The site is/was recently occupied by one and two storey retail/office buildings, and open vehicle parking areas.

The site is legally known as Lot 1 in SP 17870. The approximate boundary of the site is shown in Figure 1.

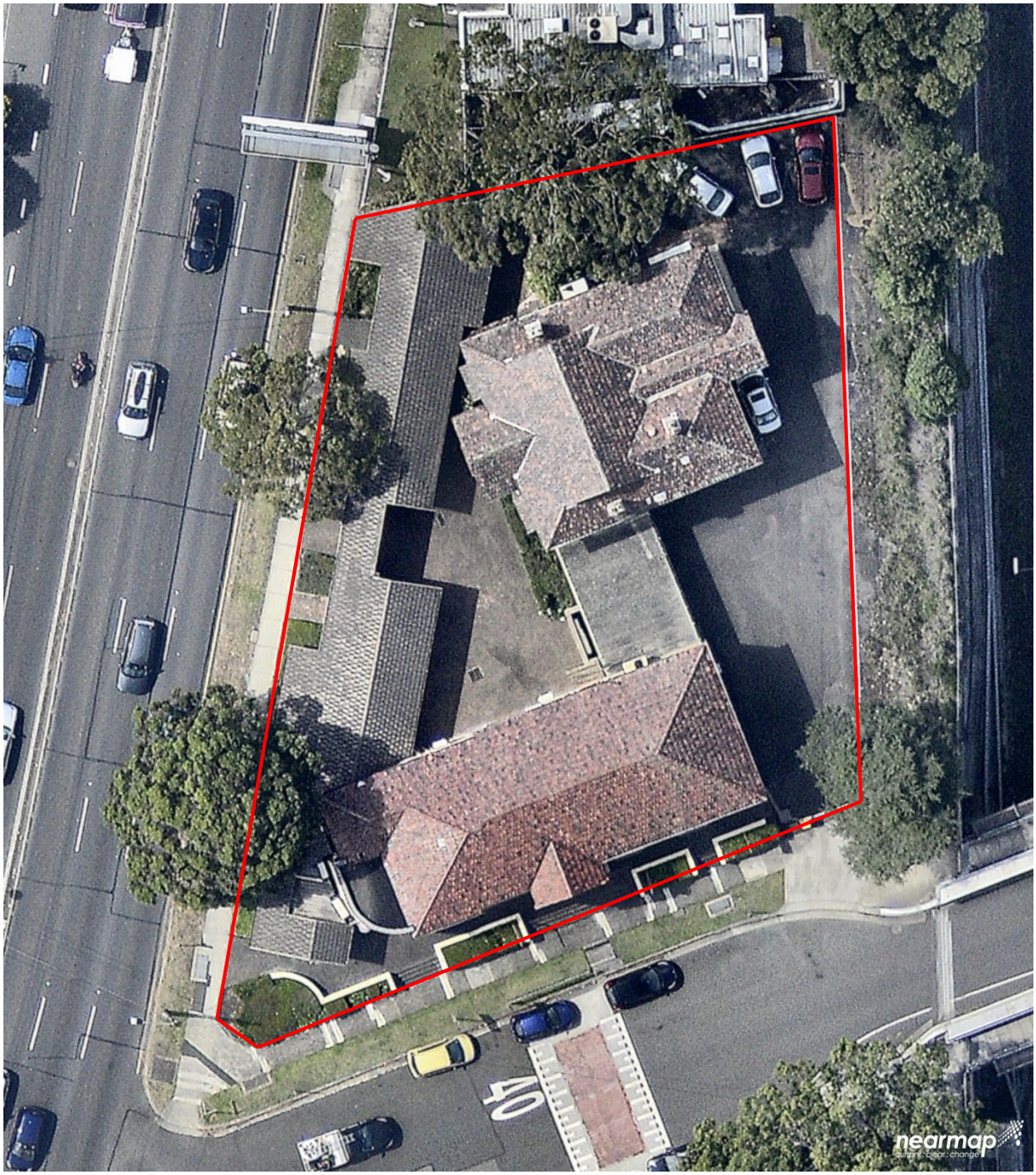


Figure 1: Location of 871 – 877 Pacific Highway, Chatswood

3.2 Proposed Development

The proposed development will include the demolition of the existing buildings, and the construction of a new six-storey residential unit building with two basement car park levels. The proposed bulk excavation level is at approximately RL 101 m AHD with localised deeper excavations for lift pits and footings. The ground surface is currently at around RL 108 m AHD. The bulk excavation depths are therefore in the order of up to 7 m with localised deeper excavations. The sides of the excavation will be supported both temporarily and permanently using a combination of soldier pile walls and contiguous pile walls. Small areas in which excavation is not proposed are located near the northern, western and eastern site boundaries.

The extent of the proposed basement is shown on Drawing RAP1 in Appendix B.

3.3 Geology and Hydrogeology

The Geological Survey of NSW 1:100,000 Geological Series Sheet 9130 (Sydney) indicates that the site is underlain by Ashfield Shale, which typically comprises black to dark grey shale and laminite. The corresponding Soil Landscape Series Sheet, by the former NSW Department of Land and Water Conservation, indicates that bedrock at the site is overlain by erosional soils of the Glenorie soil association, typically comprising red and yellow, moderately reactive clay soils.

The regional groundwater table is likely to be well below the bedrock surface. This is based on the fact that the railway cutting to the east of the site is dry.

3.4 Site History

Douglas Partners prepared a *Detailed Site Investigation (Contamination)* report for the proposed development in 2015 (Ref. 84722.00). The available site history information indicates that the site may have originally been used for residential purposes prior to redevelopment into commercial premises in the 1970s. A more detailed description of the site history is provided in the previous report.

4. Previous Contamination Investigation

4.1 Summary of Previous Investigation

The field work for the previous *Detailed Site Investigation (Contamination)* included the drilling of nine boreholes (BH1 to BH7, BH1A and BH2A) at the locations shown on Drawing RAP2 in Appendix B.

Bores BH1 and BH2 were drilled to depths of 8.3 m and 7.8 m using a truck-mounted DT100 drilling rig to install temporary groundwater monitoring wells. They were commenced using solid flight augers then continued using rotary wash-boring equipment inside top casing. Soon after rock was encountered, the bores were advanced using NMLC-sized diamond core drilling equipment.

Bores BH3 to BH7, BH1A and BH2A were augered using a 3.5 t hydraulic excavator for contamination investigation purposes.

Filling was found to vary from 0.3 m to 0.6 m depth in the boreholes and contained some demolition material (e.g. brick).

Soil sampling for contamination assessment purposes was performed in general accordance with the standard sampling procedures outlined in the *Douglas Partners Field Procedures Manual*. All sampling data were recorded on chain-of-custody information sheets. The sampling generally included:

- Soil sampling using decontaminated and/or disposable equipment;
- Placement of samples into laboratory prepared jars and immediate capping;
- Labelling of sample containers with individual and unique markings including project number, sample location, sample depth and date of sampling; and
- Storage of sample containers in a cooled, insulated container for transport to the laboratory.

The ground surface levels at the bores were measured to AHD using an automatic level.

The field work for the groundwater assessment included the installation of two temporary groundwater monitoring wells (BH1 and BH2). This involved placing Class 18 uPVC screen and solid casing in each borehole. A gravel pack was placed around the screen and a bentonite plug was placed above the gravel. The remainder of the void was backfilled with drill cuttings and the top of the wells were finished with a steel cover mounted flush with the surface.

Groundwater sampling was attempted some 3 weeks after the installation of the wells although the wells were dry and therefore samples could not be collected.

4.2 Summary of Soil Contamination Conditions

A summary of the previous laboratory test results is provided in Table 1. A table detailing individual results is included in Appendix C.

Table 1: Summary of Previous Laboratory Test Results for Filling/Natural Soil

Analyte	No. of Samples	Maximum Concentration (mg/kg)	Minimum Concentration (mg/kg)	Average Concentration[1] (mg/kg)
Benzene	7	<0.2	<0.2	N/A
Toluene	7	<0.5	<0.5	N/A
Ethylbenzene	7	<1	<1	N/A
Xylene	7	<3	<3	N/A
TRH_{C6-C9}	7	<25	<25	N/A
$TRH_{C10-C36}$	7	280	<250	N/A
F1	7	<25	<25	N/A
F2	7	<50	<50	N/A
F3	7	260	<100	N/A
F4	7	<100	<100	N/A
Total PAH	7	24	NIL +ve	8.8
B(a)P	7	2.5	<0.05	0.9
B.TEQ	7	3.5	<0.5	1.2
OCP	7	NIL +ve	NIL +ve	N/A
PCB	7	NIL +ve	NIL +ve	N/A
Phenol	7	<5	<5	N/A
Arsenic	7	50	<4	12
Cadmium	7	0.7	<0.4	0.3
Chromium	7	61	18	31.7
Copper	7	55	6	35.1
Lead	7	560	6	186.1
Mercury	7	0.4	<0.1	0.1
Nickel	7	76	3	19.1
Zinc	7	290	27	156.7

Notes: TRH = total recoverable hydrocarbons; F1 = C_6-C_{10} – BTEX; F2 = >C_{10}-C_{16} – Naphthalene; F3 = >C_{16}-C_{34}; F4 = >C_{34}-C_{40}; PAH = polycyclic aromatic hydrocarbons; OCP = organochlorine pesticides; PCB = polychlorinated biphenyls; B(a)P = Benzo(a)pyrene; B.TEQ = carcinogenic PAH; N/A = not applicable; [1] where detected

In addition to the chemical analysis outlined above, six filling samples were also analysed for asbestos. Asbestos (bonded and fibrous) was identified in two of the samples analysed (BH1A/0.4-0.5 m and BH6/0.3-0.45 m).

4.3 Summary of Groundwater Analysis

As outlined in Section 4.1, groundwater sampling could not be undertaken because the wells were dry and therefore samples could not be collected.

5. Adopted Comparative Criteria

5.1 Soils

The comparative criteria adopted for the site are the Health-based Investigation Levels (HILs) and Health-based Screening Levels (HSLs) for residential sites with minimal access to soil as outlined in the 2013 version of the *National Environment Protection (Assessment of Site Contamination) Measure* (NEPM). Clayey soils have been assumed.

Contaminant concentrations in areas on the site in which vegetation is proposed will also need to be compared to the Ecological-based Investigation Levels (EILs) and Ecological-based Screening Levels (ESLs) outlined in NEPM. The concentration measured in the natural soil on the site has been used to assess allowable concentrations where 'added' limits apply.

The adopted comparative criteria for soils are shown in Tables 2 and 3.

Table 2: Adopted Comparative Criteria for Organic Contaminants

Analyte	Adopted HIL/HSL (mg/kg)	Adopted EIL/ESL (mg/kg)
Benzene	0.5	50
Toluene	160	85
Ethylbenzene	55	70
Xylene	40	105
F1	45	180
F2	110	120
Total PAHs	400	
B(a)P TEQ	4	
B(a)P		0.7
Naphthalene	5	170
OCPs	Various	
PCBs	1	
Phenol	45,000	

Notes: TRH = total recoverable hydrocarbons; F1 = C_6-C_{10} – BTEX; F2 = >C_{10}-C_{16} – Naphthalene;
PAHs = polycyclic aromatic hydrocarbons; OCPs = organochlorine pesticides; PCBs = polychlorinated biphenyls;
B(a)P TEQ = carcinogenic PAHs based on Benzo(a)pyrene toxicity

Table 3: Adopted Comparative Criteria for Heavy Metals

Analyte	Adopted HIL/HSL (mg/kg)	Adopted EIL/ESL (mg/kg)
Arsenic	500	100
Cadmium	150	
Chromium	500	400
Copper	30,000	280
Lead	1200	1100
Mercury	120	
Nickel	1200	170
Zinc	60,000	260

5.2 Groundwater

The comparative criteria adopted for the site are the Health-based Screening Levels for Vapour Intrusion (HSLs) for residential sites as well as the Groundwater Investigation Levels (GILs) for Fresh Waters as outlined in the 2013 version of the *National Environment Protection (Assessment of Site Contamination) Measure* (NEPM).

The adopted comparative criteria for groundwater are shown in Tables 4 and 5.

Table 4: Adopted Comparative Criteria for Organic Contaminants

Analyte	Adopted HSL (µg/L)	Adopted GIL (µg/L)
Benzene	800	950
Xylene		550
F1	1000	
F2	1000	
Naphthalene		16

Notes: F1 = C_6-C_{10} – BTEX; F2 = >C_{10}-C_{16} – Naphthalene;

Table 5: Adopted Comparative Criteria for Heavy Metals

Analyte	Adopted HIL/HSL (µg/L)	Adopted GIL[1] (µg/L)
Arsenic		24
Cadmium		0.2
Chromium		1
Copper		1.4
Lead		3.4
Mercury		0.06
Nickel		11
Zinc		8

Notes: [1] These values are hardness-dependent and therefore higher GILs may be applicable subject to further assessment

6. Comparison of Known Concentrations to Comparative Criteria

6.1 Soils

The testing undertaken to date indicates that all of the soil samples were within the adopted health-based investigation/screening levels for residential sites with minimal access to soils.

Three filling samples (BH1A/0.4-0.5 m, BH3/0.1-0.2 m and BH4/0.15-0.3 m) exhibited concentrations of Benzo(a)pyrene and/or Zinc which exceeded the ecological-based criteria. The ecological-based criteria are only considered relevant for areas of the site in which the existing filling and soil is to remain and therefore only the sample from BH3 is relevant.

Asbestos was detected in two of the filling samples (BH1A/0.4-0.5 m and BH6/0.3-0.45 m) which is probably present due to previous demolition activities on the site. These two samples were obtained from within the proposed basement area and will therefore not remain on site, although it should be noted that asbestos could also be present elsewhere on the site between the sampling locations.

6.2 Groundwater

There is no groundwater data available to date to allow comparison with the adopted criteria. It is noted that groundwater is expected to be below the basement level because the railway cutting, which is immediately to the east of the site and lower than the proposed basement level, is dry. Nevertheless, assessment of seepage along the northern boundary does form part of the RAP requirements due to the presence of a service station adjacent to the site.

7. Potential for Contamination from Shell Service Station

The Shell service station to the north of the development site is likely to contain numerous underground storage tanks (USTs) for petrol and diesel storage. The *Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2008* outlines monitoring requirements for owners of USTs to reduce the risk of off-site migration of contaminants from service station sites. These are presumably being followed.

Although the Shell service station site is not on the Public Register of Notices issued under the *Contaminated Land Management Act 1997*, the site is on the *List of NSW Contaminated Sites Notified to EPA as of 8 May 2017* listed as "Under Assessment". This suggests that some fuel leakage may have occurred on the site and the EPA is investigating it. As such, there is a risk of contamination of the soil/rock/seepage water along the northern boundary of the development site and this has been considered in developing this RAP.

8. Remediation Options

8.1 Remediation Hierarchy

The preferred remediation hierarchy for the soils on the site is based on Section 3.1.8 of the *Australia and New Zealand Guidelines for the Assessment and Management of Contaminated Sites*, ANZECC 1992. These guidelines state that the preferred order of options for site clean-up and management are:

- on-site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level; and
- off-site treatment of excavated soil which, depending on the residual levels of contamination in the treated material is then returned to the site, removed to an approved waste disposal site or facility or used as fill or landfill.

Should it not be possible for either of these options to be implemented, then other options to be considered include:

- Removal of a contaminated soil to an appropriate site or facility, followed where necessary by replacement with clean fill;
- Isolation of the soil by covering with a properly designed barrier;
- Choosing a less sensitive land-use to minimise the need for remediation works which may include partial remediation; or
- Leaving contaminated material in-situ providing there is no immediate danger to the environment or community and the site has appropriate controls in place.

The broad categories of soil remediation options that may have the potential to accomplish the remediation objectives are listed below in the order of the preferred remediation hierarchy:

- Treatment;
- Removal to landfill;
- Physical barrier systems;
- Institutional controls; and
- No action.

The preferred remediation hierarchy for the groundwater on the site is based on Section 4.3.11 of *Contaminated Sites: Guidelines for the NSW Site Auditor Scheme (2nd edition)*, DEC NSW, 2006. These guidelines state that site auditors must check that all primary sources of groundwater contamination (e.g. leaking infrastructure) and secondary sources (e.g. non-aqueous phase liquids, adsorbed phase products) have been removed or otherwise addressed appropriately. The guidelines also state that auditors must ensure that adequate consideration has been given to the nature and extent of contamination, and the risks which the contamination may be posing to human health and the environment.

Information on each of the potential remediation options for soil contamination (possible and known) and groundwater contamination (possible) is provided below.

8.2 Remediation Options

8.2.1 Removal to Landfill

Removal to landfill involves physically excavating and moving impacted soil to an off-site location for storage, treatment or disposal. Disposal to landfill may require prior treatment of the impacted soil if the chemical levels exceed landfill criteria as defined in the *Waste Classification Guidelines* (NSW EPA, 2014).

This type of treatment may cause potential impacts on the local community from waste transport, as well as imposing an unnecessary burden on the capacity of the receiving landfill. Essentially this option would only be suitable under circumstances where construction of basements was proposed and which would in any case require removal of the material as part of the site formation process. To undertake such removal when it is not necessary would contravene the principles of the *Waste Avoidance and Resource Recovery Act 2001*.

8.2.2 Physical Barrier Systems

Physical barrier systems limit access to the impacted soil/groundwater, mitigate surface water infiltration through the underlying material (where necessary) and control or reduce migration of the contaminants into the surrounding environment (where necessary). This option can include creating barriers around and/or on top of the impacted soil/groundwater, or relocating the contaminants on-site to a constructed entombment. In addition, the physical barrier can also be used to control the emission of odours or volatiles (if present) and to reduce erosion, infiltration and improve aesthetics.

Physical barrier layers can include clean filling, low permeability soils such as clays, synthetic membranes such as high density polyethylene (HDPE), geotextile fabrics, bituminous materials, paving and concrete. Appropriate site grading and drainage systems may also be required to remove water from the capped areas (pavements and slabs) and to control surface run-off. Concrete barriers, bituminous pavements and various membranes may be vulnerable to cracking or shearing, depending on their proposed use, loading and exposure but these cracks or ruptures can be repaired providing appropriate inspection and maintenance is conducted as necessary.

8.2.3 Institutional Controls

Institutional controls include measures such as land-use restrictions through zoning controls to preclude certain types of land use, mechanisms of notification such as the Planning Certificate or land title information, site access restrictions, restriction on long term intrusive works or redevelopment and relocation or isolation of potential receptors. Although exposure can be reduced by these means, the impacted media (contaminants) are not directly affected or treated. Generally, development control is exercised through the development approval process, and any restriction in land-use or the need for ongoing site management can be flagged via the site audit system.

8.2.4 No Action

No action means that no response is considered necessary to remediate the site as there is not considered to be a risk to the environment or the community from the contamination identified.

8.3 Preferred Remediation Strategies

The majority of the filling and soils on the site will be excavated to form the proposed basement which will expose bedrock. Only the soils in the small areas outside the basement will remain and, if the soils contain elevated concentrations of contaminants, it is considered practical to also remove these materials from the site as the volume is small compared to the volume of the basement materials.

Although groundwater was not assessed as it was not encountered previously, demolition of the existing buildings will allow assessment of groundwater/seepage water along the northern boundary which is where contamination is likely to be present (if present at all).

The preferred remediation strategies are therefore a follows:

1. Excavation of impacted filling/soils from within the new basement zone (i.e. the majority of the site) and off-site disposal;
2. Validation and assessment of contaminants remaining within the small areas outside the basement. Any additional volume of contamination soil should also be removed;
3. Assessment of groundwater/seepage water conditions at the Shell service station boundary; and
4. If hydrocarbon contamination is found to be present, incorporating a physical barrier into the structure to prevent the ingress of groundwater and vapours into the building along with remediation (by others) of the Shell site.

9. Remediation Strategy

9.1 Sequence of Remediation

The proposed methodology comprises the following sequence of steps:

- Sampling, testing and validation of soil contaminants within the small areas outside the basement once demolition activities have been completed;
- Sampling, testing and validation of soil/groundwater contaminants along the northern site boundary;
- Revision of this RAP in the event that remediation is required in these zones;
- Negotiation with Shell to remediate any contamination associated with their operations. This may also include constructing water-tight and vapour-proof basement walls along the northern boundary to prevent hydrocarbon ingress (if found to be an issue that cannot be resolved by other means);
- Confirmation of the classification of all soils to be removed from the site prior to the commencement of excavation;
- Excavation of soil/fill from within the excavation zone(s) and disposal of materials at a suitably licenced facility;
- Sampling, testing and validation of groundwater/seepage water contaminants within the basement (if present);
- Revision of this RAP in the event that further remediation is required in this zone;
- Provide a Validation Report for the site and, where required, an Environmental Management Plan (EMP) which includes any future long-term (ongoing) management requirements post development.

Essentially the proposed remediation strategy seeks to minimise potential exposure (routes) to the possible contaminants. The proposed physical barrier system may need to include water and vapour-tight basement walls and floor, depending on the validation results.

Following the completion of the remediation works and the receipt of any related analytical results from the validation sampling, a Validation Report will be prepared in general accordance with the requirements of the NSW OEH *Guidelines for Consultants Reporting on Contaminated Sites* (2011).

This report will include:

- details of the implementation of the RAP and any variations to the remediation strategy including unexpected finds;
- a rationale and justification for the validation strategy adopted;
- results of any additional sampling undertaken during the remediation works;
- evaluation against the site criteria (where appropriate);
- as-built construction diagrams of the physical barrier system;

- verification of regulatory compliance;
- a clear statement on whether the site is considered suitable for its intended land-use; and
- any limitations, assumptions and uncertainties relevant to the conclusions of the report.

9.2 Possible Barrier Systems

Any physical barrier systems required will need to comprise concrete walls, and possibly a slab, that are to be designed to be water-tight as well as vapour-tight. The detailed design has yet to be undertaken but this should be reviewed by the environmental consultant to ensure its suitability for use as a physical barrier system.

Essentially the barrier system should meet the requirements of the *Guidelines for the NSW Site Auditor Scheme (2nd Edition)* (NSW DEC, 2006) which states that the physical barriers should meet the following requirements:

- Maximises the long term stability of the capping and or containment system and any proposed structures above it (from an engineering perspective) and where applicable, minimises the potential for leachate formation and/or volatilisation;
- Does not include the erection of structures on the capped or contained areas that may result in risk of harm to the public health or the environment; and
- Recommends a notification mechanism to ensure that the capped or contained areas are protected from any unintentional or uncontrolled disturbance that could breach the integrity of the physical barrier, such as placing a notation or covenant on the property title or a notation on a Section 149 certificate or issuing a notice or placing a notation on the title to the land under the *Contaminated Land Management Act 1997* to require maintenance of remediation under the Act.

Documentation which is proposed as an integral component of the validation reporting of barrier systems is as follows:

- 'As-built' engineering plans of the barrier system, including details of the stormwater management system;
- Provision of a photographic record of the condition and installation of the physical separation barrier in a suitable format;
- Survey details and plans taken during the installation of the physical separation barrier to show elevation and thickness of the barrier components;
- A statement from an appropriately qualified engineer confirming that the newly installed walls and slabs have a suitable design life commensurate with the development;
- A statement by a suitably qualified assessor indicating that the concrete barrier system has been installed in accordance with the appropriate Australian and/or Council Standards; and
- Construction certificates for the re-development of the site.

9.3 Waste Disposal

Any excavated spoil or surplus materials which require disposal off-site will need to be classified in accordance with *Waste Classification Guidelines* (NSW EPA, 2014). Groundwater required to be removed during construction will also need to be assessed to determine appropriate seepage water treatment and/or disposal options.

9.4 Loading and Transport of Contaminated Material

Transport of contaminated material from the site shall be via a clearly delineated haul route and this route shall be used exclusively for entry and egress of vehicles used to transport contaminated materials within and away from the site.

Removal of waste materials from the site shall only be carried out by a contractor holding an appropriate license, consent or approvals (where required) to dispose the waste materials according to the classification outlined in *Waste Classification Guidelines* (NSW EPA, 2014) and with the appropriate approvals obtained from the NSW EPA, if required.

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 (where appropriate) provided to the Environmental Consultant and the Principal's Representative (PR). A site log shall be maintained by the PR based on discrete excavation (numbered) locations to track disposed loads against on-site origin, location of the materials and sample numbers.

The proposed waste transport route will be outlined in the CEMP and truck dispatch shall be logged and recorded by the contractor for each load leaving the site. A record of the truck dispatch will be provided to the Environmental Consultant via the PR.

9.5 Disposal of Contaminated Material

All contaminated materials excavated and removed from the site shall be disposed of to an appropriately licensed landfill. Copies of all necessary approvals shall be given to the Environmental Consultant via the PR prior to any contaminated material being removed from the site. Copies of all consignment notes for the transport, receipt and disposal of the materials will be maintained as part of the site log and made available to the Environmental Consultant for inspection and reporting purposes upon request.

9.6 Imported Fill

Material imported to site shall be clean filling, which is to be analysed and certified as VENM, as well as meeting the remediation acceptance criteria via a validation certificate by the contractor. The material should also comply with relevant legislation e.g. *Protection of Environment (Operations) Act 1997*.

Analytical results presented by the contractor to validate imported fill shall be NATA accredited and obtained at an appropriate frequency and sampling density according to the NSW EPA guidelines. Sampling density is discussed in Section 11.2.

Such clean-fill validation results will be presented in the final validation report along with details of site of origin, volume and date of receipt on the site.

10. Community Consultation

Community consultation will be undertaken in accordance with the planning approval for the project and any associated legislation and planning instruments referenced therein.

11. Site Validation Plan

11.1 Validation of Physical Barrier System

Validation requirements for the physical barriers (walls and slabs) if they are required:

- Details of materials used to form walls/slabs including concrete batch quality results from the supplier;
- As-built engineering plans indicating the details of any new barrier system;
- A statement or inspection certificate from a suitably qualified assessor, such as an Accredited Certifier, indicating that the concrete barrier systems have been installed in accordance with Australian and Council Standards;
- Survey levels results; and
- Photographs of typical construction practices from selected areas of the site.

Information from the above will be compiled in a suitable format and presented in the validation report.

11.2 Validation Sample Collection and Analysis

It is proposed that any validation, waste classification or additional site characterisation samples be collected and analysed at the following frequency:

- STOCKPILED MATERIAL – one sample per 25 m^3 should be taken (or minimum of three samples). Sample materials to be logged and described in each case.
- SAMPLES FROM SURFACE OR FROM EXCAVATIONS – one sample per 25 m^2 on the surface/excavation base and one sample per 15 lineal metres along the excavation side walls. Sample depths and materials to be logged in each case.

- IMPORTED VENM – one sample per 100 m^3 of imported fill plus certification that the material comprises VENM including details of the source site.
- GROUNDWATER – two wells installed along the northern boundary of the site to 2 m beyond the bulk excavation level.

11.3 Sample Collection and Handling

Sampling will be, in the case of stockpiles, from at least 0.5 m within the stockpile. Sampling data shall be recorded to comply with routine Chain of Custody requirements. The general sampling, handling, transport and tracking procedures for soil samples comprise:

- the use of stainless steel sampling equipment;
- washing of all sampling equipment, including drills or excavator parts 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 new glass jars, sealed with a Teflon-lined lid to eliminate cross-contamination during transportation to the laboratory;
- labelling of the sample containers with individual and unique identification including Project No. and Sample No.;
- placement of the containers into a chilled, 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.

Groundwater and vapour sampling will follow a similar procedure except that the samples will be collected in laboratory-prepared vials with appropriate preservatives for hydrocarbons products, where relevant.

11.4 Quality Assurance Plan

11.4.1 Field QA/QC

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

This should include confirmation of sampling accuracy and precision through the analysis of 10% field duplicate/replicate samples as well as the collection of field rinsate samples of sampling equipment at a rate of one sample per day of sampling operations. Appropriate sampling procedures should be undertaken to prevent cross-contamination. These should include:

- Following standard operating procedures developed for such testing;
- Site safety plans are developed prior to commencement of works;

- Duplicate or replicate field samples are collected and analysed;
- Equipment rinsate samples are analysed as part of the QA/QC programme;
- 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 groundwater originating from the site area is completed.

11.4.2 Laboratory QA/QC

The laboratory engaged for the testing should undertake 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.

11.5 Achievement of Data Quality Objectives

The scope of remediation works has been devised broadly in accordance with the seven step data quality objective process, as defined in Australian Standard *Guide to the Sampling and Investigation of Potentially Contaminated Soil Part 1: Non-volatile and semi-volatile compounds* (AS 4482.1 – 1997). The DQO process is outlined as follows:

(a) State the Problem

The site will require to be rendered suitable for residential use with minimal access to soils (i.e. high-density residential) and the contamination status of soils and groundwater immediately adjacent to the Shell service station needs assessment.

(b) Identify the Decision

Soil and groundwater that exceeds the adopted assessment criteria will need to be encapsulated beneath a physical barrier on the site or removed from the site and disposed of at an appropriately licensed landfill/treatment facility.

(c) Identify Inputs to the Decision

Findings of a previous assessment have been used to characterise the site with regard to the likely nature and extent of the contamination. These will be subject to verification once full access to the site is available (i.e. demolition has been undertaken).

(d) Define the Boundary of the Assessment

The boundary of the assessment is defined by the boundary of the site, as summarised in Section 3.

(e) Develop a Decision Rule

The progress and completeness of the site remediation works should be verified on the basis of the validation analyses. Remediation is deemed to be complete when confirmation that the physical barrier systems (if required) meet the requirements of this RAP, and in the case that soil/groundwater is to be disposed of off-site, that it has been disposed of at an appropriately licensed facility.

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

- 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 replicates samples will have a precision average of +/- 30% relative percent difference (RPD) for inorganic analytes and +/- 50% RPD for organic analytes;
- Field duplicates/replicates will be collected at a frequency of 10% of all samples, and rinsate samples of field equipment will be collected at one per day of sampling; 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.

Based on a fulfilment of the data quality objectives an assessment of the overall data quality will be presented in the final validation report.

11.6 Validation Reporting

A validation assessment report will need to be prepared by a qualified environmental consultant in accordance with NSW OEH Contaminated Sites *Guidelines for Consultants Reporting on Contaminated Sites* (2011) and other appropriate guidance documentation.

The validation report shall confirm that the site has been remediated to a suitable standard for the proposed land-use and that no related adverse human health and environmental effects have occurred as a result of the temporary works. The validation report shall also include a summary of the information from previous investigations, particularly the materials that remain on-site.

The validation report shall record the nature of the barrier system at all locations on the site with suitable supporting documentation being provided in regard to thickness, integrity and other treatments applied.

The validation report shall include details of the total volume of contaminated materials removed from site, present detailed analytical results where applicable, confirm that placed fill (if any) is clean and indicate the final disposal destination of the materials removed from site.

12. Environmental Management Plan During Remediation

The work shall be undertaken with all due regard to the minimisation of environmental effects and to meet all statutory requirements. The successful contractor shall have in place a CEMP such that work on the site complies with the requirements of the following Acts:

- Hazardous Chemicals Act;
- Environmentally Hazardous Chemicals Act;
- Dangerous Goods Act;
- Protection of the Environment Operations Act;
- Construction Safety Act; and
- Work Health and Safety Act (SafeWork NSW).

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

- Fugitive dust leaving the confines of the site is minimised;
- No water containing any suspended matter or contaminants leaves the site in a manner which could pollute the environment;
- Vehicles shall be cleaned and secured so that no mud, soil or water are deposited on any public roadways or adjacent areas; and
- Noise and vibration levels at the site boundaries comply with the legislative requirements.

The CEMP should also make provision for unexpected finds (e.g. tanks, asbestos etc.) to allow an appropriate response to such finds to be made.

13. Work Health and Safety Plan During Remediation

The remediation works contractor will be required to develop a Work Health and Safety Plan for the project. This plan should be developed in accordance with the relevant Work Health and Safety legislation and guidelines for NSW.

14. Remediation of Shell Service Station Site

This RAP has been prepared on the basis that Shell will action any remediation requirements that are required to prevent contamination from migrating onto the development site, if such migration is found to be occurring. This RAP may therefor need to be revised to accommodate such remediation works if found to be necessary. Discussions with Shell and EPA may be required pending the results of the validation works to be undertaken post-demolition.

15. Conclusion

Subject to proper implementation of the RAP and validation reporting, DP considers that the site can be made suitable for the proposed redevelopment. The short term exposure during remediation and construction works should not pose an unacceptable risk to workers. A long-term EMP should only be necessary for the site in the event that the small areas outside the basement require a management strategy to deal with residual contamination in the soils or a physical barrier system is required to prevent water/vapour ingress along the northern boundary.

If required, the EMP should contain the following information:

- Purpose, structure, context and legal status of the document;
- Description of the subsurface conditions on the site and the exposure pathways;
- Management strategies for regular maintenance activities (e.g. gardening etc.);
- Management strategies for major activities (e.g. service trenching, excavation etc.);
- Documented community liaison and complaints handling procedures;
- Work Health and Safety Plan; and
- Details of EMP implementation such as roles and responsibilities, monitoring and auditing requirements, training, record keeping, review requirements and document distribution.

The EMP will need to be applied to the site by the organisation responsible for site management (e.g. Body Corporate of the Strata Plan).

It is noted that notification of an EMP will need to be made on the land titles by way of the Section 149 Certificate under the *Environmental Planning and Assessment Act 1979*. This will ensure future owners/managers of the site are aware of its contamination status.

16. Limitations

Douglas Partners (DP) has prepared this RAP in accordance Proposal SYD170309 Rev1 dated 23 March 2017. This report is provided for the use of Megland Group 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.

In preparing this report DP has necessarily relied upon information provided by the client and/or their agents. The results described in this report are based on a previous investigation and obviously relies on the accuracy of the previous information.

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.

Douglas Partners Pty Ltd

Appendix A

About this Report

About this Report

Douglas Partners

Introduction

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

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

Copyright

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

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

Appendix B

Drawings

PACIFIC HIGHWAY

BOUNDARY

SH1 - 450Ø PILES AT 2500mm MAX CENTRES
WITH 2 ROWS OF ANCHORS

BOUNDARY

SH1-450ØPILESAT2500mmMAXCENTRES
WITH2ROWSOFANCHORS

DEEP BASEMENT EXCAVATION

SH1-450ØPILESAT2500mmMAXCENTRES
WITH2ROWSOFANCHORS

WILSON STREET

PC1

PC2

PC1

PC1

219.0x10CHS

TEMPORARY PROP
TYPICAL

219.0x10CHS

219.0x10CHS

219.0x10CHS

219.0x10CHS

BOUNDARY

SH2-450Ø CONTIGUOUS PILE WALL AT 500mm MAX CENTRES
WITH INTERNAL BRACING AT 7m MAX CENTRES

SH2-450ØCONTIGUOUSPILEWALLAT500mmMAXCENTRES
WITHINTERNALBRACINGAT7mMAXCENTRE

120DAPPROX FROM
CENTRELINEOFRAILTRACKS

120DAPPROX FROM
CENTRELINEOFRAILTRACKS

TOPOFCONCRETEBACKMAST

TOEOFCONCRETEBACKMAST

CENTRELINEOFDOWNTRACK

160DAPPROX FROM
CENTRELINEOFRAILTRACKS

EXISTING RETAINING WALL

RAILL INES

OVER BRIDGE

NOTE:
1: Base drawing from WSP Structures
(Dwg 4846 S010_01 1, dated 3.5.2017)
2: Test locations are approximate only and are shown
with reference to existing features.

0 1 2 3 4 6 8 10 15 20m

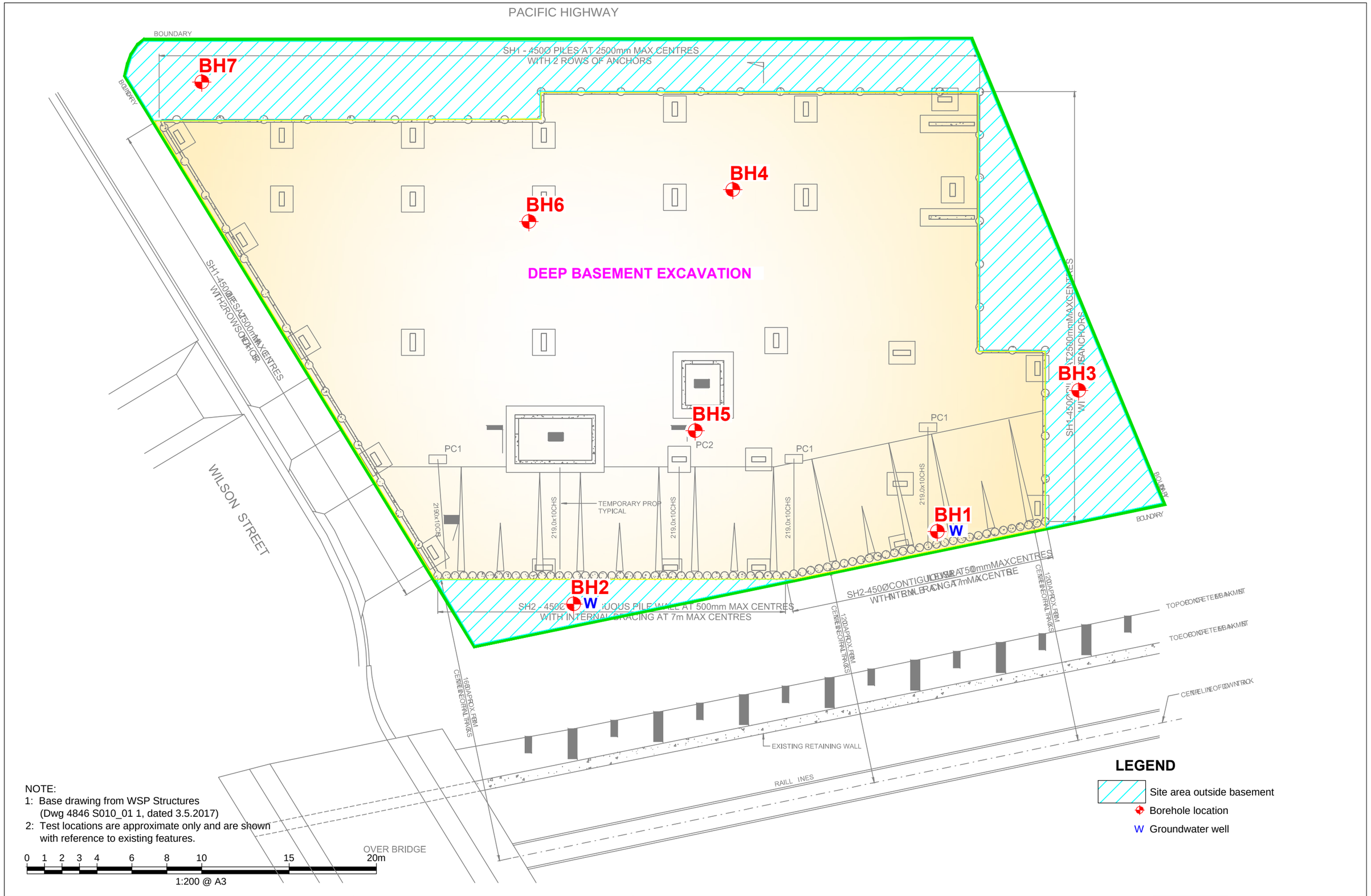
1:200 @ A3

LEGEND

Site area outside basement

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Megland Group Pty Ltd		TITLE: **Future Site Layout Plan**	PROJECT No: 84722.03
OFFICE: Sydney	DRAWN BY: PSCH	**Proposed Residential Development**	DRAWING No: RAP1
SCALE: 1:200 @ A3	DATE: 30.5.2017	**871-877 Pacific Highway, CHATSWOOD**	REVISION: 0



NOTE:
1: Base drawing from WSP Structures (Dwg 4846 S010_01 1, dated 3.5.2017)
2: Test locations are approximate only and are shown with reference to existing features.

LEGEND

- Site area outside basement
- Borehole location
- W Groundwater well

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Megland Group Pty Ltd	TITLE: **Locations of Previous Testing**	PROJECT No: 84722.03
	OFFICE: Sydney / DRAWN BY: PSCH	**Proposed Residential Development**	DRAWING No: RAP2
	SCALE: 1:200 @ A3 / DATE: 30.5.2017	**871-877 Pacific Highway, CHATSWOOD**	REVISION: 0

Appendix C

Previous Laboratory Test Results

Table C1: Contaminant Concentrations in Soils

Sample/ Depth (m)	B	T	E	X	F1	F2	F3	+PAH	B.TEQ	B(a)P	+OCP	+PCB	Phenol	Asbestos	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	(Y/N)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Primary Samples – Filling																						
BH1A/0.4-0.5	<0.2	<0.5	<1	<3	<25	<50	<100	24	3.5	2.5	NIL	NIL	<5	Y	6	<0.4	32	13	87	<0.1	13	100
BH2A/0.02-0.1	<0.2	<0.5	<1	<3	<25	<50	260	0.16	<0.5	<0.05	NIL	NIL	<5	N	<4	<0.4	61	51	6	<0.1	76	51
BH3/0.1-0.2	<0.2	<0.5	<1	<3	<25	<50	<100	23	3.4	2.4	NIL	NIL	<5	N	10	0.5	18	46	230	0.1	16	290
BH4/0.15-0.3	<0.2	<0.5	<1	<3	<25	<50	<100	9.3	1.6	1.1	NIL	NIL	<5	N	50	0.4	21	49	560	0.1	7	280
BH6/0.3-0.45	<0.2	<0.5	<1	<3	<25	<50	<100	1.7	<0.5	0.2	NIL	NIL	<5	Y	6	0.5	32	55	260	0.4	14	260
BH7/0.4-0.5	<0.2	<0.5	<1	<3	<25	<50	<100	3.2	<0.5	0.3	NIL	NIL	<5	N	7	0.7	32	26	110	0.1	5	89
Primary Samples – Natural Soil																						
BH5/0.9-1.0	<0.2	<0.5	<1	<3	<25	<50	<100	NIL	<0.5	<0.05	NIL	NIL	<5	NT	5	<0.4	26	6	50	<0.1	3	27
QA/QC Samples																						
Blank	<0.2	<0.5	<1	<3	<25	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Spike	97%	98%	96%	96%	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
TS2A (BH7/0.4-0.5)	<0.2	<0.5	<1	<3	<25	<50	<100	NIL	<0.5	<0.05	NIL	NIL	<5	NT	7	0.4	30	7	49	<0.1	3	29
TS2B (BH7/0.4-0.5)	<0.1	<0.1	<0.1	<0.3	<20	<50	<100	<0.5	<0.5	<0.5	NIL	NIL	<0.5	NT	7.1	0.5	35	23	130	0.09	<5	73

Notes: B = Benzene; T = Toluene; E = Ethylbenzene; X = Xylene; Napth. = Naphthalene; F1 = (C_6 – C_{10}) – BTEX; F2 = (C_{11} – C_{16}) – Naphthalene; +PAH = Positive polycyclic aromatic hydrocarbons; B.TEQ = Carcinogenic PAHs (as B(a)P TEQ); B(a)P = Benzo(a)pyrene OCP = Organochlorine pesticides; PCB = Polychlorinated biphenyls; As = Arsenic; Cd = Cadmium; Cr = Chromium; Cu = Copper; Pb = Lead; Hg = Mercury; Ni = Nickel; Zn = Zinc; NIL = below detection limits; NT = not tested

Table C2: Adopted Comparative Criteria for Soils

Sample/ Depth (m)	B	T	E	X	F1	F2	F3	+PAH	B.TEQ	B(a)P	OCP	PCB	Phenol	Asbestos	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	(Y/N)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Adopted Investigation/Screening Levels (mg/kg)																						
Health-Based[1]	0.5	160	55	40	45	110		400	4		Various	1	45000		500	150	500	30000	1200	120	1200	60000
Ecological[2]	50	85	70	105	180	120	300			0.7					100		400	280	1100		170	260

Notes: B = Benzene; T = Toluene; E = Ethylbenzene; X = Xylene; Napth. = Naphthalene; F1 = (C_6 – C_{10}) – BTEX; F2 = (C_{11} – C_{16}) – Naphthalene; F3 = (C_{16} – C_{34}); +PAH = Positive polycyclic aromatic hydrocarbons; B.TEQ = Carcinogenic PAHs (as B(a)P TEQ); B(a)P = Benzo(a)pyrene; OCP = Organochlorine pesticides; PCB = Polychlorinated biphenyls; As = Arsenic; Cd = Cadmium; Cr = Chromium; Cu = Copper; Pb = Lead; Hg = Mercury; Ni = Nickel; Zn = Zinc

[1]Based on NEPM Urban Residential High Density Sites; [2]Based on NEPM ESL/ACL + measured natural soil concentration