SITE AUDIT REPORT

Remediation Action Plan, Kogarah War Memorial Pool, Carss Park NSW

Prepared for: Georges River Council

Date: October 2020

Project Number: E040

Audit Number: JE081A

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Prepared for:

Georges River Council

Prepared by:

Envirocene Pty Ltd Level 1, 29 Kiora Road, Miranda NSW 2228	 Dr Julie Evans NSW EPA Accredited Site Auditor 1003

Distribution List

Report Status	Format	Recipient	Date
SAR & SAS	pdf	Georges River Council	15 October 2020

Contents

Tables

Appendices

Abbreviations

B(a)P TEQ	Benzo(a)pyrene Toxicity Equivalent Quotient
bgs	below ground surface
BH	Borehole
BTEXN	Benzene, Toluene, Ethylbenzene, Xylenes and Naphthalene
C6-<C10	Hydrocarbon chain-length fraction
CLM Act	NSW Contaminated Land Management Act 1997
COPC	Chemical of potential concern
CRC CARE	CRC for Contamination Assessment and Remediation of the Environment
EIL	Ecological investigation level
EPA	NSW Environment Protection Authority
ESL	Ecological screening level
HIL	Health-based Investigation Level
HSL	Health-based Screening Level
LEP	Local Environment Plan
LFG	Landfill gas
LNAPL	Light Non-aqueous Phase Liquid
LOR	Limit of Reporting
µg/L	micrograms per litre
m	Metre
mg/kg	milligrams per kilogram
mg/m3	milligrams per cubic metre
MW	Monitoring Well
NATA	National Association of Testing Authorities
NEPM (2013)	National Environment Protection (Assessment of Site Contamination) Measure
OCP	Organochlorine Pesticide
OPP	Organophosphorus Pesticide
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PID	Photoionisation Detector
QA/QC	Quality Assurance / Quality Control
RAP	Remediation Action Plan
RPD	Relative Percent Difference
SAQP	Sampling, Analysis and Quality Plan
SAR	Site Audit Report
SAS	Site Audit Statement
TRH	Total Recoverable Hydrocarbon
UST	Underground Storage Tank

1 Introduction

A site contamination audit has been conducted on behalf of Georges River Council (council) in relation to the site known as the War Memorial Pool, within the Carss Bush Park located at 78 Carwar Avenue, Carss Park NSW (Appendix A). The audit has been undertaken to determine if the land can be made suitable for the proposed use, subject to implementation of a specified remediation action plan (RAP).

1.1 Background to the Audit

Part of Carss Bush Park was reclaimed from Kogarah Bay in the 1940's and 1950's using uncontrolled fill from variable sources. The War Memorial Pool was constructed over part of the reclaimed land in 1965.

Georges River Council closed the pool in 2019 following investigation of environmental damage caused by the pool discharge and leaking of water into the Georges River. The pool was found to have severe cracking across major sections and its foundations, due to significant ground subsidence which has occurred over many decades. Geotechnical and contamination investigations were undertaken which identified fill material up to 6m in depth containing asbestos. In a meeting on 25 May 2020[1], council resolved that the swimming pool facility is no longer fit for purpose and to "*Undertake the immediate demolition of the Kogarah War Memorial Pool complex, decontaminate and undertake remediation of the site to eliminate the current safety risks to the community.*"

Council is currently preparing a development application (DA) for submission to the relevant planning panel for demolition and remediation of the site and redevelopment for passive public open space. As part of this process, a remediation action plan (RAP) has been prepared by Douglas Partners (DP), documenting the preferred remediation approach of cap and contain and long-term management by implementation of an environmental management plan (EMP).

1.2 Details of the Audit

Name of Site Auditor	Dr Julie Evans
Auditor's Accreditation Number	1003
Auditor's Contact Details	Envirocene Pty Ltd Level 1, 29 Kiora Road, Miranda NSW 2225 Email: jevans@envirocene.com.au
Audit number	JE081A
Entity requesting the Audit	Georges River Council
Purpose of the Audit	The audit was conducted to provide an independent review by an EPA Accredited Auditor to determine if the land can be made suitable for the proposed use if the site is remediated in accordance with a specified remediation action plan i.e. a "*Site Audit*" as defined in Section 4 "*Definitions*" of the NSW Contaminated Land Management Act 1997 (the CLM Act).
Type of Audit	The audit was commissioned in response to a request from council during a pre-lodgement meeting prior to submission of a DA and is non-statutory.

1.3 Scope of the Audit

The scope of the Audit included:

- Review of the following reports/documents:
  - 'Summary of Site Contamination, Carss Park Pool, 76 Carwar Avenue, Carss Park, NSW 2221', 15 November 2019. Construction Sciences.

[1] http://www.georgesriver.nsw.gov.au/Council/About-Your-Council/Major-Projects/Kogarah-War-Memorial-Pool

  - `Report on Detailed Site (Contamination) Investigation, Proposed Pool and Park Redevelopment, Kogarah War Memorial Pool, 78 Carwar Avenue, Carss Park. 14 September 2020. Douglas Partners. (Revision 0)
  - Remediation Action Plan, Proposed Pool and Park Redevelopment, Kogarah War Memorial Pool, 78 Carwar Avenue, Carss Park. 29 September 2020. Douglas Partners. (Revision 1)
  - Notification of the Site to NSW EPA, Kogarah War Memorial Pool, 78 Carwar Avenue, Carss Park. 18 September 2020. Douglas Partners.
  - Review of Erosion Protection Requirements, Proposed Pool and Park Redevelopment, 78 Carwar Avenue, Carss Park. 13 October 2020. Douglas Partners.
- A site visit by the Auditor on 17 September 2020.
- Discussions with council (the client), and with DP who undertook the later phase of investigation and prepared the RAP. The Construction Sciences (CS) investigation was completed prior to the Auditor's engagement and no discussion with CS was undertaken.
- The scope of the audit does not cover demolition of buildings or geotechnical specifications. The following geotechnical reports have not been formally reviewed as part of the scope for this audit but have been referred to as an additional line of evidence to confirm reported geological and hydrogeological conditions:
  - Report on Additional Geotechnical Investigation, Proposed Pool and Park Redevelopment, Kogarah War Memorial Pool, Carss Park. September 2020. Douglas Partners.
  - Geotechnical Investigation, Carss Park Swimming Pool, Carss Park. 12 November 2019. Construction Sciences.

2 Site Description

Site location and identification details are as follows:

Street Address	78 Carwar Avenue, Carss Park NSW 2221
Identifier	Part Lot 1 DP125981, Part Lot 376 DP1118749 & Lot 511 DP752056. Part of the site also extends onto unregistered crown land (Appendix A)
Local Government Area	Georges River Council
Owner	Georges River Council
Site Area	7,500m^2
Zoning	RE1 – Public Recreation (Kogarah Local Environment Plan 2012)

The site is located within the Carss Bush Park and the boundaries of the site are not well defined. A survey was provided showing the extent of the proposed remediation. The surrounding site use is summarised as follows:

North: Public parkland and playing fields

East: Embankment, raised walkway and Kogarah Bay (marine environment).

South: Parkland and Carss Park Cottage (heritage site currently being used as a museum).

West: Asphalt carpark connecting to Carwar Avenue. The carpark was investigated as part of the DSI but is not included in the scope of this audit (refer Section 8.2).

The site is adjacent to the foreshore area of Kogarah Bay, located to the east of the site. Engineered foreshore armoury measures have been implemented by council to manage erosion. These include installation of rip/rap boulders and a vegetated embankment which grades up to the level of the site and an elevated walkway. At the northern and southern ends of the foreshore to the east of the site, a seawall and on grade footpath provide erosional mitigation measures to the foreshore in lieu of the rip rap and raised pedestrian walkway, respectively. The foreshore armoury measures have been reportedly designed to an RL of 2.5mAHD to account for wave run up (0.5m) and future sea level rise (0.4m).

The site has not been identified as flood prone, although land to the north (within Carss Park Flats) has been identified in the Kogarah Bay Creek Stormwater Overland Flow Risk Management Plan to be below the flood planning level and therefore subject to stormwater flooding related development controls.

2.1 Site Inspections

DP conducted a site walkover on 22 July 2020 as part of the DSI. The following features were observed and noted:

- The site was occupied by a swimming pool (drained) with associated single-storey buildings (closed and fenced). The swimming pool was observed to have significant cracking in the walls;
- Central and western parts of the site were concrete paved or hardstand and there was some cracking evident. The eastern, northern and southern portions of the site were predominantly vegetated;
- No general storage of chemicals on site was observed, however, there was evidence of previous chemical storage associated with the operation of the swimming pool, including chlorine;
- Stormwater pits were visible throughout the site;
- Potential hazardous building materials such as fibre cement sheet and Synthetic Mineral Fibres (SMF) were present (including associated with in-ground pipes); and
- A large berm on the eastern boundary of the site indicated a significant amount of earthworks had occurred on the site.

This is consistent with the auditors observations made during a site visit on 17 September 2020.

3 Site History

DP provided a site history based on review of title deeds, maps & aerial photographs, site photographs, NSW EPA records, Safework NSW dangerous goods records, trade directories, planning certificates and council records. A summary is provided below:

Table 3.1: Site History

Date	Site	Surrounding Areas
1880's to 1920's	Title records report Part Lot 1 DP125981 owned by Mary Carss (residential) and part Lot 1 DP125981 owned by Sydney Sailors home (residential). The land transferred to Council of the Municipality of Kogarah (now Georges River Council) in the 1920's.	
1943	First available aerial photo shows the site to be vacant with natural shoreline running through the centre of site from NW to SE.	First available aerial photo shows sea wall constructed, and site used as parkland. Carss cottage present approximately 50m south of the site. Residential development surrounding the park and Kogarah Bay.
1951	Site reclamation has commenced. Zoning map indicates site used as a park (recreation).	No significant changes with the exception of a general increase in density of surrounding residential development has occurred. Leases identified within Lot 376 DP1118749 to Men's Shed, Carss Park Community Centre Building, Carss Cottage Museum & Carss Park Kiosk (date of commencement not provided).
1953	Site reclamation completed and appears to be set out as a park.	
1956	No significant changes.	
1961		
1965	Swimming pool and associated infrastructure under construction.	
1970	Swimming pool complete and carpark constructed.	
1978	Lot 511 DP752056 created (swimming pool) gazetted as public reserve. Remaining reclaimed land below original mean high water mark (MHWM) remains crown land.	
1983	Berm along eastern boundary constructed. Row of trees present.	
1990	Carpark extended to its current size.	
2019	Site reported to EPA due to pool water entering Kogarah Bay via leaking pipes and backwash pipe. Pool drained and closed.	
2020	Site unchanged.	

Safework NSW provided copies of a licence previously issued for the site approving storage of 2500L of hypochlorite solution in an above ground storage tank for chlorination of the swimming pool. No other dangerous goods storage licences were issued for the site.

The site has not been regulated by the NSW EPA under the CLM Act (1997) and at the time of completing the audit report the site was not listed as notified on the NSW EPA website2.

No current or surrendered Environmental Protection Licences have been issued under the POEO Act (1997) for the site or within 500m of the site.

[2] NSW EPA list of notified sites dated 15 October 2020: https://www.epa.nsw.gov.au/your-environment/contaminated-land/notified-and-regulated-contaminated-land/list-of-notified-sites

The summary indicates that part of the site has been reclaimed from Kogarah Bay, before being used for public open space and recreational purposes (including construction of a swimming pool).

3.1 Auditor's Opinion

The site history is well known, and no significant data gaps have been identified, although there are inherent uncertainties in the quality of the fill used in the reclamation. Some point source contamination may be expected from the storage of swimming pool chemicals and from weathering of hazardous building materials.

4 Contaminants of Concern

Specific site uses were not identified by CS during the 2019 investigation which was undertaken for waste classification purposes. Analysis was undertaken for a range of contaminants, as follows: metals, total recoverable hydrocarbons (TRH), polycyclic aromatic hydrocarbons (PAH), benzene, toluene, ethylbenzene, xylene (BTEX), organochlorine pesticides (OCP), polychlorinated biphenyls (PCB), E. Coli, faecal coliform, and asbestos.

DP provided a list of potentially contaminating site activities and associated contaminants of concern in the DSI report. These have been tabulated in Table 4.1.

Table 4.1: Contaminants of Concern

Activity	Potential Contaminants
Uncontrolled fill / land reclamation	Heavy metals, TRH, BTEX, PAH, PCB, OCP, OPP, phenols, asbestos, PFAS, nitrogen (ammonia, nitrate and nitrite) and hazardous ground gases (methane, carbon dioxide, hydrogen sulfide and carbon monoxide).
Release of swimming pool water	Microbial activity, chlorine, heavy metals, PFAS
Storage of swimming pool chemicals	
Deterioration of existing site structures (hazardous building materials)	Asbestos, SMF, lead (in paint and dust), PCBs

4.1 Auditor's Opinion

PFAS is not generally considered as a potential contaminant of concern in relation to swimming pools and given the age of the reclamation is unlikely to be of significant concern within the reclaimed fill material. Apart from this, the analyte list identified by DP adequately reflects the site history and condition.

5 Stratigraphy and Hydrogeology

Following a review of the reports provided, a summary of the site stratigraphy and hydrogeology was compiled and is presented below.

5.1 Stratigraphy

The Sydney 1:100 000 Geological Series Sheet was reviewed by DP and reported that the site is underlain by man-made fill, used to raise the natural surface elevation over former estuarine swamps and subaqueous estuarine margins. The estuarine deposits below the man-made fill typically comprise silty to peaty quartz sand, silt and clay.

The headland to the south and west of the site is underlain by Hawkesbury Sandstone, comprising medium to coarse-grained quartz sandstone with minor shale and laminate lenses. It is expected that the estuarine deposits within the site are underlain by Hawkesbury Sandstone at depth.

The sub-surface profile of the site encountered during the intrusive investigations is summarised in Table 5.1.

Table 5.1: Stratigraphy

Depth (mbgl)	Subsurface Profile
0.0 – 0.1	Concrete – in car park and building areas only (BH101-BH104, BH106, BH107, BH111-BH119)
0.0 – 5.5	FILL: grey to dark grey and brown/yellow brown to black gravelly and silty sand, sandy silt and some areas of sandy clay (dark grey, brown and yellow) with anthropogenic inclusions of ash, wood, organic matter, rootlets, fragments of shell, brick, glass (and bottles), tile, timber, metal, rubber (including tyres), plastic, fabric and asbestos containing material. Fill was encountered at all borehole locations and the majority of investigation locations terminated within fill material (generally between 1.7 to 3.0m bgl).
4.5 - 9.0	Sandy CLAY / Clayey SAND: grey, low to medium plasticity, fine grained sand, shell fragments.
9.0 – 32.5 (max depth of investigation)	CLAY: Grey and orange brown, stiff to hard clays and silty clays with medium dense and dense sand bands.
13.0 – to depth	SANDSTONE BEDROCK: Light brown/pale grey, fine to coarse grained. Sandstone bedrock was reportedly encountered at 1.6mbgl (DP 2020) and 2.5mbgl (CS 2019), but more generally at a depth of 13.0m. Bedrock was not encountered at some locations, including geotechnical bore CPT207 which terminated in clay at 32.5m bgl.

mbgl – metres below ground level

5.2 Acid Sulfate Soils

The majority of the site is located on land mapped as class 2 with the remaining areas mapped as class 5 (Kogarah Local Environmental Plan 2012), requiring assessment to determine if there are acid sulfate soils (ASS) present.

A total of 78 soil samples were "field" screened by the laboratory using the peroxide oxidation test. In addition, quantitative laboratory analysis (Scr Suite) was undertaken on 15 soil samples. Potential Acid Sulfate Soils (PASS) (pH_{FOX} <3) were identified at five locations across the site (BH103, BH108, BH111, TP120 and TP121) at variable depths ranging from 1.2-5.0m bgl. No Actual Acid Sulfate Soils (AASS) were identified by the assessment. DP concluded, *"Acid Sulfate Soils (ASS) are present at depth within the natural soils and the shallower fill profile around BH111 and TP121 from 1.2 m bgl. Moreover, whilst the screening results do not suggest any broad scale ASS impact of the shallower fill, pockets of ASS within the shallower fill, as indicated by the results from BH111 and TP121 may be encountered."*

5.3 Hydrogeology

The site is in a low-lying area of reclaimed land and the shallow groundwater table is tidally influenced. Groundwater was encountered during drilling at depths of around 2-2.2mbgl within fill. Five groundwater monitoring wells were installed screening the shallow groundwater table. Groundwater levels were measured at low tide and measured standing water levels (SWLs) ranged from to 1.76mAHD (BH107 upgradient) to 1.19mAHD (BH110 adjacent to Kogarah Bay).

Groundwater contours were not provided but based on topography and reported SWL's groundwater is expected to flow towards Kogarah Bay.

Purged groundwater was reported to be neutral (pH 6.43-7.32). Electrical conductivity ranged from 786-5,113 micro-Siemens per centimetre with the highest conductivity recorded in BH110 (adjacent to Kogarah Bay).

DP conducted a groundwater bore search on 16 July 2020. Seven registered bores for domestic and monitoring purposes are located within a 1km radius of the Site, generally located approximately 500m south-west (and upgradient) of the site. Wells were generally installed to relatively shallow depths (up to 5m bgl), with the exception of one domestic well drilled to 180m (in sandstone with a SWL recorded at 17mbgl).

5.4 **Auditor's** Opinion

The geology and hydrogeology reported by DP is acceptable for the purposes of the audit.

The site is characterised by fill material overlying natural estuarine / mangrove deposits. Groundwater is shallow, unconfined and given the proximity to Kogarah Bay, likely to be tidally influenced.

6 Evaluation of Quality Assurance and Quality Control

The Auditor has assessed the overall quality of the data by review of the information presented in the referenced reports, supplemented by field observations. The Auditor's assessment follows in Tables 6.1 and 6.2. The data set included:

- Summary of Site Contamination (CS, 2019): Soil sampling from six boreholes (BH01-BH06).
- DSI (DP, 2020): Soil sampling from 19 boreholes (BH101-BH119) and 11 testpits (TP120-TP130), and groundwater sampling from five monitoring wells (BH106-BH110).

Table 6.1: QA/QC – Sampling and Analysis Methodology Assessment

Sampling and Analysis Plan and Sampling Methodology	**Auditor's Opinion**
Data Quality Objectives (DQO) The CS Summary [of Site Contamination] report was based on results collected for the purpose of a waste classification and CS noted that "*...contamination information is not based on a satisfactory and a suitably designed Stage 2 detailed site investigation for contamination assessment. The information based on the contamination results obtained from six bore holes that were located for different objectives should not be considered suitable to characterise the contamination risks across the site.*" DQOs were outlined in the DSI report with reference to with the seven step process outlined in NSW EPA (2017) *Guidelines for the NSW Site Auditor Scheme*. The DQO's were not specific and relied on reference to various sections of the DSI report.	The CS dataset has been used as an additional line of evidence when assessing the DSI results and the limitations identified by CS have been considered. DQO's were not specifically listed in the DSI report, but reference clearly identified objectives and sampling design methodology to meet the objectives. On this basis the DQO's are considered to be acceptable.
Sampling locations (pattern, density and depth) *Soil:* Six (6) soil sampling locations were spaced across accessible areas of the site as part of an assessment to classify the material for offsite disposal (CS Summary Report). Samples were collected from a range of depths, surface to 4.95m bgl, and were analysed for metals, TRH/BTEX, PAH, OCP, PCB, coliforms and asbestos. The later DSI included 30 investigation locations spaced in accessible areas of the site. The sampling density of 30 locations over approximately 1.1 ha exceeds the minimum recommended by EPA (1995) *Sampling Design Guidelines*. The coverage provides a 95% confidence of detecting a residual hot spot of approximately 23 m diameter. The sampling targeted the fill material at the site (generally from surface to a depth of 4.5m), with most boreholes terminating within fill material. Samples were collected from the underlying natural material immediately beneath the fill interface at three locations. Samples were collected from the fill and analysed for metals, TPH/BTEX, PAH and asbestos, with limited samples also analysed for phenols, OCP/OPP, PCB, microbial activity and chloride. *Groundwater:* A total of 5 groundwater wells were installed at the site. Two monitoring wells (BH106 and BH107) were installed in the western, up-gradient side of the site with three wells (BH108-BH110) installed adjacent to the eastern boundary in assumed down-gradient positions.	The initial waste classification sampling (CS Summary) did not provide adequate coverage of the site, although the later DSI included systematic sampling and provided adequate coverage of the site. The overall sampling density exceeded the minimum sampling design requirements. Limited data was provided to determine the depth of fill and the contamination status of the underlying natural material. Considering the site history (reclaimed shallow estuarine mud flats), the data is adequate for the purposes of the audit. Groundwater wells were spaced to target both upgradient and downgradient sampling locations. Overall the investigation locations adequately targeted the main areas of concern. Ground gas was monitored using existing monitoring wells. Implications of this are discussed in Section 9.
Well construction The groundwater monitoring wells were typically installed to depths of 5 mbgl, with screen intervals of 3 m. Wells were constructed of pre-packed machine slotted PVC class 18 screen.	Groundwater is tidally influenced and some variation in SWL is expected. No evidence of LNAPL was identified. On this basis, the well construction is

Table 6.1: QA/QC – Sampling and Analysis Methodology Assessment	
Sampling and Analysis Plan and Sampling Methodology	**Auditor's Opinion**
A bentonite seal of min 0.5m thickness was placed above the screen and the well backfilled with grout to the ground surface. The SWL intersects the screen interval in most wells, with the exception of BH109.	adequate for the purposes of this audit.
Sample collection method Initial soil sample collection by CS was via grab sample from solid flight auger. Later soil sample collection by DP was undertaken using a combination of testpits and boreholes (push-tube and hand auger). Testpit samples were collected by hand directly from the excavator bucket using disposable gloves. Undisturbed push-tube samples were collected directly from the disposable push-tube sleeves. Hand auger samples were collected from the auger flights using disposable gloves. Asbestos quantification was undertaken for each of the 11 testpits (TP120-TP130). 10L samples were collected for every 1m of strata or as required based on changes in strata. Additionally, 10L samples were collected from 6 borehole locations (BH101-BH106) from a geotechnical auger (300mm diameter). Groundwater wells were installed by solid flight augers and developed prior to sampling. Samples were collected during a falling tide by low flow peristaltic pump with HDPE sample tubing.	The sample collection methodology undertaken by CS is not ideal as it can result in a loss of volatiles and sample cross contamination. However later systematic sampling conducted during the DSI was adequate. Given the key contaminants at the site are non-volatile, and taking into account the later DSI investigations overall, the soil sampling collection method was found to be acceptable. Groundwater sampling methodology was acceptable.
Decontamination procedures *Soil:* New gloves were reportedly used for each new sample. Decontamination of augers between locations was not explicitly reported *Groundwater*: Dedicated sampling equipment was used for each well. New gloves were reportedly used for each new sample.	Acceptable
Sample handling and containers Samples were placed into prepared and appropriately preserved sampling containers provided by the laboratory and chilled during storage and subsequent transport to the labs. Samples for asbestos analysis and acid sulfate soils analysis were each placed in plastic zip-lock bags. Groundwater samples to be analysed for dissolved heavy metals were field filtered using a disposable 0.45 µm filter.	Acceptable
Chain of Custody (COC) Chain of custody forms were not provided in the CS report. Completed chain of custody forms were provided in the DSI report.	The CS data was used as an additional line of evidence and the absence of COC does not materially affect the outcome of the site audit.
Detailed description of field screening protocols *Soil Vapour Screening:* DP undertook field screening for volatiles using a PID. Soil sub-samples were placed in ziplock plastic bags and the headspace measured for VOCs after allowing time for equilibration. PID readings were reported in the bore logs with generally low results. *Bulk Ground Gas Screening:* One round of preliminary bulk ground gas monitoring was undertaken by DP using a GA5000 portable landfill gas analyser to screen the groundwater monitoring wells. The GA5000 was used to assess concentrations of methane, carbon dioxide, hydrogen sulphide and carbon monoxide. The analyser was connected to monitoring well caps via a quick-connect adaptor. The analyser also recorded borehole flow rate. DP noted that the site was	*Bulk Ground Gas Screening*: The use of groundwater wells was not ideal (due to the water level) and no leak testing was undertaken prior to screening. The site is tidally influenced, and gas flow was only measured over one monitoring round during a falling tide. On this basis, the bulk ground gas screening may not be representative of worst-case conditions. The remaining field screening procedures are considered acceptable.

Table 6.1: QA/QC – Sampling and Analysis Methodology Assessment	
Sampling and Analysis Plan and Sampling Methodology	**Auditor's Opinion**
subject to tidal influences and monitoring was undertaken on a falling tide to maximize headspace in the monitoring well. A Huberg Laser One portable methane detector (with a detection limit of 1ppm) was used to undertake a surface scan for methane, comprising transects at 5m spacing in accessible areas with readings taken 50mm of the site surface. *Asbestos quantification:* 10L bulk soil samples were collected and subject to screening using a 7mm sieve. Fragments of ACM were weighed and recorded. A separate 500mL bag sample was collected and sent to the laboratory for analysis. *Groundwater:* Field parameters were measured during well sampling and development.	
Calibration of field equipment The reports indicated that calibration had been undertaken prior to use and checks were preformed during use. Calibration certificates from the equipment supplier were provided. Field calibration records were provided for PIDs, water quality meters, Huberg Laser One portable methane detector and GA5000 gas analyser.	Acceptable
Sampling logs Soil logs are provided within the report, indicating sample depth, PID readings and lithology. Groundwater field sampling records were provided, indicating SWL, field parameters, methodology and observations.	Acceptable

Table 6.2: QA/QC – Field and Lab Quality Assurance and Quality Control	
Field and Lab QA/QC	**Auditor's Opinion**
Field quality control samples Field quality control samples including trip blanks, trip spikes, field intra-laboratory and inter-laboratory duplicates were undertaken. No rinsate blanks were collected as no reusable sampling equipment came into contact with the samples.	Acceptable
Field quality control results The results of field quality control samples were generally within appropriate limits with the exception of some RPD values for PAHs and metals. In most cases (particularly for PAHs) the results were close to the laboratory LOR, causing exaggerated RPD results. In addition, the fill material was noted to be heterogenous and RPD results were elevated as a result.	Overall, in the context of the dataset reported and proposed remediation (section 12), the elevated RPD results are not considered significant and the field quality control results are acceptable.
NATA registered laboratory and NATA endorsed methods Laboratories used included ALS, SGS Australia and Envirolab. Laboratory certificates were NATA stamped.	Acceptable
Analytical methods Analytical methods were included in the laboratory test certificates with brief method summaries of in-house NATA accredited methods used based on USEPA and/or APHA methods (excluding asbestos) for extraction and analysis in accordance with the NEPM (2013). Asbestos identification was conducted by ALS, SGS and Envirolab using polarised light microscopy with dispersion staining by method AS4964-2004 *Method for the Qualitative Identification of Asbestos Bulk Samples*.	Acceptable

Table 6.2: QA/QC – Field and Lab Quality Assurance and Quality Control	
Field and Lab QA/QC	**Auditor's Opinion**
Silica gel clean-up analysis was undertaken on six selected samples where initial TRH results reported elevated concentrations. This was undertaken in accordance with the procedure outlined in NEPM (2013) Schedule B3.	
Holding times Review of the COCs and laboratory certificates indicate that the holding times had been met. DP also reported that holding times have been met.	Acceptable
Practical Quantitation Limits (PQLs) *Soil:* PQLs (except asbestos) were less than the threshold criteria for the contaminants of concern. *Asbestos:* During the CS investigation, sample size was generally around 15g and the limit of detection was reported as 0.01% w/w. The presence/absence of asbestos (<PQL) was also reported in the samples (outside the NATA accreditation). DP collected both 10L asbestos quantification samples and 500mL samples at investigation locations, in accordance with the procedures outlined in the NEPM (2013). The increased sample size can improve the likelihood of identifying asbestos material >2mm and PQLs were reported as 0.001% w/w. *Groundwater:* PQLs for the groundwater assessment were sufficiently low, with the exception of Total Phenolics (PQL 50 µg/L, trigger value 4 µg/L).	*Soil (except asbestos):* Overall the soil PQLs are acceptable. *Asbestos:* The PQLs for asbestos were addressed by the assessment criteria and were acceptable. *Groundwater*: The elevated PQLs were only marginally elevated above the trigger values and in the context of the results reported these discrepancies do not materially affect the outcome of the audit.
Laboratory quality control samples Laboratory quality control samples including laboratory control samples, matrix spikes, surrogate spikes, blanks, internal standards and duplicates were undertaken by the laboratory.	Acceptable
Laboratory quality control results The results of laboratory quality control samples were generally within appropriate limits, with the following exceptions: RPDs for laboratory duplicates were within control limits with the exception of one arsenic (67%) and two chromium results (both 67%). These were all noted to be close to the LOR and are not considered significant. Elevated matrix spike recoveries were recorded for three metals, due to background concentrations greater than or equal to 4x spike level. Remaining matrix spikes were within control limits.	The exceptions were minor and overall, the laboratory QC is acceptable.
Data Quality Indicators (DQI) and Data Evaluation (completeness, comparability, representativeness, precision, accuracy) Predetermined data quality indicators (DQIs) were set for laboratory analyses including blanks, replicates, duplicates, laboratory control samples, matrix spikes, surrogate spikes and internal standards. These were discussed with regard to the five category areas. DP concluded that "*the data obtained are reliable and useable for this preliminary assessment*."	An assessment of the data quality with respect to the five category areas has been undertaken by the auditor and is summarised below.

In considering the data as a whole the Auditor concludes that:

- In general, the data are representative of the overall conditions at the site because appropriate media have been adequately investigated for the relevant contaminants of potential concern. The exception is the bulk ground gas screening, which was not considered to be representative of worst-case conditions.

Notwithstanding this, the bulk ground gas data was considered sufficient to allow a preliminary screening of ground gas conditions at the site (further discussed in section 9).

- The DSI dataset is complete because sufficient samples have been collected and analysed from the site in accordance with documented procedures. Laboratory analysis was NATA accredited and documentation was correct. The CS dataset was collected for waste classification purposes and was used as an additional line of evidence to support the DSI dataset. On this basis the identified issues in the QA/QC relating the CS dataset did not materially affect the outcome of the audit.
- The data set is comparable because experienced staff collected the samples using appropriate sampling procedures and standard analytical methods.
- The data is likely to be accurate. The field QC was found to be acceptable and did not indicate any significant bias in the results. Standard methods were employed during sampling. The laboratories used have provided sufficient information to conclude that data is of sufficient precision.

7 Environmental Quality Criteria

The Auditor has assessed the results against Tier 1 criteria from National Environmental Protection Council (NEPC) *National Environmental Protection (Assessment of Site Contamination) Measure 1999*, as Amended 2013 (NEPM, 2013). Other guidance has been adopted where NEPM (2013) is not applicable or criteria are not provided. Based on the proposed development the criteria for 'public/recreational open space' has been referenced.

The Auditor has assessed the soil data provided with reference to Tier 1 (screening) criteria from the following:

- Human Health Assessment
  - Health Based Investigation Levels (HIL C)
  - Soil Health Screening Levels (HSL C) for Vapour Intrusion. The most conservative criteria were adopted i.e. assumed depth to source < 1 m and sand. HSL's for direct contact intrusive maintenance worker have not been included as management limits (see below) are considered protective of these exposure scenarios.
  - Asbestos Health Screening Levels (HSL C) for bonded ACM and FA/AF friable asbestos where asbestos concentrations were quantified with appropriate PQL's. Where asbestos concentrations were not quantified (i.e. presence/absence of asbestos) a positive result was considered to exceed the criteria of "*no asbestos detected in soil*".
  - Environmental Guidelines – Use and Disposal of Biosolid Products. NSW EPA (2000). Stabilisation Grade A Microbiological Standards for unrestricted use has been referenced as a screening criteria E.coli and faecal coliforms.
- Terrestrial Ecological Assessment
  - Ecological Screening Levels (ESL Urban Residential and public open space) assuming coarse soil.
  - Ecological Investigation Levels (EIL Urban Residential and public open space). Site specific EILs have been derived using the Interactive (Excel) Calculation Spreadsheet provided in the ASC NEPM Toolbox assuming the contamination is "aged", no lead background concentrations, low traffic volume, 10% clay content and site pH and cation exchange capacity (CEC) values.
- Management Limits (ML Residential, parkland and public open space) assuming coarse soil.
- Aesthetics
  - The Auditor has considered the need for remediation based on the 'aesthetic' contamination as outlined in the NEPM (2013).

The Auditor has assessed the groundwater data provided with reference to Tier 1 (screening) criteria from the following:

- Human Health Assessment
  - NEPM (2013) Groundwater Health Screening Levels (HSL C) for vapour intrusion (sand, 2 to <4 m)

The groundwater is tidally influenced and extraction for domestic and irrigation use is unlikely due to the salinity and assessment of direct contact and consumption of groundwater is not considered necessary.

- Ecological Assessment
  - ANZG 2018[3] default guideline values (DGV) referenced in ANZG (2018) for protection of aquatic ecosystems. The 95% level of protection for marine water was adopted. Some have been modified based on bioaccumulation or acute-toxicity or potential toxicity to particular species.
  - HEPA (2020) PFAS National Environmental Management Plan. Version 2.0. Ecological water quality guidelines (Interim marine 95% species protection).

The Auditor has assessed the bulk ground gas data provided by the consultant with reference to the NSW EPA (2020) *Assessment and Management Hazardous Ground Gases*.

[3] http://waterquality.gov.au/anz-guidelines

The environmental quality criteria referenced by the Auditor are consistent with those adopted by the consultants with the exception that DP used the laboratory detection limit as a screen for microbiological indicators. This does not materially affect the outcome of the audit.

8 Evaluation of Soil Results

8.1 Field Observations

Anthropogenic material was observed in the testpits and boreholes (except BH105) including timber, ash, concrete and brick rubble, glass, ceramic tile, PVC, rubber fragments, scrap metal and fragments of fibre cement sheeting (later confirmed by the laboratory as containing asbestos).

Staining, hydrocarbon odours and sulfurous odours were observed within some boreholes generally below the groundwater table. The PID results were generally low, with a maximum result of 13 ppm recorded in sample TP121/2.9-3.0.

8.2 Analytical Results

The extent of the DSI report included the carpark and covered a larger area than the current audit area. The results are considered representative of the fill across the audit site and have been included in the assessment of soil results.

The results have been assessed against the environmental quality criteria and are summarised in Table 8.1. Soil sampling locations are included in Appendix A.

Table 8.1: Evaluation of Soil Analytical Results – Summary Table (mg/kg)

Analyte	N	Detections	Maximum	n > Screening Criteria	Comments
ACM >7 mm	79	23	0.58 %w/w	15	Detected in the majority of testpits excavated at varying depths within the fill material.
AF/FA	46	<PQL	<PQL	None	-
Asbestos (presence/absence)	105	Asbestos detected in 5 samples		-	Fragments of asbestos fibre board recorded (outside scope of NATA test) in BH5 (1.9-2.0m) & BH4 (2.9-3m & 3.8-3.95)
Asbestos trace analysis	105	No respirable fibres detected in 2 samples			
Benzene	108	<PQL	<PQL	None	-
Toluene	107	<PQL	<PQL	None	-
Ethylbenzene	107	<PQL	<PQL	None	-
Total Xylenes	107	1	4	None	-
F1 (TRH C_6–C_{10} minus BTEX)	107	1	14	None	-
F2 (TRH >C_{10}–C_{16} minus naphthalene)	107	4	340	1	Minor exceedance of TPH ESL in BH111 (1.7-1.8m)
TRH >C_{10}–C_{16}	84	4	340	None	
F3 TRH >C_{16}-C_{34}	107	28	2,100 (600*)	1	Minor exceedance of TPH* ESL in BH124 (0.8-0.9m)
F4 TRH >C_{34}-C_{40}	107	16	1,400 (130*)	None	-
Naphthalene	107	<PQL	<PQL	None	-
Benzo(a)pyrene	107	54	10	11	Widespread exceedances of the ESL.
Benzo(a)pyrene TEQ	107	31	16	5	In general exceedances were marginal with the exception of BH106 (0.8-1.0m) & TP124 (0.8-0.9m).
Total PAHs	107	59	140	None	-

Table 8.1: Evaluation of Soil Analytical Results – Summary Table (mg/kg)					
Analyte	N	Detections	Maximum	n > Screening Criteria	Comments
Total Phenols	28	<PQL	<PQL	None	-
Arsenic	108	82	37	None	-
Cadmium	108	23	5.8	None	-
Chromium	108	108	990	2	Exceeds HIL/EIL in BH102 (2.5-3.0m) & TP130 (2.7-2.8)
Copper	108	103	270	2	Marginal exceedance of EIL in TP128 & TP129
Lead	108	107	1,600	3	BH111 (4.5-5m) & BH1 (1.5-1.95m) exceeded HIL/EIL BH106 (2.5-3m) exceeded HIL.
Mercury	108	60	50	None	-
Nickel	108	99	82	None	-
Zinc	108	107	3,400	7	Exceedances of EIL generally in deeper layers of fill >2mbgl.
PCB	51	1	0.3	None	-
OCP	51	2	0.8	None	-
OPP	28	0	<LOR	None	-
Total Coliforms (orgs/g))	6	5	>30,000 orgs/g	-	Maximum reported in BH5 (1.9-2.0m). Faecal coliform count not recorded but no E Coli not detected.
E Coli (orgs/g)	6	<PQL	<PQL	-	
Total Coliforms (MPN/g)	17	10	>1800 MPN/g	-	Maximum reported in TP122 (2.9-3.0). Not associated with corresponding high faecal coliform count.
Faecal Coliforms (MPN/g)	17	4	3.3 MPN/g	None	
Hydrocarbon Utilising Bacteria (cfu/g)	17	2	70cfu/g	None	-
Chloride	32	5	70	-	-

*Result following silica gel clean-up to remove polar metabolites and naturally occurring hydrocarbons.

8.3 Auditor's Opinion

In reviewing the analytical results, the Auditor notes the following:

Metals: Concentrations of metals were generally an order of magnitude below the screening criteria with the exception of some isolated exceedances of total chromium (BH102 & TP130) within deeper fill material located below the water table; marginal exceedances of the EIL for copper (TP128 & TP129) within shallow fill located above the water table; Elevated zinc concentrations (>520mg/kg) in fill material below the water table (BH102, BH104, BH111, BH112, TP130 & TP124, although in the case of TP124 this was only a marginal exceedance) and elevated lead concentrations (>1100mg/kg) in fill below the water table in BH111. No obvious differences were observed in the fill material at these locations.

Hydrocarbons: Lighter end TRH (F1 & F2) was generally not detected in the soil samples with the exception of one very low concentration detected in BH111. Several detections of F3 and F4 TRH were

noted however, following silica gel clean-up (to remove polar compounds) only two marginal exceedances of the ESL were detected (TP124 & BH111).

Concentrations of PAHs were below the screening criteria with the exception of B(a)P detected above the ESL in 10 samples and above the HIL in 4 samples. The majority of these were marginal exceedances with the exception of BH106/0.8-1.0 & TP124/0.8-0.9 (10 & 16 mg/kg respectively).

No significant light end TRH or VOCs were detected across the site, corresponding to the low PID readings recorded.

Microbiological: Total and faecal coliforms were analysed as a screen for evidence of microbial impacts. The term[4] total coliforms refers to a large group of bacteria that includes bacteria of faecal origin, as well as some bacteria that may be isolated from environmental sources. Thus the presence of total coliforms may or may not indicate faecal contamination.

Initial results reported by CS indicated elevated total coliforms in a sample collected from BH5 (1.9-2.0m). Later sampling by DP reported elevated total coliforms in TP122, although this did not correspond with elevated faecal coliform concentrations. TP122 and BH5 are located adjacent to some small buildings and small pool used by children. DP concluded that the source of microbial impact was from the recent pool operations. The auditor is of the opinion that, given the low occurrence of faecal coliforms and E Coli in the sample, the microbial activity could also be from a naturally occurring environmental source.

Asbestos: Bonded asbestos (ACM) was detected exceeding the screening criteria in the majority of testpits excavated. No asbestos fines/free asbestos was reported within the samples analysed from the testpits. ACM was also detected in some of the boreholes excavated by CS (although these were outside the scope of the NATA test and concentrations were not estimated).

Aesthetics: The presence of anthropogenic inclusions (other than asbestos) would not be a cause for concern under the proposed use, however strong odours were noted at and below the groundwater table and may cause a concern if excavation below the groundwater table was contemplated or if groundwater was to extracted for beneficial use.

In summary, the results appear to be consistent with the field observations and site history. A significant amount of fill underlies the site and is characterised by inclusions of anthropogenic material including bonded asbestos, consistent with the historical reclamation of the site. The asbestos appears to be widely distributed through the fill material and exceeds human health screening criteria. Although some TRH was identified this was demonstrated to consist mainly of polar compounds and likely to be associated with high levels of naturally occurring organic carbon within the fill and underlying natural marine sediments. Metal concentrations were generally an order of magnitude below the screening criteria, although a few isolated occurrences of elevated zinc, lead and copper were reported (particularly deeper in the fill material) and these have been considered in the context of the groundwater results (discussed in section 10).

The contamination identified within the fill material is expected to extend to the wider reclamation area within Carss Bush Park.

[4] Water Quality Monitoring - A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes; Edited by Jamie Bartram and Richard Balance; Published on behalf of United Nations Environment Programme and the World Health Organization. 1996 UNEP/WHO. ISBN 0 419 22320 7 (Hbk) 0 419 21730 4 (Pbk)

9 Bulk Ground Gas Assessment

9.1 Preliminary Screening Assessment

DP referred to the NSW EPA (2020) Assessment and Management of Hazardous Ground Gas. These guidelines advocate a multi-level risk assessment process built around a consequence based screening method and recommend using a preliminary screening assessment to identify whether it is necessary to proceed to a Level 1 risk assessment (i.e. calculation of GSV).

The auditor has considered the site characterisation provided by DP in the context of a preliminary screening assessment as follows:

Table 9.1: Preliminary Screening Assessment

Item	Auditor Comments
Potential Source of Ground Gas [Yes]	The site is underlain by between 2-5m of uncontrolled fill material over natural estuarine and mangrove mud reclaimed from Kogarah Bay. The reclamation occurred over 80years ago and the fill material appears to contain only a small amount of timber and other organic material. With reference to the gas screening data DP stated that "*Monitoring from the wells recorded generally low concentrations of methane and associated bulk gases, consistent with reclaimed land using uncontrolled fill in estuarine / mangrove / marine environments (and the groundwater results).*" The auditor agrees that there is a potential source of ground gas associated with reclamation of Kogarah Bay and this is expected to be generated though slow decay of the organic content within the fill and underlying estuarine muds.
Likely Transport Mechanisms [Yes]	The fill material is not confined, and gas generation rates are expected to be slow. Under these conditions, high gas pressure or sustained flow is not expected to occur. However, DP noted that the groundwater is tidally influenced, and with reference to the gas screening results concluded that: "*…the results may be influenced by changes in atmospheric conditions and tidal influence on the sub-surface profile that could cause a pumping effect in under favourable conditions.*" The auditor agrees that there is the potential for some pressure driven flow through tidal pumping to occur.
Potential Receptors [No]	The proposed development is described in the DSI as "*…demolition of the existing pool and associated structures and sub-surface infrastructure (e.g., pipes, including those constructed of Asbestos Containing Material (ACM)), and conversion of the area to open space grassed areas forming a connection with the existing park to the north of the site.*" DP stated, with reference to the NSW EPA (2020) "*… the guidelines primarily focus on buildings and structures which are not proposed for the site…*" and *"Given the proposed open space use of the site, the risk to site users from LFG is not considered to be of significant concern. Further consideration is required to be given to LFG risk should enclosed spaces or services be built/installed. In addition, sub-surface penetration and excavation works should also take into consideration the presence of LFG when undertaking works."* The auditor agrees that the proposed development scenario does not include receptors that may be impacted by the ground gas.

In the auditor's opinion, the preliminary screening assessment was based on sufficient, reliable information and on the basis that no receptors have been identified, in accordance with s4.3.1 of NSW EPA (2020), further risk assessment is unnecessary and no further action to manage bulk ground gas risk is required.

Institutional controls will need to be implemented to ensure no buildings, structures or subservice utilities are constructed at the site in the future without assessment of the bulk ground gas risk.

9.2 Gas Screening Results

Notwithstanding the results of the preliminary screening assessment, DP implemented "*opportunistic landfill gas screening*" as part of the DSI program as follows:

- A preliminary assessment of bulk ground gas concentrations (methane, carbon dioxide, hydrogen sulphide, carbon monoxide and oxygen) was undertaken using the five existing groundwater monitoring wells (MW106-MW110) over a single monitoring round on 5th August 2020.
- Survey of the site surface using a gas analyser in 5m transects across the site.

The results of the bulk ground gas assessment are summarised below:

Table 9.2: Bulk Ground Gas Results

	MW106	MW107	MW108	MW109	MW110
Depth to top of screen (mbgl)	1.5m	2m	2m	3m	2m
SWL (mbgl)	2.15m	1.8m	2.07m	2.55m	2.6m
Flow rate (L/hr)	0 to 0.1	-17.3 to -0.1	-22.2 to -0.6	-26 to -4	0 to 0.1
Max Carbon Dioxide (%)	15.9	2.3	0.2	0.1	14.2
Max Methane (%)	15.3	0.5	0.2	0.4	7.5
Max Carbon Monoxide (ppm)	5	1	0	0	0
Max Hydrogen Sulphide (ppm)	0	0	0	0	0
Site surface gas survey	Surface scanning recorded all concentrations for methane below 5ppm, which is 2 orders of magnitude below the adopted screening criteria of 500ppm (NSW EPA, 2020 *s3.6.2 surface emission criteria for further investigation and corrective action for a landfill surface*)				

DP reported that "*Monitoring from the wells recorded generally low concentrations of methane and associated bulk gases, consistent with reclaimed land using uncontrolled fill in estuarine / mangrove / marine environments (and the groundwater results). LFG flow rates were variable, however, were generally negative or only very marginally positive indicating limited release of LFG from the surface, consistent with the surface monitoring results. It is noted that the flow rates (and to a lesser extent concentrations) may have also been impacted by the standing water levels in the wells, most notably in BH107 and BH109.*"

DP calculated a gas screening level based on the highest gas concentration (CO_2 15.9%) and flow rate (0.1L/hr), resulting in a GSV of 1 (very low risk category) with no further action required.

9.3 **Auditor's Opinion**

As discussed in section 6, some QA/QC issues in relation to the reported gas screening results were identified as follows:

- Three of the monitoring wells (MW107, MW108 & MW109) recorded SWLs (on the day of gas sampling) above the screened section and were not appropriate for use as gas screening wells. Significant negative gas flows were recorded in these wells.
- Tidal fluctuations may cause some pressure driven (advective flow) which has not been addressed through the current monitoring program.
- No leak testing of the monitoring wells was conducted.
- The minimum requirements to assess a gas screening value and characteristic gas are detailed in the NSW EPA (2020) guideline. This requires sampling measurements to be taken during falling atmospheric pressure (the key requirement should be to capture the worst-case meteorological

scenario). Only a single monitoring round was completed, and this was not demonstrated to have been completed within a period of falling atmospheric pressure[5].

Considering these issues, the bulk ground gas screening data are unlikely to represent worst case conditions. However, the results, when viewed using a multiple lines of evidence approach appear to be consistent with the expected bulk ground gas conditions identified in the preliminary screening assessment. On this basis, the auditor agrees with the DP conclusion that "*Given the proposed open space use of the site, the risk to site users from LFG is not considered to be of significant concern*." Providing that an LTEMP is implemented to ensure no buildings, structures or subservice utilities are constructed at the site, no further action to manage bulk ground gas risk is required.

9.4 Contamination Migration Potential

Considering the source and expected low gas pressure, off-site migration of bulk ground gases is unlikely. However, bulk ground gases are expected be associated with the broader Carss Bush Park in areas where land reclamation has occurred.

This has been discussed with the EPA (Appendix B) and noted on the comments section in the site audit statement.

[5] The NSW EPA guideline recommends that for Australian conditions, a worst-case meteorological scenario can be estimated from the fifth percentile three-hour pressure decrease rate for the site, based on a two-year data set for the nearest Bureau of Meteorology site with continuous pressure recording.

10 Evaluation of Groundwater Analytical Results

Groundwater samples were collected from 5 wells on 29 July 2020 during a falling tide. The analytical results are summarised below in Table 10.1.

Table 10.1: Summary of Maximum Groundwater Investigation Analytical Results

Analyte	n	Detections	Maximum (µg/L)	n > screening criteria	comments
TRH C_6-C_{10} less BTEX (F1)	5	3	33	None	-
TRH >C_{10}-C_{16} less naphthalene (F2)	5	4	660	None	Following silica gel clean-up, no TPH was identified in the groundwater.
TRH >C_{16}-C_{34}	5	3	150	-	
TRH >C_{34}-C_{40}	5	<PQL	<PQL	-	
BTEX	5	<PQL	<PQL	None	-
Naphthalene	5	2	0.2	None	-
Benzo(a)pyrene	5	<PQL	<PQL	None	-
Anthracene	5	1	0.1	1	Marginal exceedance of DGV for 99% protection.
Fluoranthene	5	2	0.2	None	-
Phenanthrene	5	2	1	1	Marginal exceedance of DGV for 99% protection.
Phenols	5	<PQL	<PQL	None	-
Arsenic	5	3	3	None	-
Cadmium	5	<PQL	<PQL	None	-
Chromium	5	1	1	None	-
Copper	5	2	15	1	Single exceedance of DGV in BH108. Remaining downgradient wells <LOR.
Lead	5	<PQL	<PQL	None	-
Mercury	5	<PQL	<PQL	None	-
Nickel	5	5	4	None	-
Zinc	5	5	38	4	Groundwater both up and downgradient marginally exceeded DGV.
PCBs	4	<PQL	<PQL	None	-
OCPs	4	<PQL	<PQL	None	-
OPPs	4	<PQL	<PQL	None	-

Table 10.1: Summary of Maximum Groundwater Investigation Analytical Results					
Analyte	n	Detections	Maximum (µg/L)	n > screening criteria	comments
Ammonia	5	5	20mg/L	5	Exceeded DGV in all wells, with some reduction in concentrations noted in downgradient wells.
Total Coliforms	4	3	170 cfu / 100mL	-	No significant microbial activity identified.
Faecal Coliforms	4	2	80 cfu / 100mL	None	
PFHxS	3	3	0.049	-	-
PFOS	3	3	0.13	None	-
PFOA	3	3	0.015	None	-
VOCs (detections are listed below – remaining VOCS <PQL)					
Chlorobenzene	5	4	10	None	Minor detections very close to PQL.

In summary:

- Some minor exceedances of the screening criteria for anthracene and phenanthrene in BH109. These were compared to the low reliability criteria and used the 99% protection criteria (to account for bioaccumulation). The concentrations are only marginally above the assessment criteria and are not considered to be representative of significant groundwater impact.
- Zinc exceeded the screening criteria in BH106, BH107 (upgradient), BH108 & BH110 (downgradient) indicating that the leaching potential of zinc within the site appears to be low.
- Some TRH was identified although following silica gel clean-up this was identified to consist of polar compounds and likely to be associated with naturally occurring organic matter, consistent with the soil results.
- Ammonia exceeded the screening criteria (GIL of 0.91 mg/L) in all the wells sampled. DP considered this to be more consistent with generation from decay of organic matter in the reclaimed estuarine / mangrove / marine environments rather than from a landfill source.

Anions/cations were analysed and reported in the DSI report. Chloride was recorded in all samples, although an elevated concentration was recorded in BH110 (1,200 mg/L) compared to 69-120 mg/L recorded in the other samples analysed. DP noted this to be consistent with the outflow pipe and the pump / storage room located in the south-eastern corner of the site (up-gradient of BH110).

DP concluded that "*… the groundwater results do not indicate significant impact on groundwater quality from the site with the potential exception of some chloride impacts in the south-eastern corner of the site. Ipso facto, leaching of contaminants from fill above the water table is not considered to be a significant concern. It is therefore considered that results are reflective of broader groundwater quality in the area of the site and not limited to impacts from the site. Moreover, notwithstanding the technical and feasibility constraints that the site presents given its location adjacent to Kogarah Bay, shallow groundwater, deep fill and deep rock profile, it is considered groundwater remediation of the site (which forms a subsection of the reclaimed land within Carss Park / Carss Park Flats) would provide minimal to negligible environmental benefit. Any approach to improving groundwater quality at the site and neighbouring areas should therefore be undertaken at a broader level.*"

10.1 Auditor's Opinion

The auditor agrees with DP, that the identified groundwater contamination is part of a broader scale issue of reclaimed land within Carss Bush Park. The groundwater results indicate that leaching from on-site fill is not further impacting on the groundwater quality. The elevated chloride detected is expected to attenuate over time following demolition of the swimming pool infrastructure which will remove any on-going source associated with the pump house and outflow. Based on the reported analytical results, the presence of separate phase liquid in groundwater is unlikely. No volatile contamination (other than ammonia) has been identified and in any case vapour intrusion would not be a risk under the proposed development scenario.

10.1.1 Contamination Migration Potential and Assessment of Risk

The lateral and vertical extent of the groundwater contamination migrating from the site has not been delineated and the investigation report does not provide sufficient information to identify if the contamination is posing a risk to the receiving environment (i.e. Kogarah Bay). This has been discussed with the EPA (Appendix B) and further investigation and management of groundwater contamination will be undertaken in the context of the broader groundwater quality within Carss Bush Park.

On this basis management of groundwater contamination as part of the current remediation proposal is not required. It is noted that if any future remediation of groundwater is required this could interfere with activities on the site while remediation is carried out.

11 Conceptual Site Model

DP developed a conceptual site model (CSM) which was revised iteratively throughout the site assessment process to inform decisions around investigation and management requirements. Table 11.1 provides the Auditors review of the final CSM used by DP to inform the management decisions.

Table 11.1: Review of the Conceptual Site Model

Element of CSM	RAP Details	Auditor Opinion
Contaminant source and mechanism	Large scale filling of site (and off-site areas) associated with widespread land reclamation and potential uncontrolled waste fill. COPC include asbestos, chromium, copper, lead, zinc, PAH, TRH, ammonia and LFG (including methane, carbon dioxide, hydrogen sulphide and carbon monoxide). The high organic content within the reclaimed mangrove/estuarine environment also slowly generates methane and carbon dioxide. Past and current site activities - use of the site as a swimming pool and uncontrolled release of pool water into the environment and related storage of chemicals. COPC include heavy metals, chlorine, microbial activity. Deterioration of existing buildings. COPC include asbestos, SMF, lead (in paint and dust) and PCB.	The sources of contamination and contaminants of potential concern have been identified.
Affected media	Soil (fill), groundwater and ground gas.	The affected media was adequately identified.
Receptor identification	Human Health: Construction and maintenance workers; End users (members of the public); and Adjacent site users. Ecological: Terrestrial ecology (upper 2.0 m of the proposed final landform); Groundwater; and Surface water (Kogarah Bay).	Human and ecological receptors have been identified.
Exposure pathways	Ingestion and dermal contact; Inhalation of dust, vapours and/or LFG; Direct contact with local ecology (upper 2.0 m of the proposed final landform); and Lateral migration of groundwater providing base flow to water bodies. In assessing the gas screening results DP stated that "*Given the proposed open space use of the site, the risk to site users from LFG is not considered to be of significant concern.*" Leaching of contaminants and vertical migration into groundwater was identified in the CSM, although DP later reported that "*The groundwater results do not indicate significant impact on groundwater quality from the site.*"	Appropriate noting that "*inhalation of vapours and/or LFG*" was not a complete exposure pathway due to the proposed open space development.
Presence of preferential pathways for contaminant movement	Not discussed by Douglas.	These are not considered to apply to asbestos contaminated fill material.
Evaluation of data gaps	DP noted that "*Further consideration is required to be given to LFG risk should enclosed spaces or services be built/installed. In addition, sub-surface penetration and excavation works should also take into consideration the presence of LFG when undertaking works.*"	Appropriate.

12 Evaluation of Remediation Action Plan

Based on the investigation results, Douglas prepared a RAP documenting the preferred remediation approach. The Auditor has assessed the RAP with respect NSW EPA (2017) Guidelines for the NSW Site Auditor Scheme and by comparison with the checklist included in NSW EPA (2020) Contaminated Guidelines for Consultants Reporting on Contaminated Land. This is documented in Table 12.1 below.

Table 12.1: Evaluation of Remediation Action Plan

RAP Item	Auditor Comment
Remedial Goal: To establish an appropriate remediation strategy so as to render the site suitable, from a site contamination perspective, for the proposed development.	Acceptable.
Extent of Remediation Required: 1. Hazardous building materials (within site structures) to be removed in accordance with relevant legislation and guidelines prior to demolition. 2. Removal of site infrastructure associated with former swimming pool. This was proposed to mitigate on-going impacts from the former pool use and to ensure no receptors for identified hazardous ground gas. 3. Management of direct exposure to contaminated fill material (asbestos, B(a)P, lead, zinc and chromium). Bonded asbestos was identified as being the primary contaminant of concern, present at most of the site's sampling locations and at varying concentrations and depths through the fill profile. The RAP assumes that asbestos is widely distributed across the fill and is therefore the maximum extent of remediation required.	The RAP did not identify if management of direct contact and use of groundwater was required. This can be effectively managed through implementation of a long-term environmental management plan (LTEMP). The scope of this audit does not extend to demolition work (including removal and clearance of hazardous building materials). Compliance with the current legislation and guidelines will be controlled through the DA. On this basis the extent of remediation discussed in the RAP is acceptable.
Remedial options (with respect to the management of direct contact with contaminated soil) were discussed in the RAP as follows: A. Excavate all fill from the site in the upper 2 - 3 m that exceeds the screening criteria and dispose to landfill; B. Management of fill at depth through cap and containment so as to minimise future disturbance and exposure. C. Combination of Options A and B, being excavation of fill to reach design levels and capping and long-term management of fill that remains at and below bulk excavation levels.	The on-site (or off-site) treatment of the asbestos impacted soil is not a viable (technically feasible) option given the nature and extent of the fill material. Therefore, on-site containment or off-site disposal are acceptable remediation options with respect to NSW EPA policy.
Section of Preferred Option: Option C was selected as the preferred remediation option and DP provided the following justification: - The non-volatile nature of the contamination that is to be retained below the bulk earthworks level; - The NSW EPA objective of minimising waste generation (i.e., disposal of soils to landfill); - The shallow groundwater level at the site which the contaminated fill extends below. Disturbance and excavation of fill below the water table has the potential to impact on water quality. Moreover, the feasibility of lowering the groundwater table below the fill level without significant works is limited given the site's location adjacent to Kogarah Bay and the estuarine deposits that underlay the fill.	Discussed in section 12.1 below.

Table 12.1: Evaluation of Remediation Action Plan	
RAP Item	Auditor Comment
- The presence of ASS and the requirement to minimise potential impacts on the environment from ASS during works. - The need to consider geotechnical requirements for potential reuse of site won soils (e.g. sorting or sieving) and the associated asbestos risks that would need to be managed during works; - Minimizing disturbance within areas of identified tree protection zones. The RAP also stated that construction of sub-surface confined spaces, such as enclosed utility and inspection pits are prohibited under the adopted remediation strategy.	
Extent of Capping & Specification: Following bulk earthworks (cut & fill) to reach design levels, the site will be capped to provide a physical separation between site users and the contaminated fill material. The capping layer will comprise installation of a high visibility marker layer and installation of a minimum 500mm thick capping layer (consisting of 350mm of well graded and compacted ripped sandstone VENM and 150mm of topsoil and turf). To prevent erosion of the cap, sandstone blocks (500mm x 500mm) are to be installed along the eastern boundary. Along the western boundary the cap will interface with existing carpark/hardstand and marker will be secured to the base of the curb. Within the tree protection zones (TPZ) fill will be excavated by hand to a depth of 100mm followed by installation of marker layer and 100mm of free draining VENM and 200mm of topsoil or mulch. Within 300mm of the tree trunk the capping will consist of 300mm depth of mulch. The mulch will be contained using permanent edging. In the northern TPZ capping will be limited to 150mm of topsoil and turf due to the nature of the tree root system in this area, and a geogrid will be installed as an additional protection measure. A review of the long-term erosional stability of the cap design was undertaken by a geotechnical engineer[6]. This identified the following additional requirements for the cap design to account for storm surge wave run-up and sea level rise: - Inclusion of non-dispersive clay behind and below the sandstone blocks along the eastern site boundary; - Capping to consist of non-dispersive clay in areas below 2.5mAHD including within the TPZ. - Maintenance of the engineered foreshore armoury measures to mitigate erosion below the sandstone blocks along the eastern boundary.	Appendix B of the RAP includes a number of civil drawings, prepared by Enspire Solutions Pty Ltd. Drawing 200060-DA-C04.10 entitled *Remediation Plan* does not represent the final capping design. To avoid confusion, the design elements identified in the DP (2020) "*Review of Erosion Protection Requirements…*" must be incorporated into the cap design which is specified in section 7.3 of the RAP. These measures have been included to maximise the long-term stability of the cap. Restrictions on construction of buildings and sub-surface utilities on the site and maintenance of the engineered foreshore armoury can be managed through implementation of a LTEMP. Contingencies will need to be developed if future tidal inundation affects the stability and security of the capping.
Proposed Validation Criteria: Capping will need to meet the required design and specifications detailed in the RAP.	Acceptable

[6] Douglas Partners (2020) *Review of Erosion Protection Requirements, Proposed Pool and Park Redevelopment, 78 Carwar Avenue, Carss Park.* 13 October 2020.

Table 12.1: Evaluation of Remediation Action Plan	
RAP Item	Auditor Comment
Imported material: remediation acceptance criteria are listed in the RAP.	
Proposed Validation Testing: Capping: survey of extent and level following installation of marker layer and final capping layer (minimum spot heights to be measured every 15-20m^2 and every 5m along boundary). Validation inspections to be undertaken during site cut and fill (to design levels), installation of marker layer and on completion of capping. *Imported Material:* Specifications for inspection, sampling and analysis of VENM and non-VENM materials are provided in the RAP.	Acceptable.
Interim Site Management Plan (before remediation): Not discussed.	The site has been closed by council and is currently fenced to prevent access and no other interim management is considered necessary.
Unexpected Finds: The RAP includes an unexpected finds protocol that must be included in the contractor's CEMP.	The unexpected finds protocol is reasonable.
Site Management Plan (operation phase) including stormwater, soil, noise, dust, odour and OH&S: A Construction Environmental Management Plan (CEMP) and site specific WHS Plan is to be prepared by the Principal Contractor. The RAP states that the CEMP must include: Works sequence and timeline; Health and Safety Protocols; Dust minimisation measures; Noise minimisation measures; Environment protection measures; Equipment to be used; Method(s) for surveying before and after physical barrier construction; and Method(s) for inspecting and certifying construction of the physical barrier systems, including any hold points. Landfill gas and odours will also be managed during the construction phase. An asbestos management plan (AMP) will be prepared to address asbestos related works associated with the remediation.	Acceptable
Material Handling and Tracking: Material tracking is to be implemented and will be documented in the CEMP. At a minimum this is to include: - Measures to prevent cross contamination between areas being remediated (capped) and those already capped; - Nominated landfill(s); - Truck movements / site access / site egress; Proposed source(s) of materials for import and methods of certification. In addition, DP stated that the following documentation would need to be provided by the relevant parties (contractor): - Transportation Record: comprising a record of all truckloads of soil entering or leaving the site, including truck identification (e.g., registration number), date, time, load characteristics (i.e., classification, on-site source, destination); - Disposal dockets: for any soil disposed off-site. The contractor will supply records of: transportation	Acceptable providing that the CEMP is reviewed by the consultant prior to works commencing to ensure that material handling and tracking procedures will be sufficient to meet the RAP documentation requirements. This has been addressed through a condition on the site audit statement.

Table 12.1: Evaluation of Remediation Action Plan	
RAP Item	Auditor Comment
records, spoil source, spoil disposal location, receipt provided by the receiving waste facility (where available), a record of receipt from the receiving site will be supplied (i.e., the receiving sites transportation records). Note: A record of the building materials disposed off-site is also be kept and provided to the Principal on request; - Imported materials records: records for any soil imported onto the site, including source site, classification reports, inspection records of soil upon receipt at site and transportation records;	
Contingency Plan if Selected Remedial Strategy Fails: Not discussed.	The remedial strategy has a low risk of failure as the cap and contain strategy is not sensitive to the extent of contamination encountered. Contingency procedures are provided for the unexpected finds and asbestos (discussed below) which can be managed under the proposed remediation strategy.
Contingency Plans to Respond to site Incidents: Documented in the RAP.	The procedure for handling unexpected finds, which includes stopping work and identification of materials is appropriate and practical and can be implemented within the proposed remediation strategy.
Remediation Schedule and Hours of Operation: Project duration and hours of operation were not discussed.	The remediation work will require a DA and hours of operation and remediation schedule will be controlled through DA conditions.
Licences and Approvals: The remediation is deemed Category 1 remedial works under the State Environmental Planning Policy 55 - Remediation of Land (SEPP55) and requires development consent prior to commencing. Remediation will be undertaken in accordance with the conditions of the DA consent. An Asbestos Contractor will be responsible for undertaking all asbestos works involving any asbestos impacted soils and building materials and will hold a minimum of Class A licence for the removal of asbestos (issued by SafeWork NSW). An occupational hygienist (holding a SafeWork NSW Asbestos Assessor Licence) is required to provide advice on WHS issues related to any asbestos related works. The occupational hygienist will be responsible for preparation of an asbestos management plan (AMP), asbestos air monitoring, asbestos sampling and clearance inspections. Permits for removal of asbestos and Safework NSW notification will be the responsibility of the contractor. All off-site disposal of soils is to be undertaken in accordance with the Protection of the Environment Operations (POEO) Act and the NSW EPA Waste Classification Guidelines, 2014. Transport of asbestos waste / asbestos impacted soil weighing more than 100kg or consisting of more than 10m^2 of asbestos sheeting in one load must be tracked using the NSW EPA tool, WasteLocate. Imported soil must be VENM or compliant with an appropriate Resource Recovery Exemption.	The RAP did not indicate if the remediation is requires a CAA (Controlled Activity Approval under the Water Management Act 2000) for works carried out on water front land (within 40 m of beds/banks of a river/natural channel or natural channel artificially improved, lake or estuary). The Water Management (General) Regulation 2018 exempts public authorities from requiring a CAA. The proposed remediation area extends over crown land but the RAP does not document whether approval from crown land is required. This has been addressed through a condition on the site audit statement. On this basis the approvals and licences outlined within the RAP are acceptable.

Table 12.1: Evaluation of Remediation Action Plan	
RAP Item	Auditor Comment
Contacts/Community Relations: Not discussed.	This will be managed through the DA process.
Staged Progress Reporting: Not discussed	Staged progress reporting is not required.
Long term site management plan: A long term environmental management plan (LTEMP) is to be prepared at the completion of the remediation work. The RAP states that this will provide management measures to ensure the integrity of the capping system over time. Public notification is proposed through the s10.7 planning certificate. Legal enforceability can be implemented through a condition on the development consent.	Acceptable noting that the LTEMP will also need to include restrictions on construction of buildings and sub-surface utilities on the site and groundwater use.

12.1 Auditors Opinion

The NSW EPA site remediation policy (NSW EPA, 2017) states that the selected remediation option must achieve an appropriate balance between the benefits and effects of undertaking the option. In considering the appropriateness of the remediation option selected by DP, the auditor has taken into account the following:

- The site is located within the larger Carss Bush Park area, a large proportion of which has been reclaimed. The environmental benefits of remediation must be considered in the context of the larger reclaimed area.
- The environmental effects of excavation below design levels are significant due to the presence of the shallow groundwater table and ASS. Excavation of the full extent of the fill horizon would require construction of shoring and dewatering, requiring significant disturbance of the foreshore area and management of ASS.
- The fill material represents a large volume of soil with relatively low levels of contamination. The high economic cost of excavation and off-site disposal (due to the shoring, dewatering and high disposal costs involved) on-site would not be balanced by the environmental gain, when viewed in the context of the wider reclamation area.
- Council has identified that the site is affected by future tidal inundation incorporating sea level rise and there is a risk that site may become flood prone or even inundated in the future. The long-term stability of the containment strategy has been maximised by incorporation of erosion protection measures into the design. These have been based on a future predicted sea level rise of 0.4m.

Whilst excavation of the entire impacted fill horizon is technically feasible, the effects (from both an environmental and economic perspective) are not balanced by the environmental benefits, particularly when the site is viewed in the context of the larger reclaimed area.

The selected remediation option of excavation (to design levels) and cap and contain provides the best balance between the benefits and effects of undertaking the remediation. However, there is a risk of future costs associated with implementation of contingencies to manage tidal inundation affects caused by sea level rise.

The NEPM (2013) states that assessment of the social, economic, and environmental sustainability of the preferred remediation option depends on local factors and this "*...is a matter for the responsible participating jurisdiction."*

As the remediation is Category 1 (SEPP 55) requiring a DA consent, the auditor is satisfied that these issues (including risks associated with sea level rise) will be addressed by council during the DA assessment process.

On this basis, implementation of the RAP is feasible subject to the conditions listed in section 14 and would enable use of the site for the proposed public open space.

13 Compliance with Regulatory Guidelines and Directions

The Auditor has used guidelines currently approved by the EPA under section 105 of the NSW Contaminated Land Management Act 1997.

The RAP and DSI was reported in accordance with the NSW EPA (2020) Consultants Reporting on Contaminated Land. The reports generally met the requirements, exceptions and departures have been addressed by the auditor in this SAR.

The licences and approvals to be obtained for the proposed remediation work have been reviewed by the auditor and this has been documented in section 12.

13.1 Duty to Report

There is the potential for off-site migration of dissolved ammonia in groundwater. The auditor has advised the client (council) of the presence of groundwater contamination and Duty to Report provisions of S60 of the CLM Act (1997) (Appendix B).

14 Conclusions

DP concluded that "*…the site can be rendered suitable for the proposed development subject to appropriate remediation, management and site validation in accordance with this RAP.*"

Based on the information presented in the reports reviewed and observations made on site, and following the Decision-Making Process for Assessing Urban Redevelopment Sites in NSW EPA (2017) *Guidelines for the NSW Site Auditor Scheme*, the Auditor concludes that the site can be made suitable for the proposed use if remediated in accordance with the following remedial action plan:

- Remediation Action Plan, Proposed Pool and Park Redevelopment, Kogarah War Memorial Pool, 78 Carwar Avenue, Carss Park. 29 September 2020. Douglas Partners. (Revision 1)

Subject to compliance with the following conditions:

- Preparation of a Site Audit Statement certifying suitability for the proposed use, at the completion of the remediation and validation.
- Prior to commencing remediation council must ensure that any relevant approvals from crown land are obtained.
- The erosion protection elements identified in the Douglas Partners (2020) *Review of Erosion Protection Requirements, Proposed Pool and Park Redevelopment, 78 Carwar Avenue, Carss Park. 13 October 2020* must be incorporated into the cap design as specified in section 7.3 of the RAP. The civil drawings included in Appendix B of the RAP do not reflect the approved cap design specification.
- The RAP requires preparation and implementation of a construction environmental management plan (CEMP). This must include a plan to screen for ASS and a contingency protocol should ASS be encountered during the remediation. The CEMP must be reviewed and approved by the consultant prior to implementation.

Comments:

The site is located within Carss Bush Park and was reclaimed from Kogarah Bay in the 1940's and 1950's using uncontrolled fill from variable sources. The fill is characterised by inclusions of anthropogenic material including bonded asbestos, noted to be widely distributed throughout the fill material. The fill is underlain by natural estuarine sandy clay soils and sandstone bedrock. The contamination identified within the fill material is expected to extend to the wider reclamation area within Carss Bush Park.

The site is affected by hazardous ground gas associated with the reclamation expected to be generated though slow decay of the organic content within the fill and underlying estuarine muds. The proposed development scenario (public open space) does not include receptors that may be impacted and no further action to manage hazardous ground gas within the site is required. Considering the source and expected low gas pressure, off-site migration of bulk ground gases is unlikely, however, hazardous ground gases may be present in the broader Carss Bush Park in areas where land reclamation has occurred. This has been discussed with the EPA.

Groundwater was encountered at shallow depths and is tidally influenced. The groundwater is contaminated with ammonia although the results indicate that the site is not further impacting on the groundwater quality and the identified groundwater contamination is part of a broader scale issue of reclaimed land within the Carss Bush Park. This has been discussed with the EPA and further investigation and management of groundwater contamination will be undertaken in the context of the broader groundwater quality in Carss Bush Park. It is noted that if any future remediation of groundwater is required this could interfere with activities on the site while remediation is carried out. The auditor has advised the client (council) of the presence of groundwater contamination and Duty to Report provisions of S60 of the CLM Act (1997).

Douglas prepared a RAP documenting removal of existing site infrastructure and buildings, cut and fill to achieve park design levels, establishment of a cap across the site (to prevent direct exposure) and implementation of a long term environmental management plan (LTEMP). The selected remediation option of excavation (to design levels) and cap and contain provides the best balance between the benefits and effects of undertaking the remediation. The long-term stability of the containment strategy has been maximised by incorporation of erosion protection measures into the design, including maintenance of the

existing engineered foreshore armoury measures. There is a risk of future costs associated with implementation of contingencies to manage tidal inundation affects caused by sea level rise. As the remediation is Category 1 (SEPP 55) requiring a DA consent, the auditor is satisfied that this will be addressed by council during the DA assessment process.

The LTEMP will need to be implemented at the completion of the remediation and validation. The RAP states that this can be legally enforced through conditions on the DA consent.

15 Other Relevant Information

This Audit was conducted on the behalf of Georges River Council for the purpose of assessing the suitability and appropriateness of a remedial action plan (RAP), i.e. a "Site Audit" as defined in Section 4 (definition of a 'site audit' (b)(v)) of the CLM Act.

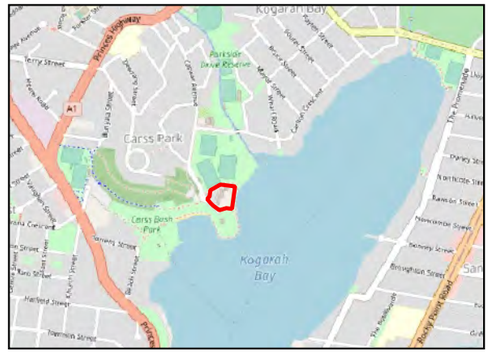
This summary report may not be suitable for other uses. The consultants listed in section 1 included limitations in their reports. The Audit must also be subject to those limitations. The Auditor has prepared this document in good faith but is unable to provide certification outside of areas over which the Auditor had some control or is reasonably able to check.

The Auditor has relied on the documents referenced in Section 1 of the Site Audit Report in preparing the Auditors' opinion. If the Auditor is unable to rely on any of those documents, the conclusions of the audit could change.

It is not possible in a Site Audit Report to present all data which could be of interest to all readers of this report. Readers are referred to the referenced reports for further data. Users of this document should satisfy themselves concerning its application to, and where necessary seek expert advice in respect to, their situation.

APPENDIX A

Attachments



LOCALITY MAP

Notes:
1. Basemap from nearmap.com (dated 01/06/2020)

Legend

Approximate Site Boundary (Remediation Boundary)

0 15 30 45 m

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	SJB Architects		
OFFICE:	Sydney	DRAWN BY:	NW
SCALE:	1:700 @ A3	DATE:	28.09.2020

TITLE: **Site Location (Remediation Area)**
Kogarah War Memorial Pool
Carss Park

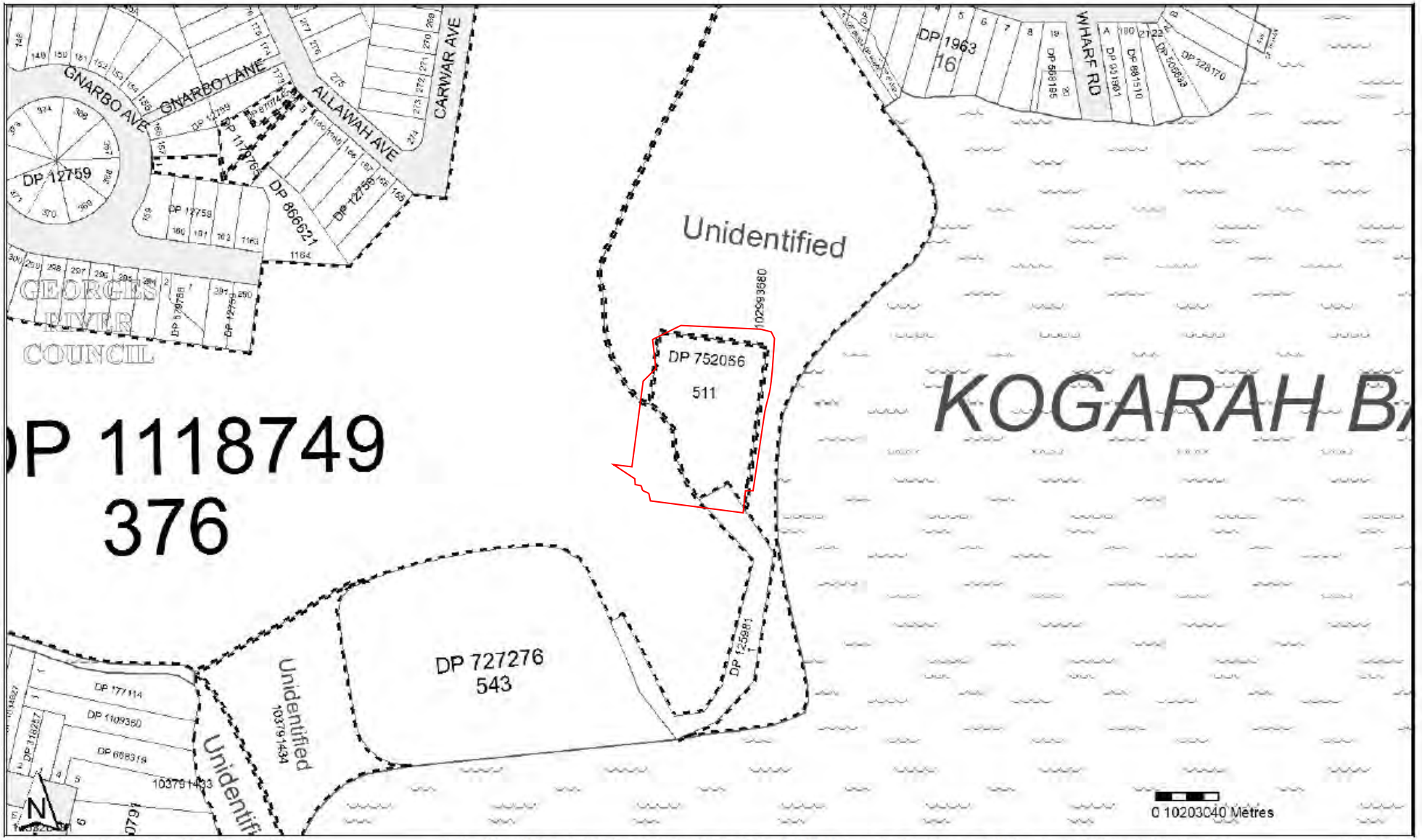
N

PROJECT No:	99751.00
DRAWING No:	R.002 - 1
REVISION:	1

LAND REGISTRY SERVICES

Cadastral Records Enquiry Report : Lot 511 DP 752056

Locality : CARSS PARK
Parish : ST GEORGE
LGA : GEORGES RIVER
County : CUMBERLAND



Notes:
1. Basemap from nearmap.com (dated 01/06/2020)
2. Test locations shown are approximate only

Legend

- Approximate Site Boundary (Remediation Boundary)
- Approximate Location of Previous Shoreline

Previous Test Locations

- CPT Locations (DP, 2018)
- Borehole Locations (DP, 2018)
- Geotechnical Investigation (Construction Sciences, 2019)

Test Locations (DP, 2020)

- Env/ Geo Boreholes
- Test Pits
- Monitoring Wells
- Hand Augers
- CPTs

0 15 30 45 m

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	SJB Architects		
OFFICE:	Sydney	DRAWN BY:	NW
SCALE:	1:700 @ A3	DATE:	28.09.2020

TITLE: **Previous Test Locations**
Kogarah War Memorial Pool
Carss Park

N

PROJECT No:	99751.00
DRAWING No:	R.002 - 2
REVISION:	1

APPENDIX B

Correspondence Relevant to the Audit

jevans@envirocene.com.au

From: Ben Livissianis <Ben.Livissianis@epa.nsw.gov.au>
Sent: Thursday, 8 October 2020 4:26 PM
To: jevans@envirocene.com.au
Cc: EPA HIEH NSW Auditors Mailbox
Subject: FW: War Memorial Pool, 78 Carwar Ave, Kogarah

Hi Julie,

Confirming our brief discussion a moment ago…..

- Thank you for informing us of the contamination outlined below as part of the audit you are undertaking on the site occupied by the former swimming pool.
- We note that Council are seeking advice on whether they have a duty to report under the CLM Act.
- Given that no development is proposed on the land, and it will be open space, we have no issues with you completing your audit.
- We will follow up on the issues you have raised about the groundwater impact and hazardous ground gases being part of the broader reclamation of the Carss Bush Park area with Council, particularly in relation to any potential risks from ground gases to adjoining structures/buildings.

If you have any plans showing the extent of the reclaimed area or the area which you believe may be potentially impacted by ground gases, it would be appreciated if you could send them though.

Please call if you wish to discuss further.

Regards,
Ben

Ben Livissianis
Unit Head Regulatory Operations – Metro South
Regulatory Operations Metropolitan
NSW Environment Protection Authority
D 02 9995 5731

www.epa.nsw.gov.au @NSW_EPA

The EPA acknowledges the traditional custodians of the land and waters where we work. As part of the world's oldest surviving culture, we pay our respect to Aboriginal elders past, present and emerging.

Report pollution and environmental incidents 131 555 or +61 2 9995 5555

From: jevans@envirocene.com.au [mailto:jevans@envirocene.com.au]
Sent: Tuesday, 22 September 2020 11:41 AM
To: EPA HIEH NSW Auditors Mailbox <nswauditors@epa.nsw.gov.au>
Subject: War Memorial Pool, 78 Carwar Ave, Kogarah

Hi,

I am writing with respect to the above site for which I am currently engaged to undertake a non-statutory site audit of a remediation action plan (RAP). The site is a former swimming pool located within the Carss Bush Park, Kogarah (see site plan attached). The swimming pool was built on the 1960's and the condition has deteriorated to the extent that it requires demolition. Council is currently preparing a DA to demolish the existing pool and associated infrastructure and conversion of the area to open space.

Site Description:

Carss Bush Park was reclaimed from Kogarah Bay in the 1940's and 1950's using uncontrolled fill from variable sources and has been used for recreational purposes since circa 1953 until the present. Investigations on the current audit site (see attached plan) encountered fill material (gravelly sand, clayey sand, sandy clay and silty clay with fragments of plastic, rags, glass, metal, concrete, timber and asbestos containing material) extending to depths ranging from 1.6m to 6.0m bgl, underlain by natural estuarine sandy clay soils and sandstone bedrock. Groundwater is located at shallow depths (between 1.5-2.6mbgl) and is tidally influenced. Investigations and a remediation action plan (RAP) have been undertaken by Douglas Partners (DP).

Soil Contamination: Concentrations of metals were generally an order of magnitude below the screening criteria with the exception of some isolated exceedances and minor elevated concentrations of zinc and copper. Some TRH was identified although this was demonstrated to be generally of a non-petroleum source and likely to be associated with high levels of organic carbon within the fill and underlying natural marine sediments. Asbestos was noted to be widely distributed throughout the fill material. No other COPC were identified.

Hazardous Ground Gas: The site is affected by hazardous ground gas (methane concentrations up to 15%) although the flow rate was not able to be measured due to tidal pumping influences within the monitoring wells. A preliminary assessment has identified that although a source of ground gas has been identified, no on-site receptors have been identified and no credible pathway between the source and receptor will be present under the proposed development scenario. However, the larger Carss Bush Park area (off-site) is also likely to be affected by hazardous ground gas and there are buildings present which may be at risk from hazardous ground gas intrusion.

Groundwater Contamination: Ammonia exceeded the screening criteria (GIL of 0.91 mg/L) in all the wells sampled. DP considered this to be more consistent with generation from decay of organic matter in the reclaimed estuarine / mangrove / marine environments rather than from a landfill source. Some very minor exceedances of the screening criteria for anthracene and phenanthrene in BH109 and zinc in BH106, BH107, BH108 & BH110 were detected. Douglas concluded that "… *the groundwater results do not indicate significant impact on groundwater quality from the site with the potential exception of some chloride impacts in the south-eastern corner of the site. Ipso facto, leaching of contaminants from fill above the water table is not considered to be a significant concern. It is therefore considered that results are reflective of broader groundwater quality in the area of the site and not limited to impacts from the site*. *Moreover, notwithstanding the technical and feasibility constraints that the site presents given its location adjacent to Kogarah Bay, shallow groundwater, deep fill and deep rock profile, it is considered groundwater remediation of the site (which forms a subsection of the reclaimed land within Carss Park / Carss Park Flats) would provide minimal to negligible environmental benefit. Any approach to improving groundwater quality at the site and neighbouring areas should therefore be undertaken at a broader level."*

Proposed Remediation: Douglas prepared a RAP documenting removal of existing site infrastructure and buildings, establishment of a cap across the site (to prevent direct exposure to soil and groundwater impacts) and implementation of a long term environmental management plan (LTEMP)..

I agree that groundwater and hazardous ground gas contamination is part of a broader scale issue caused by reclamation of the Carss Bush Park area. With respect to specific requirements of the site auditor guidelines I note that:

- S4.3.4: The groundwater results indicate that leaching from on-site (audit site) fill is not further impacting on the groundwater quality. Elevated concentrations of methane and carbon dioxide have been detected although the site infrastructure is to be demolished and open space reinstated so that no credible pathway between the source and receptor will exist following completion of the remediation.
- S4.4.2 & 4.4.3: The presence of groundwater and hazardous ground gas will not pose an unacceptable risk to users of the site under the current remediation proposal, subject to implementation of a LTEMP to restrict groundwater use and construction of buildings/sub-surface structures at the site.

- S4.2.2: The site is adjacent to Kogarah Bay and groundwater is likely to be discharging to the marine environment. The investigation report does not provide sufficient information to identify if the contamination is posing a risk to the receiving environment (i.e. Kogarah Bay).
- S3.4.6 (d) The off-site migration of groundwater is not proposed to be addressed through the current remediation proposal.
- S3.8.2 & 4.2.8: I have provided written advice to the client (Georges River Council) advising that groundwater contamination (as ammonia) exists and that the site may trigger s60 of the CLM Act (Duty to Report).
- S3.8.3, S4.4.2 & S4.4.3: Assessment of the risks and/or remediation of groundwater and hazardous ground gas at the current audit site area level would provide minimal environmental benefit. I believe that these risks should be addressed within the context of the larger Carss Bush Park area.

For these reasons I find the proposed remediation strategy of physical separation with no groundwater remediation would be feasible providing that a mechanism to assess the risks from groundwater and hazardous ground gas within the wider Carss Bush Park reclamation area is implemented, for instance through issue of a preliminary investigation order.

Please advise if this is acceptable to the NSW EPA and whether there are any issues with me completing my audit on this basis.

I would be happy to discuss this further over the telephone.

Julie Evans BSc (Hons), PhD, CEnvP SCS
NSW EPA Accredited Site Auditor

Envirocene Pty Ltd
Level 1, 29 Kiora Road, Miranda NSW 2228
Phone: 0402142050
jevans@envirocene.com.au
www.envirocene.com.au

jevans@envirocene.com.au

From: Joanna Graham <Joanna.Graham@epa.nsw.gov.au> on behalf of EPA HIEH NSW Auditors Mailbox <nswauditors@epa.nsw.gov.au>
Sent: Tuesday, 22 September 2020 5:14 PM
To: jevans@envirocene.com.au
Cc: EPA HIEH NSW Auditors Mailbox
Subject: RE: Kogarah War Memorial Pool, 78 Carwar Avenue, Carss Park

Dear Julie,

Acknowledging receipt of your advice to your client on the duty to notify under the *Contaminated Land Management Act 1997* – EPA ref no: DOC20/782613.

Kind Regards,
Jo

Jo Graham
Senior Audit Officer – Contaminated Land Advice and Audit
Environmental Solutions, NSW Environment Protection Authority
+61 2 9995 5609
joanna.graham@epa.nsw.gov.au www.epa.nsw.gov.au @EPA_NSW
Report pollution and environmental incidents 131 555 (NSW only) or +61 2 9995 5555

Please note that I work Monday-Thursday

From: jevans@envirocene.com.au [mailto:jevans@envirocene.com.au]
Sent: Monday, 21 September 2020 1:41 PM
To: Tom Heath <tom.heath@georgesriver.nsw.gov.au>
Cc: EPA HIEH NSW Auditors Mailbox <nswauditors@epa.nsw.gov.au>
Subject: Kogarah War Memorial Pool, 78 Carwar Avenue, Carss Park

Dear Tom,
Thankyou for providing the attached letter *Notification of the Site to NSW EPA, Kogarah War Memorial Pool, 78 Carwar Avenue, Carss Park*. With reference to the contents of the attached letter I note that:

- Groundwater at the site (site plan attached) is contaminated with ammonia (above the NEPM (2013) criteria) and is, or will foreseeably continue to remain above the specified concentration. The ammonia is likely to be associated with the reclamation works previously undertaken in the 1940's and 1950's that have occurred across the wider Carss Park and Carss Park Flats areas (i.e. not limited to the site). Some of the recorded concentrations may also be attributable to the underlying natural estuarine sandy clay soils.
- The site is adjacent to Kogarah Bay and ammonia in the groundwater will foreseeably migrate into the marine environment.
- Douglas have concluded that "*Given the ammonia concentrations in the up-gradient wells are higher than those recorded in the down-gradient on-site wells, the ammonia concentrations on-site would be considered to be below the local ambient background concentrations with respect to the above. In this regard, the ambient background concentrations as recorded in the wells are considered to be attributable to the wider Carss Park and Carss Park Flats land reclamation areas rather than specifically to the subject site, hence the source is a diffuse source and not attributable to a specific industrial, commercial or agricultural activity.*"

I acknowledge that groundwater contamination is likely to be part of a broader scale issue associated with reclamation of land within the Carss Bush Park, although I do not think that this would be considered as "*widespread diffuse urban pollution*" and in my opinion the site triggers the duty to report contamination listed in section 2.3 of the NSW EPA *Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997* (2015). On this basis I advise you, as the person who commissioned the site audit on behalf of Georges River Council, to seek legal advice on your duty to report contamination to the NSW EPA under s60 of the CLM Act (1997). In accordance with the requirements of s3.8.2 of Guidelines for the NSW Site Auditor Scheme (NSW EPA 2017) I have also forwarded this Email to the NSW EPA.
Kind Regards,
Julie

Julie Evans BSc (Hons), PhD, CEnvP SCS
NSW EPA Accredited Site Auditor

Envirocene Pty Ltd
Level 1, 29 Kiora Road, Miranda NSW 2228
Phone: 0402142050
jevans@envirocene.com.au
www.envirocene.com.au

From: Tom Heath <Tom.Heath@georgesriver.nsw.gov.au>
Sent: Monday, 21 September 2020 10:31 AM
To: 'jevans@envirocene.com.au' <jevans@envirocene.com.au>
Subject: Commercial in Confidence - Kogarah War Memorial Pool (SJB9008)

Hi Julie,

Hope you had a good weekend. Please find attached the letter from Douglas partners responding to EPA notification requirements. As discussed, happy for you to proceed with whatever option you believe meets your responsibilities as site auditor based on the continuation of the site audit report process for the DA.

Happy to discuss.

Tom

From: Michael Baker [mailto:mbaker@sjb.com.au]
Sent: Monday, 21 September 2020 8:34 AM
To: Tom Heath
Cc: Archive Plan Syd
Subject: Commercial in Confidence - Kogarah War Memorial Pool (SJB9008)

Hi Tom,

Please find attached advice from Douglas Partners regarding notification of the Kogarah War Memorial Pool site to the NSW EPA for your consideration.

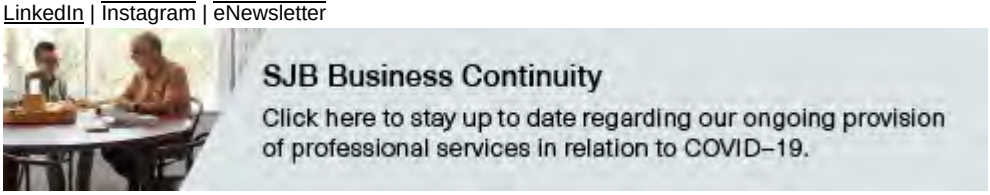
Regards

Michael Baker
Director

SJB Planning

Level 2, 490 Crown Street
Surry Hills NSW 2010
www.sjb.com.au

LinkedIn | Instagram | eNewsletter



GEORGES RIVER COUNCIL

Tom Heath
Coordinator, Environmental and Open Space Projects

Address: Georges River Civic Centre, Corner of MacMahon and Dora Streets Hurstville NSW 2220
Phone: +61293309459
Email: Tom.Heath@georgesriver.nsw.gov.au
www.georgesriver.nsw.gov.au

Georges River Council acknowledges that Biddegal people of the Eora Nation are the original inhabitants and custodians of all land and water in the Georges River region.

APPENDIX C

Site Audit Statement

NSW Site Auditor Scheme

Site Audit Statement

A site audit statement summarises the findings of a site audit. For full details of the site auditor's findings, evaluations and conclusions, refer to the associated site audit report.

This form was approved under the *Contaminated Land Management Act 1997* on 12 October 2017.

For information about completing this form, go to Part IV.

Part I: Site audit identification

Site audit statement no. JE081A

This site audit is a:

☐ ~~statutory audit~~

☑ non-statutory audit

within the meaning of the *Contaminated Land Management Act 1997*.

Site auditor details

(As accredited under the *Contaminated Land Management Act 1997*)

Name: Julie Evans

Company: Envirocene Pty Ltd

Address: Level 1, 29 Kiora Road, Miranda NSW

Postcode: 2228

Phone: 0402 142050

Email: jevans@envirocene.com.au

Site details

Address: 78 Carwar Avenue, Carss Park NSW

Postcode: 2221

Property description

(Attach a separate list if several properties are included in the site audit.)

Lot 511 DP752056, Part Lot 376 DP1118749, Part Lot 1 DP125981, part of the site also extends onto unregistered crown land. (Refer to the plan at the end of Part I of this SAS)

Local government area: Georges River Council

Area of site (include units, e.g. hectares): 7,500m^2

Current zoning: RE1 – Public Recreation

Regulation and notification

To the best of my knowledge:

☐ ~~**the site is** the subject of a declaration, order, agreement, proposal or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985*, as follows: (provide the no. if applicable)~~

- ☐ ~~Declaration no.~~
- ☐ ~~Order no.~~
- ☐ ~~Proposal no.~~
- ☐ ~~Notice no.~~

☑ **the site is not** the subject of a declaration, order, proposal or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985*.

To the best of my knowledge:

☐ ~~the site **has** been notified to the EPA under section 60 of the *Contaminated Land Management Act 1997*~~

☑ the site **has not** been notified to the EPA under section 60 of the *Contaminated Land Management Act 1997*.

Site audit commissioned by

Name: Mr Tom Heath

Company: Georges River Council

Address: PO Box 205, Hurstville NSW

Postcode: 1481

Phone: 02 9330 6400

Email: Tom.Heath@georgesriver.nsw.gov.au

Contact details for contact person (if different from above)

~~Name:~~

~~Phone:~~

~~Email:~~

Nature of statutory requirements (not applicable for non-statutory audits)

☐ ~~Requirements under the *Contaminated Land Management Act* 1997 (e.g. management order; please specify, including date of issue)~~

☐ ~~Requirements imposed by an environmental planning instrument (please specify, including date of issue)~~

☐ ~~Development consent requirements under the *Environmental Planning and Assessment Act 1979* (please specify consent authority and date of issue)~~

☐ ~~Requirements under other legislation (please specify, including date of issue)~~

Purpose of site audit

☐ **A1** To determine land use suitability

Intended uses of the land:

☐ **A2** To determine land use suitability subject to compliance with either an active or passive environmental management plan

Intended uses of the land:

OR

(Tick all that apply)

☑ **B1** To determine the nature and extent of contamination

☑ **B2** To determine the appropriateness of:

☐ an investigation plan

☑ a remediation plan

☐ a management plan

☐ **B3** To determine the appropriateness of a **site testing plan** to determine if groundwater is safe and suitable for its intended use as required by the *Temporary Water Restrictions Order for the Botany Sands Groundwater Resource 2017*

☐ **B4** To determine the compliance with an approved:

☐ **voluntary management proposal** or

☐ **management order** under the *Contaminated Land Management Act 1997*

☑ **B5** To determine if the land can be made suitable for a particular use (or uses) if the site is remediated or managed in accordance with a specified plan.

Intended uses of the land: Passive public open space

Information sources for site audit

Consultancies which conducted the site investigations and/or remediation:

Construction Sciences (CS)

Douglas Partners (DP)

Titles of reports reviewed:

'Summary of Site Contamination, Carss Park Pool, 76 Carwar Avenue, Carss Park, NSW 2221', 15 November 2019. Construction Sciences.

'Report on Detailed Site (Contamination) Investigation, Proposed Pool and Park Redevelopment, Kogarah War Memorial Pool, 78 Carwar Avenue, Carss Park. 14 September 2020. Douglas Partners.

Remediation Action Plan, Proposed Pool and Park Redevelopment, Kogarah War Memorial Pool, 78 Carwar Avenue, Carss Park. 29 September 2020. Douglas Partners.

Notification of the Site to NSW EPA, Kogarah War Memorial Pool, 78 Carwar Avenue, Carss Park. 18 September 2020. Douglas Partners.
Review of Erosion Protection Requirements, Proposed Pool and Park Redevelopment, 78 Carwar Avenue, Carss Park. 13 October 2020. Douglas Partners.

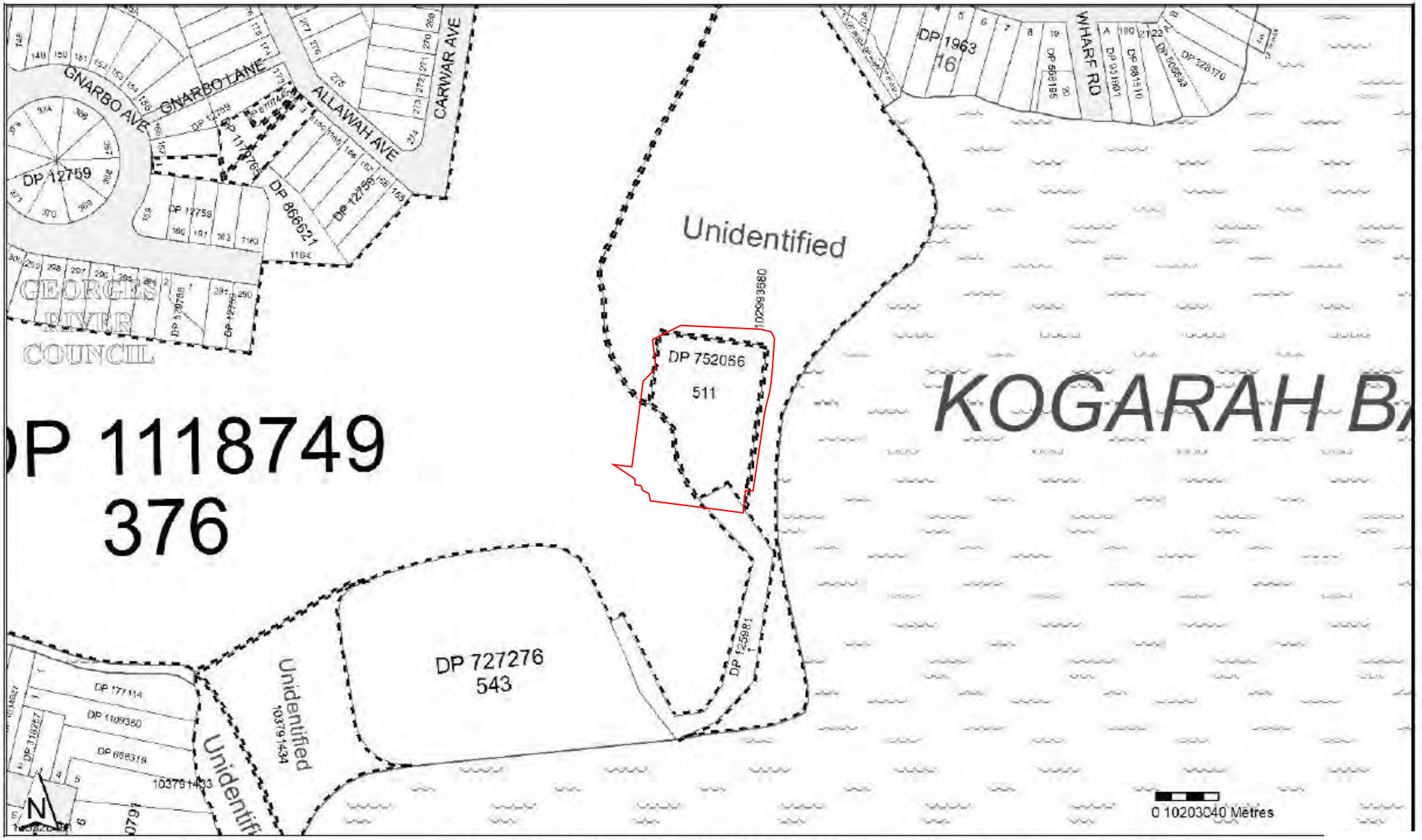
Site audit report details

Title: Site Audit Report, Remediation Action Plan, Kogarah War Memorial Pool, Carss Park NSW	
Report no. E040	Date: 15 October 2020

LAND REGISTRY SERVICES

Cadastral Records Enquiry Report : Lot 511 DP 752056

Locality : CARSS PARK
LGA : GEORGES RIVER
Parish : ST GEORGE
County : CUMBERLAND



Part II: Auditor's findings

Please complete either Section A1, Section A2 or Section B, not more than one section. (Strike out the irrelevant sections.)

- Use **Section A1** where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land uses **without the implementation** of an environmental management plan.
- Use **Section A2** where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land uses **with the implementation** of an active or passive environmental management plan.
- Use **Section B** where the audit is to determine:
  - (B1) the nature and extent of contamination, and/or
  - (B2) the appropriateness of an investigation, remediation or management plan[1], and/or
  - (B3) the appropriateness of a site testing plan in accordance with the *Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2017*, and/or
  - (B4) whether the terms of the approved voluntary management proposal or management order have been complied with, and/or
  - (B5) whether the site can be made suitable for a specified land use (or uses) if the site is remediated or managed in accordance with the implementation of a specified plan.

[1] For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

Section A1

I certify that, in my opinion:

The **site is suitable** for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

☐ Residential, including substantial vegetable garden and poultry

☐ Residential, including substantial vegetable garden, excluding poultry

☐ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry

☐ Day care centre, preschool, primary school

☐ Residential with minimal opportunity for soil access, including units

☐ Secondary school

☐ Park, recreational open space, playing field

☐ Commercial/industrial

☐ Other (please specify):

_____

OR

☐ I certify that, in my opinion, the **site is not suitable** for any use due to the risk of harm from contamination.

Overall comments:

_____

_____

_____

_____

_____

_____

Section A2

I certify that, in my opinion:

Subject to compliance with the **attached** environmental management plan[2] (EMP), the site is suitable for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

☐ Residential, including substantial vegetable garden and poultry

☐ Residential, including substantial vegetable garden, excluding poultry

☐ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry

☐ Day care centre, preschool, primary school

☐ Residential with minimal opportunity for soil access, including units

☐ Secondary school

☐ Park, recreational open space, playing field

☐ Commercial/industrial

☐ Other (please specify):

EMP details

Title:

Author:

Date: No. of pages:

EMP summary

This EMP (attached) is required to be implemented to address residual contamination on the site.

The EMP: (Tick appropriate box and strike out the other option.)

☐ requires operation and/or maintenance of **active** control systems[3]

☐ requires maintenance of **passive** control systems only[3].

[2] Refer to Part IV for an explanation of an environmental management plan.
[3] Refer to Part IV for definitions of active and passive control systems.

~~Purpose of the EMP:~~

~~Description of the nature of the residual contamination:~~

~~Summary of the actions required by the EMP:~~

~~How the EMP can reasonably be made to be legally enforceable:~~

~~How there will be appropriate public notification:~~

~~Overall comments:~~

Section B

Purpose of the plan[4] which is the subject of this audit:

To present a remediation strategy that if implemented would render the site suitable for the proposed passive public open space.

I certify that, in my opinion:

(B1)

☑ The nature and extent of the contamination **has** been appropriately determined

☐ ~~The nature and extent of the contamination **has not** been appropriately determined~~

AND/OR (B2)

☑ The investigation, remediation or management plan **is** appropriate for the purpose stated above

☐ ~~The investigation, remediation or management plan **is not** appropriate for the purpose stated above~~

~~AND/OR (B3)~~

☐ ~~The site testing plan:~~

☐ ~~**is** appropriate to determine~~

☐ ~~**is not** appropriate to determine~~

~~if groundwater is safe and suitable for its intended use as required by the *Temporary Water Restrictions Order for the Botany Sands Groundwater Resource 2017*~~

~~AND/OR (B4)~~

☐ ~~The terms of the approved voluntary management proposal* or management order** (strike out as appropriate):~~

☐ ~~**have** been complied with~~

☐ ~~**have not** been complied with.~~

~~*voluntary management proposal no.~~

~~**management order no.~~

AND/OR (B5)

☑ The site **can be made suitable** for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

☐ ~~Residential, including substantial vegetable garden and poultry~~

☐ ~~Residential, including substantial vegetable garden, excluding poultry~~

☐ ~~Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry~~

[4] For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

☐ ~~Day care centre, preschool, primary school~~

☐ ~~Residential with minimal opportunity for soil access, including units~~

☐ ~~Secondary school~~

☑ Park, recreational open space, playing field

☐ ~~Commercial/industrial~~

☐ ~~Other (please specify):~~

IF the site is remediated/~~managed~~* in accordance with the following plan (**attached**):

*Strike out as appropriate

Plan title: Remediation Action Plan, Proposed Pool and Park Redevelopment, Kogarah War Memorial Pool, 78 Carwar Avenue, Carss Park.

Plan author: Douglas Partners

Plan date: 29 September 2020 No. of pages: 81 (incl appendices)

SUBJECT to compliance with the following condition(s):

1. Preparation of a Site Audit Statement certifying suitability for the proposed use, at the completion of the remediation and validation.
2. Prior to commencing remediation council must ensure that any relevant approvals from crown land are obtained.
3. The erosion protection elements identified in the Douglas Partners (2020) Review of Erosion Protection Requirements, Proposed Pool and Park Redevelopment, 78 Carwar Avenue, Carss Park. 13 October 2020 must be incorporated into the cap design as specified in section 7.3 of the RAP. The civil drawings included in Appendix B of the RAP do not reflect the approved cap design specification.
4. The RAP requires preparation and implementation of a construction environmental management plan (CEMP). This must include a plan to screen for ASS and a contingency protocol should ASS be encountered during the remediation. The CEMP must be reviewed and approved by the consultant prior to implementation.

Overall comments:

The site is located within Carss Bush Park and was reclaimed from Kogarah Bay in the 1940's and 1950's using uncontrolled fill from variable sources. The fill is characterised by inclusions of anthropogenic material including bonded asbestos, noted to be widely distributed throughout the fill material. The fill is underlain by natural estuarine sandy clay soils and sandstone bedrock. The contamination identified within the fill material is expected to extend to the wider reclamation area within Carss Bush Park.

The site is affected by hazardous ground gas associated with the reclamation expected to be generated though slow decay of the organic content within the fill and underlying estuarine muds. The proposed development scenario (public open space) does not include receptors that may be impacted and no further action to manage hazardous ground gas within the site is required. Considering the source and expected low gas pressure, off-site migration of bulk ground gases is unlikely, however, hazardous ground gases may be present in the broader

Carss Bush Park in areas where land reclamation has occurred. This has been discussed with the EPA.

Groundwater was encountered at shallow depths and is tidally influenced. The groundwater is contaminated with ammonia although the results indicate that the site is not further impacting on the groundwater quality and the identified groundwater contamination is part of a broader scale issue of reclaimed land within the Carss Bush Park. This has been discussed with the EPA and further investigation and management of groundwater contamination will be undertaken in the context of the broader groundwater quality in Carss Bush Park. It is noted that if any future remediation of groundwater is required this could interfere with activities on the site while remediation is carried out. The auditor has advised the client (council) of the presence of groundwater contamination and Duty to Report provisions of S60 of the CLM Act (1997).

Douglas prepared a RAP documenting removal of existing site infrastructure and buildings, cut and fill to achieve park design levels, establishment of a cap across the site (to prevent direct exposure) and implementation of a long term environmental management plan (LTEMP). The selected remediation option of excavation (to design levels) and cap and contain provides the best balance between the benefits and effects of undertaking the remediation. The long-term stability of the containment strategy has been maximised by incorporation of erosion protection measures into the design, including maintenance of the existing engineered foreshore armoury measures. There is a risk of future costs associated with implementation of contingencies to manage tidal inundation affects caused by sea level rise. As the remediation is Category 1 (SEPP 55) requiring a DA consent, the auditor is satisfied that this will be addressed by council during the DA assessment process.

The LTEMP will need to be implemented at the completion of the remediation and validation. The RAP states that this can be legally enforced through conditions on the DA consent.

Part III: Auditor's declaration

I am accredited as a site auditor by the NSW Environment Protection Authority (EPA) under the *Contaminated Land Management Act 1997.*

Accreditation no. 1003

I certify that:

- I have completed the site audit free of any conflicts of interest as defined in the *Contaminated Land Management Act 1997,* and
- with due regard to relevant laws and guidelines, I have examined and am familiar with the reports and information referred to in Part I of this site audit, and
- on the basis of inquiries I have made of those individuals immediately responsible for making those reports and obtaining the information referred to in this statement, those reports and that information are, to the best of my knowledge, true, accurate and complete, and
- this statement is, to the best of my knowledge, true, accurate and complete.

I am aware that there are penalties under the *Contaminated Land Management Act 1997* for wilfully making false or misleading statements.

Signed: 

Date: 15 October 2020

Part IV: Explanatory notes

To be complete, a site audit statement form must be issued with all four parts.

How to complete this form

Part I

Part I identifies the auditor, the site, the purpose of the audit and the information used by the auditor in making the site audit findings.

Part II

Part II contains the auditor's opinion of the suitability of the site for specified uses or of the appropriateness of an investigation, or remediation plan or management plan which may enable a particular use. It sets out succinct and definitive information to assist decision-making about the use or uses of the site or a plan or proposal to manage or remediate the site.

The auditor is to complete either Section A1 or Section A2 or Section B of Part II, **not** more than one section.

Section A1

In Section A1 the auditor may conclude that the land is *suitable* for a specified use or uses OR *not suitable* for any beneficial use due to the risk of harm from contamination.

By certifying that the site is *suitable*, an auditor declares that, at the time of completion of the site audit, no further investigation or remediation or management of the site was needed to render the site fit for the specified use(s). **Conditions must not be** imposed on a Section A1 site audit statement. Auditors may include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

Section A2

In Section A2 the auditor may conclude that the land is *suitable* for a specified use(s) subject to a condition for implementation of an environmental management plan (EMP).

Environmental management plan

Within the context of contaminated sites management, an EMP (sometimes also called a 'site management plan') means a plan which addresses the integration of environmental mitigation and monitoring measures for soil, groundwater and/or hazardous ground gases throughout an existing or proposed land use. An EMP succinctly describes the nature and location of contamination remaining on site and states what the objectives of the plan are, how contaminants will be managed, who will be responsible for the plan's implementation and over what time frame actions specified in the plan will take place.

By certifying that the site is suitable subject to implementation of an EMP, an auditor declares that, at the time of completion of the site audit, there was sufficient information satisfying guidelines made or approved under the *Contaminated Land Management Act 1997*

(CLM Act) to determine that implementation of the EMP was feasible and would enable the specified use(s) of the site and no further investigation or remediation of the site was needed to render the site fit for the specified use(s).

Implementation of an EMP is required to ensure the site remains suitable for the specified use(s). The plan should be legally enforceable: for example, a requirement of a notice under the CLM Act or a development consent condition issued by a planning authority. There should also be appropriate public notification of the plan, e.g. on a certificate issued under s.149 of *the Environmental Planning and Assessment Act 1979*.

Active or passive control systems

Auditors must specify whether the EMP requires operation and/or maintenance of active control systems or requires maintenance of passive control systems only. Active management systems usually incorporate mechanical components and/or require monitoring and, because of this, regular maintenance and inspection are necessary. Most active management systems are applied at sites where if the systems are not implemented an unacceptable risk may occur. Passive management systems usually require minimal management and maintenance and do not usually incorporate mechanical components.

Auditor's comments

Auditors may also include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

Section B

In Section B the auditor draws conclusions on the nature and extent of contamination, and/or suitability of plans relating to the investigation, remediation or management of the land, and/or the appropriateness of a site testing plan in accordance with the *Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2017*, and/or whether the terms of an approved voluntary management proposal or management order made under the CLM Act have been complied with, and/or whether the site can be made suitable for a specified land use or uses if the site is remediated or managed in accordance with the implementation of a specified plan.

By certifying that a site *can be made suitable* for a use or uses if remediated or managed in accordance with a specified plan, the auditor declares that, at the time the audit was completed, there was sufficient information satisfying guidelines made or approved under the CLM Act to determine that implementation of the plan was feasible and would enable the specified use(s) of the site in the future.

For a site that *can be made suitable*, any **conditions** specified by the auditor in Section B should be limited to minor modifications or additions to the specified plan. However, if the auditor considers that further audits of the site (e.g. to validate remediation) are required, the auditor must note this as a condition in the site audit statement. The condition must not specify an individual auditor, only that further audits are required.

Auditors may also include **comments** which are observations in light of the audit which provide a more complete understanding of the environmental context to aid decision-making in relation to the site.

Part III

In **Part III** the auditor certifies their standing as an accredited auditor under the CLM Act and makes other relevant declarations.

Where to send completed forms

In addition to furnishing a copy of the audit statement to the person(s) who commissioned the site audit, statutory site audit statements must be sent to

- the **NSW Environment Protection Authority**:
  nswauditors@epa.nsw.gov.au or as specified by the EPA

  AND
- the **local council** for the land which is the subject of the audit.

Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Remediation Action Plan

Proposed Pool and Park Redevelopment
Kogarah War Memorial Pool, 78 Carwar Avenue
Carss Park

Prepared for
SJB Architects c/- SJB Planning

Project 99751.00
September 2020

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	99751.00	Document No.	R.002.Rev1
Document title	Remediation Action Plan Proposed Pool and Park Redevelopment		
Site address	Kogarah War Memorial Pool, Carss Park		
Report prepared for	SJB Architects Pty Ltd		
File name	99751.00.R.002.Rev1		

Document status and review

Status	Prepared by	Reviewed by	Date issued
Draft A	David Holden	J. M. Nash	28 August 2020
Revision 0	David Holden	J. M. Nash	14 September 2020
Revision 1	David Holden	J. M. Nash / Paul Gorman	29 September 2020

Distribution of copies

Status	Electronic	Paper	Issued to
Draft A	1	0	SJB Architects c/- SJB Planning
Revision 0	1	0	SJB Architects c/- SJB Planning
Revision 1	1	0	SJB Architects c/- SJB Planning

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

	Signature	Date
Author		29 September 2020
Reviewer		29 September 2020

bsi. ISO 9001 Quality Management
FS 604853

Douglas Partners Pty Ltd
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West Ryde NSW 2114
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West Ryde NSW 1685
Phone (02) 9809 0666

Executive Summary

This Remediation Action Plan (RAP) describes the work required to remediate the property identified as Kogarah War Memorial Pool, Carss Park ('the site') to render the site suitable for the proposed pool and park redevelopment. The scope of remediation is based on the results of previous contamination investigations and the details of the proposed redevelopment.

The objectives of the RAP are to:

- Establish an appropriate remediation strategy so as to render the site suitable, from a site contamination perspective, for the proposed development;
- Establish the site remediation acceptance criteria to be adopted and the validation requirements to confirm the successful implementation of the remediation strategy;
- Provide information on appropriate environmental safeguards required to complete the remediation works in an environmentally acceptable manner; and
- Provide information on work health and safety procedures required to complete the remediation works in a manner that would mitigate risk to the health of site workers or users.

The deeper fill is to be left *in situ* and managed through a Long Term Environmental Management Plan (LTEMP) and local authority notification. The notification would allow Georges River Council to record this information in its property information system.

The remediation approach for all fill in the upper 2 - 3 m comprises off-site disposal of soils excavated to meet design levels and management of the remaining fill through implementation of a cap and management strategy. The cap will primarily be 0.5 m thick comprising imported fill and topsoil. The cap will be amended for Tree Protection Zones (TPZ) to minimise impacts on the root zones for retained trees. Moreover, for deeper planting areas of new trees the capping thickness will generally be greater than 0.5 m.

This preferred remediation approach has been selected given:

- The non-volatile nature of the contamination that is to be retained below the bulk earthworks level;
- The NSW EPA objective of minimising waste generation (i.e., disposal of soils to landfill);
- The shallow groundwater level at the site which the contaminated fill extends below. In this regard, disturbance and excavation of fill below the water table has the potential to impact on water quality. Moreover, the feasibility of lowering the groundwater table below the fill level without significant works is limited given the site's location adjacent to Kogarah Bay and the estuarine deposits that underlay the fill;
- The presence of ASS and the requirement to minimise potential impacts on the environment from ASS during works. This is achieved though minimising both the disturbance of the ASS and lowering of the groundwater table;
- The need to consider geotechnical requirements for potential reuse of site won soils (e.g., sorting / sieving) and the associated asbestos risks that would need to be managed during works;
- Minimising the disturbance of fill within the TPZ for retained trees; and

- Management of the deeper fill below 3 m depth is proposed, which therefore already requires the implementation of an LTEMP for the site.

The successful completion of the remediation is to be validated and reported as outlined herein and a LTEMP is to be developed for the site.

In summary, it is considered that the site can be rendered suitable for the proposed development subject to appropriate remediation, management and site validation in accordance with this RAP.

Table of Contents

Page

Appendices

Remediation Action Plan
Proposed Pool and Park Redevelopment
Kogarah War Memorial Pool, Carss Park

1. Introduction

1.1 General

This Remediation Action Plan (RAP) describes the work required to remediate the property identified as Kogarah War Memorial Pool, Carss Park ('the site') to render the site suitable for the proposed pool and park redevelopment (refer to Drawing 1, Appendix A). The RAP was commissioned SJB Planning Pty Ltd (SJB) on behalf of SJB Architects Pty Ltd for Georges River Council and was undertaken in general accordance with Douglas Partners Pty Ltd (DP) proposal SYD200681.P.001.Rev0 dated 1 July 2020.

The area of proposed redevelopment and hence subject to remediation is defined by the site boundary as shown in Drawing 1, Appendix A.

The remediation strategy outlined herein comprises a cap and contain approach for the contaminated soils impacted by heavy metals and Asbestos Containing Materials (ACM) in the upper 3 m. The deeper fill is proposed to be left *in situ* and managed through a Long Term Environmental Management Plan (LTEMP) and local authority notification. The notification would allow Georges River Council to record this information in its property information system (refer to Section 4.3.4 of the NSW EPA. *Contaminated Lanbd Management, Guidelines for the NSW Site Auditor Scheme (3rd Edition)*, 2017).

The RAP includes an unexpected finds protocol and contingency measures to manage other issues which may arise during remediation and redevelopment works. The scope of remediation is based on the results of previous contamination investigations (see Section 4) and the details of the proposed redevelopment.

1.2 Site Identification

The approximately square shaped site covers an approximate area of 7,500 m^2. A swimming pool and associated single storey buildings currently occupy the majority of the site with grassed, trees and landscape areas surrounding these areas. The site information is summarised in Table 1 below and Drawing 1 (Appendix A) shows the site boundary and site layout.

Table 1: Site Information

Item	Description
Site Address	78 Carwar Avenue, Carss Park
Legal Description	• Lot 511, Deposited Plan 752056; • Part Lot 1, Deposited Plan 125981; and • Part Lot 376, Deposited Plan 111749.
Approximate Area	7,500 m^2
Zoning	RE1 - Public Recreation
Current Land Use	Recreational
Local Council Area	Georges River Council

1.3 Proposed Development

The proposed development involves the demolition of the existing pool and associated structures and underground infrastructure (e.g., pipes constructed of ACM), and conversion of the area to open space grassed areas forming a connection with the existing park to the north of the site. This may include some planting, pathways and small areas for seating and picnic shelters.

The site will be graded towards the north-east as indicated on the civil drawings provided in Appendix B.

Works also include the replacement of the existing irrigation tanks with a new tank on the southern side of the site. Shallow trenching (0.6 m deep and 1 m wide) will also be undertaken to connect a 110 mm diameter PN10 PE 100 irrigation pipe and a DN40 MD conduit for electrical cabling to the existing tanks to the new tank connection. Joints in the conduits that are below the site surface level will be sealed to mitigate the potential for gas ingress.

It is understood that the existing on-grade car park is to be retained.

2. Objectives and Scope

The objectives of the RAP are to:

- Establish an appropriate remediation strategy so as to render the site suitable, from a site contamination perspective, for the proposed development;
- Establish the site remediation acceptance criteria to be adopted and the validation requirements to confirm the successful implementation of the remediation strategy;
- Provide information on appropriate environmental safeguards required to complete the remediation works in an environmentally acceptable manner; and

- Provide information on Work Health and Safety (WHS) procedures required to complete the remediation works in a manner that would mitigate risk to the health of site workers or users.

3. Site Information

3.1 Site Description

A site walkover was undertaken on 22 July 2020 by an Environmental Scientist from DP as part of the detailed site (contamination) investigation[1]. The following features were observed and noted, with photographs included in Appendix C for reference.

- The site was occupied by a swimming pool with associated single-storey buildings. The swimming pool was observed to have significant cracking in the walls;
- Central and western parts of the site were concrete paved or hardstand and there was some cracking evident;
- The eastern, northern and southern portions of the site were predominantly vegetated;
- No general storage of chemicals on site was observed, however, there was evidence of previous chemical storage associated with the operation of the swimming pool, including chlorine;
- Stormwater pits were visible throughout the site;
- Potential hazardous building materials such as fibre cement sheet and Synthetic Mineral Fibres (SMF) were present (including associated with in-ground pipes); and
- A large berm on the eastern boundary of the site indicated a significant amount of earthworks had occurred on the site.

In addition, to the west of the site was an asphalt car park connecting to Carwar Avenue that was investigated as part of the DP (2020a). This graded from street level down towards the north and the playing fields.

The observed surrounding land-use included the following:

- North: Public parkland and playing fields;
- East: Public walking path and Kogarah Bay;
- South: Public parkland and a small sandstone cottage; and
- West: Public asphalt car park, parkland and community buildings.

[1] DP, *'Report on Detailed Site (Contamination) Investigation, Proposed Pool and Park Redevelopment, Kogarah War Memorial Pool, Carss Park'*, DP ref: 99751.00.R.001.Rev0, dated 14 September 2020 (DP, 2020a).

3.2 Regional Topography, Geology and Hydrogeology

The *Sydney 1:100 000 Geological Series Sheet* indicates that the site is underlain by man-made fill used to raise the natural surface elevation over former estuarine swamps and subaqueous estuarine margins. The estuarine deposits below the man-made fill typically comprise silty to peaty quartz sand, silt and clay.

The regional mapping also indicates that the headland to the south and west of the site is underlain by Hawkesbury Sandstone, which comprises medium to coarse-grained quartz sandstone with minor shale and laminite lenses. It is expected that the estuarine deposits within the site are underlain by Hawkesbury Sandstone at depth.

Further reference to the Sydney 1:100 000 Soils Landscape Series Sheet, prepared by the former NSW Department of Land and Water Conservation, indicated that the site lies within an area of disturbed terrain. Disturbed terrain comprises landscape that has been extensively disturbed by human activity, which has extensively modified the features of the original landscape.

The topographic contours for the site indicate the area is relatively flat, around RL 3 m AHD with regional topography sloping from west to east towards Kogarah Bay (LI&R Report page 6, Appendix D).

Given the site's location adjacent to Kogarah Bay, groundwater has been observed at relatively shallow depths in the installed groundwater wells (i.e., 1.5 m to 2.6 m bgl, refer to DP (2020a)) with some saline characteristics. Water levels may also be impacted by tidal influences.

3.3 Acid Sulfate Soils

Reference to the 1:25,000 NSW Acid Sulfate Soil Risk map for Kogarah indicates that the site lies within an area of disturbed terrain which poses an environmental risk, which requires soil investigations in the area for Acid Sulfate Soil (ASS). Previous investigations have indicated the presence of ASS within the natural soils and fill. The closest to surface being at approximately 2.4 m AHD (1.2 m bgl) in the north-western area of the site (TP121, refer to Drawing 2, Appendix A).

In this regard, whilst ASS are not typically associated with fill, DP has previously encountered this scenario in reclaimed areas where ASS has been recorded in the fill, possibly due to use of dredged or excavated sediments used in the fill or a mixing occurring with the bay sediment during fill placement / reclamation.

Based on the previous ASS results and proposed works, it is not expected that ASS would be encountered during works. Should any materials that are suspected of being potential ASS be excavated during remedial works, these would need to be subject to further ASS testing and possibly (lime) treatment. An ASS management plan would also need to be implemented in this scenario.

4. Previous Reports

The following reports were reviewed for preparation of this RAP:

- Construction Sciences Pty Ltd (CS), *'Geotechnical Investigation, Carss Park Swimming Pool, Carss Park'*, CS ref: 501790024, dated 12 November 2019 (CS, 2019a);
- CS *'Summary of Site Contamination, Carss Park Swimming Pool, 76 Carwar Avenue, Carss Park, NSW 2221'*, CS ref: 50462000024, dated 15 November 2019 (CS, 2019b);
- DP, *'Hazardous Building Materials (HBM) Survey, Kogarah War Memorial Pool, 78 Carwar Avenue, Carss Park NSW',* DP ref: 99751.02.R.001.Rev0, dated 10 August 2020 (DP, 2020b);
- DP, *'Report on Additional Geotechnical Investigation, Proposed Pool and Park Redevelopment, Kogarah War Memorial Pool, Carss Park',* DP ref: 99751.01.R.001.Rev1, dated 14 September 2020 (DP, 2020c);
- DP, *'Report on Detailed Site (Contamination) Investigation, Proposed Pool and Park Redevelopment, Kogarah War Memorial Pool, Carss Park'*, DP ref: 99751.00.R.001.Rev0, dated 14 September 2020 (DP, 2020a); and
- Moore Trees Arboriculture Services Pty Ltd (MT), (draft) *'Arboriculture Development Assessment Report, Kogarah War Memorial Pool, Carss Park, NSW, 2221'*, dated 19 August 2020 (MT, 2020).

Reference should be made to the relevant report for further information. The below is provide for summary information only.

4.1 CS (2019a)- Geotechnical Investigation and CS (2019b)- Contamination Summary

CS undertook a geotechnical investigation which incorporated contamination sampling and testing. It is noted that the contamination summary (CS, 2019b) is based on information from the geotechnical investigation and hence have been summarised together.

CS (2019a) included the drilling of six boreholes (BH01 to BH06) to depths of between 3.0 m and 13.5 m bgl using solid flight augers with standard penetration tests undertaken at 1.5 m depth intervals. The boreholes indicated that the site is underlain by 2.5 m to 4.5 m of fill (sand and clay), over the natural estuarine soil profile. The natural soils were mostly described as interbedded medium dense or denser sands and stiff to hard clays. In the boreholes to the north east of the site (BH02 to BH05) a layer of very loose to loose sand and / or soft to firm clay was encountered directly beneath the fill to a depth of between 5.2 m and 6.0 m bgl. Sandstone bedrock was encountered at depths ranging between 2.5 m and 13 m bgl in four boreholes.

CS test locations are shown on Drawing 2, Appendix A.

The contamination testing was undertaken as part of the site work to inform a waste classification assessment. It also compared the results to a residential land use (health investigation level (HIL) A) scenario to inform suitability of the site based on the results from the limited boreholes. It is unclear why a residential land use scenario was adopted given DP understands residential development has not previously (or is currently) proposed for the site. It may be that the screening criteria for this scenario was selected given they are the most conservative.

In summary, CS reported the following exceedances of the adopted HIL A and Ecological Investigation Level (EIL):

- BH1 (1.5-1.9): lead (1,270 mg/kg) exceeding the HIL (300 mg/kg) and zinc (2,250 mg/kg) exceeding the EIL (400 mg/kg);
- BH3 (0.8-0.95): B(a)P TEQ (3.3 mg/kg) exceeding the HIL (3 mg/kg) and B(a)P (2.4 mg/kg) exceeding the EIL (0.7 mg/kg);
- BH4 (3.8-3.95): zinc (590 mg/kg) exceeding the EIL (400 mg/kg);
- BH4 (2.9-3.0): detection of asbestos;
- BH5 (0.4-0.5): mercury (40 mg/kg) exceeding the HIL (40 mg/kg);
- BH5 (1.9-2.0): detection of asbestos and total coliform (23,000 org/s) exceeding the investigation criteria (1,000 org/s); and
- BH5 (2.8-2.95): total coliform (30,000 org/s org/s) exceeding the investigation criteria (1,000 org/s).

CS (2019b) indicated that the contamination status at the site, or whether it presents risks to human health or the environment, could not be ascertained based on the data available. It recommended that that a Stage 1 and Stage 2 site investigation and delineation/remediation investigations should be conducted to confirm if remediation is required and the nature and extent of remediation that is required.

Furthermore, CS (2019a) (page 6) concluded: *….'fill materials would be classified, as a minimum, General Solid Waste (Non-putrescible (GSW_NP)), however, the presence of asbestos in BH04 and BH05 indicates some areas of fill (to be delineated) would be classified as Special Waste (asbestos) subject to further leachability tests'. Soils from BH01 and BH05 may require additional treatment due the presence of pathogens…'*

It was noted that the natural soils below the fill did not record contamination, however, these samples recorded the presence of ASS. Moreover, all alluvial soils were assessed to be potential ASS and it was noted that depending on the quantity of the soils excavated an ASS management plan may be required.

4.2 DP (2020a)- Detailed Site (Contamination) Investigation

DP (2020a) was a detailed site contamination assessment comprising a review of previous reports (as also outlined herein) and an intrusive investigation involving sampling of soil and material from 19 boreholes and 11 test pits (see Drawing 2, Appendix A). Selected soil samples and five groundwater samples and five material samples were analysed for a combination of the following contaminants of concern and parameters: metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn); total recoverable and petroleum hydrocarbons (TRH/TPH); monocyclic aromatic hydrocarbons (benzene, toluene, ethylbenzene and xylene - BTEX); polycyclic aromatic hydrocarbons (PAH); organochlorine pesticides (OCP); organophosphate pesticides (OPP); PCB; phenols; asbestos; toxicity characteristic leaching procedure (TCLP); per- and poly-fluoroalkyl substances (PFAS); nitrogen (ammonia, nitrate, nitrite); pH; cation exchange capacity (CEC), anions (chloride, sulphate, alkalinity); cations (calcium, potassium, magnesium, sodium); biological oxygen demand (BOD); chemical oxygen demand (COD); and microbiological (total coliform, faecal coliform and hydrocarbon utilising bacteria).

The investigation also included the existing car park to the west of the site/remediation area.

In summary, DP (2020a) identified that with respect to soil chemical contamination the following exceedances are to be remediated and / or further investigated (including delineation) for any development works in the relevant area.

- Chromium in samples BH102/2.5-3.0 and TP130/2.7-2.8 due to HIL exceedances;
- Lead in sample BH1/1.5-1.9 (from CS (2019a)) due to HIL exceedance;
- Zinc in sample BH1/1.5-1.9 (from CS (2019a)) due to EIL exceedance;
- B(a)P TEQ in samples BH106/0.8-1.0 and TP124/0.8-0.9 due to HIL exceedances;
- TRH fraction F2 in sample BH111/1.7-1.8 due to ESL exceedance; and
- TRH fraction F3 in samples BH106/0.8-1.0, BH111/1.7-1.8, BH111/2.4-2.8 and TP124/0.8-0.9 due to ESL exceedances.

It was noted that sample TP124/0.8-0.9 is located in the eastern berm at around 4 m AHD, and hence would be excavated as part of the works to reach a final surface level of around 3 m AHD. This would therefore address the HIL and ESL exceedances noted at TP124 provided the excavated soils are not relocated within the site at a shallower depth.

Regarding the lead and zinc exceedance recorded in CS (2019a), these were identified to be within the tree protection zone (TPZ) and at depth. Given the results in the adjacent test pit (TP130) recorded significantly lower metal concentrations in samples TP130/0-0.1 and TP130/1-1.2 and the potential damage and limitations due to excavating within the TPZ (i.e., limited to 0.1 m to 0.15 m depth), removal of this contamination was considered to provide an overall negative outcome for the project and hence, it was recommended that this contamination be left in place and managed.

With respect to the chromium exceedance in sample TP130/2.7-2.8, given the depth at which the sample was taken, the non-volatile nature of the metal contamination and the shallow nature of groundwater at the site, it was considered that this could be addressed through generation of a barrier between the contamination and site users and managed under a LTEMP.

Moreover, sample locations BH102, BH106 and BH111 would not require remediation for the project given they are located outside the project area subject to the development application (i.e., located in the existing car park).

Apropos the asbestos contamination, given the detection of asbestos (at varying concentrations) in the vast majority of test pits, it was concluded that asbestos impacts are likely to be widespread at the site. It was noted that whilst a process of trying to remediate areas impacted with asbestos above the Site Assessment Criteria (SAC) could be considered, given the sporadic nature of asbestos contamination, there was considered a high risk that any such approach would result in greater areas requiring excavation than may be assumed based on the current data set. In addition, it was noted that the soils in the final landform would likely be impacted by asbestos, albeit at low concentrations within the SAC. Given this, the presence of ASS and the protection of tree root zones for those trees proposed to be retained, DP recommended a cap and contain remedial approach, thereby forming a physical barrier between the asbestos impacted soils and site users with the contamination managed under a LTEMP.

The fill in the upper 1.2 m was preliminarily classified as General Solid Waste (non-putrescible) Special Waste (asbestos) for the purpose of off-site disposal. Soil from below 1.2 m would hold the same waste classification if confirmed not to contain ASS, otherwise it would be classified as General Solid Waste (non-putrescible) Special Waste (asbestos), Acid Sulphate Soils. It was further noted that a final waste classification of soils prior to off-site disposal is required.

DP (2020a) found that the elevated concentrations of total and faecal coliform recorded in some of the soil results from adjacent to the buildings and small pool had not been replicated in the groundwater results. This suggested these impacts are relatively immobile and are most likely associated with leakage of underground services associated the site's bathrooms and possibly the use of the small pool by children. It was concluded that removal of the existing structures and sub-surface infrastructure (e.g., pipes) along with the placement of a barrier over these impacted soils (as recommended to address asbestos impacts) would address any potential risk to future site user.

The groundwater results did not indicate significant impact on groundwater quality from the site. Potential chloride impacts in the south-eastern corner of the site are expected to reduce over time following the removal of existing structures and sub-surface infrastructure (e.g., pipes) as part of the works and when the site no longer being used as pool. It was therefore considered that the recorded levels of groundwater contamination are reflective of broader groundwater quality in the area of the site and not limited to impacts from the site. Moreover, notwithstanding, the technical and feasibility constraints that the site presents given its location adjacent to Kogarah Bay, shallow groundwater, deep fill and deep rock profile (more than 32 m bgl in the north-eastern area of the site), it was considered groundwater remediation of the site (which forms a subsection of the reclaimed land within Carss Park / Carss Park Flats) would provide minimal to negligible environmental benefit. Any approach to improving groundwater quality at the site and neighbouring areas should therefore be undertaken at a broader level.

Given the depth that ASS has been encountered, even within the fill (i.e., 1.2 m bgl, ~2.4 m AHD), the disturbance of ASS was not expected to occur during works. It noted that should any materials that are suspected of being potential ASS be disturbed during remedial works these would need to be subject to further ASS testing and possibly (lime) treatment. An ASS management plan would also need to be implemented in this scenario.

Given the proposed open space use of the site, the risk to site users from LFG is not considered to be of significant concern. Further consideration is required to be given to LFG risk should enclosed spaces or services be built / installed. In addition, sub-surface penetration and excavation works should also take into consideration the presence of LFG when undertaking works.

DP (2020a) therefore recommended that:

- A RAP (this report) be developed which details the remedial works required to render the site suitable for the proposed development. The RAP is to include, *inter alia*, an Unexpected Finds Protocol procedure outlining the procedures that would be undertaken in the event that additional unexpected contamination is encountered;
- An asbestos management plan (AMP) is developed prior to commencing works;
- Management of potential exposure to LFG and microbiological (faecal and total coliform) contamination during excavation works is addressed in the site's construction environmental management plan prior to commencing works; and

- A LTEMP is developed on completion of the remedial works for long term management of the site and the LTEMP subject to a notification mechanism (such as on Council's Section 10.7 Planning Certificate).

In summary, DP (2020a) concluded that the site can be rendered suitable for the proposed open space land use subject to development of a suitable RAP (this report), undertaking the remediation works, subsequent validation of these works and the development and implementation of an LTEMP once remediation has been completed.

4.3 DP (2020b)- Hazardous Building Materials Survey

DP (2020b) comprised a hazardous building materials survey of the main building, pump house and general grounds (pools, awnings, irrigation tanks and car park). The report identified the presence of hazardous materials on all properties within the site. These included: asbestos, lead dust; lead paint; PCB; and SMF.

Appropriate management and removal of these hazardous building materials was deemed required during the demolition process for site structures.

4.4 DP (2020c)- Additional Geotechnical Investigation

The additional geotechnical investigation comprised:

- Eight piezocone penetration tests (CPT201 to CPT206) taken to depths ranging from 3.4 m to 32.5 m bgl;
- Six large diameter boreholes (BH101 (G) to BH106 (G)) drilled to depths of between 0.7 m and 1.7 m bgl in the area of the originally proposed car park to investigate the pavement subgrade. Note: these were drilled within 1 m of the contamination boreholes drilled for this DSI (BH101 (E) to BH106 (E)); and
- Six Dynamic Cone Penetrometer Tests (DCPs) taken to depths of up to 3.6 m bgl or prior refusal at test locations BH103 to BH105 in the area of the proposed car park and three extending below the base of the existing pool at BH117 to BH119.

In summary, DP (2020b) encountered the following sub-surface conditions across the site comprising:

- PAVEMENT - In the car park areas only - asphaltic concrete 20-60 mm thick over 0.3 m to 0.6 m of apparently well compacted gravelly sand;
- FILL - Mostly gravelly sand, clayey sand, sandy clay and silty clay, generally loose to medium dense or stiff to very stiff with occasional bands of very loose sand or soft to firm clay. The filling also included plastic, rags, glass, metal, concrete and timber fragments. The filling extended to depths ranging from 1.6 m to 6.0 m bgl;
- SAND - Very loose to loose sand, to depths of about 4.0 m to 6.7 m bgl, encountered only in CPT201, CPT202 and CPT206 to CPT208;
- CLAY - Soft to firm clays, to depths of about 5 m to 6.5 m bgl, encountered only in CPT201 and CPT205 to CPT208;

- CLAY - Stiff to hard clays and silty clays with medium dense and dense sand bands down to the termination depths of all CPTs (5.2 m to 32.5 m bgl) - with the exception of CPT202, CPT203 and CPT204 which terminated within the filling; and
- SANDSTONE BEDROCK - Encountered within three of the previous boreholes (BH01, BH02 and BH06), and inferred to be the cause of refusal of BH105 and some of the CPTU - depths to sandstone bedrock range from 1.6 m to more than 32.5 m bgl.

Test locations are shown on Drawing 2, Appendix A.

Taking into consideration the proposed remediation capping approach and DP's estimates of settlement, DP indicated that a lower level of ground treatment is possible to reduce the settlement by compacting the near surface layers above the water table. Given this DP (2020c) suggested the following site preparation be considered:

- Excavate the existing fill over the whole site to 0.5 m below the proposed finished levels as required for placement of the new fill in accordance with the site remediation strategy (as outlined herein);
- During demolition of the existing pool shell, excavate the sides of the existing pool to form sloping batters with overall slopes not steeper than 1:1.5 Vertical to Horizontal and preferably stepped to allow for compaction of new filling in horizontal layers;
- Compact the exposed subgrade as much as possible using either standard heavy rollers or an impact roller. If the soft clay fill is exposed in any area, then a suggested procedure would be to place a layer of geofabric across the exposed clay and then place and compact the first layer of new fill above the geofabric;
- Preference for imported fill should be given to a well graded granular material such as a ripped sandstone with a maximum particle size of 150 mm;
- Place the new fill in maximum 250 mm thick loose layers and compact to achieve a dry density ratio of between 98% and 102% relative to Standard compaction, with moisture contents maintained within 2% of Standard optimum moisture content; and
- Undertake density testing of the fill as it is compacted in accordance with the requirements of AS 3798:2007.

In addition, with respect to reuse of excavated spoil, it is noted from a geotechnical perspective site won material can be used to backfill the pool provided that:

- It contains less than 5% organic matter or foreign materials including wood, plastic or steel;
- Has a maximum particle size of 150 mm; and
- Is compacted to the specifications outlined in DP (2020c).

Reference is to be made to DP (2020b) for further geotechnical information on settlement and site preparation works.

4.5 MT (2020)- Arboriculture Report

Whilst the arboriculture report addressed various issues, most pertinent to this RAP were:

- Retention of Trees 23, 24, 27 and 32 (tree locations are indicated on the civil drawings in Appendix B);
- TPZ for the trees to be retained were between 9.6 m and 13.2 m;
- Any excavation of existing soils within the TPZ is to be to maximum 0.1 m to 0.15 m depth, no closer than 1 m to the trunk and only undertaken with hand tools; and
- Any placed fill within the TPZ is to be free draining, sand based and not high in organic matter.

It is noted that the above requirements have been considered when developing the remediation approach for the site and have generally taken precedence in the final remediation approach to allow tree health to be maintained, whilst not undermining the integrity of the remediation approach (i.e., preventing a complete source - pathway - receptor linkages).

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, *viz.* it enables an assessment of the potential source - pathway - receptor linkages (complete pathways).

The CSM presented below is an updated version of the CSM presented in DP (2020a) and is based on the previous assessments as detailed in Section 4. The CSM has been used in determining an appropriate remediation strategy for the site.

5.1 Potential Sources

Based on the current investigation, the following potential sources of contamination and associated contaminants of potential concern (COPC) have been identified.

S1 - Large scale filling of site - Associated with land reclamation and potential uncontrolled waste fill and levelling including imported contaminated fill or residual demolition waste.

COPC include asbestos, chromium, copper, lead, zinc, PAH, TRH and LFG (including methane, carbon dioxide, hydrogen sulphide and carbon monoxide).

S2 - Large scale filling of adjacent (off-site) areas - Associated with land reclamation and potential uncontrolled waste fill and levelling including imported contaminated fill or residual demolition waste.

Copper, zinc, ammonia, LFG (including methane, carbon dioxide, hydrogen sulphide and carbon monoxide).

S3 - Past and current site activities - A potential source of contamination is the use of the site as a swimming pool and uncontrolled release of pool water into the environment and related storage of chemicals.

COPC include heavy metals, chlorine, microbial activity.

S4 - Deterioration of existing buildings.

COPC include asbestos, SMF, lead (in paint and dust) and PCB.

5.2 Potential Receptors

Human Health Receptors:

R1 - Construction and maintenance workers;

R2 - End users (members of the public); and

R3 - Adjacent site users.

Note: Given the site is no longer operational and closed to public access, current site users (other than maintenance workers) are not considered receptors.

Environmental Receptors:

R4 - Terrestrial ecology (upper 2.0 m of the proposed final landform);

R5 - Groundwater; and

R6 - Surface water (Kogarah Bay).

5.3 Potential Pathways

P1 - Ingestion and dermal contact;

P2 - Inhalation of dust, vapours and/or LFG;

P3 - Direct contact with local ecology (upper 2.0 m of the proposed final landform);

P4 - Leaching of contaminants and vertical migration into groundwater; and

P5 - Lateral migration of groundwater providing base flow to water bodies.

Based on the results of DP (2020a) and the generally low chemical contaminant concentrations in the near surface soils, surface water run-off to a receiving water body from the site was not considered to be of concern.

5.4 Summary of CSM

A 'source - pathway - receptor' approach has been used to assess the potential risks of harm being caused to the identified receptors from contamination sources on or in the vicinity of the site, via exposure pathways (complete pathways). The CSM for the site is shown in Table 2 below.

Table 2: Summary of Potential Complete Pathways

Source and COPC	Transport Pathway	Receptor	Risk Management Action Recommended
S1 - Large scale filling of site COPC: asbestos, chromium, copper, lead, zinc, PAH, TRH, ammonia and LFG S3 - Past and current site activities COPC: asbestos, chlorine and microbial activity	P1 - Ingestion and dermal contact P2 - Inhalation of dust, vapours and/or LFG P3 - Direct contact with local ecology (upper 2.0 m of the proposed final landform) P4 - Leaching of contaminants and vertical migration into groundwater P5 - Lateral migration of groundwater providing base flow to water bodies	R1 - Construction and maintenance workers R2 - End users (members of the public) R3 - Adjacent site users R4 - Terrestrial Ecology (upper 2.0 m of the proposed final landform) R5 - Groundwater	Excavation of the eastern bund to remove TRH, B(a)P TEQ and asbestos contamination identified in TP124. Capping of the site to address direct exposure to asbestos, lead, chromium and microbial. Removal of site infrastructure, including sub-surface infrastructure (e.g., pipes) to reduce potential future microbial and chloride impacts. Implementation of LTEMP to manage the site in the long term. Implementation of suitable construction management procedures during works.
S2 - Large scale filling of adjacent (off-site) areas COPC: Copper, zinc, ammonia and LFG	P2 - Inhalation of dust, vapours and/or LFG. P5 - Lateral migration of groundwater providing base flow to water bodies	R1 - Construction and maintenance workers R2 - End users (members of the public) R5 - Groundwater	
S4 - Deterioration of existing buildings COPC: asbestos, SMF, lead (in paint and dust) and PCB	P1 - Ingestion and dermal contact P2 - Inhalation of dust	R1 - Current users (members of the public) R2 - Construction and maintenance workers R3 - End users (members of the public) R4 - Adjacent site users	Hazardous materials to be removed in accordance with relevant legislation and guidelines prior to demolition, with the footprints of the buildings validated upon completion of demolition.

6. Remediation Extent and Options

6.1 Area of Environmental Concern

DP (2020a) identified bonded asbestos as being the primary contaminant of concern. It was identified to be present at the majority of the site's sampling locations and at varying concentrations and depths through the fill profile. Moreover, it is noted that FA/AF analysis recorded only minor detections in samples TP120/2.0-2.1 (0.0001 g/ <0.001% w/w) and TP124/4.5-4.6 (0.0021 g/ <0.001% w/w).

With respect to soil chemical contamination the following exceedances are to be remediated and / or further investigated (including delineation) for any development works in the relevant area:

- Chromium in sample TP130/2.7-2.8 due to HIL exceedances;
- Lead in sample BH1/1.5-1.9 (from CS (2019a)) due to HIL exceedance;
- Zinc in sample BH1/1.5-1.9 (from CS (2019a)) due to EIL exceedance;
- B(a)P TEQ in sample TP124/0.8-0.9 due to HIL exceedances; and
- TRH fraction F3 in sample TP124/0.8-0.9 due to ESL exceedances.

It is noted that sample TP124/0.8-0.9 is located in the eastern berm at around 4 m AHD, and hence, would be excavated to reach the proposed bulk earthworks levels.

Regarding the lead and zinc exceedance recorded in CS (2019a), these are located within the TPZ and are at depth. As noted in DP (2020a), given the results in the adjacent (DP, 2020a) test pit (TP130) recorded significantly lower metal concentrations in samples TP130/0-0.1 and TP130/1-1.2 and the potential damage and limitations associated with excavating within the TPZ (i.e., limited to 0.1 m to 0.15 m depth, no closer than 1 m to the trunk and only undertaken with hand tools, refer to MT (2020)), removal of this contamination would be considered to provide an overall negative outcome for the project and hence, it is recommended that this contamination is left in place and managed through capping and a LTEMP.

6.2 Remediation Options

With reference to NEPC 2013, and in consideration of the potential exposure pathways, it is considered that the site can be rendered suitable with respect to the B(a)P, TRH, asbestos, lead, chromium and microbial contamination by either:

A. Excavating all fill from the site in the upper 2 - 3 m that exceeds the SAC as outlined in DP (2020a). Excavated fill to be disposed to landfill;

B. Management of fill at depth through cap and containment so as to minimise future disturbance and exposure. This management strategy would comprise placing the fill (that doesn't exceed the SAC for chemical contaminants) in areas that need to be filled (e.g., footprint of the existing pool) and construction of a capping layer over the impacted soils and preparation of a LTEMP to prevent future inadvertent exposure of the of contamination to site users. Soils that exceed the SAC for chemical contaminants would be disposed to landfill; and

C. Combination of Options A and B, where Option A is adopted for fill requiring excavation to reach design levels and Option B is adopted for fill that remains at and below bulk excavation levels.

In addition, the deeper fill is proposed to be left *in situ* and managed through a LTEMP and local authority notification. The notification would allow the local government authority to record this information in its property system information.

Option C has been selected as the preferred remediation option given:

- The non-volatile nature of the contamination that is to be retained below the bulk earthworks level;
- The NSW EPA objective of minimising waste generation (i.e., disposal of soils to landfill);
- The shallow groundwater level at the site which the contaminated fill extends below. In this regard, disturbance and excavation of fill below the water table has the potential to impact on water quality. Moreover, the feasibility of lowering the groundwater table below the fill level without significant works is limited given the site's location adjacent to Kogarah Bay and the estuarine deposits that underlay the fill;
- The presence of ASS and the requirement to minimise potential impacts on the environment from ASS during works. This is achieved though minimising both the disturbance of the ASS and lowering of the groundwater table;
- The need to consider geotechnical requirements for potential reuse of site won soils (e.g., sorting / sieving) and the associated asbestos risks that would need to be managed during works;
- Minimising the disturbance of fill within the TPZ for retained trees; and
- Management of the deeper fill below 3 m depth is proposed, which therefore already requires the implementation of an LTEMP for the site.

7. Adopted Remediation Strategy and Assessment

The remediation works must be conducted by experienced and appropriately licensed contractors. An experienced environmental consultant is to be engaged to inspect the progress of the works and to provide ongoing advice and recommendations as required. The success of the remediation works will be validated by the Environmental Consultant in consultation with other consultants (e.g., Occupational Hygienist, Asbestos Contractor).

The remediation strategy has not allowed for the construction of sub-surface confined spaces, such as enclosed utility and inspection pits and hence these structures are currently prohibited under the adopted remediation strategy. Further investigation and/or mitigation in design would be required and approval provided by the Environmental Consultant and the Site Auditor prior to any such features being constructed.

7.1 Demolition of Existing Structures (including inground infrastructure)

Initially, appropriate removal and disposal off-site of the hazardous building materials within the existing structures and accessible sub-surface infrastructure is to be undertaken. This will be followed by demolition and removal off-site of the site's structures and sub-surface infrastructure (including ACM pipes).

Following demolition works the footprints of the building are to be inspected by the Environmental Consultant to confirm findings of DP (2020a) and to check for any areas of concern (if present).

Reference is also to be made to the project's demolition and waste management plan (undertaken prior to commencing works) for further information on the demolition works.

Removal of existing structures and sub-surface infrastructure is required to address the potential for a long term source of contamination thought to be contributing to microbial and chloride contaminant loads detected in DP (2020a).

7.2 Disposal of Excavated Site Soils

DP understands that the preferred remedial approach for excavated asbestos contaminated soils is off-site disposal. Disposal would be required where asbestos contaminated soils require removal to meet bulk excavation levels. In this regard, asbestos was detected in the upper soil profile which also contained inclusions of foreign materials (including the eastern bund). Given the need to also remove large inclusions and foreign materials for geotechnical purposes (where present and which may otherwise involve the need to sort / sieve site won soils for re-use), it is considered that the health and safety issues associated with managing asbestos risks on-site from such operations would likely be too onerous.

Excavation and disposal off-site of excavated soils will also address the B(a)P and TRH ESL exceedances recorded in sample TP124/0.8-0.9 located in the eastern bund as outlined in DP (2020a).

DP notes that whilst not currently proposed, consideration could be given to retaining some of the excavated soils during works where low portions of large inclusions, foreign materials, organic matter and contaminants (most notably asbestos) are present. This would therefore limit the remedial works required prior to placement of the site won soils and reduce off-site disposal. Such a process would need to be implemented during construction and would involve a high level of supervision and input from both the environmental and geotechnical consultant.

7.3 Capping of Contaminated Fill

Following excavation of the site to reach bulk earthworks levels, the following capping process is to be implemented across the whole site to address direct exposure risk to asbestos, lead, chromium and microbial contamination in the fill. Drawings 3 to 10 in Appendix A show the general capping approach for the site, existing TPZ areas and deeper planting areas respectively.

The remedial process for the general site is (also refer to Drawing 3, Appendix A):

- As outlined in DP (2020c), following initial earthworks to reach bulk excavation levels compact the exposed subgrade as much as possible using either standard heavy rollers or an impact roller. undertake general earthworks to reach bulk excavation levels;
- Inspection and clearance of the site by the Occupational Hygienist to confirm the absence of ACM at the surface. Visual observation is to be undertaken on a (minimum) 3 m x 3 m cross grid pattern to confirm the absence of any visual identifiable asbestos at the surface. If ACM is observed at the surface this is to be removed by the asbestos contractor and the area reinspected;
- Cover the asbestos impacted fill with a marker layer comprising a geofabic with minimum 200 mm overlap between rolls. The geofabric is to be non woven, durable (minimum 140 gsm with grab tensile strength of 500 N) and of an easily identifiable colour (e.g., orange). DP would consider the Jaybro mastaTEX to be a suitable geofabirc (refer to Appendix D);
- Survey the location (GPS co-ordinates to within 100 mm of its true position) and height (AHD to within 100 mm of its true level) of the capped soils / marker layer to allow a record of the location (vertical and horizontal) to be included in the LTEMP for the site and provide base levels for the capping material. As a minimum, a survey point in the order of every 15-20 m^2 and every 5 m along the site boundary would be suitable. Survey locations and results are to be recorded on a site survey drawing;
- Place a minimum 350 mm thick capping layer comprising virgin excavated natural material (VENM) over the marker layer. Given that leaching of the fill above the water table is not considered to be of significant concern, consultation should be undertaken with the geotechnical engineer and arborist on a suitable type of fill.

  As outlined in DP (2020c):

  - Preference for imported fill should be given to a well graded granular material such as a ripped sandstone with a maximum particle size of 150 mm;
  - Place the new fill in maximum 250 mm thick loose layers and compact to achieve a dry density ratio of between 98% and 102% relative to Standard compaction, with moisture contents maintained within 2% of Standard optimum moisture content; and
  - Undertake density testing of the fill as it is compacted in accordance with the requirements of AS 3798:2007.
- Placement of a 150 mm topsoil layer and turf covering. Extra caution should be used if proposing to use a recycled product (refer to Section 10.3); and
- Survey the location (GPS co-ordinates to within 100 mm of its true position) and height (AHD to within 100 mm of its true level) at approximately the same locations undertaken for the survey post placement of the geofabric. Survey locations and results are to be recorded on a site survey drawing and compared to the initial results to confirm the cap is 500 mm thick. The survey data from both surveys is to be recorded on a site survey drawing and overlayed on a recent aerial image of the site.

For works in the existing TPZ areas reference should be made to the arborist report (MT, 2020) and the civil drawings and works undertaken in collaboration with the arborist and civil engineer. In summary, the above process outlined for capping of the site would apply for the TPZ (Type 2) areas with the following amendments and / or requirements (also refer to Drawing 4, Appendix A):

- Excavation limited to 100-150 mm using hand tools and not within 1 m of the trunk;
- Survey the boundary of the TPZ to show on survey drawings;
- VENM capping is to be a minimum 100 mm thick;
- To minimise potential ponding of water at the base of the tree, fill (VENM / topsoil) is not to be placed within 300 mm of the truck and graded up to final level at a grade of 3(H):1(V);
- Fill (soil) used in the TPZ to be free draining;
- Where the minimum 100 mm VENM layer is placed, 200 mm of topsoil or mulch is also to be placed to make an overall capping thickness of 300 mm;
- Mulch / woodchip (or similar) to be placed in the 300 mm area around base of trunk, but not mounded against the tree trunk, to cover the marker layer; and
- At the interface between the turf and mulch / woodchip areas a 90 mm x 40 mm Integrated Recycling CON920 plastic edge (charcoal colour) with rectangular profile is to be installed to delineate the two areas and assist with retention of mulch within the designated area.

Where deeper planting of new trees is undertaken, these are not to deeper than 1 m from the final surface level or extend below the marker layer (refer to Drawing 5, Appendix A).

For the interface of the capping layer with the eastern boundary, 500 mm wide and 500 mm thick durable sandstone blocks will be placed along the eastern boundary level with the top of the cap. The marker layer geofabric will extend below the base of the sandstone block. This will provide protection to the cap from the adjacent marine environment by acting as a barrier to direct impact and is in addition to the protection/mitigation measures already present (refer to Drawings 6 and 7, Appendix A).

The interfaces between the cap and the southern and western boundaries are shown on Drawings 8 and 9 in Appendix A, respectively. For the southern boundary, the installed cap is to extend 500 mm past the edge of the southern remediation boundary to allow integration between the two areas without compromising the integrity of the capping at the remediation boundary. In this regard a 90 mm x 40 mm Integrated Recycling CON920 plastic edge (charcoal colour) with rectangular profile is to be installed to delineate the edge of the remediation boundary.

With respect to the western boundary, the existing car park with its pavements and stormwater management/drainage network provides an interface with low potential for erosional impact on the cap and hence a simple and easily defined interface. The marker layer is to be secured to the base of the curb.

Concerning the small TPZ (Type 3) area along the northern boundary of the site adjacent to the existing (off-site) footpath and which is within the TPZ of off-site trees, capping in this area above the marker layer will be limited to 150 mm of topsoil. Given the small area and the benefit to tree health by minimising disturbance of the root zone, this is not considered to compromise the integrity of the approach. Notwithstanding, to assist with erosion protection of the topsoil and to provide a further

more rigid barrier, a biaxial (or triaxial) black polypropylene geogrid within minimum rib thickness of 3.4 mm and aperture dimension of 33 mm is to be used. DP would consider the Jaybro mastaGRID 40/40 to be a suitable geogrid (refer to Appendix D). The geogrid is to be installed 75 mm below the surface, extend 500 mm past the edge of the TPZ to the south and have a minimum 500 mm overlap between rolls (refer to Drawing 10, Appendix A).

Where paths, shelters and benches are to be constructed, any in ground structures (e.g., footings, etc.) are to be limited to above the marker layer. This is also to apply to any services trenches (e.g., for the irrigation tank). Should any works require disturbance of soils below the marker layer, this is to be undertaken following consultation with the environmental consultant and the implementation of an agreed construction and validation process.

The above process of controlled placement and compaction of the imported fill will minimise the potential for erosion and degradation of the placed VENM fill and will be further supplemented by the overlying topsoil. Moreover, vegetation (i.e., turfing) coverage of the topsoil and placement of mulch / woodchip within defined delineated areas will provide erosion mitigation controls. This will be further supported by the physical structures that bound the site to the north (concrete footpath), east (sandstone blocks) and west (car park).

Note: Consultation with other relevant project consultants should be undertaken where necessary when implementing the above process (e.g., civil and geotechnical engineers for compactions requirements, arborist for works in TPZ, landscape consultant for landscaping requirements, etc.).

7.4 Remediation Acceptance Criteria

For any materials being imported onto site or areas requiring further validation (e.g., unexpected finds), laboratory results are to be compared to NEPC (2013) health and ecological screening / investigation levels for a recreational / open space land use setting. Table 3 provides a summary of the levels derived from DP (2020a). Reference to DP (2020a) and NEPC 2013 is to be undertaken for greater information on how these levels have been generated.

Table 3: Health Investigation and Screening Levels

Contaminants		HIL C and HSL C - Direct Contact (mg/kg)*	Management Limit for Public Open Space (mg/kg)	EIL and ESL (mg/kg)
Metals	Arsenic	300	-	100
	Cadmium	90	-	-
	Chromium (VI)	300	-	410
	Copper	17,000	-	20
	Lead	600	-	1,100
	Mercury (inorganic)	80	-	-
	Nickel	1,200	-	190
	Zinc	30,000	-	520
PAH	Benzo(a)pyrene TEQ[1]	3	-	33[5]
	Naphthalene	1,900 (HSL)	-	170
	Total PAH	300	-	-
TRH/ TPH	C6 – C10 (less BTEX) [F1]	5,100 (HSL)	700[3]	180
	>C10-C16 (less Naphthalene) [F2]	-	1,000[3]	120
	>C16-C34 [F3]	4,500 (HSL)	2,500	300
	>C34-C40 [F4]	6,300 (HSL)	10,000	2,800
BTEX	Benzene	120 (HSL)	-	50
	Toluene	18,000 (HSL)	-	85
	Ethylbenzene	5,300 (HSL)	-	70
	Xylenes	15,000 (HSL)	-	105
Phenol	Pentachlorophenol (used as an initial screen)	120	-	-
OCP	Aldrin + Dieldrin	10	-	-
	Chlordane	70	-	-
	DDT+DDE+DDD	400	-	180[5]
	Endosulfan	340	-	-
	Endrin	20	-	-
	Heptachlor	10	-	-
	HCB	10	-	-
	Methoxychlor	400	-	-
PCB [2]		1	-	-

Notes: 1 – sum of carcinogenic PAH; 2 – non dioxin-like PCBs only; 3 – BTEXN not to be subtracted ;
4- CRC Care Technical Report No 39 for B(a)P ; 5 – for DDT only.
*Given soil vapour intrusion HSL criteria for open space land use is non-limiting for BTEXN, F1 and F2, these have not been included.

With respect to asbestos concentrations, as per NEPC 2013 *Table 7: Health Screening Levels for Asbestos Contamination in Soil* no asbestos is to be visible at the surface, bonded ACM is to be less than 0.02% and FA/AF are to have a concentration of <0.001%.

8. Regulatory Requirements and Approvals

All works must be conducted in accordance with project planning requirements.

All works must also be undertaken in accordance with the relevant regulatory criteria, including *inter alia*:

- NSW Work Health and Safety Act 2011 (WHS Act);
- NSW Work Health and Safety Regulation 2017 (WHS Regulation);
- NSW Contaminated Land Management Act 1997;
- National Environment Protection Council, National Environment Protection Measures 2013 (NEPC, 2013);
- Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia (WA DoH 2009);
- SafeWork NSW: Code of Practice How to Manage and Control Asbestos in the Workplace July 2020; and
- SafeWork NSW: Code of Practice How to Safely Remove Asbestos July 2020.

The works are considered to be Category 1 remedial works under the State Environmental Planning Policy 55 - Remediation of Land (SEPP55) which require development consent prior to commencing. This RAP and the other reports outlined herein have been undertaken in support of the development application. Prior to commencing works it is foreseen that the following primary approvals and licences will be required:

- Development consent from the planning authority;
- Approval to commence works from the planning authority/certifier under the conditions of development consent;
- Asbestos contractor with a SafeWork NSW Class A licence for the removal of asbestos (refer to Section 9.3); and
- Occupation hygienist with a SafeWork NSW Asbestos Assessor Licence (refer to Section 9.6).

9. Roles and Responsibilities

9.1 Principal

Georges River Council retains the overall responsibility for ensuring that this RAP is appropriately implemented. Georges River Council is to nominate a representative (the Principal's Representative-PR), who is responsible for overseeing the implementation of this RAP. The actual implementation of the RAP may be conducted by the Principal Contractor on behalf of Georges River Council.

9.2 Principal Contractor

The Principal Contractor (referred to hereon as the Contractor) is foreseen to be the party responsible for the day-to-day implementation of this RAP and shall fulfil the responsibilities of the Principal Contractor as defined by SafeWork NSW. It is noted that the Contractor may appoint appropriately qualified sub-contractors or sub-consultants to assist in fulfilling the requirements of the procedures.

In addition to the implementation of the RAP it will be the Contractor's responsibility:

- To obtain specific related approvals as necessary to implement the earthworks, including for example, permits for removal of asbestos-containing materials, SafeWork NSW notification, etc.;
- To develop or request and review plans to manage site works;
- That all site works and other related activities are undertaken in accordance with this RAP;
- To maintain all site records related to the implementation of the RAP;
- That sufficient information has been provided to engage or direct all required parties, including sub-contractors, to implement the requirements of the RAP other than those that are the direct responsibility of the Contractor;
- To manage the implementation of any recommendation made by those parties in relation to work undertaken in accordance with the RAP;
- To inform, if appropriate, the relevant regulatory authorities, of any non-conformances with the procedures and requirements of the RAP in accordance with the procedures outlined in this document;
- To retain records of any contingency actions;
- On completion of the project, to review the RAP records for completeness and update as necessary; and
- To recommend any modification to general documentation which would further improve the environmental outcomes of this RAP.

9.3 Asbestos Contractor

The Asbestos Contractor will be responsible for undertaking all asbestos works involving any asbestos impacted soils and building materials and will hold a minimum of Class A licence for the removal of asbestos (issued by SafeWork NSW). The Asbestos Contractor can be the same as the Principal Contractor.

Whilst the detections of asbestos fibres in soils have only been detected in deeper soils within the remediation area which are not proposed to be disturbed as part of the works, DP recommends that the asbestos contractor holds a Class A licence for the removal of asbestos to minimise delays, should friable asbestos be encountered during the remedial works. DP also notes that a Class A asbestos removalist would be required for the demolition works (e.g., friable asbestos identified in the pump house, refer to DP (2020b)).

9.4 Sub-contractors

All sub-contractors will be inducted onto the site and informed of their responsibilities in relation to this RAP as part of this induction. Signing of the site induction is to include agreement by the sub-contractors to abide by the RAP requirements. Where necessary, sub-contractors will also be trained in accordance with the requirements of this document. All sub-contractors must conduct their operations in accordance with this RAP as well as all applicable regulatory requirements.

9.5 Environmental Consultant

The Environmental Consultant will provide advice on implementing this RAP.

The Environmental Consultant will be responsible for:

- Undertaking any required assessments where applicable (e.g., waste classification, asbestos validation sampling, etc.);
- Providing advice and recommendations arising from inspections;
- Reviewing documentation and results provided by the contractor (e.g., surveys, compaction results, proposed materials to be imported); and
- Notifying their client with the results of any assessments and any observed non-conformances in a timely manner.

9.6 Occupational Hygienist

The Occupational Hygienist will provide advice on WHS issues related to any asbestos related works. The Occupational Hygienist will hold a SafeWork NSW Asbestos Assessor Licence, in accordance with the WHS Regulations.

The Occupational Hygienist will be responsible for:

- Preparing the AMP;
- Where appropriate generating the WHS plans and advice on request by the Contractor;
- Undertaking airborne asbestos monitoring;
- Undertaking clearance inspections;
- Asbestos sampling;
- Providing advice and recommendations arising from monitoring and/or inspections; and

- Notifying their client with the results of any assessments and any observed non-conformances in a timely manner.

The Environmental Consultant and Occupational Hygienist can be the same entity.

9.7 Site Workers

All workers on site are responsible for observing the requirements of this and other management plans. These responsibilities include the following:

- Being inducted on site and advised of the general nature of the remediation / environmental issues at the site;
- Being aware of the requirements of this plan;
- Wearing appropriate PPE;
- Only entering restricted areas when permitted; and
- Requesting clarification when unclear of requirements of this or any other plans (e.g., SWMS).

10. General Site Management

This section provides general information which is to be considered during the remedial works. Detailed information for the asbestos associated works, *inter alia*, on site management of asbestos materials, monitoring, documentation and roles and responsibilities are to be outlined in the AMP which is to be completed by the Occupational Hygienist prior to commencement of site works.

10.1 Stockpiling of Asbestos Impacted Soils

It is envisaged that temporary stockpiles may be formed during the fill removal / placement. Stockpiles must be managed to minimise the risk of dust generation and erosion given the likely presence of asbestos in the stockpiled materials sourced from the site. The measures required to achieve this include:

- Restrict the height of stockpiles to reduce dust generation (less than 2 m);
- Place site won stockpiles in areas yet to be validated;
- Construct erosion and sediment control measures;
- Cover stockpiles impacted by asbestos at the end of each day or when not in use with plastic or geofabric. Plastic / geofarbic is to be securely weighted down to ensure it is not blown away by strong winds;
- Keep temporary stockpiles moist (not wet), by using water spray where required; and
- Removal of stockpiles to landfill where odours are being generated.

Imported materials are to be placed as separate stockpiles and demarcated to maintain clear and distinct segregation between these and asbestos impacted stockpiles.

10.2 Waste Disposal

All off-site disposal of soils is to be undertaken in accordance with the *Protection of the Environment Operations* (POEO) Act and the NSW EPA *Waste Classification Guidelines,* 2014. Copies of all necessary approvals from the receiving site shall be given to the PR prior to any contaminated material being removed from the site. A preliminary waste classification has been provided in DP (2020a).

It is noted that ASS was detected within the shallower fill profile at TP121 in the north-western area of the site at 1.2 m bgl (~2.4 m AHD). Should these soils or any other soils be suspected of being potential ASS be disturbed during remedial works these would need to be subject to further ASS testing to confirm ASS absence/presence and hence allow waste classification under Part 4 of EPA (2014).

The sampling rate for validation / waste classification / assessment of stockpiled soils is (note that actual frequency will be determined based on volume, contamination risk and homogeneity of the material):

- Stockpiles ≤250 m^3: 1 sample per 25 m^3 and a minimum of 3 samples; and
- Stockpiles >250 m^3: 1 sample per 100-250 m^3 and a minimum of 3 samples.

If contaminated soils are stockpiled in areas other than on existing fill within the site, the footprint of the stockpile is to be validated following removal of the contaminated soils.

During excavation or stockpiling, but prior to loading out, the waste material is to be periodically inspected (and sampled if required) by the Environmental Consultant to confirm the waste classification of the material.

No soil is to leave the site without a formal waste classification report. Transport of spoil shall be via a clearly delineated, pre-defined haul route. Copies of all consignment notes for the transport, receipt and disposal of all materials are to be maintained as part of the site log and made available to the Environmental Consultant for inspection and reporting purposes upon request. It is noted that any asbestos waste / asbestos impacted soil transported in NSW weighing more than 100 kg or consisting of more than 10 m^2 of asbestos sheeting in one load is required to be recorded utilising the NSW EPA tool, WasteLocate.

All relevant analysis results, as part of waste classification reports, shall be made available to the Contractor and proposed receiving site / waste facility to enable selection of a suitable disposal location.

10.3 Importation of Soil

Any soils (including topsoil) imported are to be classified as VENM, or must be compliant with an appropriate Resource Recovery Order (RRO) and associated Resource Recovery Exemption (RRE). All imported material classifications are to be supported by the relevant chemical and physical testing results and, at a minimum, include analysis for heavy metals, TRH, BTEX, PAH, PCB and asbestos.

VENM is to be sampled for each source site at a minimum rate of 3 samples for the first 1,000 m^3 and then 1 sample per 1,000 m^3 thereafter.

As a default requirement for non-VENM materials imported under an RRO/RRE, material supplied to the site is to be sampled by the Environmental Consultant for heavy metals, TRH, BTEX, PAH, PCB and asbestos at the following rate (for each source site):

- Less than 500 tonnes - 3 samples;
- 500 < 1000 tonnes - 4 samples;
- 1,000 < 2000 tonnes - 5 samples;
- 2,000 < 3,000 tonnes - 7 samples; and
- 3,000 - 4,000 tonnes - 10 samples.

Variation to the default requirements outlined above would be subject to the level of documentation provided by the source site and approval of the Environmental Consultant and the Site Auditor.

Notwithstanding the above, all non-VENM materials are to be compliant with the relevant Resource Recovery Criteria (RRC) and requirements of the RRO / RRE.

Furthermore, results are to be compared against the Remediation Action Criteria (RAC) outlined in Section 7.4 where applicable. Note, where there is a difference between the RAC and the RRC, the more conservative criteria are to be adopted.

Prior to importation appropriate documentation confirming the classification needs to be provided to, and approved by, the Environmental Consultant. If necessary, the material is to be inspected at the source site (and sampled if required) to confirm the classification given and to confirm that there are no signs of contamination.

The material must be inspected during importation by the Contractor, and any materials not meeting the description given in the provided documentation or displaying signs of contamination are to be rejected. The Environmental Consultant is to conduct periodic inspection(s) during and / or following importation to check the same. Additional testing of the imported material may be required, as recommended by the Environmental Consultant, commensurate with the documentation and the material type / classification.

DP notes that generally materials imported under a RRO / RRE present a higher contamination risk, hence, extra caution should be used if proposing to use a recycled product.

11. Validation Plan

11.1 Data Quality Objectives and Indicators

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

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

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

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

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

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

11.2 Site Inspections

The Environmental Consultant is to conduct periodic site inspections during each phase of the remediation works (e.g., end of bulk earthworks, placement of marker layer, placement of cap) and when any issue of concern is identified. A record of the inspections and observations is to be provided as part of the Validation Assessment Report. This is to include a photographic record.

11.3 Validation Inspection and Sampling

Remediation of the site is considered complete when demolition and disposal off-site of the existing site structures (including sub-surface infrastructure), disposal off-site of excess soil, and subsequent placement of the cap over the retained fill has taken place.

Validation inspections for remediation are to be undertaken during post stripping and stockpiling of the fill, during placement of the fill in the excavation, following installation of the marker layer and on completion of the capping layer.

When inspecting areas for the presence of asbestos (i.e., prior to marker layer placement, in the TPZ areas), this is to be undertaken on a 3 m x 3 m cross grid pattern to confirm the absence of any visible asbestos at the surface.

If validation (soil) sampling is undertaken (e.g., due to unexpected finds) then the sampling rate adopted by the Environmental Consultant is to be reflective of the works being assessed. In this regard, reference is to be made to the NSW EPA *Sampling Design Guidelines 1995* for general validation of areas.

Any inspection requirements for the Occupational Hygienist are to be outlined in the AMP.

Results of the validation sampling (for soils to be retained on site or imported) are to be compared to the RAC, as outlined in Section 7.4.

11.4 Documentation Requirements

The following documents will need to be reviewed in conjunction with those outlined in the AMP as part of the validation assessment by the Environmental Consultant. These are to include and be provided to the Environmental Consultant by the relevant parties.

- Any Licences and Approvals required for the remediation works;
- Waste classification reports;
- Transportation Record: comprising a record of all truck-loads of soil entering or leaving the site, including truck identification (e.g., registration number), date, time, load characteristics (i.e., classification, on-site source, destination);
- Disposal dockets: for any soil disposed off-site. The contractor will supply records of: transportation records, spoil source, spoil disposal location, receipt provided by the receiving waste facility (where available), a record of receipt from the receiving site will be supplied (i.e., the receiving sites transportation records). Note: A record of the building materials disposed off-site is also be kept and provided to the Principal on request;
- Imported materials records: records for any soil imported onto the site, including source site, classification reports, inspection records of soil upon receipt at site and transportation records;
- Records relating to any unexpected finds and contingency plans implemented;
- Incident Reports: any WHS or Environmental Incidents which occur during the works will be documented and the PR and appropriate regulatory authority will be informed in accordance with regulatory requirements;
- Laboratory certificates and chain-of-custody documentation;
- Letters / memos as required to provide instruction or information to the Principal and Contractor;
- Airborne asbestos monitoring records;
- Asbestos clearance comprising visual inspection and validation sampling and analysis;

- Asbestos removal records;
- Inspections records from the Environmental Consultant and Hygienist; and
- Surveys: pre- and post-capping construction showing areas where asbestos impacted soils are located and capped and TPZ areas. These surveys are to be overlayed on a recent aerial image of the site.

11.5 Validation Reporting

A validation assessment report is to be prepared for the site by the Environmental Consultant consistent with NSW EPA *Contaminated Land Guidelines: Guidelines for Consultants Reporting on Contaminated Land* (EPA, 2020) and other appropriate guidance documentation.

The validation report shall describe the remediation approach adopted, methodology, results and conclusion of the assessment and make a clear statement regarding the suitability of the site for the proposed land use a recreational open space park. It is also to provide details of any ongoing (post construction / long term) environmental management (an LTEMP) which is required in order to maintain the remediation system for the retained fill on the site (i.e., ensure the integrity of the capping system over time).

12. Sample Collection and Analysis Requirements

12.1 Field Methods

When required, the following general sampling methodology is to be implemented for all soil sampling:

- Preparing records 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. For asbestos analysis, placement in a second plastic bag / sealed container, such as an esky (i.e., double bagging);
- 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 glass jars for chemical analysis into a cooled, insulated and sealed container for transport to the laboratory (cooling not required for asbestos samples); and
- Using 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.

12.2 Laboratory Analysis

Laboratory analysis of any samples relevant to the validation report is to be undertaken by laboratories with NATA accreditation for the analyte being tested and with appropriate QA / QC assessment. It is noted that FA/AF and 10 L bulk sample asbestos analysis as per NEPC 2013 is not a NATA accredited laboratory test and hence is exempt from this requirement.

At least two laboratories will be required to undertake the testing, a primary laboratory, and secondary laboratory which will analyse inter-laboratory replicate samples. In this regard replicates are to be analysed at a rate of 1 replicate sample per 10 primary samples. At least 50% of the replicates are to comprise inter-laboratory analysis.

Samples are to be analysed for the contaminants of concern identified for the sampling purpose. These contaminants are to be identified based on available laboratory results from previous testing, field observations and the objective of the analysis (e.g., samples from imported material analysed as per Section 10.3).

13. Environmental Management During Remediation and Construction

The Construction Environmental Management Plan (CEMP) is to be followed in conjunction with any other environmental management protocols stipulated in relevant SafeWork NSW, Australian Standard, and / or Council requirements. The CEMP shall be undertaken by the Principal Contractor with input from other contractor(s) and consultant(s) where required. As a minimum, the site-specific CEMP shall detail the following:

- Works sequence and timeline;
- Health and Safety Protocols;
- Dust minimisation measures;
- Noise minimisation measures;
- Environment protection measures;
- Equipment to be used;
- Nominated landfill(s);
- Truck movements / site access / site egress;
- Proposed source(s) of materials for import, and methods of certification;
- Method(s) for surveying before and after physical barrier construction;
- Measures to prevent cross contamination between areas being remediated (capped) and those already capped; and
- Method(s) for inspecting and certifying construction of the physical barrier systems, including any hold points (*may be organised and commissioned by the Principal*).

The remediation and construction works 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 the site specific CEMP such that work on the site complies with the requirements as laid down in relevant legislation, guidelines and codes.

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 (including asbestos fibres) is mitigated;
- 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 appointed remediation and construction contractors will be provided with a copy of DP (2020a) this RAP so that they are aware of the contamination status of the soils and the remediation methodology to be adopted.

The following sub-sections provide details of the environmental management practices to be employed as a minimum at the site in order to minimise and / or prevent environmental impact as a result of the remediation and / or construction works. Again, it is noted that other statutory requirements must also be followed.

The following is intended for the period during development of the site. A separate environmental management plan for long-term management of the site will be required following completion of works.

13.1 Site Delineation

Each stage of remediation and construction is to be appropriately fenced off from the remainder of the site. The fencing will be designed to:

- Prevent unauthorised entry to the work site;
- Minimise the potential for cross contamination between areas already remediated and areas still requiring remediation; and
- Capture and contain minor dust generations.

The fencing alignment applicable to each stage of works will be included in the CEMP.

13.2 Dust Control

Given asbestos has been identified on the site it is important to mitigate risk through appropriate dust control measures and that such measures are adhered to. Generation of dust, therefore, is to be kept to a minimum at all times.

During working hours, water sprays are to be used to keep the surface of any works areas and stockpiled soils (which will be kept to a minimum) reasonably damp, in order to suppress any dust. Water used for dust suppression is to be only the minimum required to reduce dust generation and must not to be allowed to escape the confines of the works areas. If excessive dust is being generated, works are to cease until the dust is sufficiently suppressed.

In summary, the following dust control procedures are to be employed to comply with this requirement as necessary:

- Ceasing works during periods of high winds (i.e., winds that can generate dust);
- Erection of dust screens around the perimeter of the site;
- Securely covering all loads entering or exiting the site;
- Use of water sprays across the site to suppress dust;
- Covering of all stockpiles remaining onsite at the end of each day or when not in use with geofabric or plastic;
- Keeping excavation and stockpile surfaces moist; and
- Regular checking of the fugitive dust to ensure compliance. Immediately implement measures to rectify any cases of fugitive dust.

Whilst air monitoring is not technically required when handling/exposed soils impacted by bonded ACM, DP would consider the implementation of asbestos air monitoring during works involving disturbance of the asbestos impacted soils as a prudent approach to site management.

Air monitoring should be undertaken in consultation with and as directed by the Occupational Hygienist. Air monitoring devices are to be kept at locations nominated by the appointed Occupational Hygienist, which will generally be at the works area boundaries. If asbestos fibres are detected during the course of the works above acceptable limits, the remediation works will cease and dust prevention measures improved. The air monitoring program to be implemented is to be outline in the AMP.

13.3 Soil / Sediment Containment

Industry standard sediment control measures (such as outlined in the ‘blue book’), including sediment fencing and / or hay bales, shall be installed where there is a potential for sediment to spill onto neighbouring areas, the car park, roads, stormwater drainage lines or Kogarah Bay.

The sediment control measures shall be regularly inspected and maintained by the Principal Contractor (site foreman).

13.4 Noise Management

Noise impacts will generally result from the excavators, truck movements and construction equipment within the site and surrounding streets, all of which have noise levels within levels normally expected at a construction site.

In order to minimise noise impacts during the remediation works, the following measures are to be implemented:

- Construction noise is to be confined to the hours stipulated by Council. No machinery / trucks are be permitted to access the site outside these hours of operation;
- Signage at the site entrance providing contact details for the site superintendent, so that noise complaints can be readily addressed;
- Establishment and monitoring of a complaints log;
- All equipment and machinery are to comply with regulatory standards for noise generation;
- Fitting mobile equipment with exhaust mufflers, when and if required; and
- Adopting traffic management measures to reduce noise.

13.5 Odour Control

In order to control odours at the site boundaries, the following processes are to be adopted:

- All plant and equipment exhaust levels are to be monitored by the site foreman to ensure acceptable levels. If unacceptable levels are determined, the equipment is to be replaced or repaired;
- If strong hydrocarbon odours are detected from any of the machinery a hydrocarbon mitigating agent is to be used;
- A complaints register is to be set up on-site for recording complaints from residents or tenants, with respect to odours or dust. The complaints register is to be completed by the Site Superintendent, as well as the corrective actions implemented; and
- Once a complaint is received, the site superintendent is to implement a corrective action to rectify any problems associated with the odour or dust source.

Investigations performed to date have not identified significant concentrations of volatile contaminants in the soil, therefore, odours are not anticipated or expected to be significant. If, however, odours are detected during the works the following protocol will be applied:

- Odour source and type of odour to be investigated by the Environmental Consultant. This could include air monitoring or sampling of any suspect media in addition to observations of physical conditions;
- Temporary covering of the source to mitigate odour release whilst waiting for monitoring / analytical results. This could include the temporary reinstatement of ground conditions; and
- Assessing more permanent ways of dealing with the issue. This may include disposal of odorous material off site, the use of masking agents or the controlled progressive excavation.

The re-use of odorous soils for construction purposes will not be undertaken unless the material has been aerated or suitably treated and the odorous material assessed to be suitable and the odour to have adequately attenuated.

13.6 Landfill Gas

Appropriate monitoring and associated management procedures / protocols are to be implemented during the construction works to address work health safety issues associated with the presence of LFG. Particular focus should be given areas that haven't been disturbed and allowed to naturally ventilate.

In this regard, with respect to the safety of site personnel, concentrations for LFG within the works area are to be checked (as deemed appropriate) using hand held monitoring instruments and are not to exceed the following criteria:

- Methane: 0.5% v/v;
- Carbon dioxide: 0.5%;
- Carbon monoxide: 10 ppm;
- Hydrogen sulphide: 30 ppm;
- Volatile organic compounds: 25 ppm; and
- Oxygen: 19.5-23.5% v/v (range).

If one or more of the above criteria are exceeded the area is to be evacuated whilst ventilation of the area takes place until all criteria are re-established below acceptance levels. The time, date, location and LFG concentrations are to be recorded when the criteria is exceeded.

Whilst not anticipated, should a confined space environment be present during the works, reference should also be made to relevant SafeWork NSW regulations and guidelines on working in confined spaces.

Additionally, WHS protocols are to be put in place to address the potential for LFG odours should this be encountered (e.g., provision for masks with organic filters).

13.7 Acid Sulphate Soils

Whilst ASS is not expected to be disturbed by the proposed works, should any materials that are suspected of being potential ASS be disturbed during remedial works these would need to be subject to further ASS testing and possibly (lime) treatment. An ASS management plan would also need to be implemented in this scenario.

ASS screening is to be undertaken on excavated soils that:

- Are from below the water table; or
- Have a sulfurous odour; or
- Are located below 2.4 m AHD, are from an area where ASS assessment has not been undertaken and are dark grey and brown and include more than 15% clay (i.e., more than trace clay) and may have a hydrocarbon odour.

14. Worker Health and Safety

A site specific WHS Plan is to be prepared by the appointed Principal Contractor in consultation with other contractors and submitted for approval by the Principal. Further information on the WHS requirements for addressing asbestos related works associated with the remediation is to be outlined in the AMP.

15. Unexpected Finds Protocol

15.1 Unexpected Finds Protocol

All site personnel are to be inducted into their responsibilities under this Unexpected Finds Protocol (UFP), which is to be included in the Contractors Site Management Plan.

All site personnel are required to report unexpected signs of environmental concerns to the Site Manager if observed during the course of their works e.g., unnatural staining, potential contamination sources (such as buried drums or tanks) or chemical spills.

Should signs of concern be observed, the contractor is to, as soon as practical:

- Place barricades around the affected area and cease work in that area;
- Notify authorities needed to obtain emergency response for any health or environmental concerns (e.g., fire brigade);
- Notify the PR of the occurrence;
- Notify any of the authorities that the Contractor is legally required to notify (e.g., NSW EPA); and
- Notify the Environmental Consultant.

The PR is to notify any of the authorities which the Principal is legally required to notify (e.g., NSW EPA).

Following the immediate response in the UFP a contingency plan is to be implemented.

15.2 Contingency Plan

The contingency plan for the site is as follows:

- The Environmental Consultant (or Hygienist as appropriate) to inspect the issue of concern and determine the nature of the issue and the appropriate approach to assessing or (if appropriate) managing the issue;
- Principal Contractor (and if required Georges River Council) is to be informed, if considered necessary, of the proposed assessment and/or management approach;
- The Environmental Consultant (or Hygienist as appropriate) to undertake an assessment considered necessary to determine the management strategy for the area;

- If contamination is found and remediation action (not specified herein) is considered necessary, a remediation strategy for the area is to be prepared by the Environmental Consultant and provided to the Principal Contractor and Site Auditor for approval; and
- If the area or proposed remediation strategy is significantly different than that detailed in this RAP, the Consent Authority or Private Certifier (as appropriate) and Site Auditor is to be provided notification of the proposed works.

16. Conclusions

It is considered that the site can be rendered suitable for the proposed development subject to appropriate remediation, management and site validation in accordance with this RAP.

The successful completion of the remediation is to be validated and reported as outlined herein.

The Environmental Consultant is to be informed if there are any changes to the remediation approach and if so this RAP must be updated in consultation with the relevant parties.

17. Future Requirements - Environmental Management Plan

On completion of the works a post LTEMP is to be developed for the site. This is to outline the management practices to be implemented to prevent damage or degradation of the capping layer and hence protect its integrity. It is also to outline processes to repair and make good the capping in the event of planned or inadvertent breaches such that related risks are mitigated and that any potential exposure of the contaminated soils to site users is minimised.

Requirements for the LTEMP are set out in the NSW EPA *Guidelines for the NSW Site Auditor Scheme (3nd Edition), October 2017*. In summary, the LTEMP is required to be able to be made legally enforceable, developed by a suitably qualified Environmental Consultant and reviewed and agreed with the Site Auditor and Georges River Council. With respect to a mechanism for legal enforcement, DP understands that Council foresee one approach to this being through a condition of the development consent. On agreement by all parties to the LTEMP, appropriate public notification of the plan for the site is to be undertaken, typically this involves Council notifying the presence of the EMP on the site's Section 10.7 Planning Certificate.

18. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at Kogarah War Memorial Swimming Pool in general accordance with DP's proposal SYD200681 dated 1 July and acceptance received from Michael Baker of SJB Planning Pty Ltd on behalf of SJB Architects Pty Ltd. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of SJB Architects for this project only and for the purposes as described in the report. It may also be used by Georges River Council under the same DP Conditions of Engagement. 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.

This RAP has been prepared based on the results of previous investigations at the site and the proposed works. Should site conditions encountered during works differ from those currently understood and as outlined in this report, or the proposed construction works be altered, or the remedial approach amended without DP's knowledge and agreement, this RAP would no longer be valid for remediation of the site.

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

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

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

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

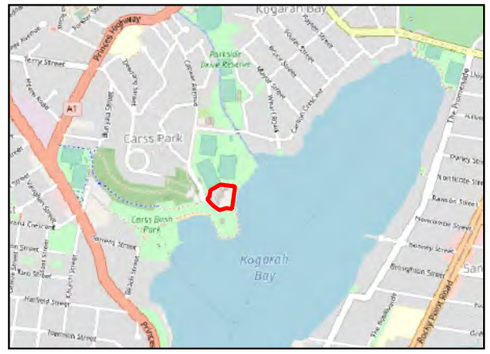
The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk.

Douglas Partners Pty Ltd

Appendix A

Drawings

About This Report



LOCALITY MAP

Notes:
1. Basemap from nearmap.com (dated 01/06/2020)

Legend

Approximate Site Boundary (Remediation Boundary)

0 15 30 45 m

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	SJB Architects		
OFFICE:	Sydney	DRAWN BY:	NW
SCALE:	1:700 @ A3	DATE:	28.09.2020

TITLE: **Site Location (Remediation Area)**
Kogarah War Memorial Pool
Carss Park

N

PROJECT No:	99751.00
DRAWING No:	R.002 - 1
REVISION:	1

Notes:
1. Basemap from nearmap.com (dated 01/06/2020)
2. Test locations shown are approximate only

Legend

- Approximate Site Boundary (Remediation Boundary)
- Approximate Location of Previous Shoreline

Previous Test Locations

- CPT Locations (DP, 2018)
- Borehole Locations (DP, 2018)
- Geotechnical Investigation (Construction Sciences, 2019)

Test Locations (DP, 2020)

- Env/ Geo Boreholes
- Test Pits
- Monitoring Wells
- Hand Augers
- CPTs

0 15 30 45 m

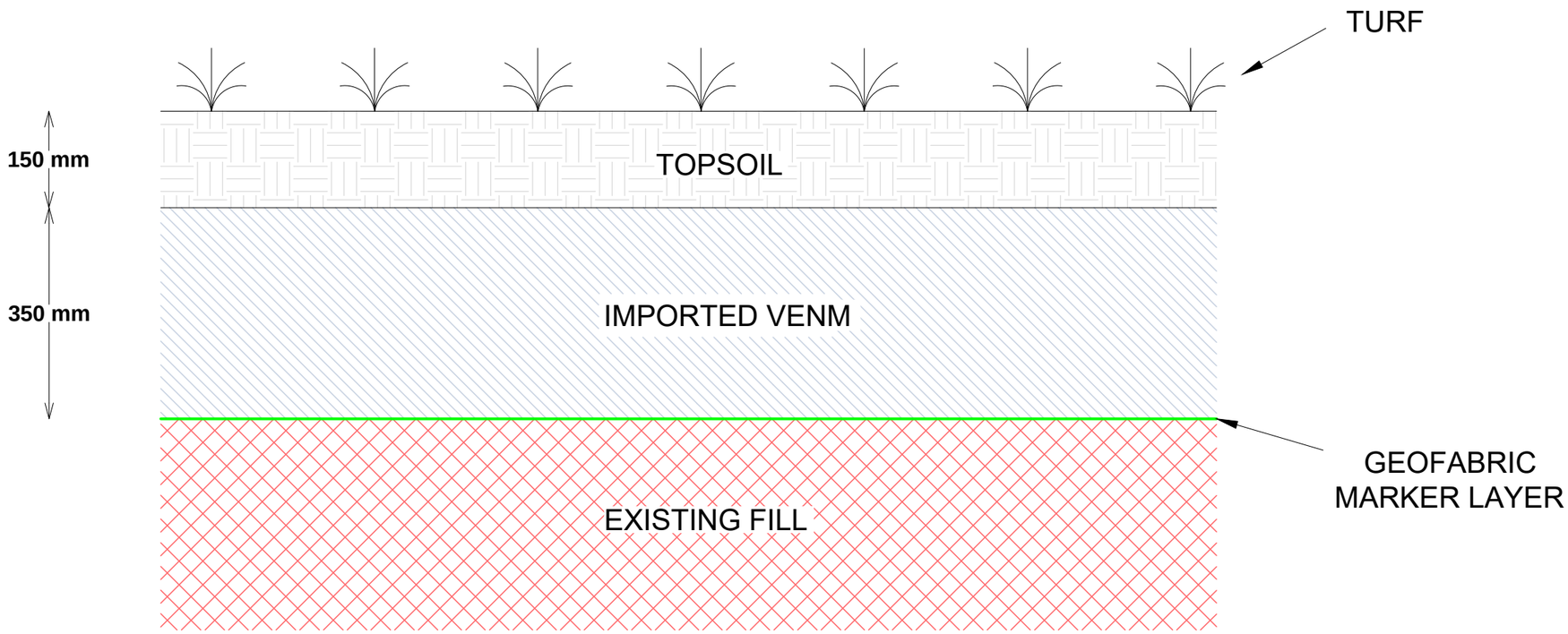
Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	SJB Architects		
OFFICE:	Sydney	DRAWN BY:	NW
SCALE:	1:700 @ A3	DATE:	28.09.2020

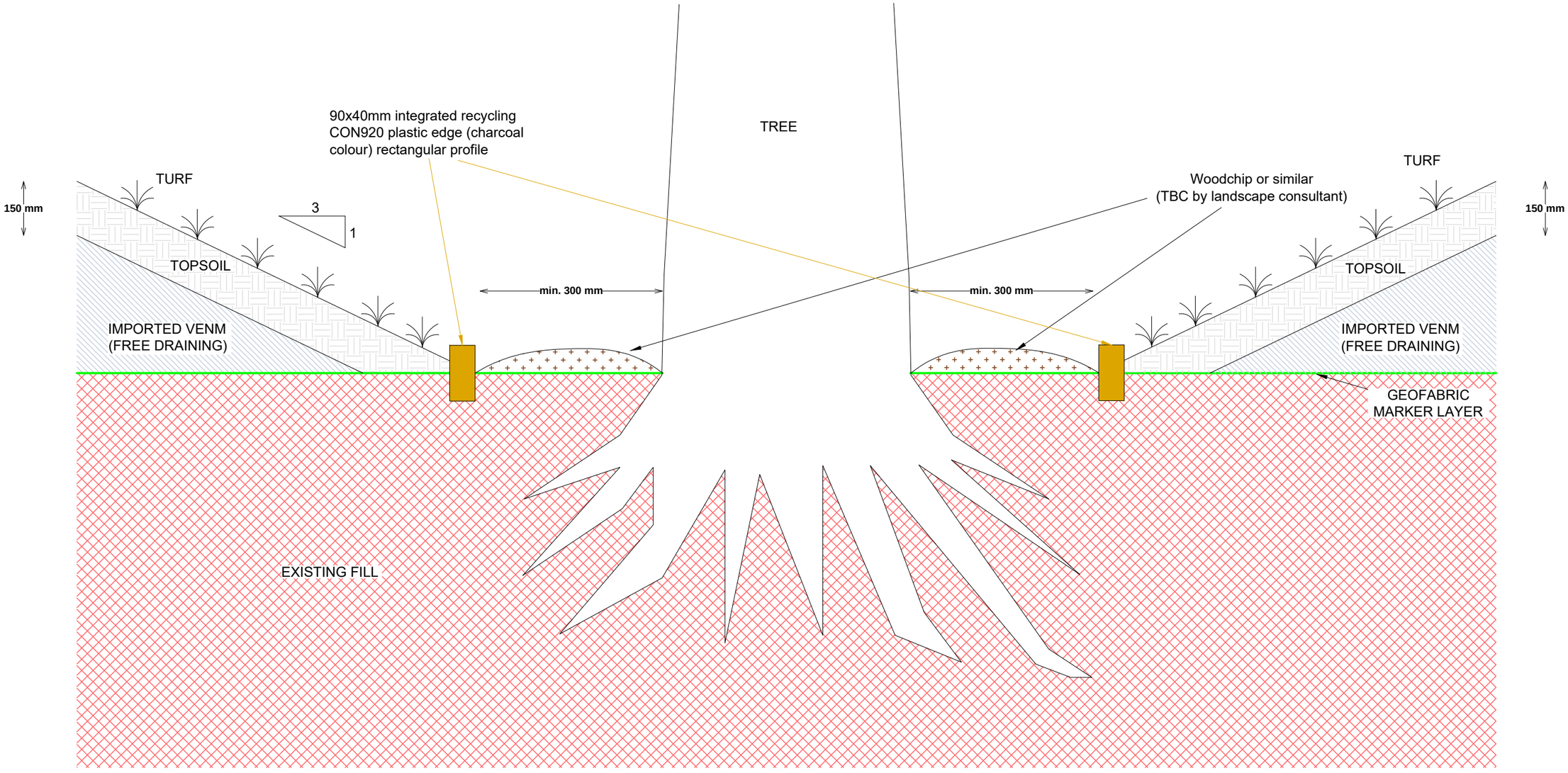
TITLE: **Previous Test Locations**
Kogarah War Memorial Pool
Carss Park

N

PROJECT No:	99751.00
DRAWING No:	R.002 - 2
REVISION:	1



Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: SJB Architects		TITLE: **Remediation Approach - Capping Strategy** **Kogarah War Memorial Pool** **Carss Park**	PROJECT No: 99751.00
	OFFICE: Sydney	DRAWN BY: JDB		DRAWING No: R.002 - 3
	SCALE: N.T.S	DATE: 21.8.2020		REVISION: 0



NOTE: - Works to be confirmed with arborist and landscape consultant prior to commecing
- If required, existing fill greater than 1 m from the trunk may be removed using hand tools to 100-150 mm deep. This is to be undertaken in consultation with the arborist.
- Refer to civil drawings for final capping thickness in Tree Protection Zones.

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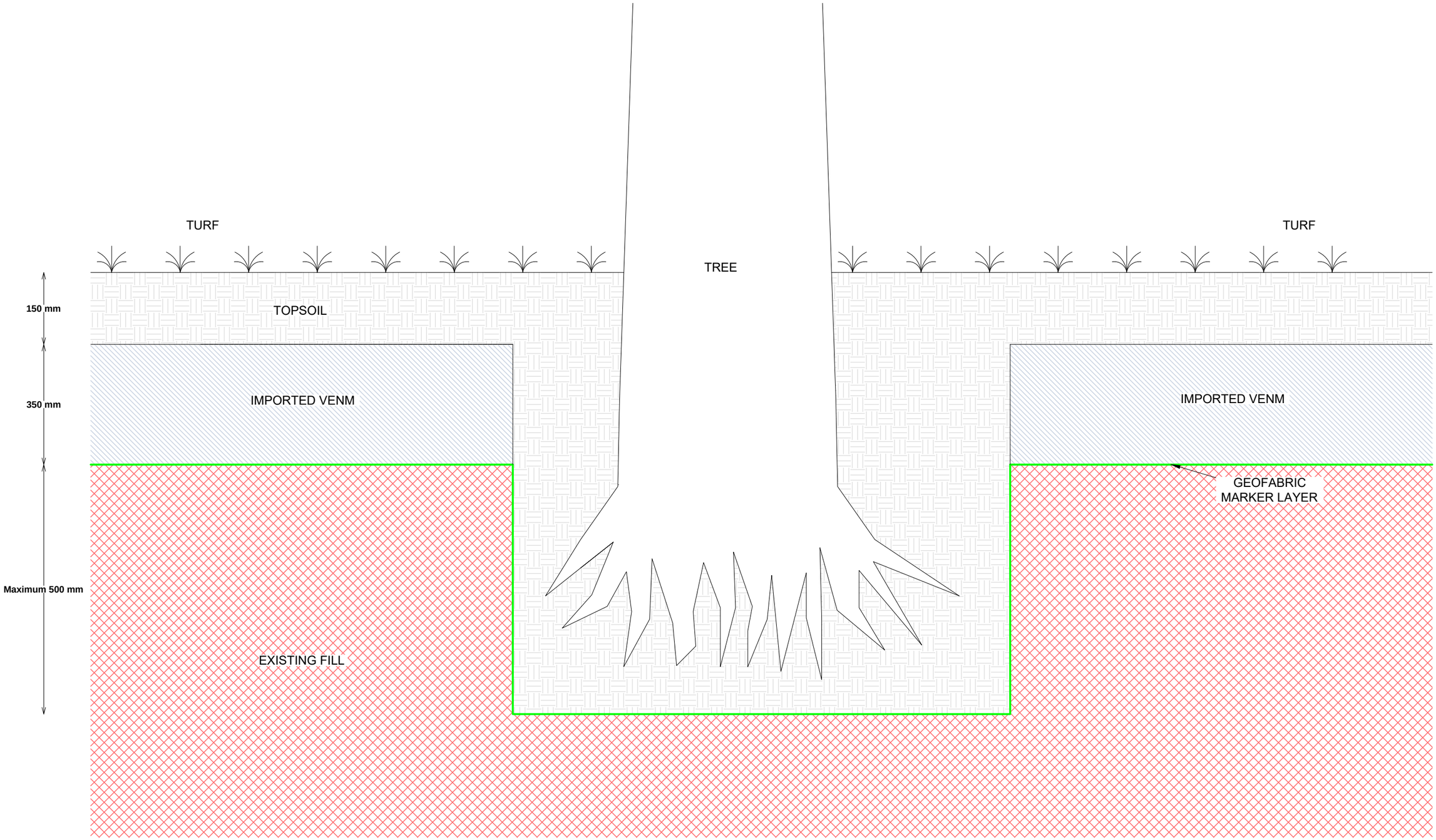
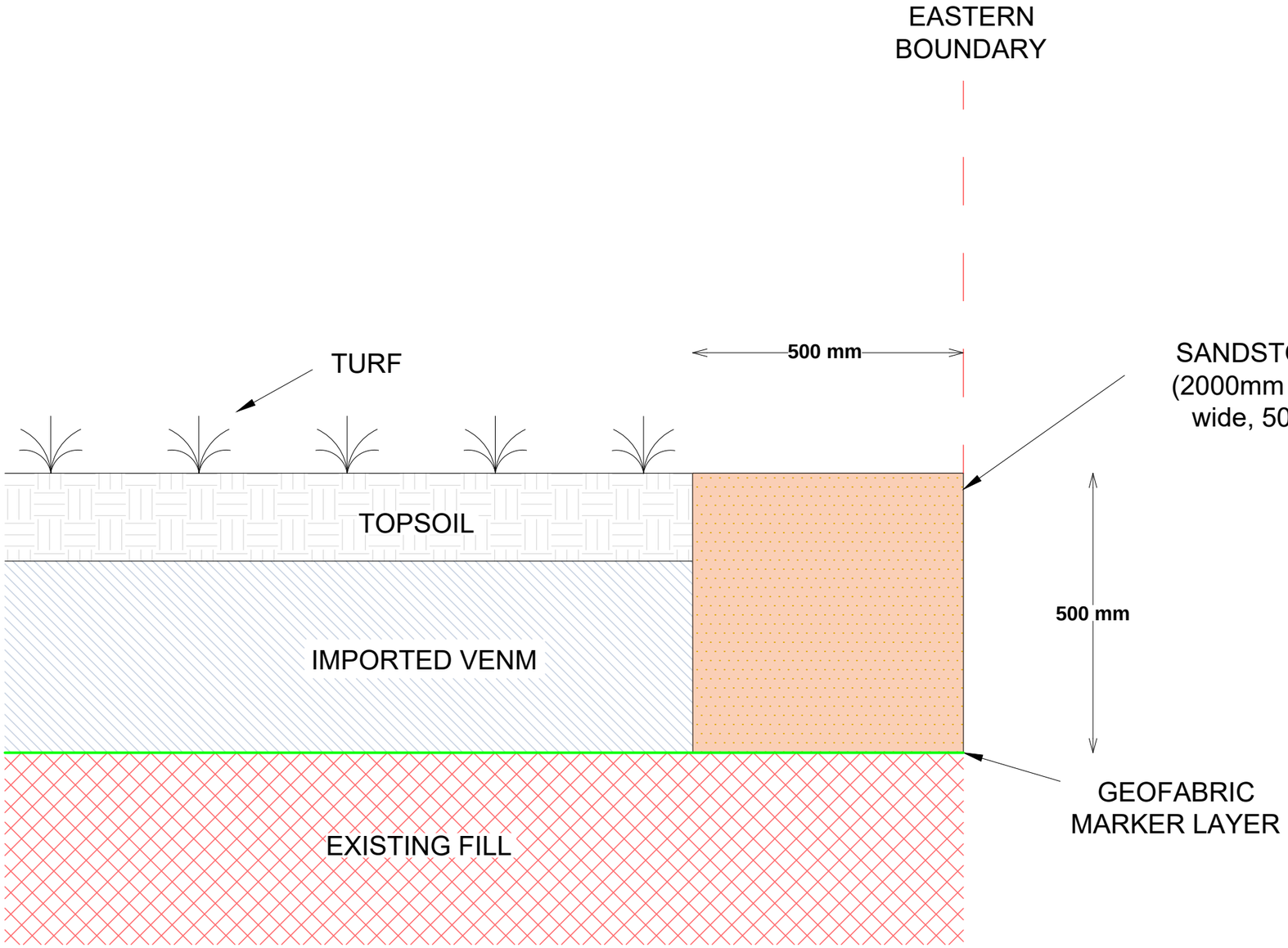
CLIENT: SJB Architects		TITLE: **Remediation Approach - Existing TPZ Areas**	PROJECT No: 99751.00
OFFICE: Sydney	DRAWN BY: JDB	**Kogarah War Memorial Pool**	DRAWING No: R.002-4
SCALE: N.T.S	DATE: 24.9.2020	**Carss Park**	REVISION: 2



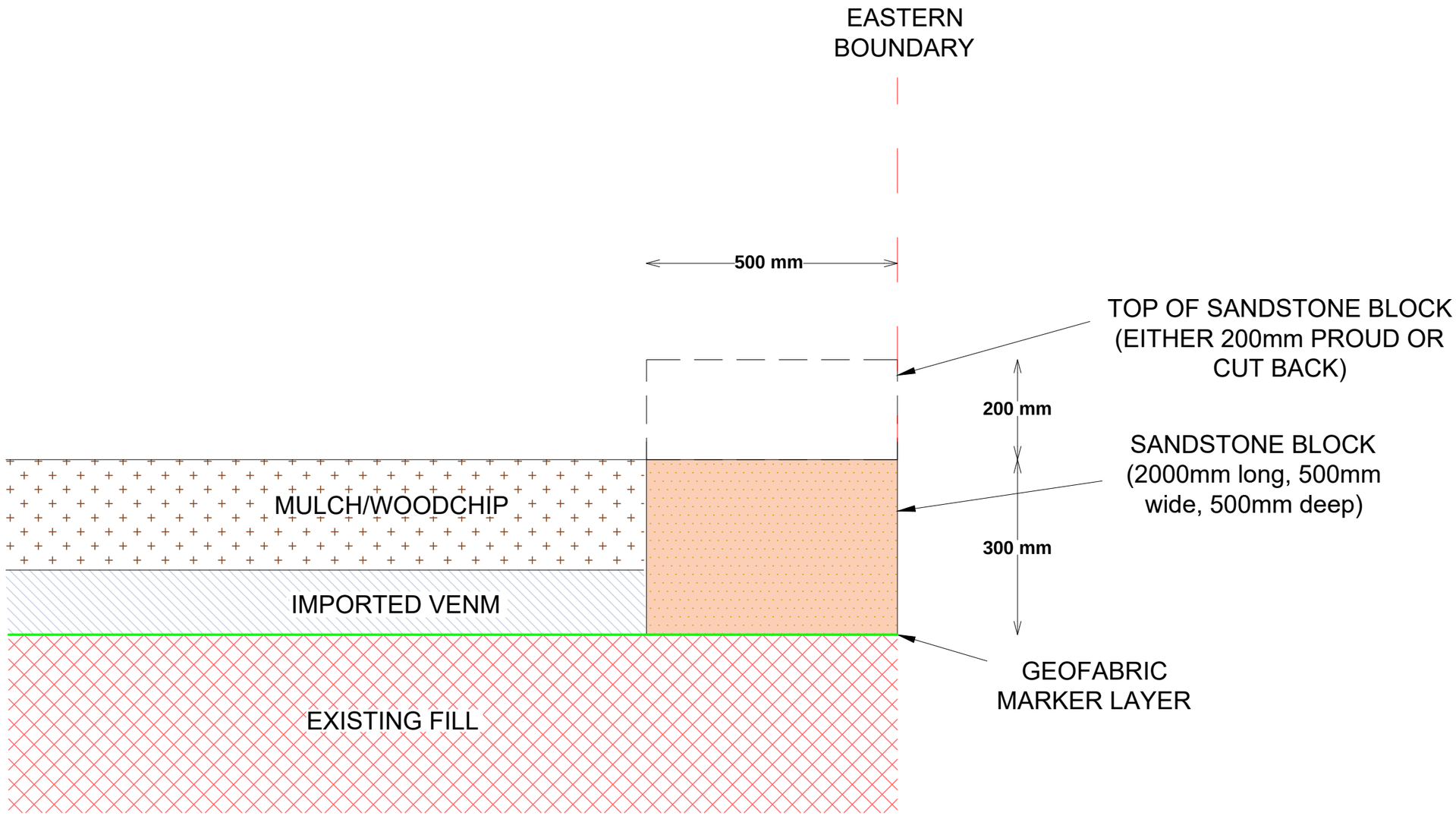
NOTE: Width and length of deeper topsoil area to be confirmed with arborist and landscape consultant

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: SJB Architects	TITLE: **Remediation Approach - Deeper Tree Planting** **Kogarah War Memorial Pool** **Carss Park**	PROJECT No: 99751.00
	OFFICE: Sydney / DRAWN BY: JDB		DRAWING No: R.002-5
	SCALE: N.T.S / DATE: 11.9.2020		REVISION: 0

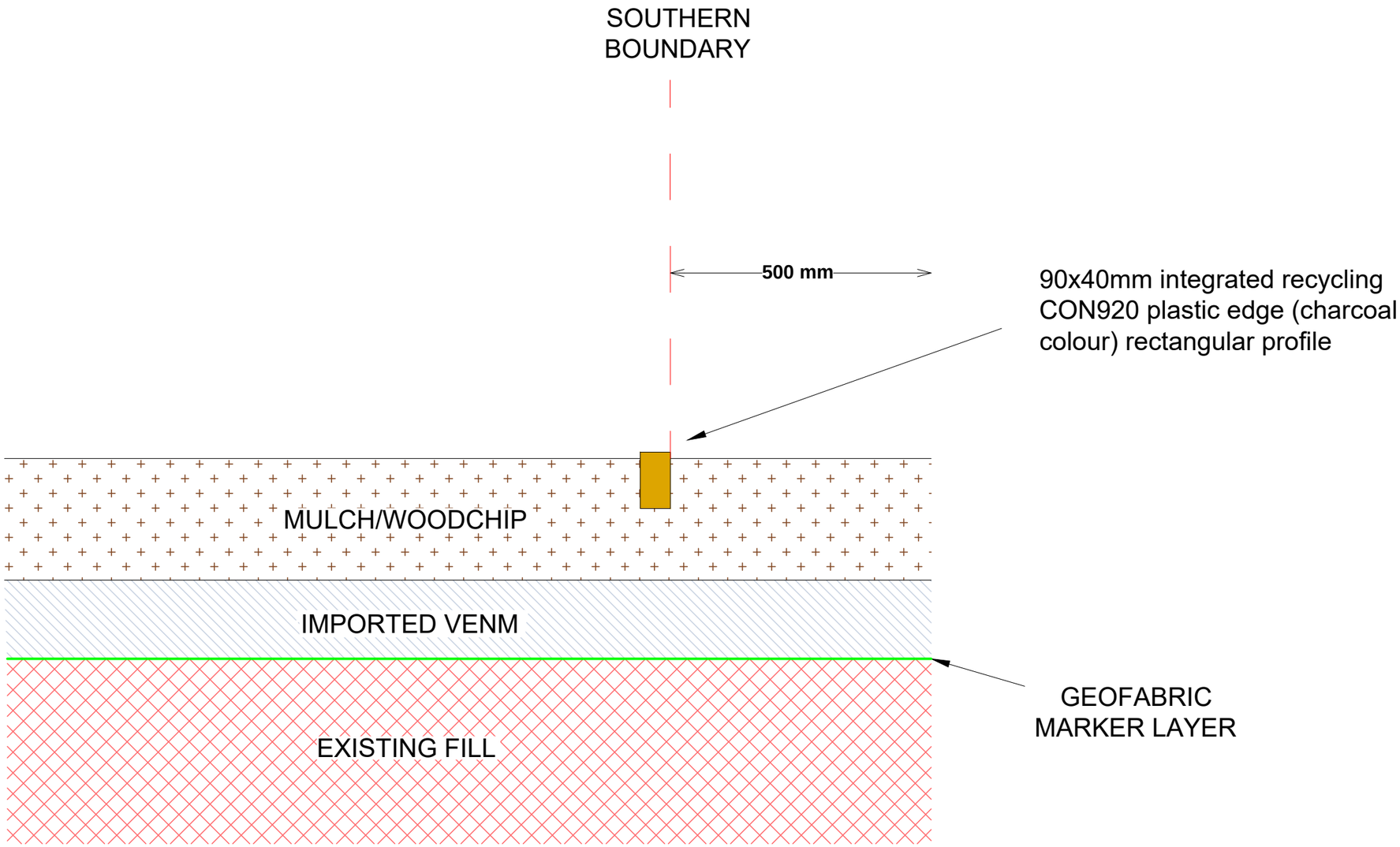


Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: SJB Architects		TITLE: **Capping Approach - Eastern Boundary**	PROJECT No: 99751.00
OFFICE: Sydney	DRAWN BY: JDB	**Kogarah War Memorial Pool**	DRAWING No: R.002 - 6
SCALE: N.T.S	DATE: 24.9.2020	**Carss Park**	REVISION: 0



Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: SJB Architects		TITLE: **Capping Approach - Eastern Boundary within TPZ (Type 2)** **Kogarah War Memorial Pool** **Carss Park**	PROJECT No: 99751.00
	OFFICE: Sydney	DRAWN BY: JDB		DRAWING No: R.002 - 7
	SCALE: N.T.S	DATE: 24.9.2020		REVISION: 0



NOTE: Works not to extend into Carss Cottage state heritage listing curtilage

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: SJB Architects		TITLE: **Capping Approach - Southern Boundary within TPZ (Type 2)** **Kogarah War Memorial Pool** **Carss Park**	PROJECT No: 99751.00
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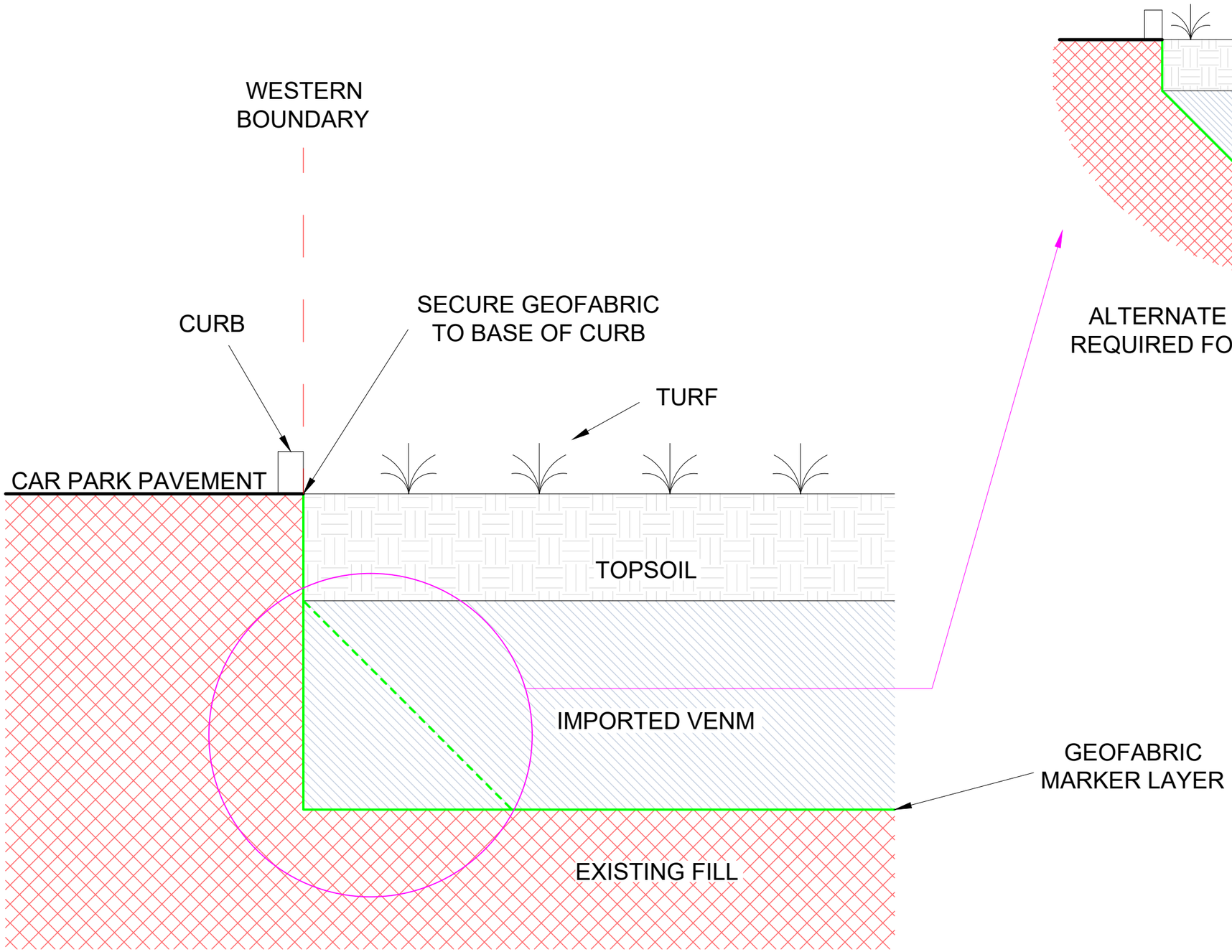
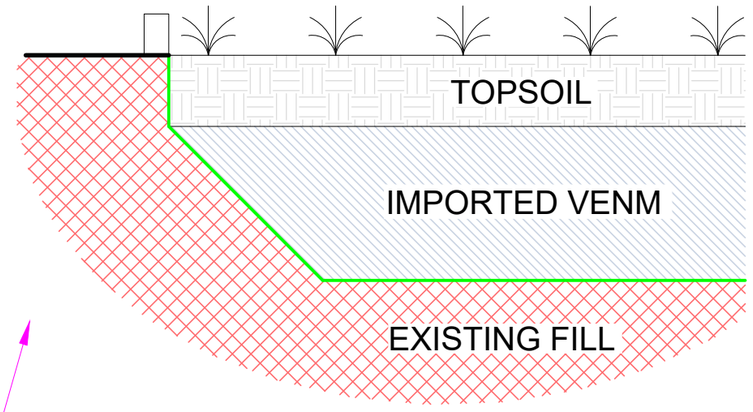
	SCALE: N.T.S	DATE: 24.9.2020		REVISION: 0

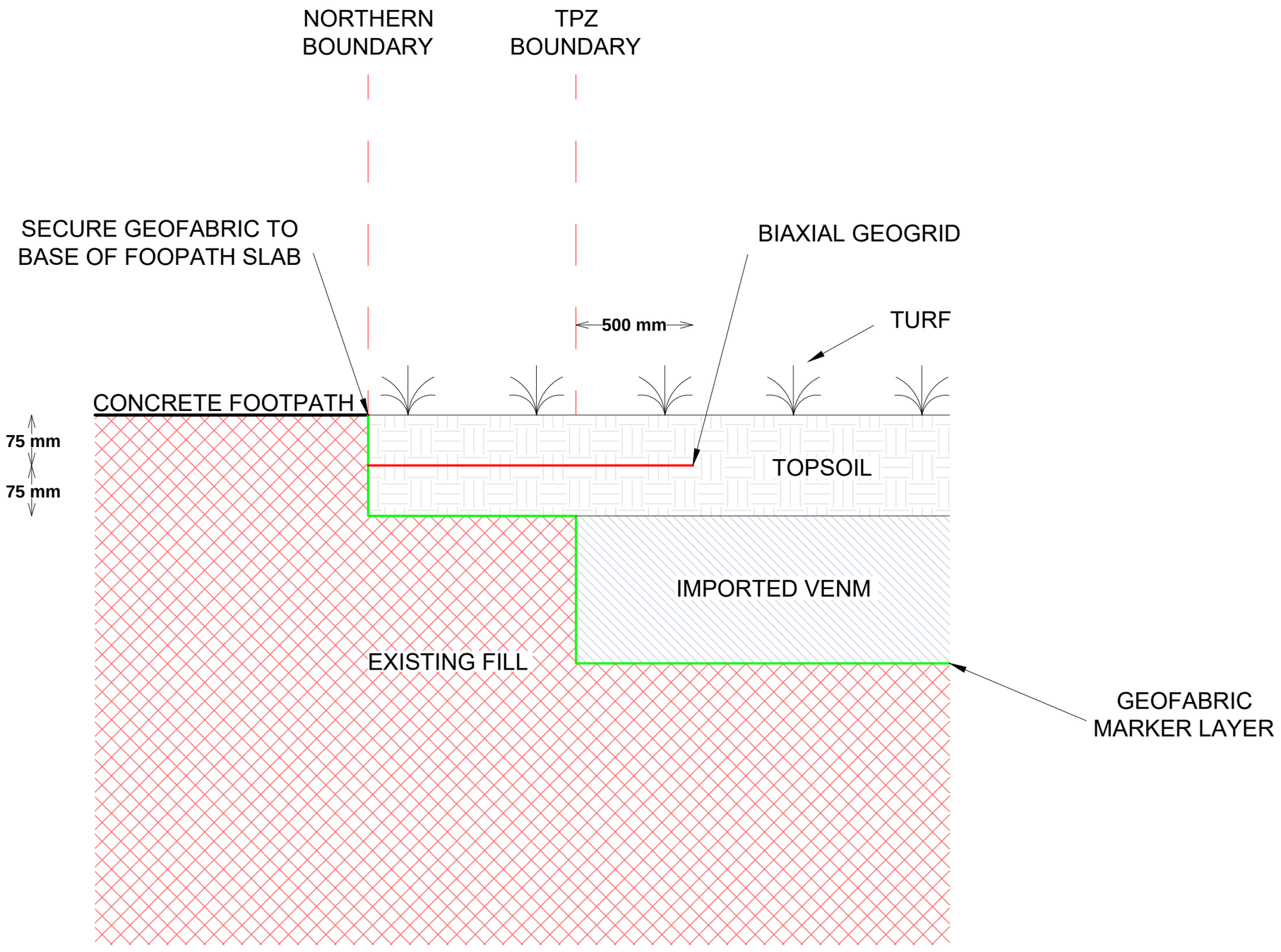




ALTERNATE APPROACH IF BATTERING IS REQUIRED FOR GEOTECHNICAL PURPOSES

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: SJB Architects		TITLE: **Capping Approach - Western Boundary**	PROJECT No: 99751.00
OFFICE: Sydney	DRAWN BY: JDB	**Kogarah War Memorial Pool**	DRAWING No: R.002 - 9
SCALE: N.T.S	DATE: 24.9.2020	**Carss Park**	REVISION: 0



Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: SJB Architects	TITLE: **Capping Approach - Northern Boundary within TPZ (Type 3)** **Kogarah War Memorial Pool** **Carss Park**	PROJECT No: 99751.00
	OFFICE: Sydney DRAWN BY: JDB		DRAWING No: R.002 - 10
	SCALE: N.T.S DATE: 24.9.2020		REVISION: 0

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

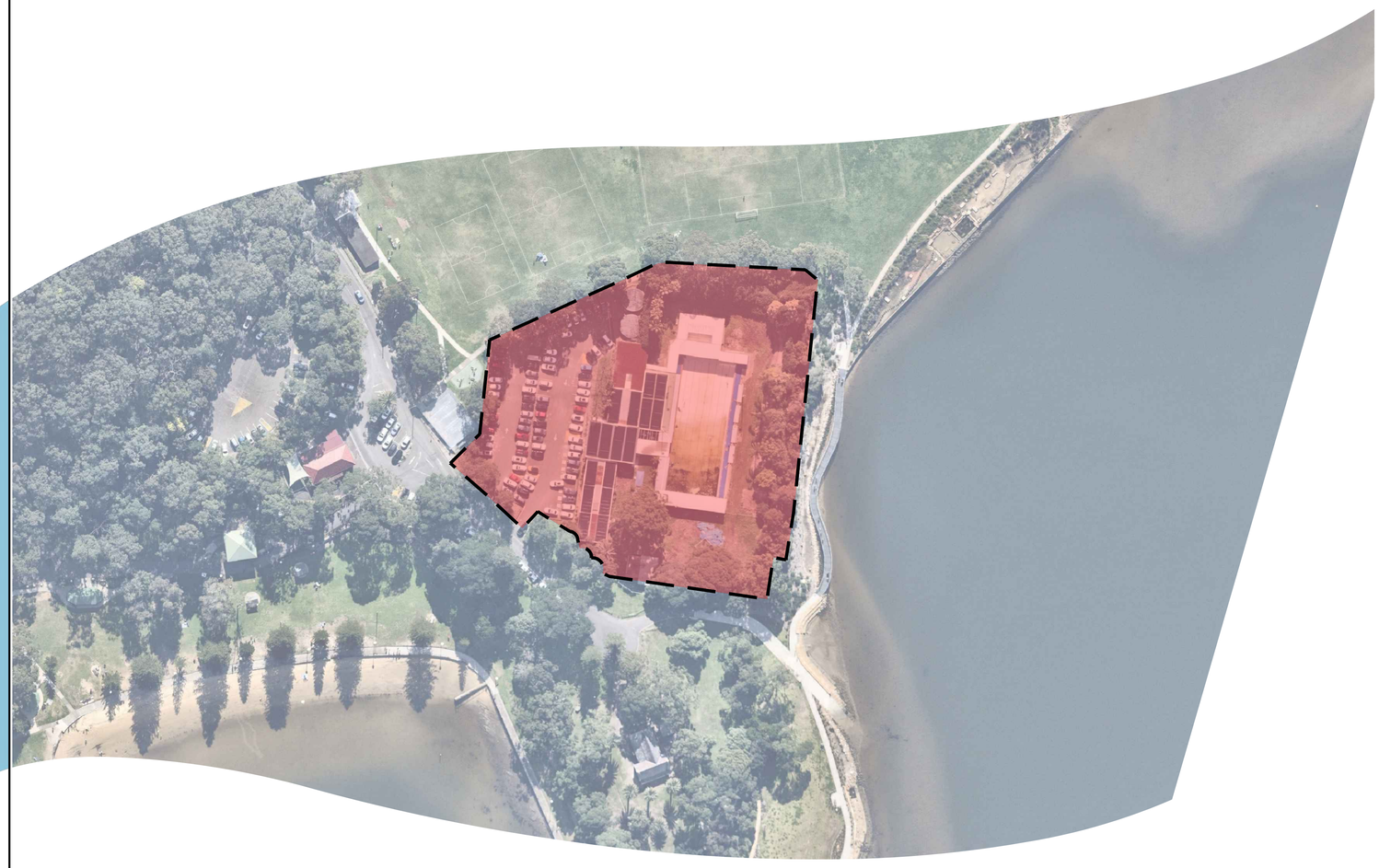
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate 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

Civil Drawings



SJB ARCHITECTS

KOGARAH WAR MEMORIAL POOL
CARWAR AVENUE, CARSS PARK
DEVELOPMENT APPLICATION

DRAWING SCHEDULE

DRAWING NUMBER	DESCRIPTION
200060-DA-C01.01	COVER SHEET AND DRAWING SCHEDULE
200060-DA-C01.21	GENERAL ARRANGEMENT PLAN
200060-DA-C03.01	EROSION AND SEDIMENTATION CONTROL PLAN
200060-DA-C03.21	EROSION AND SEDIMENTATION CONTROL DETAILS
200060-DA-C04.01	CUT AND FILL PLAN
200060-DA-C04.10	REMEDIATION PLAN
200060-DA-C05.01	SITEWORKS AND STORMWATER MANAGEMENT PLAN
200060-DA-C09.01	SITE SECTIONS

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
5	24/09/2020	ISSUED FOR DEVELOPMENT APPLICATION	JT	RT	AD	AD
4	11/09/2020	ISSUED FOR DEVELOPMENT APPLICATION	CB	RT	AD	AD
3	09/09/2020	ISSUED FOR REVIEW	CB	RT	AD	AD
2	27/08/2020	ISSUED FOR REVIEW	CB	RT	AD	AD
1	26/08/2020	ISSUED FOR REVIEW	CB	RT	AD	AD

Client

Scale
0 20 40 60 80 100m
SCALE 1:1000 @A1

North

Enspire Solutions Pty Ltd
205/275 Alfred Street N, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135

Scale: 1:1000
Date: 26/08/2020
Size: A1
Datum: AHD

Status: FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION

Project Number/Drawing Number: 200060-DA-C01.01
Revision: 5

DATE PLOTTED: 24 September 2020 3:03 PM BY : JADE TAI

CAD File: P:\200060 KogarahPool\D-Civil\00-SiteWide\Drawings\6-DACC\200060-DA-C01.01 COVERSHEET.dwg

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
2	11/09/2020	ISSUED FOR DEVELOPMENT APPLICATION	CB	RT	AD	AD
1	09/09/2020	ISSUED FOR REVIEW	CB	RT	AD	AD

Client

Scale: 0 10 20 30 40 50m — SCALE 1:500 @A1

North

Enspire Solutions Pty Ltd
205/275 Alfred Street N, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135

Project: KOGARAH WAR MEMORIAL POOL
CARWAR AVENUE, CARSS PARK
DEVELOPMENT APPLICATION

Title: GENERAL ARRANGEMENT PLAN

Scale: 1:500
Date: 09/09/2020
Size: A1
Datum: AHD

Status: FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION

Project Number/Drawing Number: 200060-DA-C01.21

Revision: 2

DATE PLOTTED: 24 September 2020 3:03 PM BY: - JADE TAI

CAD File: P:\200060 KogarahPool\D-Civil\00-SiteWide\Drawings\6-DACC\200060-DA-C01.21 GENERAL ARRANGEMENT PLAN.dwg

LEGEND

- SITE FENCE
- SITE ENTRY/EXIT
- TEMPORARY CONSTRUCTION EXIT (WASH DOWN DETAIL)
- SEDIMENT FENCE (SD 6-8)
- MESH AND GRAVEL INLET FILTER (SD 6-11)
- GEOTEXTILE INLET FILTER (SD 6-12)
- TREE PROTECTION ZONE (TPZ)

EROSION AND SEDIMENT CONTROL

GENERAL INSTRUCTIONS

1. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR THE CONTROL OF EROSION AND SEDIMENTATION TO THE SATISFACTION OF COUNCIL, NSW OFFICE OF WATER, OFFICE OF ENVIRONMENT AND HERITAGE. THE EROSION AND SEDIMENTATION CONTROLS SHOWN ON THE DRAWINGS SHALL ONLY BE USED AS A GUIDE BY THE CONTRACTOR, AND SHALL REPRESENT THE MINIMUM REQUIREMENT ONLY.

2. THE CONTRACTOR SHALL ENSURE THAT ALL SOIL AND WATER MANAGEMENT WORKS ARE LOCATED AS DOCUMENTED OR AS OTHERWISE DIRECTED BY THE SUPERINTENDENT.
   ALL WORK SHALL BE GENERALLY CARRIED OUT IN ACCORDANCE WITH
   a. LOCAL AUTHORITY REQUIREMENTS
   b. EPA REQUIREMENTS
   c. LANDCOM MANUAL "MANAGING URBAN STORMWATER, SOILS AND CONSTRUCTION", 4th EDITION, MARCH 2004.

3. MAINTAIN THE EROSION CONTROL DEVICES TO THE SATISFACTION OF THE SUPERINTENDENT AND THE LOCAL AUTHORITY.

4. WHEN STORMWATER PITS ARE CONSTRUCTED, PREVENT SITE RUNOFF ENTERING UNLESS SEDIMENT FENCES ARE ERECTED AROUND PITS.

5. CONTRACTOR IS TO ENSURE ALL EROSION & SEDIMENT CONTROL DEVICES ARE MAINTAINED IN GOOD WORKING ORDER AND OPERATE EFFECTIVELY. REPAIRS AND OR MAINTENANCE SHALL BE UNDERTAKEN AS REQUIRED, PARTICULARLY FOLLOWING STORM EVENTS.

LAND DISTURBANCE

6. WHERE PRACTICAL, THE SOIL EROSION HAZARD ON THE SITE WILL BE KEPT AS LOW AS POSSIBLE. TO THIS END, WORKS SHOULD BE UNDERTAKEN IN THE FOLLOWING SEQUENCE:
   a. INSTALL A SEDIMENT FENCE ALONG THE BOUNDARIES AS SHOWN ON PLAN. REFER DETAIL.
   b. CONSTRUCT STABILISED CONSTRUCTION ENTRANCE TO LOCATION AS DETERMINED BY SUPERINTENDENT/ENGINEER. REFER DETAIL.
   c. INSTALL SEDIMENT BASIN AS SHOWN ON PLAN, INSTALL SEDIMENT TRAPS AS SHOWN ON PLAN.
   d. UNDERTAKE SITE DEVELOPMENT WORKS IN ACCORDANCE WITH THE ENGINEERING PLANS. WHERE POSSIBLE, PHASE DEVELOPMENT SO THAT LAND DISTURBANCE IS CONFINED TO AREAS OF WORKABLE SIZE.

EROSION CONTROL

7. DURING WINDY WEATHER, LARGE, UNPROTECTED AREAS WILL BE KEPT MOIST (NOT WET) BY SPRINKLING WITH WATER TO KEEP DUST UNDER CONTROL.

8. FINAL SITE LANDSCAPING WILL BE UNDERTAKEN AS SOON AS POSSIBLE AND WITHIN 20 WORKING DAYS FROM COMPLETION OF CONSTRUCTION ACTIVITIES.

SEDIMENT CONTROL

9. STOCKPILES WILL NOT BE LOCATED WITHIN 2 METRES OF HAZARD AREAS, INCLUDING LIKELY AREAS OF CONCENTRATED OR HIGH VELOCITY FLOWS SUCH AS WATERWAYS. WHERE THEY ARE BETWEEN 2 AND 5 METRES FROM SUCH AREAS, SPECIAL SEDIMENT CONTROL MEASURES SHOULD BE TAKEN TO MINIMISE POSSIBLE POLLUTION TO DOWNSLOPE WATERS, E.G. THROUGH INSTALLATION OF SEDIMENT FENCING.

10. ANY SAND USED IN THE CONCRETE CURING PROCESS (SPREAD OVER THE SURFACE) WILL BE REMOVED AS SOON AS POSSIBLE AND WITHIN 10 WORKING DAYS FROM PLACEMENT.

11. WATER WILL BE PREVENTED FROM ENTERING THE PERMANENT DRAINAGE SYSTEM UNLESS IT IS RELATIVELY SEDIMENT FREE, I.E. THE CATCHMENT AREA HAS BEEN PERMANENTLY LANDSCAPED AND/OR ANY LIKELY SEDIMENT HAS BEEN FILTERED THROUGH AN APPROVED STRUCTURE.

12. TEMPORARY SOIL AND WATER MANAGEMENT STRUCTURES WILL BE REMOVED ONLY AFTER THE LANDS THEY ARE PROTECTING ARE REHABILITATED.

13. ACCEPTABLE RECEPTORS WILL BE PROVIDED FOR CONCRETE AND MORTAR SLURRIES, PAINTS, ACID WASHINGS, LIGHT-WEIGHT WASTE MATERIALS AND LITTER.

14. ANY EXISTING TREES WHICH FORM PART OF THE FINAL LANDSCAPING PLAN WILL BE PROTECTED FROM CONSTRUCTION ACTIVITIES BY:
   a. PROTECTING THEM WITH BARRIER FENCING OR SIMILAR MATERIALS INSTALLED OUTSIDE THE DRIP LINE
   b. ENSURING THAT NOTHING IS NAILED TO THEM
   c. PROHIBITING PAVING, GRADING, SEDIMENT WASH OR PLACING OF STOCKPILES WITHIN THE DRIP LINE EXCEPT UNDER THE FOLLOWING CONDITIONS.
   (I) ENCROACHMENT ONLY OCCURS ON ONE SIDE AND NO CLOSER TO THE TRUNK THAN EITHER 1.5 METRES OR HALF THE DISTANCE BETWEEN THE OUTER EDGE OF THE DRIP LINE AND THE TRUNK, WHICH EVER IS THE GREATER
   (II) A DRAINAGE SYSTEM THAT ALLOWS AIR AND WATER TO CIRCULATE THROUGH THE ROOT ZONE (E.G. A GRAVEL BED) IS PLACED UNDER ALL FILL LAYERS OF MORE THAN 300 MILLIMETRES DEPTH
   (III) CARE IS TAKEN NOT TO CUT ROOTS UNNECESSARILY NOR TO COMPACT THE SOIL AROUND THEM.

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
3	24/09/2020	ISSUED FOR DEVELOPMENT APPLICATION	JT	RT	AD	AD
2	11/09/2020	ISSUED FOR DEVELOPMENT APPLICATION	CB	RT	AD	AD
1	09/09/2020	ISSUED FOR REVIEW	CB	RT	AD	AD

Client

Scale: 0 5 10 20 30m — SCALE 1:300 @A1

North

Enspire Solutions Pty Ltd
205/275 Alfred Street N, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135

Project: KOGARAH WAR MEMORIAL POOL
CARWAR AVENUE, CARSS PARK
DEVELOPMENT APPLICATION

Title: EROSION AND SEDIMENTATION CONTROL PLAN

Scale: 1:300
Date: 09/09/2020
Size: A1
Datum: AHD

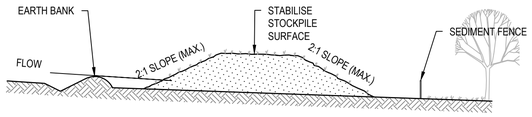
Status: FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION

Project Number/Drawing Number: 200060-DA-C03.01

Revision: 3

DATE PLOTTED: 24 September 2020 3:03 PM BY : JADE TAI

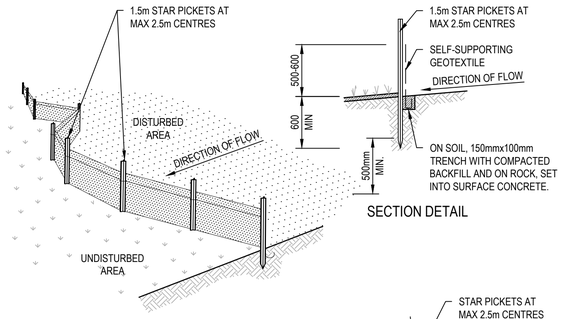
CAD File: P:\200060 KogarahPool\D-Civil\00-SiteWide\Drawings\6-DACC\200060-DA-C03.01 ERO AND SED PLAN.dwg



CONSTRUCTION NOTES

1. PLACE STOCKPILES MORE THAN 2m (PREFERABLY 5m) FROM EXISTING VEGETATION, CONCENTRATED WATER FLOW, ROADS AND HAZARD AREAS.
2. CONSTRUCT ON THE CONTOUR AS LOW, FLAT, ELONGATED MOUNDS.
3. WHERE THERE IS SUFFICIENT AREA, TOPSOIL STOCKPILES SHALL BE LESS THAN 2m IN HEIGHT.
4. WHERE THEY ARE TO BE IN PLACE FOR MORE THAN 10 DAYS, STABILISE FOLLOWING THE APPROVED ESCP OR SWMP TO REDUCE THE C-FACTOR TO LESS THAN 0.10.
5. CONSTRUCT EARTH BANKS (STANDARD DRAWING 5-5) ON THE UPSLOPE SIDE TO DIVERT WATER AROUND STOCKPILES AND SEDIMENT FENCES (STANDARD DRAWING 6-8) 1 TO 2m DOWNSLOPE.

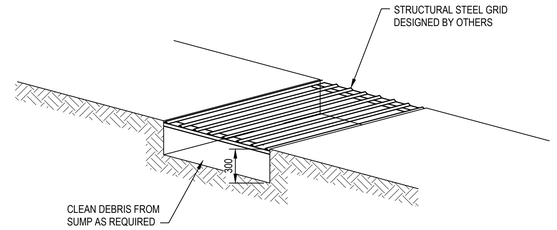
STOCKPILES (SD 4-1)



CONSTRUCTION NOTES

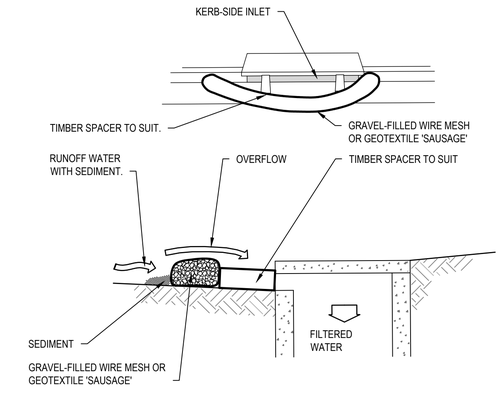
1. CONSTRUCT SEDIMENT FENCES AS CLOSE AS POSSIBLE TO BEING PARALLEL TO THE CONTOURS OF THE SITE, BUT WITH SMALL RETURNS AS SHOWN IN THE DRAWING TO LIMIT THE CATCHMENT AREA OF ANY ONE SECTION. THE CATCHMENT AREA SHOULD BE SMALL ENOUGH TO LIMIT WATER FLOW IF CONCENTRATED AT ONE POINT TO 50 LITRES PER SECOND IN THE DESIGN STORM EVENT, USUALLY THE 10-YEAR EVENT.
2. CUT A 150mm DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.
3. DRIVE 1.5 METRE LONG STAR PICKETS INTO GROUND AT 2.5 METRE INTERVALS (MAX) AT THE DOWNSLOPE EDGE OF THE TRENCH. ENSURE ANY STAR PICKETS ARE FITTED WITH SAFETY CAPS.
4. FIX SELF-SUPPORTING GEOTEXTILE TO THE UPSLOPE SIDE OF THE POSTS ENSURING IT GOES TO THE BASE OF THE TRENCH. FIX THE GEOTEXTILE WITH WIRE TIES OR AS RECOMMENDED BY THE MANUFACTURER. ONLY USE GEOTEXTILE SPECIFICALLY PRODUCED FOR SEDIMENT FENCING. THE USE OF SHADE CLOTH FOR THIS PURPOSE IS NOT SATISFACTORY.
5. JOIN SECTIONS OF FABRIC AT A SUPPORT POST WITH A 150mm OVERLAP.
6. BACKFILL THE TRENCH OVER THE BASE OF THE FABRIC AND COMPACT IT THOROUGHLY OVER THE GEOTEXTILE.

SEDIMENT FENCE (SD 6-8)



SHAKER PAD

NOT TO SCALE

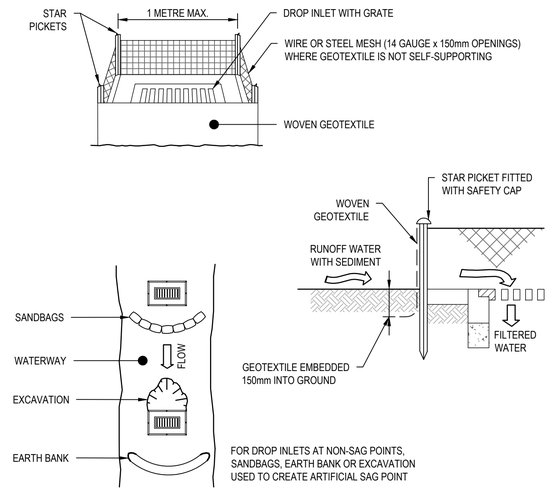


NOTE:THIS PRACTICE ONLY TO BE USED WHERE SPECIFIED IN APPROVED SWMP/ESCP.

CONSTRUCTION NOTES

1. INSTALL FILTERS TO KERB INLETS ONLY AT SAG POINTS.
2. FABRICATE A SLEEVE MADE FROM GEOTEXTILE OR WIRE MESH LONGER THAN THE LENGTH OF THE INLET PIT AND FILL IT WITH 25mm TO 50mm GRAVEL.
3. FORM AN ELLIPTICAL CROSS-SECTION ABOUT 150mm HIGH x 400mm WIDE.
4. PLACE THE FILTER AT THE OPENING LEAVING AT LEAST A 100mm SPACE BETWEEN IT AND THE KERB INLET. MAINTAIN THE OPENING WITH SPACER BLOCKS.
5. FORM A SEAL WITH THE KERB TO PREVENT SEDIMENT BYPASSING THE FILTER.
6. SANDBAGS FILLED WITH GRAVEL CAN SUBSTITUTE FOR THE MESH OR GEOTEXTILE PROVIDING THEY ARE PLACED SO THAT THEY FIRMLY ABUT EACH OTHER AND SEDIMENT-LADEN WATERS CANNOT PASS BETWEEN.

MESH AND GRAVEL INLET FILTER (SD 6-11)



CONSTRUCTION NOTES

1. FABRICATE A SEDIMENT BARRIER MADE FROM GEOTEXTILE OR STRAW BALES.
2. FOLLOW STANDARD DRAWING 6-7 AND STANDARD DRAWING 6-8 FOR INSTALLATION PROCEDURES FOR THE STRAW BALES OR GEOFABRIC. REDUCE THE PICKET SPACING TO 1 METRE CENTRES.
3. IN WATERWAYS, ARTIFICIAL SAG POINTS CAN BE CREATED WITH SANDBAGS OR EARTH BANKS AS SHOWN IN THE DRAWING.
4. DO NOT COVER THE INLET WITH GEOTEXTILE UNLESS THE DESIGN IS ADEQUATE TO ALLOW FOR ALL WATERS TO BYPASS IT.

GEOTEXTILE INLET FILTER (SD 6-12)

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF	APPD.
1	09/09/2020	ISSUED FOR REVIEW	CB	RT	AD	AD

Client

Scale
H: 0 10 20 30 40 50m
V: 0 2 4 6 8 10m
SCALE: H:1:500 V:1:100 @A1

North

Enspire Solutions Pty Ltd
205/275 Alfred Street N, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135

Project: KOGARAH WAR MEMORIAL POOL
CARWAR AVENUE, CARSS PARK
DEVELOPMENT APPLICATION

Scale: N.T.S
Date: 09/09/2020

Status: FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION

Title: EROSION AND SEDIMENTATION CONTROL DETAILS

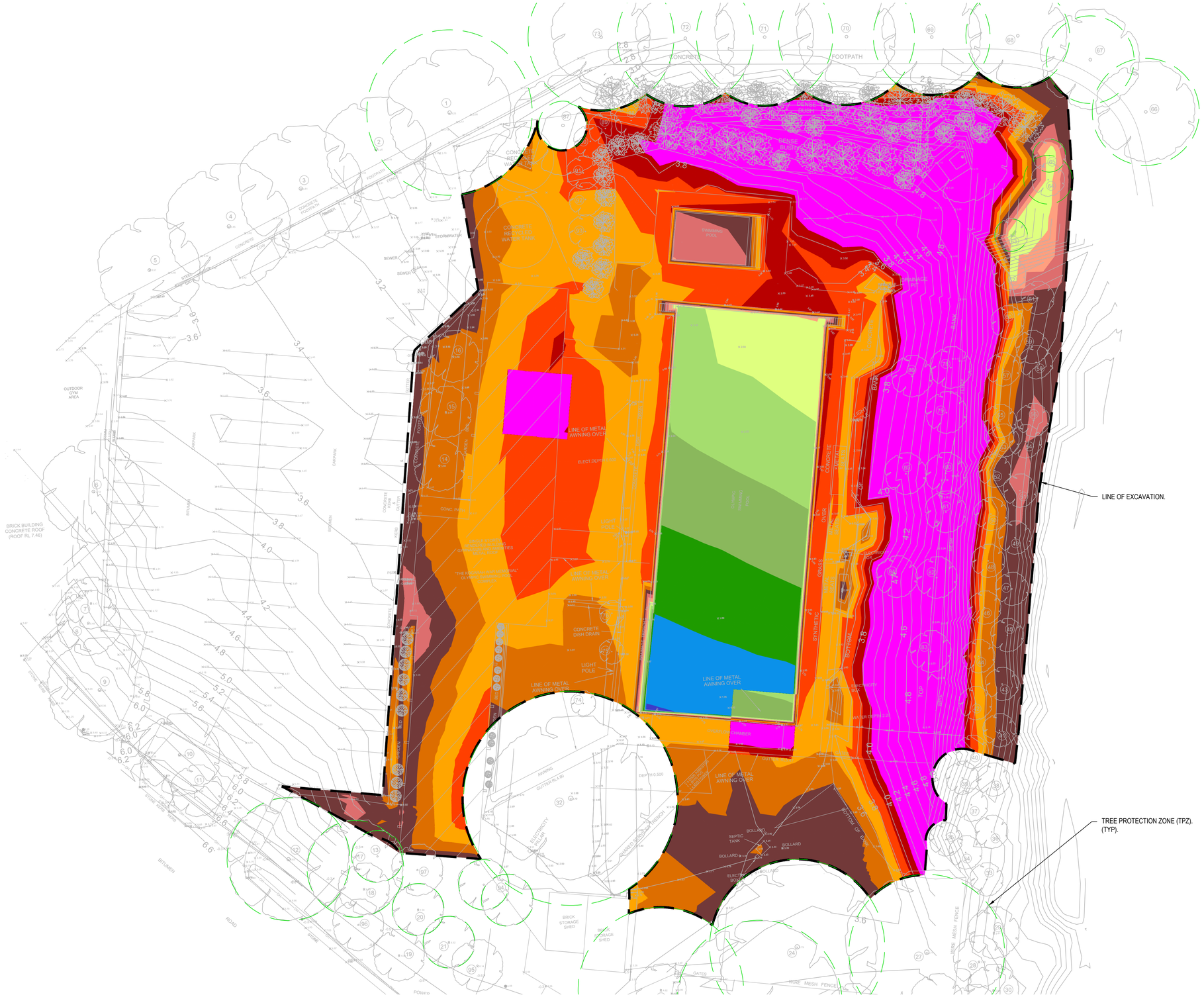
Size: A1
Datum: AHD

Project Number/Drawing Number: 200060-DA-C03.21

Revision: 1

DATE PLOTTED: 24 September 2020 3:03 PM BY: JADE TAI

CAD File: P:\200060 KogarahPool\D-Civil\00-SiteWide\Drawings\6-DACC\200060-DA-C03.21 EROS AND SED DETAILS.dwg



CUT AND FILL LEGEND

- GREATER THAN 1.4m CUT
- 1.2m TO 1.4m CUT
- 1.0m TO 1.2m CUT
- 0.8m TO 1.0m CUT
- 0.6m TO 0.8m CUT
- 0.4m TO 0.6m CUT
- 0.2m TO 0.4m CUT
- 0.0m TO 0.2m CUT
- 0.0m TO 0.2m FILL
- 0.2m TO 0.4m FILL
- 0.4m TO 0.6m FILL
- 0.6m TO 0.8m FILL
- 0.8m TO 1.0m FILL
- 1.0m TO 1.2m FILL
- GREATER THAN 1.2m FILL

CUT AND FILL VOLUMES

1. REFER SPECIFICATION NOTES FOR EARTHWORKS GENERAL REQUIREMENTS.
2. ALL WORKS TO BE CARRIED OUT IN ACCORDANCE WITH COUNCIL/RELEVANT AUTHORITY SPECIFICATIONS AND DETAILS.
3. NO ALLOWANCE HAS BEEN MADE FOR BULKING FACTORS. NOTE ALL VOLUMES DEPICTED ARE SOLID VOLUMES ONLY AND MAY NOT REFLECT DETAILED EARTHWORKS.
4. NO ALLOWANCE HAS BEEN MADE FOR DETAILED EARTHWORKS. ie SERVICE TRENCHING, DETAILED EXCAVATION AND THE LIKE.
5. APPROXIMATE BULK EARTHWORK VALUES AS FOLLOWS;

5.1 CUT TO BE REMOVED FROM SITE 6,693 m³

5.2 CLEAN BACKFILL TO POOL 455 m³

5.3 CLEAN FILL FOR CAPPING LATER 3,621 m³

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
5	24/09/2020	ISSUED FOR DEVELOPMENT APPLICATION	JT	RT	AD	AD
4	11/09/2020	ISSUED FOR DEVELOPMENT APPLICATION	CB	RT	AD	AD
3	09/09/2020	ISSUED FOR REVIEW	CB	RT	AD	AD
2	27/08/2020	ISSUED FOR REVIEW	CB	RT	AD	AD
1	26/08/2020	ISSUED FOR REVIEW	CB	RT	AD	AD

Client

Scale: 0 5 10 15 20 25m — SCALE 1:250 @A1

North

Enspire Solutions Pty Ltd
205/275 Alfred Street N, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135

Project: KOGARAH WAR MEMORIAL POOL
CARWAR AVENUE, CARSS PARK
DEVELOPMENT APPLICATION

Title: CUT AND FILL PLAN

Scale: 1:250

Date: 26/08/2020

Size: A1

Datum: AHD

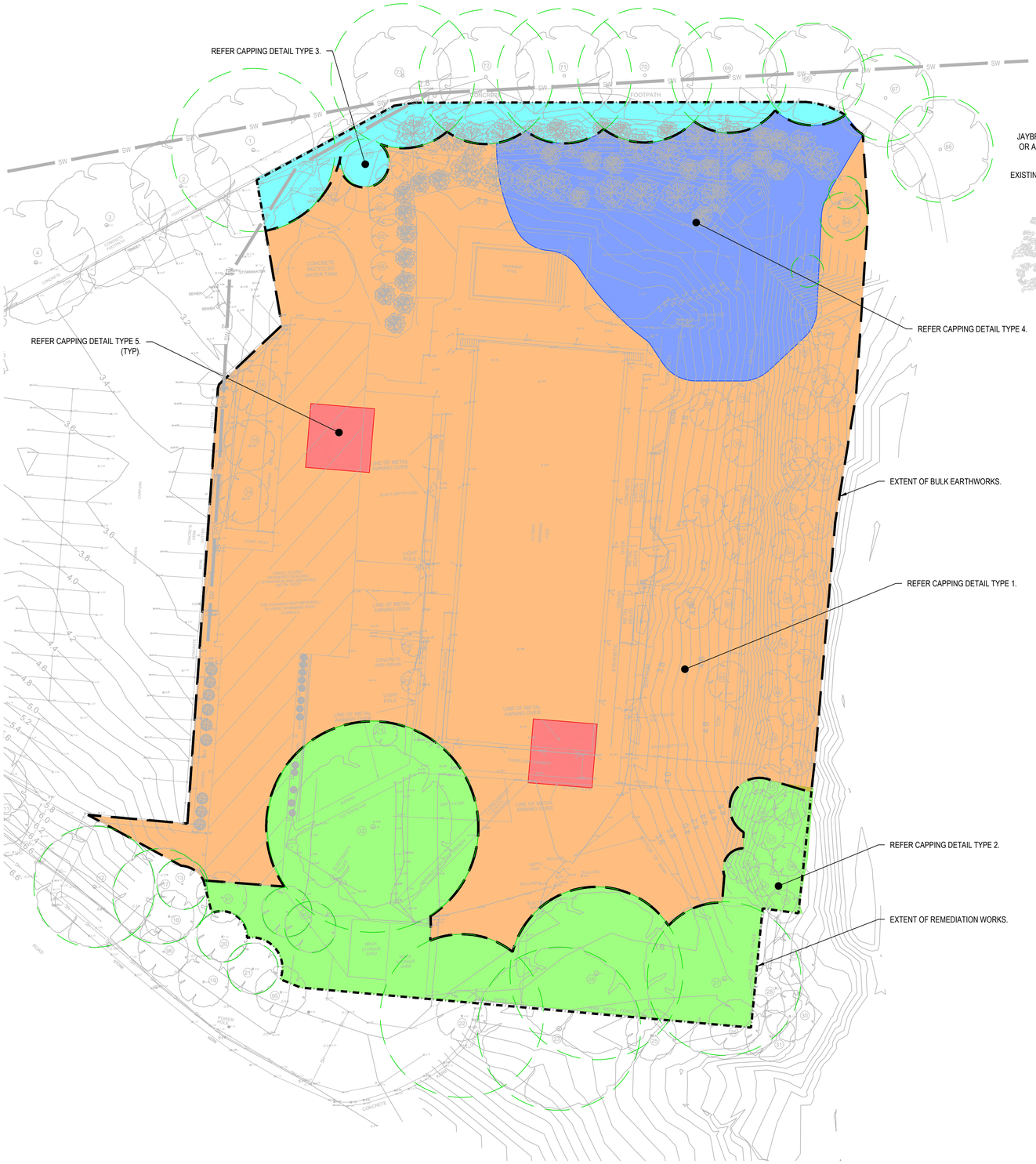
Status: FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION

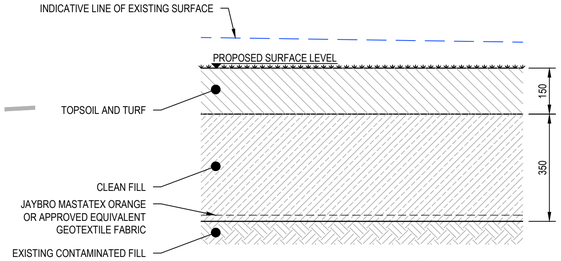
Project Number/Drawing Number: 200060-DA-C04.01

Revision: 5

DATE PLOTTED: 24 September 2020 3:11 PM BY: - JADE TAI

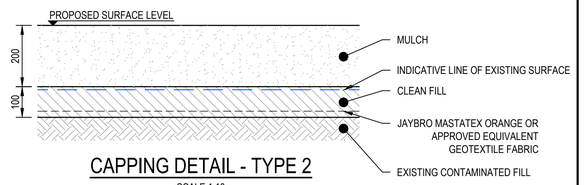
CAD File: P:\200060 KogarahPool\D-Civil\00-SiteWide\Drawings\6-DACC\200060-DA-C04.01 CUT AND FILL.dwg





CAPPING DETAIL - TYPE 1

SCALE 1:10



CAPPING DETAIL - TYPE 2

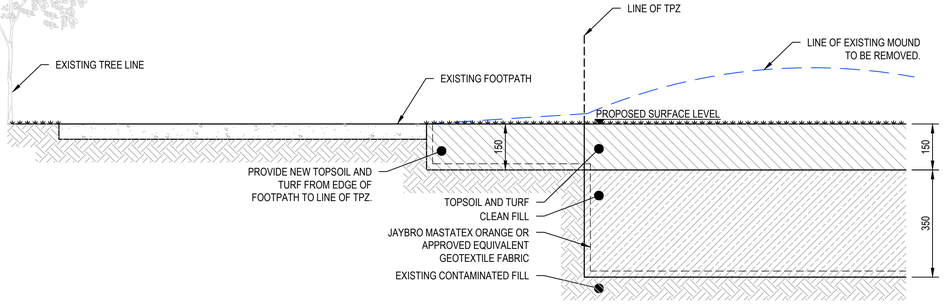
SCALE 1:10

NOTE:

1. STRIP EXISTING TOPSOIL 100mm PRIOR TO 300mm CAPPING.

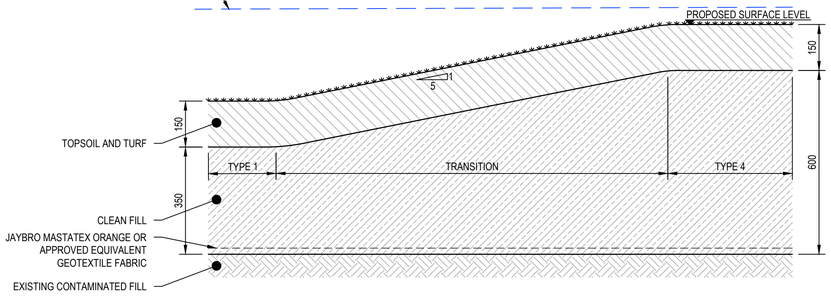
NOTES

1. REFER GEOTECHNICAL REPORT PREPARED BY DOUGLAS PARTNERS FOR REMEDIATION REQUIREMENTS.



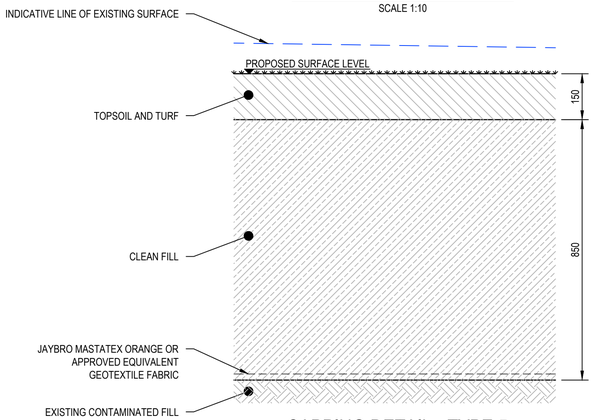
CAPPING DETAIL - TYPE 3

SCALE 1:10



CAPPING DETAIL - TYPE 4

SCALE 1:10



CAPPING DETAIL - TYPE 5

SCALE 1:10

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
4	24/09/2020	ISSUED FOR DEVELOPMENT APPLICATION	JT	RT	AD	AD
3	14/09/2020	ISSUED FOR DEVELOPMENT APPLICATION	CB	RT	AD	AD
2	11/09/2020	ISSUED FOR DEVELOPMENT APPLICATION	CB	RT	AD	AD
1	09/09/2020	ISSUED FOR REVIEW	CB	RT	AD	AD

Client: SJB

Scale: 0 5 10 20 30m — SCALE 1:300 @A1

0 200 400 600 800 1000mm — SCALE 1:10 @A1

North

enspire
Enspire Solutions Pty Ltd
205/275 Alfred Street N, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135

Project: KOGARAH WAR MEMORIAL POOL
CARWAR AVENUE, CARSS PARK
DEVELOPMENT APPLICATION

Title: REMEDIATION PLAN

Scale: AS SHOWN

Date: 09/09/2020

Size: A1

Datum: AHD

Status: FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION

Project Number/Drawing Number: 200060-DA-C04.10

Revision: 4

DATE PLOTTED: 24 September 2020 3:04 PM BY: - JADE TAI

CAD File: P:\200060 KogarahPool\D-Civil\00-SiteWide\Drawings\6-DACC\200060-DA-C04.10 REMEDIATION PLAN.dwg

INDICATIVE LOCATION OF EXISTING STORMWATER PIPE.

EXTENT OF WORKS. (TYP).

MAINTAIN EXISTING STORMWATER PIT. (TYP).

MAINTAIN EXISTING STORMWATER PIPE. (TYP).

MEMORIAL WALL

MAINTAIN EXISTING CARPARK.

INDICATIVE LOCATION OF RECYCLED WATER SERVICE

PROPOSED ABOVE GROUND RAINWATER TANK

250mm MOUND ZONE.

PROPOSED TURF TO MATCH THE EXISTING MULCH PLANTED AREA AT THE TOP OF THE EXISTING BATTER.

EXTENT OF BULK EARTHWORKS.

1m DEEP SOIL ZONE. (TYP).

EXTENT OF REMEDIATION WORKS.

TREE PROTECTION ZONE (TPZ). (TYP).

LEGEND

- 3.00 — PROPOSED CONTOUR
- 3.00 — EXISTING CONTOUR
- RW — IRRIGATION TANK PIPE TRENCH
- OVERLAND FLOW DIRECTION
- SW — EXISTING STORMWATER PIPE

NOTES

1. THE PROPOSED CONTOURS REPRESENT THE FINISHED SURFACE LEVEL. (TOP OF CAPPING MATERIAL).
2. REFER ARBORICULTURAL DEVELOPMENT ASSESSMENT REPORT FOR TPZ.

METHODOLOGY

1. STRIP EXISTING VEGETATION AND REMOVE TOPSOIL.
2. DEMOLISH EXISTING STRUCTURES INCLUDING BUILDINGS, POOL COPING AND PAVEMENTS.
3. EXCAVATE TO 500mm BELOW PROPOSED SURFACE LEVELS AND REMOVE FROM SITE IN ACCORDANCE WITH THE GEOTECHNICAL REPORT.
4. EXCAVATE 1m DEEP TREE PITS.
5. FILL POOL WITH CLEAN FILL MATERIAL TO 500mm BELOW PROPOSED SURFACE LEVEL.
6. COVER SITE WITH GEOTEXTILE LAYER.
7. FILL SITE WITH CLEAN MATERIAL (MIN 350mm FILL AND 150mm TOPSOIL).
8. TURF SITE.

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
5	24/09/2020	ISSUED FOR DEVELOPMENT APPLICATION	JT	RT	AD	AD
4	11/09/2020	ISSUED FOR DEVELOPMENT APPLICATION	CB	RT	AD	AD
3	09/09/2020	ISSUED FOR REVIEW	CB	RT	AD	AD
2	27/08/2020	ISSUED FOR REVIEW	CB	RT	AD	AD
1	26/08/2020	ISSUED FOR REVIEW	CB	RT	AD	AD

Client

Scale: 0 5 10 15 20 25m — SCALE 1:250 @A1

North

Enspire Solutions Pty Ltd
205/275 Alfred Street N, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135

Project: KOGARAH WAR MEMORIAL POOL
CARWAR AVENUE, CARSS PARK
DEVELOPMENT APPLICATION

Title: SITEWORKS AND STORMWATER MANAGEMENT PLAN

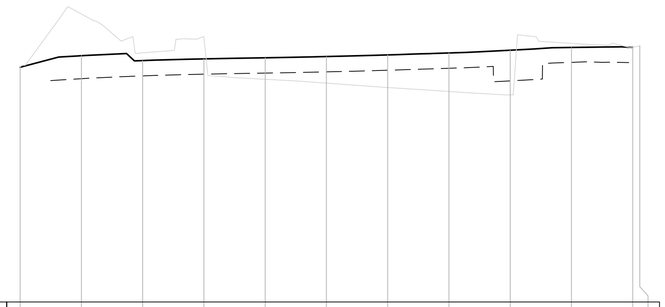
Scale: 1:250
Date: 26/08/2020
Size: A1
Datum: AHD

Status: FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION

Project Number/Drawing Number: 200060-DA-C05.01
Revision: 5

DATE PLOTTED: 24 September 2020 5:04 PM BY : JADE TAI

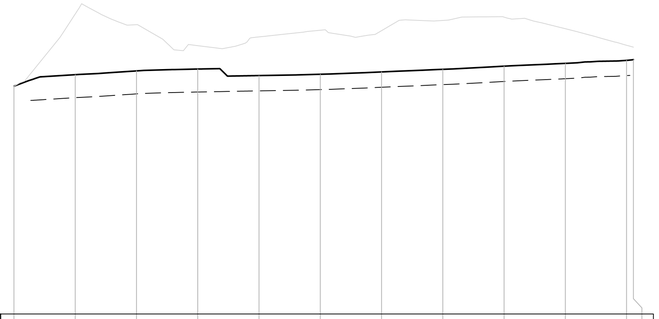
CAD File: P:\200060 KogarahPool\D-Civil\00-SiteWide\Drawings\6-DACC\200060-DA-C05.01 SITEWORKS PLAN.dwg



DATUM RL -5.0

EXISTING SURFACE	2.66	4.40	3.13	3.62	2.27	2.15	2.00	1.87	1.76	3.44	3.32	3.36
DESIGN SURFACE		3.04	2.88	2.94	2.97	3.01	3.06	3.13	3.22	3.31		
BULK SURFACE		2.29	2.38	2.44	2.47	2.51	2.56	2.63	2.22	2.82		
CHAINAGE	0.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00	101.16

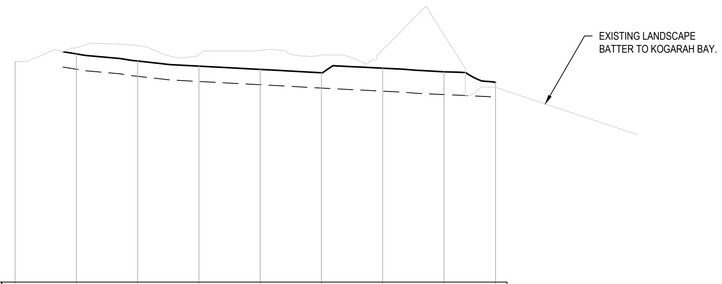
SECTION 1
SCALE 1:500 (H)
SCALE 1:100 (V)
C05.01



DATUM RL -5.0

EXISTING SURFACE	2.44	4.79	4.44	3.76	4.04	4.26	4.25	4.58	4.69	4.31	3.77	3.71
DESIGN SURFACE		2.81	2.93	3.00	2.78	2.82	2.90	2.99	3.09	3.18	3.28	3.30
BULK SURFACE		2.06	2.18	2.25	2.28	2.32	2.40	2.49	2.59	2.68	2.78	
CHAINAGE	0.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00	101.12

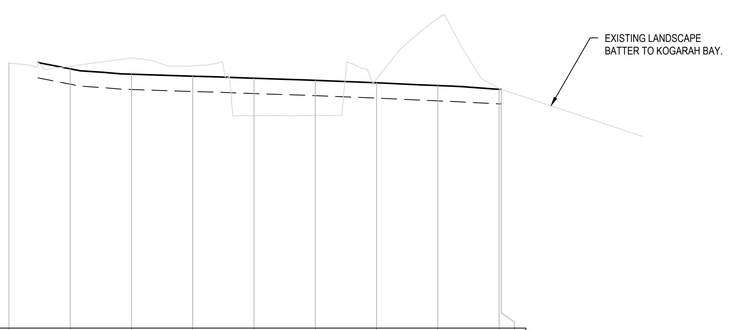
SECTION 2
SCALE 1:500 (H)
SCALE 1:100 (V)
C05.01



DATUM RL -4.0

EXISTING SURFACE	3.20	3.65	3.72	3.43	3.56	3.41	3.58	4.07	2.36
DESIGN SURFACE		3.45	3.22	3.05	2.94	2.83	2.98	2.86	2.52
BULK SURFACE		2.95	2.72	2.55	2.44	2.33	2.23	2.12	2.03
CHAINAGE	0.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	78.43

SECTION 3
SCALE 1:500 (H)
SCALE 1:100 (V)
C05.01



DATUM RL -5.0

EXISTING SURFACE	3.66	3.55	3.82	3.56	1.93	1.94	3.13	5.11	2.83	2.79
DESIGN SURFACE		3.46	3.29	3.22	3.16	3.09	3.01	2.92	2.80	2.80
BULK SURFACE		2.96	2.79	2.72	2.66	2.59	2.51	2.42	2.32	2.32
CHAINAGE	0.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	80.35

SECTION 4
SCALE 1:500 (H)
SCALE 1:100 (V)
C05.01

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
3	09/09/2020	ISSUED FOR REVIEW	CB	RT	AD	AD
2	27/08/2020	ISSUED FOR REVIEW	CB	RT	AD	AD
1	26/08/2020	ISSUED FOR REVIEW	CB	RT	AD	AD

Client

Scale
H: 0 10 20 30 40 50m
V: 0 2 4 6 8 10m
SCALE: H:1:500 V:1:100 @A1

North

Enspire Solutions Pty Ltd
205/275 Alfred Street N, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135

Project
KOGARAH WAR MEMORIAL POOL
CARWAR AVENUE, CARSS PARK
DEVELOPMENT APPLICATION

Title
SITE SECTIONS

Scale
AS SHOWN

Date
26/08/2020

Size
A1

Datum
AHD

Status
FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION

Project Number/Drawing Number
200060-DA-C09.01

Revision
3

DATE PLOTTED: 24 September 2020 3:03 PM BY: JADE TAI

CAD File: P:\200060 KogarahPool\D-Civil\00-SiteWide\Drawings\6-DACC\200060-DA-C09.01 SITE SECTIONS.dwg

Appendix C

Site Photographs

Photo 1: Looking north showing a large crack in the pool wall

Photo 2: TP121 looking east showing fill material from beneath water table

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs**	PROJECT:	99751.00
	Kogarah War Memorial Swimming Pool	PLATE No:	1
	78 Carwar Avenue, Carss Park	REV:	1
	CLIENT: SJB Architects	DATE	28/08/20

Photo 3: TP126 looking west showing the soil profile

Photo 4: P128 looking east showing soil profile and groundwater at base of test pit

Douglas Partners Geotechnics | Environment | Groundwater	**Site Photographs**	PROJECT:	99751.00
	Kogarah War Memorial Swimming Pool	PLATE No:	2
	78 Carwar Avenue, Carss Park	REV:	1
	CLIENT: SJB Architects	DATE	28/08/20

Photo 5: TP124 looking east showing soil profile with groundwater seepage at base of excavation

Photo 6: Looking south showing the location of TP120

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs**	PROJECT:	99751.00
	Kogarah War Memorial Swimming Pool	PLATE No:	3
	78 Carwar Avenue, Carss Park	REV:	1
	CLIENT: SJB Architects	DATE	28/08/20

Photo 7: Looking north from the vicinity of TP128 showing the south eastern portion of the site

Photo 8: Looking north from the vicinity of BH109 showing the eastern site boundary and the berm

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs**	PROJECT:	99751.00
	Kogarah War Memorial Swimming Pool	PLATE No:	4
	78 Carwar Avenue, Carss Park	REV:	1
	CLIENT: SJB Architects	DATE	28/08/20

Photo 9: Looking south from the vicinity of TP 122 showing the location of TP 120

Photo 10: Looking west from the vicinity of TP124 showing the north eastern portion of the site

Douglas Partners Geotechnics | Environment | Groundwater	**Site Photographs**	PROJECT:	99751.00
	Kogarah War Memorial Swimming Pool	PLATE No:	5
	78 Carwar Avenue, Carss Park	REV:	1
	CLIENT: SJB Architects	DATE	28/08/20

Photo 11: Looking south showing the existing car park from the vicinity of BH101 (not subject to remediation)

Photo 12: Looking west showing the car park from the vicinity of BH103 (not subject to remediation)

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs**	PROJECT:	99751.00
	Kogarah War Memorial Swimming Pool	PLATE No:	6
	78 Carwar Avenue, Carss Park	REV:	1
	CLIENT: SJB Architects	DATE	28/08/20

Appendix D

Example Geotextiles

MASTATEX™ Orange

Warning Layer Geotextile

Techincal Specifications

Jaybro

GEOMASTA™

DESCRIPTION

mastaTEX™ GFO is a high quality staple fiber geotextile, designed for separating contaminated and non-contaminated soils. Due to its bright Orange coloring, mastaTEX™ GFO is most commonly used as a warning layer in areas liable to future excavations. mastaTEX™ GFO provides the same performance as other geotextiles in the mastaTEX™ range.

APPLICATIONS

- Segregation of contaminated soil
- Filtration
- Warning Layer

SPECIFICATIONS

	TEST METHOD	UNIT	VALUES
INDEX PROPERTIES			
Material			Polyester (PET)
Grab Tensile Strength	AS 3706.2B	N	500
Wide Strip Tensile Strength	AS3706.2A	kN/m	8.1
Mass	AS 3760.1	gsm	140
TYPICAL HYDRAULIC PROPERTIES MEAN			
Pore Size	AS 3706.7	µm (Microns)	120
Nominal Flow Rate	AS 3706.9	l/m² /s	240
DIMENSIONS			
Width		m	6
Length		m	150
Roll Diameter		m	400

UNDERSTANDING AUSTRALIAN GEOTEXTILE STANDARDS

NSW

ROADS & MARITIME SERVICES (RMS)
QA SPECIFICATION R63 GEOTEXTILES (SEPARATION AND FILTRATION)
May 2013 Edition 4 / Revision 0

RMS R63 is the NSW Main Roads specification documentation to which all Geotextile products are to be tested and approved before use on road and bridgeworks.

Clause 2 Material Requirements specifies the minimum requirements for the raw material quality, manufacturing processes, product testing & certification.

Clause 3 Storage, Packaging, Identification and Delivery specifies the method in which the product must be packaged, stored, marked and delivered.

Clause 4 Construction Requirements covers general site preparation, installation and site requirements.

Jaybro Geosynthetics recommend the client read and understand Clause 4 and all subsequent annexures prior to installation.

QLD

TRANSPORT AND MAIN ROADS (TMR) MRTS27 GEOTEXTILES SEPARATION AND FILTRATION
June 2009

Clause 6 Material Requirements specifies the minimum requirements for the raw material quality, manufacturing processes, product testing & certification.

Clause 7 Storage, Packaging and Identification specifies the method in which the product must be packaged, stored and marked.

Clause 8 Delivery and Product Compliance covers requirements for ordering and delivery of geotextiles.

Clause 9 Construction Requirements covers general site preparation, installation and site requirements.

Clause 10 Acceptance criteria details the requirements by the contractor for onsite testing and sampling.

Jaybro Geosynthetics recommend the client read and understand MRTS27 prior to installation.

VIC

VICROADS 210 – GEOTEXTILES IN EARTHWORKS
December 2014
This section covers the requirements for the supply, handling and placing of geotextiles as listed below or used as a separation layer, or as a separation and filtration layer,in earthworks at locations shown on the drawings or specified.

210.03 Properties of Geotextiles. General; specifies material properties and manufacturing process.

Robustness; outlines how the geotextiles are to be classified according to the G Rating

Equivalent Opening Size; specifies pore size for use as a filtration material

UV Radiation Stabilisation; The geotextile shall be stabilised against deterioration due to ultra-violet radiation such that when tested in accordance with AS 3706.11 Standard

Testing; All testing shall be performed by laboratories with third party accreditation to ISO/IEC 17025 by a signatory to the International Laboratories Accreditation Cooperation (ILAC) scheme, e.g. by NATA (National Association of Testing Authorities, Australia)

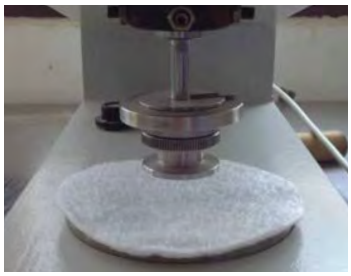
Jaybro Geosynthetics recommend the client read and understand VR210.04 and all subsequent annexuresprior to installation

NATA
WORLD RECOGNISED ACCREDITATION

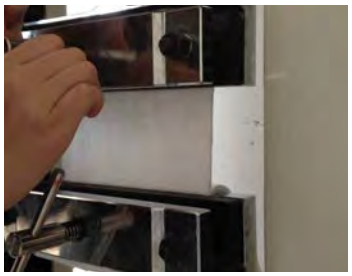
WHAT IS NATA?

National Association of Testing Authorities is the authority responsible for the accreditation of laboratories, inspection bodies, calibration services, producers of certified reference materials and proficiency testing scheme providers throughout Australia. It is also Australia's compliance monitoring authority for the OECD Principles of GLP. All State Standards specify geotextile testing must be completed by a NATA accredited laboratory.

TEST METHODS



AS 3706.1
MASS & THICKNESS



AS 3706.2A
WIDE STRIP TENSILE STRENGTH

AS 3706.2B
GRAB TENSILE STRENGTH

AS 3706.4
CBR BURST STRENGTH

AS 3706.9
PERMITTIVITY

AS 3706.7
PORE SIZE

AS 3706.3
TRAPEZOIDAL TEAR STRENGTH

Jaybro
GEOMASTA™

SYDNEY
29 Penelope Crescent
Arndell Park NSW 2148

MELBOURNE EAST
Factory 3, 1364 Heatherton Road
Dandenong VIC 3175

CANBERRA
3 Daly Street,
Queanbeyan West NSW 2620

COFFS HARBOUR
Unit 5, 22 Isles Drive
Coffs Harbour NSW 2450

PERTH
Unit 1/94 Beringarra Avenue,
Malaga WA 6090

MELBOURNE
27 Tullamarine Park Road
Tullamarine VIC 3043

BRISBANE
71 Lavarack Avenue
Eagle Farm QLD 4009

NEWCASTLE
100 Glenwood Drive
Thornton NSW 2322

ADELAIDE
391 Churchill Road,
Kilburn SA 5084

AUCKLAND (NZ)
Unit2, 25 Allright Place,
Mount Wellington Auckland 1060

1300 885 364 jaybro.com.au

GEOMASTA™

MASTAGRID™ *Poly*

Polypropylene Geogrid 40/40

TECHNICAL SPECIFICATIONS

WORLD-CLASS GEOSYNTHETICS. UNBEATABLE VALUE. EXCEPTIONAL SERVICE.

DESCRIPTION

mastaGRID™ Poly is an engineered polypropylene geogrid designed for soil stabilisation, separation & reinforcement applications. This is done through the process of extruding, polypropylene sheets then both stretching in both longitudinal and transverse directions. mastaGRID™ Poly rigid biaxial geogrids perform best in granular, angular fills and are used under roads, railways, loading platforms for sub-base soil reinforcement & stabilisation.

APPLICATIONS

- Base Reinforcement
- Subgrade Reinforcement
- Embankment Stabilisation
- Slope Reinforcement

SPECIFICATIONS

			GGPB4040	
INDEX PROPERTIES	**TEST METHOD**	**UNITS**	**MD VALUES**	**TD VALUES**
Polymer		-	PP	-
Minimum Carbon Black	ASTM D 4218	%	2	-
Tensile Strength @ 2% strain	ASTM D 6637	kN/m (lb/ft)	14 (960)	14 (960)
Tensile Strength @ 5% strain	ASTM D 6637	kN/m (lb/ft)	28 (1,920)	28 (1,920)
Ultimate Tensile Strength	ASTM D 6637	kN/m (lb/ft)	40 (2,740)	40 (2,740)
Strain @ Ultimate Strength	ASTM D 6637	%	13	13
Junction Efficiency	GRI GG2	%	93	93
Flexural Rigidity	ASTM D 7748	mg-cm	4,800,000	-
Aperture Stability	ASTM D 7864	m-N/deg	0.98	-
DIMENSIONS				
Aperture Dimensions	-	mm (in)	33 (1.3)	33 (1.3)
Minimum Rib Thickness	ASTM D 1777	mm (in)	3.4 (0.13)	3.4 (0.13)
Roll Width	-	m (ft)	3.95 (12.9)	-
Roll Length	-	m (ft)	50 (164)	-
RECOMMENDED OVERLAP				
Standard Soil	-	mm	200	-
Soft /Unstable soil	-	mm	500	-

SYDNEY
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71 Lavarack Avenue
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NEWCASTLE
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6 Riversdale Road,
Welshpool WA 6106

CHRISTCHURCH
Warehouse 2 Kennaway Road,
Woolston Christchurch 8023

MELBOURNE
Building A 1-7 Cyanamid Street
Laverton North VIC 3026

CANBERRA
3 Daly Street,
Queanbeyan West NSW 2620

ADELAIDE
391 Churchill Road,
Kilburn SA 5084

AUCKLAND
8-10 Hannigan Drive,
St Johns Auckland 1072

STANDARD TEST METHODS

GEOGRID PROPERTY TO BE TESTED	TEST METHOD*	TEST NAME
Ultimate Tensile Strength/ Tensile Strength at 2% Strain	ASTM D6637-11 or EN ISO 10319	Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method
Wide Width Tensile Tests (@ 2% and 5% strain)	ASTM D4595 or EN ISO 10319	Standard Test Method for Tensile Properties of Geotextile by the Wide-Width Strip Method
Installation Damage	ASTM D5818-11	Standard Practice for Exposure and Retrieval of Samples to Evaluate Installation Damage of Geosynthetics
Junction Strength	ASTM D7737-11 (Method B – Confined)	Individual Geogrid Junction Strength
Resistance to UV	ASTM D4355-07	Standard Test Method for Determination of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
Coefficient of Direct Shear Note 1	ASTM D5321/D5321M-14	Standard Test Method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear

Note 1
Direct shear test shall apply vertical stress of 50kPa, 100kPa and 150kPa. Base layer shall consist of granular material with friction angle of 30 degree.of a soil sample.

PAVEMENT GEOSYNTHETIC PROPERTY REQUIREMENT

SUBGRADE REINFORCEMENT TYPE			TYPE 1	TYPE 2
Property	Test Method*	Unit	Subgrade Application (CBR > 3%)	Subgrade Application (CBR ≤ 3%)
Application	-	-	Reinforced subgrade with CBR > 3%	Reinforced subgrade with CBR ≤ 3%
Geogrid aperture size	-	mm	Min ≥ D50 ≈ 9.5 mm Max ≤ 2 x	Min ≥ D50 ≈ 9.5 mm Max ≤ 2 x D85 ≈ 38 mm
Geogrid junction strength at 2% strain	ASTM D7737-11	kN/m	≥ 9.5	≥ 12.5
Tensile strength (Ts) at 2% strain in any direction of the MD and CMD Note 1	ASTM D6637-11 / ASTM D4595 or EN ISO 10319	kN/m	≥ 10.5	≥ 14
Resistance to installation damage (Rd) Note 1 & 2	ASTM D5818-11	%	≥ 85	≥ 85
Resistance to UV (Ruv) Note 1	ASTM D4355-07	%	≥ 90	≥ 90
Coefficient of direct shear	ASTM D5321/D5321M-14	%	≥ 75	≥ 75

Note 1
For Tensile Strength (Ts) shall be at 2% strain taken from load vs strain curves obtained from a NATA approved laboratory to demonstrate the Ultimate Tensile Strength (UTS). Ts @ 2% ≤ UTS x Rd x Ruv x Rc x Rm. Other recognised laboratories can be considered provided they are recognised by NATA or NATA MRA (Mutual Recognition Arrangements) or GAI-LAP (USA). Refer to Clause 5.1.

For biaxial product, minimum strength from both directions should satisfy the requirement of Table 6.2. For uniaxial product, minimum strength from the principal direction should satisfy the requirement of Table 6.2

Note 2
The particle grading used for the installation damage test result determined in accordance with ASTM D5818 shall use a particle grading consistent with grading C of Table 7.2.4-A as defined in MRTS05 Unbound Pavements.

Note 3
D50: The particle size represented by the "50 percent passing" point when conducting a sieve analysis of a soil sample.

D85: The particle size represented by the "85 percent passing" point when conducting a sieve analysis of a soil sample.

Note 4
Pavement geosynthetic reinforcement to be used in natural subgrades with pH value between 4 and 9.

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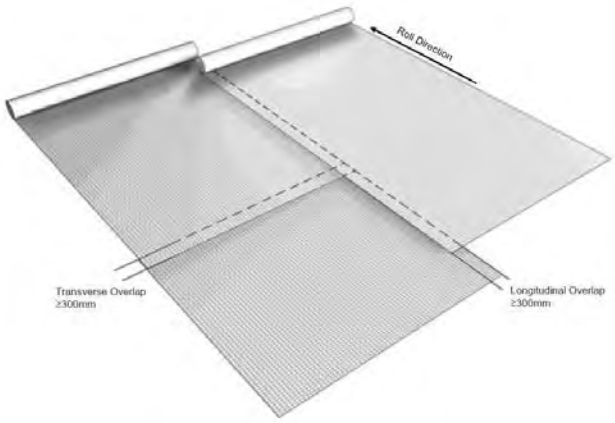

OVERLAP

The recommended minimum overlap for woven geotextile is 1000 mm in all directions for all subgrade CBR values. The recommended minimum geogrid/geocomposite overlaps are shown below:

SUBGRADE CBR	MINIMUM OVERLAP
> 2	300 - 450mm
1 – 2	600 - 900mm
0.5 – 1	900mm
< 0.5	Advice from Engineering and Technology Branch to be obtained
All roll ends	900mm
All woven geotextiles	Standard Test Method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear

TESTING OF SITE SAMPLES

The tensile strength at 2% strain of the sampled pavement geosynthetics shall be tested by the Contractor:

Identification information including the pavement geosynthetic
supplier, type, batch identification, and details of the order represented by sample, sample date and roll directional markings shall be shown on or attached to the test reports.

The tensile strength at 2% strain test results shall be calculated from the results of tests carried on a minimum number of five test specimens.
For the appropriate test method refer Table 4.

The characteristic value of the strength properties listed in Table 9.3 shall be calculated in accordance with the requirements of Clause 12 of MRTS01 Introduction to Technical Specifications.

PROPERTY	CHARACTERISTIC VALUE REQUIREMENT FOR COMPLIANCE	
	TYPE 1	TYPE 2
Application	Subgrade Application (CBR > 3%)	Subgrade Application (CBR ≤ 3%)
Tensile strength (Ts) at 2% strain in any MD and CMD*(kN/m)	10.5	14

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