

Northern Beaches Council

Addiscombe Road, Manly Vale
Interim Site Management Plan

December 2020

Executive summary

Northern Beaches Council (Council) owns and manages a former landfill site located at Addiscombe road, Manly Vale (Lots 1-3 and former Lot 4, DP 818957) (the site).

A Voluntary Management Proposal (VMP) for the site was recently prepared by Council and approved by the NSW Environmental Protection Authority (EPA) subject to the conditions outlined in its letter of 2 October 2019. To support Council with the VMP, GHD have been engaged to develop this Interim Site Management Plan (ISMP).

This ISMP has been developed to provide measures for the management of contamination at the site to reduce the risks to human health and the environment with consideration of the site's current condition and associated land uses (a mixture of secured vacant areas and publicly accessible land, with a small portion used by adjacent residents).

The implementation of the measures outlined in this ISMP are the responsibility of Council, and includes Council's obligations to inform other parties of the measures.

This ISMP is to be applied to the site for the time that the site remains in its current condition and uses. At this time, it is intended that this ISMP will commence operation from the time that it is endorsed by Council and the NSW EPA accredited Site Auditor (Site Auditor). It will continue to operate and be refined / updated at identified periodic junctions and /or if significant changes occur at the site or next to it that would warrant an update to be made to it in the future. The ISMP will remain in force until the future use of the land is identified and a remediation plan is established. Council will arrange for the ISMP to be reviewed and updated as required, and it must be endorsed by the Site Auditor.

It should be noted that this ISMP is not intended to replace or supersede existing health and safety plans for the site. This ISMP should be considered as a supplement to those documents, and is particularly targeted to deal with site related contamination issues.

The procedures outlined in this ISMP include the following:

- Documentation of current Council management actions
- Immediate management actions
- Interim environmental monitoring
- Inspection and maintenance
- Unexpected finds
- Non compliance and management
- ISMP implementation reviews and ISMP updates
- Reporting requirements
- Triggers for change to the ISMP and procedures.

This report is subject to, and must be read in conjunction with, the limitations set out in Section 7 and the assumptions and qualifications contained throughout the Report.

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Glossary

Acronym	Definition
ACM	Asbestos containing material
ADWG	Australian Drinking Water Guidelines
AHD	Australian Height Datum
ANZG	Australian and New Zealand Guidelines
ASS	Acid sulphate soils
bgl	Below ground level
BPEM	Best practice environmental management
BTEXN	Benzene, toluene, ethylbenzene, xylene and naphthalene
bTOC	Below top of casing
CLM Act	Contaminated Land Management Act, 1997
COPC	Contaminant of Potential Concern
Council	Northern Beaches Council
DBYD	Dial Before You Dig
DDT	Dichloro-diphenyl-trichloroethane (insecticide)
DP	Deposited plan
EILs	Ecological Investigation Levels
ESLs	Ecological Screening Levels
EPA	Environmental Protection Authority
GILs	Groundwater Investigation Levels
HILs	Health Investigation Levels
HSLs	Health Screening Levels
ISMP	Interim Site Management Plan
LOR	Limit of reporting
LNAPL	Light non-aqueous phase liquid
m	metres
NEMP	National Environmental Management Plan (PFAS)

Acronym	Definition
NEPM	National Environmental Protection Measure
NHMRC	National Health Medical Research Council
OCP/OPP	Organochlorine pesticides / organophosphorus pesticides
PACM	Potential asbestos containing material
PAHs	Polycyclic Aromatic Hydrocarbons
PB	Parsons Brinkerhoff
PFAS	Per- and poly-fluoro alkyl substances
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonate
POEO	Protection of the Environment Operations
PPE	Personal Protective Equipment
QA / QC	Quality assurance / quality control
RAP	Remediation Action Plan
SPR	Source-Pathway-Receptor
TCLP	Toxicity Characteristic Leaching Procedure
VMP	Voluntary management proposal
WRL	Water Research Laboratory

1. Introduction

1.1 Overview

Northern Beaches Council (Council) owns and manages a former landfill site located at Addiscombe Road, Manly Vale (Lots 1-3 and former Lot 4, DP¹ 818957) (the site). Lot 4 is noted to have been merged with the road reserve, but has been considered within this document. The site location is shown on Figure 1, Appendix A along with the relevant Lots and DPs.

Council has been managing this site as a contaminated site since 2000.

A Voluntary Management Proposal (VMP, Northern Beaches Council 2019) for the site was recently prepared by Council and approved by the NSW Environmental Protection Authority (EPA) subject to the conditions outlined in its letter of 2 October 2019. The VMP and EPA letter are provided in Appendix B. To support Council with the VMP, GHD have been engaged to develop this Interim Site Management Plan (ISMP) in general accordance with the requirements of the VMP.

Based on the current use of the site (a mixture of vacant areas and publicly accessible land, with a small portion accessed by adjacent residents) this ISMP has been developed to ensure the site is adequately managed from human health and environmental perspectives. A preliminary contamination assessment of the site is provided in Appendix C, including site background, an assessment of contamination status and a conceptual site model. The preliminary contamination assessment documents the current understanding of site conditions and provides the foundations of the management actions outlined in this ISMP. It is intended that the ISMP will remain in force until the future use of the land is identified and a remediation plan is prepared, at which point further assessment and updated site management plans will be required.

This report is subject to, and must be read in conjunction with, the limitations set out in Section 7 and the assumptions and qualifications contained throughout the Report.

1.2 Purpose

The purpose of this ISMP is to provide management procedures for the site to reduce potential risks to human health and the environment from contamination associated with the landfill, and to address the relevant requirements of the VMP.

Details of the VMP are presented in Section 1.6, and the VMP is provided in Appendix B.

1.3 Objectives

As per the VMP (Northern Beaches Council, 2019), the objective of this ISMP is to outline the interim management procedures to be implemented, thereby reducing imminent risk from potential contamination to sensitive receptors (human health and the environment). The management measures include reducing the likelihood of potential source-pathway-receptor (SPR) linkages outlined in Appendix C, or require gathering of additional data to demonstrate if there is a complete SPR linkage.

It should be noted that this ISMP is not intended to replace or supersede existing health and safety plans for the site. This ISMP should be considered as a supplement to those documents, and is particularly targeted to deal with long-term contamination issues.

¹ Deposited Plan

1.4 Responsibilities

The implementation of the measures outlined in this ISMP will be the responsibility of the site owner who is currently:

Northern Beaches Council or their nominee (including any nominated site manager), PO Box 82 Manly (postal address).

Contact details of the Council are provided in Table 1-1.

Table 1-1 Council contact details

Council contacts	Phone number	Email
Council customer service	1300 434 434	council@northernbeaches.nsw.gov.au

Council's responsibilities include informing other parties of their obligations to comply with the ISMP. Council's representatives employed to undertake physical works are responsible for complying with the relevant requirements of this ISMP.

Subject to commercial agreement, responsibility for some or all of the management measures outlined in this ISMP may be transferred to a future site owner / operator. It is noted that such a transfer will require a formal revision of the ISMP and subsequent endorsement of the ISMP by Council and a NSW EPA accredited Auditor (further discussed in Section 4.5).

1.5 Timeframes

This ISMP is to be applied to the site for the time that the site remains in its current condition and uses. At this time, it is intended that this ISMP will commence operation from the time that it is endorsed by Council and a NSW EPA accredited Site Auditor. It will continue to operate and be refined / updated:

- At identified periodic junctions as outlined in Section 4.5 and Section 5, and /or
- If significant changes occur at the site or next to it that would warrant an update to be made to the ISMP in the future.

The ISMP will remain in force until the future use of the land is identified and a remediation plan is established or until EPA re-assess regulation of the site and the ISMP is determined to no longer be required. Council will arrange for the ISMP to be reviewed and updated as required and must be reviewed and endorsed by a NSW EPA accredited Site Auditor.

1.6 Regulatory framework

The framework adopted by GHD for the preparation of this document is based on guidelines "made or approved" by the NSW EPA under Section 105 of the *Contaminated Land Management Act, 1997* (the CLM Act).

No current or historical licences or notifications were found in a search of the NSW EPA Protection of the Environment Operations (POEO) public licence register by GHD (based on a search conducted on 16 March 2020).

GHD understands that the following approvals, licenses and notices currently apply to the site:

- Voluntary Management Proposal (VMP) prepared by Council and approved by the EPA in 2019 (Approval no. 20191721).
- Notice to amend approved Voluntary Management Proposal (Notice Number 20204404) from the EPA in 2020.

In 2004, the NSW EPA issued a remediation declaration (2103038), pursuant to Section 21 of the *Contaminated Land Management Act 1997*. However, this is understood to no longer be active.

A VMP for the site was prepared by Council and approved by the NSW EPA subject to the conditions outlined in its letter of 2 October 2019 (provided in Appendix B). Aspects of the VMP and the NSW EPA letter relating to the development of this ISMP are reproduced below:

VMP

- *O.1 Development of Interim Site Management Plan*

The Interim Site Management Plan shall be developed detailing the summary of the management actions to take place thereby reduced (sic) from contamination to sensitive receptors.

Noting that they are intimately linked to the ISMP, GHD has also addressed and incorporated objectives O.2 and O.3 of the VMP into this ISMP. These being as follows:

- *O.2 Regular monitoring of fence conditions (as described in section 2C) (of the VMP)*

Currently the majority of the contaminated site is fenced (see figure 3) (of the VMP) to prevent human access and therefore reducing the potential risks through direct contact with contaminated soil. The fenced perimeter will be monitored regularly by the environmental officer at NBC (Council) to ensure full functionality as an entrance deterrent.

- *O.3 Maintenance and monitoring of informal pathway (refer to section 2c (of the VMP)*
Regular monitoring of fence conditions (as described in section C) (of the VMP)

The informal pathway linking Campbell Parade to Addiscombe road (see figure 3) (of the VMP) is used daily by commuters, to ensure commuter safety regular asbestos inspections will be undertaken by a licensed contractor.

No remediation activities will take place under this Voluntary Management Proposal.

EPA Letter

The conditions of approval include the following:

- *An auditor accredited under the Contaminated Land Management Act 1997 (CLM Act) must be engaged to confirm the adequacy of the Interim Site Management Plan ("The Plan").*
- *The Plan will then be implemented under this VMP, with compliance reporting to be provided annually by the end of August each year.*
- *The end date for this VMP will be 30 September 2022, at which time the EPA will re-assess regulation under the CLM Act.*
- *Any report submitted to the EPA to comply with this Notice must be prepared, or reviewed and approved, by a practitioner certified by an EPA-recognised scheme.*

Additionally, GHD notes that the EPA letter requires that *Council must specify that the site is the subject of a VMP on any planning certificate for the land issued under section 10.7 of the Environmental Planning and Assessment Act 1979. This obligation forms part of the requirements of section 59(2) of the CLM Act.*

1.7 Site summary

The site fronts onto Manly Creek and is approximately 1 km upstream of Manly Beach, as shown on Figure 1 in Appendix A. An informal public footpath is present on the eastern site boundary, which is used by local residents as a thoroughfare between Campbell Parade to the north, and Addiscombe Road to the south. Push bike riders, school children, walkers and dog walkers frequently use this informal footpath. The majority of the site is fenced to prevent public access and is covered by a variety of dense vegetation including non-native species. A relatively small grassed area (circa 1730 m², not including the footpath area) that is unfenced is present in the site's south eastern corner. Vegetation along the commonly used eastern boundary of the site consists of grassed areas, small to large shrubs and small to large trees. Additionally, a small portion of land immediately adjacent to the southern site boundary (circa 100 m²) is currently accessible by the residents south of the site. The area appears to be in use as a driveway/access route to the backyard area of their house.

The site identification details are summarised in Table 1-2. A survey of the site showing lot boundaries and key site features is provided in Appendix D.

Table 1-2 Site identification details

Item	Description
Street Address	Addiscombe Road, Manly Vale NSW 2093
Certificate of Title Details (Vol/Folio) and Parcel/Lot Number	Lots 1-3, DP818957 Lot 4 has been merged with the road reserve and has been included in the ISMP.
Owner	Lots 1 & 2 are Council owned allotments. Lot 3 is considered 'Reserve Trust' under Section 95 of the <i>Crown Lands Act 1989</i> , and Council was appointed manager of this land on 20 November 1992. Former Lot 4 and the road reserve area are understood to be managed by Council.
Site Zoning	Zone RE1 – Public Recreation (Manly Local Environmental Plan 2013).
Current Use	The majority of the site is fenced, vacant land. A small portion of the site is a public park and informal footpath.

2. Basis of assessment

2.1 Rationale for assessment criteria

The framework adopted by GHD for the purpose of data evaluation includes guidelines “made or approved” by the NSW EPA under Section 105 of the *Contaminated Land Management Act, 1997* (the CLM Act), as outlined in Section 1.6.

The assessment criteria were selected to allow decisions to be made for the identified receptors, outlined in Appendix C. Commercial/industrial and recreational land use settings are considered appropriate (and somewhat conservative) for the site based on the current land use of Council owned vacant land and public open space, and off-site land use settings (immediately adjacent) are considered to be commercial/industrial and residential (noting that residents to the south are accessing a small portion of the site).

Assessment of COPC will be undertaken as per the VMP (with the addition of PFAS), with remaining COPC identified as part of the preliminary site assessment in Appendix C to be assessed in future as outlined in the Section 5 ‘Triggers for change to the ISMP’.

The nominated criteria in the following subsections will be reviewed by the Environmental Consultant (or suitably qualified party) carrying out the monitoring specified in this ISMP prior to reporting the results of each monitoring round to ensure they remain protective of the identified receptors.

2.2 Groundwater investigation levels

The adopted assessment criteria and sources are summarised in Table 2-1.

In accordance with NSW EPA (2007) *Guidelines for the Assessment and Management of Groundwater Contamination*, contaminants identified in groundwater will be screened against existing generic GILs which protect the following environmental values:

- Drinking water.
- Aquatic ecosystems.

On the basis that groundwater is likely to discharge to the local water systems (Manly Creek and Manly Lagoon), which is likely to fluctuate between fresh and brackish depending on ocean connectivity and tidal levels at Manly Beach, both fresh and marine water guidelines have been considered. The Australian and New Zealand Guidelines (ANZG) (2018) Water Quality Guidelines for fresh and marine waters with a 95% protection level will therefore be adopted, on the basis that Manly Creek is a slightly disturbed ecosystem². It is noted that the NEPM Groundwater Investigation Levels (GILs, 2013) are consistent with ANZG (2018) for each COPC with a nominated criterion, except perfluorooctane sulfonate and perfluorooctanoic acid (PFOS and PFOA respectively) which are classified as ‘under consideration’ by ANZG (2018) at the time of issue of this report. The PFAS National Environmental Management Plan (NEMP, 2020) freshwater guidelines for 99% species protection will therefore be adopted, noting that the fresh and marine water quality guidelines are the same. A 99% species protection level will be adopted for PFAS analytes to account for potential bioaccumulation.

The groundwater quality results will also be compared against drinking water and recreational guidelines, protective of human health (Australian Drinking Water Guidelines (ADWG) v3.5 updated August 2018, and National Health and Medical Research Council (NHMRC) updated August 2018 respectively). Screening of results against recreational criteria was considered

² As defined by ANZG (2018): <https://www.waterquality.gov.au/anz-guidelines/resources/key-concepts/level-of-protection#slightly-to-moderately-disturbed-systems>

applicable given the presence of an accessible standing water body (Manly Creek) immediately adjacent to the site where groundwater is likely to be discharging. There are 15 registered groundwater bores identified within 500 metres of the site, some of which are licenced for domestic use. However it is noted that the surrounding area is serviced by a mains potable water supply, and all registered bores are separated from the site by Manly Creek which is likely to be drawn preferentially to abstraction bores. It is therefore unlikely that human receptors are using groundwater hydraulically connected to the site for drinking water in the area, and application of and drinking water guidelines (ADWG v3.5 updated August 2018) is a conservative measure to address the requirements of NSW EPA (2007).

Table 2-1 Groundwater and surface water investigation level summary

Reference	Application
ANZG) (2018) Water Quality Guidelines - fresh and marine waters, 95% species protection level	Protective of ecology in Manly Creek
PFAS NEMP (2020) freshwater guidelines, 99% species protection	Protective of ecology in Manly Creek, noting that criterion for fresh and marine waters is the same. 99% species protection level applied to account for potential bioaccumulation.
ADWG v3.5 updated August 2018	Protective of human health via drinking water, including direct contact and accidental consumption.
NHMRC updated August 2018 respectively	Protective of human health via recreational use of Manly Creek.

2.3 Surface water investigation levels

Surface water will be assessed against the same criteria as adopted for groundwater. The criteria are summarised in Table 2-1.

2.4 Soil investigation levels

The assessment criteria outlined in Table 2-2 will be adopted for the purpose of soil investigations. It is noted that not all land use scenarios considered will be applicable at all investigation locations, and that assumptions on the soil type may be altered by findings during the soil investigation.

Table 2-2 Soil investigation level summary

Reference and guideline	Land use scenario
NEPM 2013 Health Investigation Levels (HILs)	Commercial/industrial – HIL D
	Residential – HIL A
	Recreational – HIL C
NEPM 2013 Ecological Investigation Levels (EILs)	Commercial/industrial
	Urban residential and public open space

Reference and guideline	Land use scenario
NEPM 2013 Ecological Screening Levels (ESLs), with 'coarse' soil classification adopted as a conservative measure to account for the presence of sand in some historic soil samples	Commercial/industrial
	Urban residential
PFAS NEMP 2020 Human health investigation levels	Residential with garden/accessible soil - HIL A
	Public open space – HIL C
	Industrial commercial – HIL D
PFAS NEMP 2020 Ecological guideline values	Direct exposure
	Indirect exposure

Additionally, observations recorded on soil logs will be compared against Section 3.6 of the NEPM (2013) Schedule B1 '*Aesthetic considerations*' to assess the possible presence of waste. As stated in the NEPM (2013), general aesthetic assessment considerations include:

- That chemically discoloured soils or large quantities of various types of inert refuse, particularly if unsightly, may cause ongoing concern to site users.
- The depth of the materials, including chemical residues, in relation to the final surface of the site.
- The need for, and practicality of, any long-term management of foreign material.

2.5 Landfill gas criteria

The assessment criteria for the LFG monitoring will be in general accordance with the Environmental Guidelines for Solid Waste Landfills (NSW EPA, 2016), Safe Work Australia Hazardous Chemical Information System, and the Victorian EPA '*Siting, design, operation and rehabilitation of landfills – Best practice environmental management*' (2015, herein referred to as the 'VIC EPA Landfill BPEM'). The criteria are summarised in Table 2-3.

Table 2-3 Landfill gas assessment criteria

Parameter	Adopted assessment criteria	Application
Methane	5% volume/volume (v/v)	Lower explosive limit of methane in air – protective of acute risks.
	1% v/v	Protective of human health at the site boundary.
Carbon dioxide	1.5% v/v above established background level ¹	Protective of human health at the site boundary.
Hydrogen sulfide	10 ppm	Time weighted average protective of human health.
<p>TABLE NOTES:</p> <p>1 - No established background level at this time so 1.5% v/v will be applied</p>		

3. Site management strategy

This ISMP has been developed to provide measures for the management of contamination at the site to reduce the imminent risks to human health and the environment with consideration of the site's current condition and associated land uses (a mixture of secured vacant areas, publically accessible land, and a small portion accessed by adjacent residents). The strategy of the ISMP has been based on the SPR linkages and the data gaps identified in Appendix C, within the framework of the relevant regulatory guidance identified in Section 1.6, including the site VMP.

Considering this, the site management strategy has been designed to have three primary types of management tasks:

- Immediate management actions.
- Interim environmental monitoring.
- Routine inspection/maintenance works for the site.

The general task items and anticipated time frames are summarised in a 'management actions checklist' in Appendix K, with further detail provided in the following sub sections.

All management activities are the responsibility of Council as the current site owner/manager (or their nominee) or any future land owner to undertake, and will be undertaken by suitably qualified personnel. The site owner will implement appropriate workplace safety management measures and procedures for all site workers conducting the works, including safety measures associated with ground gas risks.

3.1 Immediate management actions

3.1.1 Restricting access to shallow soils in recreational area

Council wish to maintain the southern portion of the site as a public open space for recreational use, shown on Figure 6. However, some exposed waste was observed in this area during a site inspection in February 2020. Additionally, the concentration of lead and zinc in shallow soils in this area is noted to be elevated (PB, 2008a) and asbestos has also previously been identified in surface soils. Therefore Council need to restrict the access of recreational users to shallow soil by either:

- Fencing the recreational area shown on Figure 6 to prevent public use – GHD understands this is not Council's preference, however it is likely to be an economically feasible option for Council. Refer to Section 3.3.1 for further discussion of fencing.
- Covering the area shown on Figure 6 with 100 mm of mulch and/or healthy grass which is sufficient to prevent contact with underlying soils, as an interim barrier to possible receptors. The cover must be maintained as outlined in Section 3.3. A more formal capping layer would need to be installed if triggers for change in land use are proposed or occur, as outlined in Section 5.

Council may choose to use a combination of these two options (in conjunction with minor landscaping such as installation of retaining walls to optimise cost and land use) as long as 100% of the recreational area shown on Figure 6 is fenced or covered.

Council will undertake these works within one year of endorsement of the ISMP by the site Auditor. In the interim, signage will be installed at the entrances to the site warning site users that contaminated soils are present in these areas. Signage should also include warning not to eat any vegetation present at the site.

3.1.2 Restricting access to shallow soils in the footpath area

Council wish to maintain the informal footpath on the eastern site boundary for public use. This area is shown on Figure 6. Based on the presence of contamination in shallow soils (including asbestos) in this area and the associated potential exposure pathways (direct contact and inhalation of dust), Council needs to manage the access of footpath users to shallow soil.

Signage will be installed at the entrances to the informal footpath warning site users that contaminated soils are present in this area (and should also include warning not to eat any vegetation present at the site unless qualitative risk assessment is undertaken as an alternative). Signage will be in addition to continuation of the sparrow picking program described in the VMP and Appendix C, which is undertaken on the informal pathway with monitoring summarised as follows:

- 'Bi-monthly' (understood by GHD to be every second month) by the site owner to record the condition and absence/presence of PACM.
- Monthly by a licensed contractor, conducting a visual inspection for PACM which shall be removed and appropriately disposed of by the contractor if located.

In addition, GHD recommends that cover be applied to the footpath area as an interim measure for site management, to mitigate potential source pathway receptor linkages between exposed waste and site users (including potential asbestos fibers in dust). The interim cover layer shall comprise a high visibility marker layer at the base (such as orange geofabric), covered with a minimum of 100 mm of chemically and physically suitable material (such as crushed sandstone or mulch). Alternatively, a more formal hardstand could be used above the marker layer.

The frequency of the sparrow picking program may be reduced once interim cover is applied. Inspection and maintenance shall be undertaken as outlined in Section 3.3.3.

Council will undertake these works within one year of endorsement of the ISMP by the site Auditor.

3.1.3 Management of the embankment area

The following actions shall be undertaken by Council to meet the objective of restricting exposure of ecological (and potentially human) receptors to contamination (exposed waste) in this area:

1. Complete an initial holistic inspection of the eastern site boundary adjacent to Manly Creek, to confirm if additional areas of the embankment require management (if not already completed as part of the current site works outlined in Appendix C).
2. Ensure mulch cover has been applied to all areas of exposed waste (as required) as an interim cover material.
3. Undertake inspections of the embankment to ensure appropriate cover is still in place, as per Section 3.3.3.

The findings of the inspection, the type, depth and area of mulching works, and evidence of the monthly inspections should be recorded for inclusion in annual reporting (as per Section 4.3).

Council will undertake these actions within one year of Auditor endorsement of this ISMP. In the interim, signage should be placed along the edge of the embankment indicating that there are contaminated soils in the area. Signage should also include warning not to eat any vegetation present at the site.

3.2 Interim environmental monitoring program

A comprehensive monitoring network will be installed, and a monitoring program will be implemented at the site. The monitoring program shall be implemented for perpetuity until reasonable evidence can be provided that monitoring is no longer required (as outlined in Section 5.3).

In the first year following Auditor endorsement of the ISMP, Council will undertake a targeted surface soil assessment and install the groundwater / landfill gas monitoring bores (as outlined in Section 3.2.1 and Section 3.2.2 respectively). Within two months of the well installation works being completed, Council shall initiate ongoing monitoring of groundwater, surface water and landfill gas, as outlined in Section 3.2.3, Section 3.2.4 and Section 3.2.5 respectively.

The environmental monitoring program outlined in this ISMP will be reported annually, including recommended updates to the ISMP (if required) based on the results of ongoing monitoring, maintenance and future developments at or adjacent to the site, as outlined in Section 4.3. The monitoring program would be re-evaluated and amended as necessary until such time it is determined that monitoring is no longer required (as defined in Section 5.3).

Any updates to the environmental monitoring program will be identified, justified and implemented through liaison with a NSW EPA accredited Auditor and, if necessary, the NSW EPA. Any agreed amendments to the environmental monitoring program will be documented through updates of this ISMP (as outlined in Section 4.5).

Monitoring will be undertaken by suitably qualified personnel, as defined by the NEPM (2013). Council will implement appropriate management measures and procedures for all site workers conducting monitoring at the site, including safety measures associated with ground gas risks. All fieldwork will be thoroughly documented for future reference if required, as outlined in Section 4. Documentation will include field sampling records, instrument calibration records, sample chain of custody records and analytical requests.

3.2.1 Targeted soil assessment

A targeted soil assessment will be undertaken to meet the following aims:

- Provide an indication of the likelihood of contamination extending off-site.
- Assess possible health risks to identified human receptors adjacent to the site (south and west).
- Confirm that historic analytical results are still representative of current site conditions.

Results of the targeted soil assessment may trigger further management actions and/or an update to the ISMP, as outlined in Section 5. Based on the overall objective of this ISMP, it was not considered necessary to conduct soil sampling in the vacant area of the site, the recreational area or along the public footpath at this time, as these areas will be managed as outlined in Section 3.1.

Soil sampling methods will be consistent with the assessment methodologies outlined in the NEPM. The anticipated sample method and schedule of analysis is outlined in Table 3-1. Test pits will not be undertaken at this stage, due to access restrictions and associated safety issues.

The location of soil investigation locations and samples will be as follows, and as shown on Figure 3 (Appendix A):

- A surface soil sample (0.0 to 0.2 m bgl) will be collected from the site boundaries and analysed for COPC by a laboratory as indicated in Table 3-1. Sampling locations will include:

- Three locations along the southern site boundary (adjacent to residential properties, along the driveway). In conjunction with historic sampling locations and samples from BH104 (outlined below), this will result in a sampling density of one per 10 m boundary length, with two locations corresponding with historical results.
- Five locations along the western site boundary (adjacent to commercial/industrial properties). In conjunction with historic results, this will result in a sampling density of approximately one per 20 m boundary length.
- Soil samples from installation of the three boundary groundwater monitoring wells (to correspond to the proposed drilling locations outlined in Section 3.2.2).
 - Samples will be collected at the surface (0 m bgl), 0.5 m bgl, 1 m bgl and every metre thereafter (including at the base of the well). Of these, two from each monitoring location will be analysed by the laboratory for COPC.

The targeted soil assessment will be undertaken in conjunction with the drilling works outlined in Section 3.2.2, both of which will be undertaken within one year of the endorsement of the ISMP by the Site Auditor.

Table 3-1 Soil assessment analytical suite

Sample type		Sample method	Number of samples	Analytical suite
Primary samples	Surface soil	Spade / hand tool	8	<ul style="list-style-type: none"> • Asbestos (presence / absence) • PFAS (standard level 28 suite) • Metals (cadmium, copper, chromium, lead, magnesium, mercury, nickel, zinc) • PAHs • Cyanide and arsenic
	Soil (monitoring wells)	Drilling	6	
Quality assurance / quality control samples	Inter laboratory duplicate	-	1 per 10 primary samples ¹	<ul style="list-style-type: none"> • Metals (cadmium, copper, chromium, lead, magnesium, mercury, nickel, zinc) • PAHs • Cyanide and arsenic
			1 per 5 primary samples ²	<ul style="list-style-type: none"> • PFAS (standard level 28 suite)
	Intra laboratory duplicate	-	1 per 10 primary samples ¹	<ul style="list-style-type: none"> • Metals (cadmium, copper, chromium, lead, magnesium, mercury, nickel, zinc) • PAHs • Cyanide and arsenic
			1 per 5 primary samples ²	<ul style="list-style-type: none"> • PFAS (standard level 28 suite)

TABLE NOTES

1 – As per the NEPM (2013)

2 – As per the PFAS NEMP (2020) for PFAS analysis

3.2.2 Installation of groundwater and landfill gas monitoring wells

Groundwater

At least three new groundwater monitoring wells are to be installed as part of the groundwater triangulation works proposed by GHD, 2020 (provided in Appendix L); specifically locations BH101, BH102 and BH104. These are shown on Figure 5, Appendix A, noting that:

- The bore locations shown on Figure 5, Appendix A, are the ideal placement (at the site boundary, on site). However, it is anticipated that logistical issues will prevent the installation of at least two of the bores on site due to access constraints for a drill rig. If this is found to be the case, the relevant wells will be installed as shown in the triangulation report in Appendix L (as close to the site boundary as possible, but located off site). This assumes that access to the adjacent land to install and monitor these wells can be obtained by Council with the relevant land owner (s). Consideration of well design will be required to ensure that the alternate well locations meet the aim of assessing potential risk to identified receptors. Groundwater wells would typically aim to be screened with approximately 1 m above groundwater strike and 2 m below the groundwater strike, with the screen within a single geological unit where possible.
- The naming convention in the triangulation report is nominal and is therefore not shown on Figure 5.
- These are proposed to be dual purpose monitoring wells for both groundwater and landfill gas monitoring purposes, noting that this may not be possible depending on the geology encountered (as discussed in Appendix L).

Two additional locations (BH103 and BH105) are recommended in the triangulation of groundwater study (GHD, 2020, provided in Appendix L) in the central portion of the site. These were recommended to characterise the primary source zone, but have not been considered necessary for the purpose of interim site management (as outlined in Appendix C). However, there is merit in the installation to occur in conjunction with boundary wells from an financial perspective, as these may be installed for future monitoring purposes as outlined in Section 5.

Soil sampling and analysis will be undertaken during installation of the wells, as outlined in Section 3.2.1. Additionally, all bores will be surveyed to provide top of casing measurements in m AHD to enable groundwater flow direction estimates.

Subsurface landfill gas

Landfill gas bores will be installed at the site in a staged method as a more feasible approach to assessing landfill gas at the site³. The preliminary gas bore monitoring network to be installed at the site is presented in Figure 5 (Appendix A), noting that these are the same bores for groundwater monitoring. The proposed bore network includes the installation of at least three monitoring bores targeting:

- Identified possible receptors (adjacent commercial/industrial and residential buildings).
- The site perimeter to understand possible migration patterns.

³ The site boundary adjacent to potential human receptors (southern and western) is approximately 311 m long. The VIC EPA Landfill BPEM recommends landfill gas bores be places a maximum of 20 m apart for permeable and/or fracture dominated strata within 150 m of development areas. Therefore, according to the VIC EPA Landfill BPEM, the site would require 16 bores around the boundary to intercept any landfill gas escaping laterally from the site. However, given that the site is known to have been landfilled with a mix of waste streams (the majority of which is likely to have been incineration waste) and is relatively old, it is likely that there will be a low volume of gas still being generated at the site.

As discussed above, installation of landfill gas bores on the inside and adjacent to the site boundary would be ideal, however is considered unlikely to be feasible due to topography and vegetation causing access constraints for a drill rig. The installed wells should be designed in general accordance with B7.3 and B7.4 of the VIC EPA Landfill BPEM (2015). Currently, a target depth of approximately 5 m bgl (based on lowest known elevation of waste, as outlined in Appendix G, and depending on groundwater elevation encountered) is anticipated. The screen is anticipated to start from at least 1 m bgl to ensure an adequate seal is installed close to the ground surface whilst still allowing some screen to be exposed above the groundwater level.

Following the initial annual monitoring period, the monitoring data will be assessed and the monitoring network augmented as necessary.

The proposed monitoring bores will be designed and installed by suitably qualified personnel, as defined in the NEPM (2013). Monitoring bores should be installed with an ex-cap (also known as a gas cap) to allow gas monitoring.

Soil sampling and analysis will be undertaken during installation of the wells, as outlined in Section 3.2.1.

3.2.3 Groundwater monitoring

Monitoring locations

Groundwater monitoring will be undertaken at the five existing monitoring bores with bore logs available (MW01, MW02, MW03, MW13 and MW14, shown on Figure 2) and those installed as per Section 3.2.2.

Sampling methods

All sampling and analysis will be conducted by appropriately qualified personnel (as defined in the NEPM, 2013) using low flow sampling methods. If low flow sampling is not achievable due to poor groundwater recovery, bailers will be used to collect a grab sample. Gauging of groundwater levels to m bgl and m AHD and monitoring for LNAPL using an interface meter will be undertaken prior to initiating sampling.

Analysis and sample frequency

The analytical suite and associated monitoring frequencies are tabulated in Table 3-2.

An appropriate quality control program shall be in place to ensure that results of analysis are reliable and accurate. Quality assurance / quality control (QA/QC) samples have been included in Table 3-2.

In addition to the laboratory analysis, field measurements will be recorded for standing water level and water quality parameters, including dissolved oxygen, temperature, pH, electrical conductivity, and reduction-oxidation potential.

Table 3-2 Groundwater quality monitoring parameters

Sample type	Number of samples for analysis	Frequency of sampling per year	Analytical suite
Primary groundwater samples (one per location)	Minimum – 8 Maximum - 10	Quarterly	<ul style="list-style-type: none"> PFAS (standard level 28 suite) Dissolved metals (cadmium, chromium, copper, lead, magnesium, mercury, nickel, zinc) Cyanide and arsenic

Sample type	Number of samples for analysis	Frequency of sampling per year	Analytical suite
			<ul style="list-style-type: none"> • Nutrients (ammonia, total nitrogen, nitrate, nitrite and total phosphate) • Dissolved methane
Inter laboratory duplicate	1 per 5 primary samples for PFAS, and 1 per 10 for all other analytes ¹	Quarterly	<ul style="list-style-type: none"> • PFAS (standard level 28 suite) • Dissolved metals (cadmium, copper, chromium, lead, magnesium, mercury, nickel, zinc) • Cyanide and arsenic • Nutrients (ammonia, total nitrogen, nitrate, nitrite and total phosphate)
Intra laboratory duplicate	1 per 5 primary samples for PFAS, and 1 per 10 for all other analytes ¹		

TABLE NOTES:

1 - As per PFAS NEMP (2020) requirements for PFAS analysis, and the NEPM (2013) for all other analytes

Reporting of results

Analytical results will be compared against the adopted assessment criteria outlined in Section 2 and factual reporting of groundwater monitoring events will be undertaken after each event, with assessment of results undertaken annually, as outlined in Section 4.1 and Section 4.3 respectively.

3.2.4 Surface water monitoring

Monitoring locations

Surface water monitoring will be undertaken at the two historic locations (SW1 and SW2) and at one upgradient and one down gradient location from the site (nominally termed SW3 and SW4) as shown on Figure 2 (Appendix A).

Sampling methods

Surface water samples will be collected via grab sampling methods from the shoreline. Assuming the reachable water column is less than 0.5 m deep, the sample should be collected from at least half the water depth, and care should be taken to avoid surface films entering the sample. If the water column is greater than 0.5 m deep, the sample should be taken 20 to 30 cm below the surface of the water.

Analysis and frequency

The analytical suite and associated monitoring frequencies for surface water sampling are tabulated in Table 3-3. An appropriate quality control program shall be in place to ensure that results of analysis are reliable and accurate. Quality assurance / quality control (QA/QC) samples have been included in Table 3-3.

In addition to the laboratory analysis, field measurements will be recorded for water quality parameters, including dissolved oxygen, temperature, pH, electrical conductivity, and reduction-oxidation potential.

Table 3-3 Surface water monitoring parameters

Sample type	Number of samples for analysis	Frequency of sampling per year	Analytical suite
Primary surface water samples (one per location)	4	Quarterly	<ul style="list-style-type: none">• PFAS (standard level 28 suite)• Dissolved metals (cadmium, copper, chromium, lead, magnesium, mercury, nickel, zinc)• Cyanide and arsenic• Nutrients (ammonia, total nitrogen, nitrate, nitrite and total phosphate)• TRH• PAH
Surface water - Inter laboratory duplicate	1 per 5 primary samples for PFAS, and 1 per 10 for all other analytes ¹	Quarterly	<ul style="list-style-type: none">• PFAS (standard level 28 suite)• Dissolved metals (cadmium, copper, chromium, lead, magnesium, mercury, nickel, zinc, cyanide and arsenic)• Nutrients (ammonia, total nitrogen, nitrate, nitrite and total phosphate)• TRH• PAH
Surface water - Intra laboratory duplicate	1 per 5 primary samples for PFAS, and 1 per 10 for all other analytes ¹		
<u>TABLE NOTES:</u> 1 - As per PFAS NEMP (2020) requirements for PFAS analysis, and the NEPM (2013) for all other analytes			

Reporting of results

Analytical results will be compared against the adopted assessment criteria outlined in Section 2. Factual reporting of surface water monitoring events will be undertaken per event, and results will be assessed annually as outlined in Section 4.1 and Section 4.3 respectively.

3.2.5 Landfill gas emissions monitoring

Subsurface bore monitoring will be undertaken as described below. It is noted that the significance of landfill gas potentially present at the site is currently unknown. However, based on the age, quantity and estimated waste types present at the site, the volume of landfill gas is considered likely to be relatively low. Furthermore it is understood that there are no on-site buildings, limited on-site subsurface services (Sydney Water Sewer main only) and large parts of the site are heavily vegetated and fenced, currently limiting the ability to monitor surface gas appropriately and access to those areas.

Therefore no subsurface service, building accumulation or surface gas monitoring has been included in this monitoring program at this stage of assessment. The ISMP may require updates based on the results of sub-surface gas monitoring to include these additional monitoring types if found to be required, as outlined in Section 5.2.

Subsurface bore monitoring locations

Monitoring will be undertaken at the three landfill gas bores installed, outlined in Section 3.2.2 (presented in Figure 5, Appendix A). As noted in Section 3.2.2, if logistical issues prevent the installation of wells as intended, alternative locations should ensure the overall aim of assessing

potential risk to identified receptors, including the use of alternative sampling methods if required (for example shallow monitoring probes installed with hand tools).

Sample method, analysis and sample frequency

Subsurface bore monitoring will be undertaken at the three proposed landfill gas monitoring bores, as outlined in Table 3-4. A landfill gas meter will be used to monitor the gas parameters. Additionally, standing groundwater levels, base of well, climatic observations and technician's observations will be recorded.

Table 3-4 Subsurface landfill gas monitoring parameters

Sample type	Number of locations for analysis	Frequency	Parameters to be monitored
Primary landfill gas sample (via landfill gas meter)	3	Every second month in first year, then once per 6 month period in the following years.	<ul style="list-style-type: none"> • Methane • Carbon dioxide • Oxygen • Hydrogen sulfide • Balance • Borehole pressure • Gas flow
Groundwater elevation (via gauging with an interface probe)	3		<ul style="list-style-type: none"> • Standing groundwater level • Base of well

Reporting of results

Results will be compared against the adopted assessment criteria outlined in Section 2.

If an exceedance of the adopted criteria is detected during monitoring, the responsible Council contact identified in Table 1-1 (or direct Council contact responsible for project, if known) will be notified immediately via a phone call. This will be followed up in writing via email by the party who identified the exceedance. Factual reporting of landfill gas monitoring events will be undertaken after each event, and results assessed annually, as outlined in Section 4.1 and Section 4.3 respectively.

3.3 Routine inspection and maintenance

This section identifies the proposed inspection and maintenance activities to be undertaken at the site based on the current environmental management measures being undertaken by Council outlined in Appendix C, the immediate actions outlined in Section 3.1, and the current proposed long term land use (predominantly vacant land, with a small portion of land used for recreational purposes).

Inspection and maintenance works are intended to be carried out until they are no longer required to be included in a revised ISMP (as agreed between Council, a NSW EPA accredited Auditor and potentially the NSW EPA). Inspections and maintenance works can be undertaken by Council or a delegated representative, unless otherwise stated in the following subsections. Council personnel/representatives undertaking the inspection and/or maintenance works should have appropriate environmental management experience, in order to ensure that the objectives of the inspection/maintenance are adequately met.

3.3.1 Procedure 1 – Security fencing and signage

Area Affected: The fencing surrounding the site boundary and the vacant area of the site, as shown on Figure 6.

Objective: Prevent access by unauthorised persons by ensuring appropriate fencing (and signage to indicate authorised access only) sufficient to control access to the vacant area of the site.

Procedure: The area shall be surrounded by fencing on all sides. The recreational area in the southern portion of the site (as shown on Figure 6) will remain accessible to the public unless Council chooses to include this area in the vacant area by fencing it, as discussed in Section 3.1.1.

Signage shall be placed at a minimum of 50 m intervals around the fence boundary detailing 'no unauthorised access' and advising of potential risks associated with doing so. The fencing shall be a minimum of 1.8 m high or sufficient to prevent unauthorised access (strong and high enough).

Access gates should be locked with a key, and the keys should be held with Council or their nominee (including any nominated site manager), and authorisation for access should be obtained from this source. The site should only be accessed by authorised personnel and a record of those with access keys should be maintained by Council.

Inspections shall be undertaken in accordance with Section 3.3.7.

Inspection Frequency: The fence and signage should be inspected monthly (as per the VMP).

Reporting: The outcomes of the fencing and signage inspection will be reported in accordance with Section 4.2.

Actions: If the fencing or signage has been damaged or degraded, it should be reinstated to meet the requirements of this procedure as soon as reasonably practicable.

3.3.2 Procedure 2 - Sediment fence maintenance

Area Affected: Eastern site boundary adjacent to the footpath, as shown in Figure 6.

Objective: Maintain the condition of the existing sediment fence to prevent sediment in surface water runoff from the site entering Manly Creek.

Procedure: The existing sediment fence is a continuous installation along the full length of the eastern site boundary, as shown in [Photograph 3](#).

Inspection of the sediment fence will be undertaken in accordance with Section 3.3.7, to identify any failures such as collapse or gaps that would allow water to flow over the top or around it.

Inspection Frequency: Once per six months and within two weeks of a rainfall event which has caused flooding along any of the footpath area.

Reporting: The sediment fencing should be reported in accordance with Section 4.2.

Actions: If the sediment fencing has been damaged or degraded, it should be reinstated to meet the requirements of this procedure as soon as reasonably practicable.

3.3.3 Procedure 3 - Ground cover and vegetation inspection and maintenance

Areas Affected: Areas accessible to human receptors such as the recreational area, public footpath and eastern embankment (as shown on Figure 6).

Objective: Confirm that existing or newly applied ground/vegetation cover is well maintained and sufficient in the short term to reduce the likelihood of potential human health impacts from underlying waste (such as via dermal contact or inhalation of asbestos fibres).

Procedure: Exposed waste is to be covered with inert, clean soils, mulch and/or vegetation.

Inspection of the covered surfaces will be undertaken to identify any failures such as excessive erosion exposing waste, differential settlement causing ponding, land slippage, and leachate seepage/surfacing. If previous cover is observed to have significantly degraded or eroded, the area should be re-covered.

In order to achieve the above, regular mowing and maintenance is required of the on-site vegetation in accessible areas. This would be undertaken as required to allow effective inspection and monitoring of the landfill, and may include:

- Regular mowing of grasses in public open space areas.
- Targeted replacement of vegetation affected by waste, landfill gas or erosion if necessary, to maintain the vegetation cover.
- Targeted removal of unsuitable vegetation that may have seeded naturally on the site.

Inspections will be undertaken in accordance with Section 3.3.7.

Inspection Frequency: Every second month for a period of 6 months after completion of the covering works in each area. After the initial 6 months, an inspection once per six months should be undertaken and within two weeks of a rainfall event which has caused flooding along any of the footpath area.

Reporting: The ground and vegetation cover should be reported in accordance with Section 4.2. If the interim cover is noted to have been eroded such that the marker layer or waste is exposed, the inspector shall

communicate this to the site owner within one week of undertaking the inspection.

Actions:

If the ground and/or vegetation cover is damaged or degraded it should be reinstated to meet the requirements of this procedure. Works should be undertaken in accordance with subsurface works outlined in Section 3.3.4. The sparrow picking program outlined in Appendix C shall be re-initiated until such time that the disturbed areas of ground/vegetation cover are reinstated, including engagement of a contractor to undertake the works who is licenced to remove asbestos.

3.3.4 Procedure 4 - Subsurface works

Area Affected:

All site.

Objective:

To aid in protecting the health and safety of workers if subsurface works are required. Council will provide the details of this ISMP to 'Dial Before You Dig' (DBYD) requests for the site to ensure the management information is passed on to prospective intrusive maintenance workers.

Procedure:

Subsurface works (i.e. below the ground surface at the site) shall only be undertaken when absolutely necessary and all measures should be undertaken to maintain the integrity of the capping and vegetation layers (if present). Any subsurface works shall be undertaken in accordance with the following measures.

Supervision and standard of works

All subsurface works involving the disturbance of the ground cover and vegetation layer must be undertaken in accordance with relevant provisions including:

- Wearing appropriate Personal Protective Equipment (PPE) (as described below);
- The workers should provide a safe work method statement providing reference to the ISMP to Council. This shall be reviewed and authorised by the Council prior to conducting works;
- If uncovered, waste / fill materials are to be kept contained at all times; and
- Appropriate decontamination facilities are to be provided to allow the safe removal and storage of PPE.

All workers potentially exposed to impacted materials (for example waste materials) are required to wear appropriate levels of PPE as identified by their safe working method statement.

Soils management

In undertaking excavation works, at least two distinct soil types may require excavation, including:

- Surface vegetation and topsoil materials; and
- Underlying fill / waste material.

These materials must be kept segregated during all stages of the works. Where materials become mixed at any stage, then the mixed materials shall be classified as contaminated soils. It is recommended that lining be placed under the areas used for the stockpiling materials to prevent potentially mixing with non impacted soils, and impacted material is covered with plastic lining to prevent potential exposure. Stockpiles may also need to be appropriately bunded to prevent erosion / contaminated run-off from the stockpiled materials.

Dust and asbestos control measures

Dust control measures (such as damping down soils) shall be employed during all stages of subsurface works.

Airborne fibre monitoring should be completed by a competent person during all excavation works (greater than 0.1 m bgl) in accordance with the *NOHSC:3003, Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres, 2nd Edition, 2005* and analysed by a NATA accredited laboratory. Due to the potential presence of fibrous asbestos, is noted that any worker on site doing subsurface works is required to have a Type A licence prior to undertaking the work.

Reinstatement of cover and vegetation

The ground cover is to be reinstated immediately at the cessation of any subsurface works. This shall include re-instatement in accordance with Section 3.3.3.

New structures

No structures are to be erected on the site without an assessment of risk, including risk of installing building foundations (as relevant).

Repair to ground cover

Any breaches in the site ground cover shall be repaired within one day of identification by Council or notification to Council their representative.

Where the ground cover cannot be repaired within this timeframe, the area of the breach shall be delineated by site fencing and signage until repair works are undertaken.

Inspection Frequency: During and at completion of subsurface works, and undertaken in accordance with Section 3.3.7.

Reporting: At the completion of any subsurface works, the reinstatement of the ground cover layer and vegetation (as appropriate) shall be reported in accordance with Section 4.2. Subsurface works shall also be clearly documented including as constructed plans, surveys and photographs of the works and provided to Council.

Actions: A breach of the ground cover layers or ground surface should be dealt with as soon as reasonably practicable as outlined in this procedure. If

the ground or vegetation cover is insufficient post inspection it should be reinstated to meet the requirements of this procedure.

3.3.5 Procedure 5 - Landfill gas and leachate management systems

No specific landfill gas or leachate management measures have been included in this ISMP as they do not currently exist at the site and there is a lack of environmental data pertaining to these issues to fully verify the need for such systems at this time.

Based on the results of ongoing monitoring and maintenance and future developments at or adjacent to the site, requirements for additional landfill gas and leachate management measures may be identified. If this is found to be the case, those measures will be identified, justified, designed and installed through liaison with Council, a NSW EPA accredited Auditor and, if necessary, the NSW EPA. This process will include identification of suitable inspection and maintenance activities for these additional measures if eventually installed.

3.3.6 Procedure 6 - Environmental monitoring infrastructure maintenance

Area Affected: Environmental monitoring locations (as detailed on Figure 2 and Figure 5).

Objective: Environmental monitoring is required to confirm the contamination status of the site. Maintenance of the monitoring infrastructure is required to ensure that the monitoring network retains adequate integrity and performance to meet this aim.

Procedure: Council (or suitably qualified personnel) will undertake the environmental monitoring program outlined in Section 3.2. Additionally, Council (or suitably qualified personnel) will undertake regular inspection and maintenance of the landfill gas and groundwater monitoring wells during each monitoring round to confirm the integrity and performance of them. This will include the following:

- Inspection of well protection measures (such as gatic cover or monument cover) and reinstatement if necessary.
- Inspection of the well caps to confirm the pipework is sealed airtight, and replacement of well caps if necessary.
- Inspection of pipework for any damage, repair and reinstatement as necessary, including clearing of blockages in wells as needed.

Frequency: Every groundwater and landfill gas monitoring event as required by Section 3.2.3 and Section 3.2.5 respectively, and undertaken in accordance with Section 3.3.7.

Reporting: Inspections shall be reported in accordance with Section 4.2.

3.3.7 Procedure 7 - Site inspections

Area Affected: Fencing around the site, sediment fences, ground and vegetation cover, completed subsurface works and environmental monitoring infrastructure.

Objective: To check the continued integrity of the fences, cover, and monitoring infrastructure. The inspection should be completed by a person who

is recognised as being appropriately competent in the field of contaminated sites as per the criteria provided to National Environment Protection (Assessment of Site Contamination) Measures, 1999 (amended 2013).

Procedure:

An inspection of the area/infrastructure shall be undertaken by Council or their nominee (including any nominated site manager) or any future land owner. If required, an environmental Consultant can be contracted to conduct the inspections.

The inspections should include as a minimum (as relevant to the task):

- Inspection of the integrity of the area/infrastructure;
- Walkover the areas where additional ground cover had been applied, and assessment for consistent ground levels and cover, and that the coverage is a minimum of 80% vegetation based on visual estimation to meet objectives detailed in Section 3.1.1 and Section 3.1.2;
- Inspection of any areas of apparent disturbance or breaks to assess potential of breaching;
- Ensure there are no redundant materials are stored on site.

Where an area of potential breaching is confirmed, the area shall be clearly marked by the placement of survey flag or otherwise. Repairing the breach shall be undertaken in accordance with the relevant procedure.

Frequency:

As required by Section 3.3.1 to Section 3.3.6.

Reporting:

Inspections shall be reported in accordance with Section 4.2.

3.4 Unexpected finds

It is anticipated that new information regarding the site condition and/or contaminants present will become available via the implementation of the immediate management actions, environmental monitoring and/or any intrusive works. It is therefore necessary to ensure that a protocol has been provided should unexpected materials be found at the site.

Unexpected situations may include:

- The uncovering of greater amounts of ground contamination than presently known; and
- The uncovering of types of contamination that are presently unknown.

Details of the procedures that will be adopted in the event of these occurrences are defined below:

- If unexpected materials are identified, all works should be ceased and Council or the future land owner should be contacted immediately.
- The location, form, volume, type and chemical characteristics of the material will need to be assessed by an appropriately qualified person.

The proposed strategy to deal with the characterised material should be undertaken by an appropriate qualified person, and should be assessed and dealt with in accordance with the legislation and guidance detailed in Section 1.6.

Copies of all unexpected finds, assessment of finds and actions to deal with the finds should be reported, and copies held by Council or any future land owners. The unexpected finds will be reported and assessed as part of the annual reports, outlined in Section 4.

3.5 Non-compliance with management strategy

To ensure that the ISMP is implemented as intended, a non-compliance protocol is required to ensure that any identified issues are adequately communicated and documented. Such non-compliances may include such events as:

- Missing, or lateness, in undertaking management works or inspection events.
- Breaches of environmental controls on site.

Where non-compliance is identified by a responsible organisation (for example, the EPA, regulatory authority or an Environmental Consultant), they shall inform Council of the non-compliance in writing. Council shall have the responsibility of informing the non-complying parties and/or documenting in writing the non-compliance, and rectify the non-conformity as soon as possible (as per the requirements of the relevant procedure(s) where non-compliance has occurred). Details of the action taken to rectify the non-compliance shall be provided to Council if undertaken by a third party.

Where non-compliance cannot be rectified, then the ISMP will require review as per the requirements of the review procedures outlined in Section 3.6 and Section 4.5.

Copies of non-compliance notifications and rectifications should be held by Council or any future land owners. The non-compliance events will be reported and assessed as part of the annual ISMP Implementation reports, outlined in Section 4.4.

3.6 Implementation review of the ISMP

The implementation of the procedures outlined in Section 3.2 to Section 3.5 of this ISMP needs to be checked by an appropriately qualified third party (as defined by the NEMP, 2013) or a suitably qualified employee to ensure that they have been adequately⁴ undertaken within the specified timeframes. Specific tasks that will be undertaken by that person shall include:

- Review of verification, environmental monitoring and inspection reports generated by or on behalf of Council to ensure it meets the requirements of this ISMP.
- Liaison with Council as required in interpreting the requirements of the ISMP.

Where non-compliance is detected during the review process, then the relevant parties shall be informed of the non-compliance as per Section 3.5.

The ISMP implementation review will be undertaken annually, and shall be reported in accordance with Section 4.4. In addition, the ISMP should be reviewed and updated as outlined in Section 4.5. All ISMP reviews shall be retained by Council and any other future land owner for a period of seven years.

⁴ 'Adequate' is defined as meeting the overall management objective of the actions listed in this ISMP.

4. Reporting requirements

4.1 Event based environmental monitoring reports

Factual monitoring reports shall be prepared within one month of each groundwater, surface water and/or landfill gas monitoring event to ensure that the required information is collated in an adequate time frame. A management actions checklist is provided in Appendix K, which indicates the frequency of monitoring events.

Council or any future land owners are to ensure that environmental monitoring reports are prepared by an appropriately qualified person (as defined in the NEPM, 2013). The report shall contain the following (as a minimum):

- Type and date of monitoring events undertaken in the monitoring period.
- Summary of the methodology and the QA/QC undertaken.
- Summary of analytical results compared to appropriate screening criteria outlined in Section 2.
- Summary of any notifications to Council of exceedances of landfill gas criteria.
- Site observations during monitoring events.
- Collated field notes, chain of custody, laboratory and equipment calibration documentation.

Various environmental media can be combined into one factual report if timeframes allow. Additionally, final monitoring events in the annual period may be reported as part of the annual environmental monitoring report if convenient.

The outcomes of the factual environmental monitoring reports and further assessment of long term trends will be compiled in an annual monitoring report. Details of the annual reporting requirements are provided in Section 4.3.

4.2 Reporting on maintenance and inspections activities

Area Affected: Areas outlined in Section 3.3.1 to Section 3.3.7.

Objective: To provide results of inspections in a clear and concise format and to allow comparison to site management requirements.

Procedure: *Reporting*

Council or any future landowners should ensure that inspection reports are prepared by an appropriately experienced person, as defined in Section 3.3. The nominated person shall prepare reports summarising each respective inspection event completed under this ISMP. Each report shall contain details of the following (where relevant):

- Type and date of inspection events undertaken in the reporting period;
- Name and organisation of person undertaking inspection
- Site observations during inspection
- Notes of activities undertaken during inspection
- Assessment of vegetation across covered areas

- Assessment of cover across areas where additional ground cover has been added
- Assessment of boundary fencing
- Whether any development or demolition has taken place on site
- Assessment of any redundant materials at the site, including illegally dumped materials or stockpiled materials.
- Any relevant recommendations for future monitoring or implementation of the ISMP.

A copy of each inspection report should be held by Council or any future land owners.

Assessment

Any breaches in the vegetation, cover or fencing must be clearly identified in the inspection report. Any breaches rectified, necessitating the inspection and inspection report shall be noted in the report.

An example inspection report is provided in Appendix J.

Frequency: Within two weeks of the completion of an inspection event.

Inspection / Reporting: Copies of all inspection reports should be held by Council or any future land owners, and shall be compiled in annual reports, as outlined in Section 4.4.

4.3 Annual environmental monitoring reports

An annual report will be completed by the end of August of each year, to align with the VMP and NSW EPA requirements (refer to Appendix B). Each annual report will be submitted to the NSW EPA for review (noting that it must be reviewed by a Certified Environmental Practitioner (contamination specialist) prior to submission).

Each annual report shall compile and, where relevant, assess the outcomes of the following works:

- Any immediate management actions undertaken.
- Environmental monitoring.
- Unexpected finds.

Based on the outcomes of these works, each annual environmental monitoring report will provide the following information, assessment and guidance:

- Summary of management actions undertaken at the site over the annual period.
- Type and date of monitoring events undertaken.
- Summary of the methodology and the QA/QC.
- Summary of key site observations during monitoring events.
- Collated field notes, chain of custody, laboratory and equipment calibration documentation.
- Assessment of environmental monitoring results including:
 - Summary of analytical results compared to appropriate screening criteria outlined in Section 2.

- Brief comparison of results to previous results (if available) graphically or pictorially to assess long term trends at the site. Statistical analysis should also be used to establish a trend and to assess the contingency scenario's outlined in Section 5.2.
- Assessment of potential impacts of the site on existing and future receptors.
- Assessment of potential impacts from any unexpected finds and breaches of the ISMP.
- Consideration of monitoring cessation criteria, outlined in Section 5.3.
- Recommendations for:
 - Additional management works (such as installation of formal landfill gas or leachate capture systems, or formal capping) and/or monitoring infrastructure required for further investigation works (if any).
 - Amendments to the current environmental monitoring program (if any).

The outcomes of the annual report will be actioned through updates of this ISMP (as outlined in Section 4.5) once EPA endorsement has been received by Council.

4.4 ISMP implementation review report

The implementation of the ISMP requires assessment by an appropriately qualified third party or a suitably qualified employee (as defined in Section 3.3) to ensure that the monitoring and inspection requirements have been adequately undertaken within the specified timeframes. The implementation review shall be undertaken annually, within one month of submitting the annual environmental monitoring report and shall also be submitted to the NSW EPA.

The reviewer (as outlined in Section 3.6) shall include the following as part of the report (as a minimum):

- Review of annual environmental monitoring and inspection reports generated by or on behalf of Council to ensure it meets the requirements of this ISMP.
- Liaison with Council as required in interpreting the requirements of the ISMP.
- Review of unexpected finds and non-compliance records (as outlined in Section 3.4 and Section 3.5 respectively). The review should clearly document changes to the areas of known contamination (as outlined in Appendix C), based on the unexpected finds encountered.
- Recommendations for updates to the ISMP (as needed, with consideration of triggers outlined in Section 5.1) to ensure it remains relevant and valid.

4.5 Review of the ISMP and updates

The need to update the ISMP will be reviewed throughout the annual works, once an annual environmental report has been accepted by the EPA, and via the ISMP implementation review. In particular, the ISMP will be reviewed and updated (if required) after the first annual period in which new data will have been obtained for site characterisation purposes. Additionally, the ISMP shall be reviewed as per Section 5. If found to be required, the ISMP will be updated at those times.

These reviews shall consider:

- The frequency of environmental monitoring and site inspections required.
- Any non-compliance with the ISMP that have been unable to be resolved.
- Any changes in state or national environmental protection or occupational legislation or guidelines that impact any part of the ISMP.

- Proposed changes in land use of the site or adjoining sites.

Where a review identifies items which require modification or addition to the ISMP, then a revision of the ISMP shall be endorsed by a Site Auditor prior to becoming the overarching document for management of the site. All ISMP reviews or revisions shall be retained by Council or future land owners.

5. Triggers for change to the ISMP

5.1 Site changes and new information

The Council shall undertake a review of the ISMP, including an assessment of data gaps outlined in Appendix C, if one or more of the following scenarios occur, to ensure that the ISMP continues to remain appropriate to be used at the site:

- There is a change in current or intended site use, including implementation of any remedial measures in preparation for a new site use.
- There is a change in site ownership.
- At the end of every 3 years from implementation of the ISMP.
- Environmental monitoring or additional site investigations identify potential significant risk to receptors, as outlined in annual reports.
- There are changes to adjacent land use to a more sensitive receptor (e.g. a child care is developed on the residential property south of the site, or residential properties are developed west of the site).
- Environmental contingency scenarios outlined in Section 5.2 are triggered.
- Environmental monitoring cessation criteria outlined in Section 5.3 are met.

All reviews and updates to the ISMP will be carried out in accordance with Section 4.5.

5.2 Environmental contingency scenarios

The following potential scenarios have been considered:

1. Groundwater concentrations of COPC show significant ⁵ increasing trends.
2. Surface water concentrations of COPC showing significant ⁶ increasing trends downgradient of the site.
3. Landfill gas show increasing trends off-site, and/or exceed of the lower explosive limit of methane in air.

Contingency actions for Scenarios 1 to 3 are discussed in the following sub sections. The actions outlined below are not necessarily definitive and should additional actions be identified as being appropriate, those additional actions should also be considered.

5.2.1 Groundwater

In the event that significant ⁶ increases in groundwater concentrations of COPC are observed at the site boundary, the following actions will be implemented:

- Frequency of monitoring will be re-assessed, with a view to increasing as appropriate.
- Review of the conceptual site model (CSM) for the site to assess whether any previously discounted source-pathway-receptor linkages may be present, and should these be

⁵ For the purposes of this EMP, *significant* will be interpreted as a relative percent difference (RPD) of greater than 50% in results from successive groundwater or surface water monitoring events. Isolated increases of >50% RPD can sometimes occur between data; however, a significant increase will be considered if there is a consistent occurrence of >50% RPD in data over successive events. The selection of >50% RPD is greater than what would be accepted as a relative percent difference for organics in quality control sampling from a duplicate pair.

identified, development of an appropriate sampling and analysis plan which could include installation of additional groundwater monitoring wells.

- Consideration will be given to undertaking a hydrogeological fate and transport assessment and/or site specific risk assessment.

5.2.2 Landfill gas

In the event that increases or acute risk concentrations of landfill gas are observed at the site boundary, the following actions will be implemented:

- Frequency of monitoring will be re-assessed, with a view to increasing as appropriate.
- A surface, sub-surface service and building accumulation landfill gas assessment will be undertaken on and off-site respectively (as accessible for monitoring) within one week of the results if acute risk is identified, and within two months if general increase is observed. Results from this assessment will inform further management actions potentially required including temporary exclusion zones, further assessment and off-site stakeholder engagement.
- Installation of additional landfill gas monitoring wells, including in the central portion of the site to characterise the source zone (locations as outlined in GHD, 2020).
- Consideration will be given to undertaking a landfill gas risk assessment.

5.2.3 Surface water

In the event that significantly ⁶ increasing trends of COPC are observed in surface water down gradient of the site, the following actions will be implemented:

- Frequency and location of monitoring will be re-assessed, with a view to increasing as appropriate to confirm the source of contaminants observed is/is not the site.
- Installation of groundwater elevation data loggers in at least two of the groundwater monitoring wells located on the eastern side of the site, plus one groundwater monitoring location on the west or south-west portion of the site. Groundwater elevation data should be compared to surface water elevation data (captured through tidal measurements converted to m AHD via a surveyor measurement) to confirm the possible direction of groundwater flows.

Consideration will be given to:

- Undertaking a groundwater hydrogeological fate and transport assessment and/or risk assessment.
- Undertaking an assessment of leachate at the site, including installation of monitoring wells in the central portion of the site.

5.3 Cessation of environmental monitoring

Environmental monitoring requirements may be reviewed, and the frequency changed as per the ISMP review process outlined in Section 4.5. Environmental monitoring may be ceased for the relevant media completely if the associated criteria outlined in the following sub sections are met. If the criteria are met, the ISMP must be updated in accordance with Section 4.5, including endorsement of the updated ISMP by a Site Auditor. Environmental monitoring must be undertaken in accordance with the ISMP until such time as the updated ISMP is endorsed.

GHD notes that these criteria may require updating as part of the ISMP review process if additional information indicates the cessation criteria are not adequately protective of identified receptors.

Where concentrations of contaminants do not decrease below the nominated assessment criteria in Section 2, or are not considered stable based on statistical assessment (e.g. Mann-Kendall analysis), then annual monitoring shall continue until a stable and decreasing trend is achieved. If the contamination status does change and is considered to pose a potentially unacceptable risk to human health or the environment as documented in an annual environmental report, the contingency scenarios outlined in Section 5.2 are initiated.

5.3.1 Groundwater

Groundwater monitoring can be removed from the ISMP if no potential adverse risk to identified receptors is considered to be present based on analytical results, and the following criteria are met:

- Overall decreasing trends are demonstrated showing that concentrations of contaminants have decreased over a minimum three year period (using quarterly data); and
- Mann Kendall analysis (confidence interval of 90%) shows the following COPC to have stable or decreasing trends in at least three consecutive monitoring events at all monitoring locations:
 - PAHs (including benzo(a)pyrene),
 - TPHs,
 - Metals including lead, cadmium, copper, zinc and arsenic.
 - Ammonia
 - PFAS

The baseline data set used for the Mann Kendall analysis should be groundwater results as of November 2017 (or later if no pre-existing data present), and Mann Kendall analysis should include all groundwater results from 2017 onwards. The maximum concentration of duplicate pairs should be considered, and where the concentration is less than the LOR, the value of the LOR shall be used.

5.3.2 Surface water

Surface water monitoring can be removed from the ISMP if no potential adverse risk to identified receptors is considered to be present based on analytical results, and the following criteria are met:

- Overall decreasing trends at monitoring locations down gradient of the site are demonstrated showing that concentrations of contaminants have decreased over a minimum three year period (using quarterly data); or
- Groundwater is shown to not be discharging to surface water via an assessment of groundwater elevations, including consideration of tidal fluctuations.

5.3.3 Landfill gas

Landfill gas monitoring can be removed from the ISMP if the following criterion is met (as per NSW EPA, 2016):

- Gas concentration levels in all perimeter gas wells have fallen to less than 1% methane (volume/volume) and less than 1.5% carbon dioxide (volume/volume) above the established natural background (defined in Table 2-3 for this site) for a period of at least 24 months.

5.3.4 Surface soils

As noted in Section 3.1.2, a sparrow picking program for PACM is required to be undertaken as per Appendix C and the VMP for surface soils on the informal footpath, until an interim cover is installed. Once a cover is installed, general inspections of the cover must be undertaken as outlined in Section 3.3.3. If the interim cover is observed to have been eroded such that the marker layer or waste is exposed, the sparrow picking program outlined in Appendix C shall be re-initiated until such time that the disturbed areas of ground/vegetation cover are reinstated, including engagement of a licenced contractor to undertake the works.

Regular inspection and/or the sparrow picking program are not intended to cease until such time that a formal cap is installed and has been assessed over some years and found to be in good condition and stable, with acceptable stormwater drainage and with no evidence of erosion, cracking, dead vegetation, ponding, differential settlement or slope instability (as per NSW EPA, 2016).

6. References

- Australian and New Zealand Environmental Conservation Council (ANZECC & ARMCANZ 2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*.
- Cardno, 2011. *Manly Lagoon Dredging Project – Summary Environmental Report*. Dated September 2011.
- Coffey, 2009. Statutory site audit report and site audit statement, Lots 1 to 4 (DP 818957) Addiscombe Road, Manly Vale 2093. Dated 27 October 2009.
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- GHD, 2020. Northern Beaches Council, *Lot 1-4 Addiscombe Road, Manly Vale – Works specification for triangulation of groundwater*. March 2020.
- Heads of EPAs (HEPA) Australia and New Zealand, 2020. *PFAS National Environmental Management Plan (NEMP) – Version 2.0*. January 2020.
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- Manly Council, 2010. *Manly Lagoon – Our Lagoon*. <http://www.manlylagoon.com.au/home/> [accessed 15 October 2018]
- National Health and Medical Research Council (NHMRC 2008) *Guidelines for Managing Risk in Recreational Waters*.
- Northern Beaches Council (NBC), 2019. *Voluntary Management Proposal Under the Contaminated Land Management Act 1997*. Dated 15 August 2019.
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- Parsons Brinckerhoff (PB), 2006. *Proposed Remediation of Contaminated Land. Lots 1-4 DP818957 Addiscombe Road, Manly Vale. Project Application and Preliminary Environmental Assessment*. Dated August 2006.
- Parsons Brinckerhoff (PB), 2008a. Remedial Action Plan - Lots 1 to 4 (DP 818957) Addiscombe Road, Manly Vale, NSW. Dated September 2008.
- Parsons Brinckerhoff (PB), 2008b. Environmental and Groundwater Management Plan – Lots 1 to 4 (DP 818957) Addiscombe Road, Manly Vale, NSW. Dated September 2008.
- Patterson Britton, 2002. Excerpt from 'Sediment information' Issue No 1 Sept 2002 (Appendix to Patterson Britton & Partners 2003 report).
- Patterson Britton, 2007. Excerpt from 'Sites 1 and 2 additional sediment sampling and testing', Issue No. 2 October 2007.
- Victorian EPA, 2015. *Siting, design, operation and rehabilitation of landfills – Best practice environmental management*.

7. Limitations

This report: has been prepared by GHD for Northern Beaches Council and may only be used and relied on by Northern Beaches Council for the purpose agreed between GHD and the Northern Beaches Council as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Northern Beaches Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Northern Beaches Council and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

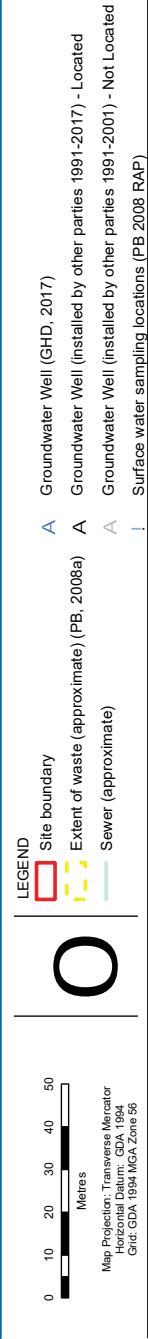
Appendices

Appendix A - Figures



LEGEND		Northern Beaches Council		Job Number	
Site Boundary		Interim Site Management Plan,		12522471	
		Addiscombe Road, Manly Vale, NSW		Revision	
				Date	
				27 Mar 2020	

Updated: 2020/03/27 15:00:00 (Project: 12522471) GIS Maps (Deliverables: 12522471_2020_Manly Vale_Site_Location.mxd)
© 2020. While every care has been taken to prepare this map, GHD and NSW L.P. make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in negligence or otherwise) for any loss or damage suffered by any party as a result of its use. This map, being inaccurate, incomplete or unreliable in any way, and for any reason.
Data source: Imagery, e-land and Property Information (Extracted: 27/03/2020). Streets, Waterways - NSW L.P. 2015 DTDB. Created by Watson2





LEGEND




Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

Grid: GDA 1994 MGA Zone 56

© 2021/12/22/2471/GIS Map/Deliverables/12322/21, 2003, MANDV, Soilsampling.conditions and
G012012522/2471/GIS Map/Deliverables/12322/21, 2003, MANDV and NSW IP make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind
(whether in contract, tort or otherwise) for any expenses, losses, damages and/or consequential damage which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.
Data source: Intensity, Land and Property Information (Extruded), 1990/20. Streets, Waterways - NSW IP/25 DTDB. Created by welson2.

HLA, (2000) Historic asbestos sampling locations 1-22 (PB 2008 RAP)

HLA* (2000) Histologic asbestos sampling locations 1-22 (GTA, (1993) Historic sampling locations (PB 2008 RAP)

 Targeted monitoring - monitoring well soil sampling

Targeted monitoring - surface soil sampling

Grid: GDA 1994 MGA Zone 56

Northern Beaches Council
Interim Site Management Plan,
Addiscombe Road, Manly Vale, NSW

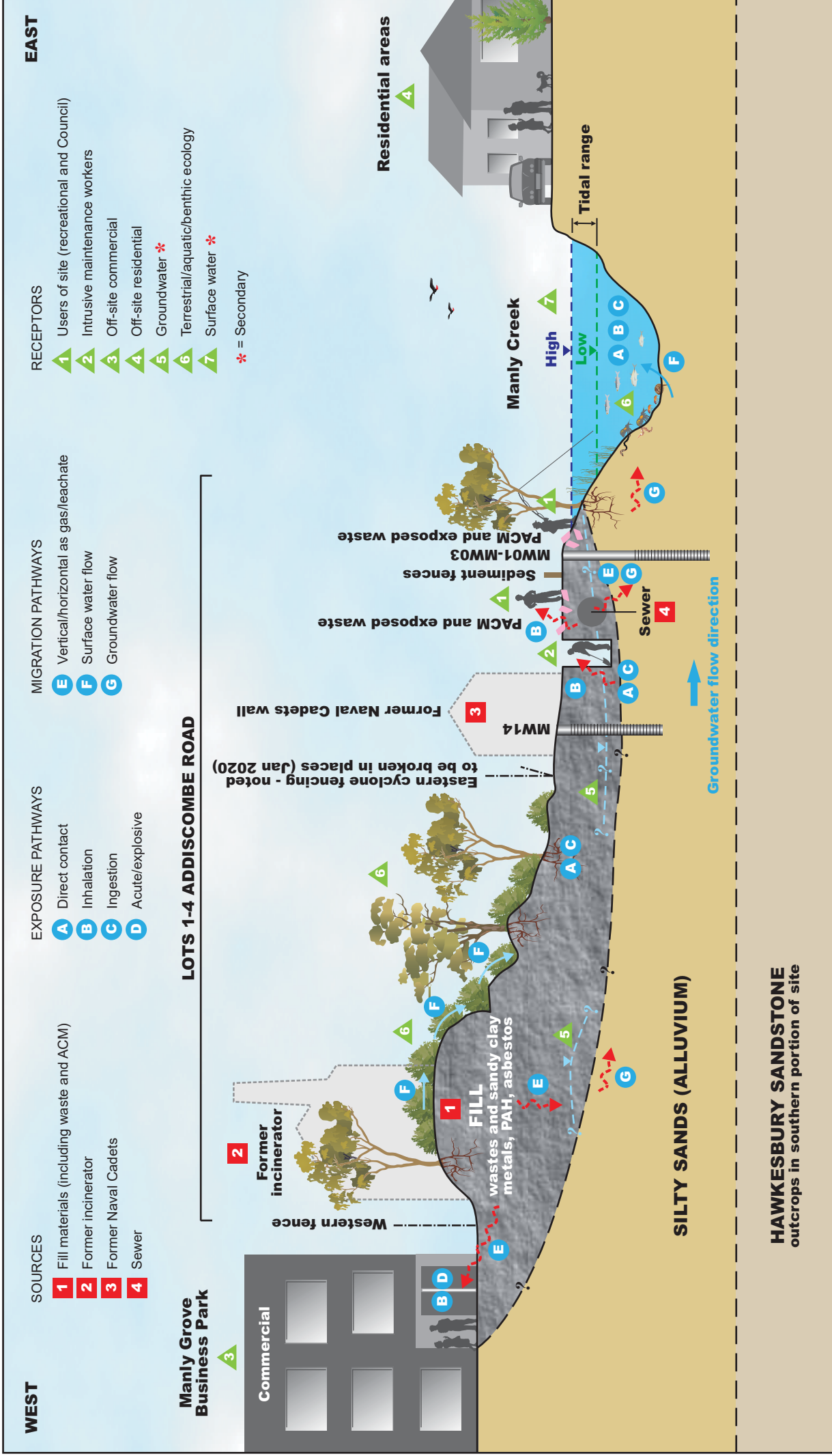


Job Number	12522471
Revision	A
Date	16 Sep 2020

Soil Sampling Locations

Figure 3

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydney@ghd.com.au **W** www.ghd.com.au



Job Number
12-522471

Revision
0

Date
17 Mar 2020

Northern Beaches Council
Lot 1-4 Addiscombe Road, Manly Vale, NSW



Preliminary Conceptual Site Model

Figure 4

LEGEND

- Former site infrastructure (demolished)
- Groundwater - PB (2008) S6=4mBGL, BH1 - dry Ammonia, zinc, lead, nitrate, copper, cadmium, chromium (GHD 2018)
- Surface water flow
- Vertical/horizontal migration

Conceptual diagram only - scale is approximate



Northern Beaches Council
Interim Site Management Plan, Addiscombe Road,
Manly Vale, NSW



Job Number
Revision
Date

12522471
A
18 Sep 2020

Proposed New Groundwater
and Landfill Gas Locations

Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydney@ghd.com.au W www.ghd.com.au

Figure 5

LEGEND

- Site Boundary
- LFG/GW bores (noting these may be dual purpose wells, as described in GHD, 2020)

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1984
Grid: GDA 1984 MGA Zone 56

0 10 20 30 40 50
Metres

G:\21\12522471\GIS Maps\Drawings\12522471_2016_MANLYVALE_Landfill Gas Monitoring Network.mxd
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Data source: Imagery - eLand and Property Information (Extracted: 18/09/2020); Streets, Waterways - NSW LPI 2015 DTDB. Created by: ghd2020



Job Number		12522471
Revision		A
Date		18 Sep 2020
Northern Beaches Council		
Manly Vale Groundwater Monitoring		
Lot 1-4 Addiscombe road, Manly Vale, NSW		



- LEGEND
- Site Boundary
 - Extent of waste (approximate)
 - Fenced, vacant area
 - Embankment
 - Recreational area
 - Public pathway
 - Area accessed by adjacent residents



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1984
Grid: GDA 1984 MGA Zone 56

Inspection and Management Areas

Figure 6

Appendix B – VMP and EPA response letter

VOLUNTARY MANAGEMENT PROPOSAL UNDER THE CONTAMINATED LAND MANAGEMENT ACT 1997

Part 1

Preliminary Details

1. Proponent's Details

(a) Name and contact details

If a registered company, company name:

Trading as:

ACN:

If not a registered company, your full name(s):

Trading as: **Northern Beaches Council**

ABN: 57 284 295 198

Phone: 1300 434 434

Fax: (02) 9976 1400

Email: council@northernbeaches.nsw.gov.au

Postal address: PO Box 82, Manly NSW

Postcode: 1655

EPA licence number (if applicable):

(b) Who the EPA should contact with technical enquiries about the proposal

Name: **Rachael Cook**

Employer/Company: Northern Beaches Council

Position title: Environment Officer - Coast & Catchments

Type of business: Local Government

Phone (business): (02) 9970 1661

Phone (after hours):

Fax: (02) 9976 1400

Email: Rachael.Cook@northernbeaches.nsw.gov.au

Proponent: Northern Beaches Council

Site: Lots 1-4, DP818957, Addiscombe Road, Manly Vale

Proposal Date: 15th August 2019

2. Site to which proposal applies

The site to which the proposal applies (“the site”) is:

This proposal refers to lots number 1-4 Addiscombe Road (DP 818957), Manly Vale 2095. GPS coordinates for the site is addressed in Table 1.

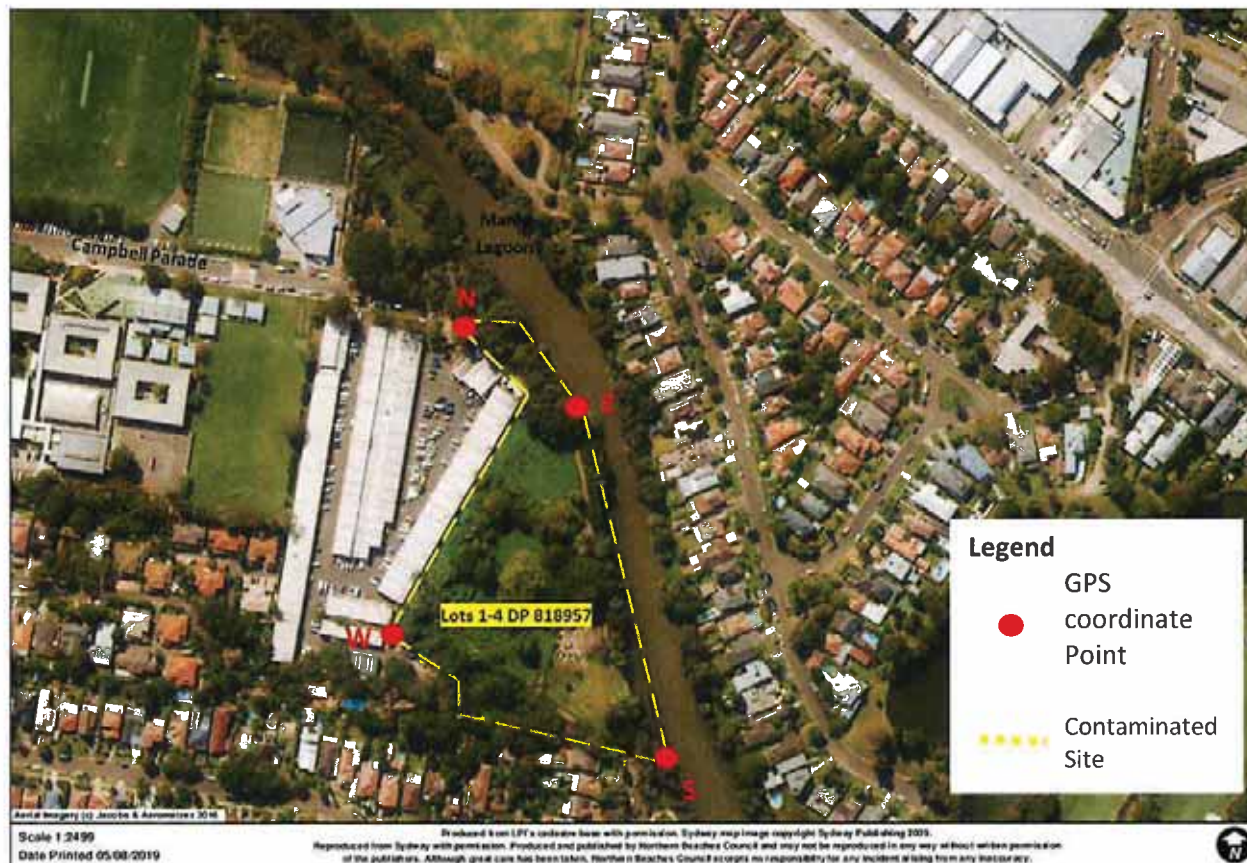


Figure 1: Location of Lots 1-4 Addiscombe Road DP 818957, Manly Vale. Total area of contaminated site is 1.73 ha.

Table 1: Coordinates of lots 1-4 Addiscombe Road, Manly Vale; Refer to figure 1 for reference. All coordinates are obtained from Northern Beaches Council Spatially Enabled Application (SEA) using GDA 1994, MGA 56.

West (W)	340185.859,6260527.290
East (E)	340303.307,6260615.558
North (N)	340225.252,6260699.449
South (S)	340333.946,6260459.447

Proponent: Northern Beaches Council

Site: Lots 1-4, DP818957, Addiscombe Road, Manly Vale

Proposal Date: 15th August 2019

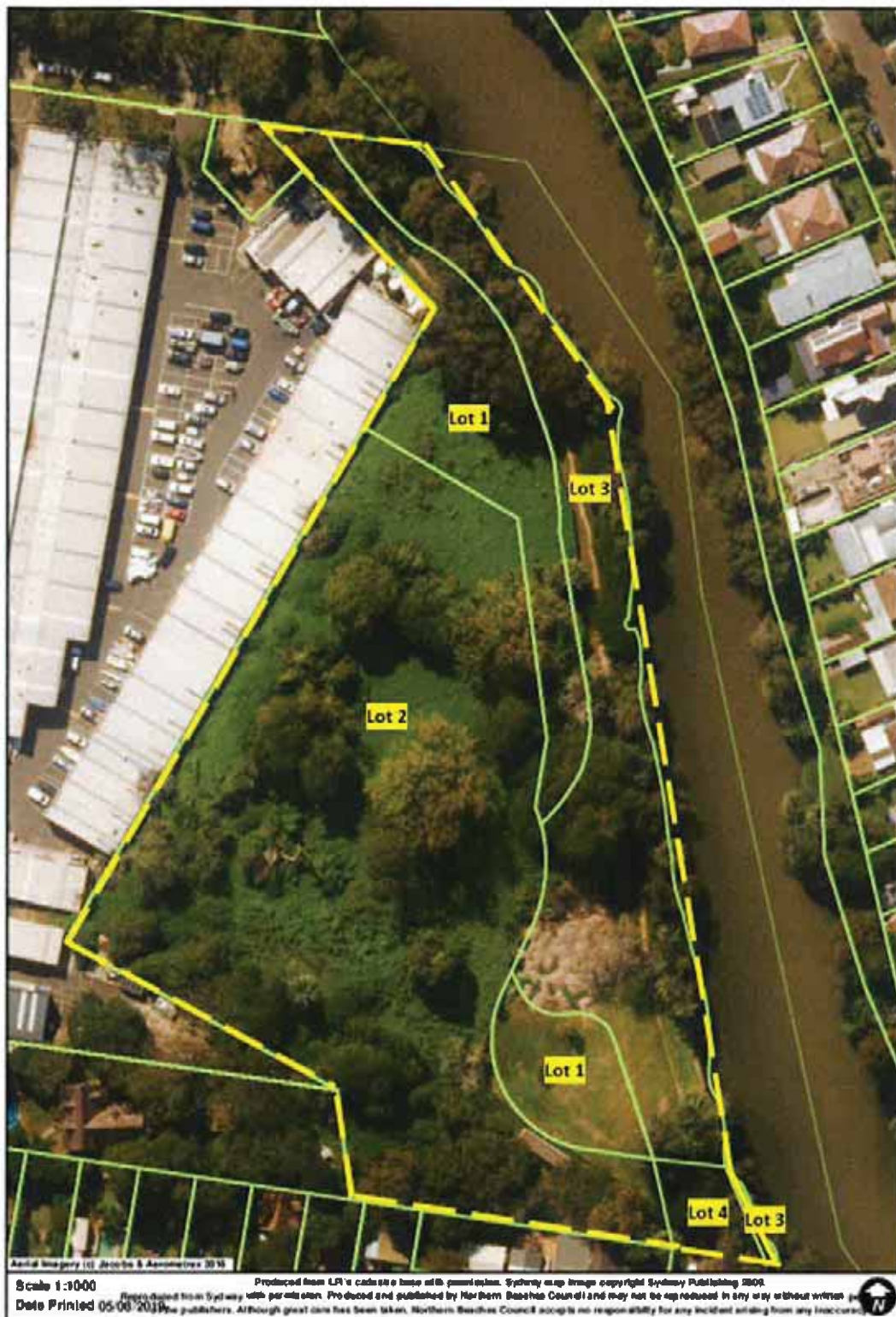


Figure 2: Description of Lots 1-4 at Addiscombe road; DP 818957. Note Lots 1 & 2 are split into 2 parts and labelled accordingly.

Proponent: Northern Beaches Council

Site: Lots 1-4, DP818957, Addiscombe Road, Manly Vale

Proposal Date: 15th August 2019

3. The contamination

Soil and/or groundwater and/or surface water at the site are contaminated with substances and the contamination is significant enough to warrant regulation under the *Contaminated Land Management Act 1997*. The substances of concern ("the contaminants") are:

- Asbestos
- Poly Aromatic Hydrocarbons (PAH's)
- Benzo(a)pyrene
- Total Petroleum Hydrocarbons (TPH's)
- Lead
- Cadmium
- Copper
- Zinc
- Ammonia

4. The management proposal

The management proposal ("the proposal") comprises:

- a) the information set out above;
- b) the actions, works and other components set out in the following documents:

Table 2: Documentation commissioned by council detailing actions, works or other components related the contaminated site

Title	Prepared by	Year Published
Remediation Action Plan Lots 1-4 (DP 818957), Addiscombe Road, Manly Vale NSW	Parsons Brinckerhoff	September 2008
Environmental and Groundwater Management Plan: Lots 1-4 (DP 818957), Addiscombe Road, Manly Vale NSW.	Parsons Brinckerhoff	September 2008
Statutory Site Audit Report Lots 1-4 (DP 818957), Addiscombe Road, Manly Vale NSW 2093	Tony Scott	October 2009
Site Audit Statement Lots 1-4 (DP 818957), Addiscombe Road, Manly Vale NSW 2093	Parsons Brinckerhoff	October 2009
Manly Vale Groundwater Monitoring Groundwater Assessment Report 2017-2018	GHD	December 2018

Manly Vale Groundwater Monitoring Groundwater Assessment Report 2017-2018 made the following recommendations:

Undertake triangulation studies of groundwater to establish if Manly Lagoon is recharged by groundwater from the contaminated site

Assess contaminants in surface water for the protection of potential recreational users

Install groundwater monitoring wells up-gradient to investigate whether there is any background contamination

Proponent: Northern Beaches Council

Site: Lots 1-4, DP818957, Addiscombe Road, Manly Vale

Proposal Date: 15th August 2019

Numerous other documentation had been prepared by various agencies with respect to contamination at the site since 1991. The above documentation reflects the most current Council commissioned documentation.

- c) the undertakings set out in Part 2 of this document; and
- d) the performance schedule set out in Part 3 of this document.

Part 2

Undertakings Included in Voluntary Management Proposal

Explanatory Note:

Before the EPA can approve a voluntary management proposal under section 17 of the Contaminated Land Management Act 1997, it has a statutory obligation to satisfy itself that the terms of the proposal (as modified by any conditions to be imposed by the EPA) submitted to it under section 17 are appropriate. In addition to including an appropriate investigation plan, remedial action plan or other plan of management, to be acceptable to the EPA a proposal would usually include the undertakings set out below. These undertakings are important and will form part of the terms of the proposal. If the proposal is approved, they must be complied with in order for the EPA to be satisfied that the terms of the proposal have been carried out.

THE PROPOSAL INCLUDES THE FOLLOWING UNDERTAKINGS:

General

1. All works or activities carried out in connection with the proposal, including sampling and preparation of associated reports ("the activities"), will be carried out in accordance with applicable provisions of *State Environmental Planning Policy 55 – Remediation of Land* and any requirements imposed under it in relation to the activities.
2. All matters listed as relevant to a remediation action plan by the EPA's *Guidelines for Consultants Reporting on Contaminated Sites* (1997) will be taken into account in the carrying out of the activities.
3. All the activities will be carried out consistently with guidelines made or approved under section 105 of the CLM Act.
(See www.epa.nsw.gov.au/clm/guidelines.htm)
4. All the activities will be carried out in compliance with applicable NSW environmental legislation, and in particular:
 - i) All the activities, including:
 - (1) the processing, handling, movement and storage of materials and substances used to carry out the activities; and
 - (2) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activitieswill be carried out in a competent manner;
 - ii) All plant and equipment installed at the site or used in connection with the activities:
 - (1) will be maintained in a proper and efficient condition; and
 - (2) will be operated in a proper and efficient manner.
5. All the activities at the site will be carried out in a manner that prevents or minimises the emission of dust, odour and noise from the site.
6. Waste generated or stored at the Site will be assessed and classified in accordance with the EPA's *Waste Classification Guidelines Part 1: Classifying Waste*.
(See www.epa.nsw.gov.au/wasteregulation/classify-guidelines.htm)

Proponent: Northern Beaches Council

Site: Lots 1-4, DP818957, Addiscombe Road, Manly Vale

Proposal Date: 15th August 2019

7. All waste transported from the Site that is required by the *Protection of the Environment (Waste) Regulation 2005* to be tracked must be tracked using the EPA's on-line tracking system or an alternative tracking system approved in writing by the EPA.

(See www.epa.nsw.gov.au/owt/aboutowt.htm)

8. The proponent will make this voluntary management proposal available to the public free of charge and consents to the EPA placing this proposal on its public website.
9. The proponent will make all documents referred to in, and required to be prepared under, this voluntary management proposal available to the public free of charge, unless the proponent identifies commercial-in-confidence or private/personal information (including information relating to a third party) within those documents. In these cases, the proponent will remove such information from the documents to make the documents suitable for public release.
10. The proponent will:
 1. prior to the implementation of the proposal provide for the EPA's approval a strategy for communicating about that implementation, particularly the actual management works, with members of the public who are likely to have a real interest in or be affected by that implementation; and
 - ii) implement the strategy as approved in writing by the EPA.

Monitoring, Record Keeping & Reporting

11. At least until the EPA has notified the proponent that the EPA no longer considers that the contamination is significant enough to warrant regulation under the *Contaminated Land Management Act 1997*, record and retain all monitoring data and information and provide this record to the EPA at any reasonable time if so requested by the EPA and as specifically provided under the proposal.
12. The EPA will be informed in writing within 7 days of the proponent becoming aware of information or data indicating a material change:
 - a) in conditions at the site, or
 - b) in its surrounding environment,which could adversely affect the prospects of successful management of the site or result in harm to the environment.
13. The EPA will be informed in writing within 7 days of the proponent becoming aware of any failure, either by the proponent or any other person, to comply with any term of the proposal.
14. The EPA will be informed in writing as soon as practicable of any notification by the proponent, its employees or its agents to an appropriate regulatory authority other than the EPA of any pollution incident at the site within the meaning of the *Protection of the Environment Operations Act 1997*.

(See <http://www.epa.nsw.gov.au/licensing/dutytonotify.htm>)

Performance Schedule

15. The performance schedule which is in Part 3 of this document will be adhered to.

Proponent: Northern Beaches Council

Site: Lots 1-4, DP818957, Addiscombe Road, Manly Vale

Proposal Date: 15th August 2019

Part 3

Performance Schedule

Explanatory Notes:

The performance schedule required must provide a clear and concise list of:

- key milestones and dates by which they are to be achieved and
- the objectives and principal features of the investigation or remedial action plan.

The performance schedule is very important because it provides a concise set of performance indicators which will be used, along with an evaluation of compliance with the terms in Part 2 of this document, to assess whether or not the terms of the proposal have been carried out.

To be acceptable to the EPA, the performance schedule **must** include precise, measurable and time-bounded performance indicators. Where it is appropriate for the investigation or other management to be done in stages, performance measures for each stage must be provided. EPA approval of later stages will be dependent on the completion and/or performance of earlier stages being demonstrated to the EPA's satisfaction.

The performance schedule should adhere to the structure set out in the following table.

PART 3 – PERFORMANCE SCHEDULE	
The schedule should concisely set out:	
1. Objectives of the proposal	
2. Principal features of the proposal	
a. <u>Capital works</u>	
b. <u>Investigation and/or Remediation</u>	
c. <u>Monitoring</u>	
3. Reporting requirements and timeframes for submission of reports	
4. Key milestones and deadlines for investigation or remediation activities	

An example of a performance schedule is set out on the next page.

Proponent: Northern Beaches Council

Site: Lots 1-4, DP818957, Addiscombe Road, Manly Vale

Proposal Date: 15th August 2019

PERFORMANCE SCHEDULE

1. Objectives of the proposal

This proposal is for the ongoing management of Lots 1-4, DP818957, Addiscombe Road Manly Vale. Management objectives for the site were developed by assessing risk to sensitive receptors including human health and the surrounding environment.

The main objective of NBC for Lots 1-4, Addiscombe Road, is the ongoing management of contamination to reduce the risks to human health and the natural environment. This will be addressed through the following mechanisms:

O.1 Development of Interim Site Management Plan

The Interim Site Management Plan shall be developed detailing the summary of management actions to take place thereby ensuring reduced risk from contamination to sensitive receptors.

O.2 Regular monitoring of fence condition (as described in section 2C)

Currently the majority of the contaminated site is fenced (see figure 3) to prevent human access and therefore reducing the potential risks through direct contact with contaminated soil. The fenced perimeter will be monitored regularly by the environment officer at NBC to ensure full functionality as an entrance deterrent.

O.3 Maintenance and monitoring of informal pathway (refer to section 2C)

The informal pathway linking Campbell Parade to Addiscombe road (see figure 3) is used daily by commuters, to ensure commuter safety regular asbestos inspections will be undertaken by a licenced contractor.

No remediation activities will take place under this Voluntary Management Proposal.

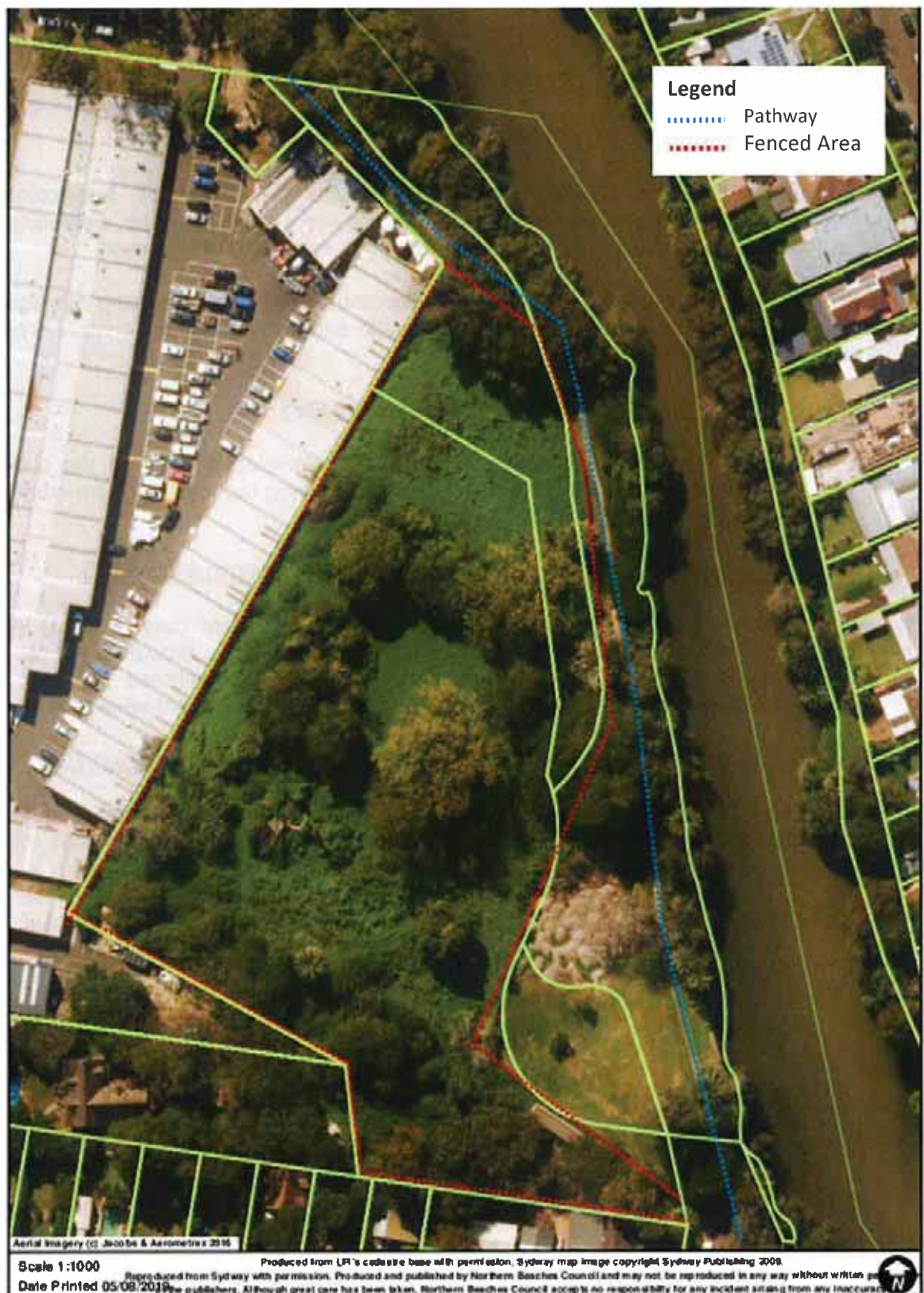


Figure 3: Lots 1-4 (DP 818957) Addiscombe Road, Manly Vale. Fenced area and footpath.

Proponent: Northern Beaches Council

Site: Lots 1-4, DP818957, Addiscombe Road, Manly Vale

Proposal Date: 15th August 2019

2. Principal features of the proposal

The principal features of this proposal are:

a. Capital works

No capital works will take place under this voluntary management proposal.

b. Remediation

No remediation will take place under this voluntary management proposal.

c. Monitoring

P.1 Regular monitoring of fence condition

The fence surrounding Lot 2 (as shown in figure 2) will be monitored monthly to ensure condition is adequate in preventing human exposure to area with concentrated contaminants. Monitoring will be conducted by the environment officer, recorded and saved on the record management system.

P.2 Regular monitoring of informal pathway

The informal pathway (as shown in figure 2) will be monitored bi-monthly by the environment officer for condition and Potential Asbestos Containing Material (PACM). The monitoring of the pathway will be recorded and saved on the record management system.

Furthermore a licenced contractor shall conduct monthly visual checks of PACM. If any PACM is found on site it shall be removed and disposed of by a licenced contractor. During this time pathway access will be temporarily restricted to the public until declared safe for public use.

3. Key milestones for investigation, remediation and other actions

No investigations, remediation or other actions will take place under this voluntary management proposal.

Key Milestone	Deadline
Monitoring of Fence	Monthly
Monitoring of informal pathway by environment officer	Bi Monthly
Monitoring of informal pathway by licenced contractor	Monthly
Investigation into triangulation studies of groundwater monitoring as recommended by GHD in the 2017-2018 report	December 2019

4. Reporting requirements and timeframe for submission of reports

The EPA must be provided with the following reports by the deadlines specified below:

Report	Deadline
R.1 Development of Interim Site Management Plan	February 2020
R.2 Annual reporting to EPA confirming compliance with management actions	Annually in August

Proponent: Northern Beaches Council

Site: Lots 1-4, DP818957, Addiscombe Road, Manly Vale

Proposal Date: 15th August 2019

Signature of proponent


This application for approval of this voluntary management proposal may only be signed by a person(s) with the legal authority to sign it. The various ways in which the application may be signed, and the people who may sign the application, are set out in the categories below.

Please tick (✓) the box next to the category that describes how this application is being signed.

If the proponent is:		The application must be signed and certified by one of the following:
an individual	<input type="checkbox"/>	the individual.
a company	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	the common seal being affixed in accordance with the <i>Corporations Act 2001</i> , or two directors, or a director and a company secretary, or if a proprietary company that has a sole director who is also the sole company secretary – by that director.
a public authority other than a council	<input type="checkbox"/> <input type="checkbox"/>	the chief executive officer of the public authority, or by a person delegated to sign on the public authority's behalf in accordance with its legislation (Please note: a copy of the relevant instrument of delegation must be attached to this application).
a local council	<input type="checkbox"/> <input type="checkbox"/>	the general manager in accordance with s.377 of the <i>Local Government Act 1993</i> ('LG Act'), or the seal of the council being affixed in a manner authorised under the LG Act.

I/We (the proponent):

- ***apply for approval of the voluntary management proposal set out in this proposal and in any documents referred to in Part 1.4 of this proposal***
- ***declare that the information in this proposal form (including any attachment or document referred to in Part 1.4 of this proposal) is not false or misleading.***

Signature		Signature	
Name (printed)	J. H. Brouwer	Name (printed)	
Position	CEO	Position	
Date	6 September 2019	Date	

Seal (if signing under seal):

Proponent: Northern Beaches Council

Site: Lots 1-4, DP818957, Addiscombe Road, Manly Vale

Proposal Date: 15th August 2019



DOC19/802127-1

Rachael Cook
Environment Officer
Northern Beaches Council
PO Box 82
MANLY NSW 1655

By email: Rachael.Cook@northernbeaches.nsw.gov.au

Dear Ms Cook,

1-4 Addiscombe Road, Manly Vale NSW

The EPA is writing to you in relation to the Voluntary Management Proposal (VMP) provided on 9 September 2019 for the management of contamination of 1-4 Addiscombe Road, Manly Vale NSW.

Approval of VMP

The EPA considers that the proposal is suitable for approval subject to conditions. The conditions of approval include the following:

- An auditor accredited under the *Contaminated Land Management Act 1997* (CLM Act) must be engaged to confirm the adequacy of the Interim Site Management Plan ("The Plan").
- The Plan will then be implemented under this VMP, with compliance reporting to be provided annually by the end of August each year.
- The end date for this VMP will be 30 September 2022, at which time the EPA will re-assess regulation under the CLM Act.
- Any report submitted to the EPA to comply with this Notice must be prepared, or reviewed and approved, by a practitioner certified by an EPA-recognised scheme.

Please find enclosed the Notice of Approval of VMP (Notice No.20191721), which includes all conditions of approval. The notice and the proposal will be published on the Contaminated Land Record of Notices at <http://app.epa.nsw.gov.au/prclmapp/searchregister.aspx>.

If Council is unable to meet any deadlines identified in the VMP, a written request for an extension must be provided. The request must be made 21 days before the milestone date, and must outline the reasons for the delay, a revised time period within which the milestone will be achieved and a statement explaining why enforcement action should not be taken.

Notation on Planning Certificates

Please note that Council must specify that the site is the subject of a VMP on any planning certificate for the land issued under section 10.7 of the *Environmental Planning and Assessment Act 1979*. This obligation forms part of the requirements of section 59(2) of the CLM Act.

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Cost Recovery

Section 34 of the CLM Act allows the EPA to recover its costs in relation to assessing and settling the terms of a VMP, monitoring action under an approved VMP, seeking compliance with an approved VMP or matters associated with, or incidental to, any of these matters. A draft Cost Recovery Notice is provided for your information and records.

The associated and incidental matters that are itemised in the draft Cost Recovery notice relate to the correspondence and review of draft and final VMP. If you have any comments on the draft Cost Recovery Notice, they are required within 14 days of the date of this letter. Please note the EPA will issue a final Cost Recovery Notice and invoice based on this draft notice if no comments are received from you by the end of the comment period.

If you wish to discuss any matters raised above, please contact Ulli Manuel on (02) 99955611 or via e-mail at ulli.manuel@epa.nsw.gov.au.

Yours sincerely



2 October 2019

ROB HOGAN
Manager Contaminated Land Regulation
Environment Protection Authority

Enclosures: VMP Approval Notice No. 20191721 and Draft Cost Recovery Notice

Appendix C – Preliminary contamination site assessment

Appendix C

1. Site information

1.1 Site identification

The site identification details are summarised in Table C1-1. A survey of the site showing lot boundaries and key site features is provided in Appendix D.

Table C1-1 Site identification details

Item	Description
Street Address	Addiscombe Road, Manly Vale NSW 2093
Certificate of Title Details (Vol/Folio) and Parcel/Lot Number	Lots 1-3, DP818957 Lot 4 has been merged with the road reserve, and has been included in the ISMP.
Owner	Lots 1 & 2 are Council owned allotments. Lot 3 is considered 'Reserve Trust' under Section 95 of the <i>Crown Lands Act 1989</i> , and Council was appointed manager of this land on 20 November 1992. Former Lot 4 and the road reserve area is understood to be managed by Council.
Site Zoning	Zone RE1 – Public Recreation (Manly Local Environmental Plan 2013).
Current Use	The majority of the site is fenced, vacant land. A small portion of the site is a public park and informal footpath.

1.2 Surrounding land use and zoning

The current surrounding land uses and zonings are summarised below in Table C1-2.

Table C1-2 Description of surrounding land use and respective zonings

Orientation	Description of Surrounding Land Use	Zoning (Manly Local Environmental Plan 2013)
North	Manly Creek and public park land (Nolan and Passmore Reserve)	RE1 – Public recreation RE2 – Low density residential
East	Manly Creek immediately east of the site with low density residential and Manly Lagoon beyond.	RE1 – Public recreation RE2 – Low density residential
South	Low density residential immediately to the south with Addiscombe Road and Manly Golf Club beyond.	RE2 – Low density residential RE2 – Private recreation
West	A small general industrial area (including mechanics workshop and gas supplier) immediately to the west of the site followed by a school (NBSC Mackellar Girls Campus).	IN2 – Light Industrial

1.3 Environmental setting

The environmental characteristics of the site are summarised in Table C1-3.

Table C1-3 Local environmental characteristics of the site

Characteristic	Details
Topography	<p>The topography of the site includes a high point in the middle of the site with gentle slopes downwards to the north, south, east and west. A steep downwards slope is present from the informal footpath to the river. PB (2008a) reported elevation levels on site to be between 0.5 to 10 m Australian Height Datum (m AHD). No recent site survey is known to exist for the site.</p>
Hydrology	<p>The nearest surface water feature is Manly Creek, located directly adjacent to the eastern boundary of the site. Generally Manly Creek is understood to flow in a south-easterly direction towards Manly Lagoon and Manly Beach, and is effected by tides.</p>
Geology	<p>The Sydney Geological Series Sheet S1/56-5, 1:250,000 (1966) indicates that the site is underlain by Hawkesbury Sandstone and alluvial sediments potentially including gravel, sand, silt and clay.</p> <p>During drilling and groundwater well construction in 2016 (primarily undertaken on the site's eastern boundary), the following geology was encountered:</p> <ul style="list-style-type: none"> • Sand fill from ground surface to a maximum of 2.3 m below ground level (m bgl, approximately). • Silty sand (natural sediments) from ground surface or base of fill to 5 m bgl (maximum depth of wells installed). <p>Investigations by PB (2008) undertaken across the central portion of the site indicate the presence of fill (including waste) located at depths ranging between 0.15 m bgl and 5 m bgl.</p>
Hydrogeology	<p>Groundwater at the site was observed at approximately 0.6 m to 2.6 m below top of casing (m bTOC) in wells MW13 and MW03 respectively by GHD between 2016 and 2020.</p> <p>The groundwater monitoring wells have not been surveyed and so groundwater elevations and groundwater flow directions cannot be confirmed at this time. PB (2008) inferred that shallow groundwater flow at the site is to the northeast towards Manly Creek. Given the site's topography and the presence of Manly Creek, GHD concurs with PB's inference.</p> <p>The <i>1:2,000,000 Groundwater in New South Wales, Assessment of Pollution Risk Map</i> indicates that Manly Vale area is likely to be underlain by alluvial and other unconsolidated deposits with moderate to high potential for groundwater movement. The map also indicates that groundwater salinity is likely less than 1,000 mg/L, which is suitable for stock, domestic and some irrigation purposes.</p>

Characteristic	Details
Registered bores	<p>A groundwater bore search was completed by GHD on 2 October 2018. A review of the <i>Department of Primary Industries All Groundwater Data Map</i>, accessed at that time, indicates that there are 15 registered groundwater bores within a 500 m radius of the site. These bores are used for domestic, irrigation and recreational purposes. The closest well is approximately 53 m east from the site, and was noted to have a depth of approximately 6 m bgl. Given the presence of Manly Creek, it is unlikely that the groundwater monitored at the site would reach any of these extraction bores unless significant volumes of water were being extracted. Manly Creek represents a constant head boundary, and is likely to be drawn preferentially to extraction wells.</p> <p>Eighteen groundwater monitoring bores were installed at the site prior to 2017, nine of which are known to have been destroyed or lost (PB, 2008b). The remaining nine bores were not located by GHD during a site inspection in 2017, however three were located in January 2020 (wells BH1, S6 and S10). Five additional monitoring bores were installed by UNSW Water Research Laboratory (WRL) and GHD in 2017.</p>

1.4 Flora and fauna

No sensitive flora or fauna species are known to be present on-site. There are wetland areas located south west of the site, however these are not listed as “nationally important wetlands” on the Department of Environment *Protected Matters Search Tool*⁽⁶⁾.

As summarised by PB (2008a), IT Environmental literature review (2001) concluded that Manly Creek has significant environmental problems resulting in low animal, flora and fauna diversity and abundance (as well as reduced aesthetic and recreational value). Cardno (2011) conducted daily inspections of the local ecology of Manly Creek during a dredging program, which included observations of the following:

- Threatened bird species – Little Pied Cormorant (*Phalacrocorax melanoleucos*) and their nests in the casuarinas on the lagoon bank.
- Seagrass communities – Based on advice from Council, GHD understands that additional seagrass mapping was carried out by Cardno in 2013, and no seagrass was present in the area (GHD has not reviewed this report).
- Threatened floral communities – Swamp Sclerophyll Forest on Coastal Floodplains and Swamp Oak Floodplain forest.

During the February 2020 site inspection undertaken by GHD with Council, two species of edible native plants were observed adjacent to the informal public footpath. These were:

- *Tetragonia tetragonioides*, also known as New Zealand Spinach.
- *Carpobrotus*, commonly known as Pig-face.

‘Morning Glory’ (an invasive weed) was observed to be present on-site in a number of locations during the site inspection undertaken in February 2020 (discussed in Appendix C, Section 1.3).

6 <http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf> accessed 29/06/2015

1.5 Site history

The site history has been obtained from various environmental reports prepared for the site between 1991 and 2008. A detailed, chronological discussion is provided in Appendix E, and is broadly summarised as follows:

- The site is thought to have been originally low-lying and swampy.
- In 1910, Manly and Warringah Councils initiated the use of the site as a rubbish tip (Journal of Local History, 2006).
- A waste incinerator was built at the site in 1913 (Journal of Local History, 2006).
- From 1914, the site operated as a rubbish tip that included use of the garbage incinerator (PB, 2008a). The site was used to store incinerated and 'regular' waste, including waste that could not be incinerated. The incinerator in the 1920's is shown in Photograph 1.
- It is reported that the Manly incinerator operated until 1939 (Journal of Local History, 2006). According to the Journal of Local History (2006), the incinerator was demolished in 1940, however the site was still used as a tip until the 1950's.
- Manly Council leased a portion of the land in 1953 for use as a joinery works (PB, 2008).
- In 1968/1969, Naval Cadets leased a portion of the site for a training facility (TS Condamine) within Lot 3 (crown land) and Lot 1 (Council land). The primary Naval building was demolished in 2006 (PB, 2008).
- The site has remained vacant since 2006, with minor portions accessible to the general public for use as a recreational area and informal footpath. Additionally, a small area of the southern site boundary is currently accessible by the residents immediately south of the site, however it is not clear when this area became readily accessible.



Photograph 1 Scanned aerial provided by Council – 1920's aerial view of Manly Council incinerator (facing south) showing Addiscombe Road leading to Manly Creek and the site.

1.6 Observations from site inspection (Feb 2020)

A site inspection was undertaken by Council, GHD and the appointed NSW Site Auditor (Louise Walkden of Ramboll) on 6 February 2020. The following was observed during this inspection:

- No buildings were present on the site.
- The ground surface rises steeply from the perimeter of the site to the central area, which is a gently undulating plateau.
- The internal fence surrounding the vacant area was damaged in at least two locations on the site. No damage to the fence on the outer site perimeter was observed (noting southern perimeter boundary fence was not inspected). Evidence of trespassers were observed in the central portions of the site. For example, near groundwater monitoring well S6, sofas and rubbish were noted.
- The vegetation across the central portions of the site was less dense than previously encountered by GHD in 2017 (GHD, 02018). The site however was still fairly heavily vegetated. All vegetation was observed to be healthy. 'Morning Glory' (an invasive weed) was observed in a number of locations at the site.
- Exposed waste was identified in two publically accessible areas outside the fence as follows:
 - Between monitoring wells MW01 and MW14 in the southern portion of the site.
 - Along the embankment of Manly Creek on the northern portion of the site, between groundwater wells MW03 and MW13. This is shown in [Photograph 2](#).



Photograph 2 Exposed waste on the embankment, between groundwater monitoring wells MW03 and MW13

Waste materials observed at these two locations included slag / clinker, ceramics, glass and potential asbestos containing materials (PACM). The PACM sighted was only at one location, on the embankment adjacent to Manly Creek.

- The informal footpath continues to be in use by the local community. A number of runners and cyclists were observed during the site inspection; as well as dog walkers and families.
- A light sheen was observed on surface water in Manly Creek near the 'polluted water' sign adjacent to the site's northern boundary.
- Three existing groundwater monitoring wells were found in the central portion of the site. These are believed to be wells S6, BH1 and S10 based on their locations (refer Figure 2 in Appendix A).
- Council have installed sediment fencing and undertaken minor landscaping works (predominantly revegetating) along the eastern site boundary to limit surface water transport of sediments to Manly Creek. These are shown in Photograph 3.

The residential driveway located on the southern portion of the site was not inspected, as it was only confirmed to be located within the site boundary once a site survey had been conducted in May 2020 (survey provided in Appendix D).



Photograph 3 Facing south along the eastern footpath, showing the sediment fences installed on the eastern site boundary

1.7 Council actions since GHD site inspection (Feb 2020)

1.7.1 Restoration of fencing around vacant area of site

The majority of the site is currently vacant land, which Council wishes to maintain as such. During a site inspection in February 2020, the fence surrounding the vacant area (as shown on Figure 6) was noted to be broken in a number of places, including adjacent to the recreational area in the southern portion of the site, and adjacent to the informal public footpath in the north of the site.

Council have undertaken repair works of the fence, as shown in Appendix I. The fence should be inspected and maintained as per Section 3.3 to ensure the objective of restricting access to the vacant area is met.

1.7.2 Sparrow picking program

Council have engaged a licensed contractor to undertake regular visual inspection and removal of PACM (process referred to as 'sparrow picking') of the informal footpath, as per condition 2c-P2 of the VMP and as outlined in Appendix I. The VMP states that the informal pathway shall be monitored:

- 'Bi-monthly' (understood by GHD to be every second month) by the site owner to record the condition and absence/presence of PACM.
- Monthly by a licensed contractor, conducting a visual inspection for PACM which shall be removed and appropriately disposed of by the contractor if located.

The sparrow picking program shall be ongoing until such time that a formal capping layer is designed and implemented. The frequency of sparrow picking can be reduced once an interim cover layer is applied, as discussed in Section 3.1.2.

1.7.3 Upgrades of embankment

Exposed waste was observed on the Manly Creek embankment, along the north-east portion of the site boundary between wells MW03 and MW13, as shown in Photograph 3. Since February 2020, Council have added mulch cover to portions of the embankment, and added a variety of plants. Limited documentation of these works has been provided to inform the extent (laterally and vertically) of the cover works, and GHD has not undertaken a subsequent inspection.

Therefore the actions outlined in Section 3.1.3 should be undertaken by Council to ensure that the aim of restricting exposure of ecological (and potentially human) receptors to contamination is met.

2. Contamination status

Thirteen previous reports pertaining to the site were listed in Appendix A of PB (2006) dating from 1991 to 2002. The majority of these reports focused on potential remediation activities. A brief summary of the aim and conclusions of these reports is provided in Appendix F.

Based on a review of previous reports, the potential contamination issues relevant to this ISMP have been identified and are summarised in the following sub sections. Further details and discussion of these aspects is provided in Appendix G.

Table C2-1 Summary of contamination

Characteristic	Comments
Waste operations	<p>A variety of materials may have been landfilled at the site including building, municipal and incinerated wastes. The waste footprint at the site as estimated in PB (2008a) is shown on Figure 2, Appendix A. It is anticipated that use of daily cover may have been extremely limited, and it is unknown if the landfill was ever formally capped once it was closed (noting that exposed waste was observed in February 2020, as discussed in Appendix C Section 1.3). It is believed that:</p> <ul style="list-style-type: none"> – No engineered barrier systems such as basal and/or side wall liners were installed at the site. – No engineered leachate collection and treatment systems were installed at the site. – No landfill gas (LFG) collection and treatment systems were installed at the site.
Groundwater	<p>Eighteen groundwater monitoring wells were installed at the site between 1990 and 2002, and five additional monitoring bores were installed in 2017 (shown on Figure 2, Appendix A). Available bore logs are provided in Appendix H, however GHD notes that not all bore logs are available for these groundwater monitoring wells. The general trend of groundwater flow is likely to be in an easterly to north-easterly direction toward Manly Lagoon, which follows the local topography of the site.</p> <p>No light non-aqueous phase liquid (LNAPL) was observed during the 2017 groundwater monitoring program. Based on groundwater analytical data from 2017;</p> <ul style="list-style-type: none"> – The concentration of lead, nitrate, and PAH (total) exceeded the adopted assessment criteria protective of human health (drinking water and recreational – ADWG 2018 and NHMRC 2018, NEPM 2013 health screening levels (HSLs) for commercial/industrial landuse). It was considered unlikely that these exceedances posed a risk to human health due to the general lack of receptors in the vicinity of the site. – The concentration of ammonia, cadmium, chromium, copper, lead and zinc exceeded the nominated ecological assessment criteria (NEPM 2013 groundwater investigation levels (GILs) for fresh and marine ecosystems), protective of marine and freshwater ecosystems, and may indicate a risk to ecological systems from site contamination.

Characteristic	Comments
Surface water	<p>There are no known formal surface water drains on site. However, there may be stormwater discharge points into Manly Creek at the northern and southern extents of the site where public roads terminate against the site boundary.</p> <p>The most recent surface water data collected for the purpose of contamination assessment (PB in 2005) from two sampling locations on Manly Creek (SW1 and SW2, Figure 2, Appendix A) identified the following:</p> <ul style="list-style-type: none"> – The concentration of benzo(a)pyrene, copper, fluoroanthene, lead, PAHs, pyrene and total petroleum hydrocarbons (TPH) were less than the detection limit at both locations. – The concentration of zinc exceeded the adopted criteria of 130 ug/L, and the concentration of ammonia was also greater than the detection limit at both SW1 and SW2 (0.08 ug/L and 0.07 ug/L respectively). – Based on the concentrations of faecal coliforms, it was suggested that the impact on the aquatic ecosystems in the lagoon is likely to be from urban stormwater and sewer overflow from upgradient sources. <p>Previous surface water investigations (WS Rooney and Associates (1997) and IT (2001) as summarised by PB, 2008a) concluded that the risk of heavy-metal toxicity to aquatic life in Manly Lagoon was likely to be low, and limited to a toxicological risk from ingestion or remobilisation of copper, lead and zinc from the sediments. The 2006 non-statutory Site Audit Report (conducted by HLA) concurred that dissolved zinc in groundwater discharging to the lagoon is not bioavailable to organisms in the lagoon (PB 2008a).</p> <p>Manly Creek is known to be tidal, and the site experiences flooding from storm surges in Manly Creek.</p>
Sediments	<p>An investigation of dredged sediment from Manly Creek (Patterson Britton, 2007) concluded that both the muddy overflow and the raw feed products of dredged material from Manly Creek may be suitable for use as a primary capping layer at the site, if appropriately dewatered, treated, and compacted. Results of 'SPOCAS' analytical testing of the dredged material indicated that the risk of acid sulphate soils (ASS) ranged from very high to none, with the majority of the samples being 'very high'.</p>
Soil and soil leachate	<p>Historical soil sampling locations are shown on Figure 3, Appendix A. The contaminants of potential concern (COPC) in soils across the site identified in previous investigations were asbestos, heavy metals (cadmium, lead and zinc), and PAHs. Furthermore:</p> <ul style="list-style-type: none"> – These contaminants were identified to a maximum depth of 4 m bgl. – 'Asbestos' observations and analytical results include detections of amosite, chrysotile, crocidolite, and observations of asbestos containing material (ACM) sheeting at various locations across the site. – Lead was the most wide spread contaminant, occurring in both surface and sub-surface samples. The majority of surface and 0.1 m bgl samples had a concentration of more than 2000 mg/kg which exceeds the current NEPM (2013) criteria for recreational and

Characteristic	Comments
	<p>commercial/industrial land use scenarios (600 and 1500 mg/kg respectively).</p> <ul style="list-style-type: none"> – GHD also notes that TPH was detected at four soil investigation locations, to a maximum depth of 3 m bgl. <p>GHD notes that the primary COPC (identified by the 2006 site auditor and noted above) are generally not considered prone to degradation in natural environments (with the exception of TPH's). Therefore it is considered by GHD that these historic analytical results are likely to be somewhat representative of the current site conditions.</p> <p>According to PB (2008a), in general the material sampled in previous investigations appears to have had a low potential to leach COPC. Selected soil samples analysed up to 3 m bgl showed that soil in approximately the top 1 metre was most likely to leach (PB, 2008a).</p> <p>Council has undertaken a number of 'sparrow picking' events for the collection of visible PACM along the informal footpath area. Suspected fibrous asbestos fragments (PACM) have been collected from the surface in each sparrow picking event to date, as documented in Appendix I.</p>
Sub-surface and surface landfill gas	<p>No recent landfill gas (LFG) assessments have been carried out at the site. A soil gas survey of 61 locations using vapour probes was undertaken by GTA (1991 and 1993) to a maximum depth of 1 m. That assessment did not identify high levels of volatile organic compounds, combustible or toxic gases in the samples taken during the investigation.</p>
Flora and fauna	<p>Cardno (2011) collected samples of fish fillets from fish caught in Manly Creek and Manly Lagoon for laboratory testing of COPC. The fish toxicology analytical results showed that the concentrations of arsenic, copper, selenium and zinc were elevated in the fillet samples, with low levels of lead and mercury.</p>
Remediation works to date	<p>No remediation works are known to have been carried out to date at the site, with the exception of excavation works of surface soils undertaken post demolition of the Naval training facility. GHD understands that remediation works outlined in the PB (2008a) Remediation Action Plan (RAP) have not commenced at the site, and that the RAP (PB 2008a) has not been amended to incorporate the previous Site Auditor comments (Coffey, 2009).</p>

3. Conceptual site model

Based on the available information detailed above, the following preliminary contamination conceptual site model (CSM) has been developed for the potential sources of contamination (on-site and off-site) that may have, or may be able to, impact upon receptors on and off site. This preliminary CSM was developed to assist with the ongoing management of the site.

3.1 Sources

Sources of contamination and the COPC can be determined from the current and historic site activities. The potential sources and associated COPC for this site are summarised in Table C3-1. Based on previous investigations, the COPC listed in the VMP (Council 2019) are asbestos, PAHs (including benzo(a)pyrene), TPHs, lead, cadmium, copper, zinc and ammonia.

Table C3-1 Identified sources and associated COPC at the site

Source		Current / historical sources	COPC ¹
On-site	Fill materials, including landfilled waste and topsoils	Current	Dissolved and/or solid phase: acid (sulphides), ACM (including fines and friable), alkalinity, major cations and anions (particularly potassium), metals, nutrients (particularly ammonia), PFAS, and OCP/OPP/DDT (pesticides and insecticides). COPC associated with waste incineration outlined below. Gaseous phase: carbon dioxide, hydrogen sulphide and methane.
	Former incinerator and incinerated waste materials	Historic infrastructure, waste materials still present on site.	Dissolved and/or solid phase: ACM, dioxins/furans, metals, PAHs (including benzo(a)pyrene), PFAS, phenols, polychlorinated biphenyls (PCBs).
	Former Naval cadets facility (including building/flag pole, training activities and demolition works)	Historic	Dissolved, solid and/or volatile phases: ACM (including fines and friable), BTEXN, lead, TRHs and PFAS.
	Sewer pipeline (eastern part of the site)	Current	Dissolved and/or solid phase: Faecal coliforms and other microbes, fluoride. Gaseous phase: carbon dioxide, hydrogen sulphide and methane
	Former joinery works	Historic	Dissolved and/or solid phase: ACM (including fines and friable), metals
Off-site	Mixed commercial / industrial land uses	Current	Unknown COPC
	Manly Creek	Current	Dissolved phase – unknown COPC

TABLE NOTES:

1 – COPC identified based on Appendix A in the *State Environment Planning Policy (SEPP) 55* (1998) and the NSW EPA *Solid Waste Landfill Guidelines* (2016). COPC abbreviations are as follows: ACM – asbestos containing material, PFAS – per- and poly-fluoro alkyl substances, DDT – Dichloro-diphenyl-trichloroethane (insecticide), OCP/OPP – organochlorine pesticides / organophosphorus pesticides, PAHs – polycyclic aromatic hydrocarbons, BTEXN – benzene, toluene, ethylbenzene, xylene and naphthalene.

3.2 Pathways

3.2.1 Migration pathways

The identified COPC could migrate from potential sources via the following pathways:

- Vertical / horizontal as gas, vapours and/or leachate (including along underground service trenches)
- Surface water flows (dissolved phase and/or as sediment)
- Groundwater flow (dissolved phase), including via discharge of groundwater to surface water
- Leakage from the sewer pipeline
- Uptake by vegetation
- Aerial dispersion (such as dust)

3.2.2 Exposure pathways

The primary pathways by which receptors (users of the site and surrounding area) could be exposed to the sources of contamination outlined in Table C3-1 are considered to be:

- Inhalation of contaminated shallow soil and dust (potentially including asbestos) and/or gas/vapours.
- Direct dermal contact with contaminated soil.
- Ingestion of soil, water and/or vegetation.
- Acute exposure via fire or explosions relating to gases and/or vapours accumulated in confined spaces.

3.3 Receptors

The key receptors of interest are considered to include:

- Recreational users of the site (current and future).
- On-site and off-site workers (including intrusive maintenance workers, Council, full time commercial/industrial and administrative staff, and construction/maintenance workers).
- Off-site residential inhabitants (noting that a small portion of the southern site boundary is accessible by adjacent residential receptors).
- Aquatic and terrestrial ecological receptors including those in Manly Creek and edible vegetation.
- Groundwater and surface water systems on and off-site.

As discussed in Table C1-3, it is unlikely that groundwater monitored at the site would reach any registered extraction bores in the local area unless significant volumes of water were being extracted. Manly Creek represents a constant head boundary, and is likely to be drawn preferentially to groundwater from the site at the extraction wells. Beneficial use of groundwater has therefore not been considered further for this assessment.

3.4 Potential source-pathway-receptor (SPR) linkages

Based upon the information in Appendix C Section 3.1 to 3.3, complete pathways may exist which may present a risk of contamination to human health and/or the environment. A summary of these SPR linkages is provided in Table C3-2 below, and are shown in Figure 4 .

Table C3-2 Summary of SPR linkages – conceptual site model

Potential source	Potential migration or exposure pathways	Potential Receptors	SPR linkage complete?
Fill materials including landfilled waste (and associated leachate and landfill gas), topsoils and incineration waste.	Direct contact with and/or inhalation of contaminated soils (including asbestos).	Recreational users of the site, on and off-site commercial workers (including intrusive maintenance workers), residents south of the site, on-site terrestrial ecology.	Likely– elevated concentration of lead identified by PB (2008a), and observed PACM in shallow soils. Residents south of the site shown to have access to on-site soils.
	Vertical / horizontal migration of gas and subsequent direct contact, inhalation, ingestion or acute exposure.	Recreational users of the site, on and off-site commercial workers (including intrusive maintenance workers), on site terrestrial ecology, off-site residential.	Possible, noting that no recent previous gas investigations have been undertaken.
	Vertical / horizontal migration of leachate and subsequent direct contact, inhalation or ingestion.	Groundwater systems, surface water systems (Manly Creek), aquatic and terrestrial ecology (via groundwater), on and off-site intrusive maintenance workers.	Likely -concentration of COPC greater than adopted assessment criteria in 2017.
	Surface water flows (dissolved phase and/or as sediment)	Surface water systems (Manly Creek) and subsequently aquatic ecology.	Possible, however it is noted that the ground surface is mostly vegetated and sediment fences are present on site boundary.
Former infrastructure (including Naval cadets facility, incinerator and joinery works)	Direct contact with and/or inhalation of contaminated soils (including asbestos).	Recreational users of the site, on and off-site commercial workers (including intrusive maintenance workers), residents south of the site, on-site terrestrial ecology.	Likely– elevated concentration of lead identified by PB (2008a), and observed PACM in shallow soils. Residents south of the site shown to have access to on-site soils.
	Vertical / horizontal migration of COPC and subsequent direct contact, inhalation or ingestion.	Groundwater systems, surface water systems (Manly Creek), terrestrial and aquatic ecology (via groundwater), on and off-site intrusive maintenance workers.	Likely – shallow groundwater in low lying areas, and concentration of COPC greater than adopted assessment criteria in 2017.

Potential source	Potential migration or exposure pathways	Potential Receptors	SPR linkage complete?
Sewer pipeline	Leaking from pipeline, and subsequent direct contact, ingestion and/or inhalation of soils, water and gas.	Intrusive maintenance workers, groundwater, terrestrial and aquatic ecology (via groundwater).	Possible, noting that no previous investigations specifically assessed the pipeline as a potential source.
Off site sources (including adjacent land uses and Manly Creek)	Vertical / horizontal migration of COPC and subsequent direct contact, inhalation or ingestion.	Recreational users of the site, groundwater systems, surface water systems (Manly Creek), terrestrial and aquatic ecology (via groundwater), on and off-site intrusive maintenance workers.	Possible – limited understanding of COPC associated with off-site sources or their propensity to migrate onto the site.

3.5 Data gap summary

During the review of historical documents and the development of the CSM for the site, GHD has identified a number of contamination related data gaps. These are outlined in Table C3-3.

GHD recommends that the actions identified in Table C3-3 below be completed to further inform management strategies for the site. Items already considered as part of this ISMP are highlighted in blue. The remaining data gaps are not considered necessary for immediate management of the site at this time, and can therefore be addressed in a site management plan once a final land use is confirmed (as outlined in Section 5, subject to outcomes of annual environmental assessment and subsequent updates of this ISMP).

In summary, the following data gaps have been considered further, and subsequent monitoring is recommended in this ISMP:

- Groundwater well installation up-gradient of the site and groundwater monitoring.
- Surface water monitoring.
- Landfill gas well installation and monitoring.
- Surface soil assessment at the site boundary.

Table C3-3 Identified data gaps and relevance to ISMP

Item number	Data gap	Comments	Actions and timeframes
1.	No holistic formal Preliminary Site Investigation (PSI) appears to have been completed for the site or adjacent properties.	<p>This ISMP has reviewed and commented upon much of the data that a typical PSI would cover (Appendix C). However, there is data that has not been reviewed or discussed that would add value to understanding of the site and potentially required management measures. This data includes:</p> <ul style="list-style-type: none"> – Title deeds review – may inform on previous industries and locations. – Comprehensive aerial photograph review – to inform on the understanding of the sites land use history. – Review of Dangerous Goods Search – may inform on previous licences for storage at the site and associated COPC. – Complete review of previous reports – would provide further understanding of the site and potentially close some of the existing data gaps outlined below. 	<p>Completion of a formal PSI document, and incorporation of relevant findings into an update of the ISMP.</p> <p>Can be undertaken if a trigger for change is proposed or occurs, as per Section 5.</p>
2.	Missing bore logs for previously installed groundwater monitoring locations.	<p>The lack of bore logs reduces the usability of some of the existing wells for monitoring purposes, as GHD is unable to confirm their construction details (particularly total depth and screen interval).</p>	<p>Can be undertaken if a trigger for change is proposed or occurs, as per Section 5.</p>
3.	No perimeter subsurface landfill gas monitoring network or recent landfill gas monitoring data (surface or subsurface).	<p>Most recent data is from 1991 and is therefore outdated. Identified potential SPR linkages in Appendix C Table C3-2.</p> <p>It is noted that the significance of landfill gas potentially present at the site is currently unknown. However, based on the age, quantity and estimated waste types present at the site, the volume of landfill gas is considered likely to be relatively low. Furthermore, it is understood that there are no on-site buildings, limited on-site subsurface services, and large parts of the site are heavily vegetated and fenced. Therefore no subsurface service, building accumulation or surface gas monitoring has been included in this monitoring program at this stage of assessment, as discussed further in Section 3.2.5.</p>	<p>Assessment and management as per Section 3.2.5 of this ISMP, noting that this ISMP may require updates based on the results of sub-surface gas monitoring to include additional gas monitoring types if found to be required, as outlined in Section 5.2.</p>
4.	Limited surface water data, in terms of understanding stormwater flows across the	<p>No known up and downstream surface water samples from Manly Creek analysed for COPC to confirm potential impacts from the site and/or up gradient industries. Previous studies (IT 2002, HLA 2006) indicated that</p>	<p>Include surface water monitoring and analysis of COPC in regular surface water monitoring</p>

Item number	Data gap	Comments	Actions and timeframes
	site, and concentration of COPC in stormwater.	dissolved zinc in groundwater discharging from the site to the lagoon is unlikely to be bioavailable.	undertaken by Council, noting item 2 below, and discussed further in Section 3.2.4 of this ISMP.
5.	No groundwater data from assumed up gradient of the site.	This data would help confirm if COPC are entering the site from adjacent properties and/or allow quantification of the potential impacts from the site on Manly Creek.	Undertake triangulation work as per GHD, 2020, and include up-gradient monitoring wells in future groundwater monitoring events as per Section 3.2.3 of this ISMP.
6.	Not all identified COPC monitored for in groundwater, surface water and soils.	Groundwater monitoring has previously been undertaken at the site for an extensive range of COPC. However some COPC, including PFAS, potassium, OCP/OPP and DDT, have not been analysed for in groundwater and surface water analysis is limited to broad ecosystem indicators (refer to item 5 above). Assessment of soils has not included some COPC, including dioxins and furans, PFAS, OCP/OPP and DDT.	Assessment and management of COPCs identified in the VMP, plus PFAS, as per Section 3 of this ISMP. Additional COPC should be assessed if a trigger for change is proposed or occurs, as per Section 5.
7.	No sediment samples tested near site.	The lack of sediment samples makes it difficult to understand potential impacts to off-site ecosystems emanating from the site. GHD notes that Council has installed sediment fences along the eastern site boundary to reduce the likelihood of future sediment movement into Manly Creek via surface water flows.	Assessment of sediment from Manly Creek. Can be undertaken if a trigger for change is proposed or occurs, as per Section 5. Maintenance of the sediment fences, as outlined in Section 3.3.2 of this ISMP.
8.	On-site soils not assessed since 2006 and not all COPC identified in Appendix C Table C3-1 assessed. Additionally, extent of soil contamination and/or fill off-site potentially associated with the site is not delineated, particularly in areas with identified receptors. The CSM (outlined in Appendix C	<p>The site has had extensive soil testing undertaken, as discussed in Appendix C Table C2-1 and shown in Figure 3 (Appendix A). As outlined in Table C2-1, the primary COPC are generally not considered prone to degradation in natural environments (with the exception of hydrocarbons). Therefore, it is considered by GHD that these historic analytical results are likely to be somewhat representative of the current site conditions.</p> <p>Analysis of PFAS, DDT, OCP/OPP, dioxins and furans has not previously been undertaken. However:</p> <ul style="list-style-type: none"> - Further testing and analysis of the majority of on-site soils is not considered necessary based on the presence of other COPC in 	Assessment of targeted surface soils along site boundary as per Section 3.2.1. If future remediation works are required, further assessment of soils may be also required.

Item number	Data gap	Comments	Actions and timeframes
	Section 3.4) identified that a complete SPR linkage for direct contact and/or inhalation of contaminated soils by users of the site is considered likely. Based on survey and site observations, residents to the south appear to have access and be regularly using a small portion of the site.	<p>shallow soils, indicating that management actions are required at the site.</p> <ul style="list-style-type: none"> - The possible presence of COPC leaching from soils would be assessed / managed in this ISMP by including those COPC in groundwater and surface water analysis (outlined in Section 3.2). <p>A targeted soil assessment at the site boundaries adjacent to identified receptors would provide an indication of the likelihood of off-site soil contamination and possible risk to identified receptors, particularly in the southern portion of the site where the adjacent residents are accessing a portion of the site.</p>	
9.	Unknown capping design across landfill area.	Some exposed waste was observed in the vacant area in the central portion of the site, footpath and embankment during a site inspection in February 2020. It is unknown if the landfill was ever formally capped once it was closed. The CSM (outlined in Appendix C Section 3.4) identified that a complete SPR linkage for direct contact and/or inhalation of contaminated soils by users of the site is considered likely. Council have undertaken some management actions along the embankment since the February site inspection (refer to Appendix C Section 1.7), however ongoing inspections and subsequent management is required.	<p>Management of surface soils on site via inspection and/or restricted access as per Section 3.1 and Section 3.3 of this ISMP.</p> <p>Assessment of formal capping requirements and options to be undertaken if a trigger for change is proposed or occurs, as per Section 5.</p>
10.	Leachate levels and composition in waste not assessed since 2008.	Due to the lack of a formal leachate collection system at the site, assessment of potential leachate at the site would be conducted via groundwater monitoring.	Assessment and management as per item 6 of this table. Further assessment can be undertaken if a trigger for change is proposed or occurs, as per Section 5.
11.	Unknown if edible plants on site can / are bio-accumulating COPC and/or if	The precise extent of edible plants on site is not known. Furthermore, it is unknown if the edible plants on site plants are used as a regular food source and if the plants are able to bioaccumulate.	Installation of signage to warn site users of potential risks, as outlined in Section 3.1.

Item number	Data gap	Comments	Actions and timeframes
	they are likely to be consumed by site users.	Given the location of the site in a mixed residential/ commercial setting and the small area of accessible vegetation to the public, the potential risk to human health from consumption of edible plants from the site is considered likely to be low.	As an alternative to signage, it may be possible to complete a simple qualitative risk assessment that demonstrates the risk from this exposure pathway is low and acceptable.
<u>Table notes:</u>			
Blue shading = included in this ISMP.			

Appendix D – Site survey

Appendix E – Site history

The following record of site history has been obtained from various environmental reports prepared for the site (1991 – 2008, as indicated in the following text):

- The Addiscombe Road site was first granted to D'Arcy Wentworth in 1818. The site is thought to have been originally low-lying and swampy. The site was vacant and may have been used for pastoral uses. Between 1818 and 1917 the Wentworth Estate had several private owners.
- In 1910, Manly and Warringah Councils agreed to use this area as a rubbish tip, to accommodate the gradual increase in population in Manly (Journal of Local History, 2006). In 1912, a portion of the Wentworth Estate was purchased by Manly Council.
- An incinerator was built at the site in 1913 (Journal of Local History, 2006):
 - It was a 'Hughes Sterling destructor' design and could burn approximately 50 tons (T) of garbage per week.
 - The site was fenced and the foreman and fireman lived in two cottages at the site, close to two creeks.
- In 1914 the site was subject to provisions of Section 55 of the Public Health Act 1902 (NSW). An interpretation of the notice indicates the order may have been issued due to the site's low-lying and swampy nature. The notice was revoked in April 1990.
- From 1914 the site operated as a rubbish tip that included use of the garbage incinerator (PB, 2008a):
 - The site was used to incinerate waste, and store incinerated and 'regular' waste. PB (2008a) states that the tip also accepted waste that could not be incinerated.
 - In 1917, the boundaries of 'Warringah Shire' were altered, and the site was proclaimed part of Manly.
 - There were frequent smoke complaints from local residents (most of whom resided in Warringah Shire) during the incinerator's operation (Journal of Local History, 2006).
 - There was increasing pressure on the incinerator's capacity during the 1920's, as the population of Manly continued to grow. From 1926, there was public outcry for the incinerator to be removed.
 - The incinerator in the 1920's is shown in Photograph 1.
- It is reported that the Manly incinerator operated until 1939 (Journal of Local History, 2006), after which time rubbish was trucked to an incinerator in Mosman. In 1940, the incinerator was demolished. However, the site was still used as a tip post demolition of the incinerator, and garbage was occasionally burnt on site in the open after 1940 (sometimes by spontaneous combustion; Journal of Local History, 2006).
 - Rubbish continued to be disposed of at the Addiscombe Road tip until the 1950's.
 - Due to the period of waste disposal on site, there is potential for per- and polyfluoroalkyl substances (PFAS) to be present on site.
 - A dog pound is also thought to have operated onsite around this period.
 - Residents complained about the continual smell, rats and cockroaches. Manly Council attempted to control the vermin issue using "fogging" (Journal of Local History, 2006).
 - According to PB (2008a), aerial photographs taken between 1943 and 1951 show a large un-vegetated raised area in the middle of the site with a surrounding 'ring-road'. This is consistent with the site being used as a tip during this period.
 - In 1957, Manly Council decided to reserve the Addiscombe Road tip for Council's use only.
- Manly Council leased a portion of the land in 1953 for use as a joinery works (PB, 2008).

- In 1958, Warringah Council and Manly Council considered a land swap which would add the Addiscombe Road site to Warringah's District Park (Journal of Local History, 2006), however this was not agreed at the time.
- In 1968/1969, Naval Cadets leased a portion of the site for a training facility (TS Condamine) within Lot 3 (crown land) and Lot 1 (Council land).
 - During this period, an area of the Addiscombe Road site became an informal dumping ground and squatting site (Journal of Local History, 2006).
 - An aerial photograph from 1996 shows vegetation around the perimeter of the site with a non-vegetated area in the middle of the site. Large trees and the naval base are also present on site (PB, 2008a).
 - The primary building was demolished in 2006 (PB, 2008a).
- In 1988, Manly Council rezoned the site as 'residential' and sold the land to the NSW Department of Housing for the development of affordable housing. However, in 1989, Warringah Council objected to any housing development, claiming that the site was not suitable from contamination and flooding perspectives (Journal of Local History, 2006).
- According to the Journal of Local History (2006), investigations undertaken in 1994 confirmed that the land was contaminated with "heavy metals". This corresponded with findings in 1988 that the lagoon was 'polluted with leachate bearing heavy metals'. No description of the investigation works undertaken are provided, or which heavy metals were considered to have been the primary contaminants.
- According to PB (2008), an aerial photograph from 1999 shows increased vegetation across the site.
- The *Contaminated Land Management Act 1998* placed responsibility on Manly Council for remediation of the site. However in 2002, Warringah and Manly Councils, and the Department of Housing, each agreed to pay \$600,000 to remediate the site, and return ownership of the site to Warringah Council. However this was never carried out.
- In 2004, the NSW EPA issued a remediation declaration (2103038), pursuant to section 21 of the *Contaminated Land Management Act 1997*. This is understood to no longer be active.
- In 2007, Warringah Council withdrew from agreement to remediate site. Warringah and Manly Council were amalgamated in 2016 to form 'Northern Beaches Council', who is considered the current site owner/manager.
- The site has remained vacant since 2006, with minor portions accessible to the general public for use as a recreational area and footpath.

With reference to aerial photographs from 1943 (PB, 2008), the surrounding areas have historically been used for farming and residential purposes while more recently being used for commercial, industrial and residential purposes.

Appendix F – Previous environmental investigation summaries

F.1 Patterson Britton (2002) - Excerpt from '*Sediment information*'

Core sediment samples were collected from nine locations on the western bank of Manly Lagoon.

The visual description of sediments did not identify foreign objects or contaminant indicators other than 'plastic' in one sample. Analytical results of 'SPOCAS' testing indicated that the risk of acid sulfate soils (ASS) ranged from very high to none. Analytical testing for potential contaminants was undertaken, however the scanned version of the results table provided to GHD was not legible.

F.2 PB (2006) - *Proposed Remediation of Contaminated Land. Lots 1-4 DP818957 Addiscombe Road, Manly Vale. Project Application and Preliminary Environmental Assessment*

The aim of the report was to support an application for approval to carry out proposed remediation works by identifying likely environmental impacts of the remediation works and mitigation measures of the works.

"Metals, asbestos and PAHs impacts were identified", and the report concluded that the proposed remediation works would "protect the environment from further degradation".

F.3 Patterson Britton (2007) - Excerpt from '*Sites 1 and 2 additional sediment sampling and testing*'

Eight sample locations were assessed in Manly Creek. Sediment samples were collected using a 'vibrocore'.

The concentration of chromium, nickel, lead, and benzo(a)pyrene exceeded the 'inert' and/or 'solid waste' waste classification guidelines (noted to now be outdated). The results of 'SPOCAS' analytical testing indicated that the risk of ASS ranged from very high to none, with the majority of the samples being classified as 'very high'.

F.4 PB (2008a) - *Remedial Action Plan - Lots 1 to 4 (DP 818957) Addiscombe Road, Manly Vale, NSW*

The concentration of COPC (metals and PAHs) across the site in soil and groundwater were noted to be above the guidelines applied at the time. These referenced in this investigation were NSW DEC (2006) *Guidelines for the NSW Site Auditor Scheme (2nd edition)* – health-based investigation levels for parks, recreational open space, playing fields including secondary schools and ANZECC (2000) *Fresh and Marine Waters Quality Guidelines* – trigger values for the protection of 95% of marine water species. PB concluded that any remaining potential risk could be managed by a combination of strategic soil/fill excavation, disposal, filling and capping, ongoing management and institutional controls.

The site was declared a 'remediation site' by the Department of Environment and Conservation, and PB submitted a project application and preliminary environmental assessment (August 2006) on behalf of Council for approval to carry out the proposed remediation. The environmental assessment was submitted in conjunction with the remedial action plan (RAP). The RAP primarily proposed capping / containment of contaminated material as a concept remedy.

F.5 PB (2008b) – Environmental and Groundwater management Plan – Lots 1 to 4 (DP 818957) *Addiscombe Road, Manly Vale, NSW*

- The environmental management plan (EMP) provides an overall management strategy for controlling potential exposure to soil and groundwater contamination, and includes a groundwater management plan (GMP).
- Management control measures for a number of potential exposure pathways are outlined, and a cap monitoring/inspection plan is provided. The GMP outlines groundwater goals and monitoring program, as outlined in Section C.6 below.

F.6 PB, (2008c) - Groundwater management plan summary

A groundwater management plan (GMP) is provided as part of the site Environmental management plan (EMP) developed by PB (2008b). The goal for groundwater at the site was to demonstrate an improvement in groundwater quality at the boundary of the site with Manly Lagoon. In summary, the GMP states that the following should be undertaken:

- Installation of five monitoring wells along the foreshore boundary. GHD notes that two were installed in 2017 by WRL, and GHD completed the remaining three as part of GHD's groundwater investigations in 2017 (outlined in Section E.3).
- A program of groundwater monitoring should be conducted "bi-annually" for a period of two years following remediation work.
- Groundwater gauging and sampling will be done in accordance with standard industry practice. The GMP provides an outline of the recommended procedure.
- Statistical assessment to assess ongoing groundwater concentration trends.

Based on concentration trends of COPC, contingency measures and actions have been developed by PB (2008b). These are summarised in Table E1.

Table E1 GMP contingency scenario's (PB, 2008b)

Concentration trend	Recommended actions (PB, 2008b)
Decreasing trend	- Review groundwater monitoring requirements (reduce frequency). The site audit statement (Coffey 2009) states that the EMP/GMP must be implemented for the complete duration that residual contamination remains on the site.
No improvement or increasing trend	- Quantitative risk assessment, including fate and transport modelling for each COPC - If risk assessment indicates unacceptable risk to human and ecological receptors further contingency measures should be investigated and re-evaluation of the remedial options

F.7 Coffey (2009) – Statutory site audit report and site audit statement, Lots 1 to 4 (DP 818957) *Addiscombe Road, Manly vale 2093*

The Audit report stated that the RAP is appropriate for the purpose stated by PB (2008b) subject to further investigative work in a staged approach. Changes required by the Audit statement included variation in the groundwater sampling frequency, a need for further soil validation works, development of an interim site management plan, and detailed design / technical specifications for the 'cap and contain' management strategy.

F.8 GHD (2018) – Northern Beaches Council, Manly Vale Groundwater monitoring – Groundwater assessment report 2017-2018

The objectives of this project were to assess the groundwater conditions at the site and evaluate the trend of groundwater conditions over a period of twelve months.

Three monitoring wells (MW01 to MW03) were installed, and six groundwater monitoring events (GMEs) over a 12 month period (undertaken once per two month period) at locations MW13, MW14, MW01, MW02 and MW03 was undertaken.

Overall, it was recommended that groundwater monitoring continue to monitor possible migration of contaminants from the site to Manly Lagoon with a reduced sampling frequency. Additionally, given the age and varying conditions of the documents identified above, the current data gaps identified in relation to other possible environmental issues at the site and the findings of this report, GHD considered that a clear and holistic 'road map' of future works for the site needs to be developed. Such a document should consider the site in its current condition and Council's required long term use.

GHD understands that remediation works have not commenced at the site, and that the RAP (PB 2008a) has not been amended to incorporate the Site Auditor comments (Coffey, 2009). Further, on 11 of April 2013, the National Environment Protection Council (NEPC) amended the National Environment Protection (Assessment of Site Contamination) Measure 1999 (the ASC NEPM), which included updated clean-up criteria based on updated risk assessment data. The amendment of the ASC NEPM took effect in each jurisdiction on 16 May 2013, the day after it was registered on the Federal Register of Legislative Instruments (FRLI) in 2013. These updates to legislation must be considered when assessing the conclusions of potential environmental impacts at the site in previous investigations.

F.9 Manly Council (not dated) – Voluntary management proposal under the Contaminated Land Management Act 1997 – Part 1, Draft

The document outlines the site and contaminants of potential concern (COPC), with reference to the RAP (PB, 2008a). It states that the proponent (Council) will provide a strategy to the EPA for approval for communicating about the implementation (particularly the actual management work) with members of the public. Additionally, the Council must then implement the management strategy as approved in writing by the EPA. Amongst other reporting requirements, the Council must notify the EPA within 7 days of becoming aware of information indicating change in conditions at the site or in the surrounding environment.

Remediation is proposed to be undertaken in two stages; development and implementation of an interim site management plan (ISMP) including a monitoring plan, and then remediation of the site for use as open space lands (to be confirmed following completion of stage 1).

- Stage 1 management and monitoring objectives are listed, including meeting the requirements of the Site Auditor as stipulated in the Site Audit Statement (Coffey, 2009), collect data to complete data gaps, and define the extent of the impact of groundwater contamination at adjoining sites (including Manly Lagoon). The requirements to complete these objectives are listed.
- Stage 2 objectives to be defined post completion of Stage 1.

Milestone dates are not provided.

Appendix G – Contamination status

G.1 Waste operations

G.1.1 Waste types, footprint and quantities received

The site was used as a landfill from approximately 1914 to 1950's (noting potential illegal dumping in the 1960's as well). There is limited information available in relation to the types of waste landfilled at the site. PB (2008a) suggested that a variety of materials may have been landfilled at the site including:

- Earthen fill materials (for example soil and rocks)
- Building waste (for example bricks, concrete, metals, wood, glass, plastics)
- Municipal waste
- Incinerated waste

The waste footprint at the site as estimated in PB (2008a) is shown on Figure 2, Appendix A. Detailed records of the quantities of waste disposed of at the site are not available. PB (2008a) estimated that the quantity of waste and fill on site is approximately 25,000 m³. It is noted that this footprint is an estimate only and requires further confirmation.

According to PB (2008a), the site is underlain by fill to depths of approximately 5 m bgl. The high points in land surface observed close to the centre of the site are understood to be fill material.

G.1.2 Waste handling and covering

No detailed records on landfilling practices for the site are understood to be available. Given the time of operation (circa 1914 to 1950's), it is likely that the landfilling activities were completed in accordance with typical practice at those times. It is anticipated that use of daily cover may have been extremely limited (if at all, based on complaints from local residents of odour), and that equipment to place and compact the waste may have been basic by modern standards (a tractor or bulldozer). Occasional fires may have been used as a management procedure to reduce surface litter.

It is unknown if the landfill was ever formally capped once it was closed. Exposed waste was observed during a site visit (February 2020) in two publicly accessible areas outside the fence as follows:

- Between monitoring wells MW01 and MW14 in the southern portion of the site.
- Along the embankment of Manly Creek on the northern portion of the site, between monitoring wells MW03 and MW13. This is shown in Photograph 3.

The exposed waste indicates that a formal cap is unlikely to be present across the site, at least in these locations.

G.1.3 Engineered systems

No records of installed engineering systems for the site are understood to be available. Given the time of operation (circa 1914 to late 1950's), it is likely that the landfilling activities were completed in accordance with operational methods in existence at those times. As such, it is believed that:

- No engineered barrier systems such as basal and side wall linings were installed at the site.
- No engineered leachate collection and treatment systems were installed at the site.
- No landfill gas (LFG) collection and treatment systems were installed at the site.

G.2 Remediation works to date

Although there have been a number of reports pertaining to potential remediation activities at the site, no remediation works are known to have been carried out to date, with the exception of excavation works of surface soils undertaken post demolition of the Naval training facility.

According to PB (2008a), the site was declared a 'remediation site' by the Department of Environment and Conservation, and PB submitted a project application and preliminary environmental assessment (August 2006) on behalf of Manly Council for approval to carry out the proposed remediation. The environmental assessment was submitted in conjunction with a remedial action plan (RAP).

The RAP primarily proposed capping / containment of contaminated material as a concept remedy. Prior to commencing the capping works, soil validation works, landfill gas monitoring, surface and groundwater monitoring were recommended to be undertaken. Additionally a series of management plans were identified for during and post remediation works.

The draft VMP prepared by Manly Council (not dated) proposed that remediation be undertaken in two stages; development and implementing an interim site management plan (ISMP) including a monitoring plan, and then remediation of the site for use as open space lands (to be confirmed following completion of stage 1).

GHD understands that remediation works have not commenced at the site, and that the RAP (PB 2008a) has not been amended to incorporate the Site Auditor comments (Coffey, 2009).

G.3 Groundwater

G.3.1 Groundwater monitoring locations

The following groundwater well installation works have been conducted at the site:

- Nine groundwater wells (MV1 to MV7, MV3a and MV4a) were installed (GTA 1991, Flour Daniel 1997) during the early 1990s, which have been deemed to be 'destroyed or lost'. These wells have not been located by GHD during site visits.
- A further nine monitoring wells (BH1 to BH4 and S5 to S9) were subsequently installed (IT 2002b). Three of these were located in February 2020 by Council during a site visit.
- Five additional monitoring wells were installed by UNSW Water Research Laboratory (WRL) and GHD in 2017. WRL installed wells MW13 and MW14 (also known as ML20 and ML21 respectively) as part of a broader catchment network. GHD installed wells MW01 to MW03 along the eastern perimeter of the site, adjacent to Manly Creek.

The location of historic and current monitoring wells is shown on Figure 2, Appendix A. Available bore logs are provided in Appendix H, however GHD notes that not all bore logs are available for identified monitoring locations. This reduces the reliability of data obtained for monitoring purposes, as GHD is unable to confirm their construction details (particularly total depth and screen interval).

G.3.2 Hydrogeology

The following hydrogeological characteristics for the site were discussed by PB (2008a):

- Groundwater beneath the site is believed to have connection with Manly Creek. A perched groundwater mound may also exist in some areas of the site, based on the level of fill and natural lithology beneath the site.
- The variation in static water levels measured over a tidal period has previously been shown to be small (0.033 m at wells BH4 and S8), while the corresponding hydraulic gradient over the same period was found not to be significant (approximately 0.005).

- Based on previous investigations, PB (2008a) stated that the general trend of groundwater flow was in an easterly to north-easterly direction toward Manly Lagoon, which follows the local topography of the site. The flow appears to be dictated by steeply elevated rock faces on the southern boundary and variations in the fill/natural soils located towards the northern areas of the site. These rock faces are assumed to limit the flow of groundwater from the general catchment area toward the site, and it was concluded that the major source of groundwater under the site is expected to be from infiltration from a limited catchment area rather than regional groundwater flow (PB, 2008a). However, GHD notes that this may not necessarily be the case as Manly Creek provides a constant head source immediately adjacent to the site which may reverse the flow across the site.
- Hydraulic conductivity (k) tests undertaken by IT (2001) on groundwater wells BH2 to BH4 indicated an average conductivity of 0.96, 0.63 and 0.31 metres per day respectively. The k value for BH4 was indicated as representing groundwater flow through the site's sandy soils. Higher k readings in BH2 and BH3 may indicate more permeable regions of the site/fill.

GHD conducted groundwater monitoring of five groundwater wells every two months for a year in 2017 (GHD, 2018). A summary of hydrogeological conclusions made are provided below (noting that further discussion of COPC is provided in Section E.3.3 below):

- Standing groundwater was encountered between 0.55 m bTOC (MW13) and 2.58 m bTOC (MW14) over the monitoring period.
- The groundwater level at each location appeared to be relatively stable over time, with the exception of MW14. This monitoring location is further away from Manly Creek compared to the remaining monitoring locations, and was noted to frequently be purged dry during groundwater sampling. Based on bore logs provided by the Council (provided in Appendix H), monitoring well MW14 was installed into the waste profile. It is therefore likely that groundwater at this well highly influenced by subsurface heterogeneity and is possibly more impacted by rainfall events than the remaining locations. This is supported by relatively low EC readings at well MW14.
- Based on the observed site and regional topography, it is likely that groundwater in the local area flows east and is discharging into Manly Creek. This corresponds with the conclusions made by PB (2008a).
- Field EC readings indicated that groundwater at the eastern site boundary is brackish. This suggests that there may be mixing of fresher groundwater with seawater, possibly due to tidal influences.
- The linear nature of the groundwater monitoring network used in this investigation and the absence of survey data means that the gauged standing water levels measured during the groundwater monitoring program could not be used to accurately assess groundwater flow directions at the site. Groundwater flow directions beneath the site are likely to be highly variable across the site due to the former landfilling activities on site. Council subsequently engaged GHD to report on potential triangulation of groundwater at the site (GHD, 2020), which included the installation of up gradient monitoring wells (and further discussion of the existing well network), however these works are yet to be undertaken.

G.3.3 Contaminants of potential concern in groundwater

The most recent groundwater assessment was conducted by GHD (2018), which indicated the following groundwater conditions, and provided the following recommendations in regards to future works at the site:

- No light non-aqueous phase liquid (LNAPL) was observed during the groundwater monitoring program.
- The concentration of PAH (total), lead and nitrate exceeded the adopted assessment criteria protective of human health (drinking water and recreational – ADWG 2018 and NHMRC 2018, NEPM HSLs commercial/industrial 2013). Based on groundwater analytical data from 2017;
 - It was considered unlikely that these exceedances posed a risk to human health due to the general lack of receptors in the vicinity of the site. However, further signage around Manly Lagoon to prevent people from using it for recreational purposes was recommended. GHD conducted a site visit in February 2020 and noted that a warning sign existed at the northern end of the public footpath as shown in Photograph 4, however none was observed at the southern end or on the opposite creek banks.
 - Additionally, collection of surface water data was recommended to compare concentrations of COPC against assessment criteria protective of potential recreational receptors.



Photograph 4 Warning sign observed in February 2020 adjacent to Manly Creek at the northern end of the site, to minimise recreational use.

- The concentrations of ammonia, cadmium, chromium, copper, lead and zinc exceeded the nominated ecological assessment criteria (NEPM GILs fresh and marine), protective of marine and freshwater ecosystems, and may indicate a risk to ecological systems from site contamination. Recommendations of the report regarding this were:

- Up-gradient groundwater monitoring wells were recommended to be installed, to determine if the concentrations are indicative of site contamination or background concentrations. Council subsequently engaged GHD to report on potential triangulation of groundwater at the site (GHD, 2020), which included the installation of up gradient monitoring wells. However, these works are yet to be undertaken.
- Additionally, collection of surface water data was recommended to compare concentrations of COPC against assessment criteria protective of these ecosystems.
- The Mann-Kendall test was performed to evaluate the trend of selected contaminants. Based on the annual period of monitoring completed, statistically significant increasing trends were calculated for ammonia, copper, lead and zinc, and a downward trend was calculated for phosphate. It is noted that these trends may not be statistically significant on a longer term basis when more climatic stressors are included.
- The monitoring locations monitored by GHD (2018) were not the same as those used in previous assessments. Therefore, comparison of current analytical data with historic concentrations for the purpose of trend assessment must be used with caution. A broad comparison of 2017 analytical data with a historic data set (PB, 2008b) suggests that the concentration of COPC at the site boundary is less than that in the central portion of the site. It is unclear if the lower concentrations observed are due to environmental degradation of the contaminant plume, or if the recorded concentrations indicate limited migration of COPC via groundwater towards the eastern site boundary.
- The analytical suite used in 2017/2018 (dissolved metals (cadmium, copper, chromium, lead and zinc), heavy metals, PAH (trace levels), TPH, nutrients (total N, nitrate, nitrite and total P) and ammonia) was considered to be generally appropriate. It was recommended that arsenic be regularly included in future monitoring events (it was accidentally analysed once during the monitoring period) due to the elevated concentrations identified in Monitoring Event 1. Additionally, GHD (2018) considered it appropriate to also include PFAS in at least one future monitoring event to ascertain its presence/absence, based on the site history as discussed in Appendix E.

The RAP (PB, 2008a) and recent groundwater assessment (GHD, 2018) both confirmed COPC, which are summarised in Table F1. The analytical suite used in the groundwater assessment was based on the COPC identified in the RAP (PB, 2008a), however analytical results indicated that a limited set of these were present at the site at concentrations greater than the LOR and/or adopted assessment criteria, as indicated in Table F1. The COPC identified in the RAP were based on the results of earlier assessments, and were noted in the DECC Declaration notice.

Table G1 COPC as identified by recent studies

	RAP (PB, 2008a)	Groundwater assessment (GHD, 2018)
COPC	<ul style="list-style-type: none"> Heavy metals (lead, cadmium, copper and zinc). PAHs, including benzo(a)pyrene TPH C₁₀-C₃₆ Ammonia 	<p>Concentrations above adopted assessment criteria:</p> <ul style="list-style-type: none"> Dissolved metals (cadmium, copper, chromium, lead, zinc and arsenic) Ammonia and nitrate <p>Additional COPC tested:</p> <ul style="list-style-type: none"> PAH (trace levels) ¹ TRH ¹ Nutrients (total nitrogen, nitrite and total phosphate) PFAS ².

TABLE NOTES:

1 - Noted to have concentrations less than the LOR at all locations in all monitoring rounds in 2017, with the exception of trace level naphthalene in one monitoring event.

2 - Not analysed for but subsequently identified as a potential COPC.

Based on the results of the field tests, and considering the hydrogeological setting discussed in Section F.3.2, PB (2008a) determined an approximate contaminant loading for zinc using a calculated flow rate (seepage) of 1.5 m³ per day along the length of the creek, and average zinc concentration of 22 ug/L. The contaminant loading estimate was determined to be 0.3 g/day, and was considered not likely to have a significant effect on Manly Creek and Manly Lagoon (PB, 2008a). Subsequently, zinc was determined not to be a suitable water quality indicator with respect to Manly Creek.

G.4 Surface water

The closest surface water body is Manly Creek, immediately adjacent to the eastern site boundary. There are no known surface water drains on site. However, there may be stormwater discharge points into Manly Creek at the northern and southern extents of the site where public roads terminate against the site boundary.

As summarised by PB (2008a), WS Rooney and Associates (1997) made the following conclusions in regards to Manly Creek:

- The risk of heavy-metal toxicity to aquatic life in Manly Lagoon is probably low and limited to a toxicological risk from ingestion or remobilisation of copper, lead and zinc from the sediments. The levels of copper identified were not considered to be toxic to crustaceans.
- The study also found that if the creek/lagoon was flushed or mixed with sea and fresh water the copper and chromium toxicity levels were likely to decrease due to an inverse relationship of dissolved oxygen and water hardness.
- Overall improvement in oxygen levels of the creek were also found to have a desirable outcome for the site.

Two previous reports subsequently assessed the use of zinc as an indicator of ecosystem health in Manly Creek (IT 2001 literature review and subsequent risk based assessment, as summarised in PB 2008a), however both concluded that "dissolved zinc in the groundwater at

Addiscombe Road is an insignificant contributor to bioavailable zinc in the lagoon". Additionally, nutrients, dissolved oxygen and microbial contamination were identified as more suitable indicators, corresponding with the findings of WS Rooney and Associates (1997).

The 2006 non-statutory Site Audit Report (conducted by HLA) concurred that dissolved zinc in groundwater discharging to the lagoon is not bioavailable to organisms in the lagoon (IT, 2002). However, the auditor did note that ongoing monitoring may be required to confirm the findings of the IT risk assessment, based on a lack of QA/QC data for the 2002 assessment.

The most recent surface water data collected for the purpose of contamination assessment was collected by PB in 2005 (PB, 2008a). Two sampling locations on Manly Creek immediately adjacent to the site were assessed, as shown in Figure 2 (Appendix A), with the following conclusions:

- The concentration of total petroleum hydrocarbons (TPH), fluoroanthene, pyrene, benzo(a)pyrene, PAHs, copper and lead was less than the detection limit at both locations.
- The concentration of zinc was 104 ug/L and 132 ug/L in SW1 and SW2 (respectively) which exceeded the adopted criteria of 130 ug/L, and the concentration of ammonia was also greater than the detection limit (0.08 ug/L and 0.07 ug/L respectively).
- Faecal coliforms were detected at concentrations exceeding ANZECC 2000 recreational water quality guidelines for both primary and secondary contact in both surface water samples, suggesting that the impact on the aquatic ecosystems in the lagoon (from upgradient contamination sources). These are likely to be from urban stormwater and sewer overflow from upgradient sources.

Cardno (2011) noted that the concentration of ammonia was elevated up stream and adjacent to the site during dredging works being undertaken, however the concentration returned to background levels once dredging was completed. This indicates that COPC are most likely to be associated with sediments in the Creek.

GHD is aware that Council undertakes regular surface water monitoring of Manly Creek (in addition to other waterways within the Council catchment), which is assessed for broader ecosystem health parameters.

G.5 Sediments

Sediment investigation works were conducted in Manly lagoon by Patterson Britton (2007) to examine the physical and chemical properties of the sediment under three conditions to confirm if the dredged sediment would be suitable for use as a capping layer. The intention was to use available dredged sediment either in a raw or separated (hydrocycloned) state as a low permeability capping material to control infiltration into the former Addiscombe Road landfill. Based on the sediment evaluation, Patterson Britton (2007) considered that both the muddy overflow and the raw feed products may be suitable as a primary cap, if appropriately dewatered, treated, and compacted.

Results of 'SPOCAS' analytical testing indicated that the risk of ASS ranged from very high to none, with majority of the samples being 'very high' (Patterson Britton, 2007). Additionally, the concentration ranges for the following analytes were (noting no units were provided, but were assumed to be ug/L):

- Chromium: 9-30
- Nickel: 2.0-30
- Lead: 29-190
- Benzo-a-pyrene: 0.13-1.70.

The Site Audit Report (Coffee, 2009) discussed that sediment samples collected by IT (2002a) had highly reducing organic materials which made laboratory extraction of analytes difficult.

Manly and Warringah Councils undertook dredging in Manly Lagoon to remove accumulated sediments from November 2010 and March 2011 (Cardno, 2011). The aim was to improve water quality by increasing connectivity between the lower and upper reaches. No formal assessment of sediment for COPC was undertaken.

Sediment fences were observed during a site visit (February 2020) to have been installed by Council along the eastern perimeter of the site to limit surface water transport of sediments to Manly Creek. These are shown in Photograph 3.

G.6 Soils and soil leachate

G.6.1 Soil

The locations of historic sample locations are shown on Figure 3, Appendix A. A summary of analytical soil results between 1991 and 2001 at these locations is provided in PB, 2008a.

Specifically, the following soil investigation works and conclusions have been made in the more recent, previous investigations (as summarised by PB 2008a):

- 20 potential asbestos samples were analysed for asbestos by HLA Envirosiences in 2000. The investigation confirmed asbestos was present over a majority of the site, with high likelihood of presence beneath surface areas. The asbestos was mostly observed as broken cement sheeting fragments on the surface, including within some small stockpiles located in various areas of the site.
- A site wide investigation undertaken by IT Environmental (2002), including 16 soil samples (SS13-SS28). The concentration of lead, PAHs and asbestos were found to be above the site criteria across the site, indicating widespread contamination both at the surface and in subsurface layers.
- 27 locations were assessed by BT Environmental in 2004, targeting the former Naval training facility which was suspected to have caused surface contamination of the site, derived from leaded paint and asbestos that weathered from the former main building and flag pole. The following is noted:
 - The soil profile, to a maximum investigation depth of 1.0 m, was characterised by fill material consisting of gravely sand with brick, timber, wire, ceramic, glass, coal, slag, coke and shell fragments.
 - Analytical results for arsenic, copper, lead, zinc and benzo(a)pyrene exceeded the adopted levels provided within the NSW EPA (1995) 'Guidelines for the NSW Site Auditors Scheme' and NEHF (1996) 'Health Based Soil Investigation Levels'.
 - Asbestos fibres (bundled form) were identified in surface samples (<0.1 m depth) collected from around the building.

A 2006 non-statutory site audit (HLA, 2006) of validation works undertaken by BT Environmental Services concluded that the contamination of near surface soil that occurred during the use of the site for training purposes was excavated and removed from the site and noted that deeper contaminated fill material (not related to Defence operations) remains at the site.

- The concentrations of lead, copper and zinc in BT Environmental soil validation samples are noted to have exceeded adopted criteria in most validation samples (criteria adopted is not known to GHD), indicating that some surface soil contamination from metals is likely to have remained on site after completion of the excavation works. Asbestos was not

identified in any of the validation samples suggesting that soils impacted by asbestos from the training activities were removed and validated.

A second 2006 non-statutory site audit (HLA, 2006 as summarised by PB 2008a) stated that the COPC in soils across the site identified in previous investigations were heavy metals (cadmium, lead and zinc), PAHs, and asbestos. Based on PB, 2008a:

- These contaminants were identified to a maximum depth of 4 m bgl.
- 'Asbestos' observations and analytical results include detections of chrysotile, crocidolite, arsonite and ACM sheeting at various locations across the site.
- Lead was the most wide spread contaminant, occurring in both surface and sub-surface samples. The maximum surface concentration was 125,000 mg/kg (units assumed by GHD) at location 'D', with the majority of surface and 0.1 m bgl samples having a concentration greater than 2000 mg/kg which would exceed the current NEPM (2013) criterion for recreational and commercial/industrial land use scenarios (600 and 1500 mg/kg respectively).
- GHD also notes that TPH was detected at four soil investigation locations, to a maximum depth of 3 m bgl.

GHD notes that the primary COPC (identified by the 2006 site auditor and noted above) are generally not considered prone to degradation in natural environments (with the exception of TPH's). Therefore it is considered by GHD that these historic analytical results are likely to be somewhat representative of the current site conditions.

G.6.2 Leachate from soils

PB (2008a) states that the quality of potential leachate was previously assessed using Toxicity Characteristic Leaching Procedure (TCLP) and ASTM methods for PAHs and metals in soil samples. The results of these methods indicate that PAHs were below the laboratory limits of reporting for all samples analysed, with the exception of three samples (IT 2005, as summarised by PB 2008a).

There was no assessment criteria for soil leachate, however TCLP tests for metals demonstrated low levels of leachable zinc in the soil at three locations, in addition to some lead (IT 2005 and Groundwater Technology Australia 1991, as summarised by PB 2008a). In general the material sampled in previous investigations appears to have had a low potential to leach.

Soil leachate results were considered to show a correlation with groundwater monitoring data by PB (2008a). Selected soil samples analysed up to 3 m bgl showed that soil in approximately the top 1 metre was most likely to leach (PB, 2008a).

G.7 Subsurface and surface landfill gas

No recent landfill gas (LFG) monitoring or assessments have been carried out at the site.

According to PB (2008a), the soil gas survey undertaken by GTA (1991 and 1993) undertook an environmental assessment of the site involving a soil gas survey of 61 locations using vapour probes (VP1 to VP61) to a maximum depth of 1 m. The assessment did not identify high levels of volatile organic compounds, combustible or toxic gases in the samples taken during the investigation. It was considered likely that the degradation of organic matter in the underlying sediments and in the lagoon waters may generate ammonia, hydrogen sulphide and carbon dioxide.

G.8 Known sub-surface services

A 'Dial Before You Dig' (DBYD) information request was submitted by GHD for the site and its environs in January 2020.

No on-site services were identified, with the exception of:

- A Sydney Water sewer line, extending along the eastern boundary of the site adjacent to Manly Creek. This is shown on Figure 2, Appendix A.
- Two NBN 'pits' (size 8) in the south west corner of the site, however the plans do not indicate any cables connecting to these pits.

GHD notes that the Council are listed as one of the information providers for this site, and therefore assumes that the site is already registered with DBYD.

G.9 Buildings and structures

There are no buildings currently present on site.

Historic infrastructure included a dog pound, potential infrastructure associated with the joinery works, and a building for the Naval Cadets training facility (TS Condamine - within Lot 3 and Lot 1) which was demolished in early 2006.

G.10 Sensitive flora and/or fauna

No sensitive flora or fauna species are known to be present on-site. However, it is noted that the wetland area located south west of the site is listed as "nationally important wetlands" on the Department of Environment *Protected Matters Search Tool* ⁽⁷⁾. GHD has therefore assumed that a number of sensitive species (flora and fauna) are likely to be present adjacent to the site.

As summarised by PB (2008a), IT Environmental literature review (2001) concluded that Manly Creek has significant environmental problems resulting in low animal, flora and fauna diversity and abundance (as well as reduced aesthetic and recreational value). A lack in aquatic benthic However, Cardno (2011) conducted daily inspections of the local ecology of Manly Creek during a dredging program, which included the following:

- Threatened bird species – Little Pied Cormorant (*Phalacrocorax melanoleucos*) and their nests in the She Oaks on the lagoon bank.
- Seagrass communities
- Threatened floral communities – Swamp Sclerophyll Forest on Coastal Floodplains and Swamp Oak Floodplain forest.

Additionally, Cardno (2011) collected samples of fish fillets for laboratory testing of COPC. The fish toxicology analytical results showed that the concentration of arsenic, copper, selenium and zinc were elevated in the fillet samples, with low levels of mercury and lead.

During the February 2020 site inspection undertaken by GHD with Council, two species of edible native plants were observed adjacent to the public footpath. These were:

- *Tetragonia tetragonioides*, also known as New Zealand Spinach
- *Carpobrotus*, commonly known as Pig-face

Both are very common along the coast of Sydney. The potential for these plants to bioaccumulate metals or other COPC identified in shallow soil and groundwater is not currently known. Additionally, it is not known if these plants are a regular source of food for human receptors.

⁷ <http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf> accessed 29/06/2015

Appendix H – Groundwater well bore logs



BOREHOLE LOG

ENVIRONMENTAL-GROUNDWATER

MONITORING WELL MW01

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Client Northern Beaches Council Project Manly Vale Groundwater monitoring Project No. 2126852 Site Lot 1-4 Addiscombe Road, Manly Vale Location Lot 1-4 Addiscombe Road, Manly Vale Date Drilled 31/10/2017 - 31/10/2017	Drill Co. Terratest Driller Dave Rig Type Geoprobe Drill Method Push Tube Total Depth (m) 5 Diameter (mm) 150	Easting, Northing . Grid Ref GDA94_MGA_zone_48 Elevation Collar RL 0 Logged By Ashleigh Neil Checked By Stefan Charteris
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B.C.L No. N/A	Casing PVC (Class 18)	Screen 0.5mm Slotted PVC (Class 18)	Surface Completion Gatic
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Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation (m)
0.5	PT				Grout		SAND, fine to medium (FILL)	M		Fill, no odour	-0.5
1					Sand		Silty SAND, fine to medium, dark grey-brown (NATURAL - SOIL)	VM		No odour no staining	-1
1.5					Bentonite						-1.5
2											-2
2.5											-2.5
3					Backfill		Termination Depth at: 5.00 m. Target depth achieved.				-3
3.5											-3.5
4											-4
4.5											-4.5
5											-5
5.5											-5.5
6											-6
6.5											-6.5
7											-7
7.5											-7.5
8											-8
8.5											-8.5
9											-9
9.5											-9.5

Notes			
GHD Soil Classifications The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.			
Drilling Abbreviations AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler		Moisture Abbreviations D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	
		Consistency Abbreviations Granular Soils VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense, VD - Very Dense	Cohesive Soils VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard







BOREHOLE LOG

MONITORING WELL MW02

ENVIRONMENTAL-GROUNDWATER

Page 1 of 1

Client Northern Beaches Council	Drill Co. Terratest	Easting, Northing .
Project Manly Vale Groundwater monitoring	Driller Dave	Grid Ref GDA94_MGA_zone_48
Project No. 2126852	Rig Type Geoprobe	Elevation
Site Lot 1-4 Addiscombe Road, Manly Vale	Drill Method Push Tube	Collar RL 0
Location Lot 1-4 Addiscombe Road, Manly Vale	Total Depth (m) 3	Logged By Ashleigh Neil
Date Drilled 31/10/2017 - 31/10/2017	Diameter (mm) 150	Checked By Stefan Charteris

B.C.L No. N/A		Casing PVC (Class 18)			Screen 0.5mm Slotted PVC (Class 18)		Surface Completion Gatic				
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
0.5	PT						Silty SAND, fine to medium, dark grey-brown (NATURAL - SOIL)	VM		No staining, no odour	-0.5
1											-1
1.5											-1.5
2											-2
2.5											-2.5
3						Termination Depth at: 3.00 m. Target depth achieved.				-3	
3.5											-3.5
4											-4
4.5											-4.5
5											-5
5.5											-5.5
6											-6
6.5											-6.5
7											-7
7.5											-7.5
8											-8
8.5											-8.5
9											-9
9.5											-9.5

Notes

GHD Soil Classifications The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Push tube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	Granular Soils VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense, VD - Very Dense	Cohesive Soils VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard



BOREHOLE LOG

MONITORING WELL MW03

ENVIRONMENTAL-GROUNDWATER

Page 1 of 1

Client Northern Beaches Council Project Manly Vale Groundwater monitoring Project No. 2126852 Site Lot 1-4 Addiscombe Road, Manly Vale Location Lot 1-4 Addiscombe Road, Manly Vale Date Drilled 31/10/2017 - 31/10/2017	Drill Co. Terratest Driller Dave Rig Type Geoprobe Drill Method Push Tube Total Depth (m) 5 Diameter (mm) 150	Easting, Northing . Grid Ref GDA94_MGA_zone_48 Elevation Collar RL 0 Logged By Ashleigh Neil Checked By Stefan Charteris
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B.C.L No.		N/A		Casing		PVC (Class 18)		Screen		0.5mm Slotted PVC (Class 18)		Surface Completion		Gatic	
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)				
0.5	PT				Grout		SAND, fine to medium, dark brown (FILL)	SM	L	Fill contains ACM and rubbish	-0.5				
1					Sand						-1				
1.5					Bentonite						-1.5				
2											-2				
2.5							Silty SAND, fine to medium, dark grey- brown (NATURAL - SOIL)	VM		No odour no staining	-2.5				
3											-3				
3.5					Backfill						-3.5				
4											-4				
4.5											-4.5				
5							Termination Depth at: 5.00 m. Target depth achieved.				-5				
5.5											-5.5				
6											-6				
6.5											-6.5				
7											-7				
7.5											-7.5				
8											-8				
8.5											-8.5				
9											-9				
9.5											-9.5				

Notes

GHD Soil Classifications The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations

AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Push tube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler

Moisture Abbreviations

D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated

Consistency Abbreviations

Granular Soils VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense, VD - Very Dense

Cohesive Soils VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard



Drilling & piezometer installation log

WRL Project : 17023

Date drilled : 30/3/17

1215pm

Location :

WALKING TRACK BEHIND
ATKIE ADDISCOMBE RD

Drilled by: TIGHTSIDE

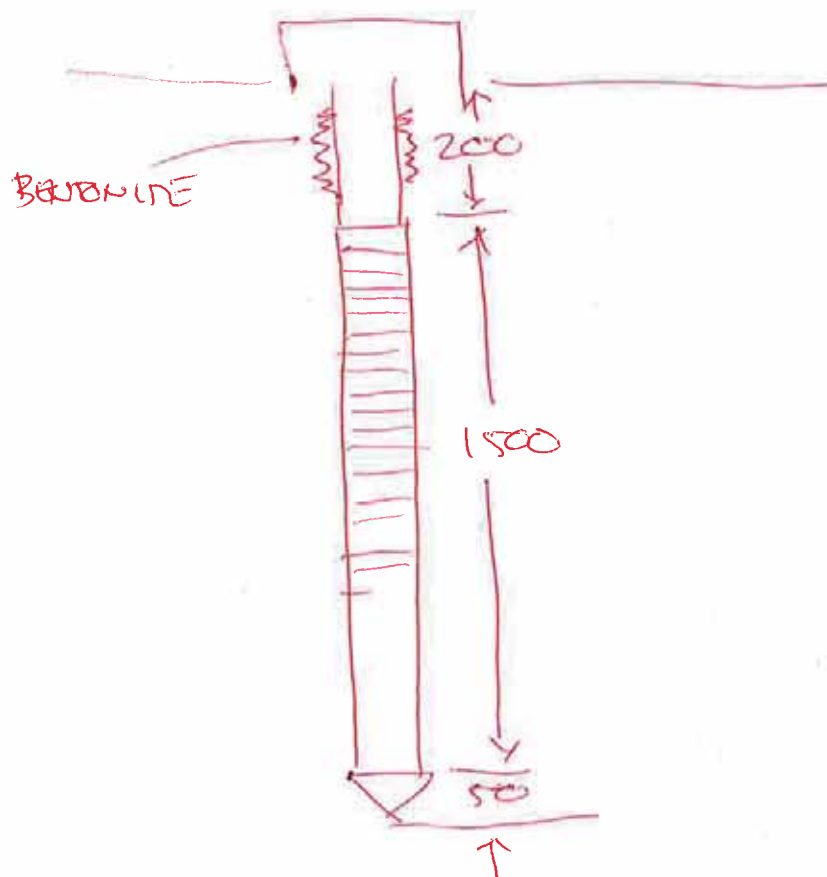
Bore/piezo no.:

ML20

CONTAMINATED

Logged by: DSR

Depth (m)	Thickness (m)	Lithology & grain size	Textural maturity (eg. sorting, angularity)	Colour (Munsell chart)	Bore/piezo completion details (eg. PVC class, diameter, screen length, depth, sump, bentonite depth, gravel pack depth, yield, moisture observed)
		UNDER CARBONATES. 8m FROM LAGOON			E N Z SWL = 0.13 TOP OF PVC
0-500		DARK BROWN SANDY SILTY LOAM - TOPSOIL. ROOTS. GRAVELS. DRY			ML20-1
500-700		BROWN SAND LARGE ROOTS MOIST			ML20-2
700-900		DARK BROWN/BLACK. COMPACTED SILT/CLAY. NO PLASTICITY. DRY. FINE ROOTS. HISTORICAL SURFACE?			ML20-3
900-2500		LIGHT BROWN/GREY SAND POORLY SORTED. WET. LOOSE.			ML20-4





Drilling & piezometer installation log

WRL Project : 2017023 - MANLY LAGOON

Date drilled : 30/3/17 1400

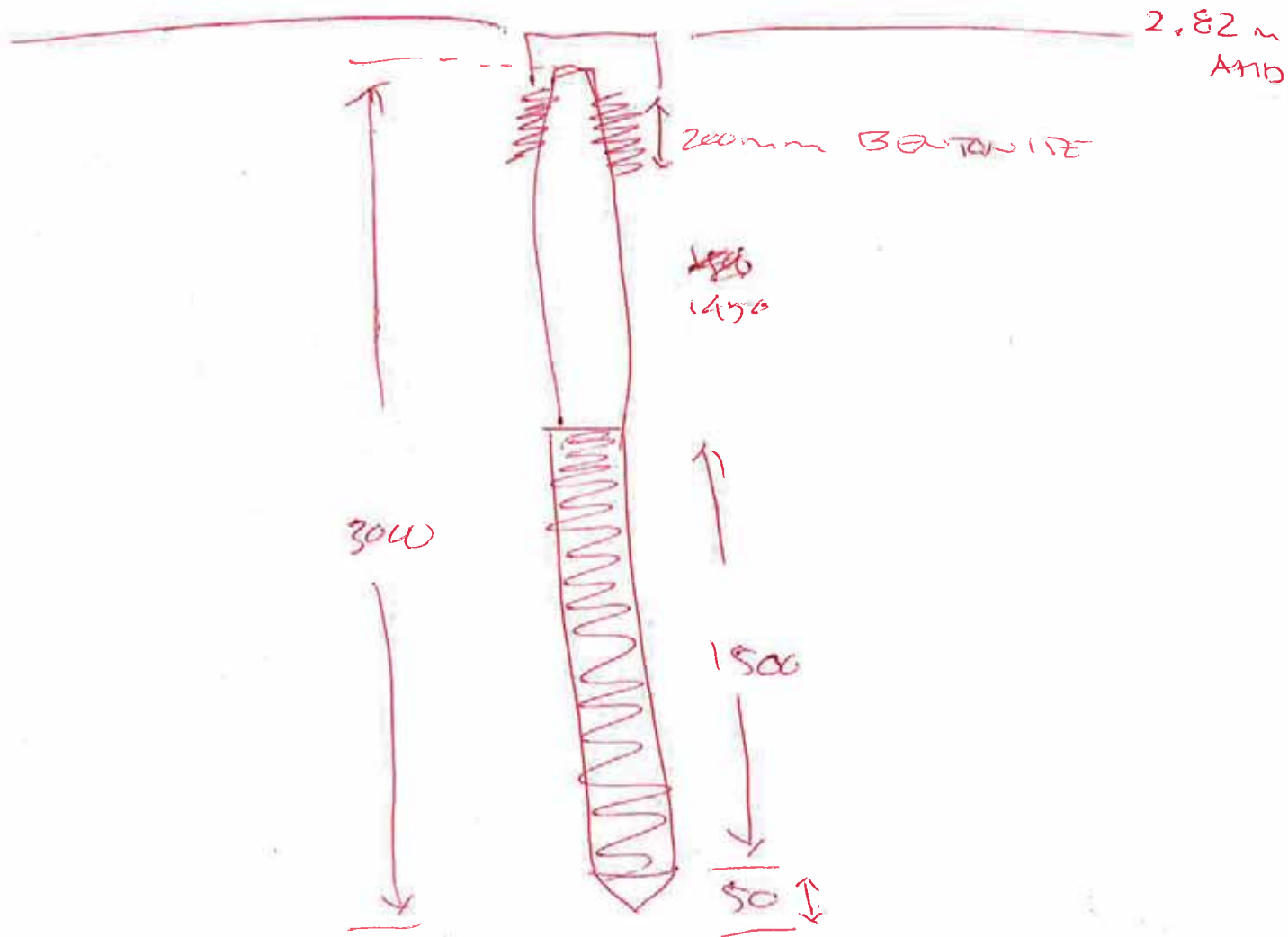
Location : ADDISCOMBE RD

Drilled by: TIGHTSITE

Bore/piezo no.: ML21

Logged by: DUNCAN

Depth (m)	Thickness (m)	Lithology & grain size	Textural maturity (eg. sorting, angularity)	Colour (Munsell chart)	Bore/piezo completion details (eg. PVC class, diameter, screen length, depth, sump, bentonite depth, gravel pack depth, yield, moisture observed)
GRASS, OPEN SKY 40m FROM LAGOON					E = 340279.333 N = 6260503.097 Z = 2.819 SWL = 1.42m TOP OF PVC
0-1700		FILL, DARK BROWN SANDY GRAVEL COBBLES, HOUSEHOLD WASTE (GLASS ETC) (ben)		10y2 3/3	ML21-1
1700-3300		GREY BROWN SAND POORLY SORTED WET, LOOSE, ROOTS/ORGANICS @ 3000m		10y2 4/3	ML21-2



Appendix I – Council annual report on sparrow picking and fence repairs

Appendix B – Before and after fence repair

Perimeter of Fencing (in yellow)



Fencing to be repaired (identified by letters which appear in the map)

Part A



Part B



Part C



Part D



Part E



Part F



Part G



Part H



Part I



Part J



Part K



Part L



Part M



Part N



Map showing location of fence sections to be repaired



Repaired Fencing

Part A



Part B



Part C



Part D



Part E



Part F



Part G



Part H



Part I



Part J



Part K



Part L-M



Part N



Ulli Manuel

TRIM: 2020/493473

Project Officer
Contaminated Sites, NSW EPA
(02) 9995 5611
ulli.manuel@epa.sw.gov.au

Dear Ulli,

RE: 1-4 Addiscombe Road, Manly Vale NSW

Thank you for your ongoing support regarding the site management of Lots 1-4 Addiscombe Road, Manly Vale NSW. As per the approved Voluntary Management Proposal (approval no. 20191721) Council has employed a licenced contractor to conduct monthly visual checks of PACM, with removal and disposal if found of the informal pathway connecting Campbell Parade with Addiscombe Road through the contaminated site.

Monthly sparrow picking of the pathway eliminates the pathway – receptor linkage, thereby reducing potential health impacts on receptors using the informal pathway as thoroughfare between Campbell Parade and Addiscombe Road. Council's environment officer from the Coast and Catchments team have confirmed the robustness and removal of asbestos from the licenced contractor by attending bi-monthly site visits.

Please see Appendix A as a confirmation of the visual checks and removal by the licenced contractor and the locations of asbestos along the pathway. Although the contractor was engaged in April 2019 Council has requested the reports from this time onwards. However, we have been unsuccessful in retrieving reports prior to March 2020 due to staff movement within the contracted company. The contractor has agreed to provide regular monthly reports moving forward.

Monitoring of the fence showed that it needed repair in a number of locations. This was carried out earlier this year to prevent access to the large portion of the site. Appendix B shows the before and after of the fence repair.

Please note that Council will be addressing the presence of asbestos on the informal pathway and restricted access to the fenced off portion of the site as part of the management actions in the Interim Site Management Plan which will be delivered to the EPA in December 2020.

Please feel free to contact me on 0468 596 329 or rachael.cook@northernbeaches.nsw.gov.au should you wish to discuss further.

Kind Regards,



Rachael Cook
Environment Officer – Coast and Catchments
Northern Beaches Council
24th August 2020



Integrated Management System

FRM_048 Asbestos removal confirmation letter



Appendix A – Asbestos Removal

March 2020
Northern Beaches Council

Reference: Addiscombe Road

Dear Stephen,

In accordance with your instructions, Eminent Waste has carried out the 'sparrow pick' to remove all visible surface ACM (asbestos containing material) from the area nominated at the above site.

The works have been completed & a visual inspection of the area was conducted. We are satisfied that all visible ACM has been removed & safely disposed of to an EPA approved waste facility. Please refer to the accompanying photographs of the cleared area located in appendix A.

Please note that this letter is not a Clearance Certificate in accordance with Section 3.10 of the Code of Practice: How to Safely Remove Asbestos [Safe Work Australia, 2018] or under Section 474 of the Work Health and Safety Regulation 2017. It is a letter to confirm the removal & process. This is a visual inspection only, conducted by a competent person.

Should you have any queries regarding this letter of confirmation, please contact the undersigned.

Kind Regards,

Lee Mulreay
Project Manager
Eminent Waste Pty Ltd
P: 02 9318 1833
M: 0406 902 567
W: www.atr.com.au



Integrated Management System

FRM_048 Asbestos removal confirmation letter





Integrated Management System

FRM_048 Asbestos removal confirmation letter



20/4/20

Northern Beaches Council

Reference: LM Graham Reserve, Curl Curl Dog Park & Addiscombe Rd- 13th April 2020

Dear Stephen,

In accordance with your instructions, Eminent Waste has carried out the 'sparrow pick' to remove all visible surface ACM (asbestos containing material) from the areas nominated the above.

The works have been completed & a visual inspection of the area was conducted. We are satisfied that all visible ACM has been removed & safely disposed of to an EPA approved waste facility. Please refer to the accompanying photographs of the cleared area located in appendix A.

Please note that this letter is not a Clearance Certificate in accordance with Section 3.10 of the Code of Practice: How to Safely Remove Asbestos [Safe Work Australia, 2018] or under Section 474 of the Work Health and Safety Regulation 2017. It is a letter to confirm the removal & process. This is a visual inspection only, conducted by a competent person.

Should you have any queries regarding this letter of confirmation, please contact the undersigned.

Kind Regards,

Steve Hardy

LM Graham Reserve



Only few small pieces asbestos found outside green keepers shed & toward aquatic centre just outside of field barrier.



Integrated Management System

FRM_048 Asbestos removal confirmation letter



Curl Curl Dog Park



10kg glass picked alongside path & few areas in Dog Park. Also sandy patches in front of lagoon. Approx. 200/300g asbestos found spread over all areas

Addiscombe Rd



Few small pieces of asbestos found at start of track the rest in middle section of pathway. 300g worth of fragments spread along track.



Integrated Management System

FRM_048 Asbestos removal confirmation letter



25/5/20

Northern Beaches Council

Reference: LM Graham Reserve, Curl Curl Dog Park & Addiscombe Rd- 18th May 2020

Dear Stephen,

In accordance with your instructions, Eminent Waste has carried out the 'sparrow pick' to remove all visible surface ACM (asbestos containing material) from the areas nominated the above.

The works have been completed & a visual inspection of the area was conducted. We are satisfied that all visible ACM has been removed & safely disposed of to an EPA approved waste facility. Please refer to the accompanying photographs of the cleared area located in appendix A.

Please note that this letter is not a Clearance Certificate in accordance with Section 3.10 of the Code of Practice: How to Safely Remove Asbestos [Safe Work Australia, 2018] or under Section 474 of the Work Health and Safety Regulation 2017. It is a letter to confirm the removal & process. This is a visual inspection only, conducted by a competent person.

Should you have any queries regarding this letter of confirmation, please contact the undersigned.

Kind Regards,

Steve Hardy

APPENDIX A

LM Graham Reserve



Only a few small pieces asbestos found around corner of field near green keepers shed



Integrated Management System

FRM_048 Asbestos removal confirmation letter



Curl Curl Dog Park



200g asbestos found spread well apart over Dog Park & lagoon. 15kg glass mix steel & rubbish picked from sandy areas of park & front of lagoon

Addiscombe Rd



Handful of small asbestos fragments found at start and finish of pathways. Mostly in areas crushed tile & glass exposed



Integrated Management System

FRM_048 Asbestos removal confirmation letter



Northern Beaches Council

Reference: LM Graham Reserve, Curl Curl Dog Park & Addiscombe Rd- 23rd June 2020

Dear Stephen,

In accordance with your instructions, Eminent Waste has carried out the 'sparrow pick' to remove all visible surface ACM (asbestos containing material) from the areas nominated the above.

The works have been completed & a visual inspection of the area was conducted. We are satisfied that all visible ACM has been removed & safely disposed of to an EPA approved waste facility. Please refer to the accompanying photographs of the cleared area located in appendix A.

Please note that this letter is not a Clearance Certificate in accordance with Section 3.10 of the Code of Practice: How to Safely Remove Asbestos [Safe Work Australia, 2018] or under Section 474 of the Work Health and Safety Regulation 2017. It is a letter to confirm the removal & process. This is a visual inspection only, conducted by a competent person.

Should you have any queries regarding this letter of confirmation, please contact the undersigned.

Kind Regards,

Steve Hardy

LM Graham Reserve



A few small pieces asbestos found around corner of field near green keepers shed



Integrated Management System

FRM_048 Asbestos removal confirmation letter



Curl Curl Dog Park



200-300g asbestos found spread well apart over Dog Park & lagoon. 20kg glass & rusted metal from various areas in park & sand in front of lagoon.

Addiscombe Rd



A few small asbestos fibro pieces. A syringe. Mostly in areas crushed tile & glass exposed.



Integrated Management System

FRM_048 Asbestos removal confirmation letter



Northern Beaches Council

Reference: LM Graham Reserve, Curl Curl Dog Park & Addiscombe Rd- 29th July 2020

Dear Stephen,

In accordance with your instructions, Eminent Waste has carried out the 'sparrow pick' to remove all visible surface ACM (asbestos containing material) from the areas nominated the above.

The works have been completed & a visual inspection of the area was conducted. We are satisfied that all visible ACM has been removed & safely disposed of to an EPA approved waste facility. Please refer to the accompanying photographs of the cleared area located in appendix A.

Please note that this letter is not a Clearance Certificate in accordance with Section 3.10 of the Code of Practice: How to Safely Remove Asbestos [Safe Work Australia, 2018] or under Section 474 of the Work Health and Safety Regulation 2017. It is a letter to confirm the removal & process. This is a visual inspection only, conducted by a competent person.

Should you have any queries regarding this letter of confirmation, please contact the undersigned.

Kind Regards,

Steve Hardy

LM Graham Reserve



Integrated Management System

FRM_048 Asbestos removal confirmation letter



A few small pieces asbestos found around corner of field near green keepers shed as usual



Integrated Management System

FRM_048 Asbestos removal confirmation letter



Curl Curl Dog Park



Only few pieces of asbestos found spread apart. Approx. 25kg glass & rusty metal picked threw out usual dry patches of Dog Park & in front of lagoon.

Addiscombe Rd



Integrated Management System

FRM_048 Asbestos removal confirmation letter



Approx. 500g asbestos picked spread far apart mostly from pathway & embankment next to the bark piles.
Heavy weather would have exposed majority.

Council PACM & Fence Condition Checking

Month	Bi-monthly Asbestos Check	Monthly Fence Check	Responsibility
September	N/A	Fence okay	Rachael Cook – Environment Officer, Coast and Catchments
October	Glass present on path near embankment, contractor notified for monthly removal	Fence okay	Rachael Cook – Environment Officer, Coast and Catchments
November	N/A	Fence okay, weeds dominating some fence areas	Rachael Cook – Environment Officer, Coast and Catchments
December	No asbestos seen during visit	Fence okay, weeds dominating some fence areas. Contractors sprayed weeds on fence next to pathway.	Rachael Cook – Environment Officer, Coast and Catchments
January	N/A	Fence okay, tree branches starting to dominate a few fence areas	Rachael Cook – Environment Officer, Coast and Catchments
February	No asbestos seen during visit	Poor, damage in some locations	Rachael Cook – Environment Officer, Coast and Catchments
March	N/A	Poor, damage in some locations	Rachael Cook – Environment Officer, Coast and Catchments
April	Small amount on path, contractor notified for scheduled removal	Poor, damage in some locations. Council starts requests for Contractor to repair fencing	Rachael Cook – Environment Officer, Coast and Catchments
May	N/A	Poor, damage in some locations. Contractor engaged to repair fencing	Rachael Cook – Environment Officer, Coast and Catchments
June	Small amounts of glass, contractors notified for scheduled removal	Fence repaired in damaged sections	Rachael Cook – Environment Officer, Coast and Catchments
July	N/A	Good condition	Rachael Cook – Environment Officer, Coast and Catchments
August	Small amount of asbestos seen during visit, contractor notified for monthly removal	Good condition	Rachael Cook – Environment Officer, Coast and Catchments

Appendix J – Example inspection report

The purpose of the Inspection Report is to maintain a record of inspections undertaken on the site and to record the results of the inspections, including a record of any corrective actions that are required.

The Inspection Report is required to be completed by the site owner (or suitable representative) following completion of the inspection.

Inspection report

Date initiated	
Time	
Inspector (Name and Signature)	
Site area	
Observations	
Problems noted (if any)	
Reported to (name and role):	
Corrective action recommended	
Verified by property Manager upon completion:	
Feedback response to prevent future occurrences	
Date closed	

Appendix K – Management actions checklist

Management category	Management action ¹	Time frame ¹	Action completed?
Current Council actions/ programs	Sparrow picking program as per the VMP (Northern Beaches Council, 2019) ²	'Bi-monthly' (understood by GHD to be every second month) by the site owner. Monthly by a licensed contractor.	Ongoing
Immediate actions	Restricting access to shallow soils of recreational area (either fencing or ground cover)	Completed within one year of endorsement of the ISMP by the site Auditor.	
	Restricting access to shallow soils of footpath area (ground cover)	Completed within one year of endorsement of the ISMP by the site Auditor.	
	Embankment area initial inspection, additional cover and documentation.	Completed within one year of endorsement of the ISMP by the site Auditor.	
	Install site signage	Completed within one year of endorsement of the ISMP by the site Auditor.	
Interim environmental monitoring program	Baseline soil monitoring and well installation	Completed within one year of endorsement of the ISMP by the site Auditor.	
	Groundwater monitoring	Quarterly per year following endorsement of the ISMP by the site Auditor.	Ongoing
	Surface water monitoring	Quarterly per year following endorsement of the ISMP by the site Auditor.	Ongoing
	Landfill gas monitoring	Every second month in first year, then once per 6 month period in the following years following endorsement of the ISMP by the site Auditor.	Ongoing
Routine inspection and maintenance	Fence inspection and maintenance (as per routine inspection and maintenance)	Monthly	Ongoing
	Sediment fence maintenance	Once per six months	Ongoing
	Ground cover and vegetation inspection	Every second month for a period of 6 months after completion of the covering works in each area. After the initial 6 months, annual inspections should be undertaken.	Ongoing
	Environmental monitoring infrastructure maintenance	Every groundwater and landfill gas monitoring event	Ongoing
	Subsurface works	As required	Ongoing

Table notes:

1 – Management actions and timeframes listed in this table are a summary of the main report, and should be read in conjunction with the relevant sections.

2 – Frequency of sparrow picking program may be reduced once restricting access to shallow soils of footpath area has been completed.

Appendix L – Groundwater triangulation report



Northern Beaches Council

Lot 1-4 Addiscombe Road, Manly Vale

Works specification for triangulation of groundwater elevation

March 2020

This document is in draft form. The contents, including any opinions, conclusions or recommendations contained in, or which may be implied from, this draft document must not be relied upon. GHD reserves the right, at any time, without notice, to modify or retract any part or all of the draft document. To the maximum extent permitted by law, GHD disclaims any responsibility or liability arising from or in connection with this draft document.

WATER | ENERGY & RESOURCES | ENVIRONMENT | PROPERTY & BUILDINGS | TRANSPORTATION

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Appendices

Appendix A - Figures

Appendix B – Example groundwater gauging sheet

1. Introduction

1.1 Overview

Northern Beaches Council (Council) owns a former landfill site located at Lots 1-4 Addiscombe Road, DP 818957, Manly Vale (the site). Council has been managing this site as a contaminated site since 2000 and they have been in contact with the NSW Environmental Protection Authority (EPA) over this period.

GHD conducted groundwater monitoring of five groundwater wells every two months for a year in 2017. The groundwater assessment report (GHD 2018) noted, based on the observed site and regional topography, that it was likely that groundwater in the local area is discharging into Manly Creek and Manly lagoon. However, it was also noted that the groundwater monitoring locations assessed by GHD were in a single line along the eastern site boundary and were unable to characterise the groundwater flow direction. A subsequent recommendation of the report was that Council consider triangulation of groundwater monitoring points, and survey existing monitoring wells to confirm groundwater flow directions.

After the groundwater assessment, a Voluntary Management Proposal (VMP) for the site was prepared by Council (2019) and approved by EPA, subject to the conditions outlined in its letter of 2/10/2019. GHD were engaged by Council to supply two components of the VMP, which included:

- Development of an Interim Site Management Plan (ISMP) – documented separately to this report.
- Development of a specification to triangulate groundwater across the site – provided in this report.

1.2 Purpose

The purpose of this document is to provide a work specification that outlines how groundwater triangulation investigations should be undertaken and to address the requirements of the VMP relevant to groundwater triangulation studies.

1.2.1 Scope of works

Specifically, this document aims to provide the following:

- Briefly summarise the relevant site environmental and hydrogeological conditions.
- Outline a possible methodology and potential timing for site investigations of triangulated groundwater flow directions.
- Provide an indicative itemised budget for the completion of the relevant studies.

1.3 Limitations

The content of this report is subject to the limitations and assumptions outlined throughout the report and in Section 6.

2. Site information

2.1 Site identification

The site is adjacent to Manly Creek and is approximately 1 km upstream of Manly Beach. The site identification details are summarised in Table 2-1, and the site is shown on Figure 1, Appendix A.

Table 2-1 Site identification details

Item	Description
Street Address	Addiscombe Road, Manly Vale NSW 2093
Certificate of Title Details (Vol/Folio) and Parcel/Lot Number	Lots 1-3, DP818957 Lot 4 (known as former lot 4) has been merged with the road reserve and is not to be included in the investigation as it's no longer incorporated within the DP818957 plan area.
Owner	Lots 1 & 2 are Council owned allotments, and Lot 3 is owned by the NSW Office of Land & Water.
Site Zoning	Zone RE1 – Public Recreation (Manly Local Environmental Plan 2013).
Current Use	Portion of the area is a public park and foot path, with the remainder as fenced, vacant land (noting that the fence is of varying states of condition).

A sewer line and a path exist along the eastern boundary of site, which is used by local residents as a thoroughfare between Campbell Parade to the north, and Addiscombe Road to the south. Push bike riders, school children, walkers and dog walkers frequently use the area. A portion of the site is fenced to prevent public access.

Vegetation along the commonly used eastern boundary of the site consists of grassed areas, small to large shrubs and small to large trees. Most of the site is fenced off from the public and is covered by a variety of grasses, vines, shrubs and trees.

2.2 Summary of site history

The following record of site history is obtained from various environmental reports prepared for the site (1991–2008) and Addiscombe Road, Manly Vale Site History (DPWS 2001).

- Between 1914 and 1917, Council operated the site as a rubbish tip that included a garbage incinerator. Available information suggests that the incinerator was located in the south-west portion of the site and that waste from the incinerator was disposed of at the tip.
- Rubbish continued to be disposed of at the Addiscombe Road tip until the 1950s. Due to the period of waste disposal on site, there is potential for per- and polyfluoroalkyl substances (PFAS) to be present on site.
- In 2004, the EPA declared the area a “remediation site” under section 21 of the Contaminated Land Management Act 1997.
- The site has remained predominantly unused since at least 2006, with small areas of the site used over the previous years as a Naval Cadets training facility and as a joinery works.
- A series of environmental investigations were undertaken between 2002 and 2018, including the GHD groundwater assessment (GHD, 2018).
- Subsequently, a Voluntary Management Proposal (VMP) for the site was recently prepared by Council and approved by EPA (subject to the conditions outlined in its letter of 2/10/2019). GHD notes that the EPA requires Auditor endorsement of the ISMP.

The surrounding areas have historically been used for farming and residential purposes while more recently being used for commercial, industrial and residential purposes.

2.3 Environmental setting

The environmental characteristics of the site are summarised in Table 2-2.

Table 2-2 Local environmental characteristics of the site

Characterising	Details
Topography	The topography of the site includes a high point in the middle of the site with gentle slopes downwards to the north, south, east and west. A steep downwards slope from the path to the river was noted (the embankment). PB (2008a) reported elevation levels on site to be 0.5 – 10 mAHD.
Hydrology	The nearest surface water feature is Manly Creek, located directly adjacent to the eastern boundary of the site. Generally the creek flows in a south-easterly direction towards Manly Lagoon and Manly Beach, however it is noted to be somewhat tidal and the flow rate would vary depending on the height of the tidal variations.
Geology	<p>The Sydney Geological Series Sheet S1/56-5, 1:250,000 (1966) indicates that the site is underlain by Hawkesbury Sandstone and alluvial sediments potentially including gravel, sand, silt and clay.</p> <p>During drilling and groundwater well construction in 2016 (primarily undertaken on the eastern site boundary), the following geology was encountered:</p> <ul style="list-style-type: none"> • Sand fill from approximately 0 m below ground level (m bgl) to a maximum of 2.3 m bgl. • Silty sand (natural sediments) to 5 m bgl (maximum depth of wells installed). <p>Investigations by PB (2008) undertaken across the central portion of the site indicate the presence of fill (including waste) located at depths ranging between 0.15 m bgl and 5 m bgl.</p>
Hydrogeology	<p>Groundwater at the site was observed at approximately 0.6 m to 2.6 m below top of casing (m bTOC, MW13 and MW03 respectively) by GHD between 2016 and 2020.</p> <p>The groundwater monitoring wells have not been surveyed, such that groundwater elevations and groundwater flow direction cannot be determined. PB (2008) inferred that shallow groundwater flow at the site is to the northeast towards Manly Creek. Given site topography and the presence of Manly Creek, GHD concurs with PB's inference.</p> <p>The <i>1:2,000,000 Groundwater in New South Wales, Assessment of Pollution Risk Map</i> indicates that Manly Vale area is likely to be underlain by alluvial and other unconsolidated deposits with moderate to high potential for groundwater movement. The map also indicates that groundwater salinity is likely less than 1,000 mg/L, which is suitable for stock, domestic and some irrigation purposes.</p> <p>Further discussion of groundwater conditions is provided in Section 2.4.</p>

Characterising	Details
Registered bores	<p>A groundwater bore search was completed by GHD on 2 October 2018. A review of the Department of Primary Industries All Groundwater Data Map, accessed in October, indicates that there are 15 registered groundwater bores within a 500 m radius of the site. These bores are used for domestic, irrigation and recreational purposes. The closest well is approximately 53 m east from the site, and was noted to have a depth of approximately 6 m bgl. Given the presence of Manly Creek, it is unlikely that the groundwater monitored at the site would reach any of these extraction bores unless significant volumes of water were being extracted. Manly Creek represents a constant head boundary, and is likely to be drawn preferentially to extraction wells.</p> <p>Eighteen groundwater monitoring bores were installed at the site prior to 2017, nine of which are known to have been destroyed or lost (PB, 2008b). The remaining nine bores were not located by GHD during a site inspection in 2017, however three were located in January 2020 (BH1, S6 and S10). Five additional monitoring bores were installed by UNSW Water Research Laboratory (WRL) and GHD in 2017.</p>

2.4 Summary of groundwater conditions

GHD conducted groundwater monitoring of five groundwater wells every two months for a year in 2017 (GHD, 2018). A summary of groundwater conclusions and recommendations made are provided below (noting that further discussion is provided in GHD, 2018 regarding other environmental factors at the site):

- Standing groundwater was encountered between 0.55 m bTOC (MW13, also known as ML20) and 2.58 m bTOC (MW14, also known as ML21) over the monitoring period.
- The groundwater level at each location appears to be relatively stable over time, with the exception of MW14. This monitoring location is further away from Manly Creek compared to the remaining monitoring locations, and was noted to frequently be purged dry during groundwater sampling. Based on bore logs provided by the Council, monitoring location MW14 was installed into the waste profile. It is therefore likely that groundwater at MW14 is highly influenced by subsurface heterogeneity and is possibly more impacted by rainfall events than the remaining locations. This is supported by relatively low EC readings at MW14.
- Based on the observed site and regional topography, it is likely that groundwater in the local area flows east and is discharging into Manly Creek. Field EC readings indicated that groundwater at the eastern site boundary is brackish. This suggests that there may be mixing of fresher groundwater with seawater, possibly due to tidal influences. The linear nature of the groundwater monitoring network and the absence of survey data means that the gauged standing water levels measured during the groundwater monitoring program cannot be used to assess groundwater flow directions at the site.
- The concentration of a number of analytes (including polycyclic aromatic hydrocarbons (PAHs), lead, nitrate, chromium, zinc, copper, ammonia, and cadmium) exceeded the adopted human health and/or ecological criteria (primarily NEPM and ADWG/NHMRC guidelines). The following is noted:

- It is considered unlikely that these exceedances pose a risk to human health due to the general lack of receptors in the vicinity of the site. Further signage around Manly Creek and Manly Lagoon to prevent people from using it for recreational purposes was recommended.
- Exceedances of ecological assessment criteria (NEPM GILs fresh and marine), protective of marine and freshwater aquatic ecosystems may indicate a risk to ecology from site contamination. Up-gradient groundwater monitoring wells were recommended to be installed, to determine if the concentrations are indicative of site contamination or background concentrations.
- The Mann-Kendall test was performed to evaluate the trend of selected contaminants. Based on the annual period of monitoring completed, statistically significant increasing trends were calculated for ammonia, copper, lead and zinc, and a downward trend was calculated for phosphate. It is noted that these trends may not be statistically significant on a longer term basis when more climatic stressors are included.

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3. Groundwater triangulation method

The aim of groundwater triangulation is to confirm:

- Groundwater flow direction across the site, and subsequently confirm whether dissolved phase contaminants from the former landfill are likely to be migrating from the site towards Manly Creek.
- That the primary source of contaminants identified in groundwater wells along the eastern site boundary is the former landfill and not background levels or contaminants migrating onto the site from possible up gradient sources (such as the commercial area, gun range or Manly Creek – depending on groundwater flow direction).

To achieve these aims, GHD recommends undertaking the following:

1. Installation of three groundwater wells around the perimeter of the site and two groundwater wells within the waste footprint.
2. Survey of new / existing groundwater wells, and of Manly Creek water levels at predicted high/low tides to convert standing water measurements to elevations.

Further details on these tasks (including anticipated time frames) are provided in Sections 3.1 and 3.2 respectively, and the associated estimated costs are outlined in Section 4. GHD has assumed that Council would engage an environmental consultant (the Consultant) to assist in undertaking the works outlined.

GHD notes that analysis of groundwater elevation data from loggers previously installed by Council in MW13 and MW14 would provide an indication of variation in groundwater flow directions due to tidal/storm surge effects on water levels in Manly Creek, which would further inform contaminant flux to Manly Creek. Additionally, analysis of surface water samples collected adjacent to the site for contaminants of potential concern (COPC) may also provide further information for management of potential contamination emanating from the site.

3.1 Groundwater well installation

3.1.1 Guidelines

Installation of groundwater monitoring wells and subsequent groundwater gauging should be undertaken in accordance with the relevant sections of the following guidelines¹:

- NPEC, 2013. *National Environment Protection (Assessment of Site Contamination) Measure* (NEPM) 1999, amended 2013.
- National Uniform Drillers Licensing Committee (NUDLC), 2012. *Minimum Construction Requirements for Water Bores in Australia*. 3rd Edition.
- NSW Department of Environment and Conservation NSW, 2007. *Guidelines for the Assessment and Management of Groundwater Contamination*.
- NSW EPA, 2014. *Waste Classification Guidelines*.
- NSW EPA, 2016. *Environmental Guidelines – Solid waste landfills*. 2nd Edition.
- Victoria EPA, 2006. *Hydrogeological Assessments (Groundwater Quality) guidelines*. Publication No: 668.
- Victoria EPA, 2000. *Groundwater sampling guidelines*. Publication No: 669

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¹ Alternative methods may be possible subject to agreement with Council

3.1.2 Investigation locations

Five monitoring wells are recommended to enable adequate delineation of groundwater across and up-gradient of the site. The anticipated monitoring locations are shown on Figure 1, Appendix A. Existing bores are also shown on Figure 1 for reference. The proposed locations have been radially placed around and on the site to enable identification and assessment of groundwater 'mounding', which commonly occurs in landfills.

The bores have nominally been named BH101 to BH105, and have been included in the method specification for the following reasons:

- BH101 – triangulate and characterise groundwater up gradient of the site. The location is noted to be off-site within the Manly Vale Business Park, and immediately adjacent to identified receptors (commercial). GHD considered it impractical to drill this location within the site boundary due to dense vegetation and undulating topography in the north-western portion of the site.
- BH102 - triangulate and characterise groundwater up gradient of the site. The location is noted to be off-site within the Manly Vale Business Park. GHD considered it impractical to drill this location within the site boundary due to dense vegetation and steep topography in the south-western portion of the site.
- BH103 – characterise groundwater at the source, and enable assessment of standing water/leachate levels within the southern portion of the landfill.
- BH104 - triangulate and characterise groundwater up gradient of the site. The location is also noted to be immediately adjacent to identified receptors (residential).
- BH105 - characterise groundwater at the source, and enable assessment of standing water/leachate levels within the northern portion of the landfill.

It is noted that proposed locations BH103 and BH105 within the site may not be required if suitable existing bores can be located and identified. Historic monitoring wells have been observed near the proposed locations. They were assumed to be BH1 and S6, however no identification number was observed on these wells to confirm this assumption. Additionally, no bore logs have yet been found for these locations to confirm their construction details (particularly total depth and screen interval). They have therefore been considered to be unsuitable for the purpose of this assessment at this stage.

3.1.3 Personnel

Groundwater well installation requires a specialised skill set. As such, personnel skilled in the installation and monitoring of groundwater wells should undertake or be present to oversee the works. It is recommended that the works be overseen by the nominated Consultant, in conjunction with a driller licenced to installed groundwater wells.

3.1.4 Health and safety, and access permissions

GHD recommends that the Consultant prepare a Safety Plan for the site, which will detail the Health, Safety and Environment (HSE) risks associated with the project, the control measures that will be implemented to manage health safety and environmental risks, procedures for managing occurrence of issues and personnel responsibilities.

To manage the risk of impacting underground utilities during the intrusive drilling works, the Consultant should undertake:

- A 'Dial Before You Dig' search for copies of publically available services plans.
- A review of any additional services plans provided by Council or private property owners.

Each drilling location should also be cleared of underground utilities by a professional cable locator that is Telstra accredited. If underground services are possible in the area in or around the proposed drilling locations, non-destructive drilling methods should be used to 1.0 m below ground level.

One of the proposed drilling locations is off-site in the adjacent commercial property (to the west, discussed in Section 3.1.2). The Consultant should contact 'Tower Holdings Proprietary Limited' (Tower Holdings) regarding any drilling to be undertaken at Manly Grove Business Park to identify and organise any relevant approvals and permits.

The Consultant will organise the approvals and permits required for drilling and installation of the groundwater wells. Preparation of HSE documents, liaison with Tower Holdings and completion of Dial Before You Dig search is estimated to take a minimum of 2 days (allowing time for search results to be returned to the Consultant). Clearance of underground utilities should be undertaken by an accredited service locator prior to drilling of the groundwater wells, but can be done as part of that phase of works and has therefore been included in Section 3.1.5.

The Consultant should take all reasonable precautions to minimise the potential for damage to underground services (via the use of a professional cable locator, the Dial Before You Dig search, as well as a site inspection and non-destructive drilling if needed).

3.1.5 Drilling and well installation

The Consultant will contract a driller to advance five boreholes, which will subsequently be converted into groundwater monitoring wells. Service locating will be undertaken by an accredited service locator on the day of and prior to drilling (as outlined in Section 3.1.4). Drilling and well installation works should be undertaken in accordance with the guidance outlined in Section 3.1.1, with the general process outlined below.

The Consultant should allow for these soil boreholes to be drilled to a maximum depth of 10 m bgl (or until groundwater is intercepted) using an appropriate drilling rig and method (such as solid flight augers on a track mounted Geoprobe drill rig, subject to driller's expertise) for the purposes of and subsequent conversion of these soil boreholes into groundwater wells. In the event that deeper groundwater characterisation is required, the Consultant should review the site conditions and geology, and liaise with Council to discuss the options and requirement for the assessment of deeper groundwater.

The groundwater monitoring wells should be constructed with 50 mm diameter class 18 threaded PVC pipe with factory slotted PVC screen. The screens will be isolated within a single geological strata encompassing the shallow aquifer system so that they are suitable for the purposes of groundwater assessment. Where possible, consideration of possible future landfill gas (LFG) monitoring should be considered in the screen interval design and use of 'ex-caps', which is further discussed in Section 3.4.

An example of a groundwater monitoring well design is shown in Figure 3-1 (NUDLC, 2012). Grout and bentonite pellets are shown to be used as backfill around the PVC pipe, which are necessary to ensure the geological layer being monitored remains isolated. Drilling spoil is not to be used as backfill. Additionally, it is essential to ensure that no contaminants are introduced that may affect any future monitoring or sampling results. The gravel pack should extend at least 0.3 m above the screen interval.

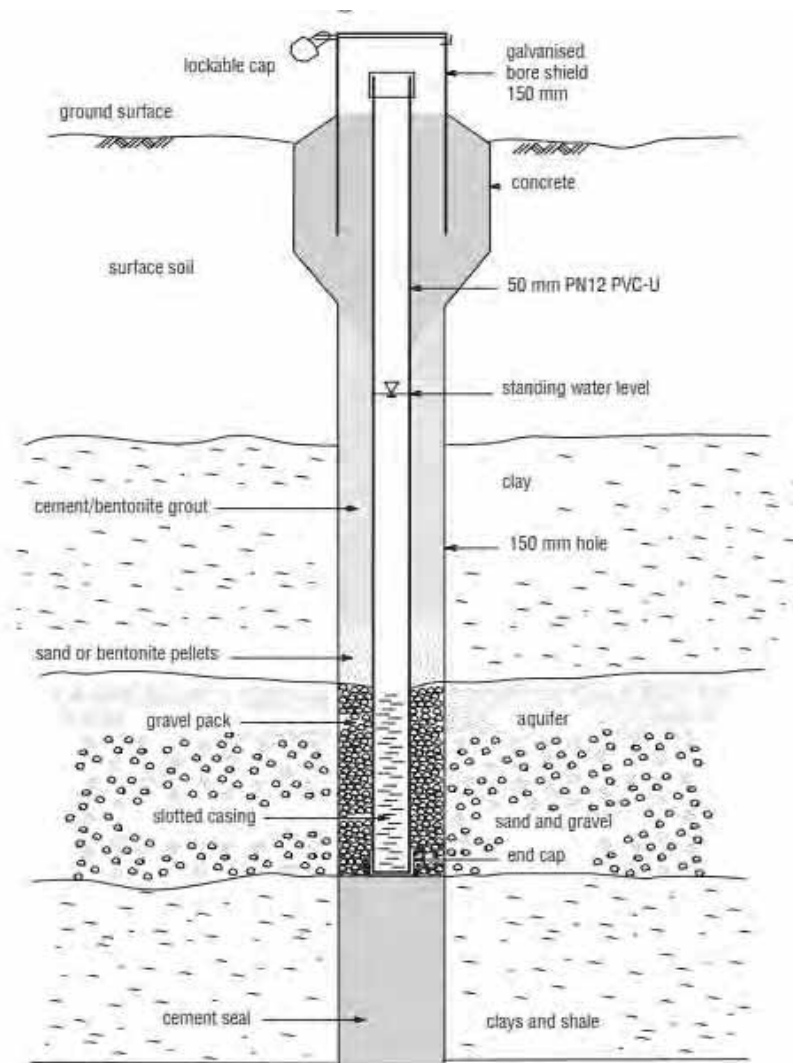


Figure 3-1 General design of a groundwater monitoring bore (NUDLC, 2012)

Groundwater wells will be completed using monument covers unless otherwise agreed with Council and Tower Holdings to protect the groundwater monitoring wells from damage. These wells will be long-term structures, and are likely to require ongoing maintenance to ensure they remain functional.

The drilling program would include the following:

- Soil logging of the boreholes by a trained and experienced Consultant to assess the underlying lithology and contaminant indicators, and generation of a bore log per location to document the lithology encountered and the well construction details. Soil logging should be done in general accordance with the Australian Standard AS 1726-2017 (Geotechnical Site Investigations).
- To aid in protection against possible health and explosive risks associated with landfills, appropriate gas monitoring will be undertaken by the drilling subcontractor and/or consultant during drilling.
- Development of the newly installed groundwater wells. Three well volumes (or until well becomes dry) should be purged per well and disposed of off-site to an appropriately licenced facility.
- Collection and analysis of samples of waste soil and waste water for the purpose of off-site waste disposal.

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It is expected that the drilling program (including the service clearance, drilling works, well installation and development) would take approximately three days to be completed. Waste classification and disposal timeframes are subject to receipt of analytical results from the laboratory and availability of the waste contractor. It is expected this process would occur over a two week period.

3.1.6 Groundwater gauging

The Consultant will conduct a round of groundwater gauging of the five newly installed wells (BH101 to BH105) and eight existing functional wells (MW01 to MW03, MW13, MW14, BH1, S6 and S10). This should be done at least 24 hours after well development of the newly installed groundwater wells (to allow for groundwater levels to stabilise) using an interface probe.

The Consultant should record the date, time, bore depth and water level in metres below top of casing (m bTOC). Additionally, use of an interface probe will enable the Consultant to measure and record the depth of any light non-aqueous phase liquid (LNAPL) that may be present in the wells. An example groundwater gauging record sheet is provided in Appendix B. Where possible, depth measurements should be recorded to the nearest 1 mm (i.e. 0.001 m). Any additional observations regarding odour or other characteristics should also be recorded.

The Consultant would arrange for all groundwater wells to be surveyed by a licenced surveyor while on site gauging the groundwater wells. The gauging and surveying is estimated to take a minimum of half a day. Further discussion of the surveying is provided in Section 3.2.

3.1.7 Decontamination

All reusable sampling equipment (i.e. drilling equipment and the interface probe) should be decontaminated prior and at completion of undertaking works at each location. Equipment should be cleaned using an appropriate method such as triple rinsing with tap and deionised water and/or use of an appropriate detergent.

3.1.8 Waste management

Waste will be generated by the site works and is anticipated to include:

- Spoil from drilling works (estimated to be approximately one 200 Litre drum).
- Groundwater waste (estimated to be approximately two 200 Litre drums).

The Consultant should arrange for temporary storage at the site of the waste generated. The Consultant will discuss with Council a suitable storage location on site for the temporary of the drums.

Subsequent removal by an appropriately licensed waste contractor would occur once the waste soil and water have been appropriately characterised in accordance with NSW waste classification guidance by the Consultant, including the collection of at least one sample per media type (soil and water) for laboratory analysis. The costs for off-site disposal is subject to waste classification results. A provisional cost estimate has been included in Section 4, however this is likely to require confirmation with a waste contractor after the provision of laboratory results for waste classification purposes.

3.2 Survey of wells

The Consultant should have the new and existing functional groundwater wells surveyed by a licenced surveyor, to enable adequate interpretation of groundwater flow directions. The survey data for each well should include:

- Top of casing in metres Australian height datum (mAHD).

- Top of cover in mAHD.
- GPS coordinates.

It is expected that a professional, licenced surveyor would achieve a +/- 5 mm level of accuracy (vertical and horizontal).

3.3 Reporting

The Consultant should prepare a factual report after the groundwater installation, gauging and surveying of the wells. The report should provide the data collected to Council and should detail the results of the groundwater triangulation investigation. The report will include the following key information:

- A summary of the project purpose and objectives.
- A summary of the field works undertaken (including methods used), site conditions and any issues identified during the program.
- Tabulated groundwater elevation results.
- Bore logs for the newly installed wells.
- Field sheets
- GIS plans showing the installed monitoring well locations and interpolated groundwater contours (based on the gauging results and survey data).
- Conclusions detailing the expected groundwater flow direction on site.
- Recommendations (where required).

3.4 Additional considerations

The installation of groundwater monitoring wells on and up gradient of the site presents an opportunity for Council to receive additional value in the overall management of the site, including the following:

- In addition to providing Council with groundwater flow direction via groundwater gauging, the installation of groundwater wells around the perimeter of the site will assist with delineation of groundwater contamination impacts up gradient of the site as part of a likely ongoing groundwater monitoring program. This will enable Council to identify if the landfill is acting as a primary source of contamination to Manly Creek.
- It is likely that LFG monitoring will be required as part of future management actions for the site. As such, the newly installed groundwater monitoring wells may be able to be designed to be dual purpose in some locations (i.e. also able to be used to monitor for landfill gas). The installation of combined groundwater and landfill gas monitoring wells as part of the groundwater triangulation investigation could reduce future landfill gas bore installation costs by creating efficiencies, and could result in the provision of monitoring bores suitable for ongoing LFG monitoring and risk assessments. Typical design features of a LFG bore is shown in Figure 3-2, and can be compared against groundwater well features shown in Figure 3-1. It is noted that the screen interval design is the primary component that must be considered for both purposes prior to installation, and that it is unlikely that any of the existing groundwater monitoring wells can be converted into fully suitable LFG bores (logs would need to be sighted to fully confirm this though).

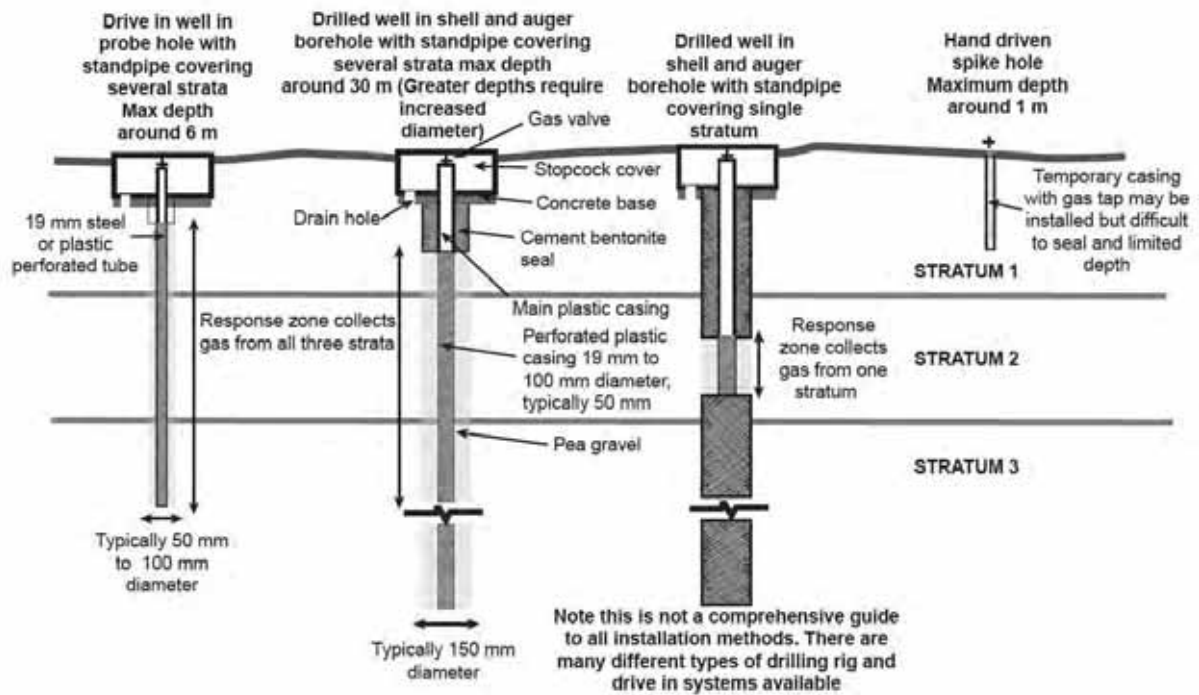


Figure 3-2 Key features required for a gas monitoring well (Wilson et al 2009)

4. Cost specification

The estimated costs for the works outlined in Section 3 are provided in Table 4-1. All fees are exclusive of GST, and are indicative only based on the following assumptions:

- No allowance has been made for meetings with Council to discuss the work.
- Safe physical and legal access to the site would be available to the Consultant, at no cost.
- Field works would be undertaken on normal business days (Monday to Friday and not on public holidays) and between the hours of 7:30 am to 5 pm.
- The Consultant would collect and submit two samples (one soil and one water) for laboratory analysis on a standard turnaround time of five working days.
- No allowance has been made for review of the report document by an Auditor.
- The Consultant hourly fees are similar to those of GHD, which have been used as the basis for this estimate of cost.

The actual price may vary (plus or minus) by 30% depending on suppliers and the Consultant, therefore a nominal additional allowance of 30% has been included in Table 4-1 for reference. GHD requests that Council remove the indicative Consultant fees, expenses and subcontractor costs included in any documents that Council makes publicly available, and in the interest of commercial confidentiality, that Council does not share these fees with other consultants.

Table 4-1 Breakdown of estimated costs (excluding GST)

Task	Consultant Fees	Expenses	Subcontractors / laboratory	Total (excl GST)
Project management	\$2,500	-	-	\$2,500
Drilling and installation of five new monitoring wells, preparation of safety documentation, DBYD	\$7,100	\$1,200	\$8,900	\$17,200
Gauging and surveying of wells	\$1,800	\$200	\$1,500	\$3,500
Waste classification and removal	-	-	\$1,800	\$1,800
Reporting	\$7,000	-	-	\$7,000
Total (excl. GST):	\$18,400	\$1,400	\$12,200	\$32,000
Total with +30% allowance (excl. GST)	\$9,100	\$1,820	\$15,860	\$41,600

5. References

Department of Environment and Conservation NSW, 2007. *Guidelines for the Assessment and Management of Groundwater Contamination*.

GHD, 2018. *Manly Vale Groundwater Monitoring – Groundwater Assessment Report 2017-2018*. Dated December 2018.

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NSW EPA, 2019. Letter to Council subject: *1-4 Addiscombe Road, Manly Vale*. Dated 2 October 2019, document reference number 'DOC 19/802127-1'.

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Victoria EPA, 2000. *Groundwater sampling guidelines*. Publication No: 669

Wilson et al, 2009. *Ground Gas Handbook*. Whittles Publishing, Scotland.

6. Limitations

This report: has been prepared by GHD for Northern Beaches Council and may only be used and relied on by Northern Beaches Council for the purpose agreed between GHD and the Northern Beaches Council as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Northern Beaches Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Northern Beaches Council and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has prepared the preliminary cost estimate set out in section 4 of this report ("Cost Estimate") using information reasonably available to the GHD employee(s) who prepared this report; and based on assumptions and judgments made by GHD (including quotes from subcontractors).

The Cost Estimate has been prepared for the purpose of this report and must not be used for any other purpose.

The Cost Estimate is a preliminary estimate only. Actual prices, costs and other variables may be different to those used to prepare the Cost Estimate and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD does not represent, warrant or guarantee that the [works/project] can or will be undertaken at a cost which is the same or less than the Cost Estimate.

Where estimates of potential costs are provided with an indicated level of confidence, notwithstanding the conservatism of the level of confidence selected as the planning level, there remains a chance that the cost will be greater than the planning estimate, and any funding would not be adequate. The confidence level considered to be most appropriate for planning purposes will vary depending on the conservatism of the user and the nature of the project. The user should therefore select appropriate confidence levels to suit their particular risk profile.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

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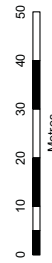
Appendices

Appendix A - Figures

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LEGEND



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Groundwater Well (GHD, 2017)
Groundwater Well (installed by o
Groundwater Well (installed by o
Proposed Bores for Triangulation



Northern Beaches Council
Manly Vale Groundwater Monitoring
Lot 1-4 Addiscombe road, Manly Vale, NSW

Job Number	12522471
Revision	A
Date	12 Feb 2020

Proposed Bores for Triangulation

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Appendix B – Example groundwater gauging sheet

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Client:	WL Meter Type: Dip / Fox / Int.Fce / Gge
Project:	Date:
Job No.:	Time:
Location:	Sampler:

[illegible]

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55088/https://projectsportal.ghd.com/sites/pp15_04/manlyvaleismp/ProjectDocs/12522471-REP-Triangulation Report Lot 1-4 Addiscombe Road.docx

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Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	AW and FS	S Charteris 		M Welsh		6/03/2020

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27/https://projectsportal.ghd.com/sites/pp15_04/manlyvaleismp/ProjectDocs/12522471-REP- ISMP Lot 1-4 Addiscombe Road Version 3.docx

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Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	A Walker F Salmon	Helen Milne		Matthew Welsh		10/12/2020

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