Northern Beaches Council

John Fisher Park, Curl Curl, NSW

Environmental Management Plan

22 March 2019

55351/119299 (Rev 1)

JBS&G

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Table of Contents

Tables

Figures

Attachments

1. Introduction

1.1 Background

JBS&G Australia Pty Ltd (JBS&G) has been engaged by Northern Beaches Council (Council, the client) to prepare an Environmental Management Plan (EMP) for John Fisher Park (the site), located across the boundary between the suburbs of Curl Curl and North Curl Curl, NSW. The site comprises an area of approximately 50 hectares (ha). The site location and boundary are shown on **Figure 1**, **Attachment B.** The current site layout is shown on **Figure 2**, **Attachment B.**

The area is occupied by John Fisher Park (including Greendale Creek, Curl Curl/Harbord Lagoon, Flora and Ritchie Roberts Reserve, and surrounding parkland), and associated Abbott Road Land, is a mixture of Council, Crown and Department of Education & Communities owned land being managed by the Council. The site is currently used for public open space and recreational activities. JBS&G understand the land use is to remain the same and continue for recreation and open space purposes. Further site conditions are provided in **Section 2.**

Previous intrusive investigations conducted across the site have identified landfill material buried on site which requires management to minimise the potential risks posed to site users, workers and the surrounding environment.

Two areas of the site have previously been investigated, remediated and signed off as suitable for open space land use, subject to the implementation of existing EMPs. The requirements of those EMPs (as listed in **Section 1.3**) apply to specific areas on the site (Weldon Oval and Adams St Reserve). The areas managed under existing EMPs are shown on **Figure 2**, **Attachment B.**

The EMP is based upon draft EMPs developed by JBS&G during 2013 and 2016 (JBS, 2013 and JBS&G, 2016) and updated to incorporate the results of recent assessment/monitoring events and to ensure consistency with current industry guidelines. Since the draft EMP (JBS, 2013 and JBS&G, 2016), the site boundary has been expanded to include Flora and Richie Roberts Reserve, North of Adams Street to the lagoon (**Figure 2**, **Attachment B**). The EMP is an overarching document for the management of identified contamination issues, and as necessary the assessment of contamination encountered during future investigation of the site. This EMP provides controls for the site particularly where no existing EMP currently applies.

The EMP has been prepared in general accordance with guidelines made or approved by the NSW Environmental Protection Authority (EPA) in consideration of NSW Government Environmental Management System (EMS) Guide (2009), and other applicable guidelines and standards.

1.2 Objectives

The purpose of this EMP is to provide for consistent application of contamination management controls across the site to protect the health and safety of persons who access the site, including maintenance workers, and to prevent degradation of the environment. The EMP will ensure continued suitability of the site for open space with recreational use.

Specifically, the objectives of the EMP are to:

- Summarise the identified environmental issues at the site requiring management, in order to ensure the adequate protection of site users, the surrounding community and the environment;
- Identify roles and responsibilities for the implementation of the EMP and for managing the identified environmental issues at the site;
- Document management measures to be implemented to address the identified issues and unexpected environmental issues at the site;

- Document environmental monitoring and reporting requirements; and
- Provide a framework for the review and revision of the EMP as necessary to ensure the appropriateness of the plan should further investigation/regulatory information become available.

It is understood that responsibility for implementation of the EMP will be borne by Northern Beaches Council.

1.3 Previous Reports

Documents considered as part of the preparation of this EMP include:

- Report for Reub Hudson Oval, Groundwater and Landfill Gas Monitoring Summary Report. GHD, File Reference: 21/16354/139628, May 2008 (GHD, 2008);
- Rehabilitation Environmental Monitoring, Weldon Oval, Curl Curl. Coffey Environments, 6 August 2009 (Coffey, 2009a);
- Rehabilitation Environmental Monitoring, Weldon Oval, Curl Curl. Coffey Environments, 11 September 2009 (Coffey, 2009b);
- Rehabilitation Environmental Monitoring, Weldon Oval, Curl Curl. Coffey Environments, 11 June 2010 (Coffey, 2010a);
- Rehabilitation Environmental Monitoring, Weldon Oval, Curl Curl. Coffey Environments, 14 July 2010 (Coffey, 2010b);
- Rehabilitation Environmental Monitoring, Weldon Oval, Curl Curl. Coffey Environments, 29 September 2010 (Coffey, 2010c);
- Curl Curl Lagoon Groundwater Assessment, August 2010, Final Draft, File Reference 1089RP01FD, WSP Environment and Energy 2010 (WSP, 2010);
- Adams Street Oval Rectification Works, Remediation Action Plan. Sinclair Knight Mertz, Final V2, December 2011 (SKM, 2011);
- Validation Report, Weldon Oval, Curl Curl, NSW. WSP Environment & Energy, File Reference: 00002339.01, July 2012 (WSP, 2012a);
- Landfill Gas Monitoring Summary Report, Weldon Oval, Curl Curl, NSW. WSP Environment & Energy, File Reference: 00002339.04, July 2012 (WSP, 2012b);
- Stormwater and Estuary Modelling for Curl Curl Lagoon, 30 May 2012, Revision 1, Document R.N2126.001.01.docx, BMT WBM Pty Ltd, 2012 (BMT, 2012);
- Playing Field – Adams Street Oval, Curl Curl, NSW, Environmental Management Plan. Sinclair Knight Mertz, Final V1, July 2012 (SKM, 2012);
- Site Audit Report, Adams Street Oval, Lalchere Street, Curl Curl, NSW. Peter J Ramset & Associates, October 2012 (PJR&A, 2012);
- John Fisher Park, North Curl Curl, NSW, Overview of Contamination Issues. JBS Environmental, JBS 42494-52767 (Rev 0), 17 December 2012 (JBS, 2012a);
- John Fisher Park, Curl Curl, NSW, Groundwater Assessment and Estuary Modelling Review. JBS Environmental, JBS 42494-52765, 14 December 2012 (JBS, 2012b);
- John Fisher Park, North Curl Curl, NSW, Asbestos Assessment. JBS Environmental, JBS 42540-53128, 21 February 2013 (JBS, 2013);

- John Fisher Park, North Curl Curl, NSW, Draft Environmental Management Plan, JBS Environmental Pty Ltd, 42669-53811 Rev B, April 2013 (JBS&G, 2013);
- John Fisher Park, Curl Curl, Sampling, Analysis and Quality Plan (SAQP) – Landfill Gas Assessment, 2015 (Jacobs, 2015);
- John Fisher Park, Curl Curl, NSW, Landfill Gas Assessment, Jacobs Group (Australia) Pty, Project IA066000, Final V1, February 2016 (Jacobs, 2016);
- John Fisher Park, Curl Curl, NSW, Groundwater Monitoring - June 2016, WRL Technical Report 2016/08, UNSW Australia Water Research Laboratory, Project 2016014, Final, 30 June 2016 (UNSW WRL, 2016);
- John Fisher Park, Curl Curl, NSW, Gas Risk Appraisal, JBS&G, Rev 0, 52197-105749, October 2016 (JBS&G, 2016);
- John Fisher Park, Curl Curl, NSW, Groundwater and Landfill Gas Monitoring Report, Jacobs Group (Australia) Pty, Project IA153200, Final, 7 August 2017 (Jacobs, 2017);
- John Fisher Park, Curl Curl, NSW, Landfill Gas Monitoring Report – May 2018, Jacobs Group (Australia) Pty, Project IA187500, V1_Final, 29 August 2018 (Jacobs, 2018); and
- John Fisher Park, Curl Curl, NSW, Landfill Gas Monitoring Report – June 2018, Jacobs Group (Australia) Pty, Project IA187500, V1_Final, 24 August 2018 (Jacobs, 2018);

1.4 Ongoing Existing Management Plans

EMPs which are already being implemented on areas of the site include:

- Playing Field – Adams Street Oval, Curl Curl, NSW, Environmental Management Plan. Sinclair Knight Mertz, Final V1, July 2012 (SKM, 2012); and
- Environmental Management Plan, Weldon Oval, Curl Curl, NSW. WSP Environment & Energy, July 2012, Revision 2 (WSP, 2012).

2. Summary of Site Conditions

2.1 Site Details

Detailed information of the site condition, physical characteristics, history and surrounding land uses provided in the following sections are summarised from previous site reports. A list of site reference reports is provided in **Section 1.3** and **Section 1.4.**

Site details and environmental setting are summarised in **Table 2.1** below.

Table 2.1 Summary of Site Details & Environmental Setting

Site Details	
Site Address	John Fisher Park, Curl Curl, NSW, 2099
Site Area	Approximately 50
Approximate Geographical Co-Ordinates (GDA94 – MGA56)	John Fisher Park – E: 341403.657, N: 6262387.752 Flora & Ritchie Roberts Reserve – E: 342242.854 N: 6262428.373
Topography	Approximately 3-15 m Australian Height Datum (m AHD)
Local Government Authority	Northern Beaches Council
Site Zoning	RE1 Public Recreation and RE2 / RE3 Private Recreation
Previous Use	Poorly drained estuarine flats. In the early 20th century, the land was cleared and drained for the creation of market gardens. The market gardens were converted to a 'tip' in the early 1950's. The site was subject to significant reclamation works between the 1950s to the late 1970s. The reclamation was achieved by uncontrolled filling with both domestic and commercial waste which comprised a mixture of putrescible and non-putrescible waste material. The site was rehabilitated for open space land use following a series of civil works in the late 1970s and use for recreation facilities.
Current Use	Open space with a series of recreational facilities and playing fields with Greendale Creek and Curl Curl Lagoon located in the centre of the park. Facilities within the park include the Curl Curl Sports Centre, Curl Curl Youth and Community Centre, North Curl Curl Community Centre and Community Gardens, Arts and Crafts Centre (creative space), amenity buildings, temporary toilet/canteen facility on the Abbott Road land, benches, picnic tables and barbecue facilities. Flora and Richie Roberts Reserve comprises open space with areas of dense vegetation, an access road and car parking, seating area, off leash dog play areas with entry access footpaths to North Curl Curl beach. There are also a number of children's playground areas and hard-surfaced netball courts, access roads and car parks in the north of the site.

Site Details	
	The site is currently open for public access however; buildings onsite are generally locked when not in use. Griffin Road runs north-south through the eastern portion of the site, separating Flora and Ritchie Roberts Reserve and Curl Curl Lagoon. Current site layout is shown on **Figure 2, Attachment B**.
Proposed Use	Maintained for current use as public open space land with recreational use

2.2 Surrounding Land Use

The site is bounded by a mixture of urban residential, commercial and industrial development with areas of open space and recreation facilities. The land use of directly adjacent properties or properties across adjacent roads are summarised below:

- North: Abbott Road and Abbott Road Land including residential properties;
- South: Residential properties;
- East: North Curl Curl beach; and
- West: Harbord Road and commercial/industrial development.

Griffin Road runs north-south through the eastern portion of the site, separating Flora and Richie Roberts Reserve in the east.

3. Identified Environmental Impacts

3.1 Summary of Identified Contamination Issues

A number of previous assessments have been undertaken across various areas of the site, followed by remedial works and the implementation of EMPs in two separate areas within the site boundary.

This EMP has been developed with consideration to the results of previous assessments (as listed in **Section 1.3**).

Readers are referred to these original site assessment reports for the full details and source documentation.

Contamination issues identified during previous site assessments which require management in accordance with this EMP are summarised below:

- Soil contaminants including, petroleum hydrocarbon (measured as TRH), polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), heavy metals and pesticides within the landfill material at depth;
- Asbestos Containing Materials (ACM) within the landfill material at depth, within the landfill cover/capping material (before late 1970s) and fragments of non-friable ACM on the ground surface where no surface cover (grass, paving etc.) was present;
- Landfill gas including, methane, carbon dioxide, hydrogen sulphide and carbon monoxide associated with the decay of putrescible material and degrading organic material such as timber, food or green waste, as well as volatile organic compounds (VOCs);
- Groundwater contaminants and water quality parameters including, ammonia, TRH, VOCs such as chlorobenzene and trichloroethene, heavy metals, pH and dissolved oxygen;
- Contaminated groundwater discharging into Greendale Creek and Curl Curl Lagoon impacting the surface water quality, including contaminants of ammonia, chloride and sodium;
- Potential acid sulfate soils (PASS) identified in natural soils beneath landfill material.

Further details assessing the level of risk associated with each of the identified environmental impacts is summarised in **Attachment C.**

4. Regulatory Requirements

Future activities on site are required to be undertaken in accordance with environmental and occupational health and safety legislation and associated regulations. The primary Acts, Regulations and Guidelines currently in place are listed below with a brief summary of their applicability.

Please note that this list is not intended to be a comprehensive listing of current applicable Acts and Regulations. The Council and contractors would be required to satisfy themselves that all applicable permits and licences have been obtained and their conditions satisfied.

Work Health and Safety Act 2011 (WHS Act 2011)

- The overarching Act for NSW setting law relating to employee health and safety and employer responsibilities.

Work Health and Safety Regulation, 2017 (WHS Regulations, 2017)

- Sets Regulations and details the duties for employers to achieve required employee health and safety performance in reference to the management and working with ACM. The WHS Regulation 2017 also contains requirements for maintenance of asbestos registers.

Protection of the Environment Operations Act 1997 (POEO Act 1997)

- The POEO Act enables the Government to set out explicit protection of the environment policies (PEPs) and adopt more innovative approaches to reducing pollution. Includes regulation of waste activities including appropriate assessment, classification and disposal of waste including waste soil.

Contaminated Land Management Act 1997 **(CLM Act 1997)**

- The CLM Act controls the assessment of contamination and management of contaminated soils and groundwater. The Act also contains guidance for the determination of whether a site is considered to be a Significantly Contaminated Site and allows for accreditation of Site Auditors.

Environmental Planning and Assessment Act NSW (EP&A Act 1979)

- The EP&A Act allows plans to be made (environmental planning) to guide the process of development including development on potentially contaminated land. Linked to State Environmental Planning policy (SEPP) 55 'Remediation of Land' relating to making planning decisions in regard to contaminated and potentially contaminated land.

State Environmental Planning Policy (SEPP) 55 'Remediation of Land'

- SEPP 55 relates to the decision-making process in undertaking remediation of land and making planning decisions in regard to contaminated and potentially contaminated land.

Duty to Report Contamination under the Contaminated Land Act (2009)

- The Duty to report guidelines comes under the CLM Act, with the guidelines indicating that a person whose activities have contaminated land or a landowner whose land has been contaminated is required to notify the EPA when they become aware of the contamination.

Waste Avoidance and Resource Recovery Act 2001 (WARR Act)

- The WARR Act replaced the Waste Minimisation and Management Act 1995 and controls waste generation and reduction.

4.1 Other Applicable Permits

Works conducted on site which may cause disturbance or exposure will need to be conducted by appropriately trained staff, with the reporting and notification of the works conducted in accordance with the regulations and approved code of practice.

Other applicable permits and/or codes of practice are listed as following, but not limited to:

- Conveyancing Act No. 6, NSW 1919;
- WHS Regulations 2017 with regards to confined space;
- Confined Spaces Code of Practice 2016;
- How to safely remove asbestos Code of Practice 2018;
- How to manage and control asbestos in the workplace Code of Practice 2016;
- Excavation work Code of Practice 2015 and
- Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases, NSW EPA 2012.

5. EMP Application and Responsibilities

5.1 EMP Application

This EMP is to be applied at all times during ongoing operation of the site for the current land use as open space recreation. Any workers on site should be made aware of the EMP and its requirements.

This includes workers associated with utilities or other infrastructure on site that is not owned/controlled by Council, and those undertaking activities which have the potential to disturb surface cover or involve soil excavation.

Council is to ensure the long-term implementation and on-going monitoring of the site in accordance with the EMP. Northern Beaches Council could consider notifying via planning certificates issued under the EPA Act 1979.

Controls in this EMP apply to all activities on site, but are particularly important for activities involving disturbance or exposure of the landfill cover layer and/or soil/fill materials and groundwater beneath the site surface, such as:

- Demolition and removal of any existing pavements or other structures across the site;
- Underground utilities installation, maintenance or removal;
- General maintenance activities including grass cutting, weeding, planting vegetation;
- Building maintenance in subfloor or confined areas;
- Surface water drainage works including irrigation;
- Minor or Intrusive excavations (e.g., dug, cut, piled, bored, etc.).

Should any works potentially involve the disturbance or exposure of the impacted material then the site workers will be required to be suitability inducted into this EMP, trained and inspections conducted prior to and post site works.

It is noted that assessment, remediation and validation works have been conducted at Weldon Oval and Adams St Reserve to make them suitable for recreational and sports use, as long as they are managed in accordance with the existing EMPs (WSP, 2012 and SKM, 2012). The works at Weldon Oval and Adams St Reserve have been signed off by EPA-accredited auditors. The controls in the EMPs prepared for these areas apply for these specific areas only (**Figure 2**, **Attachment B**).

This EMP is in no way intended to replace or supersede existing EMPs and/or Health and Safety Plans provided for these areas of the site.

5.2 EMP Responsibilities

5.2.1 Site Owner (Northern Beaches Council)

It is the responsibility of the site owner to ensure that:

- A person in a senior management position in the organisation is appointed, for the purposes of this EMP, as Owner's Representative and given the responsibility for ensuring the EMP is provided to relevant staff and other stakeholders and implemented appropriately; and
- The EMP is reviewed and updated regularly by an appropriately qualified and experienced person to ensure it complies with any updates to regulatory requirements and its relevance to site conditions following any works by Council or others at the site.

5.2.2 Operator/Maintainer (Northern Beaches Council)

It is the responsibility of Northern Beaches Council as the operator and maintainer of the park to ensure that:

- A person in a management position is appointed as the nominated Site Environmental Manager and given the responsibility for ensuring implementation of the provisions of the EMP including:
- Implementation of the requirements of the EMP;
- Distribute of a copy of this EMP to the Site and Building Managers, and communications as required to ensure understanding of, and agreement with, the requirements of the EMP by the Site and Building Managers;
- Actions as necessary to ensure the ongoing monitoring of soil and groundwater contamination, landfill gas and monitoring of the surface coverage as outlined in this EMP;
- The health, safety and environmental requirements specific to the contamination issues on the site, as outlined in this EMP, are complied with; and
- Environmental incidents and unexpected site conditions are reported in a timely manner to the Environmental Manager, and appropriate statutory authorities as necessary in accordance with legislation.

5.2.3 Building Managers

The Building Managers are those that manage facilities within the park including the Curl Curl Sports Centre, the Curl Curl Youth and Community Centre, the Scout Hall and the temporary toilet/ canteen facility on the Abbott Road Land. The Council is the Building Manager for the amenity blocks and any remaining facilities.

Building Managers are required to:

- Maintain the integrity of the ground cover and conduct any works likely to disturb the ground or subsurface soils in accordance with this EMP;
- Liaise with Council and the appointed Environmental Manager as required to ensure compliance with the EMP;
- Liaise with Council and the appointed Environmental Manager in the event of proposed ground disturbance or subsurface works; and
- Report any breaches of the ground surface in a prompt manner and participate in any reporting/actions associated with rectifying the ground surface maintenance measures.

5.2.4 Contractors/Others

It is the responsibility of contractors or others working on the site to ensure that:

- A person in charge of site works (e.g. Site Forman, Project Manager, Site Supervisor, or similar) is appointed, for the purposes of this EMP, and given responsibility for ensuring successful implementation of this EMP including appropriate communication with the Owner's Representative and/or Environmental Manager as required;
- Works are conducted in compliance with the EMP requirements, in addition to any other specific requirements for the tasks undertaken;
- Notify the Environmental Manager of any unexpected finds encountered during works;
- Any works with asbestos should give appropriate consideration to requirements of Safe Work Australia, SafeWork NSW and other relevant guidelines, codes of practice and standards; and
- Any works involving hazardous materials, contaminated and waste material should be completed in accordance with relevant legislation, guidelines and standards.

Responsibilities are summarised in the **Table 5.1** below:

Table 5.1 EMP Responsibilities

Position	Responsibilities
Site Owner	• Ensures EMP provided to relevant Council staff and others as required • EMP is reviewed and updated regularly to be consistent with site conditions and relevant legislation/guidelines As outlined in Section 3.4.6 of the Guidelines for the NSW Site Auditor Scheme (2006), Council should provide for: a) Public notification of the existence of the EMP on appropriate property records (e.g. planning certificates prepared for the site as created under planning certificates Environmental Planning and Assessment Act 1979); and b) Enforcement of the EMP as a condition in any future development consent for additions or alterations to the development that may involve disturbance of soil at the areas of the site to which this EMP applies
Environmental Manager	• Approve the EMP • Advise personnel of the requirements of the EMP • Induct employees before and during the works as appropriate • Provide a copy of the EMP to the **Person in Charge** of on-site works • Ensure Council staff comply with the EMP • Ensure Council employees working under the EMP understand all requirements of the EMP and ensure compliance with the EMP is a condition of agreement as part of induction into the EMP • Ensure all non-conformance and/or complaints are recorded. Example registers are provided in **Attachment D**
Person in charge of on-site works	• Notify Council's **Environmental Manager** if ACM or any unexpected find is encountered during works • Implement the EMP to ensure compliance • To ensure environment protection measures are in place • Record non-conformance and follow up with corrective measures • To ensure monitoring is implemented during ACM works as outlined in the EMP • Ensure non-conformance and/or complaints are reported to the Environmental Manager • Undertake corrective actions as may be requested by the **Environmental Manager** regarding specific environmental or safety issues • Ensure all works comply with relevant regulatory requirements as set out in the EMP

6. Ongoing Environmental Management Controls and Monitoring

6.1 Basic Personal Protective Equipment and Hygiene

Notwithstanding the outcomes of the job risk analysis to be completed as part of a safety plan for any works at the site, workers who may potentially come into contact with contaminated soils are anticipated to wear, as a minimum, the following personal protective equipment (PPE):

- Overalls or long-sleeved shirt and long pants;
- Heavy duty outer gloves (e.g. leather) where there is a risk of cuts or abrasions;
- Otherwise latex/nitrile outer gloves if in direct contact with contaminated soil;
- Steel capped boots; and
- Safety glasses.

Additional PPE is required as described below when working with potentially asbestos impacted material.

Basic rules of hygiene should apply with no eating, drinking or smoking during the works. Wash hands following the works and before eating or drinking.

6.2 Inspections of Surfaces

The existing cover layer should be well maintained to prevent exposure of underlying soil and potential ACM. If the cover layer is significantly disturbed, and the underlying soil is exposed, there is a potential risk of exposure to contaminants, and for contaminants to migrate through landfill gases, dust or surface water erosion.

To ensure appropriate surface cover is maintained, the following is required:

Periodic inspections by the Environmental Manager:

- The Environmental Manager shall undertake an environmental inspection on a periodic basis to ensure that surface soils have adequate vegetation (grass) cover across all areas of the site, and that fragments of ACM or other wastes have not been exposed at the surface of the site.

Detailed annual inspection by an appropriately qualified person:

- Detailed inspections should occur at least annually to assess for the potential for exposed contaminated landfill materials, and to document that surface cover and capping has been maintained. It is recommended this annual inspection is completed by someone trained in identifying waste and ACM, preferably an appropriately qualified, trained and experienced environmental consultant / hygienist / competent person.

Ad hoc inspections:

- Additional ad hoc site condition assessments may be undertaken, and any degradation in site cover, exposed landfill material or visible ACM noted and communicated for action in accordance with this EMP. It may be appropriate for such assessments to be made following heavy rainfall episodes or heatwaves which could damage the surface cover layer and expose landfill materials or visible ACM.

Should park surfaces be disturbed (e.g. exposed landfill materials, dead or dying grass cover or other vegetation), the site surface should be repaired appropriately to ensure subsurface soils are adequately covered;

Any visible ACM fragments exposed will need to be removed in compliance with the requirements of the SafeWork (2016) Code of Practice 'How to manage and control asbestos in the workplace', other relevant regulatory requirements;

Any other waste material exposed, or other unexpected finds should be managed in compliance with this EMP and relevant regulatory requirements;

An example inspection sheet is included in **Attachment D.**

6.3 Minor Surface Works / Maintenance

No specific controls are required for minor surface works including weeding, gardening, grass cutting, cleaning and general maintenance of park surfaces and above ground structures, as these should not result in penetration of the existing cover layer.

- All workers and contractors should be inducted into the EMP prior to commencing works at the site; and
- Any unexpected finds/conditions including exposed landfill materials, visible ACM and other waste materials observed during minor works should be reported and documented in accordance with this EMP.

6.4 Intrusive Works

Due to the presence of soil and groundwater contamination identified at the site, during all works that include intrusive works, the following management measures will apply:

Prior to any intrusive work commencing:

- Approval for the works must be sought from the **Environmental Manager** who will assess whether the works are necessary or if there is an alternative that will not result in exposure of potentially impacted fill or groundwater, and whether the works are required to be carried out by a specialist contractor;
- The **Environmental Manager** must review the information available for the site to determine if ACM or other contaminants is likely or known to be present in the relevant work site location (see also **Section 6.5**);
- The **Environmental Manager** must also review and approve the job specific risk assessment (JSRA) and safe work method statements (SWMS) for the works and ensure that site personnel and/or contractors who will undertake the works are inducted into the EMP;
- The works area must be isolated from casual entry using temporary barriers (or fencing as otherwise required for the works involved) and only personnel inducted in the requirements of the EMP will be permitted to enter the works area;
- Sufficient room must be provided within the works area to allow stockpiling of spoil from excavations, if required, in accordance with **Section 6.7**;
- A water supply must be provided to the works area for the purpose of maintaining excavation surfaces, exposed asbestos impacted fill or soil in the excavations and stockpiles in a moist state;
- During intrusive works, air monitoring must be conducted to monitor the potential generation of methane gas in any excavations and to monitor the explosive limit of the methane in accordance with **Section 6.6**;
- Stockpiles of excavated spoil must be managed in accordance with **Section 6.7**;
- Excavated materials should be returned to the subsurface in the same order in which they were excavated;

- The potential for dust generation must be managed in accordance with the requirements outlined in **Section 6.8**;
- Personnel entering the works area must wear appropriate PPE, including PPE appropriate for works where asbestos materials may be encountered, in accordance with **Section 6.1 and Section 6.5.1**;
- All excess excavated material must be removed from site in accordance with the requirements outlined in **Section 6.10**;
- Potential groundwater flowing into any excavations must be treated as contaminated and, if necessary, must be removed from the site in accordance with the requirements outlined in **Section 6.12**;
- Unexpected finds should be managed with consideration to the requirements outlined in **Section 6.13.**

Should methane be reported at levels at or above the explosive limits, then all works in the vicinity are to cease until the methane levels reduce or mitigation measures can be implemented to make the work area safe. Further requirements are outlined in **Section 6.6**. The EPA should also be notified should methane concentrations be recorded above 1.25% v/v in any buildings at the site.

6.5 Asbestos

6.5.1 Surface Cover Maintenance

Minor bonded ACM fragments have been identified on the ground surface across the site. If ACM is identified, it should be collected in accordance with SafeWork NSW (2018) How to Safely Remove Asbestos and disposed of at an appropriately licensed waste facility.

PPE to be worn during the collection and removal of ACM fragments must include:

- disposable coverall and gloves; and
- a P2 disposable respirator or half faced respirator fitted with a particulate cartridge.

Maintenance of the existing ground cover as outlined in **Section 6.2** is required to prevent access to sub-surface soils.

6.5.2 Works Involving Soil Disturbance and Maintenance

Minor bonded ACM fragments have been identified at isolated locations across the site at depth within the landfill material. Additionally, elevated chemical contaminants have also been identified in sub-surface soils.

The process relating to soil disturbance where interception of ACM is likely is as follows:

- All site workers should be inducted to the EMP prior to commencement of the works;
- Site works should be completed in accordance with relevant regulatory requirements;
- If more than 10 m^2 of bonded asbestos is encountered, then a Class B (bonded asbestos) licensed contractor must be engaged to undertake any works with the ACM impacted material. For < 10 m^2 bonded asbestos, it is recommended a Class B licensed contractor be engaged, although for minor amounts of bonded ACM fragments Council may choose to proceed to undertake any works in accordance with this EMP and relevant SafeWork guidelines;
- In the event that greater than 100 kg of asbestos waste or 10 m^2 of asbestos sheeting requires offsite disposal, the waste regulation requires transporters of asbestos to record information about the movement of loads of asbestos waste from the site of generation to the final disposal point using the EPA developed online system called Waste Locate. This

ensures asbestos waste is disposed of lawfully in NSW and assists transporters of these materials to fulfil their legal obligations; and

- Unexpected conditions should be managed with consideration to the unexpected finds protocol provided in **Attachment E.**

6.5.3 Asbestos Air Monitoring

During any fill/soil excavation in areas where ACM has been or is identified, transport or placement works on site involving (>10m^2) bonded ACM and/or friable (FA / AF):

- Airborne asbestos fibre monitoring will be undertaken using calibrated portable air sampling pumps;
- Air monitoring should be undertaken by a competent person, as defined in WHS Regulation (2011) or a Licensed Asbestos Assessor (LAA), for works involving non-friable asbestos. For works involving friable asbestos, air monitoring must be undertaken by a SafeWork Licensed Asbestos Assessor (LAA);
- Monitoring locations shall be determined by the competent person or LAA but shall include at least 4 locations surrounding the daily specific work area. At the end of each monitoring period the pump and attached filter will be collected and analysed at a National Association of Testing Authorities (NATA) accredited laboratory;
- Monitoring works shall be conducted in accordance with the National Occupational Health and Safety Commissions' Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres 2nd Edition (NOHSC:3003 (2005)) and the procedures and results shall be NATA accredited;
- The following action levels will be applied upon receipt of daily results, as outlined in the Safe Work Australia (2011);
    - Reading of less than 0.01 fibres/mL – control measures in place are working effectively, site works to continue;
    - Reading between 0.01 and 0.02 fibres/mL – a review of control measures shall be completed in the work area;
    - Reading greater than 0.02 fibres/mL – works shall cease until the cause of contamination is identified and rectified;
- It is noted that these action levels adopted are more conservative than the exposure standard for airborne asbestos (0.1 fibres/mL (TWA)) as outlined in Safe Work Australia's (2013) Workplace Exposure Standards for Airborne Contaminants (SWA 2013) for an 8-hour shift; and
- The results of air monitoring will be available on a 24-hour turnaround time basis. Daily air monitoring reports shall be displayed in a common area outside of the asbestos work area (e.g. site office or lunch shed) or be able to be produced upon request.

6.6 Building Maintenance

Maintenance works conducted on the ground floor or above in buildings across the site may be conducted with the normal level of PPE for that task as outlined in **Section 6.1.**

Additional procedures are required where maintenance works are conducted in pits or subfloor or confined areas where landfill gas has the potential to accumulate. Where building maintenance works are to be conducted subfloor or confined areas, the following procedures are to be implemented:

- All subfloor or confined areas shall be treated as confined spaces. All confined spaces shall be tested and cleared for the accumulation of methane and landfill gases with a calibrated meter capable of measuring lower explosive limit based on methane concentrations, and concentrations of oxygen, hydrogen sulphide, carbon monoxide and carbon dioxide. All works in confined spaces shall be undertaken in accordance with clauses 65 to 77 and other relevant sections of the Work Health and Safety Regulation 2017;
- As long as monitoring continues to indicate a normal atmosphere with no elevated landfill or volatile gases; and
- If monitoring is not conducted continuously throughout the works, PPE to be worn during works includes a half-faced respirator fitted with an organic vapour cartridge.

6.7 Soil Management

During any soil excavation works on site:

- Any asbestos or other contaminated soil that is excavated during onsite works, such as maintenance of underground services, must be securely stockpiled;
- Where possible, stockpiles should be placed on a sealed surface or on plastic sheeting to prevent cross contamination of unsealed surfaces;
- If it is not possible to stockpile on a sealed or plastic covered surface, the unsealed surface within the footprint of the stockpiles must be visually inspected by a person who is appropriately qualified to recognise ACM, and samples collected and analysed to confirm that cross contamination has not occurred;
- Stockpiles must be placed in a secure location onsite and covered if to remain for more than 24 hours; and
- Appropriate sediment and erosion controls must be implemented and maintained for the duration of soil management works, consistent with Landcom (2004) Managing Urban Stormwater: Soils and Construction guide and other relevant guidelines/standards.

6.8 Dust Management

During intrusive works that will disturb asbestos or other impacted soils:

- Exposed impacted fill or soils in the walls and floors of excavations and stockpiles of spoil should be kept moist to prevent the generation of dust from these sources;
- Care should be taken to not over-wet excavations and/or stockpiles such that excess runoff is generated;
- Works should cease should visible dust be migrating from the work site area, until such time as dust is controlled or conditions causing dust migration (e.g. excessive wind) improve;
- For substantial soil disturbance works, appropriate dust controls should be applied at work site boundaries; and
- Any non-compliances or migration of dust from site boundaries should be reported to the Environmental Manager and appropriate information recorded in the Environmental Incidents Register in **Attachment D.**

6.9 Odour Management

Given the nature of the soils (landfill material) at the site, there may be odour issues.

Where complaints occur, the following will be undertaken:

- Disturbance of soils during meteorologically favourable periods only;

- Covering of impacted soils; and/or
- Installation of an odour screening / masking system at the site boundaries if the initial management approaches are ineffective.

Additional odour suppression actions to reduce the odours may include: increasing the amount of covering of excavations / stockpiles; mist sprays; odour suppressants; or maintenance of equipment.

6.10 Waste Management

Where waste materials including excess soil are required to be removed from site:

- Any material to be disposed offsite should be classified in accordance with EPA 2014 Waste Classification Guidelines or guidelines that may be in force at that time.
- Materials removed from site for waste disposal should be classified prior to removal, and tracked from 'cradle to grave' with transport and disposal documentation maintained consistent with relevant regulatory requirements.
- Any asbestos waste must be removed, transported and disposed as special waste in accordance with relevant guidelines and legislative requirements.

6.11 Acid Sulfate Soils Management

If acid sulfate soils are disturbed during any construction they will require management in accordance with the *Acid Sulfate Soil Manual*, NSW Acid Sulfate Soil Management Advisory Committee, August 1998, (ASSMAC 1998).

6.12 Groundwater Management

Due to the presence of elevated ammonia, TPH, VOCs and heavy metals in the groundwater, the groundwater is considered to be a contaminated. Consequently, there will be no unlicensed abstraction of groundwater, and no abstraction of groundwater which is potentially contaminated such that it is unsuitable for the proposed use.

If any groundwater requires removal during works on site, this should be undertaken by a licensed contractor and disposed offsite in accordance with EPA 2014 Waste Classification Guidelines.

6.13 Surface Water Management

Due to the presence of chemical contamination, in particular elevated ammonia in the surface water of Curl Curl Lagoon, which is a key indicator for leachate contamination from landfills, the surface water is considered contaminated. Given the chemical composition of ammonia, and the dilution factor presented by inputs into Curl Curl Lagoon, the risk to site users is considered low, however continued deterrence from users swimming within the highly disturbed waters of Curl Curl Lagoon is appropriate.

6.14 Unexpected Finds

As surface and sub-surface conditions can vary, there is the potential for unexpected contamination or aesthetic issues to be encountered during general maintenance or intrusive works at the site.

Unexpected finds, such as previously unreported potentially impacted (e.g. stained, odorous) fill/soil should be managed with consideration to the unexpected finds protocol provided in **Attachment E.**

6.15 Emergency Preparedness and Response

The following procedure will be followed in the event the capping layer is breach so that the underlying contaminated fill and/or groundwater is exposed:

- If possible, stop the activity or process that has exposed the impacted fill;

- Assess the hazards associated with the exposure of the impacted material and ensure that appropriate procedures are included in the response to address such hazards, with reference to the Unexpected Finds Protocol and other controls in this EMP; and
- Repair the capping layer such that the impacted fill is once again isolated beneath the clean cap;
- Collect and secure any impacted fill that may remain exposed and stockpile securely so that it is protected from casual access;
- Offsite disposal of the impacted fill;
- Review the activity or process that led to the exposure of the fill and revise procedures or actions accordingly to prevent a reoccurrence;
- Complete an environmental incident/corrective action report in accordance with the current quality procedure; and
- Review and revise the EMP to reflect any changes that have to be made to prevent a reoccurrence.

6.16 Emergency Contacts

Emergency contacts are listed in **Table 6.1** following.

Table 6.1 – Emergency Contacts

Emergency Contact	Contact number
Northern Beaches Council (Environment Resilience & Climate Change)	1300 434 434
Northern Beaches Council (Environmental Sustainability)	9942 2322
Emergency Services (Police, Fire, Hazmat, Ambulance)	000/112
Dee Why Family Medical Centre (Pacific Parade)	1300 333 949
NSW State Emergency Service	13 25 00
Work Safe NSW	13 10 50
EPA Pollution	13 15 55

6.17 Ongoing Environmental Inspections

A detailed site inspection shall be conducted by the Environmental Manager at the following times throughout the occupation of the site (**Table 6.2**).

Table 6.2 – Ongoing Environmental Inspections

Inspection Time	Inspection Frequency
Annual site inspection	Once per year
Following an accidental breach/penetration of the capping layer	Following incident
Following break / repair of capping layer	Upon completion

- Records of the inspection shall be retained by the Council; and
- Inspection of the cover in the vicinity of the trees should be completed during regular maintenance of the park.

It is expected that the EMP will be incorporated into the overall maintenance and environmental management procedures for the site prepared by the site owner.

7. Landfill Gas Monitoring

The current risk to sensitive offsite receptors from LFG migrating offsite is considered low, however the source of LFG still remains on site and any future change to the site or ambient conditions may increase the risk of LFG migrating offsite and impacting sensitive receptors.

As recommended and stated in site assessment reports (see **Section 1.3**), landfill gas monitoring should be conducted on a quarterly basis on all existing perimeter and offsite monitoring wells subject to ongoing review of results. Landfill gas monitoring location plans are presented in **Attachment F**. The quarterly monitoring is proposed to detect potential LFG migration patterns due to seasonal variations in weather conditions and potential changes in landfill conditions such as landfill settlement, construction of new or replacement structures, and landscaping or land use practices.

The quarterly monitoring programme will further demonstrate Council's due diligence and commitment in addressing the LFG issues at the site, providing further certainty for Council and stakeholder groups that the risk posed by LFG at the perimeter of the site and in offsite monitoring wells continues to remain low. Landfill gas monitoring should be undertaken by a suitably qualified environmental consultant in accordance with relevant guidelines.

The quarterly monitoring program should be designed so that one monitoring round targets the periods of lowest and most rapid fall in atmospheric pressure conditions typically observed in Sydney during the December/January period (based on information from the Bureau of Meteorology).

The monitoring should be undertaken on calm days with wind speeds not exceeding 10 km/h and preferably during periods of relatively low and stable atmospheric pressure (less than 101.3 kPa).

Maximum readings of methane, carbon dioxide, carbon monoxide and hydrogen sulphide and the lowest reading of oxygen should be recorded for each location.

Landfill gas monitoring should be conducted within the site as described below.

7.1 Outdoor Surface Areas

Surface emission rates onsite were calculated during the landfill gas risk assessments for the site (see **Section 1.3**). The results indicated that the vertical release of LFG under current site conditions presents a low risk to current and future outdoor users of the site due to the almost immediate dilution of LFG in the ambient atmosphere and the absence of places for the gas to accumulate (no habitable sub-surface rooms observed within on-site buildings).

It is therefore not considered necessary to undertake ongoing outdoor surface monitoring.

7.2 Internal Building Monitoring

Landfill gas risk assessments undertaken did not identify elevated concentrations of methane above background levels within buildings onsite which could present a potential risk to building users. The specific buildings investigated were the Curl Curl Sports Centre, the Curl Curl Youth, the Community Centre and four amenities buildings. The potential gas risk to future users of the facilities is considered low, therefore it is not considered necessary to undertake ongoing quarterly internal building gas monitoring. Given the presence of enclosed spaces, in particular store rooms and cupboards it is recommended to install gas monitor/alarm systems in each building to notify users should a risk arise.

Mechanisms should be put in place by the Council, that if future Development Applications (DA) require the excavation of underground structures (e.g. car parks and/ or basements / service trenches) a suitably qualified Environmental Consultant should be engaged to undertake due

diligence LFG monitoring pre, during and post construction. Where building maintenance works are to be conducted, the procedures outlined in **Section 6.6** should be followed.

7.3 Monitoring Wells

All existing perimeter and offsite wells should be monitored on a quarterly basis (monitoring locations are presented in **Attachment F**).

The LFG monitoring should be undertaken in general accordance with the procedures outlined in Example 5.1 Typical gas monitoring round of the CIRIA C665 (2007) and Guideline for the Assessment and Management of Sites Impacted by Hazardous Ground Gases (NSW EPA, November 2012).as detailed below:

1) Record daily (and if appropriate hourly) atmospheric pressure readings during period before the monitoring visit;
2) Calibrate the instruments before the monitoring visit;
3) Before starting the monitoring round, turn on the monitoring equipment, attach tubing and run through clean air and zero the methane. This needs to be done well away from any sources of soil gases and/or vapours such as vehicles and monitoring locations;
4) Keep the monitoring equipment switched on between boreholes to prevent having to zero the methane each time it is switched on. However, ensure methane is zeroed before beginning to monitor at subsequent wells. Keeping the monitoring equipment on also purges any residual gas;
5) Record the atmospheric pressure reading from the monitoring equipment. Also record weather, record air temperature and ground condition at the site. This information is important as it may influence the interpretation of the gas results;
6) Switch on the flow meter; attach the inlet tube to the gas tap and open. Record the range of pressures and flow readings on the gas monitoring proforma, making sure “positive” or “negative” is recorded;
7) Close the gas tap and remove the gas flow meter tubing;
8) Attach the monitoring equipment tubing to the gas tap and open. Switch on the pump and record the peak and steady reading for methane (% v/v), methane (% LEL), carbon dioxide (% v/v) and steady reading for oxygen (% v/v). It is also good practice to record the time taken to reach the steady reading;
9) If the gas readings have not reached a steady value after three minutes, record the concentrations and the direction and rate of change in concentration (that is steadily increasing/rapid decrease). Where the concentrations are decreasing always record the peak concentration;

   If very high readings are recorded on the monitoring equipment it is worth monitoring the well for a longer period (up to 10 minutes) to determine if the concentrations are related to build up of gas in the well (for example from a pocket of methane within a layer of alluvium) or are being constantly replenished by methane or carbon dioxide from the soil. The readings over time should be recorded on the gas monitoring sheets.

   Note: The Monitoring equipment is liable to suck up water from the boreholes. Watch the clear plastic tubing (attached to the tap) carefully and if this should happen, quickly detach the tubing from the inlet and switch off the pump. Record the gas concentrations and make a note that water was sucked up. Check the filter and if wet, replace with a dry filter. Remove water from the tubing.

10) Once data is recorded remove the tubing from the gas tap and close the tap. Purge the monitoring equipment in clean air (away from the borehole/and other sources of gas) until the methane and carbon dioxide concentrations return to zero and the oxygen is reading atmospheric concentrations;

11) Record the water level and well depth using a dip meter, usually obtained by removing the gas tap or cover from the borehole. Water level readings are usually recorded from the top of the borehole or from ground level or both (be consistent and note to where depth relates), the top of the water. After obtaining a reading, record on the proforma and replace the gas tap or cover ensuring that the tap is closed and cover locked;

12) Make a note of any defects to the boreholes and perform maintenance if appropriate; and

13) Repeat for all boreholes and record an atmospheric pressure reading once all monitoring has ceased and record on proforma. Note any trend in atmospheric pressure in the lead up to and during the monitoring visit.

The ongoing quarterly gas monitoring of perimeter wells will all the collection of data and the development of a more detailed program for future LFG monitoring.

7.4 Underground Services

During the investigations undertaken across the site, concentrations of methane exceeded the adopted site assessment criteria for one storm water drain located on the northern boundary of the site however; the potential risk posed by the elevated methane in the stormwater drain is considered to be low due to the drain being covered with an open grate through which LFG can passively vent to the atmosphere. Methane concentrations recorded in the storm water drain system most northern termination point (located north of Abbott Road) were below the adopted site assessment criteria, which indicates that the elevated methane concentrations identified are unlikely to be migrating via the stormwater drain offsite.

In addition, an investigation into a collapsed stormwater system in the centre of the site undertaken by JBS&G (JBS&G, 2016) did not identified elevated levels of LFG within underground service conduits.

It is therefore not considered necessary to undertaken ongoing gas monitoring of underground services, expect during related excavation work and/or entry as outlined in **Section 6.6.**

8. Work Health and Safety Management

It is the responsibility of the Environmental Manager, as defined in **Table 5.1**, to ensure that comprehensive health and safety programmes are implemented that are appropriate for the activities underway at a site.

Given that this EMP includes controls for working with potentially asbestos impacted materials, additional protocols and procedures must be included in the overall health and safety plan/s implemented that address the specific hazards posed by asbestos in soil.

The highest risk exposure pathway that can lead to health effects from asbestos fibres is inhalation of respirable fibres. Consequently, workers who may be exposed to dust in the atmosphere that has the potential to contain asbestos fibres must wear appropriate respiratory protection. Further, measures must be taken to ensure that asbestos fibres potentially released from soil are not carried out of the work area to areas where breathing protection would not ordinarily be considered a requirement.

The Environmental Manager should ensure that the intrusive works are carried out in accordance with relevant Job Safety Risk Assessments (JSRAs) and Safe Work Method Statements (SWMS) and requirements identified this EMP.

8.1 Specific Requirements for Working in Confined Spaces

Due to the presence of landfill gas at the site, there is potential for methane to build up in future excavations at the site. If excavations are to be entered, then entry must be undertaken in accordance with the requirements of the *Safe Work Australia 2016 Code of Practice 'Confined Spaces'* (SWA, 2016).

A separate risk assessment should be undertaken by a competent person before carrying out any work. This will assess the following:

- Nature of the confined space;
- Work that is required;
- Range of methods by which the work can be done;
- The hazards involved;
- The method selected; and
- Emergency and rescue procedures.

Monitoring of the atmospheric conditions should also be undertaken to assess whether entry of a potential confined space will require suitable PPE, including the supply of ventilation and fresh air.

Monitoring of works will also be required, as per **Section 6.6**, to monitor potential explosive limits methane present at the site.

9. Non-Compliances and Record Keeping

Where a non-compliance is identified, the non-complying party will be required to rectify the non-conformity as soon as possible, as per the requirements of the relevant procedure(s) where non-compliance has occurred. Detail of the action taken to rectify the non-compliance shall be provided to Council in writing.

Where a non-compliance cannot be rectified, the EMP will require to be reviewed as described in **Section 11.**

Council shall be responsible for the maintenance of all documents relating to the implementation of this EMP. This shall include monitoring reports, any additional assessment undertaken and any relevant correspondence between the Council, building managers and site workers including contractors.

10. EMP Notification

To ensure interested parties (e.g. council workers, contractors, service providers) are aware of the restrictions this EMP places on land comprising the site, notification of this EMP for ongoing management of landfill gas is recommended. Mechanisms that may be appropriate for this site include:

- Notification to Dial-Before-You-Dig (DBYD); and/or
- Notification on Planning Certificates issued under the EP&A Act.

Alternate notification mechanisms may be available within Council procedures to ensure Council staff and contractors continue to be made aware of the EMP and its requirements for the land.

Notification of the EMP on title to the land may be appropriate should land be disposed of in future, such that a future owner of the title is notified.

11. EMP Review and Revision

It may, on occasion, be necessary to revise the EMP to reflect changes to legislation and / or regulatory requirements, changes on site and/or improvements in technologies or knowledge.

- Revision of the EMP will be necessary if the details in the EMP have changed (i.e. further assessment provides additional data to inform the EMP, impacted material has been remediated / removed from site, and/or additional / unexpected impacts are encountered during inspections and/or site works);
- Revision of the EMP will be necessary on completion of development works to incorporate the design details;
- Revision of the EMP should be undertaken by an appropriately qualified and experienced environmental consultant;
- Copies of the revised EMP should be distributed to the current Environmental Manager for on-going implementation; and
- The Environmental Manager should ensure that the most current, up-to-date, EMP is provided to any workers on site as part of the EMP induction requirements for works on site.

12. Site Suitability

Subject to the implementation of the requirements of this EMP, and the limitations in **Attachment A,** the site is considered suitable for is current open space and recreational land use.

13. References

- EPA 2014, Waste Classification Guidelines (EPA, 2014).
- Acid Sulfate Soil Management Advisory Committee 1998, Acid Sulfate Soil Manual, (ASSMAC, 1998).
- Environmental Planning and Assessment 1979 (EPA, 1979).
- Model Work Health and Safety Act, 2015 (WHS, 2015).
- NSW EPA 2012, Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases (NSW EPA, 2012).
- SafeWork 2016, Code of Practice 'How to manage and control asbestos in the workplace' (SWA, 2016).
- Safe Work Australia 2013, Workplace Exposure Standards for Airborne Contaminants (SWA, 2013).
- NOHSC (2005). Code of Practice for the Safe Removal of Asbestos NOHSC [2002(2005)].
- SafeWork Australia 2018, Code of Practice 'How to safely remove asbestos' (SWA, 2016).
- CIRIA 2007, Assessing Risks posed by Hazardous ground gases to buildings, C665 (CIRIA, 2007)
- Environmental Guidelines: Solid Waste Landfills, State of NSW, Environment Protection Authority (EPA, 1996).
- Landcom 2004, Managing Urban Stormwater: Soils and Construction guide (Landcom, 2004).
- SafeWork Australia 2016, Code of Practice 'Confined Spaces' (SWA, 2016).
- enHealth (2005). Management of Asbestos in the Non-Occupational Environment (enHealth, 2005).
- AIOH Position Paper, Asbestos. Australian Institute of Occupational Hygienists Inc. August 2008 (AIOH 2008)

Attachment A – Limitations

Limitations

This report has been prepared for use by the client who has commissioned the works in accordance with the project brief only, and has been based in part on information obtained from the client and other parties.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by JBS&G, and should not be relied upon by other parties, who should make their own enquires.

Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements.

Limited sampling and laboratory analyses were undertaken as part of the investigations undertaken, as described herein. Ground conditions between sampling locations and media may vary, and this should be considered when extrapolating between sampling points. Chemical analytes are based on the information detailed in the site history. Further chemicals or categories of chemicals may exist at the site, which were not identified in the site history and which may not be expected at the site.

Changes to the subsurface conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this report are based on the information obtained at the time of the investigations.

This report does not provide a complete assessment of the environmental status of the site, and it is limited to the scope defined herein. Should information become available regarding conditions at the site including previously unknown sources of contamination, JBS&G reserves the right to review the report in the context of the additional information.

Attachment B – Figures

Legend:

Approximate Site Boundary

JBS&G

Job No: 55351

Client: Northern Beaches Council

Version: R01 Rev A | Date: 19-Nov-2018

Drawn By: RF | Checked By: AF

Scale 1:17,500

0 200 400

metres

Coor. Sys. GDA 1994 MGA Zone 56

John Fisher Park, Curl Curl, NSW

SITE LOCATION

FIGURE 1

File Name: 55351_01

Legend:

- Approximate Site Boundary
- Adam Street Reserve (Managed Under Existing EMP)
- Weldon Oval (Managed Under Existing EMP)

JBS&G

Job No: 55351

Client: Northern Beaches Council

Version: R01 Rev A	Date: 19-Nov-2018
Drawn By: RF	Checked By: AF

Scale 1:8,500

0 100 200
metres

Coor. Sys. GDA 1994 MGA Zone 56

John Fisher Park,
Curl Curl, NSW

SITE LAYOUT

FIGURE 2

File Name: 55351_02
Reference: www.nearmap.com - Imagery 20181023

Attachment C – Assessment of Environmental Risk

Assessment of Environmental Risk

An assessment of risk on the identified environmental impacts outlined in **Section 3** has been undertaken in order to provide effective controls to minimise potential exposure pathways associated with the future use of the site with regards human health and the environment.

A summary of identified contamination, potential health effects and exposure pathways are summarised below:

Landfill Material

The landfill contains a mixture of putrescible and non-putrescible waste, including soils, demolition waste, ACM, concrete, brick pieces, plastic, metal, broken glass, car parts, car tyres, timber, vegetation, sandstone, tree stumps and logs (SKM, 2011). The fill may contain a variety of substances that can be potentially classified as corrosive, toxic or malodorous. These can pose a risk to human and ecological health depending on the contaminant type, its form (i.e. solid, liquid, gas), concentration and method of exposure (i.e. dermal contact, ingestion, inhalation). The landfill material has also identified bonded ACM, however, can pose a risk to human health if respirable asbestos fibres are present.

Assessments provided in **Section 1.3** indicate that the lateral extent of fill material varies across the site, with landfill waste extending to the verge of Abbott Road in the north and coming within 20 m of adjoining residential properties in the south. Landfill waste material has been identified to a depth of 3.5 m below ground surface (bgs) at Weldon Oval (WSP, 2012) and Adam Street Oval Reserve in the south and to depths of 7.0 m bgs at Reub Hudson Oval (WSP, August 2010) in the north.

Prior to remedial works at Weldon Oval, a sand cover layer was identified of a depth between 0.2 m and 0.65 m (WSP, 2012). The landfill material below the cover layer comprised brick pieces, ACM sheeting, plastic sheeting, broken glass, mattress springs, carpet, car tyres and timber fragments. The landfill material extended to between 3.0 m and 3.5 m bgs. During remedial works, fill was imported and used to form a cover layer over the site comprising 0.3 m growing medium over 0.1 m sand. The resultant change to the ground level was not reported (WSP, 2012) and it is assumed the cover layer over the landfill material at Weldon Oval now comprises imported growing medium and sand (0.4 m) over the original cover layer between 0.2 m and 0.65 m depth.

The landfill cover material identified at Adams Street Reserve prior to remedial works comprised sand (cover layer) between 0.5 m and 1.0 m depth. Landfill material below the cover layer was identified to 3.0 m bgs and consisted of predominantly demolition waste including ACM, concrete, brick pieces, plastic, metal, broken glass, car parts, car tyres, timber, vegetation and sandstone (SKM, 2011). During remedial works, over 1000 m^3 of excavated natural material (ENM) was imported to resurface the entire area. The type of ENM and the resultant change to the existing ground level was not reported in the Site Audit Report, Adams Street Oval, Lalchere Street, Curl Curl, NSW (PJR&A, 2012). It is understood that the cover material overlying the landfill material now comprises imported ENM over the original sand cover layer between 0.5 m and 1.0 m depth.

During the Jacobs Land Fill Gas investigation (Jacobs, 2016), the site was split into separate areas A to F **(Attachment F)** and offsite to the North of Abbott Road. The material encountered is summarised below:

- North of Abbott Road (offsite) comprised topsoil to 0.1 m and 0.2 m bgs, fill to 0.8m depth underlain by natural sand.
- Area A comprised clayey sandy topsoil to 0.4 m bgs, fill material to 3.1 m depth consisting of sands with fragments of brick, underlain by natural material to a depth of 4.5 m consisting sands, sandy clays and clayey sandy silts.

- Area B comprised fill material to depths of 1.5 m bgs comprising gravelly sand with inclusions of tile fragments, underlain by natural sand material to 2.5 m.
- Area C comprised sand and gravel fill material with inclusions of waste (glass, fabric, plastic, fibro, ceramic and lead flashing) to depths of 2.2 m bgs, underlain by natural sands, sandy clayey silts and clayey sands with some organic matter to 3.0 m depth.
- Area D comprised topsoil material consisting of silty sand and clayey sand to 0.2 m bgs, underlain by fill material consisting of silty sand, clayey sand and sand with inclusions of gravel, ceramic pieces, brick, glass, wood, plastic and polystyrene to 2.5 m depth. Natural material underlying the fill comprised sand and silty clays to encountered depths of 3.0 m.
- Area E comprised topsoil consisting of sand and clayey sand to 0.2 m bgs, underlain by fill material consisting of sand with inclusions of gravel, brick, plastic and sandstone to 1.4 m depth. Natural material was encountered to 1.5 m depth comprising sand.
- Area F comprised fill material between 0.1 m and 0.3 m bgs, comprising sand with fragments of glass, wood and metal.

The shallow fill encountered across the remainder of the site during previous investigations was indicated as sand or clayey sand with occasional fragments of ACM. The thickness of cover material over other areas of the site is unknown.

Investigations have identified concentrations of TPH, PCBs, PAHs and heavy metals exceeding the health-based investigation levels for parks / open space land use. Soil contamination has mainly been at depth within the landfill material. Cover material has broadly been identified across the landfill material and imported to site as a growing medium.

The potential risk posed to park users by the landfill material is considered negligible where the material is covered by a sand layer, however, the cover needs to be maintained. Similarly, there is no potential risk to occupants of onsite buildings or building maintenance workers. The potential risk posed to park maintenance and excavation workers can be controlled by management procedures documented in **Section 6.3 and Section 6.4.**

ACM Fragments

Fragments of non-friable (bonded) ACM have been identified on the ground surface in isolated areas where no surface cover (such as grass, paving) were present. Fragments of bonded ACM have also been identified within material historically used to cover the landfill material, which is thought to have been imported to the site as a growing medium (before late 1970s). Asbestos fibres have not been identified in soils or in general air monitoring conducted across the site.

The main health risks associated with asbestos include asbestosis, lung cancer and mesothelioma, which are associated with the inhalation of respirable fibres and their subsequent deposition in the lung. The potential for airborne fibres to be released into the respiratory environment depends on the type of ACM, its location and condition. Fibre release is also dependent on the material being significantly compromised or disturbed to enable release (enHealth, 2005).

Bonded ACM are where the fibres are locked into a matrix (e.g. asbestos-cement, vinyl tiles). The fibres are contained within the matrix by use of such materials as resins and cement. If ACM is left in situ and remains in good condition, then there is no risk to health (AIOH, 2008), provided it is not subsequently worked (e.g. drilled, sawn).

The potential risks associated with the identified non-friable bonded ACM at the site can be managed by minimising the potential for weathering or abrading, which includes maintaining a cover layer over the identified landfill material and implementing management protocols when disturbing potentially ACM impacted ground.

The risk posed to park users by fragments of bonded ACM is negligible provided surface cover is maintained. There is no risk to occupants of onsite buildings or building maintenance workers given the bonded ACM fragments are located in isolated areas external to the buildings. The potential risk posed to park maintenance and excavation workers can be controlled by management procedures documented in **Section 6.5.**

Landfill Gas

Background

Gas monitoring (surface, sub-surface and perimeter) undertaken at the site has identified elevated levels of methane and carbon dioxide in some locations in concentrations exceeding 1.25 % (v/v) and 1.5 (v/v) respectively, which is the concentration that requires EPA notification in operational landfill monitoring (sub-surface and confined space methane), indicating the landfill material beneath the capping layer is continuing to produce landfill gas (LFG).

Landfills primarily produce methane and carbon dioxide gases, as well as other constituents including hydrogen sulphide, and may potentially contain a wide variety of hazardous properties; flammable, corrosive, toxic or malodorous components. However, the predominant gases are methane and carbon dioxide (at concentrations of between 45-60 % methane and 40-60 % carbon dioxide). Landfill gas is produced by the decay of putrescible material as well as decay of timber and green waste associated with non-putrescible landfill material (Jacobs, 2016).

Methane has a background concentration in the soil similar to that found in air. The oxygen and carbon dioxide content of soil vary as a result of biological processes with a decrease in oxygen and an inverse increase in carbon dioxide levels associated with biological respiration. Values of between 1 % and 5 % carbon dioxide are common and can be higher immediately above the water table (Jacobs, 2016).

Landfill gas can migrate vertically and laterally, depending on subsurface conditions (i.e. unconsolidated land filling) and other conditions including atmospheric pressure changes. Gas is also mobile in the sub-surface environments. Migrating gases can impact service trenches and pits, and excavations. Migration into slab-on-ground structures through cracks and joints in slabs can occur, as well as into other indoor structures via service pipes.

Methane represents an explosion risk which may occur onsite of offsite depending on subsurface conditions and migration. Other gases (such as hydrogen sulphide and carbon dioxide) can also cause a range of health effects depending on the constituent's present, their concentrations and the physical conditions (e.g. confined space, ventilation, etc.).

Landfill at the site is understood to have occurred more than 30 years ago (assumed to open 1951 and close 1975, over 25-year operation) (Jacobs, 2016), with the initial remedial works conducted in the late 1970s. EPA (2012) *'Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases'* document that the generation of methane decreases over time, with little gas produced after approximately 30 years (dependant on favourable decay conditions). However, it argues also that the Australian Greenhouse Office (2008) estimated that 23% of degradable waste remains after 30 years and 11% after 50 years. Thus, it should not be assumed that a landfill will not produce methane, just because it is old.

Monitoring Programmes and LFG Investigations

The site has been the subject of several landfill gas assessments as summarised below.

GHD, 2008 Reub Hudson Oval Report

GHD undertook surface and shallow sub-surface and perimeter landfill gas monitoring at the site during two stages of environmental assessment in 2007 and 2008 (GHD, 2008). During 2007, elevated levels of methane were recorded along the northern boundary of the site in sub-surface

monitoring wells, raising concerns that offsite migration (to the north, Abbotts Road Land) may have been occurring.

Further monitoring undertaken by GHD during 2008 recorded no elevated levels of surface gas emissions within these areas, excluding two locations (LFG1 and LFG9) which recorded methane at 15 ppm and 5 ppm respectively (NSW Benchmark threshold is 500 ppm for surface methane). This indicated sub-surface gases in general were not venting to the atmosphere at appreciable concentrations. No elevated concentrations of carbon monoxide or hydrogen sulphide was recorded in any monitoring locations. Oxygen levels were reported at normal atmospheric levels throughout the investigation.

The shallow (< 0.5 m bgs) sub-surface gas monitoring generally indicated elevated concentrations of LFG were not present in the shallow sub-surface. Methane concentrations were below the NSW EPA benchmark threshold of 1.25% v/v at all locations with the exception of LFG2, LFG3 and LFG24. Methane concentrations at these locations varied between 1.4 %, 37.9% and 7.5% v/v respectively.

Site perimeter LFG gas monitoring was undertaken to access the potential lateral migration of LFG at the site along the northern and southern site boundaries. The results indicated LFG appeared to have migrated laterally towards the sites northern and southern boundaries. Methane was recorded at elevated concentrations in all perimeter wells with the exception of GW7. The highest Methane concentrations were recorded in GW1, GW5 and GW6 along the northern site boundary, indicating possible LFG is migrating laterally, across the northern site boundary, towards nearby residential properties in Abbott Road Land.

GHD prepared a Landfill Closure Plan (GHD, 2008b) to address the landfill issues onsite, however it is understood the LCP has not been implemented onsite. GHD also prepared prepares remediation specifications for Reub Hudson Oval (GHD, 2008c).

AECOM, 2010 Reub Hudson Oval Remediation Technical Review

Aecom undertook a technical review of the background investigations and remediation proposals for the former landfill located at Reub Hudson Oval. Aecom recommended the additional landfill gas monitoring programme outlined in GDH, 2008b landfill closure plan be carried out.

WSP, 2010 Reub Hudson Oval Landfill Gas Risk Assessment

As recommended by Aecom (Aecom, 2010) a further LFG investigation was undertaken by WSP (WSP, 2010) into the buildings along the northern site boundary and potential offsite migration issues. LFG monitoring incorporated previous and newly installed wells (GW1-GW7) (GHD, 2008) and (SG01-SG10) (WSP, 2010) with four rounds of gas monitoring completed.

Elevated concentrations of methane and carbon dioxide were recorded along the northern and southern boundary in excess of adopted guideline values. Depleted levels of oxygen and low concentrations of VOC's (via PID), hydrogen sulphide and carbon monoxide were also recorded. Low flow rates between 0 L/hr and 10.5 L/hr were recorded during the monitoring event. Internal gas monitoring within buildings and service pits along the northern and southern site boundary did not record elevated levels of LFG. Additionally, no elevated methane concentrations were recorded in monitoring wells adjacent to the Scout Hall.

WSP, 2012 Landfill Gas Monitoring Summary Report, Weldon Oval

As part of the remediation strategy for Weldon Oval, WSP was engaged to undertake LFG monitoring, validation and VOC sampling. Elevated methane and carbon dioxide concentrations were recorded above adopted guidelines however, the results indicated that LFG was not migrating offsite towards residential and community land beyond the southern boundary (WSP, 2012) within this area and the site was considered suitable for continued public open space land use.

A LFG monitoring programme identified elevated concentrations of methane, carbon dioxide and hydrogen sulphide however, were localised within the vicinity of organic waste and carbon dioxide concentrations were considered associated with the natural underlying estuarine deposits. Given low flow rates were recorded during the monitoring event, it was considered the potential for gas to migrate offsite was low.

Jacobs, 2016 Landfill Gas Assessment

In order to address the ongoing LFG issues identified across the site and further characterise the potential for LFG migration along the site boundaries, Jacobs undertook gas monitoring including surface (outdoor), sub-surface, enclosed areas / confined spaces (internal buildings, service trenches, stormwater culverts), external around buildings and vapour monitoring (Jacobs, 2016) on all new and 15 existing LFG monitoring wells.

An SAQP (Jacobs, 2015) was prepared in order to outline and delineate a suitable LFG investigation, dividing the site up into separate areas (Area A to F) and north of Abbott Road (offsite). Twenty-five LFG wells where installed onsite (with the exception of LGF6) and six LFG wells were installed offsite adjacent to Reub Hudson Oval (north of Abbott Road) to address the elevated methane concentrations identified along the northern site boundary (WSP, 2010) and to access any potential migration towards neighbouring residential properties.

Surface and internal building gas monitoring was undertaken during a single visit to assess the risk posed to onsite users and building users. Six sub-surface gas monitoring events were undertaken to access potential offsite migration during variable weather conditions, pressures and periods of high and low tides. Two rounds of VOC monitoring were undertaken as part of the LFG monitoring programme to measure sub-surface VOC concentrations at each monitoring location. VOC sampling was also undertaken in five monitoring wells along the norther site boundary were VOCs had previously been detected (WSP, 2010) by installing passive diffusion VOC samplers. Jacobs, 2016 noted *'there are no known endorsed guidelines for VOC mass in passive air samplers'*, however, a conservative approach was adopted, that if VOCs are not detected above the laboratory limit of reporting (LOR) then the concentrations are likely to be below the site assessment criteria (SAC). No concentrations of VOC compounds in all passive samplers where recorded (Jacobs, 2016).

Outdoor surface gas monitoring across the site recorded methane concentrations between 1.2 ppm and 2.4 ppm, significantly below the adopted site assessment criteria of 500 ppm. Sub-surface gas monitoring across the site recorded elevated levels of carbon dioxide (above 1.5 % v/v) in all monitoring locations across the site, including the wells installed north of Abbott Road. Elevated methane concentrations were recorded in Areas A, C, D and F. Negative flow rates were recorded in the sub-surface monitoring wells indicating the wells were in vacuum during the monitoring period, however, the majority of the locations monitored returned flow rates of 0.0 L/hr.

Enclosed area monitoring such as service conduits reported methane concentrations between 4.4 ppm and 16.22 ppm which is below the adopted site assessment criteria of 500 ppm with the exception of one service pit located along the northern boundary, to the south of Abbott Road which reported methane concentrations up to 2250 ppm. The storm water drain is believed to form part of the storm water drainage system that runs south beneath the former landfill and discharges into Greendale Creek.

Internal gas monitoring within buildings onsite recorded methane concentrations between 1.4 ppm and 2.2 ppm, which co-insides with background concentrations recorded within ambient atmospheric air conditions, however, external gas monitoring was undertaken around onsite buildings recording elevated methane concentrations between 1627 ppm and 70,000 ppm, specifically around buildings location within Area A (Jacobs, 2016), however, the gas emissions are likely to vent to the atmosphere and disperse with the absence of voids and enclosed spaces for LFG to accumulate in the identified buildings onsite.

VOC monitoring recorded vapours in a range between 0 ppm and 7.4 ppm which are considered negligible in Jacobs assessment (Jacobs, 2016). VOC passive sampling did not record elevated levels of methane and all locations were reported below the laboratory LOR.

Gas monitoring has not identified significant gas flux or formation pressure at the monitored locations, which decreases the potential for lateral migration of gas. Offsite lateral migration of landfill gas could have the potential to impact adjoining residential areas. Onsite vertical migration of landfill gas has the potential to impact onsite buildings. Gas migration is dependent on a range of factors including, among others, atmospheric pressure, the presence of preferential migration pathways, cover/cap conditions and building construction.

As part of the Jacobs LFG investigation (Jacobs, 2016) and the review of all available previous investigations, the potential for future gas production onsite was considered. It is assumed any migration at the site is likely to include vertical migration from the landfill waste material through the cover layer and lateral migration towards offsite receptors via pressure driven flow.

Surface emissions are considered low due to the vertical release of LFG under current site conditions will almost immediately dilute into the ambient atmosphere.

No elevated concentrations of methane were recorded within buildings onsite and therefore the risk to building users onsite is considered low.

Concentrations of methane within enclosed spaces such as service conduits and stormwater drains are considered low due to the open grating of the pits allowing to passively vent gas to the atmosphere. Both Jacobs and JBS&G undertook an investigation into enclosed spaced (service conduits and stormwater drains) and considered these are a low risk to future site users.

A low risk to offsite receptions, building occupiers and current site users were established and the risk posed by LFG to future site users and the general public was considered negligible.

A moderate risk was assumed for maintenance and construction workers (Jacobs, 2016). The potential risk posed to building maintenance workers, park maintenance and excavation workers by landfill gas emissions can be controlled by way of procedures documented in **Section 6.6.**

JBS&G, 2016 Landfill Gas Appraisal

JBS&G undertook an investigation into a collapsed stormwater drain system onsite (JBS&G, 2016), inclusive of eight accessible stormwater pits located towards the centre of the site, in the vicinity of the sports centre, tennis courts and Abbott Road. No elevated levels of methane (below 1.25% v/v) and carbon dioxide (below 5% v/v) were recorded in the stormwater pits. In addition, no carbon monoxide, hydrogen sulphide or VOCs were detected within the area of the collapsed stormwater drain, and no depleted oxygen levels were recorded.

The stormwater system was observed to include five open grated pits, freely venting potential LFG to the atmosphere, therefore a risk to site user in confined spaces was considered unlike within the area investigated.

LFG monitoring results from all previous investigations indicate LFG is being generated on site. Whilst the source of LFG remains on site (landfill material), appropriate management of LFG should be implemented during any sub-surface excavation works occurring on site.

Jacobs 2016, recommended an ongoing environmental monitoring programme is implemented across the site, comprising all existing perimeter and offsite monitoring wells. Further details on the proposed gas monitoring programme is outlined in **Section 7.**

Jacobs, 2017 Groundwater and Landfill Gas Monitoring

To address and further assess landfill gas, groundwater and surface water issues across the site, Jacobs undertook a monitoring programme during June 2017. Monitoring included groundwater

sampling wells, surface water sampling from Curl Curl Lagoon and landfill gas monitoring (surface and subsurface, including indoor).

Subsurface monitoring wells reported carbon dioxide (30 wells) and methane (9 wells) concentrations above adopted site assessment criteria across the site, with elevated methane concentrations primarily located along the northern site boundary and at LFG28 on the southern site boundary. No exceedances were reported to the north of the site. Given the recorded flow rates during the monitoring program, and carbon dioxide / methane concentrations reported in LFG28 monitoring well, there is a potential for gas migration to the adjacent residential receptor at the south-eastern site boundary.

Heavy metals and ammonia concentrations were reported above site assessment criteria in the groundwater and surface water at the site, however the exceedances are expected to present a low risk to receiving aquatic and terrestrial ecosystems within Curl Curl Lagoon, as well as human health receptors at North Curl Curl beach. The ionic balance results indicated that groundwater from the site is unlikely to be the only influence on water quality within Curl Curl Lagoon.

Based on the findings of the investigation, Jacobs recommended a quarterly LFG monitoring programme, maintenance of LFG27 monitoring well and ongoing location, repair and maintenance of LFG monitoring wells for future monitoring purposes. In addition to LFG, the implementation of an annual groundwater monitoring program, including North Curl Curl beach and continued deterrence from humans coming in contact with Curl Curl Lagoon waters, including all findings addressed in an updated EMP to ensure appropriate mitigation measures are in place to prevent the identified risks.

Jacobs, 2018 Landfill Gas Monitoring Reports

As part of the quarterly LFG monitoring program, Jacobs undertook two monitoring rounds in May and June 2018 on all existing perimeter and off-site monitoring wells. As part of the monitoring programme, two monitoring wells were installed, and all damaged wells repaired.

Gas flow rates were reported between -1.9 and 3.8 L/hr. Carbon dioxide and methane concentrations were recorded in monitoring wells above adopted site assessment criteria. Monitoring wells located on the residential side of Abbott Road to the north of the site recorded exceedances carbon dioxide and methane concentrations.

Jacobs consider that although the current risk to off-site receptors from landfill gas migrating from the site is considered low, the source of landfill gas remains onsite and any future change to the site, site use, or ambient conditions may increase the risk of expose to landfill gas migrating offsite and impacting sensitive receptors.

It was recommended the implementation of a continued quarterly landfill gas monitoring program of all existing perimeter and off-site monitoring wells. Further details on the proposed gas monitoring programme is outlined in **Section 7.**

Groundwater and Surface Water

Ground and surface waters can be contaminated by untreated leachate from landfill sites. Leachate is the liquid that percolates through landfills as a result of infiltration and/or decomposition of the wastes. It may cause water pollution if not properly managed and could be detrimental to human and ecological health if extracted for use at the surface or contact otherwise occurs.

Groundwater beneath the site is assumed to migrate through the site toward Greendale Creek and Curl Curl Lagoon before entering with surface water. The lagoon is intermittently opened to discharge to North Curl Curl Beach. It is assumed groundwater onsite is tidally influence with the

proximity to the coast in addition, infiltration rates are considered high due to the sandy nature of the sediments.

Previous site assessments have recorded standing ground water levels between 0.86 and 5.6 m bgs. The hydraulic conductivity across the site ranged from 0.17 to 65 m/day within the fill material and from 0.09 to 2.9 m/day within the underlying natural soils (WSP, August 2010).

Previous investigations of groundwater and surface water have been undertaken that broadly assess the groundwater and surface water quality across the site. Elevated ammonia, TPH, VOCs and heavy metals have been identified in groundwater.

A review of the surface water data indicates that concentrations of ammonia, nitrate, heavy metals and TPH are less than the primary contact, recreational/open space use criteria provided in ANZECC/ARMCANZ (2000) Water Quality Guidelines. Surface water data provided by UNSW WRL, 2016 indicated the presence of ammonia, chloride and sodium within Curl Curl Lagoon, however, sodium and chloride are considered typical of estuarine environments.

From a human health perspective, potential receptors of surface water are expected to be limited to site users coming into contact with the lagoon water. From the available data there appears to be low risk to human receptors of the surface water due to chemical contamination.

The potential risk posed to park users by the groundwater contents is negligible given the groundwater is present at depth. Similarly, there is no potential risk to occupants of onsite buildings or building maintenance workers. The potential risk posed to park maintenance and excavation workers can be controlled by way of procedures documented in **Section 7**.

Acid Sulfate Soils

Previous investigations have identified Potential Acid Sulphate Soils (PASS) to be present underlying the landfill material on site. PASS that are disturbed and/or exposed to the atmosphere become acidic (low pH) and can be corrosive to concrete and building materials and may cause acidic run off resulting unacceptable impacts to the environment.

PASS does not pose a health risk, rather a risk to the surrounding environment if it is not managed appropriately, as documented in **Section 6.11**.

Attachment D – Example EMP Forms

EMP INDUCTION REGISTER

The purpose of the induction register is to acknowledge acceptance and compliance with the procedures outlined within this EMP by signing the attached log. Copies of this document must be made available for review and be readily available at the job site.

The Induction Register is required to be completed by each person inducted into the EMP.

Person	Position	Signature	Date

COMPLAINTS AND ENVIRONMENTAL INCIDENT REGISTER

The purpose of the Complaints and Environmental Incident Register is to maintain a register of complaints from local residents or concerned parties, which will include a record of any action taken with respect to the complaints.

The Complaints and Environmental Incident Register is required to be completed immediately following the receipt of any complaints associated with works undertaken at the site.

Date	Time	Type of Communication	Name, address and phone number of complainant	Nature of Complaint	Corrective Action	Dates of Response	Signature

SURFACE COVER – AD HOC INSPECTION CHECKLIST

The following checklist should be used on an ad hoc basis. It may be appropriate for such assessments to be made following heavy rainfall episodes which could disturb or remove surface cover and expose landfill materials or visible ACM.

Compliance Questions	Yes (√/x)	No (√/x)	Outcome
Site Capping Layer Inspection Date:			
Is there any degradation in site cover?			If no, no further action is required.
			If yes, the site surface should be repaired appropriately to ensure subsurface soils are adequately covered.
Have any landfill soils or visible ACM been exposed?			If no, no further action is required.
			If yes, any visible ACM fragments exposed will need to be removed in compliance with the requirements of the WorkCover Code of Practice 'How to manage and control asbestos in the workplace', other relevant regulatory requirements; Any other waste material exposed or other unexpected finds should be managed in compliance with this EMP and relevant regulatory requirements.

SURFACE COVER – PERIODIC ENVIRONMENTAL MANAGER INSPECTION CHECKLIST

The following checklist should be used for periodic inspections by an Environmental Manager.

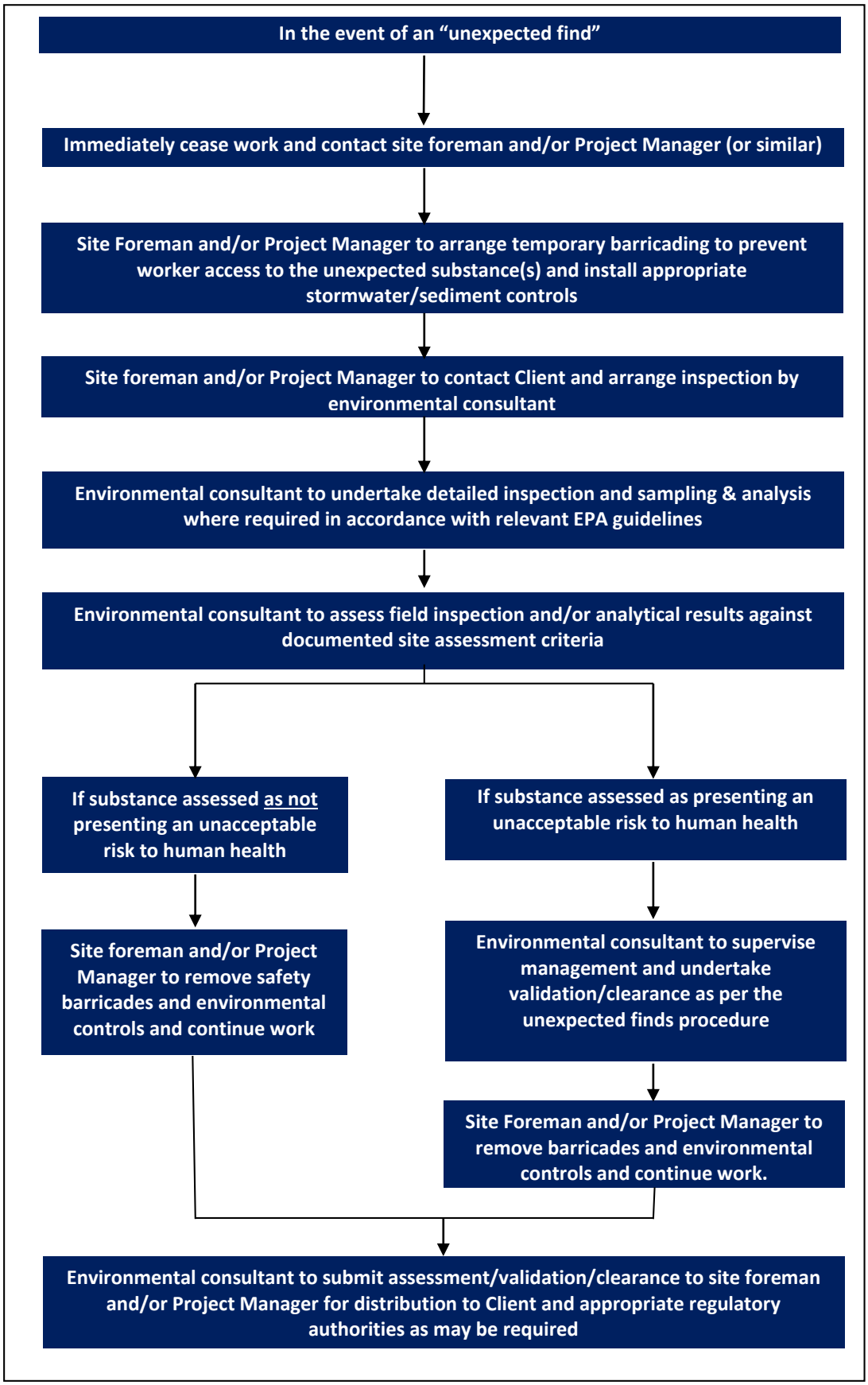
Compliance Questions	Yes (√/x)	No (√/x)	Outcome
Site Capping Layer Inspection Date:			
Is there any degradation in site cover?			If no, no further action is required.
			If yes, the site surface should be repaired appropriately to ensure subsurface soils are adequately covered.
Have any landfill soils or visible ACM been exposed?			If no, no further action is required.
			If yes, any visible ACM fragments exposed will need to be removed in compliance with the requirements of the WorkCover Code of Practice 'How to manage and control asbestos in the workplace', other relevant regulatory requirements; Any other waste material exposed or other unexpected finds should be managed in compliance with this EMP and relevant regulatory requirements.

DUST MANAGEMENT CHECKLIST

During intrusive works that will disturb asbestos or other impacted soils, the following checklist should be completed on a daily basis.

Compliance Questions	Yes (√/x)	No (√/x)	Outcome
Dust Management Inspection Date:			
Has all exposed soil/fill in stockpiles and walls and floors of excavations been kept moist?			If no, corrective actions such as wetting down the area with a hose must be taken.
			If yes, no further action is required.
Is excess run-off being caused by over wetting?			If no, no further action is required.
			If yes, stop wetting and ensure appropriate sediment controls are in place.
Is visible dust migrating from the work site area?			If no, no further action is required.
			If yes, work should cease until such time as dust is controlled or conditions causing dust migration (e.g. excessive wind) improves.
Any non-compliances or migration of dust from site boundaries should be reported to the **Environmental Manager** and appropriate information recorded in the Environmental Incidents Register.			

Attachment E – Unexpected Finds Protocol


In the event of an "unexpected find"
Immediately cease work and contact site foreman and/or Project Manager (or similar)
Site Foreman and/or Project Manager to arrange temporary barricading to prevent worker access to the unexpected substance(s) and install appropriate stormwater/sediment controls
Site foreman and/or Project Manager to contact Client and arrange inspection by environmental consultant
Environmental consultant to undertake detailed inspection and sampling & analysis where required in accordance with relevant EPA guidelines
Environmental consultant to assess field inspection and/or analytical results against documented site assessment criteria
If substance assessed as not presenting an unacceptable risk to human health
If substance assessed as presenting an unacceptable risk to human health
Site foreman and/or Project Manager to remove safety barricades and environmental controls and continue work
Environmental consultant to supervise management and undertake validation/clearance as per the unexpected finds procedure
Site Foreman and/or Project Manager to remove barricades and environmental controls and continue work.
Environmental consultant to submit assessment/validation/clearance to site foreman and/or Project Manager for distribution to Client and appropriate regulatory authorities as may be required

Attachment F – Gas Monitoring Well Location Plans

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Contamination assessment

John Fisher Park

JACOBS NSW SPATIAL - GIS MAP file : \\Jacobs.com\ANZVE\Projects\04_Eastern\IA153200\23 Spatial\GIS\Directory\Templates\Mapl\IA153200_GIS_M001_r2v1.mxd
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