Long-Term Site Management Plan, Recreational/Open-Space Land Use, Barton Park, New South Wales.

Prepared for Bayside Council.

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Edison Environmental & Engineering Pty Ltd
ABN 83 605 328 587
PO Box 564
Balmain NSW
admin@edisonenvironmental.com.au

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No of Copies	Type	Recipient Name	Positions and Company
1	Electronic: samantha.urquhart@bayside.nsw.gov.au	Bayside Council	Samantha Urquhart Manager Property
1	Electronic: james.davis@enviroview.com.au	Enviroview Pty Ltd	James Davis, Accredited Site Auditor

Guide to this Long-Term Site Management Plan (LTSMP)

This Long-Term Site Management Plan (LTSMP) relates to land that has been variously referred to as Cooks Cove, Cook Cove and Cooks Cove Inlet (Cooks Cove) consisting of that part of Barton Park between the M5 motorway to the north and Bestic Street to the south which has been referred to as the 'Southern Precinct', 'Cooks Cove Southern Precinct' (CCSP) or 'Barton Park' (the site).

The site contains a series of former landfill areas. Waste has been covered with a veneer of soil and grass. Since closure of the former landfills the site is accessible to the public and has been used continually for recreational open space land use. Waste material placed at the site gives rise to potential risks associated with buried waste, leachate, hazardous ground gases and soil vapours. The measures outlined in this LTSMP are intended to mitigate these risks. This LTSMP also outlines provisions and processes to be followed in the event that maintenance activities and works are to be undertaken at the site. This document is structured as follows:

- Section 1: Introduction. This section defines the site and provides background information to this LTSTMP;
- Section 2: Objective. The objective of this LTSMP is to detail the minimum measurements required to mitigate potential human health risks associated with former waste landfills in Barton Park. The LTSMP seeks to manage potential risks arising from the existing use of the site and does not contemplate measures associated with the redevelopment of the site;
- Section 3: Site Identification and Environmental Setting. The legal description and boundaries of the site are defined in this section along with a description of the site, geological and hydrogeological conditions;
- Section 4: The history of the site is summarised in Section 4;
- Section 5: Summary of Past Reports. The various past studies undertaken at the site are summarised in this section;
- Section 6: Conceptual Site Model (CSM). A CSM is presented in this section based on the results of past studies;
- Section 7: Management Measures: This section outlines the key measures that must be implemented in order to satisfy the objective of the LTSTMP, specifically:
    - Responsibilities. The plan specifies that a nominated Council representative shall be responsible for oversight and implementation of this LTSMP. Responsibilities of parties acting under the direction of the nominated Council representative are also specified;
    - Minimise Leachate Generation. As part of this LTSMP the top of the former waste mounds will be progressively levelled by the application of minimal quantities of topsoil to reduce infiltration (and leachate generation) and also to improve amenity;
    - Maintain Cover Soil and Grass Cover. The plan specifies that a layer of cover soil and grass cover shall be maintained at the site;
    - Landfill Gas. It is a requirement of this LTSTP that buildings on the site be maintained in a manner that prevents the ingress and/or accumulation of gases and vapour associated with buried waste. A critical element of this plan is the completion of an inaugural inspection of all buildings and enclosed spaces to assess condition and identify corrective actions required to manage potential risks. The key factors to be assessed in the inaugural (and subsequent) inspection(s) are listed in Section 7.4;

  - Intrusive Works, Maintenance and Hot Works. This LTSMP outlines a process to be followed in the event that intrusive works, maintenance and hot works are to be carried out on the site. This implementation of this process if a key component and critical to ensuring that ongoing relevance and appropriateness of the measures outlined in this LTSMP;
  - Odour Observations. The LTSMP outlines a process to be followed in the event that odours indicative of the accumulation of hazardous gases and/or vapours associated with buried waste are identified at the site. Critically, the corresponding requirement must be communicated clearly and formally to occupants and users of the site;
  - Review. Circumstances that cause the basis of this LTSMP are outlined in Section 7.7.
- Section 8: Monitoring Programme. The importance of the inaugral inspection is highlighted in Section 7.4. Monitoring requirements under this LTSTP consist of:
  - Requirement 1: Cover Inspections and Surface-Gas Emission Monitoring;
  - Requirement 2: Buildings Inspections;
  - Requirement 3: Gas-Accumulation Monitoring.

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List of Abbreviations

Units of Measure

%	per cent
ug L^{-1}	Micrograms per Litre
ug m^{-3}	Micrograms per Cubic Metre
ha	Hectare
km	Kilometres
m	Metre
m AHD	Metres Above Australian Height Datum
m BGL	Metres Below Ground Level
m BTOC	Metres Below Top of Casing
mg kg^{-1}	Milligrams per Kilogram
mg L^{-1}	Milligrams per Litre
mg m^{-3}	Milligrams per Cubic Metre
mm	Millimetre
ppm	Parts Per Million
ppb	Parts Per Billion

General

ABC	Added Background Concentrations
ACL	Added Contaminant Limit
ACM	Asbestos Containing Materials
ADWG	Australian Drinking Water Guideline
AEC	Areas of Environmental Concern
AF	Asbestos Fines
AGST	Above Ground Storage Tank
AHD	Australian Height Datum
ALS	Australian Laboratory Services Pty Ltd
ANZECC	Australian and New Zealand Environment and Conservation Council
APHA	American Public Health Association
ASS	Acid Sulphate Soils
ASSMAC	Acid Sulfate Soils Management Advisory Committee
BGL	Below Ground Level
BOD	Biochemical Oxygen Demand
BTEX	Benzene, Toluene, Ethylbenzene and Total Xylenes
CEnvP	Certified Environmental Practitioner
CLM Act	NSW Contaminated Land Management Act, 1997
CMPC	Conceptual Model of Potential Contamination
COC	Chain of Custody
CoPC	Contaminants of Potential Concern
CSM	Conceptual Site Model
CT	Contaminant Threshold
DA	Development Application
DAC	Data Acceptance Criteria
DCP	Development Control Plan
DNAPL	Dense Non-Aqueous Phase Liquid
DP	Deposited Plan
DQI	Data Quality Indicator

DQO	Data Quality Objectives
DSI	Detailed Site Investigation
EIL	Ecological Investigation Levels
EMP	Environmental Management Plan
EOH	End of Hole
EPA	Environment Protection Authority
EPA Act	Environmental Planning and Assessment Act, 1979
EQL	Environmental Quantitation Limit
ESA	Environmental Site Assessment
ESL	Ecological Screening Level
FA	Fibrous Asbestos
FID	Flame Ionisation Detector
GIL	Groundwater Investigation Level
GPS	Global Positioning System
HIL	Health Based Investigation Levels
HSL	Health Screening Levels
IAA	Interim Audit Advice
LCS	Laboratory Control Sample
LEP	Local Environment Plan
LFG	Landfill Gas
LNAPL	Light Non-Aqueous Phase Liquid
LOR	Limit of Reporting
ML	Management Limits
NATA	National Association of Testing Authorities
ND	Not Detected
NEPC	National Environmental Protection Council
NEHF	National Environmental Health Forum
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NL	Not Limiting
NSW	New South Wales
OCP	Organochlorine Pesticides
OEH	Office of Environment and Heritage
OPP	Organophosphorous Pesticides
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PID	Photo-ionisation Detector
POEO Act	Protection of the Environment (Operations) Act, 1997
PQL	Practical Quantitation Limit
PSI	Preliminary Site Investigation
PSH	Phase Separated Hydrocarbon
PSP	Project Safety Plan
QA/QC	Quality Assurance and Quality Control
RL	Reduced Level
RPD	Relative Percentage Difference
RSL	Regional Screening Level
SAC	Site Assessment Criteria
SAQP	Sampling, Analysis and Quality Plan
SAR	Site Audit Report
SAS	Site Audit Statement

SCC	Specific Contaminant Concentration
SCEW	Standing Council on Environment and Water
SILs	Soil Investigation Levels
sPOCAS	Suspension Peroxide Oxidation – Combined Acidity and Sulfate
SPT	Standard Penetration Test
SVOC	Semi-Volatile Organic Compounds
SWL	Standing Water Level
TCLP	Toxicity Characteristics Leaching Procedure
TD	Termination Depth
TDS	Total Dissolved Solids
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons
TV	Trigger Value
USEPA	United States Environment Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compounds
VOCCs	Volatile Organic Chlorinated Compounds
WHS	Work Health and Safety
--	On tables is ‘not calculated’, ‘not measured’, ‘no criteria’ or ‘not applicable

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1. Introduction

To support past planning proposals, a series of environmental studies have been undertaken since 2001 on the land extending from Kogarah Golf Course in the north to the playing fields managed by Bayside Council (Council) extending to West Botany Street in the south (Figure 1). The area has been variously referred to as Cooks Cove, Cook Cove and Cooks Cove Inlet (Cooks Cove).

The playing fields on Barton Park are located on former waste landfills. These fields have been referred to in past studies as Area C (M5 to Spring Street Drain) and Areas D and D1 (Bestic Street to Spring Street Drain). A former landfill area between Spring Street Wetland and West Botany Street (Area E) is also included in the study area for the current report (Figure 2).

The part of Barton Park between the M5 motorway to the north and Bestic Street to the south has been referred to as the 'Southern Precinct', 'Cooks Cove Southern Precinct' (CCSP) or 'Barton Park' (the site; Figure 1).

Edison Environmental & Engineering Pty Ltd (Edison) has been engaged by Council to prepare a site suitability report (Edison, 2020) and an associated Long-Term Site Management Plan (LTSMP). The suitability of CCSP for ongoing use as recreational/open space (including associated maintenance) has been considered by Edison in the report entitled *Report on Site Suitability, Recreational/Open Space, Barton Park, New South Wales.* In summary, following a thorough review of soil, water quality (groundwater and surface water) and landfill-gas monitoring results, Edison (2020) found: *'Subject to the development and implementation of a robust Site Management Plan with a documented programme of ongoing monitoring and maintenance, it is considered that the site can be made suitable for ongoing recreational/open space land use.'*

Management measures are required to:

- Reduce leachate generation in the waste mass without affecting the rate of landfill-gas production and migration. Measures should be implemented to improve site stormwater drainage;
- Ensure that adequate soil cover is maintained to prevent potential human contact with impacted cover soil, buried waste material and landfill gas (and associated trace compounds) in buildings and service conduits;
- Ensure that grass cover is maintained to minimise human contact with impacted cover soils;
- Monitor and manage potential landfill gas (and associated trace compounds) accumulation in buildings and buried service conduits;
- Implement a robust process for the management of maintenance and upgrade works to the site;
- Implement a programme of ongoing environmental monitoring.

Edison (2020) also considered notification triggers in EPA (2015) guidelines entitled *Guidelines on the Duty to Report Contamination Under the Contaminated Land Management Act 1997*. In respect to hazardous ground gases at the site '*notification is not required if approved management measures are in place to control gas entry into buildings or in ground services*.' This Long-Term Site Management Plan (LTSMP) details these management measures contemplated in EPA (2015).

1.1 Background

The most recent suite of environmental studies was commissioned by Cook Cove Inlet Pty Ltd (CCI). Ms Kylie Lloyd of Zoic Environmental Pty Ltd (Zoic) had been engaged by CCI in the role of EPA-Accredited Site Auditor (the Auditor) for the project.

On 30 August 2017, the Auditor issued a Site Audit Statement (SAS) to CCI (reference KJL144). The SAS states '*that given the presence of landfill gas concentrations above current guidance, a Management Plan should be prepared by the consultant and reviewed by a NSW EPA accredited auditor to address potential risks for any below ground works or accumulation in existing buildings prior to demolition of any such structures, or excavations.'*

The SAS also required the preparation of a Sampling, Analysis and Quality Plan (SAQP) outlining additional investigations required to inform the preparation of a landfill gas Conceptual Site Model (CSM) for Barton Park. The works as outlined in the SAQP by Consulting Earth Scientists (CES) (CES, 2017a) focused on characterising potential landfill-gas impacts at the boundary of Barton Park. Boundary segment designations are shown in Figure 3. CES (2017a) concluded that, with the exception of Boundary Segments C, D and F adjoining residential properties on West Botany Street, Firmstone Gardens and Niblick Street, potential landfill-gas risks at the site are '*very low*' on the northern, central and eastern boundaries (Segments A, B, E, H, I and J) and along the central internal Boundary Segment J. A low risk designation was applied to Segment G.

Potential landfill-gas risks associated with Boundary Segments C, D and F warrant further investigation. Potential off-site landfill-gas and soil-vapour impacts to adjoining residential properties are the subject of a separate assessment by Edison and are not considered further in this LTSMP.

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2. Objective

The objective of this LTSMP is to detail the minimum measurements required to mitigate potential human health risks associated with former waste landfills in Barton Park. The LTSMP seeks to manage potential risks arising from the existing use of the site and does not contemplate measures associated with the redevelopment of the site.

The LTSMP provides guidance on:

- Information on Contaminants of Potential Concern (CoPC);
- Measures to reduce landfill leachate generation rates by improving site drainage;
- Measures to ensure that adequate soil cover is maintained to prevent potential human contact with impacted cover soil, buried waste material and landfill gas (and associated trace compounds) in buildings and service conduits;
- Measures to ensure that grass cover is maintained to minimise human contact with impacted cover soils;
- Measures to monitor and manage potential landfill gas (and associated trace compounds) accumulation in buildings and buried service conduits;
- Specific responsibilities and obligations of relevant parties for administering the LTSMP, including a robust process for the management of maintenance and upgrade works to the site;
- Environmental monitoring requirements including trigger levels for further action developed with reference to guidelines endorsed by the Environment Protection Authority (EPA).

This LTSMP does not preclude the implementation of additional measures or management protocols beyond the minimum requirements defined herein.

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3. Site Identification and Environmental Setting

3.1 Site Identification

The Cooks Cove Southern Precinct (CCSP) (also referred to as Barton Park) consists of the following areas (Figure 2 and 4):

- Area C: Land located north of Spring Street Drain, west of the Cooks River and Muddy Creek, east of Eve Street and south of the M5 east motorway easement;
- Area D: Land located south of the Spring Street Drain, west of Muddy Creek, west of former St George Soccer Stadium, east of Arncliffe Market Garden and north of Bestic Street;
- Area D1: Area incorporating former St George Soccer Stadium, bounded by Muddy Creek to the east, Bestic Street to the south, and Area D to the west;
- Area E: Southern portion of Riverine Park bound by Spring Street Drain to the south, Spring Street Wetland to the east and West Botany Street to the west.

The legal descriptions for each area are provided below (Annexure 1):

Area C (approximately 30 ha comprising):

- Part of Lot 1 (north of Spring Street Drain), Deposited Plan (DP) 576148;
- Part of Lot 100 DP 1133869;
- Lot 6 DP 1050923;
- Part of Lot 1 DP 665481;
- Part of Lot 1 DP 219126;
- Part of land referred to in Crown Plan (CP) 12437-3000.

Area D (approximately 13 ha):

- Part of CP 12437-3000 (south of Spring Street Drain);
- Part of Lot 1 DP 576148 (south of Spring Street Drain);
- Part of Lot 100 DP 1133869;
- Part of Lot 1 DP 514811.

Area D1 (approximately 6.3 ha comprising):

- Part of Lot 1 DP 576148 (south of Spring Street Drain);
- Part of Lot 7303 DP 1148740 (south of Spring Street Drain);
- Part of Lot 100 DP 1133869;
- Part of land referred to in CP 7979-3000.

Area E (approximately 1.9 ha):

- Part of Lot 1 DP 665481;
- Part of Lot 1 DP 219126.

The site is zoned for recreational/open-space land use and Special Uses (F6 Corridor) under Sydney Regional Environmental Plan 33 - Cooks Cove (2004 No 397).

The site is located in the Local Government Area (LGA) of Bayside Council and has an area of 49.3 hectares.

3.2 Site Description

In past environmental studies the site has been divided into four (4) broad areas (C, D, D1 and E) as described below (CES, 2017b).

The land bound by Spring Street Wetland, Spring Street Canal, M5 tunnel and the Cooks River has been historically referred to as Area C. Most of Area C is occupied by a former landfill mound (Figure 2). The former landfill extends to the banks of the Spring Street Wetland in the west and M5 tunnel in the north. The former landfill batters slope towards the Cooks River and Spring Street Canal. The former landfill mound on Area C is predominantly covered with grass used for sporting activities (golf range, soccer and baseball fields). The site is uneven due to differential settlement of the underlying waste material. The batters of the former landfill are landscaped with shrubs, trees and mulch on the ground surface. Low-lying land in the south-east corner of the site along Muddy Creek/Cooks River is covered with shrubs. There is a tarred road from West Botany Street with a works depot at the end. There is also a depot/compound for the M5 Motorway in the north-east corner of Area C along the Cooks River. The Spring Street Wetland is tidal and connected to Spring Street Canal. Both the wetland and canal are fully drained of water at low tide.

The land bound by Spring Street Canal, Muddy Creek, Bestic Street and Landing Light Wetlands/market gardens has been referred to as Areas D and D1. The former landfill covers most of the site with batters sloping towards each site boundary. With the exception of the former, disused St George Soccer Stadium which is constructed on a raised fill mound on the former landfill, the top of the former landfill mound is grassed and used for passive recreation. The site is uneven due to differential settlement of the underlying waste material. Batters of the former landfill mound are grassed (southern portion) or vegetated with shrubs (northern portion). The Landing Light Wetland is located in the north-west portion of the site. The wetland is tidal and is connected with Spring Street Canal by a concrete pipe. The level of the pipe allows shallow water depth to be retained within the wetland at low tide.

Area E is a rectangular, grassed park (Riverine Park/Firmstone Gardens) between West Botany Street, Spring Street Wetland and Spring Street Canal to the west, east and south respectively. Riverine Park/Firmstone Gardens extends north beyond the boundary of Area E. The site surface is uneven. The surface is covered with grass and there are small trees along the boundary. The batter to Spring Street Wetland is covered with trees.

Structures on the site consist of brick soccer club and amenities buildings constructed on concrete slabs. The former St George stadium has been partly demolished by removing the roof sheets, glazing and doors. Access to all buildings are secured by locked doors and/or fencing. An inventory of buildings on the site is provided in Annexure 2.

3.3 Geology and Hydrogeology

The *Sydney 1:100,000 Geological Series Map* describes the underlying natural lithology as consisting of silty to peaty quartz sand, silt and clay. Ferruginous and humic cementation occurs in places, in addition to common shell layers. This material is most likely to be of alluvial origin, deposited as sub-aerial and sub-aqueous component of the Cooks River delta. The natural deposit has been reworked significantly in the last century as part of river diversion works. These works would have involved significant dredging operations (CES, 2001a). Waste landfills have been constructed over the natural sediments (Figure 2).

Based on past borehole logs presented in the site suitability report (Edison, 2020), the generalised stratigraphic sequence for the site is as follows:

- Cover soil over waste (former landfill areas): Silty sand to sandy cover soil ranging from 0.1 to 2.7 m thickness over waste material;
- Waste (mounds) consisting of compacted municipal waste material including rubber, cloth, wood, glass, plastic, metal, fabric, ceramic, ash, construction/demolition waste and organic matter;

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- Areas to the periphery of the waste mounds are underlain by reworked alluvial sediments associated with historical diversions/re-alignments of the Cooks River/Muddy Creek with surface fill material;
- Natural alluvial/estuarine sediments consisting of fine to medium-grained, loose sands to coarse-grained dense sands, black/brown peat and soft to dense clays.

Groundwater associated with filled land and underlying unconsolidated sediments is unconfined. The regional direction of groundwater flow is towards the Cooks River (CES, 2017b). Spring Street wetland, Spring Street Drain and the Landing Light Wetland are local groundwater sinks along with Cooks River and Muddy Creek.

A map showing registered groundwater extraction bores within 200 m of the site boundary is provided in the report on site suitability (Edison, 2020). Notably, there are no registered groundwater extraction bores on the site (GW111316 is a monitoring bore). A site inspection by Edison and enquiries with Bayside Council did not identify any unregistered extraction bores on the site. There are five (5) registered groundwater bores on residential properties to the west (hydraulically upgradient) of the site and four (4) bores to the south-east on the opposite side of Muddy Creek.

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4. Site History

The site history if summarised as follows (Maunsell, 2001):

- The site was used as a market garden until early in the twentieth century;
- Parts of the site were used as a sewage farm serving south and western Sydney for approximately 40 years commencing in the late nineteenth Century;
- The sewage farm was decommissioned in the 1940s and filled with waste by Rockdale Council;
- Following completion of landfill operations (1940s-1980s), the site was covered with soil, grassed and converted into a series of sports fields.

Since 2001 the site has been the subject of a series of proposals seeking consent to redevelop the site as a golf course. No substantial changes have been made to the site since 2001 other than the closure of the St George soccer stadium.

5. Summary of Past Reports

Past reports on the site are divisible into those completed prior to and following the issuance of the Site Audit Statement (SAS) KJL144 by Zoic dated August 2016.

5.1 Reports Issued Prior to Site Audit Statement

5.1.1 Maunsell McIntyre, 2001, Site History Geotechnical and Contamination Issues

Maunsell McIncyre was commissioned to undertake a review of geotechnical and contamination issues in association with a Master Plan for the broader Cooks Cove site. The report states that the site was used for the disposal of night soil from the late nineteenth century until the early-mid twentieth century. Thereafter the site was '*reclaimed by various filling materials, including mixed fill from unknown origins in Sydney, and garbage refuse placed by Rockdale Council'.*

The presence of aging waste mounds at the site has been documented since at least 2001 in relation to the Cooks Cove project.

5.1.2 CES Phase I Environmental Site Assessment (2001a)

CES prepared a Preliminary Environmental Site Assessment (PESA) for the broader Cooks Cove site on behalf of the project proponent at the time, Trafalgar Properties Pty Ltd. Nine (9) boreholes (BH101 – BH109) were drilled as part of the PESA on the broader Cooks Cove project site. Of these boreholes, three (3) (BH101, BH102, BH103) were drilled on Area C in the CCSP.

In respect to the landfills in Areas C and D, CES notes that waste has been placed directly on alluvial sediments with no evidence of leachate or gas management systems. CES further notes the presence of methane at concentrations exceeding the Lower Explosive Limit (LEL) on landfill Area C. Furthermore, evidence of the pressurisation of landfill gas in the boreholes is also noted. No groundwater wells were installed as part of the PESA.

5.1.3 CES Report on Wetland Water Sampling (2001b)

CES collected one (1) round of samples to characterise water quality in the Spring Street and Landing Light Wetlands. These tidal waterbodies are located immediately adjacent to the landfills in Areas C and D and are connected with the Cooks River. The report notes indicators that the embankment of the Area C landfill extends to the edge of the Spring Street Wetland. Seepage points were noted in the base of the embankment on a falling tide.

Based on the ammonia (74 mg L^{-1}) concentration taken at low tide and physical observations indicating a likely hydraulic connection between the Area C landfill and the Spring Street Wetland, the report concludes that the water body was impacted by landfill leachate. Notably, partial contributions from the *in situ* degradation of organic matter and possible contributions from off-site sources were also identified. The report concludes that '*while the leachate poses potential risk to the aquatic ecosystem, no threats to users of the site are envisaged under the proposed development concept involving no direct or indirect recreational contact'.*

5.1.4 Golder Associates Interpretative Report on Contamination Investigation (2002)

Golder Associates (Golder) excavated 10 test pits, drilled 13 boreholes and advanced 10 soil gas spikes at the site. A complete site plan showing the location of Golder sampling points is not available.

With respect to the waste mounds, the Golder report re-affirms that the waste has not been capped in a manner that is consistent or compliant with relevant EPA guidelines for landfill construction. The Golder report further re-affirms that the landfills are un-lined and are not fitted with leachate or gas controls.

Ammonia concentrations in groundwater monitoring wells ranged up to 301 mg L^{-1}. Concentrations in Spring Street Wetland (1.87 and 0.78 mg L^{-1}) were '*well below the level recorded by CES (74 mg L^{-1})*'.

With respect to landfill gas, Golder reports that methane levels in all gas spikes adjacent to houses were below the nominated investigation level of 1.5% volume. In contrast, levels within the landfills ranged from 10% to 77% methane by volume.

The Golder report re-affirms that groundwater in and around the waste landfills is impacted with leachate (as indicated by ammonia concentrations). The Golder report further indicates that there is landfill gas present in the waste landfills, but that gas is not present adjacent to residential houses at levels above the nominated investigation level. Notwithstanding the results of the investigation, Golder does note, however, that *'there is some risk of lateral migration to houses at Firmstone Gardens and Eve Street'.*

5.1.5 CES Report on Additional Soil, Groundwater and Landfill Gas Assessment, Area C (2008a)

CES completed the following scope of works on Area C:

- Drilling of 51 soil sampling boreholes (CBH601 – CBH651);
- Installation of 10 groundwater monitoring wells in selected boreholes (CMW601-606 with nested wells in CMW604, CMW606, CMW608, CMW609);
- Installation of landfill gas monitoring wells at 12 locations (CLG601 – CLG612). Conduct one (1) round of monitoring from each well;
- Completion of surface gas survey involving the measurement of concentrations of combustible gases (in methane equivalents) 5 cm above the site surface on a grid pattern;
- Analysis of trace Volatile Organic Compound (VOC) concentrations in one (1) round of soil-vapour samples from two (2) wells (CLG609, CLG611) with highest methane concentrations.

CES reports that the waste material in Area C is up to 8 m thick and overlies natural alluvial soils. Results indicated that groundwater was impacted with ammonia, heavy metals and petroleum hydrocarbons. Along the southern boundary, groundwater was impacted with ammonia to a depth of at least 16 m below ground level (bgl). The report notes an outward direction of groundwater flow from the landfill towards the Cooks River, Spring Street and Eve Street wetlands.

CES notes that '*the results of the groundwater monitoring programme carried out … indicate that there may be obligations to report … under the Contaminated Land Management Act 1997'.* The report recommends that legal advice be sought in relation to this matter. It is noted that, since the date of the CES report, the EPA (2015) has clarified the circumstances arising in a duty to report and that the amendment of the subsequent CLM Act no longer makes reference to the term 'significant risk of harm'.

Results of surface and sub-surface gas monitoring indicate that the rate of landfill gas generation and gas flux through the landfill cover layer is low. The report also notes that the cover soil varied in composition, thickness and permeability and does not form a suitable capping layer.

The investigation confirmed the presence of landfill gas within the landfill and inferred the off-site migration of leachate-impacted groundwater. The report also re-affirms that the landfill has not been properly closed (capped).

5.1.6 CES Report on Additional Soil, Groundwater and Landfill Gas Assessment, Area D (2008b)

CES completed the following scope of works on Area D:

- Drilling of 40 soil sampling boreholes (DBH801 – DBH840);

- Installation of nine (9) groundwater monitoring wells in selected boreholes (DMW802, DMW803, DMW806, DMW808) including nested wells at DMW803 (A/B/C), DMW806 (A/B/C) and DMW808 (A/B);
- Installation of landfill-gas monitoring wells at four (4) locations (DLG801, DLG812, DLG813 and DLG814). Conduct one (1) round of monitoring from each well;
- Completion of surface gas survey involving the measurement of concentrations of combustible gases (in methane equivalents) 5 cm above the site surface on a grid pattern;
- Analysis of trace Volatile Organic Compound (VOC) concentrations in one (1) round of soil vapour samples from two (2) wells (DLG804, DLG813) with the highest methane concentrations.

As with Area C, CES reports that the waste material overlies natural alluvial soils. Monitoring results indicate that groundwater is impacted with leachate indicators, namely ammonia, petroleum hydrocarbons and specific Volatile Organic Compounds (VOCs), particularly in the inferred downgradient direction. The report further notes that impacted groundwater is present near the site boundary and is likely to be migrating off site.

In relation to landfill gas, the report notes that landfill gas is present within the waste mass at concentrations one (1) order of magnitude greater than the Lower Explosive Limit (5% v/v). However, landfill gas had not accumulated under pressure and was not measured in the surface gas survey. The results were interpreted as an indication that gas is not being generated at a high rate or is dissipating through the cover layers at a flux equivalent to the generation rate.

The investigation confirmed the presence of landfill gas within the landfill and inferred the off-site migration of leachate-impacted groundwater. The report also re-affirms that the landfill has not been properly closed (capped).

5.1.7 CES Report on Additional Soil, Groundwater and Landfill Gas Assessment, Area E (2008c)

CES completed the following scope of works on Area E:

- Drilling of 21 soil sampling boreholes (EBH1001-1013, EBH301, ELG1001-1004, EMW1001-1004);
- Installation of four (4) groundwater monitoring wells in selected boreholes (EMW1001-1004);
- Installation of landfill gas monitoring wells at four (4) locations (ELG1001-1004). Conduct one (1) round of monitoring from each well;
- Completion of surface gas survey involving the measurement of concentrations of combustible gases (in methane equivalents) 5 cm above the site surface on a grid pattern;
- Analysis of trace Volatile Organic Compound (VOC) concentrations in one (1) round of soil-vapour samples from two (2) wells (ELG1002, ELG1004) with the highest methane concentrations.

CES reports that the waste material is up to 4 m thick and overlies natural alluvial soils. Monitoring results indicate that groundwater is impacted with ammonia, petroleum hydrocarbons and specific Polycyclic Aromatic Hydrocarbons (PAHs), particularly in the inferred downgradient direction. The report further notes that impacted groundwater is present near the site boundary and is likely to be migrating off site.

In relation to landfill gas, the report notes that landfill gas is present within the waste mass at concentrations one (1) order of magnitude greater than the Lower Explosive Limit (5% v/v). However, landfill gas had not accumulated under pressure and was not measured in the surface-gas survey. The results were interpreted as an indication that gas is not being generated at a high rate or is dissipating through the cover layers at a flux equivalent to the generation rate.

The investigation confirmed the presence of landfill gas within the landfill and inferred the off-site migration of leachate-impacted groundwater. The report also re-affirms that the landfill has not been properly closed (capped).

5.1.8 CES Remediation Action Plans, Area C, D, E (2008d; 2008e; 2008f)

Separate Remediation Action Plans (RAPs) were developed for Areas C, D and E outlining the following scope of works:

- Installation of an engineered capping layer over the former landfills;
- Implementation of a Long-Term Site Management Plan (LTSMP) detailing requirements for ongoing monitoring and maintenance;
- Construction of a soil-bentonite cut off wall around the landfill in Area C;
- Placement of a Clean Soil Barrier (CSB) on parts of Area C not within the landfill footprint;
- Placement of a gas barrier and passive drainage system under proposed buildings and structures to be built on landfilled waste.

Pursuant to the RAPs, the EPA Accredited Site Auditor (Mr Frank Mohen) issued a series of Site Audit Statements (SAS) stating that the site can be remediated to a standard suitable for the proposed open-space land use.

The RAPs have not been implemented.

5.1.9 CES Report on Surface Water Sampling (2008g)

CES conducted further investigations to assess potential off-site impacts of groundwater on the adjacent surface-water bodies. The following scope of works was undertaken:

- Summarise existing data;
- Estimate the volume of groundwater discharging into the water bodies from Areas C, D, E;
- Collection and analysis of water samples from surface-water bodies.

The report concludes that groundwater flowed outwards from the former landfills in a radial pattern and discharges into the surface-water bodies (wetlands and Spring Street Canal). Estimates of groundwater discharge rates into surface-water bodies were estimated to be: 35.5 m^3 day^{-1} from Area C; 14.3 m^3 day^{-1} from Area D; and 2 m^3 day^{-1} from Area E. Exceedances of water-quality criteria for ammonia and petroleum hydrocarbons occurred only at low tide, indicating dilution of leachate-impacted groundwater by tidal flushing.

The results re-affirm the off-site impacts of leachate-impacted groundwater on the surface-water bodies adjacent to the former landfills.

5.1.10 CES Environmental Monitoring - Area C (2010)

The following scope of work was completed in order to assess whether leachate-impacted groundwater from the landfill in Area C was likely to pose a significant risk to surrounding and receiving surface waters:

- Review existing groundwater and surface-water data collected in Area C from 2001 to 2008;
- Map seepage points around the boundary of the landfill and estimate the volume of groundwater discharging from same;
- Sampling and analysis of groundwater from existing monitoring wells on Area C;
- Sampling and analysis of bottom sediments from Spring Street Canal, Muddy Creek and Cooks River.

The report concludes that ammonia is likely to be the only compound which could be impacting on surface waters. The report further concluded that, although groundwater on Area C was impacted by landfill leachate, the impact on surface-water were minimal.

The work undertaken re-affirms that groundwater on Area C is impacted with landfill leachate and that impacts on surface water are temporally transient. That is, consistent with earlier reports, surface-water

impacts occur at low tide and are diluted by diurnal tidal flushing. These results also reflect the low volume of groundwater discharged from the former landfills.

5.1.11 CES Groundwater Monitoring, Area D and Area C (2013a)

CES monitored eight (8) existing wells at the site boundary adjacent to receiving waters: Cooks River for Area C and Muddy Creek for Area D. The monitoring was undertaken to characterise the quality of groundwater discharging into the receiving waters.

CES concluded:

- While ammonia concentrations were elevated in groundwater on Area C, '*concentrations are consistent with previous groundwater monitoring and are not considered to be significantly impacting on the overall quality of the Cooks River*';
- '*Groundwater quality in Area D/Area D1 has been identified as being below the relevant screening criteria, similar to an up-gradient surface water quality sampling location, or not considered to represent a significant risk to the water quality of Muddy Creek (or Cooks River)'.*

5.1.12 CES Review of RAPs and Environmental Data for Revised Development Proposal (2013b)

CES reviewed the RAPs (Section 5.1.8) in the context of a revised development proposal for the CCSP. Recommendations are as follows:

- Area C: Remediation by means of secure capping and either of the following in place of the cut-off wall contemplated in the preceding RAP:
    - Monitored Natural Attenuation (MNA);
    - Enhanced Natural Attenuation (ENA); or
    - The construction of a Permeable Reactive Barrier (PRB).
- Area D: This part of the site was expanded to include land occupied by the St George Soccer Stadium. CES recommended that a new RAP be prepared combining the original Area D and the additional land (D1);
- Area E: Utilise existing RAP with minor amendments;
- Site Management Plans: Develop SMPs to account for ongoing maintenance of remediation infrastructure;
- Acid Sulfate Soils (ASS): Prepare ASS Management Plans.

The review of the RAPs did not recommend any specific requirements with respect to off-site landfill gas or groundwater impacts.

5.1.13 CES SAQP for Preliminary Stage 2 Environmental Site Assessment Area D1 (2015)

CES prepared a detailed Sampling, Analysis and Quality Plan (SAQP) for a preliminary Stage 2 ESA on Area D1.

5.1.14 CES Area D1 Preliminary Stage 2 ESA and Area C Groundwater Monitoring Event (2016a)

The ESA was conducted generally in accordance with the SAQP. The objectives were as follows:

- Assess the suitability of D1 for the proposed use (public open space);
- Assess whether or not the site (current form) is adversely impacting on the surrounding (off site) environment;
- Conduct an additional round of groundwater sampling on Area C to compare and asses temporal changes in groundwater quality.

CES concludes that ground conditions in Area D1 were comparable to those encountered in Area D. CES concludes that leachate-impacted groundwater was likely to be migrating off site and discharging into the Cooks River and Muddy Creek. The rate of landfill gas generation and the quantity of gas present were assessed as being low.

The data re-affirm the presence of landfill gas within the waste mass in addition to the off-site migration of leachate-impacted groundwater into surface water bodies.

5.1.15 CES RAP Areas C, D, D1 and E (2016b)

CES prepared a RAP for Areas C, D, D1 and E consisting of the following items:

- Pilot Trial Study to determine the suitability of an interception trench (pump and treat), hydraulic control (reverse hydraulic gradient) or PRB for the management of leachate-impacted groundwater;
- Site capping and application of a growing medium (landscaping layer) over the site;
- Placement of a gas drainage layer under proposed buildings and structures;
- Groundwater remediation programme;
- Ongoing gas and groundwater monitoring programme focused on the site perimeter.

The RAP did not contemplate the active management of potential off-site landfill gas impacts.

The RAP has not been implemented.

5.1.16 Zoic Site Audit Report and Statement - Cook Cove Stage 1 (Areas C, D, D1, and E) (2016)

The Site Audit Statement states that the site can be made suitable for use as public open space (park, recreational/open space, playing field) subject to the following conditions:

- Preparation of a Landfill Gas Management Plan;
- Development of a landfill gas conceptual site model to identify potential pathways to sensitive receptors now and into the future. Furthermore, an SAQP is to be prepared that outlines the works required to characterise these pathways with reference to NSW EPA Ground Gas Guidelines;
- A baseline ecological survey of the Landing Light Wetlands is to be carried out and considered in the SAQP for the groundwater remediation Pilot Trial Study (PTS);
- A SAQP for the PTS should be prepared and reviewed by the Site Auditor;
- A Detailed Design RAP is to be prepared following the results of the PTS and landfill-gas monitoring.

5.2 Reports Issued pursuant to Site Audit Statement

5.2.1 CES SAQP - Landfill Gas Southern Precinct (2017a)

The SAQP details a scope of works required to *'complete a landfill gas assessment along the western and southern site boundary of the Southern Precinct … to identify any landfill gas migration that may occur after the completion of the landfill cap construction.'*

Consistent with data provided in the preceding sections, Section 1 of the SAQP notes that *'a review of the previous data … indicated that although gas concentrations were elevated within the waste mass, there was no evidence of gas accumulation and pressure (based on the low flow rates detected) and as such a low risk to the off-site residential receptors'.*

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The scope of works outlined in the SAQP is as follows:

- Installation of 18 gas monitoring bores to the level of groundwater arranged 50 metres apart. Eight (8) boreholes were located along the southern boundary and 10 were located along the northern boundary;
- Completion of four (4) rounds of monitoring in the proposed and existing three (3) wells.

5.2.2 CES SAQP - Pumping Tests and Leachate Treatment Pilot Trial, Southern Precinct (2017c)

The SAQP details the scope of works associated with the completion of aquifer pumping tests and leachate treatment plant trials. The scope of works outlined in the SAQP is as follows:

- Drilling of pumping wells (2) and observation wells (12);
- Conduct two (2) aquifer pumping tests;
- Test the operation of an Aerobic Digestion Biological Treatment (ADBT) plant during the pumping test.

5.2.3 CES Draft Preliminary Environmental Site Assessment, Spring Street Wetland (2017d)

CES conducted a Preliminary ESA (PESA) on the Spring Street Wetland. The boundary of the study site (area 1.2 ha) generally corresponds with the high-water mark of the wetland. The wetland was not assessed in any of the previous investigations. The scope of works is as follows:

- Review historical and background information;
- Drill 10 hand auger holes and four (4) sediment samples;
- Collection of surface-water samples from three (3) locations.

Consistent with earlier reports, photographs presented in the report show waste material in the banks of the wetland indicating that the waste was placed to the edge of the water body. The photographs also note visible seepage from the landfill batter and associated indicators of leachate impact.

The report concludes that the wetlands were '*constructed recently (between 1991 and 2000) using former landfill leachate and stormwater control measures to create the base topography for the wetlands*'. The report further concludes that '*the site is not suitable to be classified as an area of ecological significance and requires remediation to improve its ecological/environmental status'.* The report recommends that the wetlands be removed and capped.

The PESA makes no reference to potential landfill-gas impacts in the wetland and states that ammonia concentrations in surface water do not exceed the nominated site assessment criterion.

5.2.4 CES Leachate Management System, Pilot Trial Report (2017e)

The works outlined in the corresponding SAQP (Section 5.2.1) were executed by CES.

The report confirms outward groundwater flows from the former landfills. The report states that '*it is unlikely that there is a hydraulic connection between the leachate and the underlying natural groundwater'*. While the results of pumping tests may support this assertion, the statement is inconsistent with past results of groundwater monitoring in nested wells on Area C that indicate natural alluvium is impacted with leachate (Section 5.1.5). To clarify, there is no leachate barrier or collection system in the base of the former landfills (such a barrier would form an aquitard or aquifuge separating groundwater in the waste and underlying alluvium). While there may be differences in the hydraulic conductivity of the waste and

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alluvium, borehole logs and monitoring results indicate an hydraulic connection between leachate and underlying natural groundwater.

The report also notes that no drawdown in the wetlands was detected during the pumping tests. The report concludes that a '*leachate treatment remediation system is feasible for remediation of the leachate/impacted groundwater at the site'*. While the extraction and treatment of leachate and impacted groundwater may be a feasible option to reduce outflows from the site, the environmental benefits to be gained are questionable. In support of this argument it is noted that Spring Street Wetland and Drain are flushed dry by diurnal tides, bed sediments in the waterways are a likely contributor of ammonia to surface water and the ultimate receiving waterways (Muddy Creek/Cooks River) are highly degraded as a result of urban runoff. Additionally, lowering water levels within the former waste mass has the potential to increase landfill gas emissions and landfill gas generation rates.

5.2.5 CES Draft Detailed Design Remediation Action Plan, Southern Precinct (2017b)

The Draft Detailed Design Remediation Action Plan (DDDRAP) is intended to replace prior RAPs prepared for the site.

The scope of remediation works outlined in the document includes:

- Capping of former landfills;
- Placement of gas drainage and barrier under proposed buildings;
- Placement of a clean soil barrier outside the landfill footprint;
- Construction of a leachate management system consisting of a series of pumping wells and an on-site treatment plant.

A Site Management Plan (SMP) is also specified in the DDRAP to define restrictions for the site in addition to monitoring and maintenance requirements for the leachate management system infrastructure.

Other than gas barriers and drainage layers under proposed (future) site buildings, the DDRAP recommends '*no management of landfill gas … due to the absence of pressured gas accumulation of detectable surface gas emissions'.*

Gas and soil-vapour risks to off-site residential properties are the subject of a separate on-going assessment by Edison.

It is noted that potential risks associated with hazardous ground gases on the site have not been assessed in accordance with EPA (2019) guidelines.

5.2.6 CES Baseline Landfill Gas Assessment Report, Southern Precinct (2017f)

The report is summarised as follows:

- Landfill gas studies were conducted in the Southern Precinct generally in accordance with a scope of works outlined in a Sampling, Analysis and Quality Plan (SAQP) prepared by CES (2017a);
- The aim of the works was to '*complete a landfill gas assessment along the western and southern site boundary of the Southern Precinct … to identify any landfill gas migration that may occur after the completion of the landfill cap construction*.'
- The following scope of works was completed:
    - Installation of 18 gas monitoring bores arranged 50 metres apart. Eight (8) boreholes were located along the southern boundary and 10 were located along the northern boundary;
    - Completion of five (5) rounds of monitoring in the new and existing three (3) wells.

- CES (2017b) divided the boundary of the Southern Precinct into 10 segments (A to J) as shown in Figure 3;
- Gas Screening Values (GSV) and Characteristic Situations (CS) as per EPA (2019) guidelines have been re-calculated by Edison in the site suitability report (Edison, 2020). The resultant level-2 risk assessment is comparable with that of CES (2017g) other than a designation of CS 2 which was applied where either methane concentrations exceeded 1% or carbon dioxide concentrations exceeded 5% regardless of the CS determined by GSV as per EPA (2019) guidelines;
- Conclusions are as follows:
    - Low or very low risk from landfill gas exists along the northern and eastern boundaries (Boundary Segments A, B, E, H and I) and along the central internal Boundary Segment J;
    - Low risk from landfill gas migration has been identified to residential properties on the southern boundary of the site (Boundary Segment G);
    - Moderate to low risk from landfill gas migration has been identified on the western boundary (Boundary Segments C and F) due to the presence of housing in close proximity to the site;
    - Moderate risk from landfill gas migration has been identified on the western boundary (Segment Boundary D) due to the close proximity of housing <u>and waste</u> to the site boundary.

5.2.7 CES Surface Water Sampling 2017 Report, Southern Precinct (2017g)

CES completed a programme of surface-water sampling to characterise *'heavy metal concentrations in surface water bodies surrounding the site, and assess the possibility that elevated concentrations of boron within the leachate could be sourced from saline intrusion from nearby water bodies'*. Samples were collected from 10 locations (high and low tide) and analysed for concentrations of heavy metals.

In relation to the matter of boron concentrations arising from saline water intrusion, the report concludes in the negative.

The document does not add any significant additional information in regard to the objectives of this report.

5.3 Assessment of Site Suitability (Edison, 2020)

Edison (2020) assessed the suitability of the site for ongoing use as recreational/open space (including associated maintenance). Data from past studies were consolidated and reviewed in this report to create a dataset that can be used to assess the suitability of the site for the use as described. This validated dataset was used as a basis to assess the suitability of the site for ongoing recreational/open-space land use.

Data from the following key documents were used to address the objective of this report:

1. Consulting Earth Scientists, 2008a: *Report on Additional Soil, Groundwater and Landfill Gas Assessment.* Report ID: CES050706-BCC-16-F - Area C. 4 August 2008;
2. Consulting Earth Scientists, 2008b: *Report on Additional Soil, Groundwater and Landfill Gas Assessment.* Report ID: CES050706-BCC-19-F - Area D. 5 August 2008;
3. Consulting Earth Scientists, 2008c: *Report on Additional Soil, Groundwater and Landfill Gas Assessment.* Report ID: CES050706-BCC-20-F - Area E. 5 August 2008;
4. Consulting Earth Scientists, 2008g: *Report on Surface Water Sampling.* Report ID: CES050706-BCC-28-D. 12 November 2008;
5. Consulting Earth Scientists, 2010: *Environmental Monitoring - Area C.* Report ID: CES050706-BCC-29-F. 9 June 2010;
6. Consulting Earth Scientists, 2013a: *Re: Groundwater Monitoring, Area D and Area C, Cooks Cove Development, Arncliffe.* Report ID: CES130608-BP-AF. 18 October 2013;
7. Consulting Earth Scientists, 2016a: *Area D1 Preliminary Stage 2 Environmental Site Assessment and Area C Groundwater Monitoring Event Report, Cooks Cove, Bestic Street, Banksia, NSW.* Report ID: CES130608-BP-AJ. 12 February 2016;
8. Consulting Earth Scientists, 2017f: *Baseline Landfill Gas Assessment Report, Southern Precinct, Cook Cove Development, Banksia NSW. Prepared for Cook Cove Inlet Pty Ltd.* Report ID: CES130608-BP-BD. 9 November 2017.

Based on a thorough evaluation of source documents, the data presented in the key documents was considered to be of suitable quality to satisfy the objective of the report with the exception of Area D where supporting documents had not been provided for review. Consequently, data for Area D as reported in CES (2008b) is treated as having low reliability. Notwithstanding, groundwater, surface-water and landfill-gas data in subsequent reports (CES, 2008g; CES, 2010; CES, 2017f) were considered sufficient to satisfy the objective of the report with respect to Area D.

The site is mostly (80-90%) occupied by former municipal waste landfills placed over alluvial sediments associated with the Cooks River and Muddy Creek. The landfills have been constructed without engineering controls to manage leachate or gas impacts associated with leaching or degradation of deposited waste. The waste has been covered with a thin veneer of cover soil of varying thickness and permeability. Based on borehole logs the generalised site stratigraphy consists of:

- Cover soil over waste (former landfill areas): Silty sand to sandy cover soil ranging from 0.1 to 2.7 m thickness over waste material;
- Waste (mounds) consisting of compacted municipal waste material including rubber, cloth, wood, glass, plastic, metal, fabric, ceramic, ash, construction/demolition waste and organic matter;
- Areas to the periphery of the waste mounds are underlain by reworked alluvial sediments associated with historical diversions/re-alignments of the Cooks River/Muddy Creek with surface fill material;
- Natural alluvial/estuarine sediments consisting of fine to medium-grained, loose sands to coarse-grained dense sands, black/brown peat and soft to dense clays.

Concentrations of heavy metals exceeded the Site Assessment Criteria (SAC) for recreational/open-space land use in some samples of cover soils. The potential for the presence of Asbestos Containing Materials (ACM) in cover soil and waste is also acknowledged. Additionally, exceedances of the nominated SAC occurred in samples of buried waste material. Under a scenario of ongoing recreational/open-space land use, management measures are required with respect to the potential risk to users of the site from contact with exposed cover soils (concentrations exceeding the SAC) and, potentially, exposed waste materials in the event that cover soils are eroded.

Groundwater at the site is unconfined, occurring within the waste mass and underlying alluvium. Groundwater is impacted with constituents derived from anoxic and anaerobic waste degradation (primarily ammonia) is hydraulically connected to the surrounding surface-water bodies resources, namely: Spring Street Wetland; Spring Street Drain/Canal; Cooks River; Muddy Creek and the Landing Lights/Riverine Park Wetlands. The estimated quantity of impacted groundwater (and therefore contaminant loading) discharging to surface-water bodies is small relative to the volume of the diurnal tidal prism. Furthermore, the receiving waterways are substantially degraded as a result of urban runoff and organic-rich bed sediments, particularly in the wetlands, are also likely to constitute a source of ammonia at low tide. On these bases, the risks arising from ammonia-impacted groundwater to baseflows in surface-water bodies are considered to be low. The likelihood of potential human contact with impacted groundwater is low due to the configuration of the discharge zone to receiving surface-water resources. Any management measures implemented to address ammonia impacts on surface-water systems must consider potential impacts on landfill-gas production and migration as well as loading of the waste mass. Measures should be implemented to minimise leachate generation by improving drainage and reducing infiltration.

Elevated concentrations of methane, derived from anaerobic waste degradation, are present within the waste mass. Off-site impacts on residential receptors are the subject of separate investigations by Edison and are not considered within the report. Methane is not accumulating under significant pressure within the waste mass, likely due to poor compaction on placement and the thin, relatively porous cover soils. Trace Volatile Organic Compounds (VOCs) have been detected at low concentrations within the waste mass (*e.g.*, Benzene, toluene and chlorobenzene and 1,2,4 trimethyl benzene). Methane has been detected in some buildings on the site albeit at low concentrations. Management measures are required with respect to potential landfill-gas emissions and exposure under a scenario of ongoing recreational/open-space land use.

Triggers that may give rise to a requirement to notify the Environment Protection Authority (EPA) under Section 60 of the *Contaminated Land Management Act 1997* (EPA, 2015) have been considered. It was concluded that notification is not required with respect to landfill provided that '*management measures are in place to control gas entry into buildings or in ground services'.* Concentrations of ammonia in groundwater and surface water may trigger a technical duty to report on the following basis: groundwater quality on the site is impacted by landfill leachate at low tide; leachate-impacted groundwater is migrating off the site; measurable water-quality impacts are reported in the surface-water system adjoining the site at low tide. However, based on the transient nature of surface-water impacts, contributions from natural sources and the degraded condition of the waterways, the impact of ammonia on the aquatic ecosystem is considered to be low.

Management measures are required to mitigate potential human-health risks associated with waste fill, cover soil with heavy metal concentrations above the SAC and hazardous ground gases within the site. Subject to the development and implementation of a robust Site Management Plan with a documented

programme of ongoing monitoring and maintenance, it is concluded that the site can be made suitable for ongoing recreational/open space land use. The management plan should address the following:

- Measures to reduce leachate generation in the waste mass without affecting the rate of landfill-gas production and migration. Measures should be implemented to improve site stormwater drainage;
- Ensure that adequate soil cover is maintained to prevent potential human contact with impacted cover soil, buried waste material and landfill gas (and associated trace compounds) in buildings and service conduits;
- Ensure that grass cover is maintained to minimise human contact with impacted cover soils;
- Implement measures to monitor and manage potential landfill-gas (and associated trace compounds) accumulation in buildings and buried service conduits;
- Implement a robust process for the management of maintenance and upgrade works to the site;
- Implement a programme of ongoing environmental monitoring.

The following data gaps require assessment in the implementation of the management plan:

- The location of service trenches and in-ground structures has not been accurately identified or mapped;
- Area D data are preliminary only as no tables or supporting documents have been provided to Edison for review. One (1) additional round of groundwater and surface-water monitoring is recommended to characterise groundwater and surface-water quality at the site (Areas C, D, D1, E);
- The area occupied by St George Stadium has not been assessed (except for some gas accumulation monitoring in buildings). An assessment of this area is required prior to any re-development programme;
- Groundwater flow contours require validation for Area C as data on the altitude of well collars have not been provided in past documents. Groundwater wells should be surveyed, and updated groundwater flow contours should be plotted based on updated monitoring data;
- With the exception of studies around the site boundary (CES, 2017f), an assessment of risks associated with hazardous ground gases in accordance with EPA (2019) have not been undertaken for the site. One (1) initial round of monitoring from existing wells within the site should be undertaken to assess hazardous ground-gas impacts in accordance with EPA (2019) guidelines;
- Surface-gas survey data is preliminary only as tabulated raw data has not been provided. One (1) round of surface-gas emission monitoring should be undertaken to set a baseline dataset for the LTSMP;
- Soil-vapour data (VOCs in soil vapour) is preliminary as only one (1) round of sampling using Tedlar bags has been undertaken. One (1) round of sub-slab soil vapour monitoring should be undertaken to assess poetical impacts in buildings on the site;
- Potential off-site landfill-gas and soil-vapour impacts to adjoining residential properties are the subject of a separate assessment by Edison and are not considered further in the report.

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6. Conceptual Site Model

A Conceptual Site Model (CSM) is a representation of site-related information regarding contamination sources, receptors and exposure pathways (NEPC, 2013). The development of a CSM is a dynamic process; the data gathered at each stage of the investigation are used to refine the CSM and inform decisions regarding further investigation or management.

The CSM presented below has been prepared with reference to guidelines endorsed by the EPA, specifically NEPC (2013).

6.1 Assumptions and Data Gaps

The CSM is based on the assumption that existing data represents the site conditions and that there have been no material changes in environmental conditions since data were collected. This assumption is considered to be reasonable considering that the site has not been materially altered in the time since data were collected.

Data gaps are as follows:

- The location of service trenches and in-ground structures has not been accurately identified or mapped;
- Area D data are preliminary only as no tables or supporting documents have been provided to Edison for review;
- The area occupied by St George Stadium has not been assessed (except for some gas accumulation monitoring in buildings);
- Groundwater flow contours require validation for Area C as data on the altitude of well collars has not been provided in past documents;
- With the exception of studies around the site boundary (CES, 2017f), an assessment of risks associated with hazardous ground gases in accordance with EPA (2019) has not been undertaken for the site;
- Surface-gas survey data is preliminary only as tabulated raw data has not been provided;
- Soil-vapour data (VOCs in soil vapour) is preliminary as only one (1) round of sampling using Tedlar bags has been undertaken;
- Potential off-site landfill-gas and soil-vapour impacts to adjoining residential properties are the subject of a separate assessment by Edison and are not considered further in this report.

6.2 Contaminants of Potential Concern (CoPC)

The following Contaminants of Potential Concern (CoPC) have been identified:

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Period	CoPC	Phase/State	On site[2]	Off site[2]
Market Garden[1]				
<1900s	• Heavy metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn); • OCPs (Aldrin, Dieldrin, DDT and degradation products).	• Primarily sorbed on soil; • Primarily sorbed on soil.	Y Y	N N
Sewage farm				
1900s - ~1940s	• Pathogens (human waste); • Organic matter (human waste); • Nutrients (human waste); • Bio gas (primarily methane)	• Pathogens (bacteria, viruses, etc); • Solid; • Solid and dissolved; • Vapour and dissolved	Y Y Y U	N N N N
Landfilling				
~1940s - ~1980s	• Petroleum hydrocarbons; • Heavy metals; • PAHs; • OCPs/OPPs; • PCBs; • Asbestos; • Ammonia; • Landfill gas (primarily methane) • Volatile Organic Compounds (VOCs)	• Separated, dissolved, vapour; • Sorbed and dissolved; • Primarily solid phase in waste; • Primarily sorbed on soil; • Primarily sorbed on soil; • Solid and airborne particles; • Dissolved in ground/surface-water; • Vapour and dissolved; • Vapour, sorbed and dissolved.	Y Y Y Y Y Y Y Y Y	Y Y U N N N Y Y Y
Open space				
1978 - ongoing	• Aesthetics; • PACM on bare soil and from dumping; • Herbicides; • Landfill gas (primarily methane); • VOCs • Landfill leachate impact (ammonia, organic loading).	• Bare soil on site surface; • Solid; • Sorbed on soil; • Vapour and dissolved; • Vapour, sorbed and dissolved; • Dissolved. Surface water and groundwater.	Y Y Y Y Y Y	N N N Y Y Y
Note 1: EPA (2003). Note 2: Y means 'yes'; N means 'no'; U means 'unlikely.'				

6.3 Sources, Nature and Extent of Potential Contamination

The majority of the site is occupied by former municipal waste landfills placed over alluvial sediments associated with the Cooks River and Muddy Creek. The landfills have been constructed without engineering controls to manage leachate or gas impacts associated with leaching or degradation of deposited waste. The waste has been covered with a thin veneer of cover soil of varying thickness and permeability.

The waste masses at the site interface either directly or indirectly with the following tidal surface-water resources: Spring Street Wetland; Spring Street Drain/Canal; Cooks River; Muddy Creek and the Landing Lights/Riverine Park Wetlands. These water bodies are variously degraded as a result of urban development.

Groundwater at the site is unconfined and occurs with the waste mass. Groundwater is impacted with constituents derived from anaerobic waste degradation (primarily ammonia) and is hydraulically connected to the surrounding surface-water bodies. Low-reliability estimates of the quantity of impacted groundwater (and therefore contaminant loading) discharging to surface-water bodies are small relative to the volume of the diurnal tidal prism.

The waste mass contains organic matter. Elevated concentrations of methane, derived from anaerobic waste degradation, is present within the waste mass.

6.4 Exposure Pathways, Potential Receptors and Qualitative Risk Assessment

Exposure pathways and potential receptors are considered below along with a qualitative assessment of risk.

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Exposure Pathway	On site	Off site	Potential Receptors	Risk
Human Health				
Soil:				
Incidental ingestion and dermal contact	✔		Workers and visitors	Areas of bare soil pose a potential risk with respect to exposure to cover soil and exposed waste material. Concentrations of CoPC in cover soil were mostly below the SAC for open space/recreational use indicating that potential risks are low provided that adequate grass cover remains in place. Concentrations of CoPC in waste material exceed the SAC. This exposure pathway is complete only if workers intersect waste material without appropriate PPE.
Inhalation of dust and PACM fibres	✔	✔	Workers, visitors and adjoining residents	Maintenance activities (*e.g.* lawn mowing) have the potential to generate dust and exposure to CoPC. Asbestos cement fragments have been identified at the site surface. Inappropriate management methods have the potential to generate asbestos fibres from the identified fragments.
Groundwater and Surface-Water:				
Dermal contact with impacted groundwater and surface water	✔	✔	Persons exposed to impacted water at the site boundary and in waterways	Access to the groundwater discharge interface at the site boundary is difficult and limited (steep banks or muddy wetland/channel beds at low tide). Therefore, access to impacted groundwater discharge zones is considered to be unlikely.
Ingestion of marine life		✔	Ingestion of marine life impacted	The entire Cooks River and tributaries is subject to a ban on fishing for consumption (https://www.dpi.nsw.gov.au/fishing/closures/location-closures/botany-bay-and-georges-river). The ban attests to the generally degraded state of the receiving waterway.
Soil Vapour and Landfill Gas:				
Accumulation of combustible/explosive components of landfill gas (methane) in buildings and service conduits		✔	Users of buildings associated with sporting facilities constructed over waste or impacted groundwater	Initial data shows low levels of methane in site buildings. The risk is considered to be low on the basis of this data and subject to ongoing monitoring. Off-site risks to residential receptors are the subject of a separate and ongoing assessment by Edison.
Inhalation of VOC vapours in enclosed spaces (buildings)	✔	✔	Users of buildings associated with sporting facilities constructed over waste or impacted groundwater	Concentrations of VOCs in site buildings have not been assessed, however, based on the generally low methane concentrations the associated risk is expected to be low. Off-site risks to residential receptors are the subject of a separate and ongoing assessment by Edison.

Ecological				
Soil:				
Direct contact and uptake by terrestrial flora and fauna (assumed to extend to 2 m depth)	✔		Terrestrial flora and fauna within the root zone.	The waste material is impacted with concentrations of heavy metals, TRH and PAHs above the SAC. The site is an urban park with minimal plantings. Ecological risks to terrestrial flora and fauna are expected to be low.
Surface Water and Groundwater:				
Exposure to impacted groundwater migrating off site		✔	Aquatic flora and fauna in receiving water bodies	Groundwater at the site is impacted by landfill leachate at levels above the SAC (heavy metals, naphthalene and ammonia). While it is necessary to undertake additional investigations to determine the extent of off-site groundwater impacts, considering the degraded state of receiving water bodies, diurnal tidal flushing and relatively small quantity of groundwater discharge relative to the tidal prism, the risks to ecological receptors therein is considered to be low.
Exposure to impacted groundwater discharging into surface-water bodies	✔	✔	Aquatic flora and fauna in receiving water bodies	Spring Street Wetland in particular is heavily degraded with bed sediments expected to be a contributor to ammonia impacts in surface water at low tide. Surface-water impacts are temporally transient due to diurnal tidal flushing of the waterways. Considering that the waterways are significantly degraded and subject to ongoing impacts from urban runoff, the risk to aquatic flora and fauna associated with the site is considered to be relatively low.

7. Management Measures

With reference to the Edison (2020) site suitability report, management measures are required with respect to the following:

- Reduce leachate generation in the waste mass without affecting the rate of landfill-gas production and migration. Measures should be implemented to improve site stormwater drainage;
- Ensure that adequate soil cover and grass cover are maintained to prevent potential human contact with buried waste material and impacted cover soils;
- Implement measures to monitor and manage potential landfill-gas (and associated trace compounds) accumulation in buildings and buried service conduits;
- Implement a robust process for the management of maintenance and upgrade works to the site;
- Implement a programme of ongoing environmental monitoring.

7.1 Responsibilities, Management, Reporting and Communication

Council will nominate a representative with appropriate authority to administer and oversee the implementation of this LTSMP. This LTSMP also requires a nominated Certified Environmental Practitioner (Site Contamination Specialist, CEnvP) to undertake inspections and reviews. It is the responsibility of the nominated Council representative to engage and brief environmental specialists and the CEnvP as necessary and as mandated in this LTSMP.

The Council-nominated representative shall be the primary point of contact for all matters relating to works or maintenance issues with the site. The appointment of the representative shall take place by either a formal memorandum or be documented in the minutes of a formal meeting. The record of the appointment shall be appended to this LTSMP and shall include the contact details of the nominated representative. Contact details shall be updated as required.

For clarity it is noted that it is the responsibility of the nominated Council representative to brief and engage the nominated CEnvP to undertake the regular inspections and reporting. The nominated Council representative is responsible for ensuring that maintenance is undertaken and for being accountable for any design processes associated with future changes to the site.

On acceptance of this LTSMP by Council, an inaugural inspection shall be undertaken to identify any non-compliances with the LTSMP. A Corrective Action Request (CAR) shall be raised in response to each non-compliance. A sample CAR form is provided in Annexure 3.

Following initial implementation, inspections shall be undertaken annually as outlined in Section 8.

All personnel responsible for management of the site and for conducting works should be made aware of the requirements of this LTSMP. Any works that disturb the management measures outlined in this LTSMP must be promptly reported to the Council-nominated representative.

For any works undertaken as associated with in-ground or on-ground services/structures, it is recommended that an appropriately-qualified environmental consultant monitor the works and the nominated CEnvP advise on management and methodology of works to be undertaken. It is the responsibility of the nominated Council representative to brief and engage the CEnvP and other specialist consultants as required and as mandated in this LTSMP.

The Council-nominated representative shall be responsible for notifying users of the site (*e.g.*, sporting clubs) as to the existence and provisions of this LTSMP. The briefing shall also advise users of restrictions on works that may be undertaken inside buildings and outdoor areas (no excavations or disturbance of ground cover or floor slabs).

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Roles and responsibilities are summarised in Table 1.

7.2 Minimise Leachate Generation

The site surface is un-even as a result of poor waste compaction and differential settlement. As part of this LTSMP the top of the waste mounds will be progressively levelled by the application of minimal quantities of topsoil. These works will be undertaken in order to improve the amenity of the site and also to improve drainage and prevent ponding of water on the surface. In contrast to the installation of a thick capping system, these works will cause minimum disturbance to the landfill gas regime at the site while reducing the generation of leachate.

The measures outlined below with regard to the maintenance of cover soil and grass cover will also reduce infiltration and leachate generation.

7.3 Maintain Cover Soil and Grass Cover

All waste material is to be overlain by cover soil and grass such that:

- There is no visible waste material at the site surface (including batter slopes); and
- A covering of grass is maintained over all areas of cover soil (note that grass may be substituted by mulch or road materials in garden beds and roadways respectively).

The cover soil layer is to be inspected quarterly and repaired as required. A CAR is to be raised for areas of damaged grass or cover soil requiring repair or reinstatement. Repair methods may include re-grading or the application of additional, imported and validated soil. These repair works would be undertaken by Council maintenance staff or external contractors appointed by the nominated representative. Only validated, imported Virgin Excavated Natural Material (VENM) or validated topsoil shall be used for repairs. Following the works, an inspection shall be undertaken to 'close out' the CAR.

Damaged grass is to be reinstated as soon as practicable. The reinstatement may involve the application of rolled turf, grass seeds or spray grass. As above, a CAR is to be raised for repairs to grass and inspected following completion to 'close out' the request.

It is acknowledged in the site suitability report (Edison, 2020) that there may be Potential Asbestos Containing Materials (PACM) and/or Asbestos Containing Materials (ACM) in waste and possibly cover soils at the site. Accordingly, to minimise potential dust generation and risks associated with potential ACM, mowing must only take place on areas with adequate grass cover.

To minimise the potential for contact with waste and soils in landscaped areas, a layer of mulch must be applied and maintained over the soil surface in these areas. Landscaped areas are to be inspected quarterly and a CAR raised to repair areas without mulch or with exposed soils. The repair works would entail the application of additional mulch. As above, a CAR is to be raised for these repairs and these areas are to be inspected following completion to 'close out' the request.

7.4 Landfill Gas

A list of buildings and enclosed spaces (defined as internal rooms with or without windows) at the site is provided in Annexure 2 and shown on Figure 5.

In the inaugural inspection under this LTSMP, the list provided in Annexure 2 is to be 'ground truthed' and expanded to include the following details:

- Building identifier;
- Building operator;
- Room identifier;
- Floor and wall construction and condition for each room;
- Floor-slab joint details and condition;
- Floor-wall joint details and condition;
- Visible gaps that have the potential to act as gas infiltration pathways;
- Ventilation arrangements;
- Odours.

Floor slabs in existing buildings are to be inspected annually by a qualified structural engineer to identify potential pathways for the ingress of landfill gas or trace gases into indoor spaces. Defects (*e.g.,* open cracks, open expansion joints, spalling) that have the potential to allow ingress of landfill gas into enclosed spaces are to be rectified in accordance with recommendations of a qualified structural engineer. Rectification measures may include:

- Grouting of detects;
- Re-sealing of joins between floor and wall components;
- Re-sealing of floor joints;
- Overtopping slabs.

Recommendations for rectification may include a requirement to cease use of buildings (or part thereof) until the defect(s) is/are rectified. In lesser cases, the structural engineer may recommend ongoing use subject to monitoring until the defect(s) is/are rectified.

Buildings are to be adequately ventilated to minimise the potential for landfill-gas and trace-gas accumulation. The preferred arrangement is for passive ventilation including such measures as:

- Permanent vents installed in walls or windows;
- Doors on storage buildings or service areas replaced with gates;
- It may be necessary to supplement existing ventilation arrangements following the inaugural inspection under this LTSMP.

7.5 Intrusive Works, Maintenance and Hot Works

There is potential that future work will involve excavation for underground utilities installation or maintenance at the site. No intrusive works are to be undertaken on the site without prior approval of the Council-nominated representative responsible for this LTSMP (Section 7.1). Where excavation is required, a project-specific risk assessment is to be prepared and approved by the Council-nominated representative with input from the nominated CEnvP prior to execution of the works. The plan is to be appended to this LTSMP. As a minimum, the plan must include the following:

- Clear definition of works to be undertaken;
- Project-specific risk assessment;
- Isolation of the work areas by secure fencing and signage;
- Gas-monitoring programme during the works involving monitoring of combustible gas concentrations at multiple locations (in/adjacent to excavation, excavator cabin and points around the site);

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- Provisions for water management including seepage into excavations, runoff and rain water management. Importantly, any waste-contact water is to be collected and disposed off site to an appropriately-licenced liquid waste facility;
- Requirement that excavated waste materials that cannot be reinstated be lawfully disposed off site;
- Requirement that excavated waste materials be stockpiled on appropriate plastic or geo-fabric to prevent contamination of the site surface;
- Odour management measures including covering of materials and use of odour suppressants;
- Provision for supervision by a qualified environmental consultant;
- Requirement that cover soil and grass cover be reinstated at the conclusion of works.

In regard to building maintenance work, care must be taken to avoid any damage to pavements and floor slabs (which are the barrier to gas ingress). Should any work be required that may breach floors or walls of buildings then a suitably qualified structural engineer shall be engaged prior to commencing any work. The engineer shall review the design to ensure that the integrity of the structure will be restored at the conclusion of the works.

Personnel employed to undertake any intrusive or maintenance works must develop a project-specific Work Health and Safety Plan endorsed by the nominated CEnvP which limits the potential for exposure to the contaminants listed in Section 6.2 which may be present in fill/soils, groundwater and/or vapour.

For the purpose of this LTSMP, hot works is defined as any process that can create a source of ignition of flammable landfill gases. The ignition source may be associated with a naked flame or use of spark-producing tools. No hot works must be undertaken on site without approval of the Council-nominated representative. A detailed project-specific safety plan must be prepared for the hot works.

Records detailed above are to be appended to this LTSMP.

7.6 Odour Observations

Users of the site (*e.g.,* sporting clubs) are to be advised that any unusual odours observed within site buildings, specifically a landfill gas or hydrogen sulfide (rotten egg) gas odour, are to be promptly reported to the Council-nominated representative (Section 7.1). The origin of the odour should then be investigated as outlined by the nominated CEnvP to assess the level and source of potential landfill-gas ingress. Should the potential for landfill-gas ingress exist, access to the site building(s) should be limited and a structural engineer should immediately be engaged to identify the most likely breach of the building floor and recommend the necessary repairs.

7.7 Review

Circumstances that cause the basis of this LTSMP must be reflected in an addendum to this LTSMP and filed with this plan. Examples of such circumstances include (but are not limited to):

- Changes to the site use or configuration;
- Erection, removal or modification of existing structures (including access arrangements to same);
- Reported incidents associated with potential landfill gas generated at the site;
- Reported damage and subsequent repair of building pavements or penetrations should include a review of the LTSMP to ensure up-to-date information of the building is maintained;
- Any works that require intrusive activities into underlying soils also require a project-specific Environmental Management Plan (EMP) prepared by an appropriately-qualified environmental consultant taking into account all aspects of the works and reviewed by the CEnvP on behalf of the

nominated representative. The EMP shall be based on a works specification and the most current information about the site. A copy of the EMP and associated documents shall be appended to this LTSMP.

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8. Monitoring Programme

Monitoring requirements are detailed below and summarised in Table 2.

8.1 Requirement 1: Cover Inspections and Surface-Gas Emission Monitoring

The site surface shall be inspected by the nominated CEnvP in accordance with the following protocol:

- Walkover inspections at nominal 25 m spacing;
- Inspections and testing are to be undertaken over accessible parts of the site (Figure 5);
- Visual inspection and measurement of methane concentrations 5 cm above the site surface;
- Monitoring to be undertaken using a calibrated device (nominally a Flame Ionisation Detector) capable of measuring methane concentrations to a level of 20 ppm. Monitoring should be undertaken on calm days (wind <10 km hr^{-1}) and preferably during periods of relatively low and stable atmospheric pressure (*e.g.*, <101.3 kPa);
- The quality assurance schedule for surface-gas surveys shall consist of a calibration check at the conclusion of the works. The data shall be accepted if the calibration check is within 10% of the calibration standard;
- Frequency: Quarterly for the first year. Following the first year, and assuming monitoring results are in accordance with EPA (2016) guidelines, reduce methane measurements to an annual frequency;
- Coverage: The entire site is to be inspected and monitored (Figure 4).

The protocol is based on EPA (2016) guidance for active landfill sites. While the site is not an active landfill, the method is thorough and considered to be a defensible basis for assessing cover condition and surface gas emissions.

The following actions will be taken if exposed waste material or bare soil is observed:

- Exposed waste material:
  - i. Prevent access to the area immediately;
  - ii. Raise a CAR;
  - iii. Repair or replace cover material with approved imported soil (VENM);
  - iv. Reinstate grass cover;
  - v. Undertake surface landfill-gas monitoring following completion;
  - vi. Undertake final inspection following completion of works;
  - vii. Close out the CAR once works (*e.g.,* cover soil and grass reinstatement) have been completed and surface-gas survey results have been reviewed by the CEnvP;
- Exposed cover soil:
  - i. Inspect the site to confirm that waste materials are not exposed;
  - ii. Provided that waste materials are not exposed, re-vegetate grass cover as soon as practicable;
  - iii. Until grass cover is reinstated, increase the frequency of inspections and surface-gas surveys to weekly to ensure that waste materials are not exposed.

Depending on circumstances, the following measures may also be considered:

- Increasing frequency of building-gas or surface-gas monitoring;
- Flux monitoring to quantify the emission rate;
- Installation of sub-surface gas monitoring wells or monitoring of existing sub-surface gas monitoring wells on site.

In the absence of an EPA-endorsed criterion for closed former landfills, the EPA (2016) '*threshold for further investigation or corrective action'* of 500 ppm is adopted for surface-gas emission monitoring undertaken as part of this LTSMP. The criterion applies to areas on active landfills with intermediate cover and also '*finally-capped areas'.* Rather than being a criterion for remediation or specific action, exceedance of the threshold value would initiate further investigation and consideration of the requirement for corrective action. (Note that the EPA (2016) guidelines do not provide a technical basis for the derivation of the 500 pm threshold value.) Examples are provided below:

- Example 1: Exceedance of the threshold value in an area with exposed waste and eroded cover soil. In this case the cover soil and grass cover would be reinstated. If the area is located in close proximity to buildings or active playing areas then the access to the area would be prohibited until rectification works are completed;
- Example 2: Exceedance of the threshold value in an area of intact cover soil and good grass cover located away from buildings. In this case the most likely response would be to delineate the extent of the exceedance and repeat monitoring.

8.2 Requirement 2: Buildings Inspections

Requirements for annual building inspections are outlined in Section 7.4.

8.3 Requirement 3: Gas-Accumulation Monitoring

Gas-accumulation monitoring locations are shown on Figure 5.

In the absence of an EPA-endorsed criterion for buildings and structures on closed former landfills, the EPA (2016) '*threshold for further investigation or corrective action'* of 1% (v/v) is adopted for monitoring in enclosed structures undertaken as part of this LTSMP. The criterion applies to areas on active landfills with intermediate cover and also '*finally-capped areas'.* Rather than being a criterion for remediation or specific action, exceedance of the threshold value would initiate further investigation and consideration of the requirement for corrective action. (Note that the EPA (2016) guidelines do not provide a technical basis for the derivation of the 1% threshold value, although the value is conservative and considered to be appropriate in this instance.)

With reference to EPA (2016), concentrations of bulk gases (CH_4, CO_2, O_2, H_2S, CO) will be measured using a calibrated landfill gas analyser (*e.g.,* Geotech GA5000 or equivalent). The scope of gas-accumulation monitoring is outlined below:

- Measure concentrations of bulk gases in each room of each building identified on Figure 5;
- Measure concentrations of bulk gases under buildings if possible;
- Consistent with CES (2017f), concentrations should be recorded for 60 seconds, with readings recorded on 10 second intervals. On conclusion of the 60 seconds, the maximum, minimum and average of 10 second interval readings should be recorded;
- Consistent with EPA (2016) a SAC of 1% (*v/v*) methane shall be adopted for gas-accumulation and sub-surface gas monitoring. In the event of an exceedance, the Council-nominated representative must be notified prior to monitoring personnel leaving the site, and ventilation and daily testing must be undertaken until other control measures are implemented. Access to areas exceeding the SAC shall be prohibited until the CAR is 'closed out'. The approach below shall be followed:
    i. Daily monitoring of the building or enclosed space until ventilation or other measures have been implemented;
    ii. Identification of gas ingress source by a structural engineer;
    iii. Implementation of the structural engineer's recommendations;

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iv. Monitoring following the implementation of recommendations and decommissioning of ventilation or other temporary measures;

v. 'Close out' of the CAR once works have been completed and gas concentrations return to 'background' (defined herein as concentrations measured outside the building or structure);

- Frequency: Quarterly for the first year. Following the first year, and assuming monitoring results are in accordance with EPA (2016) guidelines, reduce methane measurements to an annual frequency.

A sample of indoor air shall be collected in the first round of gas-accumulation monitoring in cases where methane is detected above background levels inside buildings or enclosed spaces. Samples shall be 5 L in volume and shall be analysed for the USEPA TO-15 suite of Volatile Organic Compounds (VOCs).

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9.1 Site-Specific References

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10. Limitations of this Report

This report has been prepared for use by the client who commissioned the works, in accordance with the project brief and based on information provided by the client. The advice contained in this report relates only to the current project. A competent person should review all results, conclusions and recommendations before being used for any other purpose. Edison Environmental & Engineering Pty Ltd (Edison) accepts no liability for use of interpretation by any person or body other than the client. This report must not be reproduced except in full and must not be amended in any way without prior approval by the client and Edison.

The extent of sampling and analysis has been undertaken to target areas of potential environmental concern and to provide site coverage with sampling, where possible, targeting specific soil strata from where contamination is considered most likely to occur based on knowledge of site history and visual inspection. This approach has been adopted in order to maximise the probability of identifying contaminants, however, the approach may not identify contamination that occurs in unexpected locations or from unexpected sources.

Furthermore, soil, rock and aquifer conditions are variable, resulting in potential for the heterogeneous distribution of contaminants across the site. Contaminants have been identified at discrete locations, however, conditions between sample locations have been inferred based on estimated geological and hydrogeological conditions and the nature and extent of identified contamination. Boundaries between zones of variable contamination are generally unclear and have been interpreted based on available data and professional judgement. The accuracy with which subsurface conditions have been characterised depends on the frequency of sampling, field and laboratory methods and the uniformity of the substrate and is therefore limited by the scope of works undertaken.

This report is based on sampling from borehole locations placed to target potential areas of environmental concern and to provide site coverage. This report does not provide a complete assessment of the environmental status of the site and is limited to the scope defined therein. Should information become available regarding conditions at the site including previously unknown sources of contamination, Edison reserves the right to review the report in the context of the additional information.

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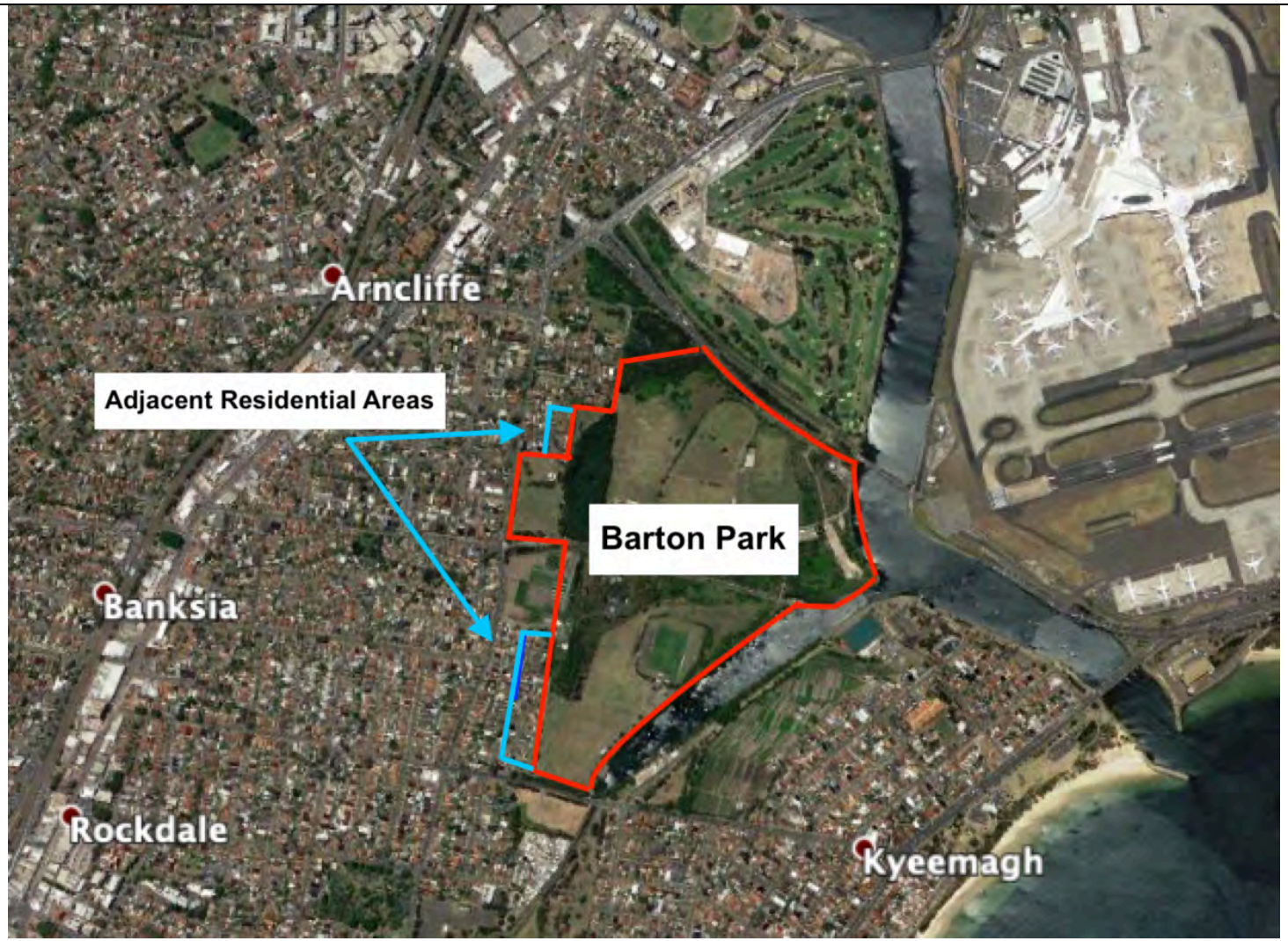
FIGURES



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N

Rev	Description	By	Date
A	Original issue	AL	9/11/17
B	Revision	AL	16/12/19

Legend:

Boundary of Barton Park

Boundary of Adjoining Residential Areas

Scale:

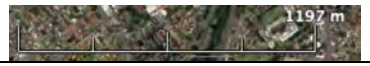

Figure 1: Site Location
Datum: Google Earth Pro

Client: Bayside Council

Project: Barton Park

Project ID: E17011-CU

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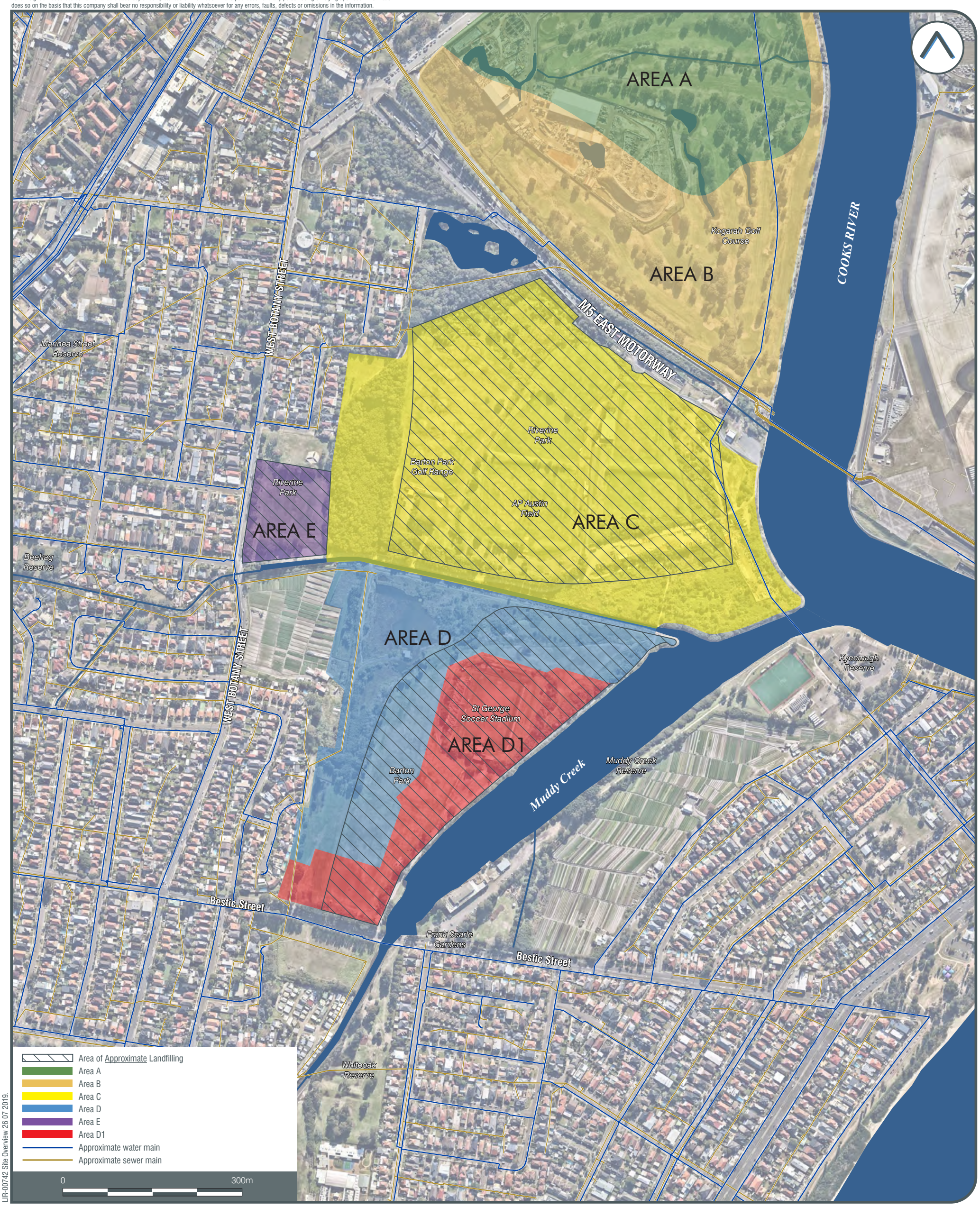

LIR-00742 Site Overview 26 07 2019.

SITE OVERVIEW

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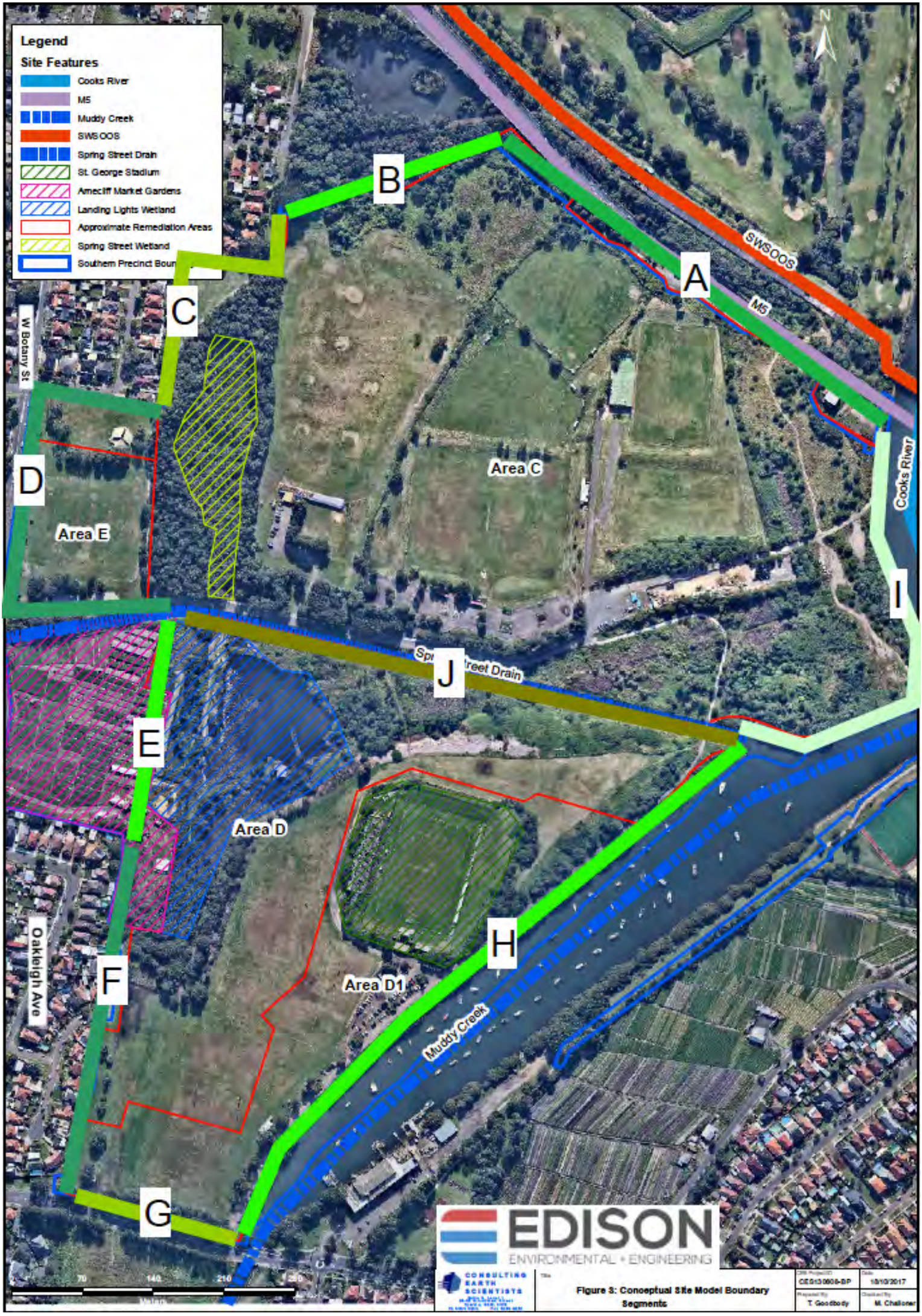
FIGURE 2


Legend
Site Features
Cooks River
M5
Muddy Creek
SWSOOS
Spring Street Drain
St. George Stadium
Ameciff Market Gardens
Landing Lights Wetland
Approximate Remediation Areas
Spring Street Wetland
Southern Precinct Boun
N
A
B
C
D
E
F
G
H
I
J
SWSOOS
M5
W Botany St
Area C
Area E
Cooks River
Spring Street Drain
Area D
Oakleigh Ave
Area D1
Muddy Creek
70
140
210
280
Meters
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CONSULTING EARTH SCIENTISTS
Figure 3: Conceptual Site Model Boundary Segments
CES130606-BP
10/10/2017
T Goodbody
M. Challoner

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LIR-00351 F4 Site boundary of Project Y 12 11 2018

SITE BOUNDARY OF BARTON PARK

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FIGURE 4

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Figure 5: Building Accumulation Monitoring Locations from CES (2017f)

CONSULTING EARTH SCIENTISTS
Suite 3, Level 1
55-65 Grandview Street
Pymble, NSW, 2073
Ph 9449 5200 Fax 9983 9583

Title	CES Project ID:	Date:
Figure 3: Building Accumulation Monitoring Locations	CES130608-BP	27/07/2017
	Prepared By: T. Goodbody	Checked By: M. Challoner

TABLES

Table 1: Roles and Responsibilities				
Role	**Responsibility**	**Documentation**	**Certification**	**Other**
Council-Nominated Representative	- Responsible for LTSMP execution - Primary point of contact for all matters relating to works or maintenance issues with the site - Brief site users as on the requirements of the LTSMP	- LTSMP	- N/A	Note: There may be multiple representatives for different parts of the site. Must be a formal appointment.
Certified Environmental Practitioner (CEnvP)	- Regular inspection, maintenance and monitoring reporting - Reporting to Council-nominated representative - Preparation or review of risks assessments and plans for intrusive works and future changes to the site	- LTSMP - Inspections and monitoring reports - Corrective Action Requests (CARs) - Risk assessments and work plans	- Certified Environmental Practitioner (CEnvP)	
Environmental Consultant	- Supervision of intrusive works and future changes to the site	- Risk assessments and work plans - Daily activity logs - Records of raw material sources	- Appropriate tertiary qualification	- Must be approved by council-nominated representative
Site Users (*e.g.,* Sporting Clubs)	- Comply with LTSMP - Not undertake excavations or disturbance of ground cover or floor slabs - Advise of any unusual odours observed within site buildings, specifically a landfill-gas or hydrogen sulfide (rotten egg) gas odour	- LTSMP		
Structural Engineer	- Building inspections - Advise scope of works to repair structures and pavements or to improve ventilation	- As required	- Certified Practicing Structural Engineer	

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Table 2: Monitoring and Inspection Schedule				
Item	**Test**	**Min. Test Frequency**	**Responsibility**	**Other**
Cover Inspections and Surface-Gas Emission Monitoring	- Walkover inspections at nominal 25 m spacing across accessible parts of the site - Visual inspection and measurement of methane concentrations 5 cm above the site surface - Monitoring to be undertaken using a calibrated device capable of measuring methane concentrations to a level of 20 ppm. Monitoring should be undertaken on calm days (wind <10 km hr-1) and preferably during periods of relatively low and stable atmospheric pressure (*e.g.,* <101.3 kPa)	- Quarterly for first year then reduce methane measurements to annual frequency - Calibration standard check reading at conclusion of survey	- Nominated Council Representative to engage CEnvP or approved environmental consultant	
Building Inspections	- Visual inspection. Walls free of protrusions capable of penetrating leachate barrier system.	- Each wall and room	- Nominated Council Representative to engage CEnvP or approved environmental consultant and structural engineer	

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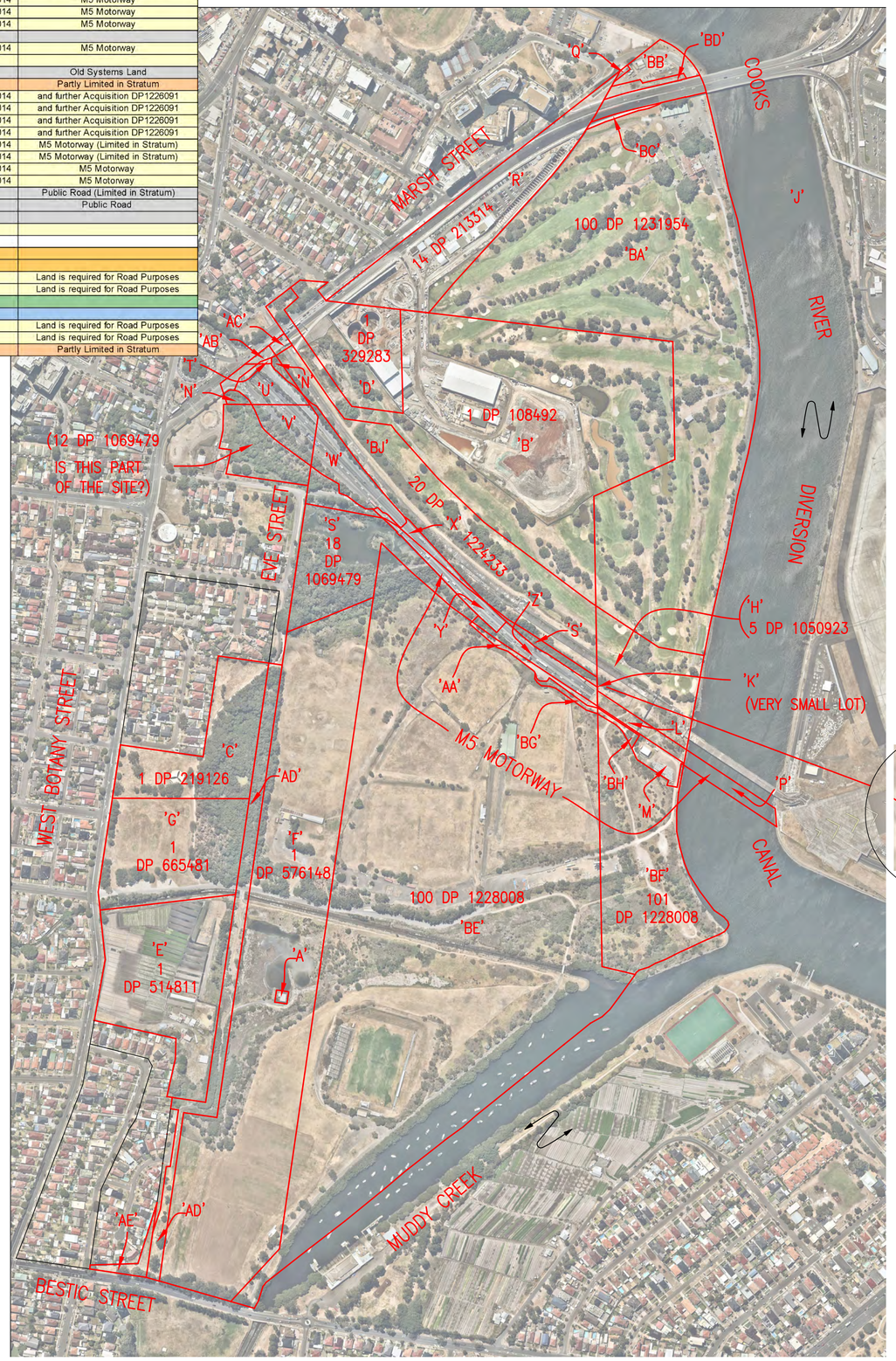
Gas-Accumulation Monitoring	- Measure concentrations of bulk gases in each room of each building - Measure concentrations of bulk gases under buildings if possible - Concentrations should be recorded for 60 seconds, with readings recorded on 10 second intervals. On conclusion of the 60 seconds, the maximum, minimum and average of 10 second interval readings should be recorded	- 1 test per room in each building - 1 test under each building (minimum) - Quarterly for first year then reduce methane measurements to annual frequency	Nominated Council Representative to engage CEnvP or approved environmental consultant	

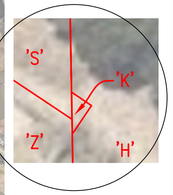
ANNEXURE 1:
Lot and Deposited Plan

Folio Identifier	Veris Plan Identifier	Lot No	DP No	Owner as Noted on Title	Current Alternate Name	Acquisition Notation or Road	Comments
1/107987	A	1	DP107987	Commonwealth of Australia			Subject of Lease to Sydeny Airports
1/108492	B	1	DP108492	The Council of the Municipality of Rockdale	Bayside Council	DP1224219	Subject of Lease for Roads Act
1/219126	C	1	DP219126	The Council of the Municipality of Rockdale	Bayside Council		
1/329283	D	1	DP329283	The Commissioner for Main Roads	RMS	DP1224223	
1/514811	E	1	DP514811	Minister Administering the Environmental Planning and Assessment Act			
1/576148	F	1	DP576148	The Council of the Municipality of Rockdale	Bayside Council		
1/665481	G	1	DP665481	Rockdale Council	Bayside Council		
5/1050923	H	5	DP1050923	Commonwealth of Australia			
7/1050923	J	7	DP1050923	The State of New South Wales			Cooks River Diversion Canal
9/1050923	K	9	DP1050923	Roads and Traffic Authority of New South Wales	RMS	Dedicated as Road 7-3-2014	M5 Motorway
10/1050923	L	10	DP1050923	Roads and Traffic Authority of New South Wales	RMS	Dedicated as Road 7-3-2014	M5 Motorway
11/1050923	M	11	DP1050923	Roads and Traffic Authority of New South Wales	RMS	Dedicated as Road 7-3-2014	M5 Motorway
11/1069479	N	11	DP1069479	The Council of the Municipality of Rockdale	Bayside Council	DP1226091	
12/1050923	P	12	DP1050923	Roads and Traffic Authority of New South Wales	RMS	Dedicated as Road 7-3-2014	M5 Motorway
13/570900	Q	13	DP570900	The Commissioner for Main Roads	RMS	DP1224202	
14/213314	R	14	DP213314	Rockdale Council	Bayside Council	DP1224202	Old Systems Land
18/1069479	S	18	DP1069479	Sydney Water Corporation			Partly Limited in Stratum
25/1069479	T	20	DP1069479	Roads and Traffic Authority of New South Wales	RMS	Dedicated as Road 7-3-2014	and further Acquisition DP1226091
26/1069479	U	26	DP1069479	Roads and Traffic Authority of New South Wales	RMS	Dedicated as Road 7-3-2014	and further Acquisition DP1226091
27/1069479	V	27	DP1069479	Roads and Traffic Authority of New South Wales	RMS	Dedicated as Road 7-3-2014	and further Acquisition DP1226091
28/1069479	W	28	DP1069479	Roads and Traffic Authority of New South Wales	RMS	Dedicated as Road 7-3-2014	and further Acquisition DP1226091
29/1069479	X	29	DP1069479	Roads and Traffic Authority of New South Wales	RMS	Dedicated as Road 7-3-2014	M5 Motorway (Limited in Stratum)
30/1069479	Y	30	DP1069479	Roads and Traffic Authority of New South Wales	RMS	Dedicated as Road 7-3-2014	M5 Motorway (Limited in Stratum)
31/1069479	Z	31	DP1069479	Roads and Traffic Authority of New South Wales	RMS	Dedicated as Road 7-3-2014	M5 Motorway
32/1069479	AA	32	DP1069479	Roads and Traffic Authority of New South Wales	RMS	Dedicated as Road 7-3-2014	M5 Motorway
35/1069479	AB	35	DP1069479	Rockdale Council	Bayside Council	DP1226091	Public Road (Limited in Stratum)
36/1069479	AC	36	DP1069479	Rockdale Council	Bayside Council	DP1226091	Public Road
100/1133869	AD	100	DP1133869	Rockdale Council	Bayside Council		
A/400546	AE	A	DP400546	The Commissioner for Main Roads	RMS		
100/1231954	BA	100	DP1231954	Kogarah Golf Club Limited		DP1224202	
101/1231954	BB	101	DP1231954	Kogarah Golf Club Limited		DP1224202	
102/1231954	BC	102	DP1231954	Roads and Maritime Authority	RMS		Land is required for Road Purposes
103/1231954	BD	103	DP1231954	Roads and Maritime Authority	RMS	DP1231486	Land is required for Road Purposes
100/1228008	BE	100	DP1228008	The State of New South Wales			
101/1228008	BF	101	DP1228008	Her Most Gracious Majesty Queen Elizabeth the Second			
102/1228008	BG	102	DP1228008	Roads and Maritime Authority	RMS		Land is required for Road Purposes
103/1228008	BH	103	DP1228008	Roads and Maritime Authority	RMS		Land is required for Road Purposes
20/1224233	BJ	20	DP1224233	Sydney Water Corporation			Partly Limited in Stratum

TITLE REVIEW PLAN



M.G.A. NORTH



ISSUE	DATE	AMENDMENT	BY

TYPICAL NOTES:

1. ORIGIN OF LEVELS SSM 0000, R.L.00.000 (A.H.D.)
2. BEARINGS ARE ON XXXX NORTH
3. NO BOUNDARY SURVEY HAS BEEN UNDERTAKEN.
4. BEARINGS & DISTANCES HAVE BEEN COMPILED FROM TITLE AND/OR DEED INFORMATION SUPPLIED BY DEPARTMENT OF LANDS NSW.
5. RELATIONSHIP OF IMPROVEMENTS AND DETAIL TO BOUNDARIES IS DIAGRAMMATIC ONLY AND SPECIFIC DETAILS, IF CRITICAL, WILL REQUIRE FURTHER SURVEY.
6. SERVICES SHOWN ARE BASED ON VISIBLE SURFACE INDICATORS EVIDENT AT THE DATE OF SURVEY AND THE RELEVANT SERVICE DIAGRAMS OF THE VARIOUS AUTHORITIES. ALL SERVICE MUST BE VERIFIED ON SITE PRIOR TO ANY WORK BEING UNDERTAKEN. LINKER SURVEYING PTY LTD BEAR NO RESPONSIBILITY FOR THE ACCURACY OR COMPLETENESS OF THE SERVICES SHOWN HEREON.
7. RIDGE, EAVE & GUTTER HEIGHTS HAVE BEEN OBTAINED BY AN INDIRECT METHOD AND ARE ACCURATE FOR PLANNING PURPOSES ONLY.
8. ADJOINING BUILDINGS AND DWELLINGS HAVE BEEN PLOTTED FOR DIAGRAMMATIC PURPOSES ONLY AND SPECIFIC DETAILS, IF CRITICAL, WILL REQUIRE FURTHER SURVEY.
9. THE DIAMETER (ø), SPREAD (S) & HEIGHT (H) OF EACH TREE IS INDICATIVE ONLY AND SPECIFIC DETAILS, IF CRITICAL, WILL REQUIRE FURTHER SURVEY.
10. CONTOURS ARE AN INDICATION OF THE TOPOGRAPHY ONLY. SPOT LEVELS SHOULD BE USED IF DETAILED DESIGN IS TO BE UNDERTAKEN.
11. CONTOUR INTERVAL XXX.METRE.

LEGEND OF TYPICAL CODES

AE	– ARCHITECTURAL EMBELLISHMENT	MUD	– METAL LID
AP	– ALIGNMENT PIN	NS	– NATURAL SURFACE
AWN	– AWNING	OCC	– STRUCTURE
BALC	– BALCONY	OPT	– OPTUS PIT
BAWN	– BOTTOM OF AWNING	PC	– PRAM CROSSING
BB	– BOTTOM OF BANK	PED	– PEDESTRIAN CROSSING
BCH	– BOTTOM OF CHIMNEY	PERG	– PERGOLA
BD	– BOTTOM OF DOOR	PM	– PERMANENT MARK
BDY	– BOUNDARY	PP	– POWER POLE
BF	– BOTTOM OF FENCE	ROK	– ROCK
BHR	– BOTTOM OF HANDRAIL	RLWY	– RAILWAY
BIT	– BITUMEN	RM	– REFERENCE MARK
BK	– BOTTOM OF KERB	RR	– ROOF RIDGE
BLD	– BUILDING	RSN	– CONCRETE NAIL
BM	– BENCH MARK	SDW	– SEWER
BOL	– BOLLARD	SHR	– SHRUB
BR	– BOTTOM OF ROCK	SIP	– SEWER INSPECTION PIT
BRK	– BRICK	SLH	– SEWER LAMP HOLE
BRW	– BOTTOM OF RETAINING WALL	SMH	– SEWER MANHOLE
BS	– BOTTOM OF STEPS	SP	– SIGN POST
BW	– BOTTOM OF WALL	SSM	– STATE SURVEY MARK
BWIN	– BOTTOM OF WINDOW	SV	– STOP VALVE
CHIM	– CHIMNEY	SW	– STORM WATER
CL	– CENTRELINE	TARCH	– TOP OF ARCH
CLID	– CONCRETE LID	TAWN	– TOP OF AWNING
COL	– COLUMN	TB	– TOP OF BANK
COM	– COMMUNICATIONS PIT	TBX	– TELSTRA BOX
CONC	– CONCRETE	TCH	– TOP OF CHIMNEY
CPT	– CARPORT	TD	– TOP OF DOOR
D	– DOOR	TEL	– TELSTRA PIT
DD	– DISH DRAIN	TELP	– TELSTRA PILLAR
DH	– DRILL HOLE	TF	– TOP OF FENCE
DHW	– DRILL HOLE & WINGS	TG	– TOP OF GUTTER
DWY	– DRIVEWAY	THR	– TOP OF HANDRAIL
EB	– EDGE OF BITUMEN	TI	– TRAFFIC ISLAND
EBOX	– ELECTRICITY BOX	TK	– TOP OF KERB
EC	– EDGE OF CONCRETE	TL	– TRAFFIC LIGHT
ED	– EDGE OF DOOR	TP	– TOP OF PARAPET
EG	– EDGE OF GARDEN	TR	– TREE
ELEC	– ELECTRICITY PIT	TRF	– TOP OF ROOF
ELP	– LIGHT POLE	TRK	– TOP OF ROCK
EP	– EDGE OF PATH	TRW	– TOP OF RETAINING WALL
ER	– EDGE OF ROAD	TS	– TOP OF STEPS
FCE	– FENCE	TW	– TOP OF WALL
FL	– FLOOR LEVEL	TWIN	– TOP OF WINDOW
FFL	– FINISHED FLOOR LEVEL	US	– UNDERSIDE
FP	– FENCE POST	UAWN	– UNDERSIDE OF AWNING
GD	– GLASS DOOR	UKS	– UNKNOWN SERVICE
GL	– GROUND LEVEL	USB	– UNDERSIDE OF BEAM
GM	– GAS METER	USC	– UNDERSIDE OF CEILING
HPG	– HIGH POWDERED GAS	USE	– UNDERSIDE OF EAVE
HR	– HANDRAIL	USG	– UNDERSIDE OF GUTTER
HYD	– HYDRANT	V	– VENT
IL	– INVERT LEVEL	VER	– VERANDAH
K	– KERB	VC	– VEHICLE CROSSING
LIN	– LINTEL	W	– WINDOW
LP	– LAMP POST	WM	– WATER METER
MH	– MANHOLE		

LEGEND OF TYPICAL SERVICES

—— C ——	COMMUNICATIONS CABLE	—— RW ——	RECYCLED WATER
—CSWP—	CERAMIC STORMWATER PIPE	—— RM ——	RISING MAIN
—— E ——	UNDERGROUND ELECTRICITY CABLES	—— RMS ——	ROADS & MARITIME SERVICES
		—— S ——	SEWER
—AE——AO—	UNDERGROUND ELECTRICITY & OPTUS CABLES	—— SO ——	SEWER OUTFALL
		—— ST ——	SHARED TRENCH
—— FS ——	FIRE SERVICE	—— SW ——	STORM WATER
—— G ——	GAS LINE	—CW——CK—	STORMWATER CREEK
—— GE ——	GAS LINE & ELECTRICITY CABLES	—— T ——	TELSTRA CABLES
—— NBN ——	NATIONAL BROAD BAND CABLES	—— TG ——	TELSTRA & GAS CABLES
—— NG ——	NATURAL GAS LINE	—— U ——	UNKNOWN SERVICE
—— OH ——	OVERHEAD CABLES	—— VO ——	VOCUS CABLES
—— OPT ——	OPTUS CABLE	—— VR ——	VERIZON CABLES
—— PE ——	PRIVATE ELECTRICITY	—— W ——	WATER SUPPLY
—— PS ——	PRIVATE SEWER	—— WM ——	WATER MAIN
—— PW ——	PRIVATE WATER		

1. ALL UNDERGROUND SERVICE INFORMATION INCLUSIVE OF GENERAL POSITION AND SURFACE COVER DEPTHS NOTED ON THE PLAN ARE APPROXIMATELY ONLY.
2. ALL UNDERGROUND SERVICE INFORMATION HAS BEEN COMPILED FROM SERVICE AUTHORITY PLANS PROVIDED BY THE AUTHORITIES.
3. THE LOCATION OF SERVICES BETWEEN SURVEYED POINTS (AS INDICATED) HAVE BEEN SHOWN DIAGRAMMATICALLY ONLY USING THE SERVICE DIAGRAMS AS PROVIDED. THE EXACT LOCATION OF THESE SERVICES BETWEEN THE SURVEYED POINTS MUST BE VERIFIED PRIOR TO ANY EXCAVATION OR PILING. NO WARRANTY IS GIVEN AGAINST THE POSSIBILITY OF THE EXISTENCE OF FURTHER UNCHARTED SERVICES.
4. ALL CONTRACTORS, TRADESMEN, BUILDING & PROJECT CONSULTANTS MUST CONTACT THE VARIOUS AUTHORITIES, IN ACCORDANCE WITH STANDARD "DIAL BEFORE YOU DIG" PROCEDURES PRIOR TO UNDERTAKING ANY WORKS WITHIN THE VICINITY OF THE SERVICE LINES TO VERIFY THE POSITION OF THE SERVICE LINES.

Liability limited by a scheme approved under Professional Standards Legislation

DIAL BEFORE YOU DIG www.1100.com.au The Essential First Step

REDUCTION RATIO 1 : 4000

0 50 100 150 200 250 300 350 400

LENGTHS ARE IN METRES

CLIENT:

TITLE No:	REF:171208
DATUM: A.H.D.	ISSUE:1
DATE OF SURVEY:	ISSUE DATE:11.12.17
SURVEYOR: TM	SHEET SIZE:A1
DRAFTER: JJ	SHEET 1 OF 1 SHEETS

PLAN SHOWING TITLE & OWNERSHIP STRUCTURE OF COOKS COVE WITHIN THE BAYSIDE COUNCIL

LINKER SURVEYING
veris A Veris Company
Suite 301, Level 3, 55 Holt Street
Surry Hills NSW 2012
PO Box 1807
Strawberry Hills NSW 2012
t: (02) 9212 4655
f: (02) 9212 5254
email: reception@linkersurveying.com.au
web site: www.linkersurveying.com.au

X:\17JOBS\171204 COOKS COVE\171204 TITLE REVIEW PLAN\171204 TITLE REVIEW PLAN.DWG

ANNEXURE 2:
Inventory of Buildings Areas C, D, D1 and E

Inventory of Buildings for Areas C, D, D1 and E	
Location Ref. ID	Location Description
1	Toilet block
1	Toilet block under
2	Soccer stadium entry
2	Soccer stadium entry under
3	Soccer stadium building 1
3	Soccer stadium building 1 under
4	Soccer stadium building 2
4	Soccer stadium building 2 under
5	Soccer stadium A
5	Soccer stadium A under
6	Soccer stadium B
6	Soccer stadium B under
7	Soccer stadium C
7	Soccer stadium C under
8	Container A
8	Container A under
9	Container B
9	Container B under
10	Driving range A
10	Driving range A under
11	Driving range B
11	Driving range B under
12	Toilet / change rooms
12	Toilet / change rooms under
13	Clubhouse A
13	Clubhouse A under
14	Clubhouse B
14	Clubhouse B under

Note: Inventory of buildings summarised from table 3 of CES report *Baseline Landfill Gas Assessment Report, Southern Precinct, Cook Cove Development, Banksia* (CES Document Reference: CES130608-BP-BD) dated 28 July 2017

ANNEXURE 3:
Sample Corrective Action Request (CAR) Form

CORRECTIVE ACTION REQUEST (CAR) FORM

CAR RAISED BY:

SOURCE OF CPAR

☐ Inspection date /. /. . ☐ Site observations

☐ Report from site ☐ Internal Council referral

Description of the problem:

Signature: Date:

Nominated responsible party *(Nominated by the Council nominated representative):* .....

Completion Dates

- Implement interim measures .....
- Engage resources (internal/external) .....
- Undertake works and final inspection .....

Action required to fix the problem:

Signature *(Nominated staff member):* ..... Date: .....

Cause of the problem:

Signature *(Nominated staff member):* ..... Date: .....

Additional contributing factors to problem:

Signature *(Nominated staff member):* ..... Date: .....

Corrective action required to eliminate the cause and contributing factors:

Signature *(Nominated staff member):* Date:

Follow-up and Close-out *(Principal)*

Follow-up inspection required: ☐ No Audit Date
Audit No.

Corrective Action Effectiveness Checked: ☐ OK Date

CAR Close-out Authorised: Date: Signature: