AIR QUALITY & ODOUR MANAGEMENT SUB-PLAN

BARANGAROO STAGE 1

Document No: H010106LLC003

MP10_0227	Commercial Building C5	-	Yes
MP11_0044	Commercial Building C3	-	Yes
MP10_0025	Commercial Building C4	MOD1	Yes
MP10_0023	Bulk Excavation and Basement Car Parking	MODS1,3,4	Yes
Approval no.	*Project*	*Modifications*	*Included in current revision*

F	07/12/2012	Revised issue for additional modifications
E	17/05/2012	Revised issue for additional approvals and modifications
D	30/11/2011	Revised issue for addition of EPL requirements
C	23/09/2011	Revised issue for addition of C4 and authority comment
B	08/04/2011	Revised issue for construction including authority comments
A	10/12/2010	Initial issue for authority comment
Revision	*Date*	*Description of Change*

Table of Contents

AIR QUALITY & ODOUR RELATED ACRONYMS & GLOSSARY

Air Monitoring	Sampling for and measuring of pollutants present in the atmosphere
Air Pollutants	Amounts of foreign and/or natural substances occurring in the atmosphere that may result in adverse effects to humans, animals, vegetation, and/or materials
Ambient Level	Existing level of a phenomenon without the influence of construction activities
Background Dust Level	Dust level in the absence of construction activities
BoM	Bureau of Meteorology
DECCW	Department of the Environment, Climate Change and Water (see EPA)
DP&I	Department of Planning and Infrastructure (formerly DOP)
Dust	Particles of mostly mineral origin generated by erosion of surfaces and handling of materials
Dust Concentration	The amount of a substance, expressed as mass or volume, in a unit volume of air
Emission	A discharge of a substance (e.g. dust) into the environment
EPA	Environment Protection Authority (formerly part of OEH, DECCW)
MCOA	Minister's Conditions of Approval
Mitigation Measures	Measures employed to reduce (mitigate) an impact
NO_2	Nitrogen Dioxide
NO_X	Oxides of Nitrogen
OEH	Office of Environment and Heritage
Particulate Matter	Small solid or liquid particles suspended in or falling through the atmosphere – sometimes expressed by the term particulates
PM_{10}	Particulate matter <10µm in diameter
Pollution	The alteration of air, soil, or water as a result of human activities such that it is less suitable for any purpose for which it could be used in its natural state
TSP	Total Suspended Particulate
VOC	Volatile Organic Compound

INTRODUCTION

The Barangaroo site has been divided into three distinct redevelopment areas – the Headland Park, Barangaroo Stage 2 and Barangaroo Stage 1. Lend Lease was successfully appointed as the preferred proponent to develop Barangaroo Stage 1 (otherwise known as Barangaroo South) in 2009.

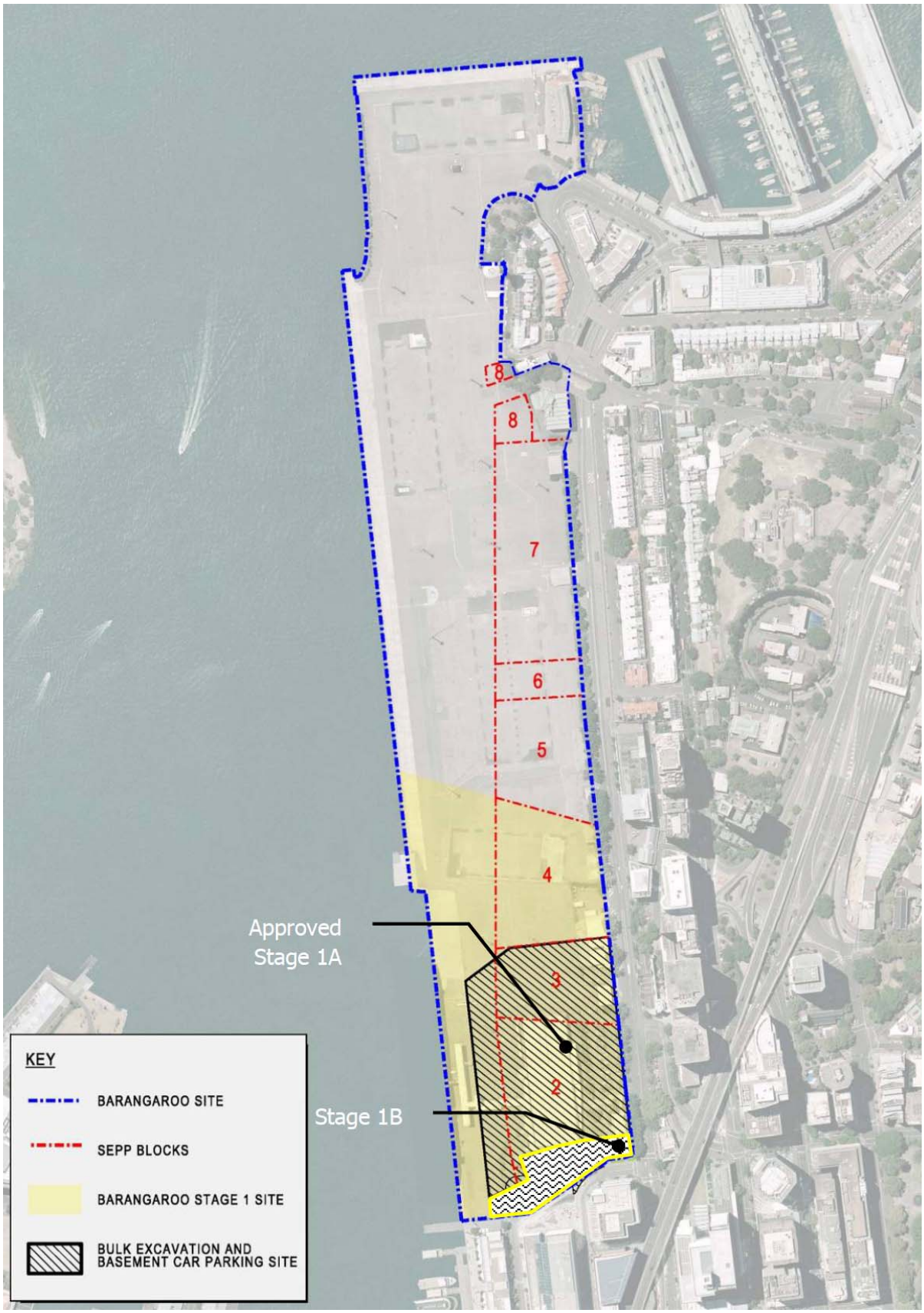
Barangaroo Stage 1 is located on the north western edge of the Sydney Central Business District (CBD). The redevelopment is bounded by Sydney Harbour to the west and north, the historic precinct of Millers Point and The Rocks to the east; and by a range of new commercial development to the south. The location of the Stage 1 construction works in relation to the remainder of the Barangaroo redevelopment area and the CBD is shown in Figure 1 below. The footprint of commercial buildings C3, C4 and C5 are entirely within Barangaroo Stage 1.

The initial phases of Barangaroo Stage 1 consist of retention wall construction and bulk excavation to create building basements, construction of a basement car parking area, and piling and construction of commercial buildings C3, C4 and C5. This management sub-plan covers these phases, and will be revised when needed to reflect the various stages of work. The current scope of this management sub-plan is summarised below.

Approval	**Phase**	**Activities**	**Included in sub-plan revision**
MP10_0023 Bulk Excavation & Basement Carparking Including MOD1 and MOD3	Establishment	• Site establishment including hoarding, access, amenities, parking and ancillary requirements. • Installation of environmental controls including dewatering & water treatment facilities. • Demolition of existing in-ground structures, footings & slabs, clearing and grubbing. • Removal of existing below ground foundations and structures such as caissons and piles. • Archaeological and other investigations. • Decommissioning, capping off and relocation of existing services.	**Yes**
	Perimeter Retaining Wall	• Construction of the basement PRW using bentonite, concrete and piles. • Temporary stockpiling of excavated material. • Transportation and disposal of material off-site where is cannot be reused on-site. • Dewatering operations, including water treatment and recycling.	**Yes**
	Bulk Excavation and Construction	• Bulk excavation of the basement within Blocks 1, 2, 3 and the adjacent public domain area. • Loading and transport of spoil to Headland Park for reuse as fill. • Classification and off-site re-use of spoil deemed excess for reuse at Headland Park. • Classification and off-site disposal to licensed landfill of spoil deemed unsuitable for re-use. • Crushing and screening facilities and operations. • Concrete batching. • Stormwater works along Hickson Road, Shelley St and Lime St. • Structural works, construction of foundations,	**Yes**

		basement levels, up to 880 car spaces and all associated elements and structures. • Road works, including the extension of Margaret Street and Lime Street. • Construction of temporary vehicular access from Hickson Road and permanent vehicular access from Margaret Street. • Temporary use of the basement for construction related storage and activity.	
MP10_0025 Commercial Building C4 Including MOD1	Piling, Podium and Tower	• Piling for construction of Building C4 foundations. • Construction of the podium and public domain. • Construction of the building and facade.	**Yes**
MP11_0044 Commercial Building C3	Piling, Podium and Tower	• Piling for construction of Building C3 foundations. • Construction of the podium and public domain. • Construction of the building and facade.	**Yes**
MP10_0227 Commercial Building C5	Piling, Podium and Tower	• Piling for construction of Building C5 foundations. • Construction of the podium and public domain. • Construction of the building and facade.	**Yes**

Figure 1: Site Layout

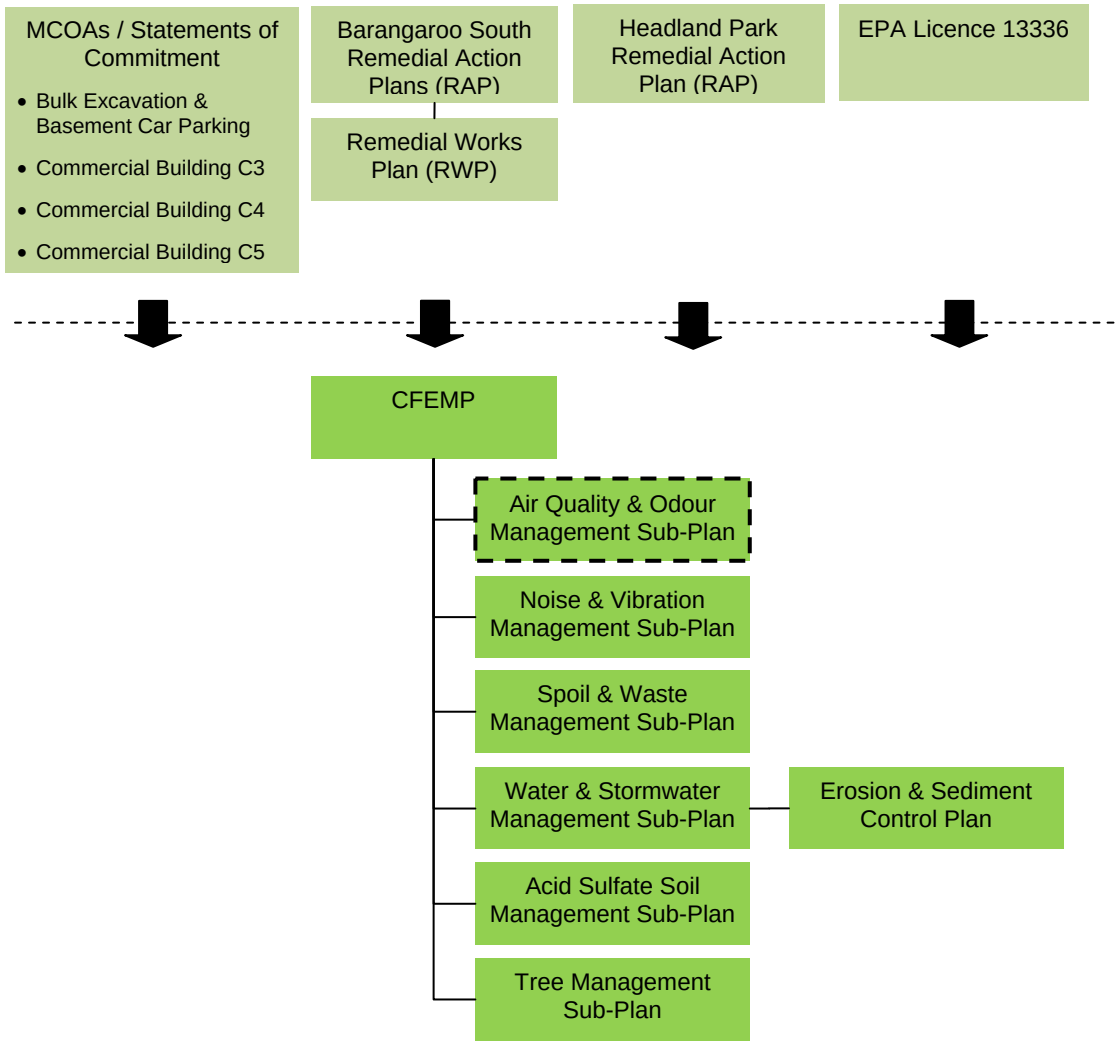


GOALS, OUTCOMES, KEY ISSUES

Scope	This *Air Quality & Odour Management Sub-Plan* details prevention and management measures for air quality and odour issues associated with construction. It defines mitigation measures to be implemented during relevant construction activities, a monitoring program that enables assessment of the impacts of construction activities on potentially affected areas, and contingency measures that may be implemented if complaints are received or exceedances are measured. This sub-plan forms part of the Lend Lease Project Management & Construction Environmental Management System (the Blue Book) and should be read in conjunction with plans shown below in Figure 2.
Goals	• To ensure that construction activities are managed to meet air quality and odour objectives as set out in environmental assessments and the Environment Protection Licence (EPL) No. 13336 issued by the Environment Protection Authority (EPA). • To provide a reactive monitoring regime to allow early detection of air quality and odour issues associated with construction, and allow a real-time assessment of various activities on the site. • To effectively manage excavation/construction activities and groundwater treatment to prevent potential odour / air quality issues.
Intended Outcomes	• Mitigation measures are implemented and maintained to achieve ambient air criteria for airborne pollutants that minimise adverse effects on sensitive receptors. Ambient air quality criteria are presented in Appendix 3. • Mitigation controls implemented and maintained to achieve EPA's odour assessment criteria for complex mixtures of odorous air pollutants. Odour assessment criteria are presented in Appendix 3. • Air quality and odour mitigation measures effective and properly maintained.
Key Issues and Sensitive Areas	Air quality is regulated by the EPA and Minister's Conditions of Approval (MCOA) requirements. **Surrounding Land Use & Receptors** The closest receptors are located approximately 20 m east of the site, in a multilevel residential building at 38 Hickson Road. A child care centre is located at 30 Hickson Road at the ground level of a multilevel office building (The Bond building), which is open to the street. Commercial development is located approximately 40 m south of the site. A number of finger wharves containing a mixture of residential and commercial developments are located to the west of the construction area, the closest being approximately 250 m away, while residential areas in Balmain East are located approximately 400 m west of the Headland Park placement area. The locations of sensitive receptors are included in Appendix 1. **Potential Impacts - Air Quality** Dust can be generated from all types of construction activities involving soil, including excavation, handling, loading and unloading from stockpiles, and wind erosion of exposed areas and stockpiles. Dust can also be generated by the on-site concrete batch plant. Soil sampling undertaken at the site identified the presence of a number of contaminants in the fill materials, including heavy metals and volatile organic compounds (VOCs). As these pollutants are contained within the soil, they may be liberated through fill handling processes, resulting in contaminant emissions to air. Construction activities will involve significant numbers of diesel-powered plant and equipment. The combustion of diesel fuel generates a range of pollutant emissions, such as oxides of nitrogen (NOX), carbon monoxide (CO) and particulate matter. Modelling of these potential impacts was undertaken as part of air quality impact assessments in environmental assessments, and subsequent

	modifications. The assessments recommended implementation of a number of measures, which are described in Section 5 of this sub-plan. Additional activities in the modifications have been re-modelled, leading to additional air quality measures that are included in Section 5 and Appendix 4 of this sub-plan. **Potential Impacts - Odour** A number of the contaminants identified at the site have associated odours. These odours may be liberated to air during excavation, handling and stockpiling of spoil material. A water treatment plant is located on the site to treat surface and ground water prior to discharge. Part of the treatment process involves the use of air strippers to remove pollutants within the water and treat the subsequent air emissions through carbon filtration. The treated air will then be released to atmosphere. Measures to manage potential impacts from odours are described in Section 5. Emission sources are further described in Appendix 2.
Statutory Requirements	*Protection of the Environment Operations Act 1997* (POEO Act) (NSW) • Section 129 provides that the applicant must not cause or permit the emission of any offensive odour from the premises, apart from where the emission is identified in an EPL as a potentially offensive odour and the odour was emitted in accordance with the condition of a licence directed at minimising odour. • Sections 124 & 125 require that no air pollution is caused by failing to maintain and operate plant, or carry out maintenance work on plant, in a proper and efficient manner. • Section 126 states that soil or dust must not be deposited or blown onto a public place. *Protection of the Environment Operations (Clean Air) Regulation 2010* (NSW): • Vehicles must not emit visible air impurities for a continuous period of 10 seconds or more (clauses 8 & 9). • Stack emissions must not exceed the regulatory limits for the type of plant operated on site.
Relationship to Other Plans	• Project EHS Management Plan • Spoil & Waste Management Sub-Plan. • Water & Stormwater Management Plan • Community and Stakeholder Engagement Strategy. • Lend Lease Project Management & Construction Global Minimum Requirements. All environment-related plans are shown in Figure 2 below.
Environmental Aspects & Impacts	Refer to the Project EHS Risk Assessment, which forms part of the Project EHS Plan.
Licence & Permit Requirements	The requirements of EPA Licence 13336 that relate to Barangaroo Stage 1 are included in Section 4 of this sub-plan. These requirements will be updated with each relevant licence variation issued by EPA.

Figure 2: Environment Document Structure



1 MCOA REQUIREMENTS

Bulk Excavation and Basement Carparking (MP10_0023)

No.	Original Ref.	Relevant Requirement	Reference
1.	A12	Prior to the commencement of barging/shipping of materials from the site, the proponent shall update the Environmental Construction Management Plan, as outlined in the Statement of Commitments. All 'barging/shipping details must be reviewed by the EPA prior to the commencement of barging/shipping activities. Environment Protection Licence No 13336 must also be varied, where relevant, prior to the commencement of barging/shipping activities to ensure environmental impacts of this activity are appropriately regulated.	Not applicable at this stage
2.	A13(d)	Prior to the issue of a construction certificate for the installation and operation of the concrete batching plant, the proponent shall update the following Plans in accordance with the terms of the respective conditions and provide a copy to the department and the City of Sydney Council:… e. C5 Air Quality Management Plan (Note: the Air Quality Management Plan is to include a reactive monitoring and management program to the satisfaction of the EPA). All management, monitoring and mitigation measures incorporated into the endorsed plans, as relevant to the operation of the concrete batching plant, are to be fully implemented for the term of operation of the concrete batching plant.	This sub-plan
3.	C5.1	Prior to the commencement of each stage of works, the Proponent must develop and provide to the DECCW for review and comment an Air Quality Management Sub Plan. The Plan must include the following elements: • Relevant environmental criteria to be used in day to day management of dust and volatile organic compounds (VOC's) / odour; • Mission statement; • Dust and VOC's / odour management strategies; • Objectives and targets; • Risk assessment; • Suppression improvement plan; • Monitoring requirements including assigning responsibility (for all employees and contractors); • Communication strategy; and • System and performance review for continuous improvement.	 Appendices 1, 3 Introduction Section 5 Introduction CFEMP Appendix 5 Corrective actions as per Appendix 3, s7.5 Appendix 3 Community & Stake-holder Engagement Strategy Project EHS Plan
4.	C5.2	The AQMP must detail management practices for all best practice dust and VOC / odour controls for each source, including (but not limited to) mitigation measures discussed in the EA (Barangaroo Site Excavation and Preparation Works, App E – Chapter 9, 20/9/10).	Section 5

<table>
<tr><th>No.</th><th>Original Ref.</th><th>Relevant Requirement</th><th>Reference</th></tr>
<tr><td>5.</td><td>C5.3</td><td>The AQMP must detail the dust and odour monitoring program to be undertaken for the proposal. These monitoring arrangements must include as a minimum, all monitoring specified in Chapter 9.3 of the EA (Barangaroo Site Excavation and Preparation Works, Appendix E – Chapter 9, 20 September 2010). The monitoring program must also include monitoring of semi-volatile organic compounds (SVOC's) and speciated VOC's.</td><td>Appendix 3</td></tr>
<tr><td>6.</td><td>C5.4</td><td>All operations and activities occurring at the premises must be carried out in a manner that will minimise or prevent the emissions of dust from the premises.</td><td>Section 5</td></tr>
<tr><td>7.</td><td>C5.5</td><td>The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.</td><td>Section 5</td></tr>
<tr><td>8.</td><td>C5.6</td><td>The applicant must not cause or permit the emission of offensive odour beyond the boundary of the premises.</td><td>Noted</td></tr>
<tr><td>9.</td><td>C5.7</td><td>All stockpiles shall be maintained at manageable sizes which allow them to be covered, if necessary, to control emissions of dust and / or VOC's and / or odour.</td><td>Section 5 AQ3</td></tr>
<tr><td>10.</td><td>C5.8</td><td>Prior to the commencement of the relevant stage of works where Treatment Tents will be utilised a detailed design plan of the Emission Control System is to be submitted to the DECCW for review and comment. The detailed design plan is to include, but not be limited to, the following information:
• Manufacturer's performance specifications which include the particle and VOC control efficiency of the proposed technology;
• Proposed monitoring to continuously confirm the performance of the proposed VOC control technology; and
• If appropriate, proposed methodology to detect carbon bed breakthrough.</td><td>Section 5 AQ23, 25</td></tr>
<tr><td>11.</td><td>C5.9</td><td>Air emissions from the plant [Treatment Tents] must comply with the limits set out in the following table:
<table>
<tr><th>Emission Point(s)</th><th>Pollutant</th><th>Units of measure</th><th>100 percentile concentration limit</th><th>Reference conditions</th><th>Averaging period</th></tr>
<tr><td>Treatment tent 1</td><td>Solid Particles</td><td>milligrams per normal cubic metre</td><td>20</td><td>Dry, 273 K, 101.3 kPa</td><td>As per test method</td></tr>
<tr><td>Treatment tent 2</td><td>Solid Particles</td><td>milligrams per normal cubic metre</td><td>20</td><td>Dry, 273 K, 101.3 kPa</td><td>As per test method</td></tr>
</table></td><td>Section 5 AQ26</td></tr>
<tr><td>12.</td><td>C5.10</td><td>The Proponent must undertake monitoring [from Treatment Tent] as set out in the following table:
<table>
<tr><th>Emission Point(s)</th><th>Pollutant</th><th>Units of measure</th><th>Frequency</th><th>Sampling Method</th></tr>
<tr><td>Treatment tent 1</td><td>Solid Particles</td><td>milligrams per normal cubic metre</td><td>Special Frequency</td><td>TM-15</td></tr>
<tr><td>Treatment tent 2</td><td>Solid Particles</td><td>milligrams per normal cubic metre</td><td>Special Frequency</td><td>TM-15</td></tr>
</table></td><td>Section 5 AQ25</td></tr>
<tr><td>13.</td><td>C5.11</td><td>The applicant must ensure that the design and construction of the [Treatment Tent] facility includes sampling positions that comply with TM-1 as set out in the Approved Methods for the Sampling and Analysis of Air Pollutants in NSW or as agreed with DECCW.</td><td>Section 5 AQ25</td></tr>
</table>

No.	Original Ref.	Relevant Requirement	Reference
14.	D3	All vehicles involved in the excavation and/or demolition process and departing the property with demolition materials, spoil or loose matter must have their loads fully covered before entering the public roadway.	Section 5 AQ1

Commercial Building C4 (MP10_0025)

No.	Original Ref.	Relevant Requirement	Reference
15.	D10	Adequate measures shall be taken to prevent dust from affecting the amenity of the neighbourhood during construction. In particular, the following measures must be adopted:	
		(1) Physical barriers shall be erected at right angles to the prevailing wind direction or shall be placed around or over dust sources to prevent wind or activity from generating dust emissions,	AQ3-5, AQ7-9, AQ12
		(2) Earthworks and scheduling activities shall be managed to coincide with the next stage of development to minimise the amount of time the site is left cut or exposed,	AQ10-11
		(3) All materials shall be stored or stockpiled at the best locations,	AQ3
		(4) Surface should be dampened slightly to prevent dust from becoming airborne but should not be wet to the extent that run-off occurs,	AQ6, AQ11
		(5) All vehicles carrying spoil or rubble to or from the site shall at all times be covered to prevent the escape of dust or other material,	AQ1
		(6) All equipment wheels shall be washed before exiting the site using manual or automated sprayers and drive-through washing bays,	AQ2
		(7) Gates shall be closed between vehicle movements and shall be fitted with shade cloth, and	AQ2
		(8) Cleaning of footpaths and roadways shall be carried out regularly.	AQ13
16.	D14	For the duration of the works air emissions must be managed in accordance with the Air Quality and Odour Management Plan and Statement of Commitments in Schedule 3.	This sub-plan

Commercial Building C3 (MP10_0227)

No.	Original Ref.	Relevant Requirement	Reference
17.	D10	Adequate measures shall be taken to prevent dust from affecting the amenity of the neighbourhood during construction. In particular, the following measures must be adopted:	
		(1) Physical barriers shall be erected at right angles to the prevailing wind direction or shall be placed around or over dust sources to prevent wind or activity from generating dust emissions,	AQ3-5, AQ7-9, AQ12
		(2) Earthworks and scheduling activities shall be managed to coincide with the next stage of development to minimise the amount of time the site is left cut or exposed,	AQ10-11

No.	Original Ref.	Relevant Requirement	Reference
		(3) All materials shall be stored or stockpiled at the best locations,	AQ3
		(4) Surface should be dampened slightly to prevent dust from becoming airborne but should not be wet to the extent that run-off occurs,	AQ6, AQ11
		(5) All vehicles carrying spoil or rubble to or from the site shall at all times be covered to prevent the escape of dust or other material,	AQ1
		(6) All equipment wheels shall be washed before exiting the site using manual or automated sprayers and drive-through washing bays,	AQ2
		(7) Gates shall be closed between vehicle movements and shall be fitted with shade cloth, and	AQ2
		(8) Cleaning of footpaths and roadways shall be carried out regularly.	AQ13
18.	D14	For the duration of the works air emissions must be managed in accordance with the Air Quality and Odour Management Plan and Statement of Commitments in Schedule 3.	This sub-plan

Commercial Building C5 (MP11_0044)

No.	Original Ref.	Relevant Requirement	Reference
19.	D10	Adequate measures shall be taken to prevent dust from affecting the amenity of the neighbourhood during construction. In particular, the following measures must be adopted:	
		(1) Physical barriers shall be erected at right angles to the prevailing wind direction or shall be placed around or over dust sources to prevent wind or activity from generating dust emissions,	AQ3-5, AQ7-9, AQ12
		(2) Earthworks and scheduling activities shall be managed to coincide with the next stage of development to minimise the amount of time the site is left cut or exposed,	AQ10-11
		(3) All materials shall be stored or stockpiled at the best locations,	AQ3
		(4) Surface should be dampened slightly to prevent dust from becoming airborne but should not be wet to the extent that run-off occurs,	AQ6, AQ11
		(5) All vehicles carrying spoil or rubble to or from the site shall at all times be covered to prevent the escape of dust or other material,	AQ1
		(6) All equipment wheels shall be washed before exiting the site using manual or automated sprayers and drive-through washing bays,	AQ2
		(7) Gates shall be closed between vehicle movements and shall be fitted with shade cloth, and	AQ2
		(8) Cleaning of footpaths and roadways shall be carried out regularly.	AQ13
20.	D14	For the duration of the works air emissions must be managed in accordance with the Air Quality and Odour Management Plan and Statement of Commitments in Schedule 3.	This sub-plan

2 STATEMENT OF COMMITMENT REQUIREMENTS

Bulk Excavation and Basement Carparking (MP10_0023)

No.	Original Ref.	Relevant Requirement	Reference
21.	PPR S.5.7	Lend Lease commits to undertake the bulk excavation and basement car park construction works generally in accordance with the findings, recommendations and mitigative strategies of the revised Air Quality Impact Assessment prepared by AECOM (10 September 2010) and letter of opinion regarding the proposed inclusion of a batching plant for Barangaroo Block 1-3 dated 3 September 2012.	Section 5
22.	PPR S.5.7	A monitoring program will be implemented that includes monitoring of PM10 levels, which will allow reactive management of elevated dust concentrations, and monitoring of TSP concentrations using high volume air samplers, which will additionally allow the analysis of heavy metals concentrations to validate the modelling results.	Appendix 3

Commercial Building C4 (MP10_0025)

No.	Original Ref.	Relevant Requirement	Reference
23.	35	Construction and site management relating to the construction of Building B4 will be in generally accordance with the Environmental, Construction and Site Management Plan prepared by Cardno & Bovis Lend Lease included at Appendix EE of the Environmental Assessment Report prepared by JBA Urban Planning Consultants dated November 2010 including the following as updated by this Statement of Commitments (refer to Commitments 37, 38 and 40): - Air Quality Impact Assessment prepared by AECOM, which addresses air quality and odour impacts (refer to Appendix GG of the Environmental Assessment Report prepared by JBA Urban Planning Consultants dated November 2010 and Letter Confirming Air Quality Impact Assessment prepared by AECOM included at Attachment V of the PPR prepared by JBA Urban Planning Consultants dated February 2011).	Section 5

Commercial Building C3 (MP10_0227)

No.	Original Ref.	Relevant Requirement	Reference
24.	SOC 34	Construction and site management relating to the construction of Commercial Building C3 will be in generally accordance with the Environmental, Construction and Site Management Plan prepared by Cardno & Lend Lease included at Appendix CC of the Environmental Assessment Report prepared by JBA Planning dated November 2011 including the following: • Air Quality Impact Assessment prepared by AECOM, which addresses air quality and odour impacts (refer to Appendix FF of the EAR).	This sub-plan

Commercial Building C5 (MP11_0044)

No.	Original Ref.	Relevant Requirement	Reference
25.	SOC 33	Construction and site management relating to the construction of Commercial Building C5 will be in generally accordance with the Environmental, Construction and Site Management Plan prepared by Cardno & Lend Lease included at Appendix CC of the Environmental Assessment Report prepared by JBA Planning dated November 2011 including the following: • Air Quality Impact Assessment prepared by AECOM, which addresses air quality and odour impacts (refer to Appendix FF of the EAR).	This sub-plan

3 OTHER COMMITMENTS

No.	Original Ref.	Relevant Requirement	Reference
26.	-	-	-

4 LICENCE AND PERMIT REQUIREMENTS

EPA Licence 13336

<table>
<tr><th>No.</th><th>Original Ref.</th><th>Relevant Requirement</th><th>Reference</th></tr>
<tr><td>27.</td><td>EPL L13336, P1.1</td><td>The following points referred to in the table below are identified in this licence for the purposes of monitoring and/or the setting of limits for the emission of pollutants to the air from the point.
<table>
<tr><th>EPA no.</th><th>Type of Monitoring Point</th><th>Type of Discharge Point</th><th>Description of Location</th></tr>
<tr><td>5</td><td>Ambient air monitoring</td><td></td><td>Location 1 as depicted on Figure 5.6, page 28 of the report supporting LVA supplied to the EPA on 10 Dec 2010</td></tr>
<tr><td>8</td><td>Ambient air monitoring</td><td></td><td>Location 4 as depicted on Figure 5.6, page 28 of the report supporting LVA supplied to the EPA on 10 Dec 2010</td></tr>
<tr><td>13</td><td>Ambient air monitoring</td><td></td><td>Location 9 as depicted on Figure 5.6, page 28 of the report supporting LVA supplied to the EPA on 10 Dec 2010</td></tr>
<tr><td>17</td><td>Discharge to air - Air quality monitoring</td><td>Discharge to air - Air quality monitoring</td><td>Vent serving the air strippers on the Wastewater Treatment Plant as depicted on drawing No EN-10 in the document titled Air Quality Impact Assessment: Water Treatment Plant supplied to the EPA on 28 July 2011.</td></tr>
</table></td><td>Appendix 3</td></tr>
<tr><td>28.</td><td>EPL L13336, L2.1, 2.4</td><td>For each monitoring/discharge point or utilisation area specified in the table\s below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table.
POINT 17
<table>
<tr><th>Pollutant</th><th>Units of measure</th><th>100 percentile concentration limit</th><th>Reference conditions</th><th>Oxygen correction</th><th>Averaging Period</th></tr>
<tr><td>Volatile organic compounds as n-propane equivalent</td><td>milligrams per cubic metre</td><td>20</td><td>Dry, 273K 101.3kPa</td><td></td><td></td></tr>
</table></td><td>Appendix 3</td></tr>
<tr><td>29.</td><td>EPL L13336, L5</td><td>The licensee must not cause or permit the emission of offensive odour beyond the boundary of the premises.
Note: Section 129 of the Protection of the Environment Operations Act 1997, provides that the licensee must not cause or permit the emission of any offensive odour from the premises but provides a defence if the emission is identified in the relevant environment protection licence as a potentially offensive odour and the odour was emitted in accordance with the conditions of a licence directed at minimising odour.</td><td>Section 5</td></tr>
<tr><td>30.</td><td>EPL L13336, O3.1</td><td>All activities on the site must be undertaken with the objective of preventing visible emissions of dust beyond the boundary of the premises. Should such visible dust emissions occur at any time, the licensee must identify and implement all practicable dust mitigation measures, including cessation of relevant works, as appropriate, such that emissions of visible dust cease.</td><td>Section 5
Section 10</td></tr>
<tr><td>31.</td><td>EPL L13336, O5.3</td><td>The discharge point height of the stack at Point 17 must be maintained at least 2.77 m above ground level.
By 16 December 2011 the licensee must provide a report to the EPA which demonstrates the air impacts under the actual discharge velocity for point 17 will not result in any exceedence of the EPA's assessment criteria.</td><td>Complete</td></tr>
</table>

<table>
<tr><td>32.</td><td>EPL L13336, M2.1</td><td>For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:
POINTS 5, 8, 13
<table>
<tr><th>Pollutant</th><th>Units of measure</th><th>Frequency</th><th>Sampling Method</th></tr>
<tr><td>Lead</td><td>micrograms per cubic metre</td><td>Special Frequency 3</td><td>Other Approved Method 1</td></tr>
<tr><td>Metallic Compounds</td><td>micrograms per cubic metre</td><td>Special Frequency 3</td><td>AM-15</td></tr>
<tr><td>PM10</td><td>micrograms per cubic metre</td><td>Continuous</td><td>AM-22</td></tr>
<tr><td>Polycyclic aromatic hydrocarbons</td><td>milligrams per cubic metre</td><td>Special Frequency 3</td><td>AM-15</td></tr>
<tr><td>Total Solid Particles</td><td>micrograms per cubic metre</td><td>Special Frequency 3</td><td>AM-15</td></tr>
<tr><td>Volatile organic compounds</td><td>milligrams per cubic metre</td><td>Continuous</td><td>Special Method 1</td></tr>
</table>
POINT 17
<table>
<tr><th>Pollutant</th><th>Units of measure</th><th>Frequency</th><th>Sampling Method</th></tr>
<tr><td>Volatile organic compounds as n-propane equiv.</td><td>milligrams per cubic metre</td><td>Special Frequency 5</td><td>Method approved in writing by the Authority</td></tr>
<tr><td>Volumetric flowrate</td><td>cubic metres per second</td><td>Special Frequency 6</td><td>TM-2</td></tr>
</table></td><td>Appendix 3</td></tr>
<tr><td>33.</td><td>EPL L13336, M8.1</td><td>For the purposes of the tables above:
Ambient Air Quality - (points 5, 8 and 13), Special Frequency 3 means: 24 Hours every 6 days;
In relation to VOC monitoring - Special Method 1 means: As per table 5.7 in Licence Variation Application dated 10 Dec 2010;
In relation to Lead monitoring - Other Approved Method 1 means: Either AM-11 or an alternative method to AM-11 for interim use that has been approved in writing by EPA.
Discharges to Air - WTP air emission monitoring (point 17 - stripper). Other method approved in writing by the Authority means: Stack Test as interim and then CEMS as described in the document titled "Air Quality and Odour Management Sub-Plan".
Special Frequency 5 means: Post commissioning, and then weekly (stack test). Continuous once CEMS is installed and operational.
Special Frequency 6 means: Post commissioning, and then weekly (as stack test) until CEMS is installed and operational.</td><td>Appendix 3</td></tr>
<tr><td>34.</td><td>EPL L13336, E1.1</td><td>30 days after commencement of works and monthly thereafter unless otherwise agreed in writing by the EPA, the licensee must submit to the Manager Sydney Industry, Environment Protection Authority, PO Box 668 Parramatta NSW 2124, a monthly air emissions monitoring report. The report must review all air monitoring data collected in compliance with the conditions of this licence and any Air Quality Management Plan and provide an interpretation of those results and any relevant site management responses.</td><td>CFEMP Appendix 9, Table 1</td></tr>
<tr><td>35.</td><td>EPL L13336, E2.3</td><td>The licensee must develop and implement an air quality management plan (AQMP) including an air quality monitoring program and VOC breakthrough action plan that will ensure WTP emissions will be controlled by best practice techniques and not cause any adverse environmental or health impact.
The AQMP must be submitted for EPA’s review prior to WTP commissioning.</td><td>This sub-plan</td></tr>
</table>

<table>
<tr><td>36.</td><td>EPL L13336, E2.4</td><td>Air Quality Monitoring Program - The licensee must develop an Air Quality Monitoring Program which must be submitted for EPA's review and approval prior to WTP commissioning. The monitoring program must include fit for purpose monitoring strategies and methods that will demonstrate air stripper and displacement tank emissions will meet emission limits while the WTP is in operation. The licensee must ensure the air quality monitoring program has commenced when WTP operations begin to demonstrate effective operation of the WTP emission control system.</td><td>Appendix 3</td></tr>
<tr><td>37.</td><td>EPL L13336, E2.5</td><td>VOC Breakthrough Action Plan - Prior to the commencement of WTP operations, the licensee must submit a VOC breakthrough action plan to EPA for review and comment. As a minimum, the plan must:
propose a preferred method for continuously monitoring VOC breakthrough in activated carbon treatment units. The preferred method must have an adequate lower detection limit to achieve meaningful comparison with licensee defined carbon breakthrough trigger(s).
nominate a VOC breakthrough trigger(s); and
define, in detail, breakthrough actions for implementation upon measurement of a VOC concentration at and above the nominated breakthrough trigger level.
The licensee must ensure the VOC breakthrough action plan has commenced when WTP operations begin.</td><td>VOC Breakthrough Management Procedure</td></tr>
<tr><td>38.</td><td>EPL L13336, E3.5</td><td>Fill material pre-classification - Site materials originating from parts of the Barangaroo Site other than the Headland Park Site that are to be used as fill must comply with the maximum criteria and daily mean criteria listed in the table below.
Prior to the receipt of materials from parts of the Barangaroo site other than the Headland Park site, material testing results for the material to be received must be reviewed and compared with the criteria in accordance with the project Materials Compliance Management System.
Materials originating from parts of the Barangaroo Site other than the Headland Park site must not be received on the Headland Park site until test results have been reviewed and it is confirmed that the material complies with the fill criteria.
<table>
<tr><th>Constituent</th><th>Maximum Criteria (mg/kg)</th><th>Daily Mean (mg/kg)</th></tr>
<tr><td>Benzene</td><td>5.2</td><td>2.8</td></tr>
<tr><td>Ethylbenzene</td><td>10</td><td>2.8</td></tr>
<tr><td>Toluene</td><td>12</td><td>3.3</td></tr>
<tr><td>Xylene (total)</td><td>43</td><td>12</td></tr>
<tr><td>2-methylnaphthalene</td><td>200</td><td>55</td></tr>
<tr><td>Cyanide</td><td>2</td><td>0.6</td></tr>
<tr><td>Acenaphthene</td><td>19</td><td>5.2</td></tr>
<tr><td>Naphthalene</td><td>170</td><td>160</td></tr>
<tr><td>Phenol</td><td>3</td><td>0.8</td></tr>
<tr><td>Dibenzofuran</td><td>53</td><td>15</td></tr>
<tr><td>Trimethylbenzenes</td><td>30</td><td>8</td></tr>
<tr><td>Styrene</td><td>7</td><td>2</td></tr>
</table></td><td>Materials Compliance Management System – for materials going to Headland Park</td></tr>
</table>

5 MITIGATION MEASURES

Ref.	Mitigation Measure	Design	Site Establishment	Construction	Relevant Location / Activity	Relevant Approval Conditions	Responsibility	Timing
	Dust and material management							
AQ1.	Cover all loads coming onto the site and departing site, including internal loads, to minimise potential spillage / dust generation. Immediately clean up any spills.		■	■	Entire site	Basement MCOA C5.2, D3 C4 MCOA D10	CS, EM	Throughout construction
AQ2.	Ensure all vehicles leaving the site or moving from unsealed to sealed roads pass through a truck wash, or a rumble-grid and pit prior to exiting, with physical removal of dirt / mud using a pressure washer if required.	■	■	■	Entire site	Basement MCOA C5.2 C4 MCOA D10	CS, EM	Throughout construction
AQ3.	Locate stockpiles to minimise wind erosion. Maintain all stockpiles at manageable sizes to allow covering.		■	■	Entire site	Basement MCOA C5.7 C4 MCOA D10	CS	Throughout construction
AQ4.	Cover any stockpiled spoil material identified as being restricted, hazardous or special waste whilst not active, including overnight.		■	■	Stockpile areas	Basement MCOA C5.2 C4 MCOA D10	CS, EM	Throughout construction
AQ5.	Cover stockpiled spoil material during windy / rainy conditions, unless spoil is damp, and provide bunding around the base.		■	■	Stockpile areas	Basement MCOA C5.2 C4 MCOA D10	CS, EM	Throughout construction
AQ6.	Use water sprays to suppress dust emissions from spoil stockpiles, loading and unloading activities, unless spoil is damp.		■	■	Entire site	Basement MCOA C5.2 C4 MCOA D10	CS, EM	Throughout construction
AQ7.	Cover or coat with sealant stockpiled material that is to remain inactive for a period greater than two weeks to prevent odour / dust generation.		■	■	Stockpile areas	Basement MCOA C5.2 C4 MCOA D10	CS, EM	Throughout construction
AQ8.	Use dust sealants or hydromulch on exposed areas vulnerable to wind erosion.		■	■	Entire site	Basement MCOA C5.2 C4 MCOA D10	CS, EM	Throughout construction

AQ9.	Minimise dust emissions by limiting exposed / excavation areas where feasible.		■	■	Entire site	Basement MCOA C5.2 C4 MCOA D10	CM, EM	Throughout construction
AQ10.	Where feasible, reduce handling / stockpiling of excavated materials through pre-testing and validation, allowing direct transport to Headland Park or off-site.	■	■	■	Entire site	Basement MCOA C5.2 C4 MCOA D10	CM, EM	Throughout construction
AQ11.	Manage in-ground dewatering ahead of bulk excavation to ensure exposed material is suitably moist.			■	Excavation area	Basement MCOA C5.2 C4 MCOA D10	CM	From start of bulk dewatering
AQ12.	Use solid 2.4m or 3m high hoardings at the site perimeter, and wind barriers at internal excavation boundaries where possible.		■	■	Entire site	Basement MCOA C5.2 C4 MCOA D10	CM	Throughout construction
AQ13.	Sweep and water using on-site sweepers and water carts haul routes, materials handling areas, site entry points and other areas as needed. A watering rate of greater than 2L per m^2 per hour is required.		■	■	Entire site	Basement MCOA C5.2 C4 MCOA D10	CS	Throughout construction
AQ14.	Control dust emissions from concrete crushing using fabric filters.		■	■	Entire site	Basement MCOA C5.2	CM, EM	While using crusher
AQ15.	Minimise dust by limiting accessibility to roads for construction vehicles. Seal haul roads outside the bulk excavation area.		■	■	Entire site	Basement MCOA C5.2	CS, EM	Throughout construction
AQ16.	Adjust work practices based on wind and weather conditions, and real time dust monitoring.		■	■	Entire site	Basement MCOA C5.2	CM, EM	Throughout construction
AQ17.	Undertake emergency dust suppression if needed during dust generating conditions (e.g. dry and windy weather) during longer non-working periods (e.g. long weekends, holidays).			■	Bulk excavation area	Best practice	CS, EM	Throughout construction
AQ18.	Ensure stockpiles, non-paved areas and dusty hardstand areas are maintained and regularly wet down and/or swept. Where practical use manually operated fixed sprays, and elsewhere use a water tanker.			■	Concrete batch plant	Basement MCOA A13d	CM, EM	Throughout construction
AQ19.	Cover conveyors used for concrete batching.			■	Concrete batch plant	Basement MCOA A13d	CS, EM	During batch plant operation
AQ20.	Separate stockpiles and site accommodation with a concrete barrier. Maintain stockpiles below 3 metres, or less than concrete barriers.			■	Concrete batch plant	Basement MCOA A13d	CS, EM	During batch plant operation
AQ21.	Use a dust extraction system and filter bag at the split drum mixer. Ensure filters are serviced in accordance with manufacturers recommendations.			■	Concrete batch plant	Basement MCOA A13d	CS, EM	During batch plant operation

AQ22.	Handle cement delivery via pneumatic methods. Store cement in silos fitted with high level alarms (including a visible beacon) and a filter bag system. Provide an automatic reverse pulse system to clean filters, and ensure filters are serviced in accordance with manufacturers recommendations.			■	Concrete batch plant	Basement MCOA A13d	CS, EM	During batch plant operation
	Control volatilisation / odours during excavation-agitation-stockpiling of VOC containing contaminated soils							
AQ23.	Apply covers, odour sealant or odour suppressant to control odours generated at the point of excavation or at stockpiles, where required.		■	■	Excavations and stockpiles	Basement MCOA C5.2	CS, EM	Throughout construction
AQ24.	If covers, sealants or suppressants are not effective as per AQ23, undertake excavations or stockpiling inside an excavation tent structure, with a suitable emissions treatment system and air quality monitoring.			■	Excavations and stockpiles	Basement MCOA C5.2, 8	CS, EM	From start of bulk excavation
AQ25.	Provide design information for the excavation tent emissions control system, as part of the VOC Breakthrough Action Plan, to EPA for review and comment. Include monitoring for compliance and breakthrough.			■	N/A	Basement MCOA C5.8, 10, 11	CM, EM	Prior to use of excavation tents
AQ26.	Ensure treated air from the excavation tent complies with the statutory limit of 20mg/m^3, and set a management trigger at 10mg/m^3.			■	Tent air discharge	Basement MCOA C5.8,9	EM	Prior to use of excavation tents
	Control odour / VOC emissions from water treatment plant							
AQ27.	Use a VOC emissions control system and continuous breakthrough monitoring at the air stripping component of the water treatment plant.			■	Water treatment plant	Basement MCOA C5.2	CM, EM	Throughout construction
	Minimise combustion emissions of TSP, PM_{10}, NO_x, CO and BTEX							
AQ28.	Turn engines off while parked on site.		■	■	Entire site	Basement MCOA C5.2	CS, EM	Throughout construction
AQ29.	Regularly tune and maintain equipment, plant and machinery to minimise visible smoke / emissions.		■	■	Entire site	Basement MCOA C5.2	CS, EM	Throughout construction
AQ30.	Implement site speed limits.		■	■	Entire site	Basement MCOA C5.2	CS, EM	Throughout construction
Responsibility Key: EM – EHS Manager (Environment), CS – Construction Supervisor, CM – Construction Manager								

6 MONITORING

Item	Frequency	Standards	Reporting	Responsibility
See Appendix 3 – Air Quality Monitoring Plan for details on monitoring.				

7 TRAINING AND RESOURCES

Training
In addition to other Lend Lease training requirements discussed in the CFEMP, inductions are required and are to address: • Site and neighbouring properties are sensitive to dust and odour. • Use of dust sweepers and water carts. • Use of the wheel wash. • Notification processes should an incident occur. Toolbox talks to be conducted on: • Dust management and restriction of working activities during windy conditions. • Road cleanliness and the importance of minimising sediment accumulation on the roadways / worksite. • Results of air quality monitoring.
Resources
• Water cart / street sweeper. • Truck wash, rumble grids. • Tarpaulins and water sprays to manage stockpiles. • Dust sealant. • Emission control systems for any excavation tents used (when required for bulk excavation), and the water treatment plant. • Monitoring equipment - High volume air samplers (HVAS), TEOM units, RAEguard Multi-Gas monitor, Summa canisters, Field Olfactometer, meteorological station, CEMS, PIDs. • Air quality specialist, EHS Co-ordinator, EHS Manager (Environment).

8 CONTACTS

Contacts
For contact names, numbers and positions, see the *Project Contacts List.*

9 REFERENCES AND REVISIONS

Related Documents
Air Quality Impact Assessment – Bulk Excavation and Basement Car Parking, AECOM, 20 September 2010
Health Impact Assessment – Bulk Excavation and Basement Car Parking, AECOM, 15 September 2010
Preferred Project Report – Bulk Excavation and Basement Car Parking, JBA Planning, September 2010
Air Quality Impact Assessment – Section 75W Application - Bulk Excavation and Basement Car Parking, AECOM, 4 November 2010
Remedial Action Plan – Barangaroo – Other Remediation Works (South) Area, AECOM, Final – 7 July 2011
Human Health and Environmental Risk Assessment Addendum - Other Remediation Works (South) Area, AECOM, Final – 4 July 2011
Air Quality Impact Assessment – Water Treatment Plant, AECOM, November 2011
Air Quality Impact Assessment – Commercial Building C4, AECOM, 26 October 2010
Preferred Project Report, Commercial Building C4, Barangaroo South, JBA Planning, February 2011.
Air Quality Impact Assessments – Commercial Building C3, Commercial Building C5, Barangaroo South, AECOM, November 2011.
Letter of Opinion regarding the proposed inclusion of a batching plant for Barangaroo Blocks 1-3, AECOM, 3 September 2012.
Air Quality Impact Assessment – Barangaroo Stage 1 Cumulative Construction Assessment, AECOM, October 2012
VOC Breakthrough Action Plan
References
Approved methods for sampling and analysis of air pollutants in NSW (OEH, 2009).
AS/NZS 3580.9.3:2003 Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - Total suspended particulate matter (TSP) - High volume sampler gravimetric method.
AS 3580.9.8-2008 Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - PM10 continuous direct mass method using a TEOM tapered element oscillating microbalance analyser.
AS/NZS 3580.1.1:2007 Methods for sampling and analysis of ambient air - Guide to siting air monitoring equipment.
AS 2923-1987 Ambient air - Guide for measurement of horizontal wind for air quality applications.
Revision, Control & Amendment
Revisions to this plan are to be made in accordance with Lend Lease Blue Book document control procedures.

10 COMPLAINTS HANDLING AND SITUATION PLANNING

Complaints Handling Procedures			
The *Community & Stakeholder Engagement Strategy* identifies policies and procedures for managing community specific issues arising from construction activities. If an environmental complaint is received, the complaints management process outlined in the Strategy will be followed. This will involve the complaint being referred directly to the EHS Manager (Environment) and/or Construction Manager. If they are on site at the time an entry in 'Consultation Manager', the project consultation database, will be made to ensure appropriate action and monitoring. A response would be required to 'close out' the complaint, and the resolution would be recorded in Consultation Manager. The *Community & Stakeholder Engagement Strategy* also outlines a number of proactive strategies for dealing with community and stakeholder issues.			
Situation Planning & Response			
Potential situations that could arise during the works include the following:			
No.	Situation	Response	Responsibility
1	Visible emissions evident from site machinery / plant.	Switch off the plant or machinery immediately if safe to do so. Investigate causes of the emissions and tag-out the plant or machinery until the problem is resolved. If required, replace the item of plant or machinery.	CM, EM
2	High levels of odour detected by staff / contractors on the site.	Cease works if safe to do so and remove workers from the immediate vicinity of the detected odour. Investigate the source and nature of the odour using PID in consultation with the EHS Manager (Environment). Eliminate or mitigate the source of the odour as per item 4 below to ensure compliance with odour levels. Only after the area has been deemed safe to work (by the EHS Co-ordinator) are workers permitted to return the area.	CM, EM, EHSC
3	High levels of dust due to weather conditions.	Cease dust generating activities under direction of the EHS Manager (Environment) or Construction Manager until adverse conditions subside. Spray (with water or sealant) or cover exposed stockpiles and other dust generating areas, and remove other causes of dust such as sediment accumulation on sealed surfaces.	CM, EM
4	High levels of dust, contaminants, or odour due to site activities	Investigate causes of the exceedance, and if necessary implement the following additional measures: • Increase the use of water sprays to suppress dust in open areas or roadways. • Consolidate material stockpiles. • Excavate spoil in a controlled enclosure (where practicable and safe). • Promptly remove exposed heavily contaminated materials. • Use fine mist sprays around the excavation area. • Use odour suppressants or deodorised water sprays on-site, ensuring the chemicals used are suitable. • Additional actions related to bulk excavation and loading, as outlined in Appendix 4.	CM, EM
Responsibility Key: EM – EHS Manager (Environment), CM – Construction Manager, CSM – Community and Stakeholder Manager, EHSC – EHS Co-ordinator			

APPENDIX 1: SENSITIVE RECEPTORS IDENTIFIED IN THE AIR QUALITY IMPACT ASSESSMENT (FROM AECOM, SEPTEMBER 2010)

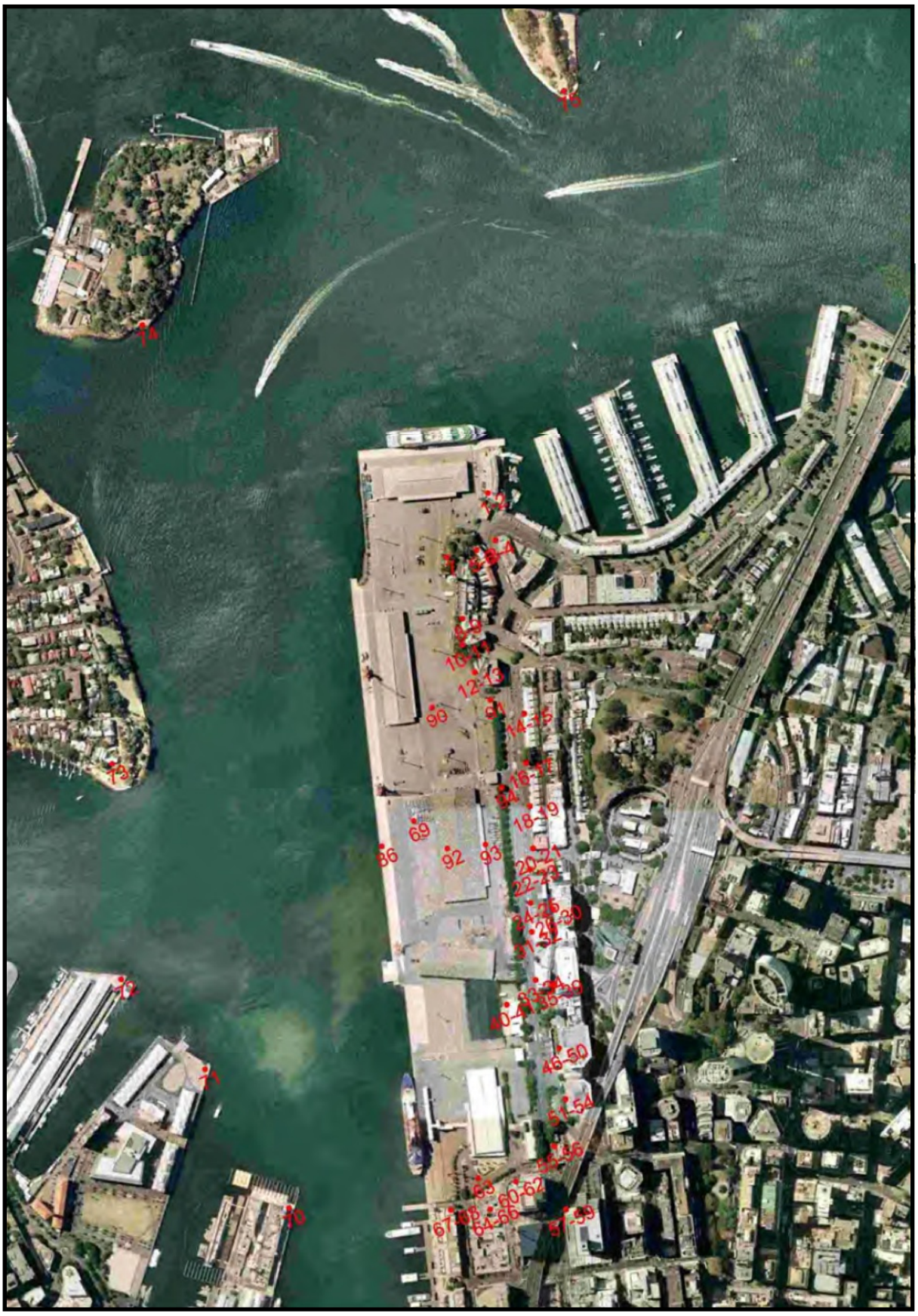
Sensitive Receptors – Ground Level

Receptor No.	Coordinates (m)		Address	Classification
	X	Y		
1	333.703	6252.36	4 Towns Place, Barangaroo	Commercial
3	333.64	6252.26	9 Towns Place, Barangaroo	Residential
5	333.64	6252.26	2 Rhodens Lane, Barangaroo	Residential
7	333.64	6252.26	Clyne Reserve	Public
8	333.748	6251.3	20 Merriman St, Millers Point	Commercial
10	333.748	6251.3	27 Bettington St, Barangaroo	Commercial
12	333.748	6251.3 25	Hickson Rd, Barangaroo	Commercial
14	333.748	6251.3	12A High St, Millers Point	Residential
16	333.748	6251.3	9A High Street, Millers Point	Residential
18	333.748	6251.3	38 High Street, Millers Point	Residential
20	333.748	6251.3	76 High Street, Millers Point	Residential
22	333.748	6251.3	High Steps, Millers Point	Residential
24	333.748	6251.3	Lend Lease	Commercial
26	333.748	6251.3	127 Kent Street, Millers Point	Commercial
31	333.69	6251.304	Child Care Centre	Commercial
33	333.69	6251.304	38 Hickson Road, Millers Point	Residential
35	333.69	6251.304	8 Jenkins Street, Millers Point	Commercial
40	333.748	6251.3	Barangaroo Display North End	Commercial
46	333.748	6251.3	Maritime Trade Towers North	Commercial
51	333.748	6251.3	Maritime Trade Towers South	Commercial
55	333.69	6251.304	Moreton's Hotel	Commercial
57	333.69	6251.304	Westpac Place	Commercial
60	333.748	6251.3	KPMG	Commercial
63	333.69	6251.304	Proposed Lend Lease Site Office	Commercial
64	333.59	6251.854	Macquarie Bank Centre	Commercial
67	333.59	6251.854	King Street Wharf North End	Commercial
69	333.59	6251.854	Passenger Terminal	Commercial
71	333.266	6251.472	Ballarat Park	Commercial
72	333.136	6251.611	Jones Bay Wharf	Public
73	333.122	6251.942	Balmain South-East	Public
74	333.171	6252.612	Goat Island South-East	Public
75	333.823	6252.97	Blues Point Reserve South	Public
86	333.54	6251.815	Site walkways	Residential
90	333.617	6252.03	Site walkways	Public
91	333.707	6252.042	Site walkways	Public
92	333.642	6251.812	Site walkways	Public
93	333.701	6251.818	Site walkways	Public
94	333.726	6251.905	Site walkways	Public
95	333.659	6251.566	Site walkways	Public
96	333.766	6251.5	Site walkways	Public
97	333.799	6251.647	36 Hickson Road	Commercial
98	333.799	6251.647	36 Hickson Road (top floor café)	Public
99	333.776	6251.946	Lance Kindergarten	Public

Sensitive Receptors – Elevated

Receptor No.	Coordinates (m)		Address	Height above ground (m)	Classification
	X	Y			
2	333.703	6252.358	4 Towns Place, Barangaroo	8	Commercial
4	333.715	6252.285	9 Towns Place, Barangaroo	5	Residential
6	333.686	6252.27	2 Rhodens Lane, Barangaroo	8	Residential
9	333.664	6252.165	20 Merriman St, Millers Point	5	Unknown
11	333.664	6252.126	27 Bettington St, Barangaroo	5	Commercial
13	333.683	6252.085	25 Hickson Rd, Barangaroo	14	Commercial
15	333.759	6252.02	12A High St, Millers Point	5	Residential
17	333.764	6251.943	9A High Street, Millers Point	5	Residential
19	333.77	6251.877	38 High Street, Millers Point	5	Residential
21	333.775	6251.812	76 High Street, Millers Point	5	Residential
23	333.77	6251.78	High Steps, Millers Point	5	Residential
25	333.771	6251.727	Lend Lease	20	Commercial
27	333.806	6251.718	127 Kent Street, Millers Point	20	Commercial
28	333.806	6251.718	127 Kent Street, Millers Point	40	Commercial
29	333.806	6251.718	127 Kent Street, Millers Point	60	Commercial
30	333.806	6251.718	127 Kent Street, Millers Point	80	Commercial
32	333.773	6251.683	Child Care Centre	20	Commercial
34	333.779	6251.61	38 Hickson Road, Millers Point	20	Residential
36	333.808	6251.604	8 Jenkins Street, Millers Point	15	Commercial
37	333.808	6251.604	8 Jenkins Street, Millers Point	30	Commercial
38	333.808	6251.604	8 Jenkins Street, Millers Point	45	Commercial
39	333.808	6251.604	8 Jenkins Street, Millers Point	60	Commercial
41	333.734	6251.572	Barangaroo Display North End	5	Commercial
45	333.791	6251.49	Hickson Street, Barangaroo	15	Commercial
47	333.815	6251.505	Maritime Trade Towers North	15	Commercial
48	333.815	6251.505	Maritime Trade Towers North	30	Commercial
49	333.815	6251.505	Maritime Trade Towers North	45	Commercial
50	333.815	6251.505	Maritime Trade Towers North	60	Commercial
52	333.825	6251.427	Maritime Trade Towers South	15	Commercial
53	333.825	6251.427	Maritime Trade Towers South	30	Commercial
54	333.825	6251.427	Maritime Trade Towers South	50	Commercial
56	333.808	6251.353	Moreton's Hotel	10	Commercial
58	333.826	6251.257	Westpac Place	20	Commercial
59	333.826	6251.257	Westpac Place	40	Commercial
61	333.748	6251.3	KPMG	15	Commercial
62	333.748	6251.3	KPMG	30	Commercial
65	333.708	6251.257	Macquarie Bank Centre	10	Commercial
66	333.708	6251.257	Macquarie Bank Centre	20	Commercial
68	333.647	6251.256	King Street Wharf North End	8	Commercial
70	333.396	6251.259	Sydney Wharf	5	Public

Sensitive Receptor Locations



APPENDIX 2: EMISSION SOURCES ASSOCIATED WITH BULK EXCAVATION AND BASEMENT CARPARK CONSTRUCTION (FROM AECOM, SEPTEMBER 2010 & OCTOBER 2010)

The following table lists emission sources associated with bulk excavation, suitable control measures as per Section 5 of this sub-plan, and expected control efficiencies.

Type	Impact	Pollutants	Sources (in order of highest potential emissions)	Control Measure	Expected control efficiency (%)
Fuel combustion emissions from vehicles and equipment	Increased risk to human health	NOx, CO PM10 TSP BTEX	Vehicle emissions Stationary plant emissions	Turn engines off while parked on site.	100%
				Vehicular access confined to designated access roads, and using rumble grids/pit on exit.	Variable[5]
				Equipment, plant and machinery regularly tuned, modified or maintained to minimise visible smoke and emissions.	Variable[6]
				Site speed limits implemented.	Variable[5]
				Minimisation of haul road lengths.	Variable[5]
Fugitive dust and odour from exposed surfaces and vehicles	Nuisance (dust and odour) Discoloration of buildings or structures Increased risk to human health	PM10 TSP Odour	Excavation area – wheel dust Excavation areas – wind erosion Stockpiles – wind erosion Excavation, loading and unloading Retention wall Excavation tent, if required	Covering loads during off-site transport	70%-99%[4]
				Erection of windbreak barriers on the Site boundary and internal excavation boundaries where practicable.	30%
				Vehicular access confined to designated access roads.	Variable[5]
				Cover or coat stockpiled material.	50-99%[1]
				Implementation of a complaints management system	0%[2]
				Adjustment of work practices (as required) based on wind observations	Variable[3]
				Adjustment of work practices (as required) based on real time dust monitoring results	Variable[3]
Hazardous and other air pollutants (from disturbance of potentially contaminated ground)	Increased risk to human health Nuisance (dust and odour)	NOx, CO PM10 TSP Odour BTEX	Excavation tent, if required Excavation area – wheel dust Excavation areas – wind erosion Excavation, loading and unloading	Covering loads during off-site transport	70%-99%[4]
				Erection of windbreak barriers at the site boundary	30%
				Watering of exposed surfaces and roads	50%
				Surface stabilisation to minimise wind blown dust	99%

[1] Watering reduces emissions by up to 50%, covering or using surfactants can reduce emissions by up to 99%.
[2] This is not a direct measure, however if handled correctly, this could lead to more direct mitigation activities being implemented reducing emissions e.g watering, excavation activity modification etc.
[3] This is dependent on the specific changes implemented.
[4] This depends on the cover. A simple tarpaulin may reduce emissions by around 70% (simple enclosure reduction efficiency), compared to a complete sealed lid reducing emissions by up to 99%.
[5] This is difficult to put a number to as it depends on a wide variety of variables. However, Vehicle haul road emissions are speed and distance dependent. Controlling speed will minimise turbulence and hence dust entrainment. The degree of reduction could be in the order of 25-50%. Minimising distance will eliminate emissions by the distance not travelled by the haul trucks.
[6] Emission reductions from proper servicing cannot be specifically defined. It may be in the order of 50-90% for NO_x and Fine Particulates, but this would vary depending on make, model, maintenance history etc. It is simply recommended that equipment be serviced to an acceptable level and that visible smoke emissions be minimised where practicable.

APPENDIX 3: AIR QUALITY MONITORING PLAN (AECOM, 2012)

Lend Lease Project Management and Construction
19 May 2012
60153531

Air Quality Monitoring Plan

Barangaroo South

Air Quality Monitoring Plan

Barangaroo South

Prepared for

Lend Lease Project Management and Construction

Prepared by

AECOM Australia Pty Ltd
17 Warabrook Boulevarde, Warabrook NSW 2304, PO Box 73, Hunter Region MC NSW 2310, Australia
T +61 2 4911 4900 F +61 2 4911 4999 www.aecom.com
ABN 20 093 846 925

19 May 2012

60153531

AECOM in Australia and New Zealand is certified to the latest version of ISO9001 and ISO14001.

Quality Information

Document	Air Quality Monitoring Plan
Ref	60153531
Date	19 May 2012
Prepared by	Adam Plant
Reviewed by	David Rollings

Table of Contents

Table of Figures

List of Tables

Glossary of Terms

AQA	Air Quality Assessment
AQMP	Air Quality Monitoring Plan
AS/NZS	Australian/New Zealand Standard
CEMS	Continuous Emission Monitoring System
DEC	NSW Department of Environment and Conservation (now EPA)
DECCW	NSW Department of Environment, Climate Change and Water (now EPA)
DoP	NSW Department of Planning (now DP&I)
DP&I	NSW Department of Planning & Infrastructure (formerly DOP)
EA	Environmental Assessment
EPA	Environment Protection Authority (formerly part of OEH, DEC, DECCW)
EPL	Environment Protection Licence
HVAS	High-Volume Air Sampler
OEH	NSW Office of Environment and Heritage
PAH	Polynuclear Aromatic Hydrocarbons
PM_{10}	Particulate Matter less than 10 micrometres in aerodynamic diameter
PoPC	Pollutants of Potential Concern
TSP	Total Suspended Particulates
VOC	Volatile Organic Compounds
WTP	Water Treatment Plant

1.0 Introduction

This Air Quality Monitoring Plan (the 'Monitoring Plan') has been prepared on behalf of Lend Lease Project Management and Construction (LLPM&C) for Barangaroo South as part of the Barangaroo Stage 1 development. The Plan is to be incorporated into the Air Quality and Odour Management Sub-Plan. The objective of this Monitoring Plan is to document the rationale and methods for the measurement of ambient pollution resulting from construction of the bulk excavation portion of the Barangaroo development and stack emissions from water treatment plant filtration discharge. Monitoring details include:

- Pollutants to be assessed;
- Monitoring equipment recommended and justification for their selection;
- Location of monitoring stations;
- Program/timing for the monitoring;
- Assessment criteria and action levels; and
- Actions to be employed should actions limits be exceeded.

The Monitoring Plan is specific to works within Blocks 1-3, and does not provide scope for monitoring during later work phases, such as Blocks 4-5 excavation or remediation activities associated with the EPA Declaration Area. Where required, separate monitoring plans will be prepared for these activities.

1.1 Objectives

The objectives of this Monitoring Plan are to:

- Identify pollutants of concern to the project;
- Identify best practice methods for measuring pollutant levels;
- Ensure regulatory requirements are addressed in the monitoring of the project;
- Provide a framework for reactive dust / Volatile Organic Compound (VOC) monitoring;
- Outline monitoring requirements for the water treatment plant;
- Ensure sufficient data is collected at appropriate locations to demonstrate adverse impacts have not occurred due to LLPM&C's activities; and
- Develop a permanent record that includes a database of air monitoring results and meteorological conditions, calibration records, and other pertinent information.

1.2 Regulatory Consultation

The conditions of consent issued by the NSW Department of Planning (DoP) in November 2010 for the Barangaroo South Bulk Excavation and Basement Carpark Works stipulated that the Monitoring Plan developed should include all monitoring specified in the AQIA included as part of the overall Blocks 1-3 EA (20 September 2010). Specifically, the consent stated:

"*The AQMP must detail the dust and odour monitoring program to be undertaken for the proposal. These monitoring arrangements must include as a minimum, all monitoring specified in Chapter 9.3 of the EA (Barangaroo Site Excavation and Preparation Works, Appendix E – Chapter 9, 20 September 2010).*"

The Monitoring Plan has been prepared to incorporate those arrangements listed in the Environmental Assessment (EA) as requested by DoP. A summary of the content of the EA relating to the monitoring plan is provided below:

- The objective of the Monitoring Plan is to:
    - Allow a real time assessment of the various activities on the site, which can then be related back to operational changes to reduce off-site impacts; and to
    - Allow reactive dust mitigation measures to be implemented based on real time monitoring data.

- Ambient monitoring at three locations during the basement carpark excavation activities;
- Monitoring of Total Suspended Particulates (TSP) using a High Volume Air Sampler (HVAS);
- Real time monitoring of Particulate Matter less than or equal to 10 microns (PM_{10}) using a Tapered Element Oscillating Microbalance (TEOM);
- Monitoring of airborne heavy metals using a HVAS;
- Monitoring of VOCs; and
- Monitoring of odour at provisionally 10 locations on and off the site.

This Air Quality Monitoring Plan meets the requirements of section E2.4 of the Environmental Protection Licence (EPL) 13336. It includes monitoring of emissions from treated Water Treatment Plant (WTP) discharge points.

2.0 Basis for Air Quality Monitoring Plan

Air Quality Impact Assessments (AQIAs) have been undertaken as part of the Environmental Assessments (EAs) (AECOM 2010a, AECOM 2010b, AECOM 2012a, AECOM 2012b) for the bulk excavation area and C3, C4, C5 commercial buildings. The AQIAs included an emissions inventory detailing the predicted sources and rates of air pollutant emissions from the project site, as well as an assessment of the predicted impacts on the surrounding environment. The following sections have been populated using the details and findings within the AQIAs and EAs.

2.1 Sources

The activities that are expected to be the primary sources of pollutants from the construction phase of Blocks 1-3 are listed below.

- Ground slab and in ground structures demolition;
- On-site concrete crushing and screening;
- Excavation and installation of basement retention systems;
- Bulk excavation of approximately 350,000 m^3 of soil (fill) and rock;
- Remediation of contaminated material from the bulk excavation works;
- Haulage of selected excavated and demolition material to potential soil treatment areas and Headland Park;
- Transport (truck or ship) of material to be disposed of off-site;
- Water treatment processes;
- Stockpiling and stockpile management; and
- Construction of basement car parking areas.

2.2 Potential Impacts

2.2.1 Air Quality

The construction activities involve excavation of a significant amount of material to form the basement. Dust can be generated from all types of activities involving soil, including excavation, handling, loading and unloading from stockpiles, and wind erosion of exposed areas.

Soil sampling was undertaken at the site and identified the presence of a number of pollutants, including heavy metals and volatile organic compounds (VOCs) (refer to AQIA, AECOM 2010a). As these pollutants are contained within the soil, they may be liberated through handling processes, resulting in contaminant emissions to air.

A water treatment plant (WTP) is located on the site to treat stormwater runoff and groundwater. The treatment process involves the use of air strippers to remove pollutants within the water and treat the subsequent air emissions through a carbon filter. The treated air is then be released to atmosphere.

2.2.2 Odour

A number of the contaminants identified at the site have associated odours. These odours may be liberated to air during excavation, handling, water treatment and stockpiling of the material.

2.3 Sensitive Receptors

The Barangaroo South site is bordered by Sydney Harbour on the western side and by Hickson/Sussex Streets to the east. A cruise passenger terminal is located to the north, while commercial office buildings are located to the south. The closest receptors are located approximately 20 m to the east of the site, in a multilevel residential building located on Hickson Road (38 Hickson Road). A child care centre is located 70 m to the north of 38 Hickson Road at the ground level of a multilevel office building (the Bond Building), which is open to the street. Commercial development is located approximately 40 m south of the site. A number of finger wharves containing a mixture of residential and commercial developments are located directly opposite the excavation area, the closest being approximately 250 m west of the site, while the residential suburb of Balmain East is located approximately 400 m to the west of the Headland Park emplacement area.

3.0 Pollutants of Potential Concern (PoPC)

3.1 Particulate Matter

Suspended particulate matter may be emitted from site via combustion activities (i.e. vehicle and plant operations) and site preparation works.

Airborne particles are commonly differentiated according to size based on their equivalent aerodynamic diameter. Particles with a diameter of less than or equal to 50 micrometres (μm) are collectively referred to as total suspended particulates (TSP). TSP primarily causes aesthetic impacts associated with settling on surfaces, which also causes soiling and discolouration. Uncontrolled emissions of these large particles, however, can cause some irritation of mucosal membranes and can increase health risks from ingestion if contaminated. Particles with diameters less than or equal to 10 μm (known as PM_{10} or fine particles) tend to remain suspended in the air for longer periods than larger particles, and can penetrate into human lungs.

Exposure to particulate matter has been linked to a variety of health effects, including respiratory problems (such as coughing, aggravated asthma, chronic bronchitis) and non-fatal heart attacks. Furthermore, if the particles contain toxic materials (such as lead, cadmium, zinc) or live organisms (such as bacteria or fungi), toxic effects or infection can occur from the inhalation of the dust.

3.2 Odour

Odour is a sensory response to the inhalation of one or more chemicals in the air we breathe. A person's perception of an odour can vary significantly depending on the sensitivity of the person, the acuteness of the person's sense of smell and the connotations that the odour bestows on that person. Odour may affect a person's quality of life and can have a large range of effects including stress and other physical symptoms.

3.3 Volatile Organic Compounds (VOCs)

VOCs are organic compounds with a vapour pressure at 20 °C exceeding 0.13 kPa. These compounds have been implicated as a precursor in the production of photochemical smog, which may cause atmospheric haze, eye irritation and respiratory effects. VOC emissions are typical for oil processing, petrochemical and chemical plants and include emissions from point sources (storage tanks and filling stations vents) and fugitive emissions from pipelines and process equipment leaks.

3.4 Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs are another category of VOCs. They contain at least two fused benzene rings and are commonly formed by the incomplete combustion of fossil fuels and other organic materials. They travel through the atmosphere as a gas or attached to dust particles. Some PAHs readily evaporate into the air. The compounds can break down over days or weeks by reacting with sunlight and other chemicals in air, but do not dissolve easily in water. PAHs are moderately persistent in the environment and can bioaccumulate.

PAHs can be inhaled or ingested, and can also be absorbed through the skin. Exposure can cause irritation of eyes and nose and other mucous membranes, headaches, nausea, damage to blood cells, liver and kidneys, and (in very high levels) may be life threatening. A number of PAHs are listed as probably or possibly carcinogenic to humans by the International Agency for Research on Cancer. They can have high acute and chronic toxicity effects on animals and aquatic life, with some also affecting agricultural and ornamental crops. Benzo[a]pyrene is one of the most toxic PAHs, and, as it typically found in the atmosphere with other PAHs, is often used as an indicator for the PAH group of pollutants. Naphthalene is another key PAH - excessive non-life-threatening exposure may cause cataracts in the eyes, while ingestion can cause abdominal cramps, nausea, vomiting, diarrhoea in young infants. It is considered a possible carcinogenic to humans and carcinogenic in animals.

3.5 Heavy Metals

A variety of heavy metals will be measured as part of the Monitoring Plan, and are discussed below:

Arsenic
Arsenic forms colourless, odourless, crystalline oxides which are hygroscopic and readily soluble in water to form acidic solutions. Arsenic(V) acid is a weak acid. Arsenic forms an unstable, gaseous hydride: arsine (AsH_3). However, in subtoxic doses, soluble arsenic compounds act as stimulants.

When heated in air, arsenic oxidizes to arsenic trioxide; the fumes from this reaction have an odour resembling garlic. This odour can be detected on striking arsenide minerals such as arsenopyrite with a hammer. Arsenic (and some arsenic compounds) sublimes upon heating at atmospheric pressure, converting directly to a gaseous form without an intervening liquid state. The liquid state appears at 20 atmospheres and above, which explains why the melting point is higher than the boiling point.

Although arsenic is sometimes found native in nature, its main economic source is the mineral arsenopyrite mentioned above; it is also found in arsenides of metals such as silver, cobalt and nickel, as sulfides, and when oxidised as arsenate minerals such as mimetite, erythrite, and more rarely arsenites. In addition to the inorganic forms mentioned above, arsenic also occurs in various organic forms in the environment. Other naturally occurring pathways of exposure include volcanic ash, weathering of the arsenic-containing mineral and ores as well as groundwater. It is also found in food, water, soil and air.

Copper
Copper is a naturally occurring substance that is an essential trace element for both animals and plants. Copper can be inhaled or ingested. Most copper released to air, water, sediment and soil strongly binds to other particles, which greatly reduces its toxicity.

Exposure to high levels of copper can, however, be harmful, and cause irritation to the nasal passages, mouth, eyes and throat, while ingestion of high concentrations can cause nausea, vomiting, liver and kidney damage and, possibly, death. Copper is classified as a hazardous substance by the office of the Australian Safety and Compensation Council.

Lead
Lead is a naturally occurring substance that can enter the body by inhalation or ingestion, and primarily affects the nervous system. Excessive exposure to lead causes symptoms such as paralysis, anaemia, abdominal pain, brain and kidney damage and death. Lead can affect reproduction as well as the mental and physical development of children. Lead may be released as particles into the atmosphere, including through windblown dust and bush fires. Lead usually attaches to particles of organic matter, clay, soil or sand, and can accumulate in tissues.

Mercury

Mercury is a naturally occurring element found in rocks and ores. Mercury chloride acts like a particle, while elemental mercury may be found as a gas in the atmosphere. It is naturally released into the atmosphere by evaporation from soils and water and volcanic eruptions. Significant anthropogenic sources of mercury are the burning of fossil fuels, municipal landfills, sewage, metal refining and chemical manufacturing.

Mercury can enter the body through inhalation, ingestion or dermal contact. The nervous system is very sensitive to all forms of mercury. Exposure can potentially causing permanent damage to the brain, eyes, kidneys and developing foetuses, and can cause fluid build-up in the lungs that can be fatal. Dermal contact can burns to the skin.

Mercury is highly toxic to aquatic life, with both acute and chronic effects. Mercury accumulates in body tissue; consumption of contaminated fish can poison humans and possibly birds and land animals. It is also highly persistent in water and the environment.

Zinc
Zinc is a naturally occurring element found in all foods as well as rocks, soil, air, water, plants, animals and humans. Trace amounts are essential for human health. It is found in a variety of compounds, the properties of which vary greatly. The metal has a strong tendency to form complexes with inorganic and organic compounds. Zinc is used in a range of manufacturing, industrial and applications such as fungicides, antiseptics, water- repellents, lubricants and concrete.

Zinc attaches to dust particles in the air and to soil and sediment particles, and can be inhaled or ingested. Excessive zinc ingestion can lead to nausea, vomiting, anaemia, and damage to the pancreas. Zinc dust irritates mucous membranes, while solid zinc compounds can irritate the skin and eyes.

4.0 Monitoring Guidance and Assessment Criteria

The NSW EPA *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DEC, 2005), hereon referred to as the Approved Methods, lists the statutory methods for modelling and assessing emissions of air pollutants from ambient environments. Monitoring has been defined in accordance with requirements outlined in the documents listed in **Section 4.1**. The available criteria for the PoPC are provided in **Section 4.2**.

4.1 Monitoring Guidance

This Monitoring Plan was prepared with consideration of the following statutory documents:

- *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (DEC, 2005);*
- *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales (DEC, 2005);*
- *Assessment and Management of Odour from Stationary Sources in NSW: Technical Framework (DEC, 2006a);*
- *Assessment and Management of Odour from Stationary Sources in NSW: Technical Notes (DEC, 2006b); and*
- *Protection of the Environment Operations (Clean Air) Regulation 2010.*

4.2 Monitoring Criteria

The details of the monitoring criteria have been separated into two sections; Ambient Criteria and WTP Stack Criteria. Further definition of the two is provided in **Section 6.0**.

4.2.1 Ambient Monitoring Criteria

Table 1 presents the Approved Methods (DEC 2005) criteria for the identified PoPC for ambient monitoring.

Due to the number of VOCs analysed, the assessment criteria for VOCs have not been presented. These criteria will be reported in the required monitoring reports where a reading above the individual VOC criteria is returned.

Table 1 Ambient Monitoring Criteria for Pollutants of Concern

Pollutant	NSW EPA Air Quality Criterion	Averaging Period
	µg/m^3	
TSP	90	Annual
PM_{10}	50 30	24 hour (Calender Day)*** Annual
Lead	0.5	Annual
	mg/m^3	
PAH (as benzo[a]pyrene) *	0.0004	1 hour
Arsenic and Compounds	0.00009	1 hour
Copper Dusts	0.0037	1 hour
Zinc (oxide fumes)	0.09	1 hour
Mercury (organic)	0.00018	1 hour
Mercury (Inorganic)	0.0018	1 hour
Odour **	-	-

µg / m^3: micrograms per cubic metre, mg / m^3: milligrams per cubic metre
* PAHs as benzo[a]pyrene must be calculated using the potency equivalency factors provided in the Approved Methods table 7.2c
** Assessment criteria for odour specified in the EPA Approved Methods relates only to predicted modelling ground level concentrations and cannot be used for the assessment of ambient odours.
*** A Calender day is defined as the 24 hour period from midnight to midnight.

4.2.2 Stack Monitoring Criteria

Table 2 presents the VOCs (as n-propane equivalent) criterion for stack monitoring. The criterion has been sourced from the *Protection of the Environment Operations (Clean Air) Regulation 2010*, and is also a limit in the Environmental Protection Licence (no. 13336) for the Barangaroo site. The on-site plant has been identified as a vapour recovery unit treating air impurities that originate from material containing any principle toxic air pollutant, and the criterion has been chosen against this identification.

Table 2 Stack Monitoring Criteria for Pollutants of Concern

Pollutant	Criterion	Unit	Averaging Period
VOC (as n-propane equivalent)	20	mg/m^3	Instantaneous
	10.2	ppm	

5.0 Responsibilities and Accountabilities

Details of roles, responsibility, authority and accountability of key project personnel are detailed in **Table 3**.

Table 3 Key Project Personnel

Role	Responsibility	Authority	Accountability
Environmental Engineer / Air Quality Specialist	Undertake pollutant monitoring in accordance with this Monitoring Plan.	Undertake monitoring and provide advice to the EHS (Environment) Manager.	Reports to the EHS (Environment) Manager
	Provide reports in accordance with **Section 7.2**	Advise trigger level and criteria exceedences.	Reports to the EHS (Environment) Manager
Construction Manager	Overall management of the project	Manage operational activities	Reports to senior management and authorities
EHS (Environment) Manager	Oversight of all air quality monitoring on site, reporting and first point of contact for community/Authority liaison	Implement contingencies if necessary, liaise with authorities.	Reports to senior management.

6.0 Monitoring Details

The details of the monitoring have been separated into two sections; Ambient and Stack. Ambient monitoring measure the pollutants of concern in the atmosphere surrounding the Barangaroo South site, while Stack locations monitor at the exhaust of potential pollution sources at the WTP.

The stack monitoring in this AQMP specifically identifies the air discharge points of the WTP from the air strippers and displacement tanks detailed in **Section 6.2**.

6.1 Ambient Monitoring

6.1.1 Ambient Monitoring Locations

The ambient monitoring locations provided in the section have been addressed for two types of monitoring locations; air quality (monitors all pollutants of concern) and odour (odour is monitored only). Where possible, given the constraints adjacent to the Barangaroo South site, monitoring equipment is to be sited with consideration of AS/NZS 3580.1.1 – 2003, Guide to Siting Air Monitoring Equipment.

The ambient air monitoring locations are listed in **Table 4** and displayed in **Figure 1.** Details of the monitoring equipment listed in the table are provided in **Section 6.1.2**. Justifications for the monitoring locations are described later in this section.

Table 4 Ambient Air Quality Monitoring Locations (all pollutants of concern)

EPL 13336 Location ID	Monitoring Equipment	Description	Approximate Location (UTM coordinate system)	
Figure 1			Metres E	Metres S
5	All Locations: • HVAS • TEOM • RaeGuard	Northern boundary of Barangaroo South	333680	6251795
8		Eastern boundary of Barangaroo South, opposite 38 Hickson Road	333750	6251590
9		South-western boundary of Barangaroo South	333640	6251285

Due to the sensitivity of odour impacts on the local community, several monitoring locations for odour have been selected in addition to the three air quality monitoring sites listed above. Monitoring will involve the use of a field olfactometer to measure the dilution-to-threshold value and odour characteristics as described in **Section 6.1.2.5**. The locations for odour monitoring are provided below in **Table 5** and displayed in **Figure 1**.

Table 5 Ambient Odour Monitoring Locations

Location ID	Monitoring Equipment	Description	Approximate Location (UTM coordinate system)	
Figure 1			Metres E	Metres S
1	All Locations: • Field Olfactometer (Nasal Ranger)	Northern Boundary	333615	6251807
2		Hickson Road	333774	6251670
3		Hickson Road	333777	6251605
4		Hickson Road	333787	6251543
5		Hickson Road	333794	6251472
6		Sussex Street	333805	6251405
7		Sussex Street	333806	6251348
8		Shelly Street	333766	6251310
9		Shelly Street	333716	6251284
10		Lime Street	333635	6251255

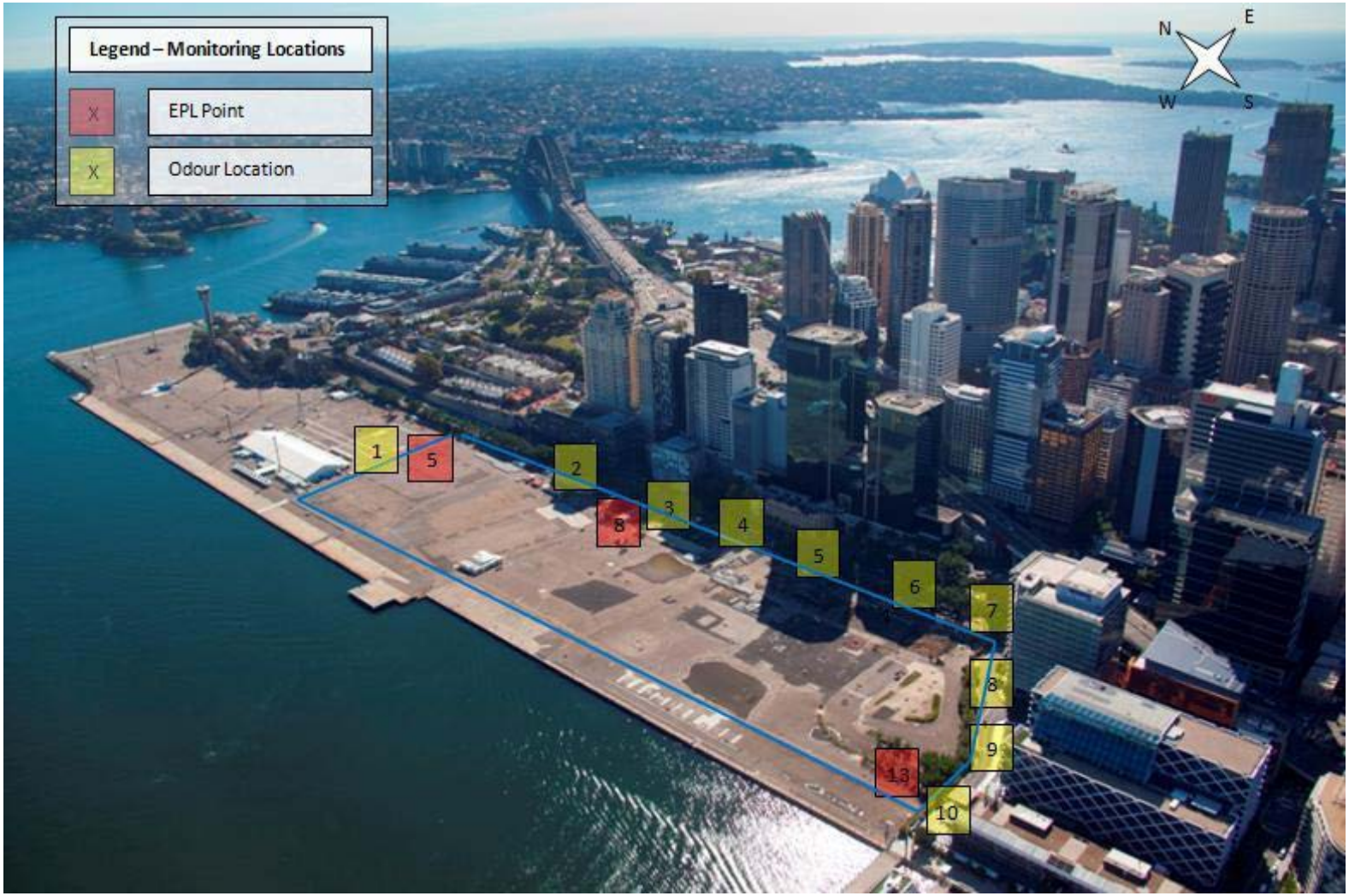


Figure 1: Air Quality Monitoring Locations

The air quality monitoring locations were chosen to best represent the areas that have been predicted by dispersion modelling (AECOM 2010a) to have the highest impacts in the local area. The additional odour monitoring locations were chosen to represent commercial and residential areas that surround the site that have the potential to be affected by odours.

Concerns were raised that the air quality to the north of the site at the passenger terminal may be adversely impacted by the development, and in particular by odour. The dispersion modelling suggests that the development may elevate the pollutant concentrations at the terminal. **EPL location 5** has been chosen to represent this northern area due to the potential sensitivity of the receptor.

Pollutant dispersion modelling predicted that the location with the highest dust concentrations is east of the development, at approximately 60 Hickson Road. This is indicative of the high westerly wind component present for the area (AECOM 2010a) combined with the proximity of this area to the main dust-generating activities and site boundary. **EPL location 8** was chosen to represent this area.

Commercial buildings, including cafes and restaurants, are located to the south of the development site. The modelling results predicted elevated concentrations of pollutants in this area (particularly following the 75W application to excavate up to the southern boundary of the site). **EPL location 13** was chosen to represent the area to the south of the development.

6.1.2 Ambient Monitoring Equipment Specifications

Based on the pollutants of potential concern detailed in **Section 3.0**, the following ambient air quality monitoring equipment is recommended for use in achieving the goals outlined in this Monitoring Plan. A justification for the choice of equipment, pollutants monitored and a brief of the equipment specifications has been provided.

6.1.2.1 High Volume Air Sampler (HVAS)

Pollutants Measured: Total Suspended Particulates (TSP), heavy metals in dust, Polycyclic Aromatic Hydrocarbons (PAHs) in dust

Standards Applicable:

- AS/NZS 3580.9.3:2003: *Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – Total suspended particulate matter (TSP) – High volume sampler gravimetric method.*
- AS/NZS 3580.9.6:2003: *Methods for sampling and analysis of ambient air – Method 9.6: Determination of suspended particulate matter – PM_{10} Total high volume sampler with size selective inlet – gravimetric method.*

Justification of equipment/method: HVAS are a commonly used system for the monitoring of dust and contaminants in ambient air, regularly requested and employed to meet NSW EPA environmental protection licence requirements and due diligence studies. HVAS can be run at selected frequencies dictated by the sample size required for the study (generally every 6 days). They are a proven method for the accurate collection of air born particulate pollutants as expected in this current project.

Equipment Brief: HVAS sampling is a gravimetric method. The HVAS (with a size selective inlet where appropriate) draws a large volume of air, typically 70 m^3/hr, through a pre-weighed and conditioned sample filter over a designated time period (typically a 24-hour period). The mass of collected particles is determined gravimetrically. Samples are collected at ambient temperature and returned to the laboratory for conditioning to pre-sampling weighing conditions of 20°C and about 50% relative humidity.

6.1.2.2 Tapered Element Oscillating Microbalance (TEOM)

Pollutants Measured: Particulate matter less than or equal to 10 microns in diameter (PM_{10})

Standards Applicable:

- *AS/NZS 3580.9.8:2001; Method 9.8: Determination of suspended particulate matter – PM_{10} continuous direct mass method using a tapered element oscillating microbalance analyser*

Justification of equipment/method: A TEOM is an automated continuous particle monitor able to record and transmit concentrations on a 10 minute time scale. They allow for the correlation of dust concentrations to source operations, and can be incorporated into reactive management plans. TEOMs have been used by private and government bodies for over 10 years in Australia and are an accepted method (when operated in accordance with relevant standards) for continuous dust monitoring by the NSW EPA.

A similar option to the TEOM is the Beta Attenuation Monitor (BAM). The BAM automatically measures and records airborne particulate concentration levels using the principle of beta ray attenuation; measurement of beta attenuation on a piece of tape pre and post loading with dust. The regulatory standard for BAMs in Australia is

AS/NZS 3580.9.11:2008. BAMs measure on an hourly basis compared to a TEOMs 10 minute measurement, making them less appropriate for reactive management plans. This also limits their usefulness for correlating the dust measurements to construction operations when trying to identify short term dust emission sources. As such, a TEOM is considered the more appropriate technology for the current Monitoring Plan.

Equipment Brief: The TEOM is an automated continuous particle monitor. The TEOM draws air through a hollow tapered tube, with the wide end of the tube fixed, while the narrow end oscillates in response to an applied electric field. The filter cartridge is at the narrow end of the tube. The sampled airflow passes from the sampling inlet, through the filter, to a flow controller. As particles are collected on the filter, the mass changes resulting in a change of the oscillating frequency. Using the rate of mass accumulation on the filter and the flowrate through the sample (main) flow controller, the TEOM's microprocessor calculates the mass concentration on a 10 minute average. The flowrate through the sample filter is set at a nominal 3.0 litres per minute (L/min). A bypass (auxiliary) flow is used to provide an additional 13.67 L/min for a total flowrate of 16.67 L/min, the design flow of the size selective inlet. To minimise the contribution of liquid water to measured particle mass, the TEOM analyser conditions the incoming sample aerosol to 50°C prior to and during its measurement.

6.1.2.3 RaeGuard Multi-Gas Monitor

Pollutants Measured: Total Volatile Organic Compounds (VOCs)

Standards Applicable: None

Justification of equipment/method: Due to the potential contamination of part of the excavated soil for the project, continuous monitoring of ambient VOCs is required. The RaeGuard is a proven method for continuous monitoring of VOC contaminated site cleanup projects, with the ability to wirelessly transmit data to an off-site logging system. The equipment can be used for the correlation of VOC concentrations to source operations, and can be incorporated into reactive management plans.

Equipment Brief: The RaeGuard is an ATEX-certified Multi Gas, wireless monitor. The photoionization detector (PID) in the RaeGuard can measure parts per million of volatile organic compounds (VOCs) (does not measure individual compounds). In addition, it can be equipped with a lower explosive limit (LEL) sensor, an oxygen sensor, and one or two electrochemical toxic sensors for measuring specific substances such as hydrogen sulfide or chlorine. An integrated wireless modem transmits real-time gas measurement data to a base station up to 3 kilometres away, which employs a standard Windows-based PC running ProRAE Remote software. The base station can simultaneously control and display readings for up to eight RaeGuard. This provides a multi-threat detection network that can monitor a wide geographic area.

6.1.2.4 Summa Canister

Pollutants Measured: Speciated Volatile Organic Chemicals (VOCs) including Naphthalene

Standards Applicable:

- *USEPA Method TO-15; Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air – Determination Of Volatile Organic Compounds (VOCs) In Air Collected In Specially Prepared Canisters And Analysed By Gas Chromatography/Mass Spectrometry (GC/MS)*

Justification of equipment/method: There are two methods for the collection of VOCs in ambient air; summa canisters and sorbent tubes. Although more expensive, summa canisters are considered more appropriate for the Monitoring Plan as they are by far the simpler system with less potential for errors caused by incorrect use, contamination or incorrect calibration. Summa collection is a proven method used extensively in Australia and globally.

Equipment Brief: A Summa canister is a stainless steel vessel in which the internal surfaces have been specially passivated using the "Summa process". This process uses an electro-polishing step followed by chemical deactivation to produce a surface that is very chemically inert. A canister will hold a high vacuum (>28" Hg) for up to 30 days. Samples can be collected over time, from 1 hour to 7 days. The time frame of the sample is selected using a separate control valve attached to the inlet of the canister. The limit of reporting is 0.5 ppbv (0.5-5 $\mu g/m^3$) when analysing for an extended TO15 suite (83 compounds) including Naphthalene.

6.1.2.5 Field Olfactometer

Pollutants Measured: Odour dilution-to-threshold value and characteristics noted

Standards Applicable: None

Justification of equipment/method: Odour measurement is a subjective science based on the nasal sensitivity of individuals. Odour is not a pollutant that can be continuously measured using electronic equipment, and due to the

low levels measured in the environment olfactometry assessment is not appropriate. In addition, odours annoyance is not directly related to its odour concentration but a reflection of many factors including its character, intensity and hedonic tone (pleasantness). With this in mind, the use of a field olfactometer, specifically the Nasal Ranger, to assess the odour is recommended. The device measures the detection-to-threshold value of an ambient odour and together with the recording of the odours character, intensity and hedonic tone provides a good measurement method.

Equipment Brief: Ambient odour monitoring is recommended to be undertaken using a Nasal Ranger® Field Olfactometer (Nasal Ranger). The Nasal Ranger uses in-field olfactometry (portable odour detecting and measuring device) for measuring and quantifying odour strength in the ambient air. A Nasal Ranger creates a calibrated series of discrete dilutions by mixing the odorous ambient air with odour-free (carbon) filtered air. Field olfactometry defines each discrete dilution level as a “Dilution-to-Threshold,” D/T, ratio. The “Dilution-to-Threshold” ratio is a measure of the number of dilutions needed to make the odorous ambient air “non-detectable”.

Field olfactometry calculates the “Dilution-to-Threshold” (D/T) ratio as:

$$D/T = \frac{\text{Volume of Carbon-Filtered Air}}{\text{Volume of Odorous Air}}$$

6.1.2.6 Meteorological Station

Pollutants Measured: Meteorological conditions, as a minimum; wind speed, direction, temperature, humidity, rainfall, pressure.

Standards Applicable:

- *USEPA (2000) EPA 454/R-99-005 – Meteorological Monitoring Guidance for Regulatory Modelling Applications*

Justification of equipment/method: Meteorological data should be recorded using an appropriate monitoring station in order to collate pollution monitoring data to climatic conditions.

Equipment Brief: The meteorological station should be set at a height of 10 meters above ground and at a distance of 10 meters from the nearest structure in accordance with *USEPA (2000) EPA 454/R-99-005* where possible. The details of an example station are provided below, with the final station still to be sourced:

- Type: Vaisala Weather Station
- Wind Speed: 0.5 - 60m/s
- Wind Direction: 0 - 359^{o} coverage
- Rainfall Accumulation & Duration
- Barometric Pressure: 600 - 1100hPa
- Air Temperature: -52^{o}C to +60^{o}C
- Relative Humidity: 0 - 100% RH

6.1.3 Ambient Monitoring Agenda

The monitoring agenda to be used throughout stages of construction, as shown in **Table 6**, has been developed to meet the objectives of this Monitoring Plan. Monitoring locations are as described in **Section 6.0**.

Monitoring may be undertaken in stages for retention system excavation and basement carpark excavation as per the AQIA. Monitoring equipment will be commissioned in a staged approach and operated on a schedule designed around the location and timing of the construction works.

Table 6 Ambient Monitoring Agenda

Parameter	Equipment	Frequency	Locations	EPA Criteria	Sampling Method
TSP	HVAS	24 hours every 6 days *	EPL points 5, 8, 13	90 µg/m^3 as an annual average.	AM-15 AS3580.9.3 – 2003
PM_{10}	TEOM	Continuous	EPL points 5, 8, 13	50 µg/m^3 as a 24 hour average.** 30 µg/m^3 as an annual average.	AM-22 AS3580.9.6 - 2003
Heavy Metals	HVAS	24 hours every 6 days*	EPL points 5, 8, 13	Refer to **Section 4.0**.	AM-15 AS3580.9.3 – 2003
PAH	HVAS	24 hours every 6 days*	EPL points 5, 8, 13	Refer to **Section 4.0**.	AM-15 AS3580.9.3 – 2003
VOC (speciated)	Summa	As needed	As needed	Refer to **Section 4.0**.	USEPA TO-15
VOC (total)	RaeGuard	Continuous	EPL points 5, 8, 13	NA	NA
Odour	Field Olfactometer	Morning, followed by afternoon if odour exceeds trigger level	All locations	NA	NA
Meteorological station	-	Continuous	EPL point 5	Site complies with *Approved Methods*	AM-1 to AM-4 USEPA (2000) EPA 454/R-99-005

* If noise complaints are likely to occur or do occur this 24 hour time frame may be reduced to 12 hours operation e.g. 7am to 7pm and compared with the same criteria.

** 24 hour average of a Calender Day defined as midnight to midnight.

6.2 Stack Monitoring

Stack monitoring will be undertaken for the Water Treatment Plant (WTP) to quantify the level of pollutants emitted to the atmosphere and compare against set trigger levels and exceedence criteria. The monitoring will be undertaken using both Continuous Emissions Monitoring Systems (CEMS) and Photo-Ionisation Detector (PID) events. Note that stack testing will be used as an interim method until the CEMS is installed and commissioned.

6.2.1 Stack Monitoring Locations

The stack monitoring locations are listed in **Table 7** and displayed in **Figure 1.** Details of the monitoring equipment listed in the table are provided in **Section 6.2.2**.

Table 7 Stack Monitoring Locations

Location ID	Monitoring Equipment	Description	Approximate Location (UTM coordinate system)	
Figure 1			Metres E	Metres S
Air Stripper Stack	CEMS (& interim stack test) (refer to **Table 8)**	WTP Air Stripper Filtration Discharge Point	333617	6251798
Displacement Tank Stack	PID	WTP Displacement Tank Filtration Discharge Point	333611	6251513

6.2.2 Stack Monitoring Equipment

The continuous monitoring (CEMS) will be undertaken using a back-flush gas chromatography (GC) system designed for automated measurement of methane and non-methane hydrocarbons. Unlike instruments that measure only methane and total hydrocarbons, the back-flush GC method provides a direct measurement of non-methane concentrations. This allows accurate and precise measurement of low levels of non-methane hydrocarbons (NMHC), even in the presence of methane at much higher concentrations.

The column design is unaffected by the oxygen content of the sample, provides complete recovery of low volatility compounds and achieves absolute separation of methane from all C2 compounds. To start an analysis cycle, a known volume of air is collected into the sample loop. Transported then to an eight port valve, located in the 150°C - 200°C detector oven, the sample is injected into a flowing stream of carrier gas to the separation column. Based on the specific chemical and physical properties of a low molecular weight and high volatility, methane moves at the highest velocity and emerges from the column first. Carried back to the detector oven the sample is then measured by the flame ionization detector.

The valve then returns to the original position resulting in the back-flush of the non-methane hydrocarbons to the FID. While NMHCs are being measured, the next sample is simultaneously collected into the sample loop.

6.2.3 Stack Monitoring Agenda

The monitoring agenda to be used throughout operation of the WTP, as shown in **Table 8**, has been developed to meet the objectives of this Monitoring Plan. Monitoring locations are as described in **Section 6.2.1**.

Table 8 Stack Monitoring Agenda

Parameter	Locations	Purpose	Method	Frequency	Sampling Method
VOC (as n-propane equivalent)	Air Stripper Stack	Compliance	CEMS-8	Continuous	USEPA (2000) Performance Specification 8
		Interim compliance until CEMS installed	Stack test	Post commissioning, and then weekly. Then as needed. Reduced where complying for three consecutive samples.	TM-34
		Breakthrough	CEM-8	Continuous	USEPA (2000) Performance Specification 8
	Displacement Tank Stack	Breakthrough	PID	Initially daily when WTP operating and pumping, otherwise weekly	PID Method

7.0 Compliance Management Protocol

7.1 Assessment of Monitoring Results

Monitoring results will be compared to the assessment criteria detailed in **Section 4.0.** Monitoring data will be reviewed continuously during business days, or at the first practicable opportunity for samples requiring laboratory analysis. Monthly monitoring reports will identify and comment on any exceedences and/or trends in monitoring results.

If trigger levels outlined below are exceeded, a notification will be sent to the relevant staff alerting them of the exceedence.

In addition, if an EPA Approved Methods (DEC 2005, refer to **Section 4.0**) assessment criteria is exceeded for any pollutant (monitoring continuous or intermittent in nature) then relevant staff will also be notified.

7.1.1 Ambient Monitoring Trigger Levels

Where a monitoring system is continuous in nature, trigger levels can be used as an early warning system for the monitoring of ambient air quality impacts on the local environment. The trigger levels are generally set below a relevant assessment criteria to alert prior to the pollutant concentration reaching the criteria value.

The trigger level for 1 hour PM_{10} has been calculated on the basis of 80% of the 24 hour assessment criteria value of 50 ug/m^3 using the following power law (Schnelle and Dey, 1999);

$$C_s = C_k(t_k/t_s)^p$$

Where:

C_s = concentration for time t_s

C_k = concentration for time t_k

t_k = longer averaging time

t_s = shorter averaging time

p = power (assumed value of 0.17)

The trigger level for VOCs has been chosen based on 10% of the OH&S-based Benzene time-weighted average. Once sufficient speciated VOC sampling data has been collected from the site to provide an approximate VOC breakdown, the trigger level will be modified if needed. This approach will result in changing VOC trigger levels, however given the heterogeneous nature of soil and contamination, this is a prudent approach.

For this Monitoring Plan, the trigger levels applied are provided in **Table 9**.

Table 9 Ambient Monitoring Trigger Levels

Pollutant	Monitoring Equipment	Timer Period	Trigger Level	Unit
PM_{10}	TEOM	24 hour rolling avg*	50	ug/m^3
		1 hour rolling avg	69	ug/m^3
		10 minute	93	ug/m^3
Total VOC	RaeGuard	Instantaneous	1.6*	mg/m^3
Odour	Field Olfactometer	Instantaneous (nose response time)	≥ 2 D/T with a mothball-type character associated with the development on two consecutive events	D/T

* Trigger level to be revised if required depending on initial monitoring results.

*A rolling 24 hour average is to be used as an indicator of future potential exceedence of the calendar 24 hour average criteria.

7.1.2 Stack Monitoring Trigger Levels

Trigger levels that have been applied for both the WTP air stripper and displacement tank discharge points are provided in **Table 10**.

Table 10 Stack Monitoring Trigger Levels

Pollutant	Location	Monitoring Equipment	Timer Period	Trigger Level *	Unit
VOC (as n-propane equivalent)	Air Stripper Stack	CEMS	Instantaneous	10	mg/m^3
				5.1	ppm
	Displacement Tank Stack	PID	Refer to **Table 8**	10	mg/m^3
				5.1	ppm
* Trigger level to be revised if required depending on initial monitoring results.					

When a trigger level is exceeded, a notification will be sent to the relevant staff alerting them of the exceedence.

Procedures relating to management of VOC breakthrough, and the trigger levels in **Table 10,** are further defined in the *VOC Breakthrough Management Procedure*.

7.2 Reporting

7.2.1 Routine Reporting

Air quality monitoring results will be reported monthly. Monitoring results will be compared to assessment criteria. Completed monitoring will be displayed against monitoring requirements (see **Section 4.1**) as a demonstration of compliance with the requirements to undertake monitoring.

7.2.2 Exceedence Reporting

The Environmental Response Form will be completed for exceedences of assessment criteria detailed in **Section 4.0** which will reference the outcomes of the investigation detailed in **Section 7.5**, and also detail the following:

- The indicators of the exceedence i.e. the criteria exceeded, and include the pollutant type, date, time, duration, location and concentration;
- The activities operating that could have or are known to have contributed to the exceedence;
- Weather conditions during the event;
- A summary of any reviews of the operating procedures; and
- Recommendations for mitigating the source of the exceedence. This may involve a short term response and/or a long term management plan.

7.3 Complaints and Enquiries Management

Complaints and enquiries will be managed as per the Community and Stakeholder Engagement Strategy.

7.4 Review of Monitoring Plan

This AQMP will be reviewed three months after the commencement of construction, and then in conjunction with the review schedule of related environmental management plans.

Additional review of this AQMP will be conducted following any change in statutory requirements, operational or management procedures or following any serious or repeated failure to meet assessment criteria.

7.5 Corrective Action and Contingencies

In the event that trigger levels and/or assessment criteria are exceeded, the EHS (Environment) Manager will take action to assess causes, consult with and discuss required remediation measures with the project team and implement/upgrade mitigation measures to reduce the chance of a non-compliance occurring.

In the case of non-compliance, corrective actions should be taken as a tailored response considering the severity and implications of the specific event. As a general guide, corrective actions may be undertaken according to this brief procedure:

- Ensure that the immediate safety of potentially affected parties is not continuing to be affected by the event;
- Review the indicators of the non-compliance against activities at the site and weather conditions, to confirm that the site contributed to the non-compliance;
- Review operating procedures for opportunities to reduce the risk of the non-compliance recurring;
- Depending on the source of the non-compliance, it may be appropriate to augment the existing measures;
- Investigate the appropriateness of upgrading plant and equipment; and
- Consider discontinuing the contributing activity until it may be done acceptably.

Reporting requirements detailed in **Section 7.2** will also be completed.

References

AECOM (2010a), Barangaroo Site Excavation and Preparation Works – Air Quality Impact Assessment, 20 September 2010.

AECOM (2010b), Barangaroo C4 Commercial Building – Air Quality Impact Assessment, 26 October 2010.

AECOM (2011a), Barangaroo C3 Commercial Building – Air Quality Impact Assessment, 9 November 2011.

AECOM (2011b), Barangaroo C5 Commercial Building – Air Quality Impact Assessment, 9 November 2011.

AECOM (2012), Air Quality Impact Assessment, s58 licence variation, 18 May 2012.

NSW DEC (2005a), Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales.

NSW DEC (2005b), Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales.

NSW DEC (2006a), Assessment and Management of Odour from Stationary Sources in NSW: Technical Framework.

NSW DEC (2006b), Assessment and Management of Odour from Stationary Sources in NSW: Technical Notes;

Rae Systems (2000), Application Note 211 – PIDs for continuous monitoring of VOCs, Rev 1 cw 09-00.

Schnelle, K. and Dey, P., (1999). Atmospheric dispersion modelling compliance guide. McGraw-Hill, New York.

APPENDIX 4: REACTIVE MANAGEMENT PROCEDURE

Reactive Management Procedure

The Air Quality Impact Assessment (AECOM, October 2012) related to cumulative impacts from the Stage 1A basement identified potential dust (as PM10) exceedences and a range of measures to minimise these. These measures have been included in Section 5 of this sub-plan.

Due to the predicted exceedances, a reactive management procedure was developed for bulk excavation in the Air Quality Impact Assessment, based on a three-stage approach as described in the text and table below:

- **Investigate**: designed to identify the likely reasons for the elevated pollutant concentration and to formulate a contingency response should the action stage be reached. Action should be undertaken at this stage if deemed necessary;
- **Action**: designed to implement those measures formulated in the investigative stage and to review their effectiveness; and
- **Stop Work**: this level is associated with a high probability of an exceedence of the pollution criterion occurring if works continue to generate dust at the current rate. All works should stop at this stage until the measured pollutant levels are below the action level.

Pollutant Monitored	Trigger Stage	Averaging Period	Trigger Value (µg/m^3)	Primary Responsibility	Action Required
PM_{10}	1 Investigate	1 Hour	85	Environment Manager	Environmental Manager to contact site operations manager and undertake review of possible dust sources operating during the average period. Identify possible control measures for these activities, action taken if deemed necessary. Complete Environmental Response Form.
		3 Hour	80		
	2 Action	1 Hour	470		Environment Manager to attend site and ensure implementation of the control actions identified in stage 1. Effectiveness of control actions to be reviewed and escalate where appropriate. Identify long-term solutions to dust issues. Complete Environmental Response Form.
		3 Hour	160		
	3 Stop Work	1 Hour	940		Targeted shut down of site activities until the measured pollutant levels are below the stated Action period trigger value. Complete Environmental Response Form.
		3 Hour	320		
Total VOC	1 Investigate	1 Hour	0.8	Environment Manager	Environmental Manager to contact site operations manager and undertake review of possible VOC sources operating during the average period. Identify possible control measures for these activities, action taken if deemed necessary. Complete Environmental Response Form.
		3 Hour	0.5		
	2 Action	1 Hour	8.3		Environment manager to attend site and ensure implementation of the control actions identified in stage 1. Effectiveness of control actions to be reviewed and escalate where appropriate. If VOC deemed to be coming from excavation area, speciation using a Summa canister will be undertaken. Complete Environmental Response Form.

Additional management measures

The Air Quality Impact Assessment requires that should the investigation trigger level for PM10 be reached, an investigation will be conducted to determine the source/s of dust, and to evaluate the appropriate measures to be implemented. Measures specified in the Air Quality Impact Assessment (in addition to those already included in Section 5 as assumed dust control measures) may include the following:

- Increased use of a water cart and/or water sprays to suppress dust in open areas or roadways;
- Installation of temporary sheeting to cover localised exposed areas or stockpiles;
- Ensuring excavated material is moist at the time of exposure and handling;
- Keep stockpiles damp where soil stockpiles are being stored up to 2 weeks;
- Covering soil stockpiles that will remain on the site for more than 2 weeks (where practicable);
- Consolidation of material stockpiles;
- Conducting the work in more favourable weather conditions;
- Use of chemical dust-suppressants provided the chemicals do not pose a contamination or occupational health and safety hazard;
- Use of alternative coverings such as hydromulch to stabilise the surface of open disturbed areas;
- Use of additional dust suppression features on items of dust generating plant and equipment;
- Securing work approval hours that permit emergency dust suppression on non-work days, if the need arises; and
- Ceasing works when works are generating unacceptable dust levels.

Should the investigation trigger level for volatile gases be detected at the site boundaries or in the surrounding area during the project, an investigation will be conducted to determine the source of the emissions, and to evaluate the appropriate measures to be implemented. These measures may include the following actions:

- Alteration in the works program to minimise the extent of disturbed open areas;
- Prompt removal and treatment of contaminated materials that have been exposed and are the source of the emissions;
- Use of fine mist sprays around the excavation area;
- Conducting the work in more favourable weather conditions;
- Use of alternate work practices to minimise the period of impact of the emissions;
- Use of additional features to control emissions from plant and equipment;
- Use of alternate work practices such as using modified equipment;
- Relocation of offending plant and equipment to less sensitive on-site areas;
- Reducing the number of plant and equipment items on-site;
- Covering the exposed areas or stockpiles; and
- Use of deodorants or masking agents.