Liddell Battery and Bayswater Ancillary Works Project

Appendix H – Air Quality Impact Assessment

Liddell Battery and Bayswater Ancillary Works Project

Air Quality Impact Assessment

| Final

February 2021

AGL Macquarie Pty Ltd

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Glossary and abbreviations

Abbreviation	Definition
AGLM	AGL Macquarie Pty Limited
Approved Methods	NSW EPA's Approved Methods for the Modelling and Assessment of Air Pollutants in NSW
AQIA	Air Quality Impact Assessment
ASL	Above sea level
BAW	Bayswater Ancillary Works
BESS	Battery Energy Storage System
CALMET	A diagnostic three-dimensional meteorological model
CALPUFF	A Lagrangian air quality dispersion model
CO	Carbon monoxide
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEC	Department of Environment and Conservation
DPIE	Department of Planning, Industry and Environment
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
EPL	Environment Protection Licence
EP&A Act	*Environmental Planning and Assessment Act 1979*
ISO	International Organisation for Standardization
kV	Kilovolt
LGA	Local government area
MW	Megawatt
MWh	Megawatt-hour
NEM	National Energy Market
NEPC	National Environmental Protection Council of Australia
NEPM	National Environment Protection Measures
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
NSW	New South Wales
OEH	Office of Environment and Heritage (now known as the Department of Premier and Cabinet (Heritage) or Heritage NSW)
PM_{10}	Particulate matter less than or equal to 10 micrometre diameter
$PM_{2.5}$	Particulate matter less than or equal to 2.5 micrometre diameter
POEO Act	*NSW Protection of the Environment Operations Act 1997*
RRR	River Road Reconstruction

Abbreviation	Definition
SCLF	Salt Cake Landfill Facility
SEARs	Secretary's Environmental Assessment Requirements
SEPP SRD	*State Environmental Planning Policy (State and Regional Development) 2011*
SO_2	Sulfur dioxide
SRTM	Shuttle Research Topography Mission
SSD	State Significant Development
TAPM	CSIRO's prognostic model known as The Air Pollution Model
TSP	Total suspended particulates
US EPA	United States Environmental Protection Agency
VOCs	Volatile organic compounds
WOAOW	Bayswater Water and Other Associated Operational Works project

Executive Summary

Background and project overview

AGL Macquarie Pty Limited (**AGLM**) owns and operates the Bayswater and Liddell power stations, Hunter Valley Gas Turbines and associated ancillary infrastructure. Liddell power station (**Liddell**) is approaching its end of life and is scheduled for closure in 2023. Bayswater power station (**Bayswater**) would continue to be operated through to 2035 to support the transition of the National Electricity Market (**NEM**) toward net-zero emissions and then is intended to be retired.

Jacobs, on behalf of AGLM is currently developing an Environmental Impact Statement (**EIS**) for the assessment of the Liddell Battery and Bayswater Ancillary Works Project (**the Project**) to facilitate the efficient, safe and reliable continuation of electricity generating works, in accordance with Division 4.7 of the *Environmental Planning and Assessment Act 1979* (**EP&A Act**). The Project is located within the Bayswater and Liddell power stations and surrounding buffer lands on the New England Highway within the Local Government Areas (**LGA**) of Muswellbrook and Singleton.

The features of the Project include:

- **The Battery**: A grid connected Battery Energy Storage System (**BESS**) with capacity of up to 500 megawatt (**MW**) and 2 gigawatt hours (**GWh**)
- **Decoupling works**: Alternative network connection arrangements for the Liddell 33 kilovolt (**kV**) switching station that provides electricity to infrastructure required for the ongoing operation of Bayswater and associated ancillary infrastructure and potential third-party industrial energy users
- **Bayswater Ancillary Works** (**BAW**): Works associated with Bayswater which may include upgrades to ancillary infrastructure such as pumps, pipelines, conveyor systems, roads and assets to enable maintenance, repairs, replacement or expansion
- **Consolidated consents:** A modern consolidated consent for the continued operation of Bayswater through the voluntary surrender and consolidation into this application of various existing development approvals required for the ongoing operation of AGLM assets.

Construction works associated with the Battery and Decoupling works would likely involve as follows:

- Installation and maintenance of environmental controls including temporary and permanent water management infrastructure
- Establishment of a new access from the existing Liddell access roads
- Establishment of a hardstand pad and construction laydown areas
- Cut and fill to Battery compound, transformer compounds, footings and construction laydown area
- Trenching and installation of cable from the Battery to 330 kV/33 kV transformer compounds
- Structural works to support Battery enclosures, inverters, transformers, buildings and transformer compounds
- Delivery, installation and electrical fit-out of the Battery
- Delivery, installation and fit out of transformers and ancillary equipment for Decoupling works
- Testing and commissioning activities
- Removal of construction equipment and rehabilitation of construction areas.

Key features of the existing environment

Surrounding sensitive receivers, prevailing meteorology, and background local air quality conditions were characterised. Fourteen residential receivers were identified within the vicinity of the Project with the nearest receiver (Liddell Recreation Area) located approximately two kilometres from the Battery. Meteorological and ambient air quality data collected at monitors operated by AGLM, as well as a number of other local industrial operators and the Department of Planning, Industry and Environment (**DPIE**) were reviewed. Using their data it was identified that meteorological conditions in 2017 represented typical local conditions, with annual prevailing winds blowing from the southeast and northwest. Data from air quality monitoring stations indicated that the Environment Protection Authority's (**EPA**) daily impact assessment criterion was occasionally being exceeded, and that annual particulate matter with an aerodynamic diameter less than 10 microns (**PM_{10}**) and particulate matter with an aerodynamic diameter less than 2.5 microns (**$PM_{2.5}$**) concentrations and deposited dust levels were also occasionally measured above relevant criteria.

Estimation of emissions to air

The rate of dust emissions from sources and activities associated with the Project, as well as the Bayswater Water and Other Associated Operational Works Project (**WOAOW**) which has the potential to take place at the same time were estimated using emissions factors developed locally contained in "Emission Estimation Technique Manual for Mining" (NPI, 2012) and by the United States Environmental Protection Agency (United States Environment Protection Agency).

Assessment of impacts

It was identified that dust during construction, and particularly arising from activities at the Battery and Decoupling areas, and construction of the new sediment basins at the conveyor M2/M3 and M2/M1/R1 transfers elements of the BAW represent the primary air-quality related risk for the Project. As a result, these aspects formed the focus of the assessment. Given the potential for these works to occur at the same time as WOAOW assessed in 'WOAOW Project: Air Quality Impact Assessment', (Jacobs, 2019), potential cumulative impacts were evaluated. These impacts were quantitatively assessed using air dispersion modelling. Potential air quality impacts from other aspects of the Project (i.e. dust emissions from other BAW aspects of the Project including conveyor shortening, environmental maintenance improvement activities, brine concentrator return water pipeline, upgrades within the Bayswater operational area, upgrades to the emergency power system, removal of the solar array and ancillary and chemical storage tank area upgrade aspects, and other emissions) were also identified and were assessed qualitatively.

Using the emissions developed as outlined above, dispersion modelling was completed to predict the potential for air quality impacts as a result of the Project, including cumulative impacts with WOAOW. This assessment determined that the Project would not result in changes to local air quality outside of historical variations and that the Project would not be the cause of exceedances of air quality criteria. Specifically, for key dust classifications, it was predicted that:

- **Total suspended particles (TSP) and $PM_{2.5}$:** Changes would not result in exceedance of the EPA's relevant impact assessment criteria at any of the nearest sensitive receivers
- **24-hour averaged PM_{10}:** Compliance with the EPA's 50 micrograms (one-millionth of a gram) per cubic metre (**$\mu g/m^3$**) assessment criterion at representative receivers. No additional exceedances of the impact assessment criteria were predicted as a result of the Project and WOAOW at receivers where background conditions were already elevated
- **Annual PM_{10}:** Negligible contributions (less than one percent (**%**)) were predicted from the Project and WOAOW, resulting in concentrations less than the 25 $\mu g/m^3$ assessment criterion at all representative receiver locations assessed, except at one location where background levels already exceeded this value
- **Annual deposited dust:** Negligible contributions (less than 1%) were predicted from the Project and WOAOW, resulting in concentrations less than the four grams per square metres (**$g/m^2/month$**) assessment criterion at all representative receiver locations assessed except two locations (R03 and R04) to the east of the Project where background levels already exceeded this value.

The potential for other air-quality related impacts including dust from other smaller aspects of the BAW component of the Project as well as other emissions to air (exhaust emissions and fugitive emissions from stored chemicals) were also assessed using a risk-based methodology based on guidance presented in 'AS/NZS ISO

31000: 2009 Risk Management – Principles and Guidelines'. Using this approach, it was determined that there was a 'low' potential for air quality impacts from these aspects of the Project.

Conclusion and recommended safeguards

The assessment found that, based on dispersion modelling carried out in accordance with regulatory guidelines, and using the risk-based assessment methodology to evaluate other aspects of the Project, the Project would not result in additional exceedances of the EPA's impact assessment criteria. However, given that elevated particulate matter concentrations have historically occurred in the Project setting, best-practice controls were recommended, consistent with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA, 2016) (**Approved Methods**). Recommended measures included watering of haulage routes, use of water sprays as applicable during material loading and unloading activities, progressive rehabilitation, active management measures and co-ordination of the Project and WOAOW activities to limit the potential for cumulative impacts.

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to quantify the potential air quality impacts for the Liddell Battery and Bayswater Ancillary Works Project in accordance with the scope of services set out in the contract between Jacobs and AGLM. That scope of services, as described in this report, was developed with AGLM.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by AGLM and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from AGLM (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

This report has been prepared on behalf of, and for the exclusive use of, AGLM, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and AGLM. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

1. Introduction

AGL Macquarie Pty Limited (**AGLM**) owns and operates the Bayswater Power Station (**Bayswater**), Liddell Power Station (**Liddell**), and the Hunter Valley Gas Turbines and associated ancillary infrastructure systems that operate to produce around 23,000 gigawatt hours (**GWh**) annually, or approximately 35 per cent (**%**) of New South Wales' (**NSW**) electricity supply.

AGLM is seeking approval for the Liddell Battery and Bayswater Ancillary Works Project (**the Project**). As a State Significant Development (**SSD**) under the *State Environmental Planning Policy (State and Regional Development) 2011* (**SEPP SRD**). The Project is subject to Part 4, Division 4.7 of the *Environmental Planning and Assessment Act 1979* (**EP&A Act**) which requires the preparation of an Environmental Impact Statement (**EIS**) in accordance with Secretary's Environmental Assessment Requirements (**SEARs**). This Air Quality Impact Assessment (**AQIA**) has been developed to support the EIS for the Project.

1.1 Purpose of this report

This AQIA report has been prepared in accordance with the SEARs issued for the Project on 29 September 2020 by the Planning Secretary of the NSW Department of Planning, Industry and Environment (**DPIE**). The SEARs relevant to air quality assessment are summarised in **Table 1.1**, along with a reference to where these requirements have been addressed.

Table 1.1 Project SEARs air quality assessment requirements

Requirement of SEARs No. SSD 8889679	Where addressed
Air – including:	
- An assessment of the likely air quality impacts of the Project in accordance with the 'Approved Methods of the Modelling and Assessment of Air pollutants in NSW', (EPA, 2016);	**Section 6** and **Section 7**
- Demonstrated ability to comply with the relevant regulatory framework, specifically the *Protection of the Environment Operations Act 1997* and *Protection of the Environment Operations (Clean Air) Regulation 2010*; and	**Section 3**
- An assessment of the likely greenhouse gas impacts of the Project.	Refer to Chapter 6 in the Project EIS

In meeting the requirements of items one and two above (noting that the third requirement is addressed separately in Chapter 6 of the EIS), the objectives of this assessment were to:

- Describe the Project setting, proposed activities and potential air quality issues (**Section 2**)
- Establish suitable air quality assessment criteria (**Section 3**)
- Describe the existing environment including surrounding receivers, terrain, meteorology and ambient air quality conditions (**Section 4**)
- Estimate emissions to air associated with the Project (**Section 5**)
- Explain the methods used to predict potential air quality impacts (**Section 6**)
- Present and discuss predicted potential impacts (**Section 7**)
- Recommend mitigation and management measures (**Section 8**).

1.2 Project location

Liddell and Bayswater are located approximately 15 kilometres (**km**) south-east of Muswellbrook, 25 km north-west of Singleton and approximately 165 km north-west of Sydney (refer to **Figure 1-1**). The total area of the AGLM landholding is approximately 10,000 hectares (**ha**), including the Ravensworth rehabilitation area, Lake Liddell and surrounding buffer lands.

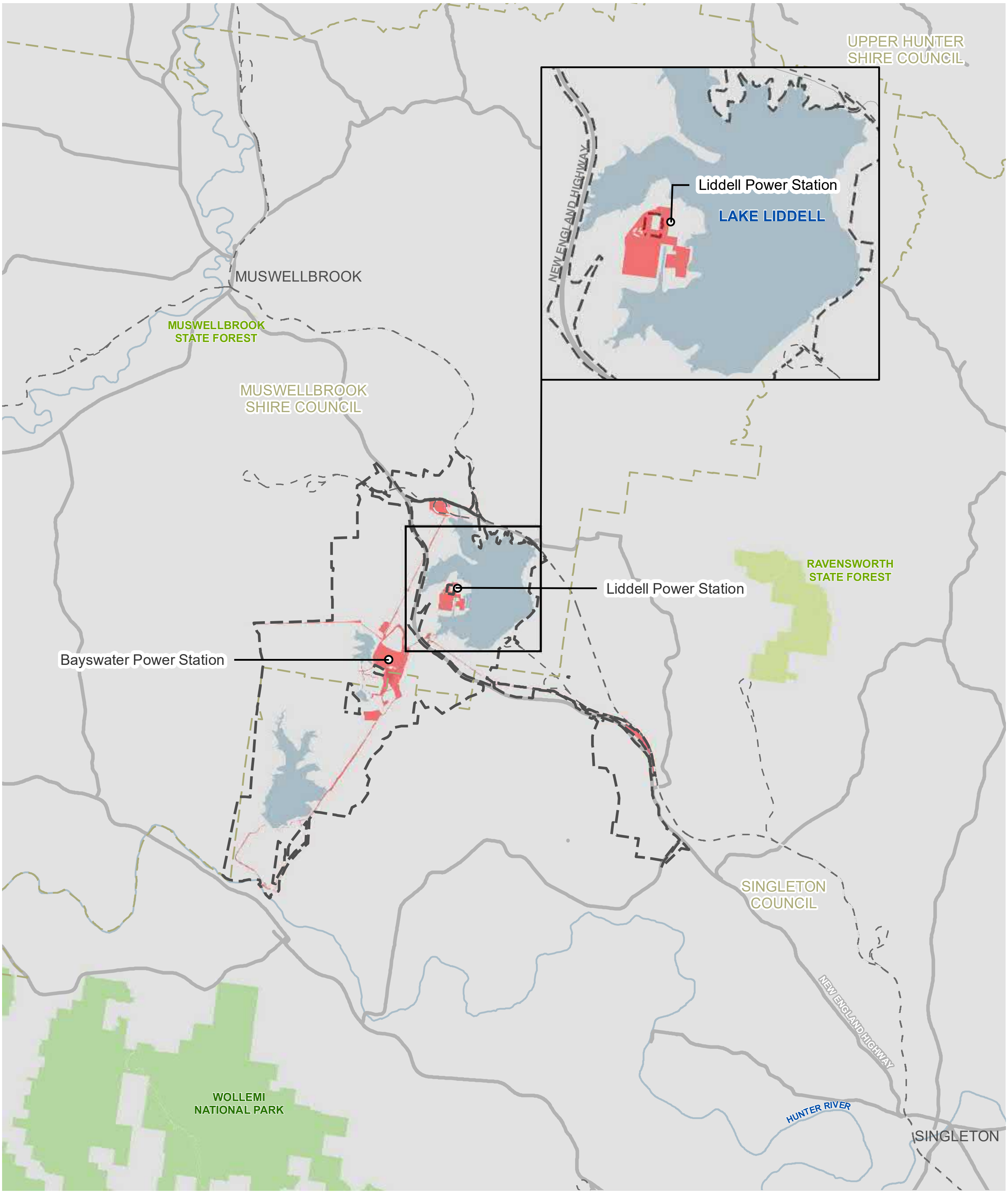
The Battery and Decoupling components would generally be undertaken in close proximity to Liddell and are targeting the use of previously disturbed operational lands no longer required for Liddell operations. The BAW would occur throughout the AGLM landholding and is located in close proximity to existing infrastructure where prior disturbance has typically occurred.

The Project is located within an area dominated by mining and power generation. The landscape local to Liddell and Bayswater is heavily influenced by industrial activity. Local land use is dominated by large-scale infrastructure associated with Bayswater and Liddell and open cut mining activities at Ravensworth Mine Complex, Mount Arthur Coal, Hunter Valley Operations, Liddell Coal Mine and the former Drayton Mine. Agricultural clearing for the purposes of grazing is also present within and surrounding the AGLM landholding.

There are limited sensitive receivers or social infrastructure in the locality of the Project. The closest social infrastructure is the Lake Liddell Recreation Area approximately 2 km north of the Battery and Decoupling areas across Lake Liddell. The closest residential areas are the Antiene subdivision, which is located approximately 4 km north of the Battery and Decoupling Project components and Jerrys Plains located over 1.5 km to the south east of the BAW area. The nearest dwelling is a rural property west of Jerrys Plains approximately 700 metres (**m**) from the Project area.

The New England Highway runs between Liddell and Bayswater, with access from the highway provided by means of a dedicated road interchange designed to service the power stations. The Northern Railway Line runs to the east of the AGLM landholding.

The majority of the AGLM landholding has been previously disturbed during the construction and operation of Liddell and Bayswater.



Legend

- Project area
- AGL owned land
- LGA boundary
- Railway
- Road
- Waterway
- Waterbody
- State forest
- National park

0 5 10 km

1:200,000 at A4

N

Data sources

Jacobs 2020
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Service and Innovation Aug 2020
AGL 2019

GDA94 MGA56

Figure 1 - 1 Project location

2. Project description

2.1 Project overview

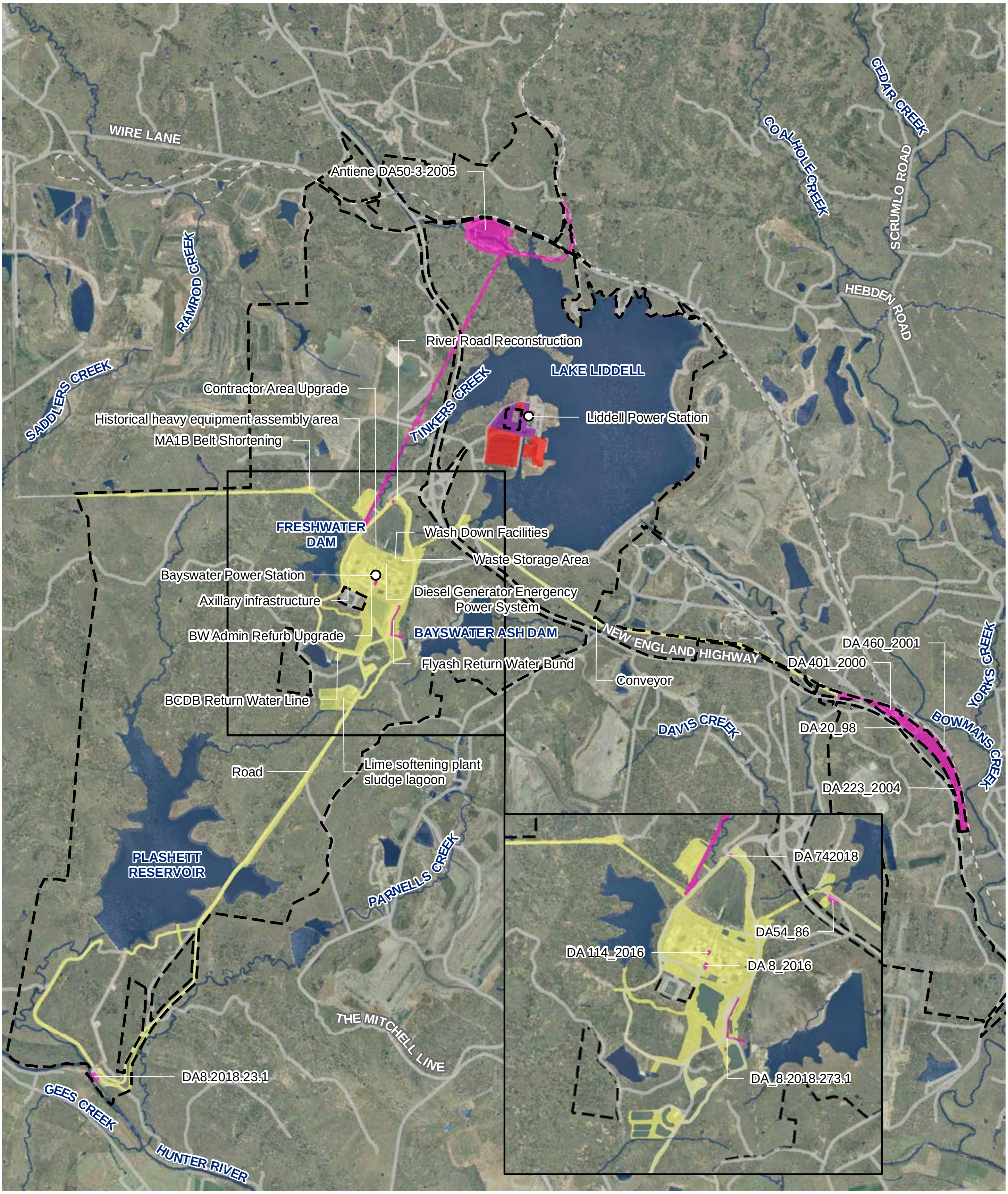
AGLM are progressing plans to facilitate the efficient, safe and reliable continuation of electricity generating works from Bayswater and Liddell. The Project would consist of the following:

- **The Battery**: A grid connected Battery Energy Storage System with capacity of up to 500 megawatt (**MW**) and 2 GWh
- **Decoupling works**: Alternative network connection arrangements for the Liddell 33 Kilovolt (**kV**) switching station that provides electricity to infrastructure required for the ongoing operation of Bayswater and associated ancillary infrastructure and potential third-party industrial energy users
- **Bayswater Ancillary Works (BAW):** Works associated with Bayswater which may include upgrades to ancillary infrastructure such as pumps, pipelines, conveyor systems, roads and assets to enable maintenance, repairs, replacement or expansion
- **Consolidated consents:** A modern consolidated consent for the continued operation of Bayswater through the voluntary surrender and consolidation into this application of various existing development approvals required for the ongoing operation of AGLM assets (Consolidated consents).

Construction works associated with the Battery and Decoupling works would likely involve as follows:

- Installation and maintenance of environmental controls including temporary and permanent water management infrastructure
- Establishment of a new access from the existing Liddell access roads
- Establishment of a hardstand pad and construction laydown areas
- Cut and fill to Battery compound, transformer compounds, footings and construction laydown area
- Trenching and installation of cable from the Battery to 330 kV/33 kV transformer compounds
- Structural works to support Battery enclosures, inverters, transformers, buildings and transformer compounds
- Delivery, installation and electrical fit-out of the Battery
- Delivery installation and fit out of transformers and ancillary equipment for Decoupling works
- Testing and commissioning activities
- Removal of construction equipment and rehabilitation of construction areas.

The key components of the Project are shown in **Figure 2.1**. A detailed description of the Project and each component is provided in Chapter 2 of the EIS.



Legend

Project area

- Bayswater Ancillary Works
- Battery energy storage system
- Decoupling area
- Consolidated consent
- AGL owned land
- Railway
- Road
- Waterway
- Waterbody

0 2 4km

1:90,000 at A4

Data sources

Jacobs 2021
AGL 2020
©Department of Finance, Service and Innovation Aug 2020

Imagery:
© Department of Customer Service 2020

GDA94 MGA56

Figure 2-1 Project overview

2.2 Construction program

The development of the Battery may be staged to respond to market demand. AGLM anticipates the construction occurring over multiple stages. These stages could potentially be:

- Stage 1 consisting of an additional 150 MW and 150 MWh
- Stage 2 consisting of an additional 150 MW and 150 MWh
- Stage 3 consisting of 200 MW and up to 1700 MWh with storage capacity being added in response to the needs of the National Energy Market (**NEM**).

The construction of each Battery stage is anticipated to take up to 12 months consisting of the civil works component, mechanical and structural component, electrical works and testing and commissioning. Stage 3 may be further divided into smaller stages subject to market demand and be delivered on a progressive basis.

The Decoupling works are proposed to be undertaken prior to 2024 to facilitate the planned closure and decommissioning of Liddell. Decoupling works are anticipated to take up to 12 months.

The BAW component would be undertaken at any time up to the planned retirement of Bayswater. For AQIA purposes, a reasonable worst-case assumption has been made that a number of BAW components could occur at one time and coincide with the worst case traffic generation for the Battery, Decoupling and ongoing and currently anticipated works outside of the Project.

2.3 Key air quality-related matters

Air quality issues can arise when emissions from an industry or activity lead to a deterioration in the ambient air quality. During construction, the primary air quality risk would be dust generated from site clearing, materials excavation, handling, transport and placement, as well as from wind erosion of stored materials and exposed surfaces resulting in impacts at surrounding sensitive receivers.

The term dust refers to particulate matter in, most commonly, the form of total suspended particles (**TSP**), deposited dust, particulate matter with equivalent aerodynamic diameter of 10 microns or less (**PM_{10}**), and finer particulate matter with equivalent aerodynamic diameter of 2.5 microns or less (**$PM_{2.5}$**). The intensity of dust-generating activities during construction is expected to be greatest at the approximate 20 ha Battery footprint. Some dust is also expected to be generated during activities at the Decoupling site and from the River Road Refurbishment and construction of the new sediment basins at the conveyor M2/M3 and M2/M1/R1 transfers elements of the BAW.

Exhaust emissions from the combustion of fossil fuels in construction plant and equipment represent another air quality risk during construction. The primary pollutants associated with plant exhaust emissions include carbon monoxide (**CO**), oxides of nitrogen (**NO_x**) including nitrogen dioxide (**NO_2**), particulate matter (PM_{10} and $PM_{2.5}$), volatile organic compounds (**VOCs**) and sulfur dioxide (**SO_2**) (depending on fuel sulfur content).

It is anticipated that there would be limited air quality-related risks during the operation of the Project. Exhaust emissions would arise from fossil fuels combusted in site vehicles, although impacts associated with this risk would not be expected given the anticipated intensity of emissions and setback distances to the nearest surrounding receivers. As part of the Decoupling works, replacement of failed and temporary emergency power system with a new system including three 415 Volt (**V**) diesel generators with two located outside the existing diesel generator building is proposed. These emergency diesel generators would operate in the event of emergency loss of power and are otherwise tested on a routine basis. Given the limited scale of use of these assets, minimal changes to location, nearest sensitive receiver being more than 7 kms away, and that air quality provisions are made for the use of these assets in Environment Protection Licence (**EPL**) 779, the temporary emergency power system aspect is in keeping with existing conditions and no additional diesel use over a do nothing scenario would eventuate.

Chemicals stored in tanks at the site that are being upgraded as part of the BAW aspect of the Project would be designed to meet relevant standards listed in the *NSW Protection of the Environment Operations (Clean Air) Regulation 2010* (**POEO Clean Air Regulation**) such that fugitive tank emissions are not expected to present a risk to air quality.

Considering the information above, it was identified that dust during construction, and particularly arising from activities at the Battery and Decoupling areas, and construction of the new sediment basins at the conveyor M2/M3 and M2/M1/R1 transfers elements of the BAW represent the primary air-quality related risk for the Project. As a result, these aspects formed the focus of the assessment. Given that there is the potential for these works to occur at the same time as WOAOW assessed in 'WOAOW Project: Air Quality Impact Assessment', (Jacobs, 2019), potential cumulative impacts were evaluated.

Potential air quality impacts from other aspects of the Project (i.e. dust emissions from other BAW aspects of the Project including conveyor shortening, environmental maintenance improvement activities, brine concentrator return water pipeline, upgrades within the Bayswater operational area, upgrades to the emergency power system, removal of the solar array and ancillary and chemical storage tank area upgrade aspects, and other emissions) have been qualitatively estimated using metrics developed based on guidance from 'AS/NZS ISO 31000: 2009 Risk Management – Principles and Guidelines' with measures developed to address any identified risks outlined in **Section 8**.

3. Policy setting and assessment criteria

3.1 Overview

There are several statutes and guidelines that apply to the regulation of emissions to air from developments in NSW including:

- *NSW Protection of the Environment Operations Act 1997* **(POEO Act**)
- POEO Clean Air Regulation
- Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (NSW Environment Protection Authority (**EPA**), 2016) (**Approved Methods**)
- Approved Methods for Sampling and Analysis of Air Pollutants in NSW, (NSW Department of Environment and Conservation (**DEC**), 2005).

Requirements relevant to the Project from each of these documents are outlined below.

3.1.1 Protection of the Environment Operations Act 1997

The POEO Act is the primary piece of legislation for the regulation of potential pollution impacts associated with Scheduled operations or activities in NSW. Scheduled activities are those defined in Schedule 1 of the POEO Act. Liddell and Bayswater are operated under EPL 2122 and EPL 779 respectively, and these would be varied to incorporate any new scheduled activity if required. With regards to air quality, the EPLs include concentration limits for the licenced plant operational discharge points (Condition L3 and L6 in EPL 2122 and L3 and L7 EPL 779). These limits apply at stacks associated with boilers from the combustion of coal for electricity generation at both plants and are not expected to apply to the activities associated with the Project, noting the provisions for emergency generator operations in EPL 779.

Both licences also include the conditions listed in **Table 3.1** regarding the mitigation and management of odour and dust from operations. It is expected that these conditions would also apply to the Project.

Table 3.1 EPL 2122 and EPL779 air quality requirements

EPL	Condition number	Details
EPL 2122	L5	L6.1 No condition of this licence identifies a potentially offensive odour for the purposes of section 129 of the POEO Act. Note: Section 129 of the POEO Act, 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 EPL as a potentially offensive odour and the odour was emitted in accordance with the conditions of a licence directed at minimising odour.
EPL 779	L6	L5.1 No condition of this licence identifies a potentially offensive odour for the purposes of section 129 of the POEO Act. Note: Section 129 of the POEO Act, 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 EPL as a potentially offensive odour and the odour was emitted in accordance with the conditions of a licence directed at minimising odour.
EPL 2122 and EPL 779	O3	O3.1 The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises. O3.2 All operations and activities occurring at the premises must be carried out in a manner that will minimise the emission of dust from the premises. O3.3 Trucks entering and leaving the premises that are carrying loads of dust generating materials must be covered at all times, except during loading and unloading.

3.1.2 Protection of the Environment Operations (Clean Air) Regulation 2010

The POEO Clean Air Regulation contains provisions for the regulation of emissions to air from wood heaters, open burning, motor vehicles, fuels and industry. The Project does not involve changes to any scheduled activities under Schedule 3 of the POEO Clean Air Regulation. As such the applicability of the POEO Clean Air Regulation to the Project is expected to be limited.

3.1.3 Approved Methods for the Modelling and Assessment of Air Pollutants in NSW

The Approved Methods (EPA, 2016) was published by the EPA and outlines the approach to be applied for the modelling and assessment of air pollutants from stationary sources in NSW. The air pollutants most relevant to the Project are particulate matter emissions from excavation works and material handling, transport and processing activities; as well as from wind erosion of stored materials and exposed surfaces.

There are various classifications of particulate matter and the EPA has developed assessment criteria for:

- TSP, to protect against nuisance amenity impacts
- PM_{10}, to protect against health impacts
- $PM_{2.5}$, to protect against health impacts
- Deposited dust, to protect against nuisance amenity impacts.

Most of the EPA criteria are drawn from National standards for air quality set by the National Environmental Protection Council of Australia (**NEPC**) as part of the National Environment Protection Measures (**NEPM**). To measure compliance with ambient air quality criteria, the former Office of Environment and Heritage (**OEH**) (now DPIE) has established a network of monitoring stations across the State and up-to-date records are published on DPIE's website.

Air quality impacts from a project are determined by the level of compliance with the air quality criteria set by the EPA as part of their Approved Methods. These criteria are outlined in **Table 3.2** and apply to existing and potential sensitive receivers such as such as residences, schools and hospitals.

Table 3.2 EPA impact assessment criteria

Substance	Averaging time	Criterion	Source
Particulate matter (PM_{10})	24-hour	50 one-millionth of a gram (**µg/m³**)	EPA (2016) / DoE (2016)
	Annual	25 µg/m³	EPA (2016) / DoE (2016)
Particulate matter ($PM_{2.5}$)	24-hour	25 µg/m³	EPA (2016) / DoE (2016)
	Annual	8 µg/m³	EPA (2016) / DoE (2016)
Particulate matter (TSP)	Annual	90 µg/m³	EPA (2016) / NHMRC (1996)
Deposited dust	Annual (maximum increase)	2 grams per square metres (**g/m²**)/month	EPA (2016) / NERDDC (1998)
	Annual (maximum total)	4 g/m²/month	EPA (2016) / NERDDC (1998)

The EPA air quality assessment criteria relate to the total concentration of air pollutant in the air (that is, cumulative) and not just the contribution from project-specific sources. Therefore, some consideration of background levels needs to be made when using these criteria to assess the potential impacts. Further discussion of local background air quality conditions is provided in **Section 4.4.**

In situations where background levels are elevated, the proponent must "demonstrate that no additional exceedances of the impact assessment criteria will occur as a result of the proposed activity and that best management practices will be implemented to minimise emissions of air pollutants as far as is practical" (EPA, 2016).

3.1.4 Approved Methods for Sampling and Analysis of Air Pollutants in NSW

The Approved Methods provides guidance for the monitoring and analysis of air pollutants in NSW. This standard applies to the air quality monitors used to establish local background air quality conditions (see **Section 4.4**).

4. Existing environment

4.1 Surrounding receivers

Figure 4.1 displays land uses around the Project, including the location of nearby sensitive receiver locations and nearby meteorological and ambient air quality monitoring stations.

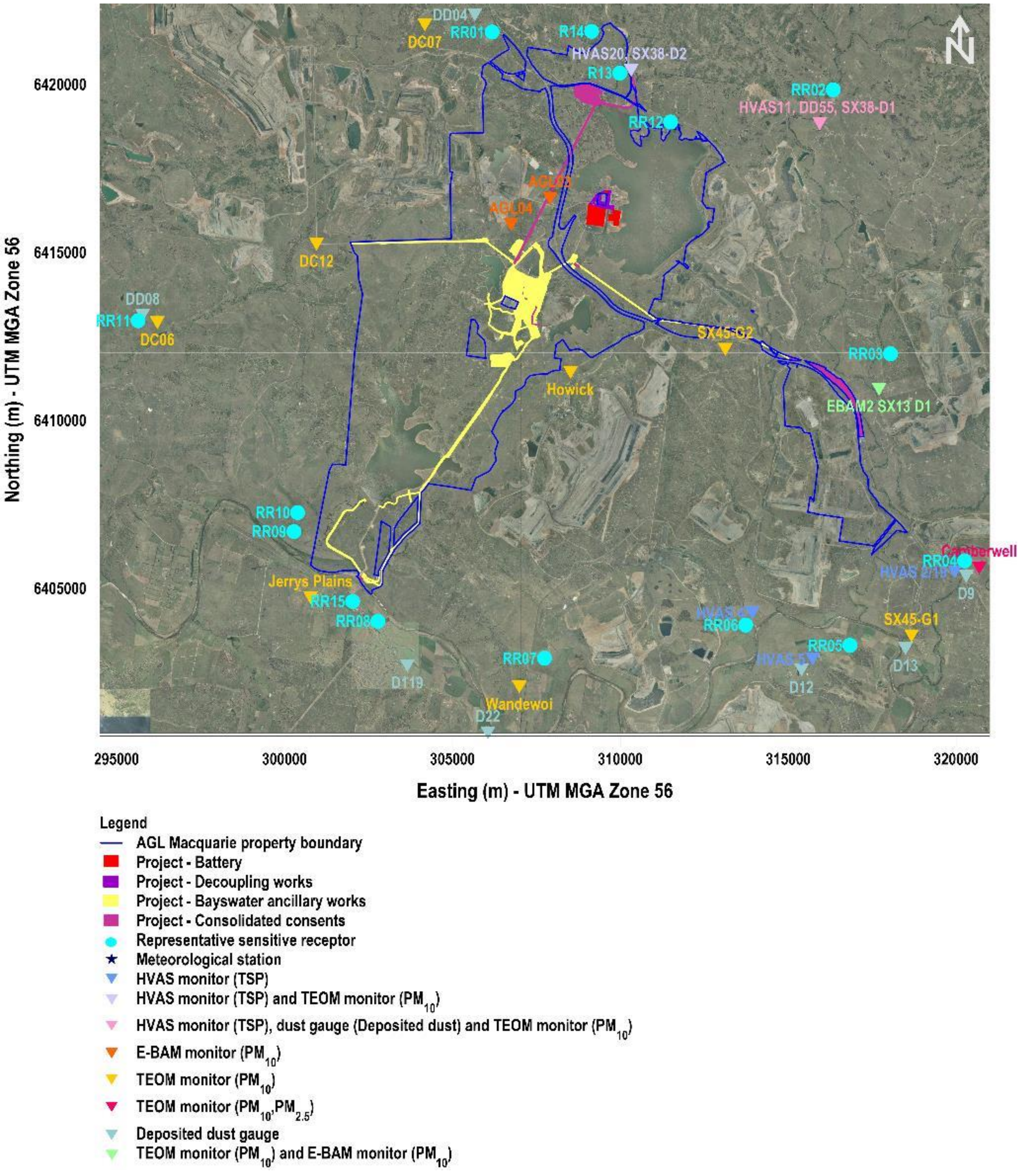


Figure 4.1 Project setting

As **Figure 4.1** shows sensitive receiver areas are located in all directions from the Project. Fourteen representative receiver locations were established, which denote the nearest sensitive receiver locations in different directions from the Project. Details of these locations are listed below in **Table 4.1**.

Table 4.1 Nearby representative receivers

Receiver ID	X co-ordinate (UTM MGA Zone 56)	Y co-ordinate (UTM MGA Zone 56)	Approximate orientation from the Project	Approximate distance from the nearest physical works area of the Project (m)
RR01	306177	6421554	North	6,300
RR02	316337	6419837	Northeast	7,800
RR03	318041	6411978	East	3,000
RR04	320245	6405818	Southeast	8,000
RR05	316832	6403296	Southeast	8,800
RR06	313729	6403903	Southeast	8,100
RR07	307735	6402915	South	5,300
RR08	302782	6404017	South	1,100
RR09	300275	6406687	Southwest	1,000
RR10	300383	6407252	Southwest	1,100
RR11	295636	6412963	West	6,800
RR12	311493	6418878	Northeast	2,700
RR13	309979	6420335	Northeast	3,500
RR14	309141	6421575	North	4,700
RR15	302022	6404606	South	700

As listed, the nearest sensitive receiver is approximately 700 m from the nearest Project work area (excluding consent consolidation locations where no physical works would take place).

4.2 Terrain

A three-dimensional schematic of terrain features around the Project is shown in **Figure 4.2**. As displayed, elevations within approximately 10 km of the Project range from around 100 to 500 m above sea level (**ASL**). The key Project areas are set at elevations between 90 and 250 m ASL. All eleven representative receiver locations identified in **Section 4.1** located at similar elevations to the key Project areas.

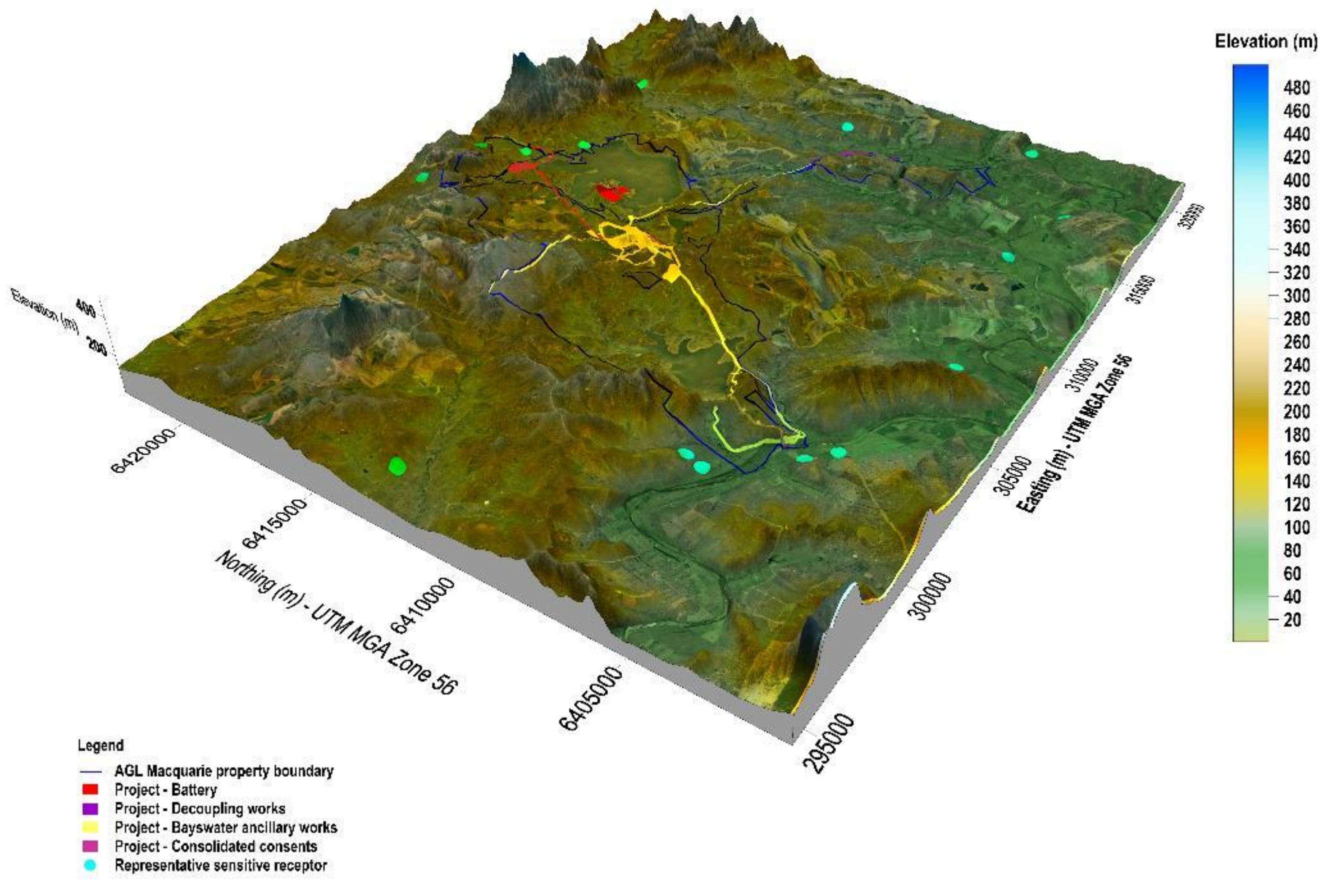


Figure 4.2 Three-dimensional schematic of Project setting

4.3 Meteorology

Meteorological conditions are important for determining the direction and rate at which emissions from a source will disperse. The key meteorological requirements of air dispersion models are, typically, hourly records of wind speed, wind direction, temperature, atmospheric stability class and mixing layer height. For air quality assessments, a minimum one year of hourly data is usually required, which means that almost all possible meteorological conditions, including seasonal variations, are considered in the model simulations.

A detailed review of meteorological data collected at AGLM's two on-site monitoring stations (AGL08 and AGL09) is presented in the report, 'WOAOW Project: Air Quality Impact Assessment', (Jacobs, 2019). This analysis reviewed wind speeds and directions measured at these stations between 2015 and 2018, identifying 2017 as a suitably representative meteorological year of assessment. Given that the Project is located in close proximity to the WOAOW Project, (2017) was also selected as a representative meteorological year for the assessment.

4.4 Background air quality

The Jacobs, 2019 reviewed background air quality data from several local ambient air quality stations operated by AGLM, as well as a number of other industrial operators and DPIE (see **Figure 4.1**). This data indicated that the EPA's daily impact assessment criterion was occasionally being exceeded around the identified nearby representative receiver locations. Annual PM_{10} and $PM_{2.5}$ concentrations and deposited dust levels were also measured above the respective 25 µg/m^3, 8 µg/m^3 and 4 g/m^2/month at some monitors. **Table 4.2** lists the background concentrations that were established which have also been adopted for this assessment.

Measurement data from all monitoring stations represent the contributions from all sources that have at some stage been upwind of each monitor. In the case of particulate matter (as PM_{10} and $PM_{2.5}$) for example, the background concentration may contain emissions from many sources such as from mining activities, construction works, bushfires and 'burning off', industry, vehicles, roads, wind-blown dust from nearby and remote areas, fragments of pollens, moulds, domestic wood fires and so on. Measured exceedances are expected to have been a result of widespread drought conditions (particularly in 2017 and 2018), with some exceedances also expected to arise from surrounding mining activities.

Table 4.2 Adopted background air quality conditions

Pollutant	Averaging time	Assumed concentrations at each representative receiver (RR) in µg/m^3													
		01	02	03	04	05	06	07	08	09	10	11	12	13	14
TSP	1-year	33	45	68	68	59	68	68	68	68	68	68	33	33	33
PM_{10}	24-hour	Maximum values measured at the stations listed below with 2017 time-varying values measured at DPIE Camberwell and Jerrys Plains applied for the additional exceedance review													
	1-year	14	13	20	27	21	21	15	17	17	17	13	18	18	18
$PM_{2.5}$	24-hour	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7
	1-year	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Deposited dust	1-year	2.3	2.3	**4.1**	**4.1**	2.9	2.9	2.3	2	2	2	1.4	2.3	2.3	2.3

24-hour averaged PM_{10}:
RR01: BHP Mount Arthur Coal (MAC) DC07
RR02: Glencore Liddell Coal Operations SX38-D1
RR03: Glencore Mount Owen Complex SX13 D1
RR04: DPIE Camberwell
RR05 and RR06: Glencore Ravensworth Coal SX45-G1
RR07: Hunter Valley Operations Wandewoi
RR08 to RR10: DPIE Jerrys Plains
RR11: BHP MAC DC06
RR12: Glencore Liddell Coal Operations SX38-D2.

5. Emissions to air

5.1 Emissions inventory

As identified in **Section 2.3**, the most significant emission to air from the Project will be dust (particulate matter) generated from site clearing and levelling; materials excavation, handling, transport and placement, and from wind erosion of stored materials and exposed surfaces. Estimates of these emissions are required by the dispersion model. Total dust emissions have been estimated by analysing details of the Project and identifying the location and intensity of dust generating activities. Operational parameters have been combined with emissions factors developed both locally and by the United States Environmental Protection Agency (**US EPA**).

The emission factors used for this assessment have been drawn largely from the following sources:

- ‘Emission Estimation Technique Manual for Mining’ (NPI, 2012)
- AP 42 (US EPA, 1985 and updates).

An emissions inventory was developed incorporating dust emissions from key sources associated with the Project, as well as emissions from WOAOW. **Table 5.1** below summarises the estimated annual TSP, PM_{10} and $PM_{2.5}$ emissions (in kg/y) with key sources from both projects displayed below in **Figure 5.1**. **Appendix A** provides details of the dust emission calculations including the reference calculations applied, assumptions and emission controls and where sources were allocated.

Table 5.1 Estimated emissions to air

Activity	Estimated annual emissions (kg/y)		
	TSP	PM_{10}	$PM_{2.5}$
Project component			
Project (Battery) - Dozers site clearing	216	41	2
Project (Battery) - Trucks unloading fill material for pad construction	3,840	1,376	192
Project (Battery) - Excavators on pad materials	63	30	3
Project (Battery) - Graders shaping BESS pad	248	111	12
Project (Battery) - Wind erosion pad	17,520	8,760	1,314
Project (Battery) - Haulage pad materials (from Battery and Decoupling area)	5,924	1,528	153
Project (Battery) - Haulage pad materials (from Bayswater CBP1)	16,291	4,203	420
Project (Battery) - Haulage pad materials (from Bayswater CBP2)	17,772	4,585	458
Project (Battery) - Haulage pad materials (from Bayswater CBP3)	22,215	5,731	573
Project (Battery) - Haulage pad materials (from Bayswater CBP4)	25,177	6,495	649
Project (Decoupling) - Dozers site clearing new 330 kV / 33 kV compound	72	14	1
Project (Decoupling) - Graders shaping new 330 kV / 33 kV compound	21	9	1
Project (Decoupling) - Wind erosion new 330 kV / 33 kV compound	1,226	613	92
Project (BAW) - Dozer removing existing pavement River Road Reconstruction (RRR)	72	14	1
Project (BAW) - Trucks unloading fill material RRR	69	25	3
Project (BAW) - Excavators RRR	1	1	0
Project (BAW) - Graders RRR	27	12	1
Project (BAW) - Wind erosion RRR	315	158	24
Project (BAW) - Haulage road materials RRR	1,066	275	28
Project (BAW) - Dozer constructing sediment basin at M2/M3 transfer	72	14	1
Project (BAW) - Dozer constructing sediment basin at M2/M1/R1 transfer	72	14	1

Activity	Estimated annual emissions (kg/y)		
	TSP	PM_{10}	$PM_{2.5}$
Project - Loading Battery and RRR materials at Battery and Decoupling area	31	15	2
Project - Loading Battery and RRR materials at CBP1	8	4	1
Project - Loading Battery and RRR materials at CBP2	9	4	1
Project - Loading Battery and RRR materials at CBP3	8	4	1
Project - Loading Battery and RRR materials at CBP4	8	4	1
Subtotal	**112,342**	**34,036**	**3,934**
WOAOW component			
WOAOW - Ash Dam (AD) augmentation - Excavators on augmentation materials	192	91	10
WOAOW - AD augmentation - Trucks unloading augmentation materials	11,761	4,214	588
WOAOW - AD - Wind erosion ash and augmentation materials	146,378	73,189	10,978
WOAOW - Salt Cake Landfill Facility (SCLF) - Scrappers removing topsoil	3,786	953	191
WOAOW - SCLF - Dozers ripping materials	3,739	710	35
WOAOW - SCLF - Wind erosion from landfill area	19,062	9,531	1,430
WOAOW - SCLF - Wind erosion from stockpiled materials	953	477	71
WOAOW - SCLF - Excavators on materials	4	2	0
WOAOW - SCLF - Hauling SC product	62,202	16,046	1,605
WOAOW - CBP 1 - Scrappers removing topsoil	2,522	635	127
WOAOW - CBP 1 - Wind erosion from pit 1	15,870	7,935	1,190
WOAOW - CBP 2 - Scrappers removing topsoil	3,681	927	185
WOAOW - CBP 2 - Wind erosion from pit 2	23,165	11,583	1,737
WOAOW - CBP 3 - Scrappers removing topsoil	5,983	1,506	301
WOAOW - CBP 3 - Wind erosion from pit 3	37,652	18,826	2,824
WOAOW - CBP 4 - Scrappers removing topsoil	19,041	4,793	959
WOAOW - CBP 4 - Dozers ripping materials	3,739	710	35
WOAOW - CBP 4 - Wind erosion from pit 4	119,828	59,914	8,987
WOAOW - CBP 4 - Wind erosion from stockpiled materials	876	438	66
WOAOW - CBP 4 - Excavators loading materials	48	23	3
WOAOW - Haulage CBP 4 - Ash Dam	203,202	52,420	5,242
WOAOW - Haulage CBP 4 - SCLF	58,058	14,977	1,498
WOAOW - Haulage Fly Ash	44,725	8,585	2,077
WOAOW - Haulage Rehabilitation works	25	5	1
Subtotal	**786,492**	**288,489**	**40,141**
Cumulative totals from both projects			
Total	**898,834**	**322,513**	**44,072**

It is noted that the assessment scenario above in **Table 5.1** is conservative in that all key dust generating activities associated with the Project as well as WOAOW have been assessed as occurring concurrently In reality this is not expected, with both projects expected to be undertaken in a staged manner with potential overlap only expected between some stages of both projects. Still, the assessment scenario considered represents worst-case cumulative impacts from both projects.

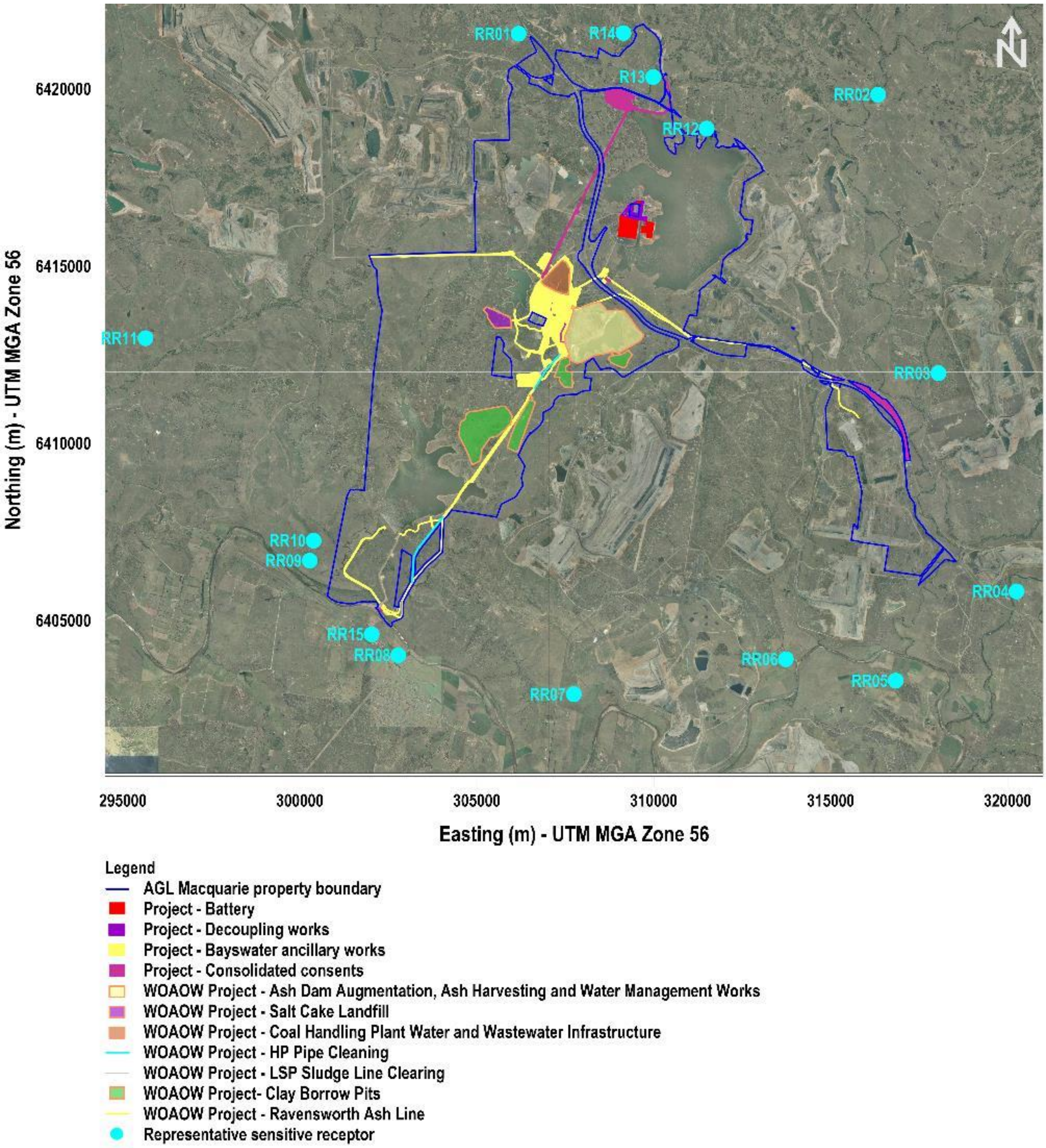


Figure 5.1 Project and WOAOW sources

5.2 Emission controls

Controls were applied to haulage activities listed in the emissions inventory as listed below in **Table 5.2**, consistent with present on-site practices. Control efficiency values were applied consistent with guidance presented in Table 4 of NPI, 2012.

Table 5.2 Emission control measures

Source/activity	Control measure	Control efficiency (%)	Reference
Hauling of materials along internal roads	Watering of haulage routes	50%	(NPI, 2012), Table 4

6. Assessment approach

6.1 Overview

This assessment has followed the Approved Methods which specifies how assessments based on the use of air dispersion models should be undertaken. The Approved Methods include guidelines for the preparation of meteorological data, reporting requirements and air quality assessment criteria to assess the significance of dispersion model predictions.

The CALPUFF computer-based air dispersion model has been used to predict ground-level concentrations and deposition levels due to the identified emission sources, and the model predictions have been compared with relevant air quality criteria. The choice of model has considered the expected transport distances for the emissions, as well as the potential for temporally and spatially varying flow fields due to influences of the locally complex terrain, non-uniform land use, and potential for stagnation conditions characterised by calm or very low wind speeds with variable wind directions.

The CALPUFF model, through the CALMET meteorological pre-processor, simulates complex meteorological patterns that exist in a particular region. The effects of local topography and changes in land surface characteristics are accounted for by this model. The model comprises meteorological modelling as well as dispersion modelling, both of which are described below.

6.2 Meteorological modelling

The air dispersion model used for this assessment, CALPUFF, requires information on the meteorological conditions in the modelled region. This information is typically generated by the meteorological pre-processor, CALMET, using surface observation data from local weather stations and upper air data from radio-sondes or numerical models, such as the Commonwealth Scientific and Industrial Research Organisations' (**CSIRO**) prognostic model known as The Air Pollution Model (**TAPM**). CALMET also requires information on the local land-use and terrain. The result of a CALMET simulation is a year-long, three-dimensional output of meteorological conditions that can be used as input to the CALPUFF air dispersion model.

Meteorological data collected in 2017 from AGLM's surface stations (AGL08 and AGL09) and upper air data generated by TAPM were used to initialise the CALMET model. CALMET was then set up with two surface observation stations (AGL08 and AGL09) and one upper air station (AGL08), based on TAPM output at AGL09. The meteorological modelling followed the guidance of TRC (2011) and adopted the "observations" mode. Key setup details for TAPM and CALMET are listed in **Table 6.1** and **Table 6.2** respectively.

Table 6.1 TAPM setup details

Aspect	Value
Model version	4.0.5
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Number of grids point	35 x 35 x 25
Year(s) of analysis	2017, with one "spin-up" day.
Centre of analysis	Bayswater Power Station (32°24' S, 150°57' E)
Terrain data source	Shuttle Research Topography Mission (**SRTM**), 30 m resolution
Land use data source	Default
Meteorological data assimilation	Bayswater meteorological stations AGL08 and AGL09 Radius of influence = 10 km. Number of vertical levels for assimilation = 4. Quality factor = 1

Table 6.2 CALMET setup details

Aspect	Value
Model version	6.334
Run mode	"observations" mode
Terrain data source(s)	United States National Aeronautics and Space Administration (**NASA**) Shuttle Radar Topography Mission (**SRTM1**) 30 metre resolution dataset
Land-use data source(s)	Digitized from aerial imagery and classified as 'water', 'barren' or 'agricultural' categories specified in "CALPUFF Modelling System Version 6 User Instructions", (TRC, 2011). This is displayed in **Appendix B**.
Meteorological grid domain	26.2 km x 21.8 km
Meteorological grid resolution	0.2 km
Meteorological grid dimensions	131 x 109 x 11
Meteorological grid origin	294900 m East, 6400500 m North. MGA Zone 56
Surface meteorological inputs	AGL08 and AGL09 for observations of wind speed and wind direction. TAPM for temperature, relative humidity, air pressure, ceiling height and cloud cover.
Upper air meteorological inputs	Upper air data file for the location of AGL08 derived by TAPM Biased towards surface observations (-1, -0.8, -0.8, -0.4, -0.2, 0, 1, 1, 1, 1, 1)
Simulation length	8760 hours (1 Jan 2017 to 31 Dec 2017)
R1, R2	0.1, 0.5
RMAX1, RMAX2	5, 20
TERRAD	3

6.3 Dispersion modelling

Ground-level concentration and deposition levels due to the identified emission sources have been predicted using the air dispersion model known as CALPUFF (Version 6.42). CALPUFF is a Lagrangian dispersion model that simulates the dispersion of pollutants within a turbulent atmosphere by representing emissions as a series of puffs emitted sequentially. Provided the rate at which the puffs are emitted is sufficiently rapid, the puffs overlap, and the serial release is representative of a continuous release.

The CALPUFF model differs from traditional Gaussian plume models (such as AUSPLUME and ISCST3) in that it can model spatially varying wind and turbulence fields that are important in complex terrain, long-range transport and near calm conditions. CALPUFF has the ability to model the effect of emissions entrained into the thermal internal boundary layer that forms over land, both through fumigation and plume trapping. CALPUFF is an air dispersion model which has been approved by the EPA for these types of assessments (EPA, 2016).

The modelling was performed using the emission estimates from **Section 5** and using the meteorological information provided by the CALMET model, described in **Section 6.2**. Predictions were made at 765 discrete receivers (including the 14 nearby sensitive receivers shown in **Figure 4.1**) to allow for contouring of results. The locations of the model receivers are shown in **Appendix B** and the modelling source locations are described in **Table B.1**.

Sources of emissions for the sources listed above in **Table 5.1** were represented by a series of volume sources. These sources were positioned at the locations shown in **Figure 6.1** as identified in **Table B-1 (Appendix B)**.

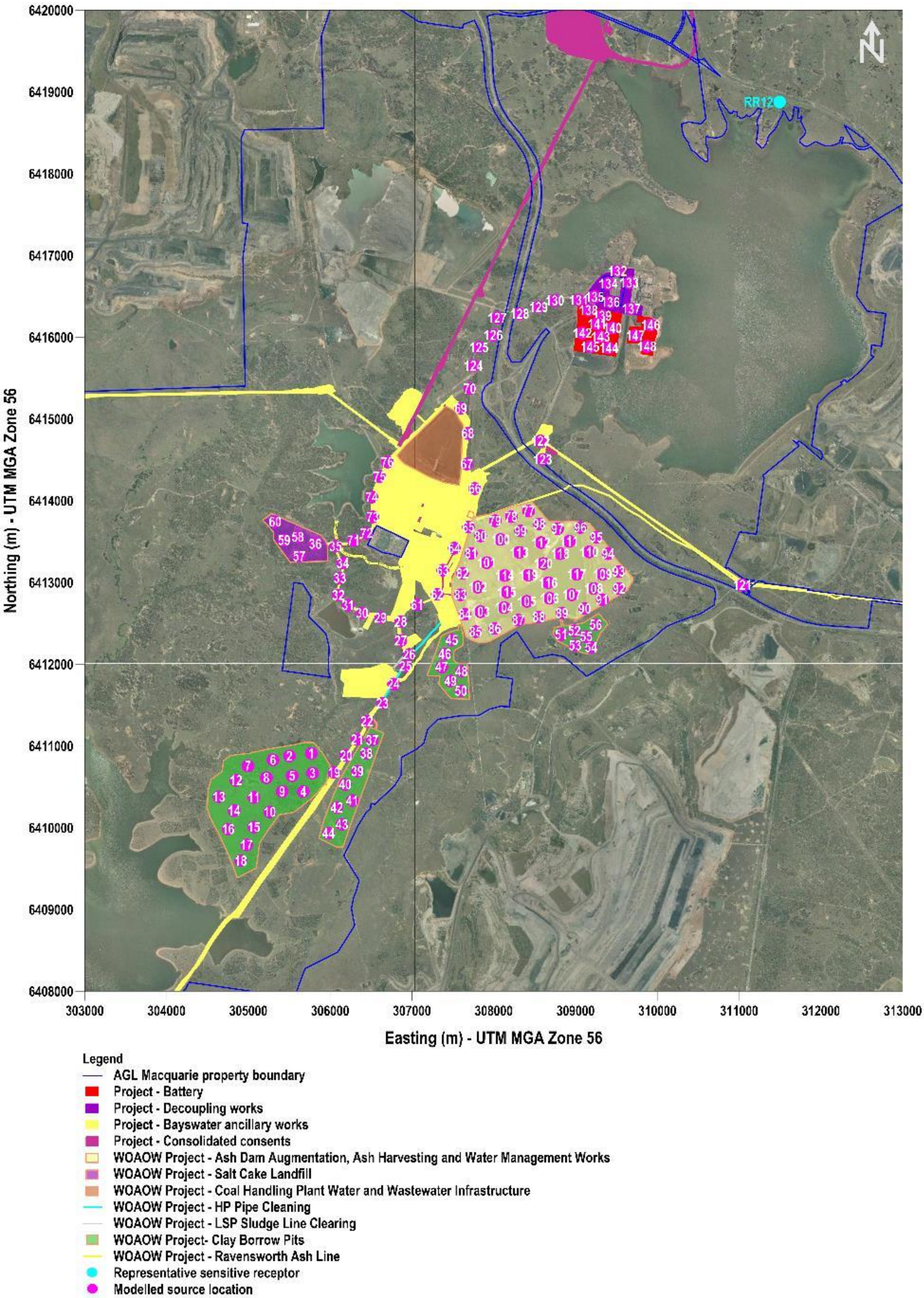


Figure 6.1 CALPUFF modelled source locations (Cumulative)

Dust emissions for all modelled sources have been considered to fit into one of three categories, as follows:

- Wind insensitive sources, where emissions are relatively insensitive to wind speed (for example, dozers)
- Wind sensitive sources, where emissions vary with the hourly wind speed, raised to the power of 1.3, a generic relationship published by the US EPA (1987). This relationship has been applied to sources such as loading and unloading of materials to/from trucks and results in increased emissions with increased wind speed
- Wind sensitive sources, where emissions also vary with the hourly wind speed, but raised to the power of 3, a generic relationship published by Skidmore (1998). This relationship has been applied to sources including wind erosion from stockpiles, exposed areas or active pits, and results in increased emissions with increased wind speed.

Emissions from each volume source were developed on an hourly time step, taking into account the level of activity at that location and, in some cases, the hourly wind speed. This approach ensured that light winds corresponded with lower dust generation and higher winds, with higher dust generation.

6.4 Other Project air quality risks

Potential air quality impacts from other aspects of the Project identified above in **Section 2.3** were qualitatively assessed using a risk-based approach based on guidance from 'AS/NZS ISO 31000: 2009 Risk Management – Principles and Guidelines'. This matrix is presented below in **Table 6.3**, with additional guidance used to estimate consequence (i.e. magnitude of impact) and sensitivity (i.e. likelihood of impacts) listed in **Table 6.4** and **Table 6.5** respectively.

Table 6.3 Air quality risk assessment matrix (based on guidance from AS/NZS ISO 31000:2009)

Consequence or magnitude of impact	Sensitivity or likelihood of impacts				
	Very unlikely	Unlikely	Possible	Likely	Almost certain
Catastrophic	(High)	(Very high)	(Very high)	(Extreme)	(Extreme)
Major	(Medium)	(High)	(High)	(Very high)	(Extreme)
Moderate	(Low)	(Medium)	(High)	(High)	(Very high)
Minor	(Low)	(Low)	(Medium)	(Medium)	(High)
Insignificant	(Low)	(Low)	(Low)	(Low)	(Medium)

Low = Negligible effect or implication on the environment. No injury, insignificant financial loss (i.e. less than $5,000), minimal environmental damage/health impacts, no complaints. Environmental impact that would not be of concern to a reasonable person.

Medium = Minor effect or implication on the environment. First-aid required, on site damage immediately contained with no long-term impacts, minor financial loss (greater than $5,000 but less than $50,000), occasional complaints, possible media interest. Localised and reversible damage to the environment.

High = Moderate, medium-term effect or implication on the environment. Medical treatment required, containable localised damage on-site, moderate financial loss (greater than $50,000 but less than $5,000,000), low likelihood of prosecution, minimal fines, occasional complains and possible media interest. Extensive and reversible or localised and irreversible environmental damage.

Very high = Long-term effect or implication on the environment. Extensive injuries, project suspensions for a period of days, major financial loss (greater than $5,000,000 but less than $100,000,000), significant on-site environmental damage, very bad media coverage, community discontent, possible prosecution. Extensive and reversible or localised and irreversible environmental damage.

Extreme = Irreversible, extensive implications on the environment. Death, project suspensions for a period of weeks, massive financial loss (greater than $100,000,000), significant off-site environmental damage, sustained bad media coverage, sustained complaints and community discontent, probable prosecution.

Table 6.4 Method for determining the potential consequence or magnitude of air quality impacts (based on guidance from AS/NZS ISO 31000:2009)

Consequence or magnitude of impact	Definition
Catastrophic	Long term (greater than three months) and irreversible impacts. Resulting in a major prosecution under relevant environmental legislation. Would cause exceedances at a larger number of receivers and potential health impacts.
Major	Medium term (between one and three months) and potentially irreversible impacts. Resulting fine or equivalent penalty notice under relevant environmental legislation. Would likely cause exceedances at a small number of sensitive receivers under most circumstances.
Moderate	Moderate and reversible impacts, or medium term (between one and three months). Has the potential to result in exceedances of air quality criteria under some circumstances.
Minor	Minor and reversible, or short-term impacts (less than one month). Of a magnitude that would not be expected to result in exceedances of air quality criteria under almost all circumstances.
Insignificant	Minor, negligible impacts. Not of a magnitude that would be expected to result in exceedances of air quality criteria under any circumstances.

Table 6.5 Method for determining the sensitivity or likelihood of air quality impacts (based on guidance from AS/NZS ISO 31000:2009)

Sensitivity or likelihood of impacts	Definition	Probability
Almost certain	The event is almost certain to occur in the course of normal or abnormal construction / operational circumstances.	Greater than 90%
Likely	The event is more likely than not to occur in the course of normal construction / operational circumstances.	51 to 90%
Possible	The event may occur in the course of normal construction / operational circumstances.	26 to 50%
Unlikely	The event is unlikely to occur in the course of normal construction / operational circumstances.	5 to 25%
Very unlikely	The event may occur in exceptional construction / operational circumstances only.	Less than 5%

7. Assessment of impacts

7.1 Overview

This section presents and discusses the results of the assessment of impacts from the primary dust-generating activities associated with the Project (including cumulative impacts from WOAOW) by classification of particulate matter. The significance of the predictions was assessed by evaluating the overall (i.e. background plus change as a result of the project) concentrations and levels against the criteria and guidance from the Approved Methods presented in **Section 3.1.3**.

An assessment of potential for air quality impacts from other aspects of the Project where emissions are anticipated to be short-term in duration and limited in intensity using the methodology outlined in **Section 6.4** is presented below in **Section 7.7**.

7.2 Particulate matter as PM_{10}

Table 7.1 below lists the predicted individual and cumulative annually averaged PM_{10} contributions from the Project and WOAOW at the representative receivers identified in **Table 4.1**.

Table 7.1 Predicted annual PM_{10} concentrations

Representative receiver	Project and WOAOW cumulative contribution (µg/m³)	WOAOW contribution (µg/m³)	Project contribution (µg/m³)	Background concentration (µg/m³)	Overall concentration (µg/m³)	Criterion (µg/m³)
RR01	0.06	0.02	0.04	14	14.06	25
RR02	0.01	<0.01	<0.01	13	13.01	
RR03	0.05	0.03	0.02	20	20.05	
RR04	0.07	0.06	0.01	**27**	27.07	
RR05	0.12	0.11	0.01	21	21.12	
RR06	0.13	0.12	0.01	21	21.13	
RR07	0.02	0.02	<0.01	15	15.02	
RR08	0.01	0.01	<0.01	17	17.01	
RR09	0.01	0.01	<0.01	17	17.01	
RR10	0.02	0.01	0.01	17	17.02	
RR11	0.02	0.02	<0.01	13	13.02	
RR12	0.02	0.01	0.01	18	18.02	
RR13	0.01	0.01	<0.01	18	18.01	
RR14	0.01	0.01	<0.01	18	18.01	
RR15	0.01	0.01	<0.01	17	17.01	

As **Table 7.1** shows, the total overall annually averaged PM_{10} concentrations were predicted to remain below the EPA's 25 µg/m³ impact assessment criterion, except at RR04 where the 2017 background concentration already exceeded this limit. At this location, contributions from the Project and WOAOW were predicted to be less than 1%.

Regarding daily averaged PM_{10}, in the year of assessment (2017) there were 33 instances at DPIE Camberwell and 1 instance at DPIE Jerrys Plains where background concentrations exceeded the EPA's 50 µg/m³ criterion. Consistent with guidance presented in the Approved Methods it was reviewed whether the Project (including the cumulative impacts from WOAOW) would cause additional days of exceedance at surrounding sensitive receivers. This review including the maximum Project and WOAOW 24-hour PM_{10} contributions and changes in the number of exceedances is presented below in **Table 7.2**.

Table 7.2 Review of change in number of days with PM_{10} concentrations exceeding 50 µg/m^3

Receiver	Maximum 24-hour cumulative contribution, Project and WOAOW (µg/m^3)	100th percentile Background concentration (µg/m^3)	Maximum total concentration (µg/m^3)	Number of daily exceedances per year (existing)	Change in number of daily exceedances per year
RR01	0.72	42	<43	0	0
RR02	0.27	49	<50	0	0
RR03	0.79	**63**	<64	33	0
RR04	0.45	**104**	<105	33	0
RR05	0.56	55	<56	33	0
RR06	0.69	**55**	<56	33	0
RR07	0.51	48	<49	0	0
RR08	0.28	**51**	<52	1	0
RR09	0.35	**51**	<52	1	0
RR10	0.50	**51**	<52	1	0
RR11	0.32	38	<39	0	0
RR12	0.66	42	<43	0	0
RR13	0.48	42	<43	0	0
RR14	0.40	42	<43	0	0
RR15	0.25	**51**	<52	1	0

As **Table 7.2** shows, it was predicted that the Project (and WOAOW) would not result in any additional days where PM_{10} concentrations were above 50 µg/m^3.

Maximum annual and daily PM_{10} contributions from the Project and WOAOW are presented as contour plots in **Appendix C**.

7.3 Particulate matter as $PM_{2.5}$

Predicted annual $PM_{2.5}$ cumulative and total (i.e. including background) concentrations from the Project and WOAOW at the identified representative receiver locations are listed below in **Table 7.3**

Table 7.3 Predicted annual $PM_{2.5}$ concentrations

Representative receiver	Project and WOAOW cumulative contribution (µg/m^3)	WOAOW contribution (µg/m^3)	Project contribution (µg/m^3)	Background concentration (µg/m^3)	Overall concentration (µg/m^3)	Criterion (µg/m^3)
RR01	0.01	<0.01	<0.01	7.4	7.41	8
RR02	<0.01	<0.01	<0.01		<7.41	
RR03	0.01	0.01	<0.01		7.41	
RR04	0.01	0.01	<0.01		7.41	

Representative receiver	Project and WOAOW cumulative contribution (μg/m³)	WOAOW contribution (μg/m³)	Project contribution (μg/m³)	Background concentration (μg/m³)	Overall concentration (μg/m³)	Criterion (μg/m³)
RR05	0.02	0.02	<0.01		7.42	
RR06	0.02	0.02	<0.01		7.42	
RR07	<0.01	<0.01	<0.01		<7.41	
RR08	<0.01	<0.01	<0.01		<7.41	
RR09	<0.01	<0.01	<0.01		<7.41	
RR10	<0.01	<0.01	<0.01		<7.41	
RR11	<0.01	<0.01	<0.01		<7.41	
RR12	<0.01	<0.01	<0.01		<7.41	
RR13	<0.01	<0.01	<0.01		<7.41	
RR14	<0.01	<0.01	<0.01		<7.41	
RR15	<0.01	<0.01	<0.01		<7.41	

As **Table 7.3** shows, it was predicted that the Project (and WOAOW) would not result in annual $PM_{2.5}$ concentrations above the 8 μg/m³ criterion.

Regarding 24-hour averaged $PM_{2.5}$, predicted contributions and total (i.e. including background) concentrations from the Project and WOAOW are summarised below in **Table 7.4**.

Table 7.4 Predicted daily $PM_{2.5}$ concentrations

Representative receiver	Project and WOAOW cumulative contribution (μg/m³)	WOAOW contribution (μg/m³)	Project contribution (μg/m³)	Background concentration (μg/m³)	Overall concentration (μg/m³)	Criterion (μg/m³)
RR01	0.13	0.09	0.04	24.7	24.83	25
RR02	0.06	0.05	0.01		24.76	
RR03	0.17	0.16	0.01		24.87	
RR04	0.09	0.09	<0.01		24.79	
RR05	0.10	0.10	<0.01		24.8	
RR06	0.12	0.12	<0.01		24.82	
RR07	0.09	0.09	<0.01		24.79	
RR08	0.05	0.05	<0.01		24.75	
RR09	0.05	0.04	0.01		24.75	
RR10	0.07	0.06	0.01		24.77	
RR11	0.06	0.06	<0.01		24.76	
RR12	0.13	0.08	0.05		24.83	
RR13	0.07	0.06	0.01		24.77	
RR14	0.06	0.05	0.01		24.76	
RR15	0.04	0.04	<0.01		24.74	

As displayed below in **Table 7.4**, this was also the case for daily $PM_{2.5}$, with total concentrations also predicted to remain below the EPA's 25 µg/m^3 impact assessment criterion.

As such, it was also concluded that changes in annual and daily $PM_{2.5}$ concentrations as a result of the Project would not result in concentrations exceeding EPA criteria at surrounding receivers.

Maximum annual and daily $PM_{2.5}$ contributions from the Project and WOAOW are presented as contour plots in **Appendix C.**

7.4 Total suspended particulates (TSP)

Predicted changes in annual TSP at the identified surrounding receivers are summarised below in **Table 7.5**.

Table 7.5 Predicted annual TSP concentrations

Representative receiver	Project and WOAOW cumulative contribution (µg/m^3)	WOAOW contribution (µg/m^3)	Project contribution (µg/m^3)	Background concentration (µg/m^3)	Overall concentration (µg/m^3)	Criterion (µg/m^3)
RR01	0.04	0.01	0.03	33	33.04	90
RR02	0.01	<0.01	<0.01	45	45.01	
RR03	0.07	0.05	0.02	68	68.07	
RR04	0.09	0.08	0.01	68	68.09	
RR05	0.14	0.13	0.01	59	59.14	
RR06	0.16	0.14	0.02	68	68.16	
RR07	0.02	0.02	<0.01	68	68.02	
RR08	0.01	0.01	<0.01	68	68.01	
RR09	0.01	0.01	<0.01	68	68.01	
RR10	0.02	0.01	0.01	68	68.02	
RR11	0.03	0.02	0.01	68	68.03	
RR12	0.02	0.01	0.01	33	33.02	
RR13	0.01	0.01	<0.01	33	33.01	
RR14	0.01	<0.01	<0.01	33	33.01	
RR15	0.01	0.01	<0.01	68	68.01	

As **Table 7.5** shows, cumulative total annually averaged TSP was predicted to remain below the EPA's 90 µg/m^3 impact assessment criterion at identified representative receiver locations.

Annual TSP concentrations are displayed as contours in **Appendix C**.

7.5 Deposited dust

Predicted changes in annually averaged deposited dust levels at the surrounding receivers are summarised in **Table 7.6**.

Table 7.6 Predicted annual deposited dust

Representative receiver	Project and WOAOW cumulative contribution (µg/m³)	WOAOW contribution (µg/m³)	Project contribution (µg/m³)	Background concentration (µg/m³)	Overall concentration (µg/m³)	Criterion (µg/m³)
RR01	0.005	0.001	0.004	2.3	2.305	4
RR02	0.001	<0.001	<0.001	2.3	2.301	
RR03	0.012	0.008	0.004	**4.1**	4.112	
RR04	0.015	0.014	0.001	**4.1**	4.115	
RR05	0.024	0.022	0.002	2.9	2.924	
RR06	0.025	0.023	0.002	2.9	2.925	
RR07	0.002	0.002	<0.001	2.3	2.302	
RR08	0.001	0.001	<0.001	2.0	2.001	
RR09	0.002	0.001	0.001	2.0	2.002	
RR10	0.002	0.001	0.001	2.0	2.002	
RR11	0.004	0.004	<0.001	1.4	1.404	
RR12	0.001	0.001	<0.001	2.3	2.301	
RR13	0.001	0.001	<0.001	2.3	2.301	
RR14	0.001	<0.001	<0.001	2.3	2.301	
RR15	0.001	0.001	<0.001	2.0	2.001	

As **Table 7.6** shows it was predicted that the cumulative levels would remain below the EPA's 4 g/m²/month impact assessment criterion at all nearby sensitive receivers except RR03 and RR04 where 2017 background concentrations were already measured above the EPA's criterion. The highest contribution from the Project and WOAOW was less than 1%. Additionally, in 2018, the annual deposited dust level at Glencore RC's D9 used to characterise background levels at RR03 and RR04 was 3.6 g/m²/month.

7.6 Summary of impacts from primary dust-generating activities

In summary, the following changes in local air quality as a result of the Project were predicted:

- **TSP and $PM_{2.5}$:** Changes would not result in exceedance of the EPA's relevant impact assessment criteria at any of the nearest sensitive receivers
- **24-hour averaged PM_{10}:** Compliance with the EPA's 50 µg/m³ assessment criterion at representative receivers RR01, RR02, RR07 and RR11. No additional exceedances of the impact assessment criteria were predicted as a result of the Project and WOAOW at receivers where background conditions were already elevated (RR03, RR04, RR05, RR06, RR08, RR09 and RR10)
- **Annual PM_{10}:** Negligible contributions (less than 1%) were predicted from the Project and WOAOW, resulting in concentrations less than the 25 µg/m³ assessment criterion at all representative receiver locations assessed except RR04 where background levels already exceeded this value
- **Annual deposited dust:** Negligible contributions (less than 1%) were predicted from the Project and WOAOW, resulting in concentrations less than the 4 g/m²/month assessment criterion at all representative receiver locations assessed except RR03 and RR04 where background levels already exceeded this value.

Noting the conservatism of the assessment approach (i.e. all phases of the Project occurring at the same time, the Project and WOAOW assessed as occurring concurrently, and all key work areas of WOAOW being assessed as concurrent emitting sources), the results indicate that the Project would not result in unacceptable changes in local air quality. That is, the Project is unlikely to be the cause of exceedances of air quality criteria.

7.7 Review of other project air quality risks

As identified in **Section 2.3**, there are several other air quality-related risks associated with the Project in addition to dust impacts from the construction activities assessed above. These include:

- Dust emissions during the conveyor shortening, environmental improvement activities, brine concentrator return water pipeline, upgrades within the Bayswater operational area, upgrades to the emergency power system, removal of the solar array and ancillary and chemical storage tank area upgrades associated with the BAW component of the Project
- Exhaust emissions from plant and equipment used during the Project
- Fugitive emissions from stored fuels and chemicals.

Using the risk-based approach developed in **Section 6.4**, the following unmitigated ratings were determined for these risks:

- Dust emissions during the conveyor shortening, environmental improvement activities, brine concentrator return water pipeline, upgrades within the Bayswater operational area, upgrades to the emergency power system, removal of the solar array and ancillary and chemical storage tank area upgrades associated with BAW: 'Low' based on the expected consequence of impact being 'minor' and likelihood being 'Unlikely' given the limited intensity of emissions to air expected from these activities, and the setback distance from the nearest sensitive receivers.
- Exhaust emissions from plant and equipment used during the Project: 'Low' based on the expected consequence of impact being 'minor' given the intensity of emissions expected and likelihood being 'very unlikely' given the setback distance from the nearest sensitive receivers.
- Fugitive emissions from stored chemicals: 'Low' based on the expected consequence of impact being 'minor' given the limited quantities to be stored and likelihood being 'very unlikely' given the location in relation to surrounding sensitive receivers.

Although unmitigated risk ratings of 'low' were determined, measures were still developed in line with best practice in **Section 8**.

8. Safeguards and monitoring

As presented above, the assessment indicated that EPA impact assessment criteria for TSP and $PM_{2.5}$ would be met at surrounding sensitive receivers, with no additional exceedances of 24-hour averaged PM_{10} predicted. Negligible (less than 1%) contributions of annually averaged PM_{10} and deposited dust were predicted, although levels were noted to be already elevated above criteria at some receiver locations. Although it was found that the Project is not expected to result in unacceptable changes in local air quality, the control measures listed below in **Table 8.1** are recommended.

Table 8.1 Air quality management measures

Source/activity	Control measure	Timing	Responsibility
Loading and unloading of materials	Water sprays as applicable	During construction	Construction Contractor
	Minimising drop heights		
	Reviewing and where necessary modifying or suspending activities during dry and windy weather and elevated background air quality conditions.		
Wind erosion from stockpiles and exposed surfaces	Watering stockpiles and exposed surfaces; progressive rehabilitation of exposed surfaces (as feasible)	During construction	Construction Contractor
	Progressively rehabilitating exposed surfaces	As soon as feasible following completion	Construction Contractor
Haulage of materials in trucks	Regular watering of haulage routes	During construction	Construction Contractor
	Regular inspection and removal of debris from plant and equipment to avoid the tracking of materials on to the adjacent road network		
Exhaust emissions from plant and equipment	Inspecting all plant and equipment before it is used on-site	Prior to construction	Construction Contractor
	Ensuring that all vehicles, plant, and equipment are operated in a proper and efficient manner.	During construction	Construction Contractor
	Switching off all vehicles, plant and equipment when not in-use for extended periods		Construction Contractor
	Avoiding the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where practicable.		Construction Contractor
Fugitive emissions from stored chemicals	Limiting the quantity of chemical products stored at the site to the extent practical	During design and operations	AGLM
	Ensure that all storage tanks are fitted with the appropriate controls in-line with the Protection of the Environment Operations (Clean Air) Regulation 2010		
Cumulative impacts from the Project and WOAOW	Co-ordinating activities between both projects to limit the potential for cumulative dust impacts	During construction	Construction Contractor

These controls should be implemented in addition to the controls recommended for WOAOW.

9. Conclusions

An assessment was completed to evaluate potential changes in air quality from the Project at the AGLM land holding and surrounds. Consistent with the requirements of the SEAR's, this assessment was undertaken in accordance with the guidance presented in the Approved Methods.

As part of the assessment, key features of the existing environment were determined including the identification of surrounding sensitive receivers; prevailing meteorology; and background local air quality conditions. Fourteen residential receivers were identified within the vicinity of the Project. Meteorological and ambient air quality data collected at monitors operated by AGLM, as well as a number of other local industrial operators and DPIE were reviewed and conditions in 2017 were identified as being representative of the long-term conditions.

Emission rates for key Project dust-generating activities were estimated from local and international guidance. Modelling was then carried out with these emissions to predict the potential for air quality impacts as a result of the Project, including cumulative impacts from WOAOW. This assessment determined that worst-case potential impacts as a result of the Project would not result in unacceptable changes to local air quality. Specifically, it was predicted that:

- **TSP and $PM_{2.5}$:** Changes would not result in exceedance of the EPA's relevant impact assessment criteria at any of the nearest sensitive receivers
- **24-hour averaged PM_{10}:** Compliance with the EPA's 50 µg/m^3 assessment criterion at representative receivers RR01, RR02, RR07 and RR11. No additional exceedances of the impact assessment criteria were predicted as a result of the Project and WOAOW at receivers where background conditions were already elevated (RR03, RR04, RR05, RR06, RR08, RR09 and RR10)
- **Annual PM_{10}:** Negligible contributions (less than 1%) were predicted from the Project and WOAOW, resulting in concentrations less than the 25 µg/m^3 assessment criterion at all representative receiver locations assessed except RR04 where background levels already exceeded this value
- **Annual deposited dust:** Negligible contributions (less than 1%) were predicted from the Project and WOAOW, resulting in concentrations less than the 4 g/m^2/month assessment criterion at all representative receiver locations assessed except RR03 and RR04 where background levels already exceeded this value.

The potential for other air-quality related impacts including dust from other smaller aspects of the BAW component of the Project as well as other emissions to air (exhaust emissions and fugitive emissions from stored chemicals) were also assessed using a risk-based methodology based on guidance presented in 'AS/NZS ISO 31000: 2009 Risk Management – Principles and Guidelines'. Using this approach, it was determined that there was a 'low' potential for air quality impacts from these aspects of the Project.

Measures were recommended to control emissions to air including watering of haulage routes, use of water sprays as applicable during material loading and unloading activities, progressive rehabilitation, active management measures and co-ordination of the Project and WOAOW activities to limit the potential for cumulative impacts.

10. References

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Appendix A. Emissions calculations

Emission estimates, controls factors, emission factors and input variables

Emission calculations																						
Project and WOAOW Project cumulative sources																						
	Annual emissions (kg/y)						TSP		PM10		PM2.5		Variables									Reference
Activity	TSP	PM10	PM2.5	Control (%)	Intensity	Units	Factor	Units	Factor	Units	Factor	Units	Area (m2)	(ws/2.2)^1.3	Moisture (%)	Speed (km/h)	t/truck	km/trip	Silt (%)	Total average weight (t)	Bulk Density (t/m3)	
Project (Battery) - Dozers site clearing	216	41	2	0	120	h/y	1.79753	kg/h/v	0.34125	kg/h/v	0.01706	kg/h/v	-	-	7.9	-	-	-	6.9	-	-	EETM Mining, Section 1.1.5
Project (Battery) - Trucks unloading fill material for pad construction	3840	1376	192	0	320000	t/y	0.01200	kg/t	0.0043	kg/t	0.001	kg/t	-	-	-	-	-	-	-	-	-	EETM Mining, Section 1.1.6
Project (Battery) - Excavators on pad materials	63	30	3	0	320000	t/y	0.00020	kg/t	9.3E-05	kg/t	0.000	kg/t	-	1.13	7.9	-	-	-	-	-	-	EETM Mining, Section 1.1.2, AP42-13.2.4
Project (Battery) - Graders shaping BESS pad	248	111	12	0	1303.57	VKT/y	0.19007	kg/VKT	0.085	kg/VKT	0.0095	kg/VKT	-	-	-	5	-	-	-	-	-	EETM Mining (2012), Section 1.1.14
Project (Battery) - Wind erosion pad	17520	8760	1314	0	20	ha	876.0	kg/ha/y	438.0	kg/ha/y	65.7	kg/ha/y	181161	-	-	-	-	-	-	-	-	EETM Mining, Section 1.1.18
Project (Battery) - Haulage pad materials (from Battery and Decoupling area)	5924	1528	153	50	5714	VKT/y	2.07339	kg/VKT	0.53488	kg/VKT	0.05349	kg/VKT	-	-	-	-	28	1	5.1	-	-	AP-42-13.2.2
Project (Battery) - Haulage pad materials (from Bayswater CBP1)	16291	4203	420	50	15714	VKT/y	2.07339	kg/VKT	0.53488	kg/VKT	0.05349	kg/VKT	-	-	-	-	28	11	5.1	-	-	AP-42-13.2.2
Project (Battery) - Haulage pad materials (from Bayswater CBP2)	17772	4585	458	50	17143	VKT/y	2.07339	kg/VKT	0.53488	kg/VKT	0.05349	kg/VKT	-	-	-	-	28	12	5.1	-	-	AP-42-13.2.2
Project (Battery) - Haulage pad materials (from Bayswater CBP3)	22215	5731	573	50	21429	VKT/y	2.07339	kg/VKT	0.53488	kg/VKT	0.05349	kg/VKT	-	-	-	-	28	15	5.1	-	-	AP-42-13.2.2
Project (Battery) - Haulage pad materials (from Bayswater CBP4)	25177	6495	649	50	24286	VKT/y	2.07339	kg/VKT	0.53488	kg/VKT	0.05349	kg/VKT	-	-	-	-	28	17	5.1	-	-	AP-42-13.2.2
Project (Decoupling) - Dozers site clearing new 330 kV / 33 kV compound	72	14	1	0	40	h/y	1.79753	kg/h/v	0.34125	kg/h/v	0.01706	kg/h/v	-	-	7.9	-	-	-	6.9	-	-	EETM Mining, Section 1.1.5
Project (Decoupling) - Graders shaping new 330 kV / 33 kV compound	21	9	1	0	108.631	VKT/y	0.19007	kg/VKT	0.085	kg/VKT	0.0095	kg/VKT	-	-	-	5	-	-	-	-	-	EETM Mining (2012), Section 1.1.14
Project (Decoupling) - Wind erosion new 330 kV / 33 kV compound	1226	613	92	0	1.4	ha	876.0	kg/ha/y	438.0	kg/ha/y	65.7	kg/ha/y	181161	-	-	-	-	-	-	-	-	EETM Mining, Section 1.1.18
Project (BAW) - Dozer removing existing pavement River Road Reconst.	72	14	1	0	40	h/y	1.79753	kg/h/v	0.34125	kg/h/v	0.01706	kg/h/v	-	-	7.9	-	-	-	6.9	-	-	EETM Mining, Section 1.1.5
Project (BAW) - Trucks unloading fill material River Road Reconst.	69	25	3	0	5760	t/y	0.01200	kg/t	0.0043	kg/t	0.001	kg/t	-	-	-	-	-	-	-	-	-	EETM Mining, Section 1.1.6
Project (BAW) - Excavators constructing road River Road Reconst.	1	1	0	0	5760	t/y	0.00020	kg/t	9.3E-05	kg/t	0.000	kg/t	-	1.13	7.9	-	-	-	-	-	-	EETM Mining, Section 1.1.2, AP42-13.2.4
Project (BAW) - Graders constructing road River Road Reconst.	27	12	1	0	142.857	VKT/y	0.19007	kg/VKT	0.085	kg/VKT	0.0095	kg/VKT	-	-	-	5	-	-	-	-	-	EETM Mining (2012), Section 1.1.14
Project (BAW) - Wind erosion road	315	158	24	0	1.44	ha	876.0	kg/ha/y	438.0	kg/ha/y	65.7	kg/ha/y	181161	-	-	-	-	-	-	-	-	EETM Mining, Section 1.1.18
Project (BAW) - Haulage road materials	1066	275	28	50	1029	VKT/y	2.07339	kg/VKT	0.53488	kg/VKT	0.05349	kg/VKT	-	-	-	-	28	5	5.1	-	-	AP-42-13.2.2
Project (BAW) - Dozer constructing sediment basin at M2/M3 transfer	72	14	1	0	40	h/y	1.79753	kg/h/v	0.34125	kg/h/v	0.01706	kg/h/v	-	-	7.9	-	-	-	6.9	-	-	EETM Mining, Section 1.1.5
Project (BAW) - Dozer constructing sediment basin at M2/M1/R1 transfer	72	14	1	0	40	h/y	1.79753	kg/h/v	0.34125	kg/h/v	0.01706	kg/h/v	-	-	7.9	-	-	-	6.9	-	-	EETM Mining, Section 1.1.5
Project - Loading Battery and RRR materials at Battery and Decoupling area	31	15	2	0	160000	t/y	0.00020	kg/t	0.00009	kg/t	0.0000	kg/t	-	1.13	7.9	-	-	-	-	-	-	EETM Mining (2012), Section 1.1.2, AP42-13.2.4
Project - Loading Battery and RRR materials at CBP1	8	4	1	0	40000	t/y	0.00020	kg/t	0.00009	kg/t	0.0000	kg/t	-	1.13	7.9	-	-	-	-	-	-	EETM Mining (2012), Section 1.1.2, AP42-13.2.4
Project - Loading Battery and RRR materials at CBP2	9	4	1	0	45760	t/y	0.00020	kg/t	0.00009	kg/t	0.0000	kg/t	-	1.13	7.9	-	-	-	-	-	-	EETM Mining (2012), Section 1.1.2, AP42-13.2.4
Project - Loading Battery and RRR materials at CBP3	8	4	1	0	40000	t/y	0.00020	kg/t	0.00009	kg/t	0.0000	kg/t	-	1.13	7.9	-	-	-	-	-	-	EETM Mining (2012), Section 1.1.2, AP42-13.2.4
Project - Loading Battery and RRR materials at CBP4	8	4	1	0	40000	t/y	0.00020	kg/t	0.00009	kg/t	0.0000	kg/t	-	1.13	7.9	-	-	-	-	-	-	EETM Mining (2012), Section 1.1.2, AP42-13.2.4
kg/yr	**898834**	**322525**	**44075**																			

Emission calculations

Project and WOAOW Project cumulative sources

	Annual emissions (kg/y)						TSP		PM10		PM2.5		Variables									Reference
Activity	TSP	PM10	PM2.5	Control (%)	Intensity	Units	Factor	Units	Factor	Units	Factor	Units	Area (m2)	(ws/2.2)^1.3	Moisture (%)	Speed (km/h)	t/truck	km/trip	Silt (%)	Total average weight (t)	Bulk Density (t/m3)	
WOAOW - AMD - Excavators on materials	192	91	10	0	980047	t/y	0.00020	kg/t	9.3E-05	kg/t	0.000	kg/t	-	1.13	7.9	-	-	-	-	-	1.6	EETM Mining, Section 1.1.2, AP42-13.2.4
WOAOW - AMD - Trucks unloading materials	11761	4214	588	0	980047	t/y	0.01200	kg/t	0.0043	kg/t	0.001	kg/t	-	-	-	-	-	-	-	-	-	EETM Mining, Section 1.1.6
WOAOW - AMD - Wind erosion, Ash Dam	146378	73189	10978	0	167.098	ha	876.0	kg/ha/y	438.0	kg/ha/y	65.7	kg/ha/y	1670982	-	-	-	-	-	-	-		EETM Mining, Section 1.1.18
WOAOW -SCF - Scrappers removing topsoil	3786	953	191	0	130562	t	0.029	kg/t	0.0073	kg/t	0.00146	kg/t	272005	-	-	-	-	-	-	-	1.6	EETM Mining, Section 1.1.13
WOAOW- SCF - Dozers ripping materials	3739	710	35	0	2080	h/y	1.79753	kg/h/v	0.34125	kg/h/v	0.01706	kg/h/v	-	-	7.9	-	-	-	6.9	-	-	EETM Mining, Section 1.1.5
WOAOW - SCF - Wind erosion from landfill area	19062	9531	1430	0	5.4401	ha	3504.0	kg/ha/y	1752.0	kg/ha/y	262.8	kg/ha/y	54401	-	-	-	-	-	-	-	-	EETM Mining, Section 1.1.18
WOAOW - SCF - Wind erosion from stockpiled materials	953	477	71	0	1.08802	ha	876.0	kg/ha/y	438.0	kg/ha/y	65.7	kg/ha/y	10880.2	-	-	-	-	-	-	-	-	EETM Mining, Section 1.1.18
WOAOW - SCF - Excavators on materials	4	2	0	0	20000	t/y	0.00020	kg/t	9.3E-05	kg/t	0.000	kg/t	-	1.13	7.9	-	-	-	-	-	-	EETM Mining, Section 1.1.2, AP42-13.2.4
WOAOW - SCF - Hauling SC product	62202	16046	1605	50	60000	VKT/y	2.07339	kg/VKT	0.53488	kg/VKT	0.05349	kg/VKT	-	-	-	-	28	3	5.1	-	-	AP-42-13.2.2
WOAOW - CBP1 - Scrappers removing topsoil	2522	635	127	0	86957.3	t	0.029	kg/t	0.0073	kg/t	0.00146	kg/t	181161	-	-	-	-	-	-	-	1.6	EETM Mining, Section 1.1.13
WOAOW - CBP1 - Wind erosion from pit 1	15870	7935	1190	0	18.1161	ha	876.0	kg/ha/y	438.0	kg/ha/y	65.7	kg/ha/y	181161	-	-	-	-	-	-	-	-	EETM Mining, Section 1.1.18
WOAOW - CBP2 - Scrappers removing topsoil	3681	927	185	0	126932	t	0.029	kg/t	0.0073	kg/t	0.00146	kg/t	264442	-	-	-	-	-	-	-	1.6	EETM Mining, Section 1.1.13
WOAOW - CBP2 - Wind erosion from pit 2	23165	11583	1737	0	26.4442	ha	876.0	kg/ha/y	438.0	kg/ha/y	65.7	kg/ha/y	264442	-	-	-	-	-	-	-	-	EETM Mining, Section 1.1.18
WOAOW - CBP3 - Scrappers removing topsoil	5983	1506	301	0	206314	t	0.029	kg/t	0.0073	kg/t	0.00146	kg/t	429821	-	-	-	-	-	-	-	1.6	EETM Mining, Section 1.1.13
WOAOW - CBP3 - Wind erosion from pit 3	37652	18826	2824	0	42.9821	ha	876.0	kg/ha/y	438.0	kg/ha/y	65.7	kg/ha/y	429821	-	-	-	-	-	-	-	-	EETM Mining, Section 1.1.18
WOAOW - CBP4 - Scrappers removing topsoil	19041	4793	959	0	656593	t	0.029	kg/t	0.0073	kg/t	0.00146	kg/t	1367903	-	-	-	-	-	-	-	1.6	EETM Mining, Section 1.1.13
WOAOW - CBP4 - Dozers ripping materials	3739	710	35	0	2080	h/y	1.79753	kg/h/v	0.34125	kg/h/v	0.01706	kg/h/v	-	-	7.9	-	-	-	6.9	-	-	EETM Mining, Section 1.1.5
WOAOW - CBP4 - Wind erosion from pit 4	119828	59914	8987	0	136.79	ha	876.0	kg/ha/y	438.0	kg/ha/y	65.7	kg/ha/y	1367903	-	-	-	-	-	-	-	-	EETM Mining, Section 1.1.18
WOAOW - CBP4 - Wind erosion from stockpiled materials	876	438	66	0	1	ha	876.0	kg/ha/y	438.0	kg/ha/y	65.7	kg/ha/y	10000	-	-	-	-	-	-	-	-	EETM Mining, Section 1.1.18
WOAOW - CBP4 - Excavators loading materials	48	23	3	0	245012	t/y	0.00020	kg/t	9.3E-05	kg/t	0.000	kg/t	-	1.13	7.9	-	-	-	-	-	-	EETM Mining, Section 1.1.2, AP42-13.2.4
WOAOW - Haulage CBP4 - Ash Dam	203202	52420	5242	50	196009	VKT/y	2.07339	kg/VKT	0.53488	kg/VKT	0.05349	kg/VKT	-	-	-	-	28	7	5.1	-	-	AP-42-13.2.2
WOAOW - Haulage CBP4 - SCF	58058	14977	1498	50	56003	VKT/y	2.07339	kg/VKT	0.53488	kg/VKT	0.05349	kg/VKT	-	-	-	-	28	8	5.1	-	-	AP-42-13.2.2
WOAOW - Haulage FAH	44725	8585	2077	50	166667	VKT/y	0.53670	kg/VKT	0.10302	kg/VKT	0.02492	kg/VKT	-	-	-	-	24	4	8.2	23	-	AP-42-13.2.1.3
WOAOW - Haulage Rehabilitation works	25	5	1	50	60	VKT/y	0.82361	kg/VKT	0.15809	kg/VKT	0.03825	kg/VKT	-	-	-	-	24	4	8.2	35	-	AP-42-13.2.1.3
kg/yr	**898834**	**322525**	**44075**																			

Appendix B. Dispersion modelling CALPUFF discrete receptors and CALMET land uses modelled source locations

Figure B.1: CALPUFF discrete receptors and CALMET land uses

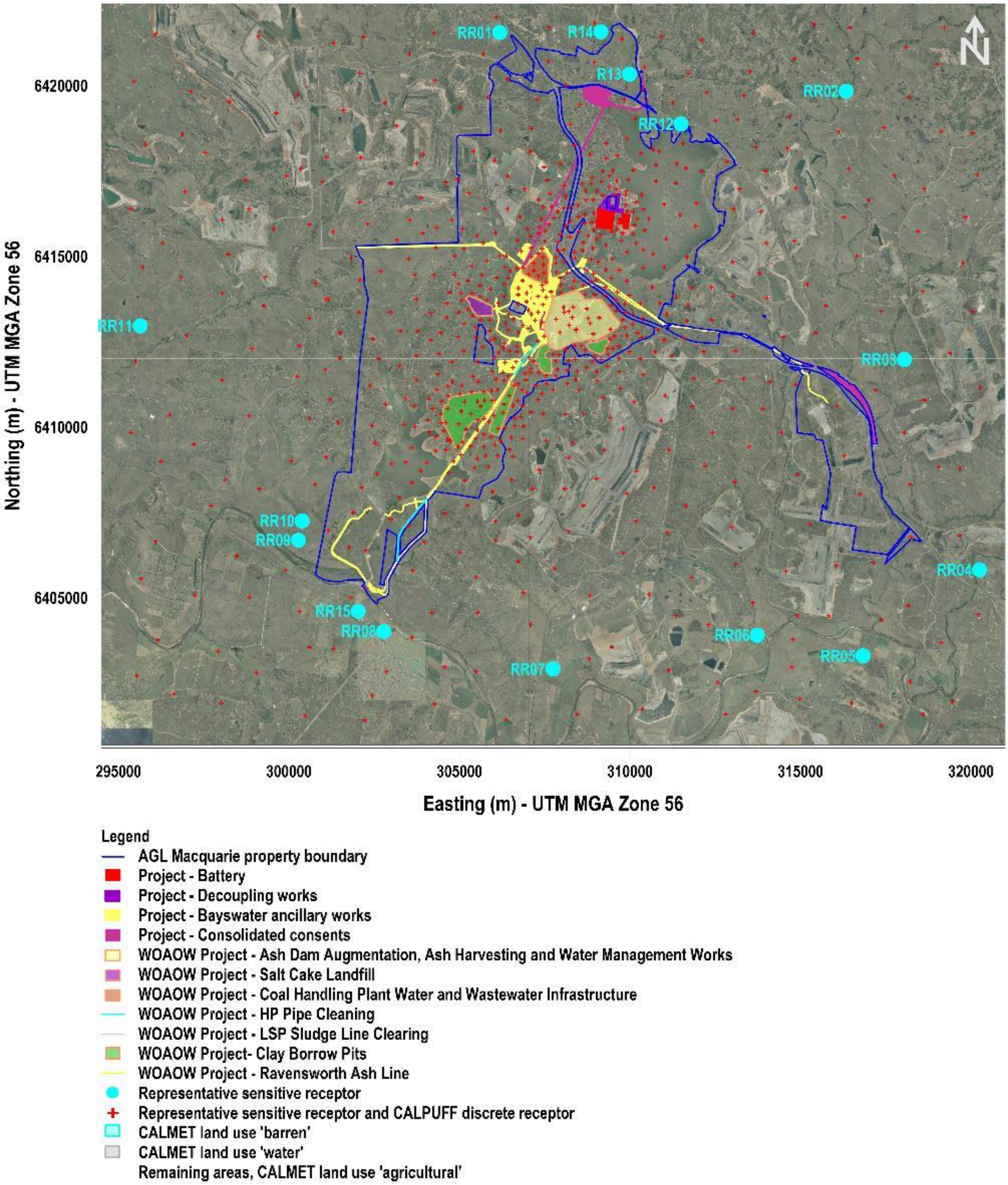


Table B.1: Modelled source locations

Source/activity	Locations where activities were modelled
Project	
Project (Battery) - Dozers site clearing	132, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147 and 148
Project (Battery) - Trucks unloading fill material for pad construction	132, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147 and 148
Project (Battery) - Excavators on pad materials	132, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147 and 148
Project (Battery) - Graders shaping BESS pad	132, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147 and 148
Project (Battery) - Wind erosion pad	132, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147 and 148
Project (Battery) - Haulage pad materials (from Battery and Decoupling area)	132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147 and 148
Project (Battery) - Haulage pad materials (from Bayswater CBP1)	51, 52, 53, 54, 55, 56, 65, 66, 67, 68, 69, 70, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147 and 148
Project (Battery) - Haulage pad materials (from Bayswater CBP2)	45, 46, 47, 48, 49, 50, 65, 66, 67, 68, 69, 70, 80, 81, 82, 83, 84, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147 and 148
Project (Battery) - Haulage pad materials (from Bayswater CBP3)	22, 23, 24, 25, 26, 27, 28, 37, 38, 39, 40, 41, 42, 43, 44, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147 and 148
Project (Battery) - Haulage pad materials (from Bayswater CBP4)	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147 and 148
Project (Decoupling) - Dozers site clearing new 330 kV / 33 kV compound	133, 134, 135, 136 and 137
Project (Decoupling) - Graders shaping new 330 kV / 33 kV compound	133, 134, 135, 136 and 137
Project (Decoupling) - Wind erosion new 330 kV / 33 kV compound	133, 134, 135, 136 and 137
Project (BAW) - Dozer removing existing pavement River Road Reconstruction	63, 64, 65, 66, 67, 68 and 69
Project (BAW) - Trucks unloading fill material River Road Reconstruction	63, 64, 65, 66, 67, 68 and 69
Project (BAW) - Excavators constructing road River Road Reconstruction	63, 64, 65, 66, 67, 68 and 69
Project (BAW) - Graders constructing road River Road Reconstruction	63, 64, 65, 66, 67, 68 and 69
Project (BAW) - Wind erosion road	63, 64, 65, 66, 67, 68 and 69
Project (BAW) - Haulage road materials	45, 46, 47, 48, 49, 50, 62, 63, 64, 65, 66, 67, 68, 69, 84 and 85
Project (BAW) - Dozer constructing sediment basin at M2/M3 transfer	122 and 123
Project (BAW) - Dozer constructing sediment basin at M2/M1/R1 transfer	121
Project - Loading Battery and RRR materials at Battery and Decoupling area	132, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147 and 148
WOAOW	

Source/activity	Locations where activities were modelled
WOAOW - Ash Dam (AD) augmentation - Excavators on augmentation materials	77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119 and 120
WOAOW - AD augmentation - Trucks unloading augmentation materials	77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119 and 120
WOAOW - AD - Wind erosion ash and augmentation materials	77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119 and 120
WOAOW - Salt Cake Landfill Facility (SCLF) - Scrappers removing topsoil	36, 57, 58, 59 and 60
WOAOW - SCLF - Dozers ripping materials	36, 57, 58, 59 and 60
WOAOW - SCLF - Wind erosion from landfill area	36, 57, 58, 59 and 60
WOAOW - SCLF - Wind erosion from stockpiled materials	36, 57, 58, 59 and 60
WOAOW - SCLF - Excavators on materials	36, 57, 58, 59 and 60
WOAOW - SCLF - Hauling SC product	35, 71, 72, 73, 74, 75 and 76
WOAOW - CBP 1 - Scrappers removing topsoil	51, 52, 53, 54, 55 and 56
WOAOW - CBP 1 - Wind erosion from pit 1	51, 52, 53, 54, 55 and 56
WOAOW - CBP 2 - Scrappers removing topsoil	45, 46, 47, 48, 49 and 50
WOAOW - CBP 2 - Wind erosion from pit 2	45, 46, 47, 48, 49 and 50
WOAOW - CBP 3 - Scrappers removing topsoil	37, 38, 39, 40, 41, 42, 43 and 44
WOAOW - CBP 3 - Wind erosion from pit 3	37, 38, 39, 40, 41, 42, 43 and 44
WOAOW - CBP 4 - Scrappers removing topsoil	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 and 18
WOAOW - CBP 4 - Dozers ripping materials	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 and 18
WOAOW - CBP 4 - Wind erosion from pit 4	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 and 18
WOAOW - CBP 4 - Wind erosion from stockpiled materials	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 and 18
WOAOW - CBP 4 - Excavators loading materials	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 and 18
WOAOW - Haulage CBP 4 - Ash Dam	19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 61, 62, 63, 64 and 65
WOAOW - Haulage CBP 4 - SCLF	19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34 and 35
WOAOW - Haulage Fly Ash	65, 66, 67, 68, 69 and 70
WOAOW - Haulage Rehabilitation works	65, 66, 67, 68, 69 and 70

Appendix C. Incremental contour plots (Project and WOAOW)

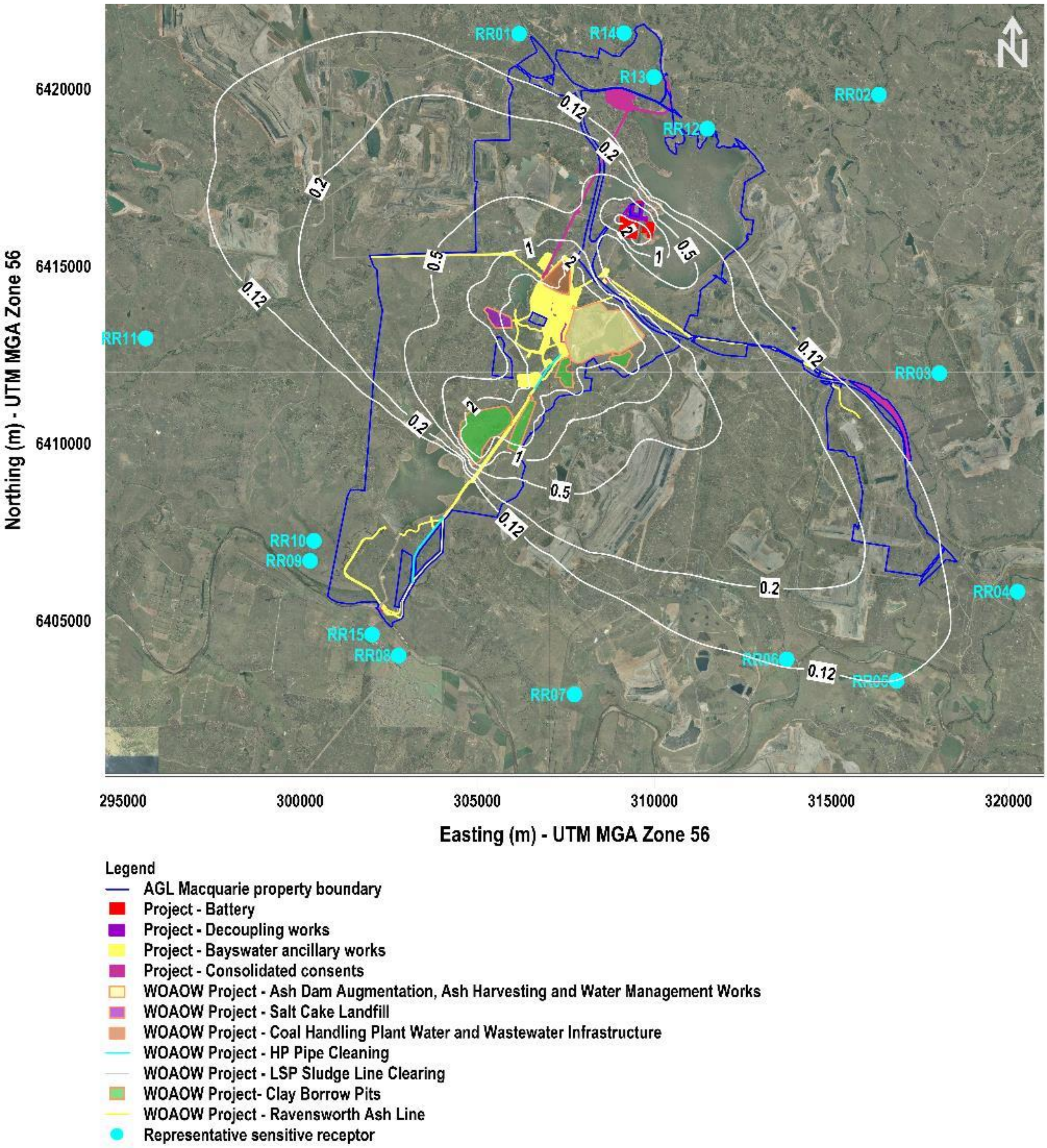
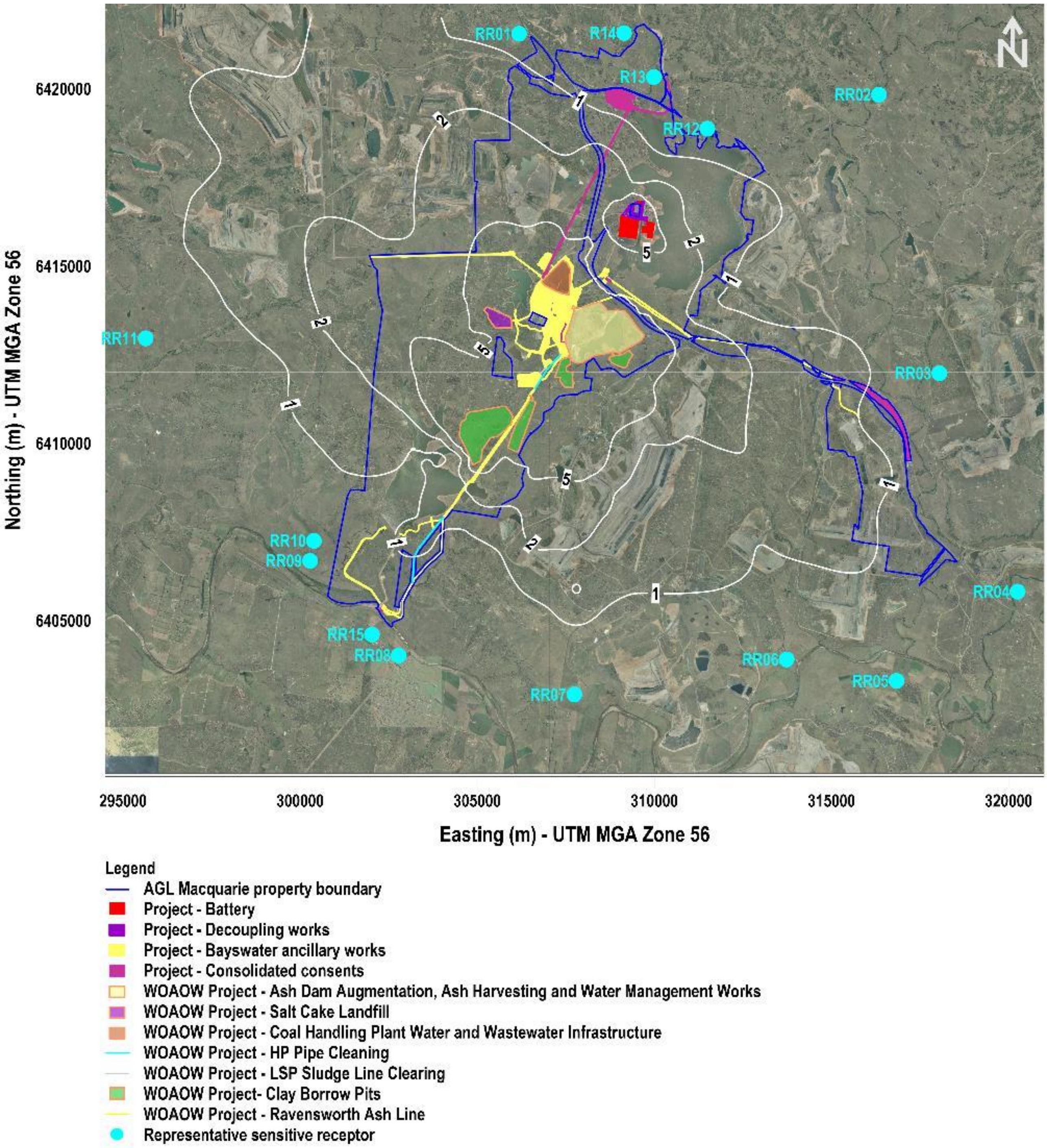
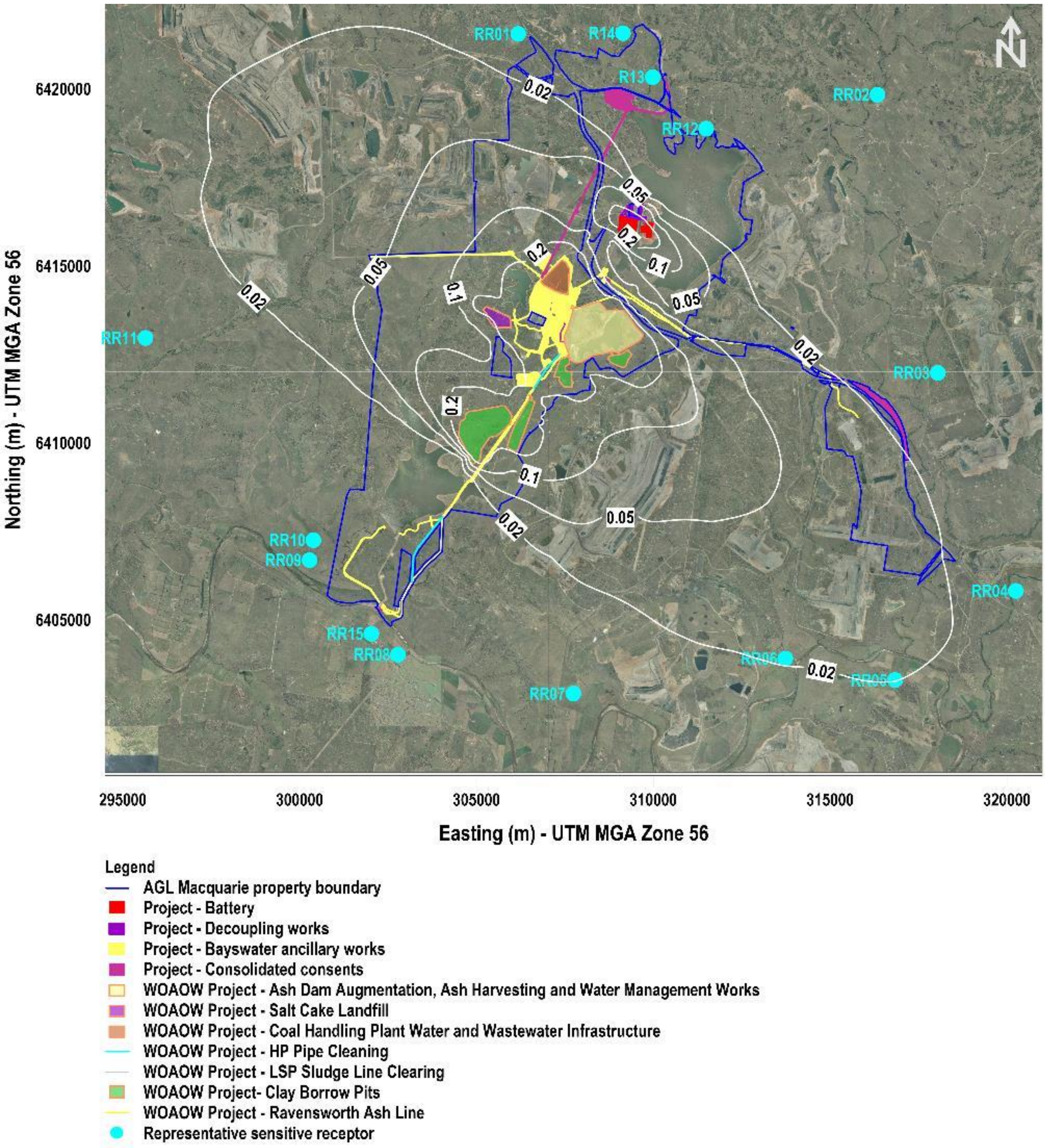


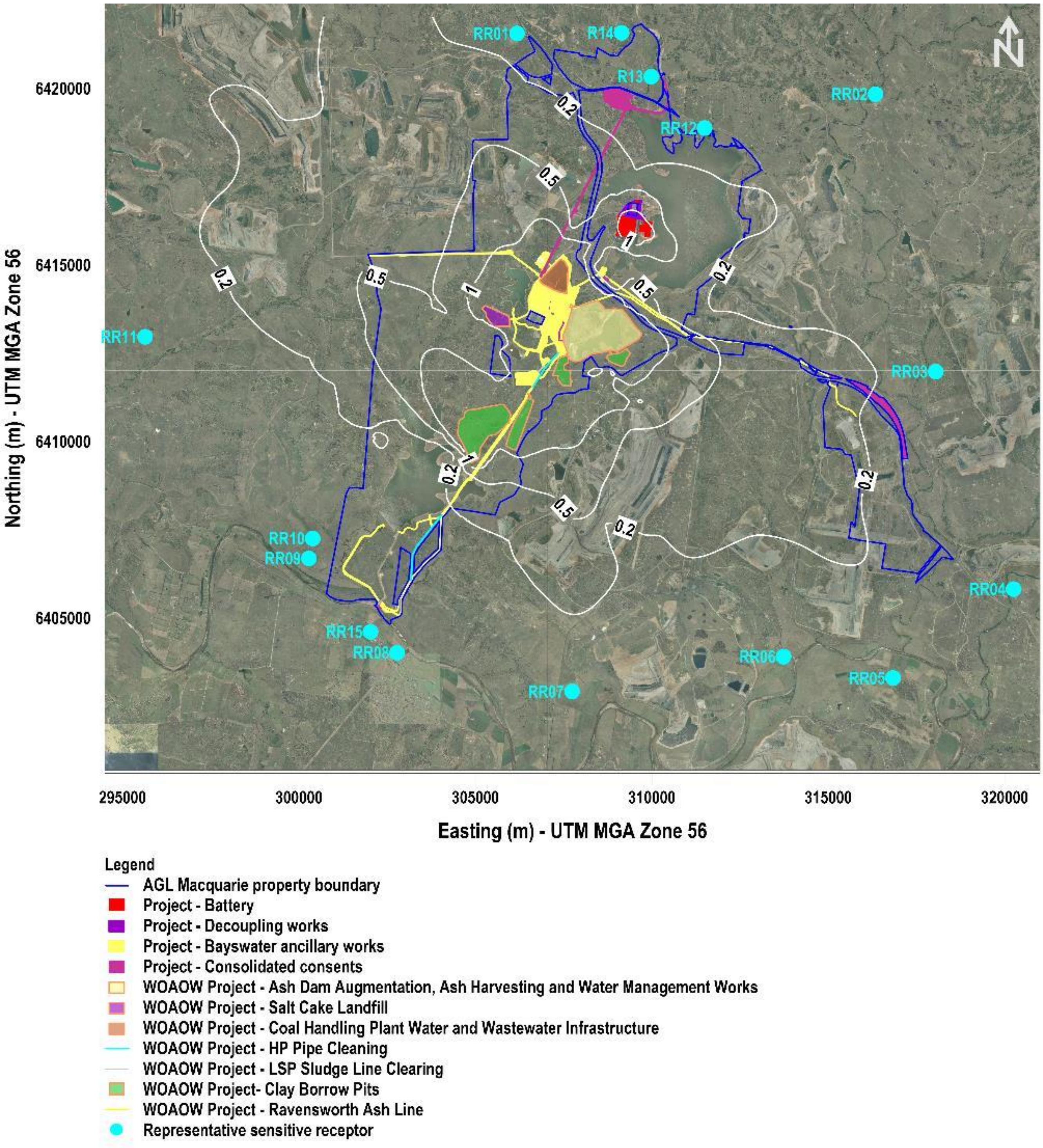
Figure C.1 Predicted annual PM_{10} ($\mu g/m^3$) contributions due to the Project and WOAOW



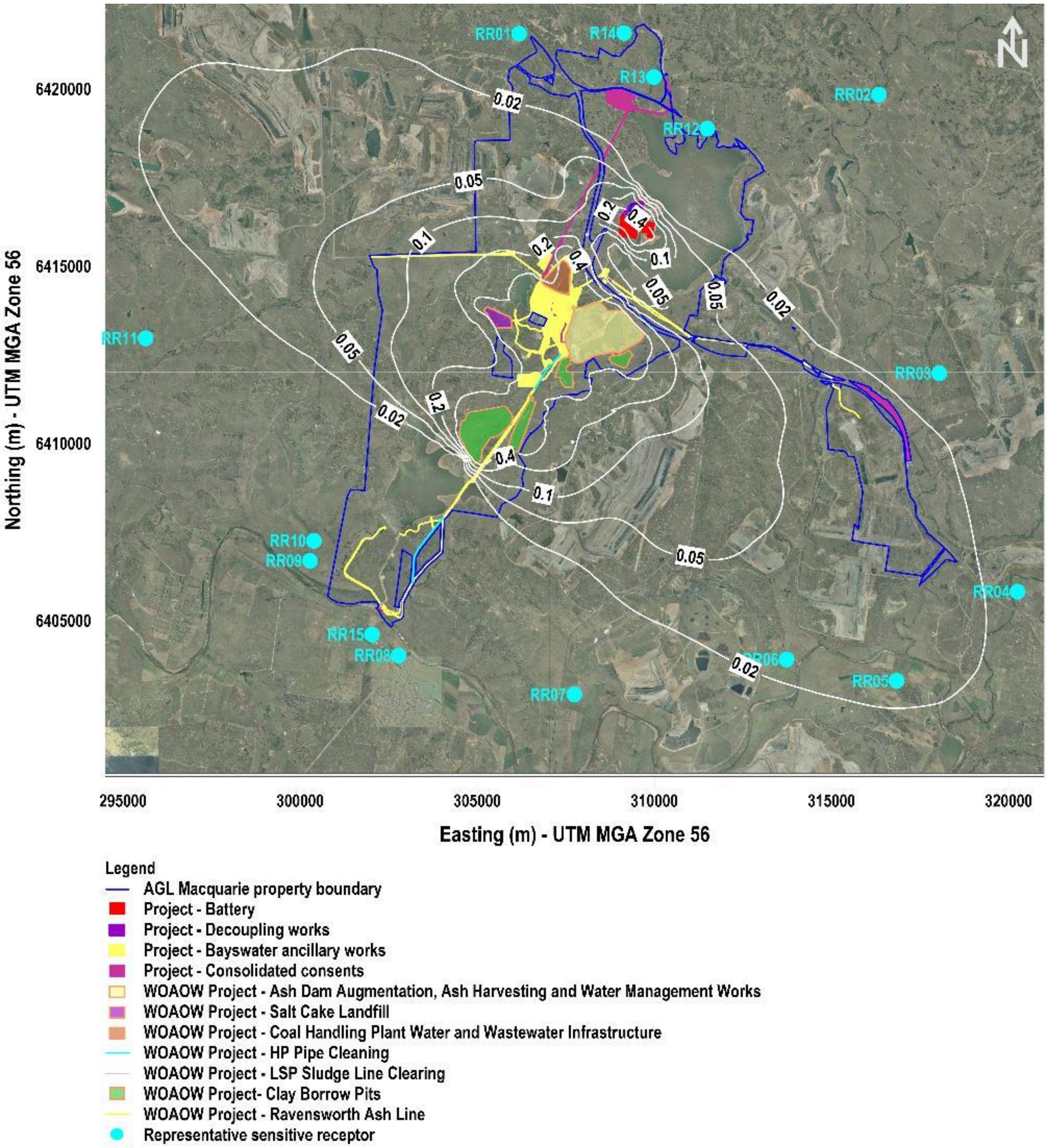
C.1 Predicted 100th percentile, daily PM_{10} ($\mu g/m^3$) contributions due to the Project and WOAOW



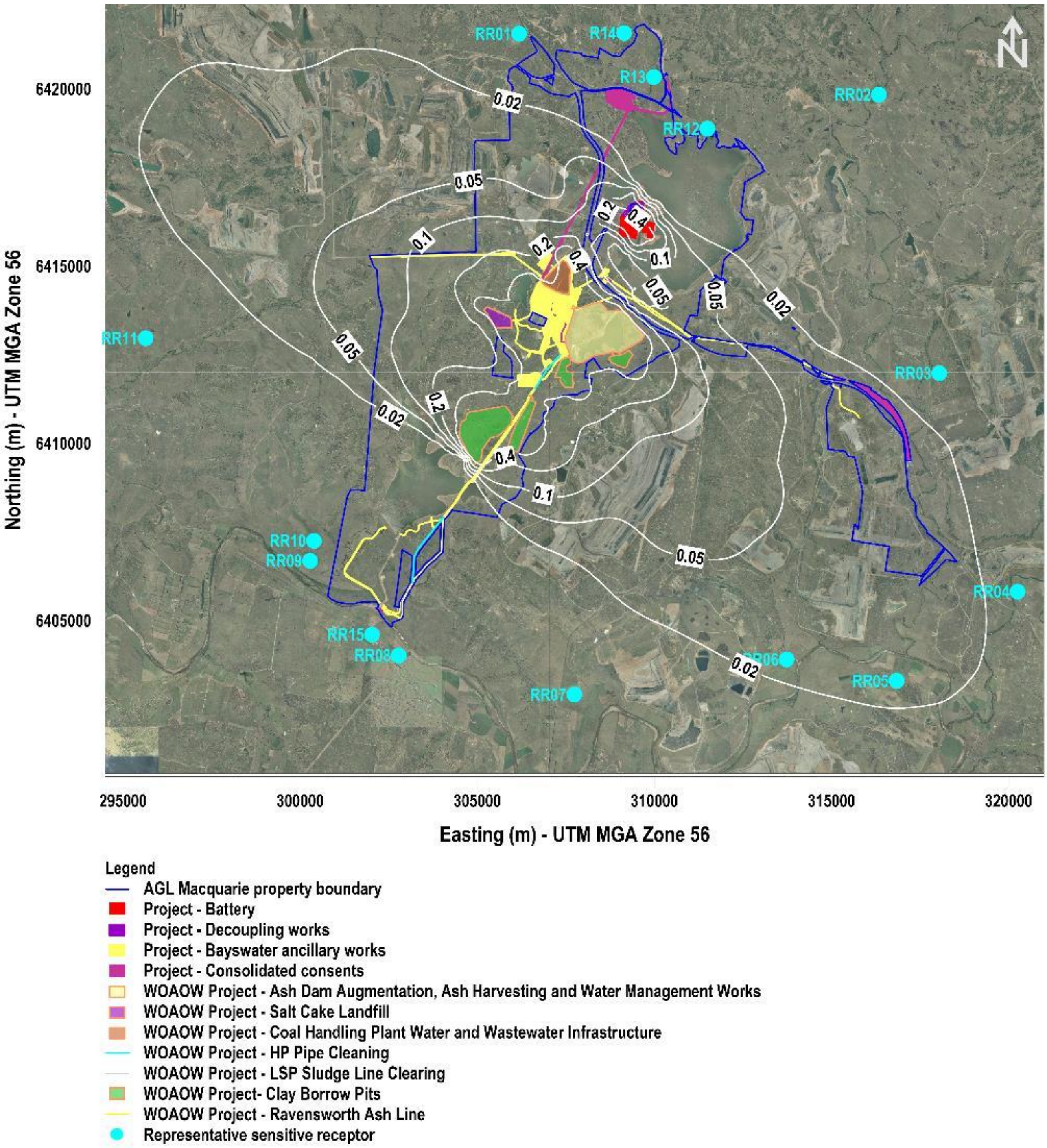
C.2 Predicted Annual $PM_{2.5}$ ($\mu g/m^3$) contributions due to the Project and WOAOW



C.3 Predicted 100th percentile, daily $PM_{2.5}$ ($\mu g/m^3$) contributions due to the Project and WOAOW



C.4 Predicted annual TSP (μg/m³) contributions due to the Project and WOAOW



C.5 Predicted annual deposited dust (g/m²/month) contributions due to the Project and WOAOW