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LIGHT WEIGHT AGGREGATE (LWA) PROJECT - BRICKWORKS, HORSLEY PARK, NSW

AIR QUALITY IMPACT ASSESSMENT

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PREPARED FOR
McKenzie Group
Level 6, 189 Kent Street
Sydney, NSW 2000
Tel: 02 8298 6800

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Airlabs Environmental Pty Ltd (Airlabs) have been commissioned by McKenzie Group Pty Ltd (McKenzie Group), on behalf of Brickworks NSW Pty Ltd (Brickworks) undertake an Air Quality Impact Assessment (AQIA) in relation to the proposed State Significant Development (SSD) Application pertaining to the Light Weight Aggregate (LWA) Project (the Project) which will be developed at Plant 2 of the existing Brickworks site at 780 Wallgrove Road, Horsley Park, NSW.

With respect to the Project, the proposed development seeks to utilise a stockpile area on the existing property at Plant 2 to construct a new rotary kiln, screening plant, remove existing stockpiles of material (to be used for manufacturing expanded clay aggregate) and ancillary site works. The development also proposes to use existing assets associated with Plant 2 including the primary crusher and extruder for LWA operations.

The Project is divided into two (2) stages – Stage 1 and Stage 2. Stage 1 of the Project comprises LWA production volumes of 300,000 tonnes per annum (tpa). An additional 300,000 tpa of LWA production is forecasted for Stage 2, which would potentially commence approximately five (5) years after commencement of Stage 1, therefore, the combined LWA production volumes for the Project comprising Stage 1 and Stage 2 operations would be 600,000 tpa. The rotary kiln for Stage 1 is designed to produce 300,000 tpa of LWA and as-such; a new rotary kiln in addition to the Stage 1 kiln would be commissioned during Stage 2 operations. Brickworks are also investigating the feasibility of using different types of fuels in the proposed rotary kilns and have identified three (3) specific fuel combinations which include:

- 100% Natural Gas;
- 90% Construction & Demolition (C&D) / Construction and Industrial (C&I) Timbers and 10% Natural Gas (based on information provided by Brickworks, it is understood that this is the preferred choice of fuel for both Stage 1 and Stage 2 operations); and
- 90% Refuse Derived Fuel (RDF) – typically comprising municipal and industrial waste and 10% Natural Gas

Regulatory requirements governing this Project include the following:

- Group 6 emission standards listed in the NSW-Environmental Protection Authority (NSW-EPA) Protection of the Environment Operations (POEO) Clean Air Regulation 2010;
- The NSW-EPA published NSW Energy from Waste Policy, as Brickworks are investigating the option of using specific beneficially derived fuels which include C&D/C&I Timbers and RDF, in conjunction with natural gas; and
- Ambient air quality limits in addition to meeting the Clean Air Regulation requirements and the Energy from Waste Policy requirements

To determine air quality impacts associated with existing operations and the proposed LWA operations, air dispersion modelling has been undertaken for all pollutants associated with existing brick manufacturing operations and activities pertaining to LWA operations.

The AQIA has been prepared in accordance with the NSW – Department of Environment and Conservation (DEC) - *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, NSW (Approved Methods). As per the Approved Methods, the NSW – Environment Protection Authority (NSW-EPA) has stipulated minimum requirements regarding information contained within an AQIA, which are outlined below. The relevant sections in this AQIA, which provide details on the EPA's minimum requirements, are mentioned alongside.

- Site Plan – **Section 2**
- Activity Description - **Section 2**

- Emissions Inventory – **Section 6**
- Meteorological Data –**Section 7.2**
- Background Air Quality Data – **Section 5**
- Dispersion Modelling – **Section 7, Section 8**
- Bibliography – **Section 11**

As the Project is being assessed as a SSD, Secretary Environmental Assessment Requirements (SEARs) have been issued for the preparation of an Environmental Impact Statement (EIS). The SEARs issued for air quality and the relevant sections of this report which address the SEARs are mentioned alongside:

- A comprehensive air quality assessment of all potential point source and fugitive air emissions (including odour) and dust impacts from the development, including details of air quality impacts on private properties in accordance with relevant Environmental Protection Authority guidelines – **Section 6, Section 7**, and **Section 8**
- Details of mitigation, management and monitoring measures for preventing and/or minimising both point and fugitive emissions – **Section 6** and **Appendix A**
- An assessment of the effectiveness of the proposed air quality mitigation measures - **Section 6, Section 7**, **Section 8** and **Appendix A**

Flue gas emissions and fugitive dust emissions associated with existing brick manufacturing operations and proposed Stage 1 and Stage 2 LWA operations at Plant 2 were identified to be the key sources of air pollution.

In order to minimise flue gas emissions generated from LWA operations, Brickworks are proposing a set of air pollution control measures for both Stage 1 and Stage 2 operations incorporating Best Available Technologies (BAT), which are in-line with best practice measures for LWA manufacturing facilities. Proposed control measures for both Stage 1 and Stage 2 operations include baghouse for controlling particulate emissions and metals, wet scrubber for reducing acid gas concentrations and Regenerative Thermal Oxidiser (RTO) for effectively minimising VOC and CO emissions. In order to determine the impacts associated with each fuel source type, pollutant emission rates were estimated by using emission factors, referenced from Emission Estimation Technique (EET) manuals.

Flue gas emissions were inventoried for Stage 1 and Stage 2 operations for the three (3) fuel combustion options and subsequently stack concentrations were calculated based on the inventoried emission rates and volumetric flow conditions for the proposed Product Combustion Stack and Cooling Air Stack. Estimated stack concentrations were then compared against Group 6 emission standards to assess compliance with the Clean Air Regulations and the Energy from Waste Policy requirements and were found to comply with the relevant emission standards for all the three (3) fuel combustion options.

For assessing fugitive dust impacts, Total Suspended Particulates (TSP) and Particulate Matter with less than 10 microns equivalent diameter (PM_{10}) emissions were inventoried for existing and Stage 1 and Stage 2 operations at Plant 2 using activity specific emission factors, activity details and control measures for dust mitigation. Background air quality concentrations were referenced from the NSW-OEH Prospect monitoring station, which is the closest to the Project Site.

Flue gas emissions and TSP and PM_{10} emissions from Plant 1 which is adjacent to the Project Site have also been quantified and included in the assessment.

Dust impacts generated from construction activities are not considered to be significant when compared to operational activities, however, sources potentially generating dust emissions during construction activities and measures that would be implemented by Brickworks to mitigate dust emissions have been outlined in **Section 6.5**.

The CALMET/CALPUFF model system was utilised to predict incremental (Project related) and cumulative ground-level concentrations at identified sensitive receptors from existing and proposed operations.

From the modelled results, it is observed that the predicted incremental and cumulative concentrations for all pollutants comply with their respective assessment criteria for all the modelled scenarios at all identified sensitive receptors. For the pollutants where cumulative concentrations have been determined, it is observed that the Project's contributions to the total concentrations are relatively minimal when compared with the corresponding background concentrations. Predicted maximum 24-hour average HF concentrations marginally exceed the assessment criteria (for existing operations and Stage 1 and Stage 2 LWA operations) at areas beyond the Plant 2 site boundary, but, not at any of the identified sensitive receptors. As per information provided to Airlabs, areas where the predicted HF concentrations exceed the limit are not considered to be areas sensitive to vegetation or classified as specialised land areas (e.g. orchids, vineyards etc.) and considering that the 24-hour average maximum HF concentrations comply with the criteria for 99% of the entire year for existing operations and Stage 1 and Stage 2 LWA operations (i.e. no predicted exceedances beyond the Plant 2 site boundary for 99% of the year), it is unlikely that there would be any adverse impacts on the surrounding environment associated with HF emissions.

Based on implementation of BAT air pollution control measures and achieving compliance with Group 6 emission standards and ambient air quality limits through dispersion modelling, it is observed that there would not be any adverse air quality impacts associated with the LWA Project.

1. INTRODUCTION

McKenzie Group Pty Ltd (McKenzie Group), on behalf of Brickworks NSW Pty Ltd (Brickworks) – have commissioned Airlabs Environmental Pty Ltd (Airlabs) to undertake an Air Quality Impact Assessment (AQIA) in relation to the proposed State Significant Development (SSD) Application pertaining to the Light Weight Aggregate (LWA) Project (the Project) which will be developed at the existing Plant 2 Brickworks site at 780 Wallgrove Road, Horsley Park, NSW (the Project Site)

In order to determine air quality impacts from existing operations and the proposed LWA operations, air dispersion modelling has been undertaken for a suite of pollutants typically generated from existing brick manufacturing operations and LWA operations.

The AQIA has been prepared in accordance with the NSW – Department of Environment and Conservation (DEC) - *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, NSW (DEC, 2005) (hereafter The Approved Methods). As per Section 9 of the Approved Methods, the NSW – Environment Protection Authority (NSW-EPA) has stipulated minimum requirements regarding information contained within an AQIA, which are outlined below. The relevant sections in this AQIA, which provide details on the EPA's minimum requirements, are mentioned alongside.

- Site Plan – **Section 2**
- Activity Description - **Section 2**
- Emissions Inventory – **Section 6**
- Meteorological Data – **Section 7.2**
- Background Air Quality Data – **Section 5.2**
- Dispersion Modelling – **Section 7, Section 8**
- Bibliography – **Section 11**

As the Project is being assessed as a SSD, Secretary Environmental Assessment Requirements (SEARs) have been issued for the preparation of an Environmental Impact Statement (EIS). The SEARs issued for air quality and the relevant sections of this report which address the SEARs are outlined in **Table 1**.

Table 1: Summary of Secretary Environmental Assessment Requirements (SEARs)

SEARs Issued	Sections of the AQIA addressing the SEARs
A comprehensive air quality assessment of all potential point source and fugitive air emissions (including odour) and dust impacts from the development, including details of air quality impacts on private properties in accordance with relevant Environmental Protection Authority guidelines	**6, 7 and 8**
Details of mitigation, management and monitoring measures for preventing and/or minimising both point and fugitive emissions; and	**6, 8, 9 and Appendix A**
An assessment of the effectiveness of the proposed air quality mitigation measures	**6, 7, 8, 9 and Appendix A**

2. PROJECT OVERVIEW

2.1 Project Locality

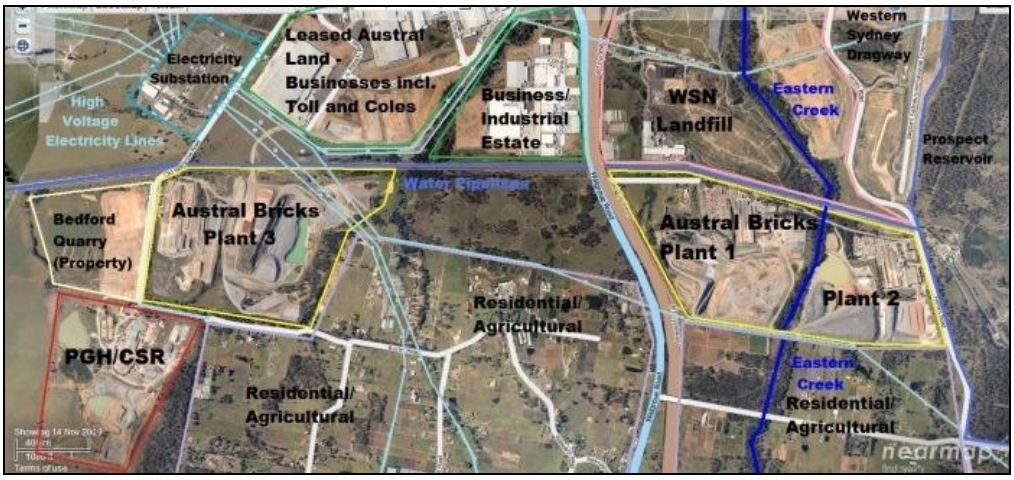
The Project Site is located at 780 Wallgrove Road, Horsley Park, NSW (Lot 7 in Deposited Plan 1059698) (**Figure 1**). The present condition of the Project Site is such that it contains existing stockpiles of clay and two facilities (Plant 1 and Plant 2) that are used for the purpose of brick manufacturing. The Project Site is currently used for the manufacture of bricks, tiles and pipe works.

Existing development at Plant 1 and Plant 2 are managed under the NSW – Environmental Protection Licence (NSW-EPL) 546, which also manages existing operations at Plant 3, which is located on Old Wallgrove Road, Horsley Park, NSW. Based on information provided by Brickworks and as per the proposal submitted by Austral Bricks (a 100% owned subsidiary of Brickworks) to the NSW – Department of Urban and Transport Planning (DUTP, 2003), it is understood that clay and shale extraction activities / operations are undertaken near Plant 3 and the extracted raw material is then supplied to Plant 1 and Plant 2. A spatial overview of Plant 1, Plant 2 and Plant 3 is shown in **Figure 2**.

Figure 1: Project Site Layout

Source: McKenzie Group, 2014

Figure 2: Spatial Overview of Brickworks – Plant 1, Plant 2 and Plant 3



Source: Pollution Incident Response Management Plant, (Austral Bricks, 2013)

2.2 Project Description

As per information provided by Brickworks, there exists a potential opportunity in Sydney to create a market for Lightweight Aggregates (LWA) with a strong and sustainable competitive advantage. Benefits of LWA include – lower dead loads when used in lightweight concrete, good fire resistance, superior acoustic properties and abrasion resistance.

The generic process for producing expanded shale LWA incorporates mining the raw material (clay/shale), crushing to appropriate sizes and storing in preparation for the process. Once prepared, the clay is extruded and then fed into a rotary kiln. After an initial drying phase, the clay enters a rapid heating zone (approximately 1250^{0}C at the point of combustion), where gases are evolved within the clay causing expansion and formation of voids. The cellular structure within the particles is developed by heating certain raw materials to incipient fusion (i.e. just below melting point). This structure is retained upon cooling. Final crushing and screening of sizes is generally required prior to stockpiling and delivery to customer.

With respect to the Project, the proposed development seeks to utilise a stockpile area on the existing property at Plant 2 to construct a new rotary kiln, screening plant, remove the existing stockpiles of material (to be used for manufacturing concrete aggregate) and ancillary site works. The development also proposes to use existing assets associated with Plant 2 including the primary crusher and extruder.

Key aspects of the Project comprise:

- **Clay Preparation System**: Existing facility at Plant 2 will be utilised for the Clay Preparation System, which will typically include existing clay / shale stockpiles, box feeders for clay and additives, rollers and extruders;
- **Rotary Kiln**: A rotary kiln will be constructed as a part of the Project. Specific details relating to the kiln and proposed air quality control systems to minimise flue gas emissions are provided in the later sections of this report;
- **Multi-fuel burner**: A multi-fuel burner would be installed, with the ability to potentially feed the following standard and beneficially derived fuel source combinations:
    - **Option 1**: 100% Natural Gas;
    - **Option 2**: 90% Construction & Demolition (C&D) / Construction and Industrial (C&I) Timbers with less than 1% of halogenated organic substances expressed as Chlorine and 10% Natural Gas, (refer **Section 4.2** for further details). Based on information provided by Brickworks, it is understood that Option 2 is the preferred choice of fuel for both Stage 1 and Stage 2 operations;
    - **Option 3**: 90% Refuse Derived Fuel (RDF) –municipal and industrial waste, typically comprising non-putrescible contents (e.g. plastics, timber, paper and fabrics) with less than 1% of halogenated organic substances expressed as Chlorine and 10% Natural Gas (refer **Section 4.2** for further details);
- **Solid Fuel Storage and Preparation Area**;
- **Crushing and Screening**: Crushing and screening infrastructure would be provided to produce size-varying graded stockpiles (e.g. 10mm, 15mm product). It is to be noted that the crushing activities associated with the Project will be relatively limited as the extrusion process itself will be providing sized products;
- **Storage and Stockpiling**: Fired material from the rotary kiln is stockpiled and conveyed to the crushing and screening system through underground reclamation. Post crushing and screening operations, graded products are stockpiled according to their size specifications;

- **Roadways and Truck Loading Facilities**: Material transport will be through the main entrance with separate in and out lanes and weighbridge. Internal roadways will allow for two (2) lanes of traffic and will contain truck loading areas next to the graded product stockpiles. Loading will be undertaken by a front-end loader;
- **Staff Offices and Amenities**: Office provision for ten (10) people and amenities for twenty (20);
- **Mobile Plants / Equipment's**: Apart from the fixed plants associated with the Project (e.g. kiln, crusher, extruder etc.) mobile plants and equipment's that would have relevance with air quality impacts include a total of five (5) front end loaders (FELs) and haul-trucks for delivering material on and off the Project site.

Proposed layout plan for the Project showing existing and proposed operations is presented in **Figure 3.**

2.2.1 Project Stages and Production Volumes

The Project is divided into two (2) stages – Stage 1 and Stage 2. Stage 1 of the Project comprises LWA production volumes of 300,000 tonnes per annum (tpa). An additional 300,000 tpa of LWA production is forecasted for Stage 2, which would potentially commence approximately five (5) years after commencement of Stage 1, therefore, the combined LWA production volumes for the Project comprising Stage 1 and Stage 2 operations would be 600,000 tpa. The rotary kiln for Stage 1 is designed to produce 300,000 tpa of LWA and as-such; a new rotary kiln in addition to the Stage 1 kiln would be commissioned during Stage 2 operations. Air quality impacts associated with both Stage 1 and Stage 2 operations (which include Stage 1 operations) have been quantitatively determined as a part of this assessment. It is to be noted that all Stage 1 and Stage 2 operational activities will be undertaken at Plant 2.

2.3 Air Quality Complaints

Airlabs, at the time of preparing the AQIA are unaware of any official records of air-quality complaints (including odour) associated with existing operations.

3. PROJECT SETTING

3.1 Existing Land Use and Topography

The Project Site is located at 780 Wallgrove Road, Horsley Park, within the Fairfield Local Government Area (LGA). The Project Site is predominantly clear of vegetation, as the land has been historically used for quarrying and brick manufacturing operations. Adjoining the Project Site is the M7 Motorway which links with the M2, M4 and M5 Motorways.

Development surrounding the Project Site predominantly comprises industrial facilities used for the purpose of warehousing and distribution and waste management / recovery facilities.

Industrial warehousing and distribution facilities are located to the north-west of the Project Site. The Eastern Creek Urban Resource – Reduction, Recovery and Recycling (UR-3R) Facility managed by Global Renewals is located due north of the Project Site and the Eastern Creek Resource Recovery Park managed by SITA Australia is located approximately 800m north of the Project Site. The Prospect Reservoir and its surrounding buffer area are located to the east, north-east of the Project Site.

The topography surrounding the Project Site varies with terrain elevations gradually increasing towards the west, south-west and south-east of the Project Site. Landforms to the north and south of the Project Site are relatively flat. Topographical features surrounding Project Site are illustrated in **Figure 4**.

Figure 3: Proposed Layout of the Project – Plant 2 – Existing and Proposed Operations

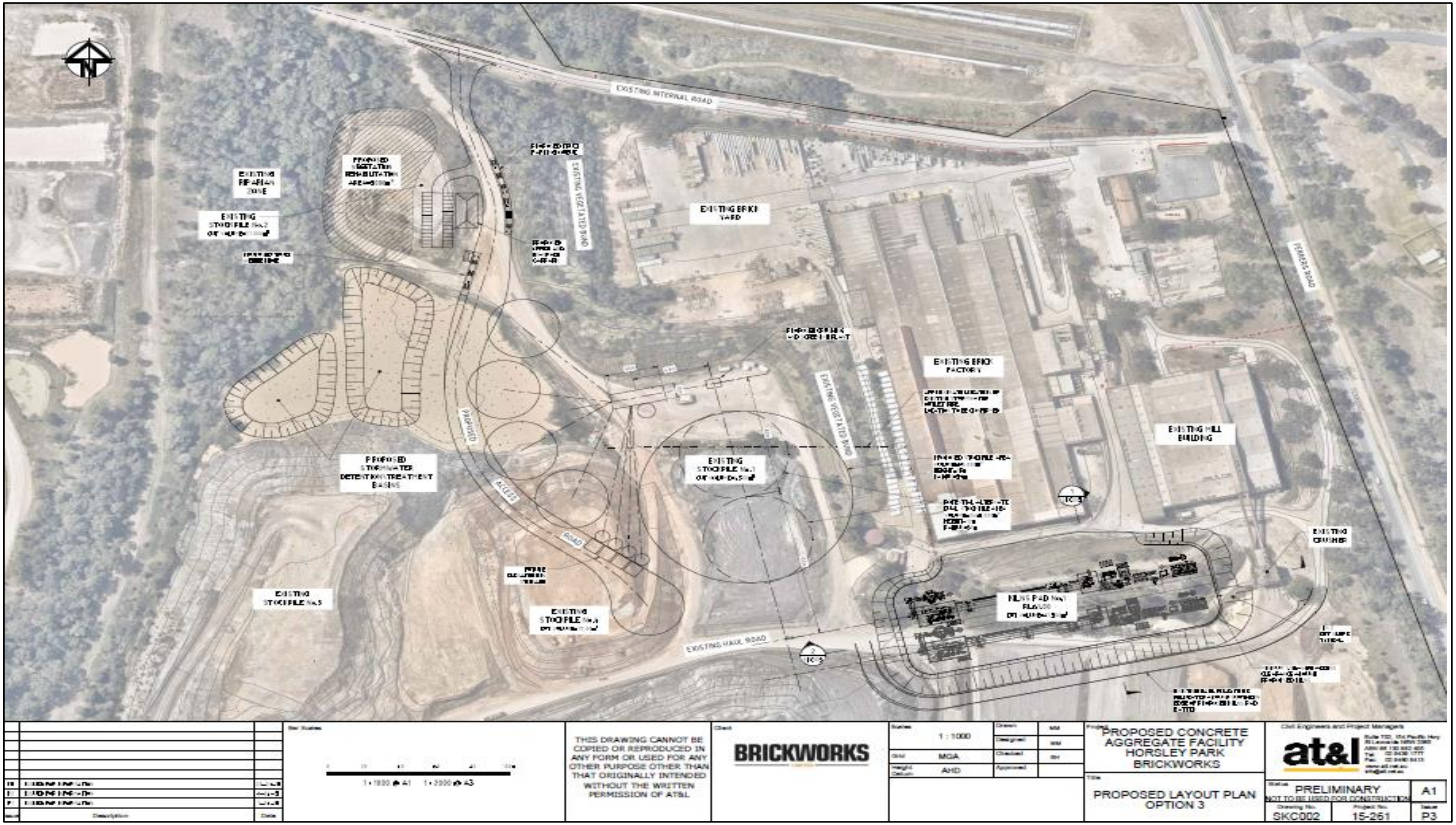
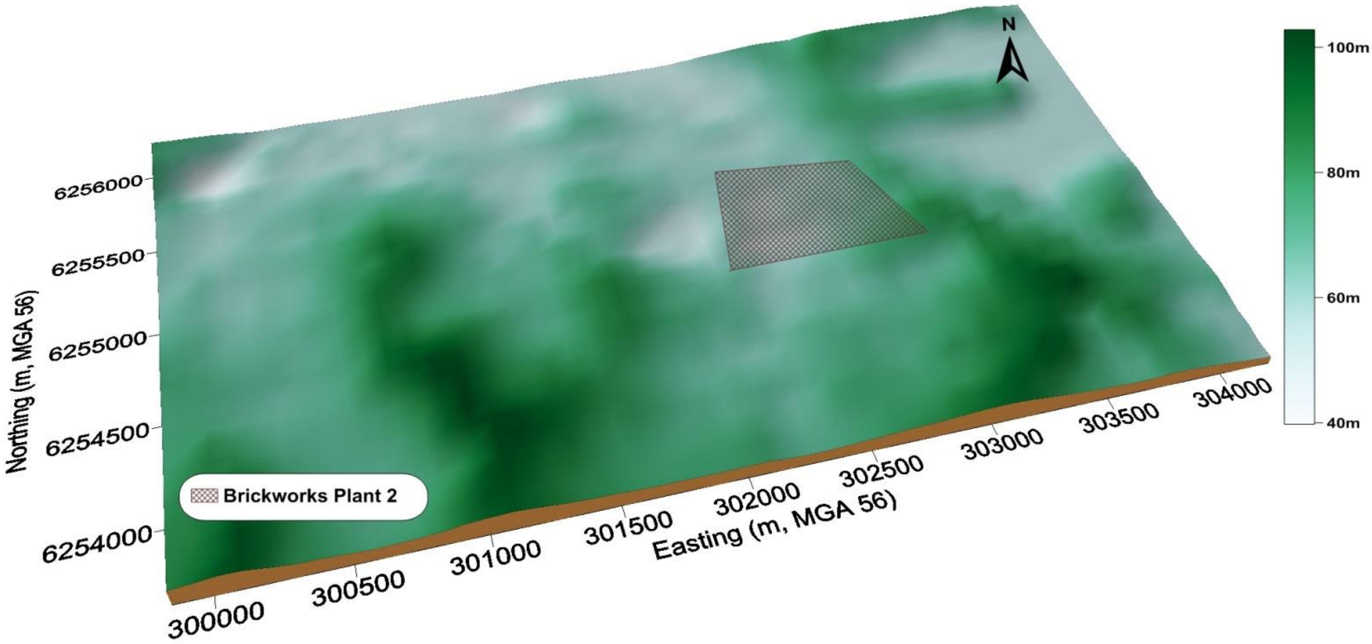


Figure 4: Topographical Features Surrounding Plant 2



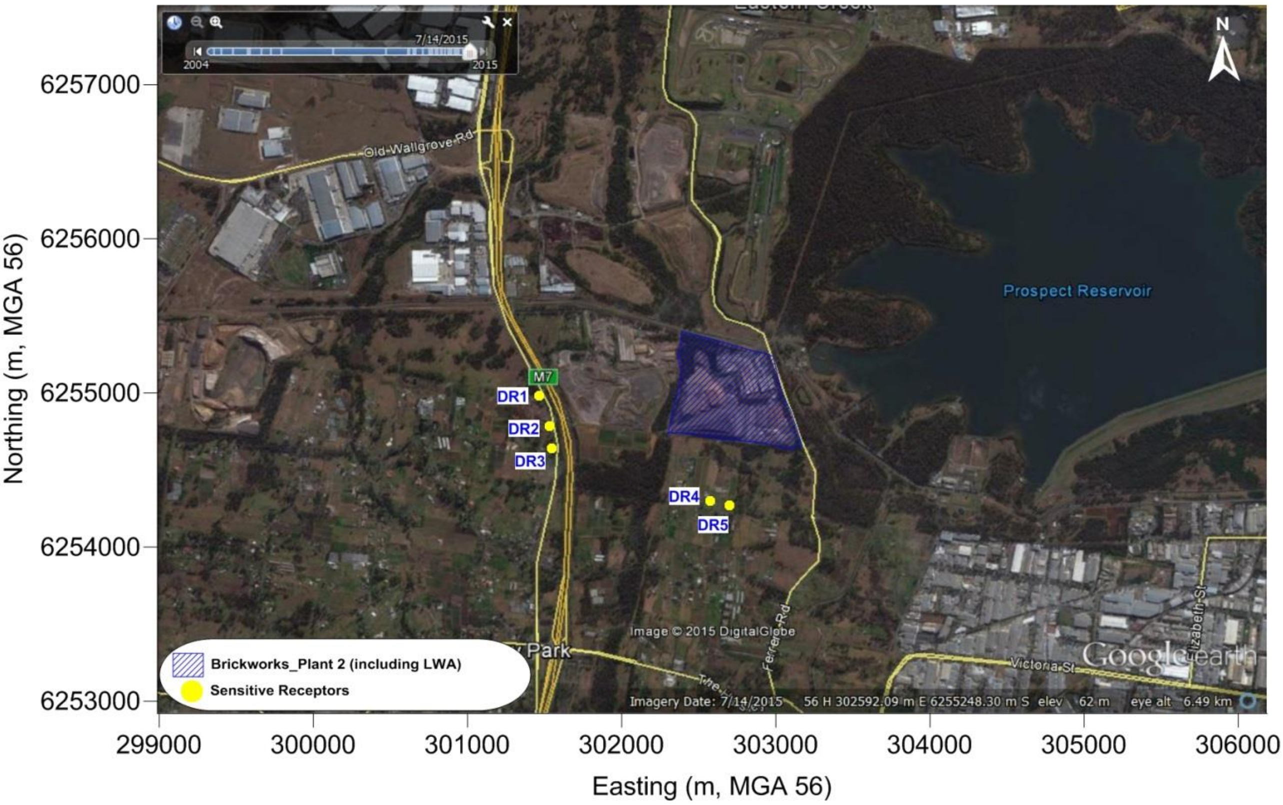
3.2 Nearest Residential Receptors

Based on aerial imagery, it is observed that existing residential development surrounding the Project Site is characterised as rural – residential. Individual residential dwellings surrounding the Project Site have been identified and those residential dwellings closest to the Project Site have been considered as sensitive receptors for the purpose of this AQIA. The identified receptors are considered to be representative of the receiving environment. Details of the identified receptors are tabulated in **Table 2** and illustrated in **Figure 5**

Table 2: Details of Selected Sensitive Residential Receptors

Discrete Receptor ID	Address	Easting (m), MGA 56	Northing (m), MGA 56	Approximate Distance (km) to the Nearest Brickworks Boundary and Orientation
DR1	785-811 Wallgrove Road, Horsley Park	301464	6254982	1.4 km/W
DR2	763-783 Wallgrove Road, Horsley Park	301531	6254784	1.2km/WSW
DR3	749-761 Wallgrove Road Horsley Park	301547	6254641	1.2km/SW
DR4	168-174 Chandos Road, Horsley Park	302576	6254299	0.5km/S
DR5	150-154 Chandos Road, Horsley Park	302700	6254271	0.5km/S

Figure 5: Aerial Imagery of Sensitive Receptors with respect to Project Site



4. REGULATORY REQUIREMENTS

Air pollutants discharged to air from clay/shale, brick manufacturing activities typically comprise:

- Particulate matter emissions released as product of combustion from process manufacturing and fugitive dust sources;
- Air pollutants released as products of combustion from process manufacturing, which include: oxides of sulfur dioxide(SO_2), oxides of nitrogen (NO_X), carbon monoxide (CO), acid gases such as hydrogen chloride (HCl), hydrogen fluoride (HF), polycyclic aromatic hydrocarbons (PAHs), polychlorinated dioxins and furans (PCDD/F), volatile organic compounds (VOC's) and heavy metals.

As mentioned in **Section 2.3**, at the time of preparation of this AQIA it is understood that no official odour complaints have been received for existing operations at Plant 1 and Plant 2. Among the fuel sources that are being considered for the LWA Project, RDF has a potential to generate odorous emissions. However, as per information provided by Brickworks it is understood that the RDF fuel delivered for the LWA Project would be non-putrescible in nature primarily comprising plastics, timber, paper and fabrics. When used as a fuel in the LWA process, it is unlikely that any significant odours will be released from the kiln stack because of the high temperatures in the kiln chamber and significant gas residence times (approximately 5 to 6 seconds) (refer **Section 4.2** for further details). Additionally, a range of air pollution control measures such as acid-gas scrubbers and regenerative thermal oxidisers (RTO) are being proposed for the kiln stack (**refer Section 6.1.2**) and as-such, taking into consideration the non-putrescible nature of the RDF, combustion processes and the proposed air pollution control measures, it is unlikely that there would be considerable odour impacts from the LWA process and as-such have been excluded from this assessment.

Regulatory requirements applicable to this study are discussed in the following sections:

4.1 Emission Limits – POEO Clean Air Regulation 2010

The NSW-Environmental Protection Authority (NSW-EPA) Protection of the Environment Operations (POEO) Clean Air Regulation 2010 (the Clean Air Regulation) prescribes in-stack emission limits / concentration standards for industrial sources in NSW. As per the Clean Air Regulation, stack emissions corresponding to LWA operations would need to comply with Group 6 standards of concentration. As there are no specific concentration standards listed for LWA manufacturing in *Schedule 3 – Standards of concentration for scheduled premises: general activities and plants*, reference was made to ceramic works which is considered to be the next closest to LWA manufacturing among all the activities and plants listed in Schedule 3. Concentration standards for the proposed LWA operations are outlined in **Table 3**.

Table 3: POEO Clean Air Regulation Standards of Concentration – Group 6

Pollutant	Standard of Concentration
Solid particles (total)	50 mg/m^3
Nitrogen dioxide (NO_2)	350 mg/m^3
Fluorine (F_2) or any compound containing fluorine as total fluoride (Hydrogen Fluoride - HF) equivalent	50 mg/m^3
Hydrogen chloride (HCl)	100 mg/m^3
Type 1 and Type 2 substances (in aggregate)	1 mg/m^3
Cadmium or Mercury (individually)	0.2 mg/m^3
Dioxins or furans	0.1 ng/m^3
Volatile organic compounds (VOC) as n-propane equivalent	40 mg/m^3

Reference conditions defined as dry, 273.15 K, 101.3kPa and 7% O_2, for all air impurities except for dioxins / furans where the required O_2 concentration is 11%

4.2 NSW Energy from Waste Policy Statement

As mentioned in **Section 2.2**, Brickworks are investigating the option of using specific beneficially derived fuel sources which include C&D/C&I Timbers and RDF, in conjunction with natural gas for LWA manufacturing. NSW-EPA published the *NSW Energy from Waste Policy* ('the Energy from Waste Policy') in March, 2014, which sets out the policy framework and overarching criteria that apply to facilities in NSW proposing to thermally treat waste or waste-derived materials for the recovery of energy.

The Energy from Waste Policy states that meeting best practice measures and implementing proven technologies will ensure that toxic air emissions and particulate matter emissions are below levels that may pose a risk of harm to the community or environment. Specific technical criteria have been formulated for facilities using waste as a source of fuel which is outlined below:

- Gas resulting from the process should be raised, after the last injection of combustion air, in a controlled and homogenous fashion and even under the most unfavourable conditions to a minimum temperature of 850^0C for at least 2 seconds;
- If a waste has a content of more than 1% of halogenated organic substances, expressed as chlorine, the temperature should be raised to 1100^0C for at least 2 seconds;

- Process and air emissions from the facility must satisfy at a minimum the requirements of the Group 6 emission standards (refer **Table 3**);
- Continuous measurement of NO_X, CO, particles (total), total organic compounds, HCl, HF and SO_2;
- Continuous measurement of temperature in the combustion chamber;
- Continuous measurement of oxygen, pressure and temperature in stack and water vapour content;
- Proof of performance (POP) trials must be conducted to demonstrate compliance with the emission standards. As a minimum, at least two measurements per year of heavy metals, polycyclic aromatic hydrocarbons and chlorinated dioxins and furans (quarterly measurement for the first year);
- Total organic carbon (TOC) or loss on ignition (LOI) content of the slag and bottom ashes must not be greater than 3% or 5% respectively, of the dry weight of the material;
- Waste feed interlocks are required to prevent waste from being fed to the facility when the required temperature has not been reached either at start-up or during operation; and
- Air quality impact assessment undertaken in accordance with the Approved Methods for Modelling.

As per information provided by Brickworks, both &D/C&I Timbers and RDF will have less than 1% of halogenated organic substances. Temperatures in the centre of the combustion chamber will have a minimum temperature of 850^{0}C and based on the design of the rotary kiln system, it is expected that the residence time of the gases in the combustion chamber will be approximately 5-6 seconds, which well exceeds the Energy from Waste residence time requirement of 2 seconds.

For compliance with the Group 6 emission standards (refer **Table 3**), air pollution control measures are being proposed for both Stage 1 and Stage 2 operations. The proposed measures have been based on Best Available Technologies (BAT) and best practice measures implemented by existing LWA manufacturing facilities. Pollutant specific control measures will be designed to ensure that compliance would be achieved with the Group 6 emission standards, thereby meeting the Clean Air Regulation requirements and the Energy from Waste Policy requirements. Specific details of proposed air pollution control measures and corresponding pollutant emission rates and subsequent compliance with Group 6 emission standards are detailed in **Section 6.1**.

4.3 Ambient Air Quality Limits

In addition to meeting the Clean Air Regulation requirements and the Energy from Waste Policy requirements, the proposed LWA operations would also need to satisfy the ambient air quality limits listed within the Approved Methods. Ambient air quality limits for the pollutants that will be assessed and their corresponding time-averaging periods are listed below:

4.3.1 Criteria for Airborne Particulate Matter

Airborne particulate matter, typically consist of particles of varying size fractions. The Approved Methods specifies air quality limits for Total Suspended Particulates (TSP) and Particulate Matter with less than 10 microns equivalent diameter (PM_{10}) for assessing impacts from dust-generating activities and operations. Although, TSP is defined as the total mass of all particles suspended in air, an effective upper limit of 30 microns aerodynamic diameter is assigned. Within the TSP matter, lie two sub-categories; particulate matter with an equivalent diameter of 10 microns (PM_{10}) and particulate matter with an equivalent diameter of 2.5 microns ($PM_{2.5}$). As particulates released from combustion process would be typically within the PM_{10} and smaller size ranges, focus is on assessing PM_{10} impacts and subsequently air quality limits associated with PM_{10} have been considered for this assessment. There are no assessment criteria for $PM_{2.5}$ in NSW. As there would be fugitive dust emissions released during operational activities, TSP emissions have also been quantified and subsequently modelled to predict impacts. . Air quality limits applicable to particulate matter referenced from the Approved Methods are summarised in **Table 4**.

Table 4: Air Quality Limits Applicable to Particulate Matter

Pollutant	Averaging Period	Concentration ($\mu g/m^3$)
TSP	Annual	90
PM_{10}	24-hour	50
	Annual	30

4.3.2 Criteria for Deposited Dust Levels

The NSW-DEC has prescribed maximum permissible dust deposition rates to regulate deposited dust levels. **Table 5** presents the limits for dust deposition, showing the allowable increase in deposited dust levels above ambient (background) levels which would be acceptable so that dust nuisance could be avoided.

Table 5: Air Quality Limits Applicable to Deposited Dust Levels

Averaging Period	Maximum Increase in Deposited Dust Level	Maximum Total Deposited Dust Level
Annual	2 g/m^2/month	4 g/m^2/month

4.3.3 Criteria for Toxic Air Pollutants

As mentioned earlier, a suite of individual toxic air pollutants in addition to particulate matter would be released as products of combustion from the various fuel combustion options. The pollutants that would be released and their applicable limits are summarised in **Table 6**.

Table 6: Air Quality Limits Applicable to Other Toxic Air Pollutants

Parameter	Assessment Criteria	Averaging Period
Sulfur dioxide (SO_2)	712 µg/m^3	10-minute
	570 µg/m^3	1-hour
	228 µg/m^3	24-hour
	60 µg/m^3	Annual
Nitrogen dioxide (NO_2)	246 µg/m^3	1-hour
	62 µg/m^3	Annual
Carbon monoxide (CO)	100 mg/m^3	15-minute
	30 mg/m^3	1-hour
	30 mg/m^3	1-hour
Hydrogen fluoride (HF)	2.9 µg/m^3 (a)	24-hour
	1.7 µg/m^3 (a)	7 days
	0.84 µg/m^3 (a)	30 days
	0.5 µg/m^3 (a)	90 days
Hydrogen chloride (HCl)	0.14 mg/m^3	1-hour
Acrylonitrile	0.008 mg/m^3	1-hour
Acetone	22 mg/m^3	1-hour
Benzene	0.029 mg/m^3	1-hour
Carbon disulphide	0.07 mg/m^3	1-hour
Chloroethane	48 mg/m^3	1-hour
Chloroform (trichloromethane)	0.9 mg/m^3	1-hour
Chloromethane	1.9 mg/m^3	1-hour
Ethylbenzene	8.0 mg/m^3	1-hour
Methylene Chloride (dichloromethane)	3.19 mg/m^3	1-hour
Phenol	0.02 mg/m^3	1-hour
Styrene	0.12 mg/m^3	1-hour
Tetrachloroethylene	3.5 mg/m^3	1-hour
Toluene	0.36 mg/m^3	1-hour
Xylene	0.19 mg/m^3	1-hour
1,1,1- Trichloroethane (methyl chloroform)	12.5 mg/m^3	1-hour
Antimony	0.009 mg/m^3	1-hour
Arsenic	0.00009 mg/m^3	1-hour
Beryllium	0.000004 mg/m^3	1-hour
Cadmium	0.000018 mg/m^3	1-hour
Chromium (III)	0.009 mg/m^3	1-hour
Chromium (VI)	0.00009 mg/m^3	1-hour
Copper dust	0.018 mg/m^3	1-hour
Lead	0.5 µg/m^3	Annual
Manganese	0.018 mg/m^3	1-hour
Mercury (inorganic)	0.0018 mg/m^3	1-hour
Nickel	0.00018 mg/m^3	1-hour

Parameter	Assessment Criteria	Averaging Period
Polycyclic Aromatic Hydrocarbons (PAHs) – as benzo-a-pyrene	0.0004 mg/m^3	1-hour
Polychlorinated Dioxins and Furans (PCDD/F) – TEQ	2.0E-09 mg/m^3 (b)	1-hour

(a) Criteria applicable for general land-use, which includes all areas other than specialised land use

(b) Toxic Equivalent (TEQ) as defined in Clause 29 of the Regulation

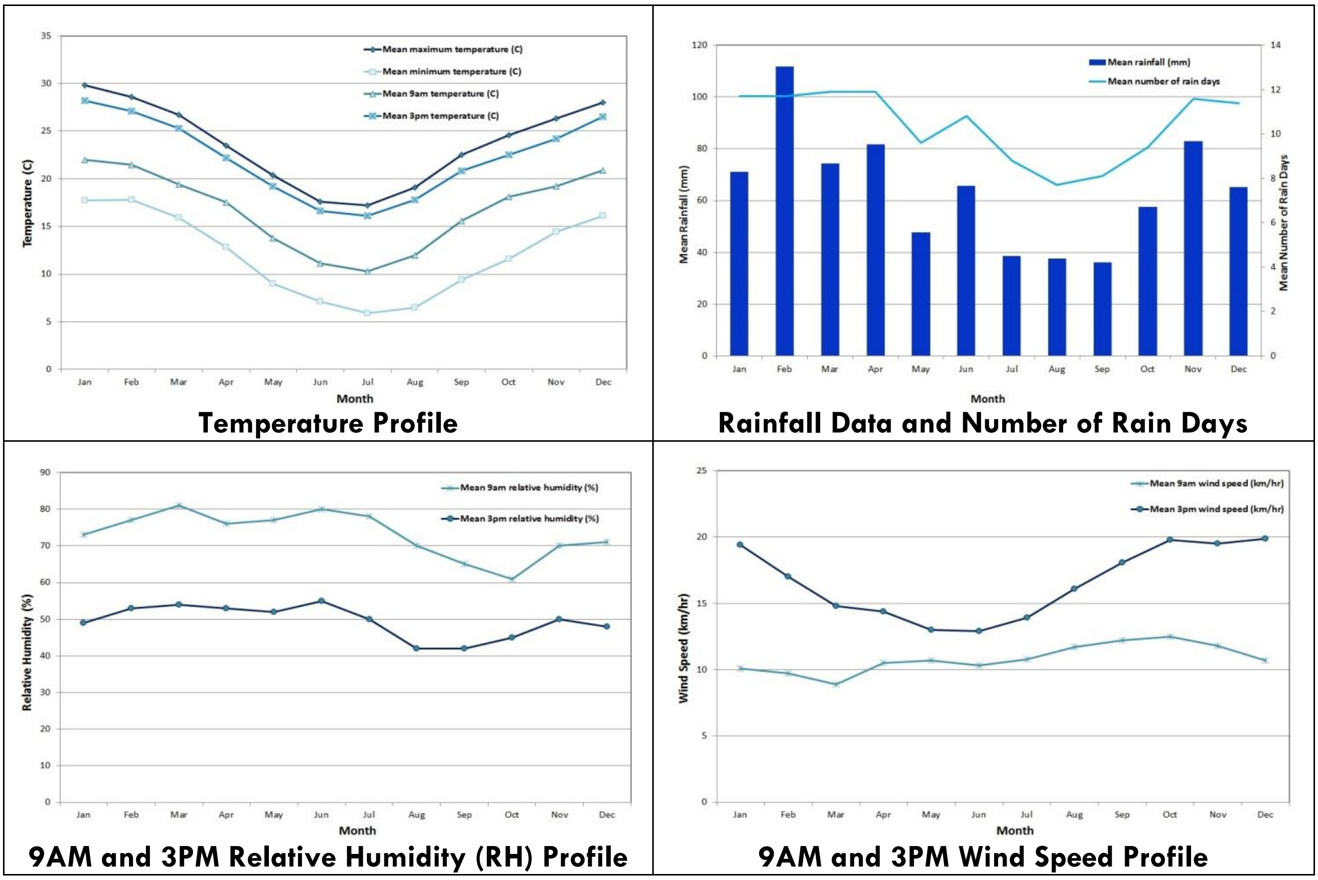
5. EXISTING ENVIRONMENT

This section characterises the long term climatic conditions and existing air quality levels surrounding the Project Site.

5.1 Climate Statistics

Long-term climatic data from the Bureau of Meteorology (BoM) Horsley Park Equestrian Centre Automatic Weather Station (AWS) (Station No: 067119) were analysed to characterise the local climatic conditions. The AWS is located approximately 2.5km south-south west of the Project Site. The key aspects that were analysed to understand the long-term climatic conditions were – mean minimum and maximum temperatures, mean 9AM and 3PM temperatures, rainfall data, mean 9AM and 3PM relative humidity (RH) levels and mean wind speeds. Analysed climate data is visually illustrated in **Figure 6**.

Figure 6: Climate Statistics – BoM Horsley Park AWS



From the data illustrated in **Figure 6**, the following observations can be made:

- Highest mean maximum temperatures are observed during January with a mean maximum temperature of 29.8^{O}C;
- July is observed to be the coldest month of all the months, with a mean minimum temperature of 5.9^{O}C;
- High rainfall is generally observed during summer seasons, with the highest rainfall levels observed during February;
- There is a clear distinction between Relative Humidity (RH) levels recorded at 9AM and 3PM. The 9AM RH levels vary between 61-81% and the 3PM RH levels vary between 42-55%;
- Similarly, a clear distinction can be observed between the 9AM and 3PM wind speeds. The mean 9AM wind speed averaged over all months is 10.8km/hr whereas the mean 3PM wind speed averaged over all months is 16.5km/hr.

5.2 Existing Air Quality

Characterising air quality levels surrounding the Project Site is a key factor, especially for determining cumulative pollutant concentrations.

No air-quality monitoring is undertaken at the Project Site, and as-such reference was drawn to the NSW-OEH ambient air quality monitoring station located at Prospect, NSW. The Prospect monitoring station is located approximately 5.3km north-east of the Project Site and records continuous concentrations of PM_{10}, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO) and ozone (O_3).

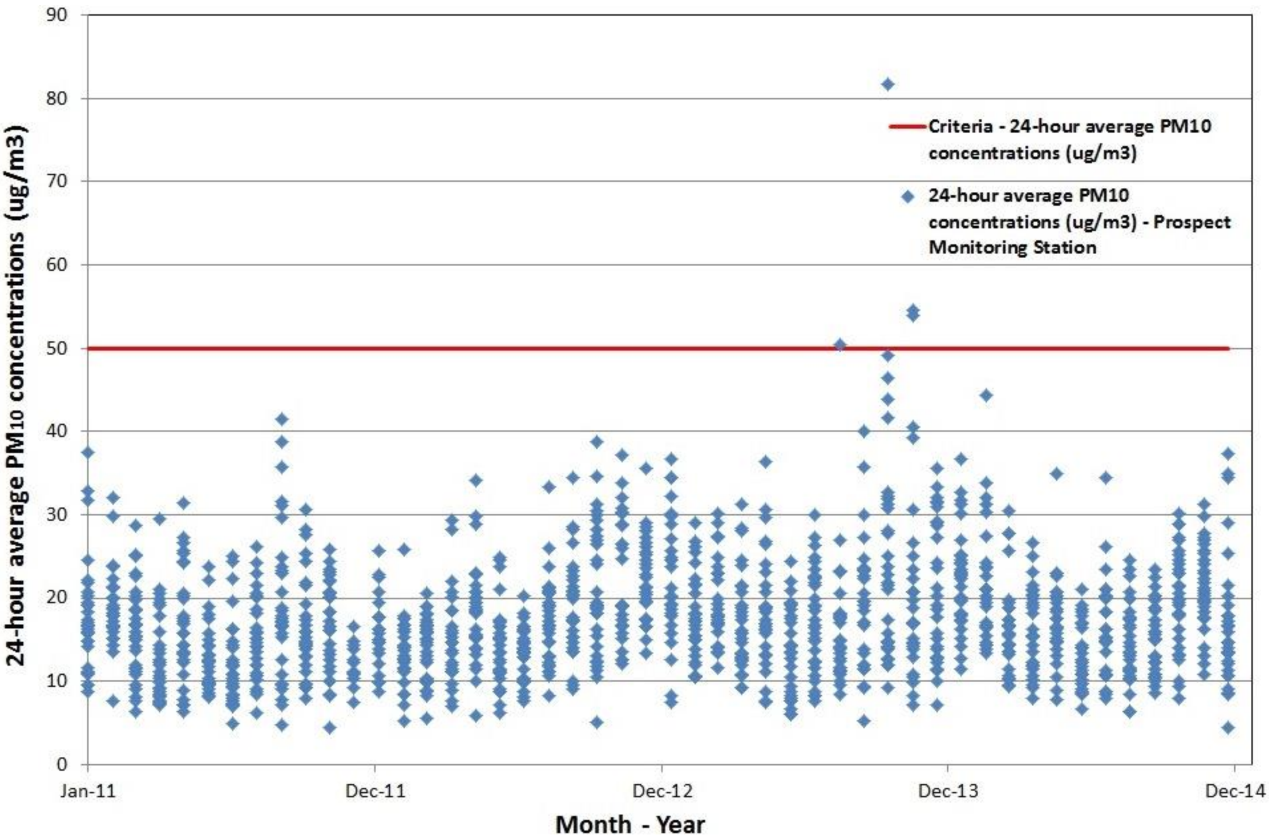
5.2.1 PM_{10} Concentrations

PM_{10} levels recorded at Prospect monitoring station from 2011-2014 were processed and are summarised in **Table 7** and illustrated in **Figure 7**.

Table 7: Measured PM_{10} Concentration Levels –Prospect Monitoring Station – 2011-14

Parameter	2011	2012	2013	2014
Minimum 24-hour average PM_{10} concentration ($\mu g/m^3$)	5	5	5	4
Maximum 24-hour average PM_{10} concentration ($\mu g/m^3$)	42	39	82	44
Average 24-hour average PM_{10} concentration ($\mu g/m^3$)	16	17	19	18
Number of days > 50 $\mu g/m^3$ (criteria)	0	0	3	0

Figure 7: 24-hour Average PM_{10} Concentrations – Prospect Monitoring Station – 2011-14



24-hour average PM_{10} concentration levels measured at Prospect monitoring station exceeded the criteria of 50 $\mu g/m^3$ on three (3) occasions in 2013. However, no such exceedances were observed in 2011, 2012 or 2014. For the purpose of assessing cumulative 24-hour PM_{10} impacts associated with the Project, the daily varying PM_{10} concentrations from the 2014 dataset at the Prospect monitoring station was taken into consideration and the highest 24-hour average PM_{10} concentration model prediction for each identified sensitive residential receptors (**Table 2**) was added to the corresponding measured 24-hour average PM_{10} background concentration. For assessing annual average cumulative PM_{10} impacts, the annual average PM_{10} concentrations measured at the Prospect monitoring station for 2014 (18 $\mu g/m^3$) was considered to be the background.

5.2.2 TSP Concentrations

TSP monitoring is not currently undertaken at the Prospect monitoring station. As no monitoring data is available, background TSP concentrations have been estimated based on a conservative assumption that 40% of TSP is PM_{10}, and as-such, based on that conservative assumption, the annual-average background TSP concentration for 2014 has been estimated to be 44 $\mu g/m^3$.

5.2.3 Deposited Dust Levels

No dust deposition monitoring is undertaken either at the Project Site or at the Prospect monitoring station. Based on similar projects undertaken by Airlabs personnel in the past, and taking into consideration the relationship between TSP levels and deposited dust levels, a conservative background value of 2.1 g/m^2/month has been applied to assess cumulative deposited dust levels.

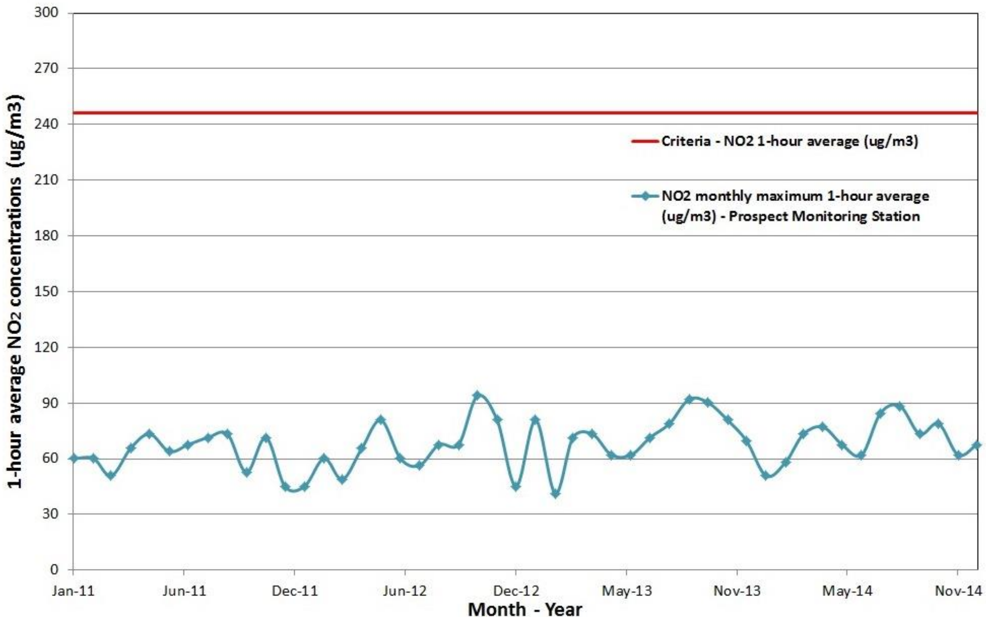
5.2.4 Nitrogen Dioxide

The monthly maximum 1-hour average NO_2 concentration levels measured at the Prospect monitoring station for 2014 are summarised in **Table 8** and the monthly maximum 1-hour average NO_2 concentration levels recorded from 2011-2014 are illustrated in **Figure 8.**

Table 8: Measured Monthly Maximum 1-Hour NO_2 Concentration Levels –Prospect Monitoring Station – 2014

Month	NO_2 Monthly Maximum 1-hour Average ($\mu g/m^3$)
January	51
February	58
March	73
April	77
May	68
June	62
July	85
August	88
September	73
October	79
November	62
December	68
Maximum in 2014	**88**

Figure 8: Monthly Maximum 1-Hour Average NO_2 Concentrations – Prospect Monitoring Station – 2011-14



The maximum monthly 1- hour average measured in 2014 (88 μg/m^3), was considered to be the background NO_2 level for assessing cumulative impacts.

5.2.5 Sulfur Dioxide

The monthly maximum 1-hour average SO_2 concentration levels measured at the Prospect monitoring station for 2014 are summarised in **Table 9**.

Table 9: Measured Monthly Maximum 1-Hour SO_2 Concentration Levels –Prospect Monitoring Station – 2014

Month	SO_2 Monthly Maximum 1-hour Average (μg/m^3)
January	31
February	34
March	39
April	26
May	21
June	16
July	31
August	10
September	50
October	21
November	21
December	37
Maximum in 2014	**50**

The maximum monthly 1- hour average measured in 2014 (50 μg/m^3), was considered to be the background SO_2 level for assessing cumulative impacts.

5.2.6 Carbon Monoxide

The background CO levels for this Project were estimated from the daily maximums derived from an 8-hour rolling average as measured by the Prospect monitoring station. The highest daily maximum value of 1.5 mg/m^3 based on an 8-hour rolling average (estimated to be 2.5 mg/m^3 based on a 1-hour average) measured across the 2014 dataset was considered to be the background CO concentration level for this assessment.

5.2.7 Hydrogen Fluoride

It is to be noted that no HF monitoring is undertaken at the Prospect monitoring station. However, taking into consideration the location of the Project Site and the nearby surroundings, it is unlikely that there would be other major contributors of HF emissions in the nearby vicinity than the existing Plant 1 and Plant 2 operations.

5.2.8 Contribution of Plant 1 Emissions

The current Scope of Work for the AQIA does not include determining air quality impacts for Plant 1 as the objective is to determine impacts associated with existing operations and the LWA Project (Stage 1 and Stage 2) at Plant 2. However, as no air quality monitoring is undertaken by Brickworks and taking into consideration that Plant 1 is located adjacent to Plant 2, emission rates have been quantified for Plant 1 in order to comprehensively determine cumulative air quality impacts within the near-field region. It is to be noted that the Prospect monitoring station will incorporate contribution from both Plant 1 and existing operations at Plant 2 and quantifying emissions from Plant 1 and Plant 2 and adding their respective contribution to the background air quality data is considered to be a conservative approach. Details regarding estimating pollutant emission rates from Plant 1 are mentioned in **Section 6.4**.

6. EMISSION ESTIMATION

Based on the understanding of the Project, pollutant emission rates have been determined for the following:

- Flue gas emissions from the proposed LWA rotary kiln stack for the three (3) fuel combustion options for both Stage 1 and Stage 2 operations;
- Fugitive particulate matter emissions corresponding to Stage 1 and Stage 2 LWA operations;
- Emissions released to air from existing brick making operations at Plant 2, which include flue gas emissions from the existing brick-kiln stack and associated fugitive particulate matter emissions; and
- Flue gas emissions from the existing brick-kiln stack at Plant 1 and corresponding fugitive particulate matter emissions.

As mentioned in **Section 2.2.1**, Stage 1 of the Project comprises LWA production volumes of 300,000 tonnes per annum (tpa) and a total of 600,000 tpa of LWA production is forecasted for Stage 2 (including 300,000 tpa of LWA from Stage 1), which would potentially commence approximately five (5) years after commencement of Stage 1. The rotary kiln for Stage 1 is designed to produce 300,000 tpa of LWA and as-such; a new rotary kiln in addition to the existing kiln would be commissioned during Stage 2 operations.

A flowchart outlining the LWA production process for both Stage 1 and Stage 2 operations has been provided by Brickworks and is illustrated in **Figure 9**.

Dust impacts generated from Stage 1 and Stage 2 construction activities are not considered to be significant when compared with operational activities, however, sources generating dust emissions during construction activities and mitigation measures that would be implemented by Brickworks are outlined in **Section 6.5**.

6.1 LWA Flue Gas Emissions

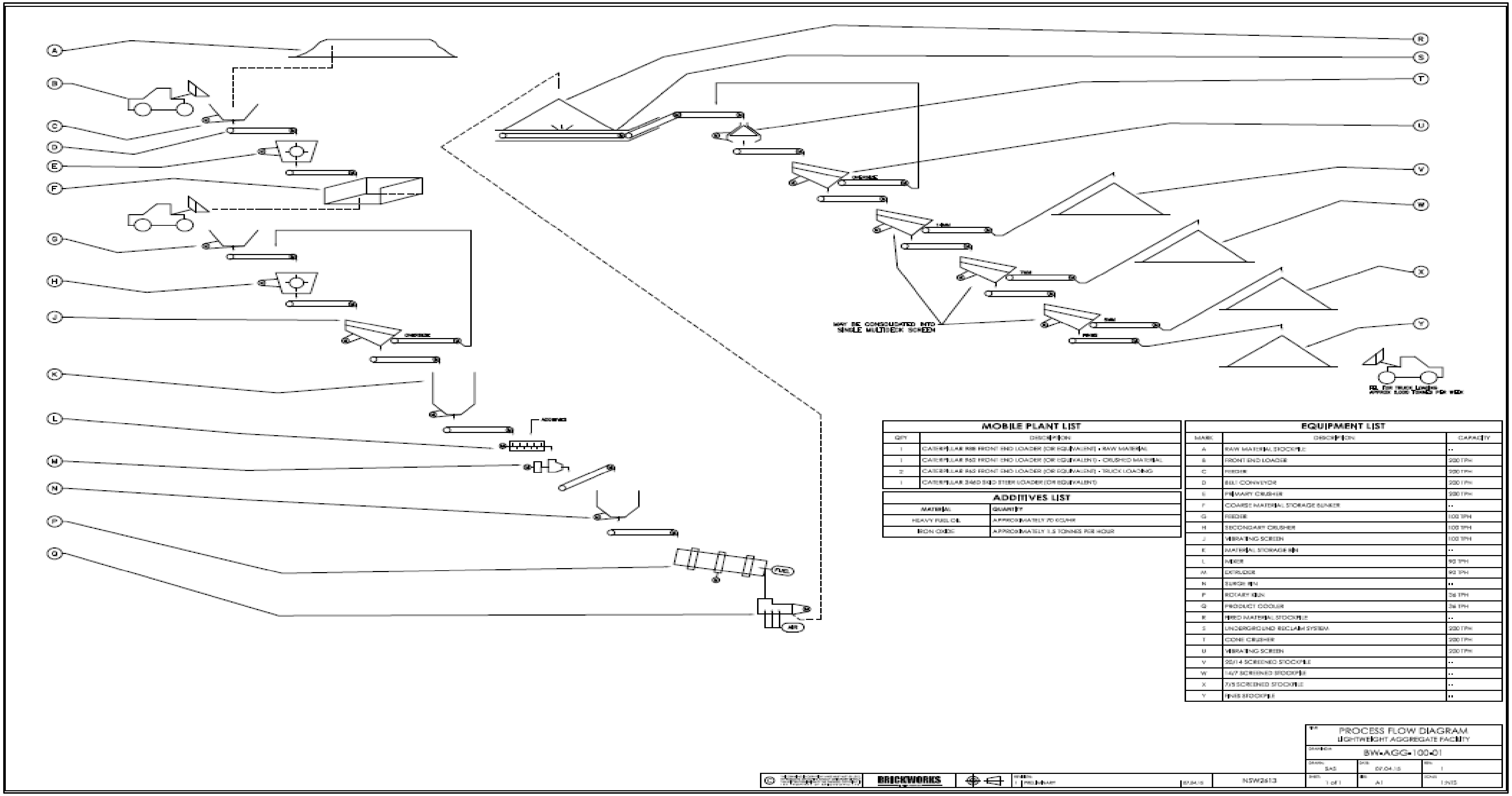
Based on review of the LWA manufacturing process, flue gas emission sources and the corresponding pollutants for both Stage 1 and Stage 2 LWA operations are outlined in **Table 10**. It is to be noted that the only difference between Stage 1 and Stage 2 operations would be the increase in the LWA production volumes from 300,000 tpa during Stage 1 to a total of 600,000 tpa during Stage 2 (which includes Stage 1) operations and commissioning of two new stacks – PCS2 and CA2. The operational process for Stage 1 and Stage 2 operations would remain the same.

Table 10: LWA Flue Gas Sources and Pollutants - Stage 1 and Stage 2 Operations

Source	Type	Associated Pollutants
Product Combustion Stack 1 (PCS 1) – Stage 1 Operations	Stack Emissions (Point Source)	Particulates, NO_2, SO_2, CO, HF, HCl, Acid Gases, Volatile Organic Compounds (VOCs), Metals, PAHs, Dioxins and Furans
Cooling Air Stack 1 (CA1) – Stage 1 Operations	Stack Emissions (Point Source)	Particulates
Product Combustion Stack 2 (PCS 2) – Stage 2 Operations	Stack Emissions (Point Source)	Particulates, NO_2, SO_2, CO, HF, HCl, Acid Gases, Volatile Organic Compounds (VOCs), Metals, PAHs, Dioxins and Furans
Cooling Air Stack 1 (CA2) – Stage 2 Operations	Stack Emissions (Point Source)	Particulates

In order to understand the flue gas emissions profile associated with the proposed Stage 1 and Stage 2 LWA operations, a desktop study of Best Available Technologies (BAT) corresponding to existing LWA manufacturing facilities has been undertaken. Additionally, air quality control measures proposed by Brickworks for Stage 1 and Stage 2 operations have been compared against BAT's to demonstrate that measures proposed by Brickworks would be in-line with best practices which would subsequently ensure that toxic air emissions and particulate matter emissions comply with the imposed limits.

Figure 9: Flowchart Illustrating LWA Production Process – Stage 1 and Stage 2 Operations



6.1.1 Best Available Technologies (BAT)

A desktop review of BATs implemented by existing LWA manufacturing facilities for minimising flue gas emissions has been undertaken and their findings are presented below. It is to be noted that at the time of preparing this assessment, limited information was available on public domain pertaining to LWA manufacturing and associated emissions and their controls.

- *Minergy Corporation, Oak Creek, Wisconsin* – This LWA manufacturing facility uses baghouse for dust and particulate emissions and scrubbing system for cleaning acid gases released in the process (Minergy, 2011);
- *Texas Industries, Clodine, Texas* – This coal-fired LWA manufacturing plant uses wet scrubbers, dry cyclones and fabric filters for emissions control (US-EPA, 1981a);
- *Arkansas LWA Corporation, West Memphis, Arkansas* – This coal-fired LWA manufacturing plant uses wet scrubber and dry cyclones for emissions control (US-EPA, 1981b);
- Section 2.4 of the US-Environmental Protection Agency (US-EPA) *AP-42 Emission Factor Documentation for AP-42 Section 11.20 – Lightweight Aggregate Manufacturing* states that emissions from rotary kilns generally are controlled by wet scrubbers. However, fabric filters (baghouse) and electrostatic precipitators (ESP) are also used to control kiln emissions.

Based on review of the publicly available information pertaining to minimising flue gas emissions generated from LWA rotary kilns, it is observed that baghouses and scrubbers are largely used as BATs for minimising particulate and acid gas (HF, HCl, SO_2 etc.) emissions.

6.1.2 Proposed Air Pollution Control Measures

In order to minimise flue gas emissions generated from LWA operations, Brickworks are proposing a set of air pollution control measures for both Stage 1 and Stage 2 operations incorporating BATs for LWA manufacturing. The proposed measures, their objectives and their estimated control efficiencies (%) are summarised in **Table 11** and a layout of the proposed air quality control measures to be installed is illustrated in **Figure 10**

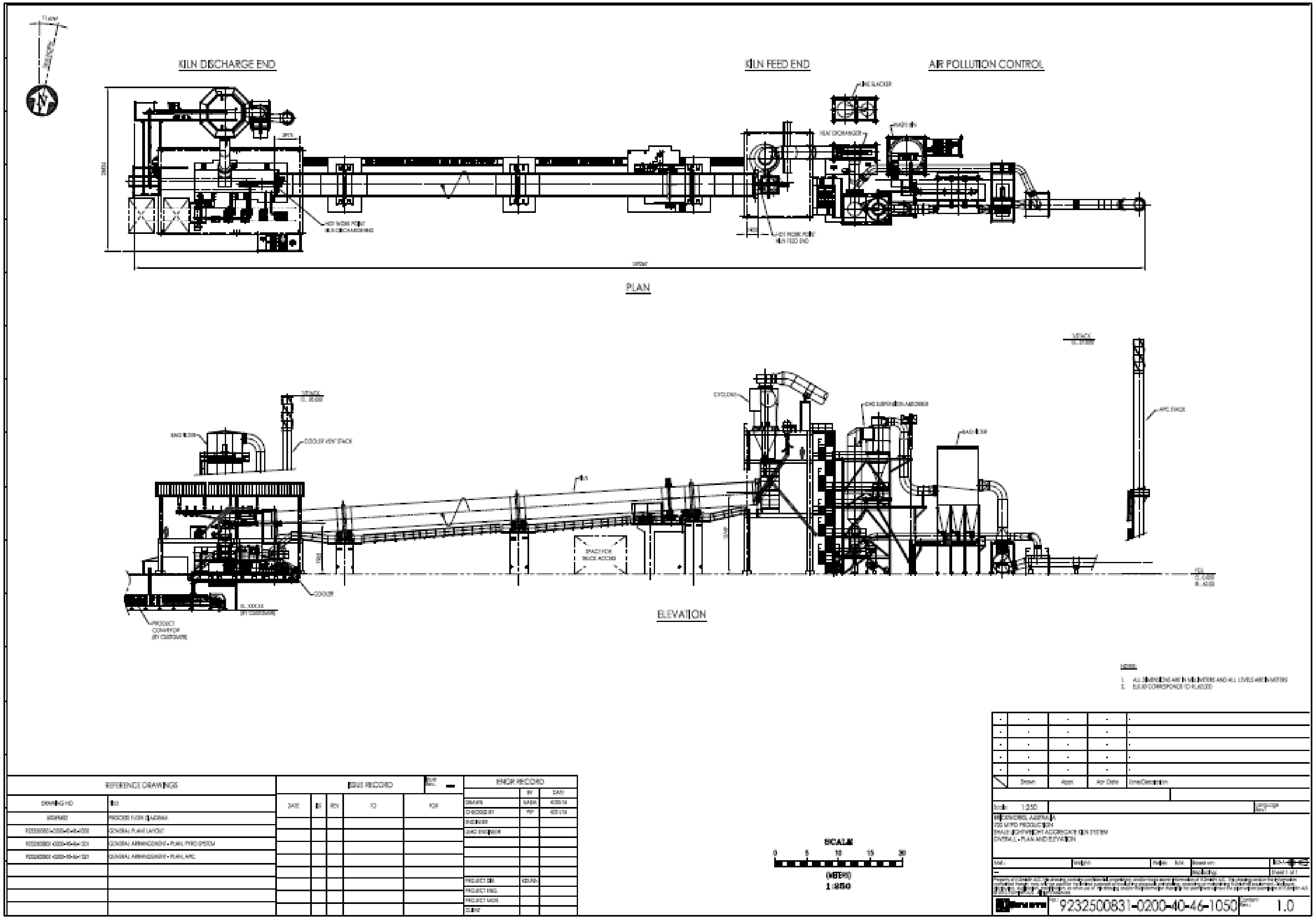
Table 11: Proposed Air Pollution Control Measures for Flue Gas Emissions – Stage 1 and Stage 2

Operational Stage and Source	Proposed Air Pollution Control Systems	Objective and Estimated Control Efficiency (%)	Estimated Control Efficiency (%)	Control Efficiency Reference Source
Stage 1 Operations				
Product Combustion Stack (PCS 1)	Baghouse Filtration	For effectively controlling particulate emissions and metals[1]	99% for particulate and metals (in particulate phase)	Control efficiency obtained from NPI – Combustion in Boilers (2011) – fabric filters (baghouses) for new equipment
		Baghouses without any carbon injection can offer up to 30% reduction in dioxins and furans emissions	30%	Emission testing undertaken by Airlabs for dioxins and furans at similar facilities
	Lime / Water Scrubbing System – (Wet Scrubber)	For effectively controlling acid gases (e.g. HF, HCl, SO_2)	95%	US-EPA Air Pollution Control Technology Factsheet for wet scrubbers and NPI – Combustion in Boilers (2011) – wet scrubber
	Regenerative Thermal Oxidisers (RTO)	For effectively controlling VOC's and Carbon monoxide emissions	95%	Firmin and Lipke, ASME 1996
Cooling Air Stack (CA1)	Baghouse Filtration	For effectively controlling particulate emissions	99%	Control efficiency obtained from NPI – Combustion in Boilers (2011) – fabric filters (baghouses) for new equipment

Operational Stage and Source	Proposed Air Pollution Control Systems	Objective and Estimated Control Efficiency (%)	Estimated Control Efficiency (%)	Control Efficiency Reference Source
Stage 2 Operations				
Product Combustion Stack (PCS 1)	Baghouse Filtration	For effectively controlling particulate emissions and metals[1]	99% for particulate and metals (in particulate phase)	Control efficiency obtained from NPI – Combustion in Boilers (2011) – fabric filters (baghouses) for new equipment
		Baghouses without any carbon injection can offer up to 30% reduction in dioxins and furans emissions	30%	Emission testing undertaken by Airlabs for dioxins and furans
	Lime / Water Scrubbing System – (Wet Scrubber)	For effectively controlling acid gases (e.g. HF, HCl, SO_2)	95%	US-EPA Air Pollution Control Technology Factsheet for wet scrubbers and NPI – Combustion in Boilers (2011) – wet scrubber
	Regenerative Thermal Oxidisers	For effectively controlling VOC's and Carbon monoxide emissions	95%	Firmin and Lipke, ASME 1996
Cooling Air Stack (CA1)	Baghouse Filtration	For effectively controlling particulate emissions	99%	Control efficiency obtained from NPI – Combustion in Boilers (2011) – fabric filters (baghouses) for new equipment

1 In addition to metals in particulate phases, baghouses in conjunction with scrubbers can considerably reduce concentration of metals in vapour phase. However, as no information is available with regards to control efficiencies, a 20% control efficiency has been applied as a conservative measure

Figure 10: Layout of the Proposed Air Pollution Control Systems for Flue Gas Emissions



By comparing the proposed air pollution control measures outlined in **Table 11** with measures implemented by other LWA manufacturing facilities, it is observed that the measure proposed by Brickworks are in-line with best practices for minimising flue gas emissions generated from the LWA manufacturing operations. Additionally, as per information provided to Airlabs by Brickworks, the rotary kiln system and air pollution control measures will be designed to ensure compliance with the Group 6 emission standards and Energy from Waste Policy requirements.

6.1.3 Estimating LWA Flue Gas Emissions

As discussed in **Section 2.2**, Brickworks are investigating a range of fuel sources for LWA production, which include natural gas and the following beneficially derived fuel sources - (C&D) / (C&I) Timbers and RDF. It is to be noted that natural gas will be used in conjunction with (C&D) / (C&I) Timbers and RDF.

In order to understand the emissions profile and subsequent impacts associated with each fuel source type, pollutant emission rates have been quantified for each of the following fuel combustion options for both Stage 1 (300,000 tpa) and Stage 2 (total 600,000 tpa – including 300,000 tpa from Stage 1) operations:

- **Option 1**: 100% Natural Gas;
- **Option 2**: 90% (C&D)/(C&I) Timbers and 10% Natural Gas fuel combination; and
- **Option 3**: 90% RDF and 10% Natural Gas fuel combination

Pollutant emission rates for each of the aforementioned fuel combustion options were estimated using emission factors, referenced from Emission Estimation Technique (EET) manuals.

It is to be noted that, there are no emission factors corresponding to LWA manufacturing operations in Australia. US-EPA have published emission factors for LWA manufacturing (US-EPA, 1995) (hereafter AP-42 LWA), however, this EET manual has not been used for estimating emission rates, as the emission factors presented in AP-42 LWA have been determined from LWA facilities using coal as a source of fuel, whereas, Brickworks are proposing to use natural gas and beneficially derived fuel sources, which would have a considerably different emissions profile when compared to emissions generated from fossil fuel combustion. Moreover, it is specified in AP-42 LWA that metals would be released as a product of combustion from the rotary kilns; however, no emission factors have been presented. For VOC's, though total VOC emission factors have been presented, no information has been provided on speciated VOC's. Factoring in these observations, the US-EPA AP-42 LWA manual was not considered and pollutant emission factors have been referenced from the following EET manuals:

- National Pollutant Inventory (NPI) , *Emission Estimation Technique Manual for Bricks, Ceramics & Clay Product Manufacturing*, Environment Australia, August 1998;
- National Pollutant Inventory (NPI) , *Emission Estimation Technique Manual for Combustion in Boilers*, Version 3.6, Australian Government – Department of Sustainability, Environment, Water, Population & Communities, December 2011;
- AP-42 Emission Factors, *Chapter 2.1 Refuse Combustion*, United States Environmental Protection Agency (US-EPA 1996); and
- Sources of Dioxins and Furans in Australia, Air Emissions – Revised Edition, (Environment Australia, 2002).

Among the referenced EET's flue gas emission factors were mainly determined from the Bricks, Ceramics & Clay Product Manufacturing EET because of the comparable similarities between raw materials associated with brick, clay and LWA manufacturing. Moreover, the EET also has specific emission factors pertaining to different types of fuel used for product manufacturing. Other manuals were referenced, when no information could be obtained from the Bricks, Ceramics & Clay Product Manufacturing EET manual.

Based on emission factors (kg of pollutant released/tonne of LWA produced) published in the aforementioned EET manuals, tonnage of LWA material produced for Stage 1 (300,000 tpa) and Stage 2 operations (600,000 tpa – Stage 1 included), amounts of fuel used, proposed air pollution control measures and their corresponding control efficiencies (**Table 11**), emission estimates have been quantified.

No specific emission factors are provided for C&D / C&I Timbers within the Bricks, Ceramics & Clay Product manufacturing EET manual, however, emission factors are available for sawdust combustion and as-such reference was made to those emission factors. Pollutant emission factors utilised for developing emission rates are presented in **Appendix A**.

Flue gas emissions inventory for Stage 1 and Stage 2 operations for the three (3) fuel combustion options are presented in **Table 12** and **Table 13**. Additionally, stack concentrations were calculated based on the estimated emission rates and volumetric flow conditions for the PCS and CA stack for both Stage 1 (**Table 14**) and Stage 2 (**Table 15**) operations (as provided by Brickworks) and subsequently compared against Group 6 emission standards (**Table 3**) to assess for compliance with the Clean Air Regulations and the Energy from Waste Policy requirements.

Estimated stack concentrations for both Stage 1 (**Table 14**) and Stage 2 (**Table 15**) operations are well below the Group 6 emission standards (**Table 3**) and as-such, comply with the Clean Air Regulation standards and the process and air emissions requirements of the Energy from Waste Policy.

Table 12: LWA Stack Emissions Inventory – Stage 1 – All Fuel Combustion Options

Pollutant	Controlled Estimated Emission Rates (g/sec) Option 1 (100% Natural Gas Combustion)	Controlled Estimated Emission Rates (g/sec) Option 2 (90% C&D /C&I Timber and 10% Natural Gas)	Controlled Estimated Emission Rates (g/sec) Option 3 (90% RDF and 10% Natural Gas) (1)
Product Combustion Stack 1 (PCS 1)			
Total Particulates	0.04	0.04	0.04
Oxides of Nitrogen (NO_X)	1.7	1.7	3.0
Sulfur dioxide (SO_2)	0.7	0.8	0.5
Carbon Monoxide (CO)	0.3	0.4	0.1
Hydrogen Fluoride (HF)	0.14	0.14	0.14
Hydrogen Chloride (HCl)	0.04	0.04	0.2
Acrylonitrile	n/a	6.4E-05	n/a
Acetone	0.008	0.002	n/a
Benzene	0.014	0.004	n/a
Carbon disulphide	0.0002	0.0001	n/a
Chloroethane	0.002	n/a	n/a
Chloroform (trichloromethane)	n/a	1.3E-06	n/a
Ethylbenzene	0.0002	0.0001	n/a
Methylene Chloride (dichloromethane)	n/a	3.2E-05	n/a
Phenol	0.0004	0.0003	n/a
Styrene	0.0001	1.1E-05	n/a
Tetrachloroethylene	1.3E-05	2.6E-06	n/a

Pollutant	Controlled Estimated Emission Rates (g/sec) Option 1 (100% Natural Gas Combustion)	Controlled Estimated Emission Rates (g/sec) Option 2 (90% C&D /C&I Timber and 10% Natural Gas)	Controlled Estimated Emission Rates (g/sec) Option 3 (90% RDF and 10% Natural Gas) (1)
Toluene	0.008	0.0012	n/a
Xylene	0.001	0.0002	n/a
1,1,1- Trichloroethane (methyl chloroform)	n/a	1.3E-06	n/a
Arsenic	1.5E-05	1.5E-05	3.4E-04
Beryllium	2.0E-07	2.0E-07	n/a
Cadmium	8.6E-06	2.9E-05	0.0005
Chromium (III)	1.4E-06	1.8E-05	n/a
Chromium (VI)	n/a	3.0E-06	0.001
Copper dust	8.3E-07	4.2E-05	n/a
Lead	5E-07	4.1E-05	0.01
Manganese	1.4E-04	0.006	n/a
Mercury (inorganic)	2.9E-05	2.9E-05	0.0003
Nickel	2.04E-06	2.8E-05	2.5E-04
Polycyclic Aromatic Hydrocarbons (PAHs) – as benzo-a-pyrene	6.2E-06	0.002	n/a
Polychlorinated Dioxins and Furans (PCDD/F) – TEQ	3.4E-11	4.7E-10	4.4E-10
Cooling Air Stack 1 (CA 1)			
Total Particulates	0.04	0.04	0.04

n/a indicates that the specific pollutant is not released during the combustion process

(1) As per Section 2.1.3.6 – Organic Compounds of the Chapter 2.1 Refuse Combustion, though organic compounds are released from refuse derived fuel combustion, emphasis has been laid on dioxin and furan emissions and as-such no emission n factors have been provided for organic compounds

Table 13: LWA Stack Emissions Inventory – Stage 2 – All Fuel Combustion Options

Pollutant	Controlled Estimated Emission Rates (g/sec) Option 1 (100% Natural Gas Combustion)	Controlled Estimated Emission Rates (g/sec) Option 2 (90% C&D /C&I Timber and 10% Natural Gas)	Controlled Estimated Emission Rates (g/sec) Option 3 (90% RDF and 10% Natural Gas) (1)
Product Combustion Stack 1 (PCS 1)			
Total Particulates	0.04	0.04	0.04
Oxides of Nitrogen (NO_X)	1.7	1.7	3.0
Sulfur dioxide (SO_2)	0.7	0.8	0.5
Carbon Monoxide (CO)	0.3	0.4	0.1
Hydrogen Fluoride (HF)	0.14	0.14	0.14
Hydrogen Chloride (HCl)	0.04	0.04	0.2
Acrylonitrile	n/a	6.4E-05	n/a
Acetone	0.008	0.002	n/a
Benzene	0.014	0.004	n/a
Carbon disulphide	0.0002	0.0001	n/a
Chloroethane	0.002	n/a	n/a
Chloroform (trichloromethane)	n/a	1.3E-06	n/a
Ethylbenzene	0.0002	0.0001	n/a
Methylene Chloride (dichloromethane)	n/a	3.2E-05	n/a
Phenol	0.0004	0.0003	n/a
Styrene	0.0001	1.1E-05	n/a
Tetrachloroethylene	1.3E-05	2.6E-06	n/a
Toluene	0.008	0.0012	n/a

Pollutant	Controlled Estimated Emission Rates (g/sec) Option 1 (100% Natural Gas Combustion)	Controlled Estimated Emission Rates (g/sec) Option 2 (90% C&D /C&I Timber and 10% Natural Gas)	Controlled Estimated Emission Rates (g/sec) Option 3 (90% RDF and 10% Natural Gas) (1)
Xylene	0.001	0.0002	n/a
1,1,1- Trichloroethane (methyl chloroform)	n/a	1.3E-06	n/a
Arsenic	1.5E-05	1.5E-05	3.4E-04
Beryllium	2.0E-07	2.0E-07	n/a
Cadmium	8.6E-06	2.9E-05	0.0005
Chromium (III)	1.4E-06	1.8E-05	n/a
Chromium (VI)	n/a	3.0E-06	0.001
Copper dust	8.3E-07	4.2E-05	n/a
Lead	5E-07	4.1E-05	0.01
Manganese	1.4E-04	0.006	n/a
Mercury (inorganic)	2.9E-05	2.9E-05	0.0003
Nickel	2.04E-06	2.8E-05	2.5E-04
Polycyclic Aromatic Hydrocarbons (PAHs) – as benzo-a-pyrene	6.2E-06	0.002	n/a
Polychlorinated Dioxins and Furans (PCDD/F) – TEQ	3.4E-11	4.7E-10	4.4E-10
Cooling Air Stack 1 (CA 1)			
Total Particulates	0.04	0.04	0.04
Product Combustion Stack 2 (PCS 2)			
Total Particulates	0.04	0.04	0.04

Pollutant	Controlled Estimated Emission Rates (g/sec) Option 1 (100% Natural Gas Combustion)	Controlled Estimated Emission Rates (g/sec) Option 2 (90% C&D /C&I Timber and 10% Natural Gas)	Controlled Estimated Emission Rates (g/sec) Option 3 (90% RDF and 10% Natural Gas) (1)
Oxides of Nitrogen (NO_X)	1.7	1.7	3.0
Sulfur dioxide (SO_2)	0.7	0.8	0.5
Carbon Monoxide (CO)	0.3	0.4	0.1
Hydrogen Fluoride (HF)	0.14	0.14	0.14
Hydrogen Chloride (HCl)	0.04	0.04	0.2
Acrylonitrile	n/a	6.4E-05	n/a
Acetone	0.008	0.002	n/a
Benzene	0.014	0.004	n/a
Carbon disulphide	0.0002	0.0001	n/a
Chloroethane	0.002	n/a	n/a
Chloroform (trichloromethane)	n/a	1.3E-06	n/a
Ethylbenzene	0.0002	0.0001	n/a
Methylene Chloride (dichloromethane)	n/a	3.2E-05	n/a
Phenol	0.0004	0.0003	n/a
Styrene	0.0001	1.1E-05	n/a
Tetrachloroethylene	1.3E-05	2.6E-06	n/a
Toluene	0.008	0.0012	n/a
Xylene	0.001	0.0002	n/a
1,1,1- Trichloroethane (methyl chloroform)	n/a	1.3E-06	n/a

Pollutant	Controlled Estimated Emission Rates (g/sec) Option 1 (100% Natural Gas Combustion)	Controlled Estimated Emission Rates (g/sec) Option 2 (90% C&D /C&I Timber and 10% Natural Gas)	Controlled Estimated Emission Rates (g/sec) Option 3 (90% RDF and 10% Natural Gas) (1)
Arsenic	1.5E-05	1.5E-05	3.4E-04
Beryllium	2.0E-07	2.0E-07	n/a
Cadmium	8.6E-06	2.9E-05	0.0005
Chromium (III)	1.4E-06	1.8E-05	n/a
Chromium (VI)	n/a	3.0E-06	0.001
Copper dust	8.3E-07	4.2E-05	n/a
Lead	5E-07	4.1E-05	0.01
Manganese	1.4E-04	0.006	n/a
Mercury (inorganic)	2.9E-05	2.9E-05	0.0003
Nickel	2.04E-06	2.8E-05	2.5E-04
Polycyclic Aromatic Hydrocarbons (PAHs) – as benzo-a-pyrene	6.2E-06	0.002	n/a
Polychlorinated Dioxins and Furans (PCDD/F) – TEQ	3.4E-11	4.7E-10	4.4E-10
Cooling Air Stack 2 (CA 2)			
Total Particulates	0.04	0.04	0.04

n/a indicates that the specific pollutant is not released during the combustion process

(1) As per Section 2.1.3.6 – Organic Compounds of the Chapter 2.1 Refuse Combustion, though organic compounds are released from refuse derived fuel combustion, emphasis has been laid on dioxin and furan emissions and as-such no emission n factors have been provided for organic compounds

Table 14: LWA Estimated Flue Gas Concentrations– Stage 1 – All Fuel Combustion Options

Pollutant and corresponding Group 6 Emission Standards	Estimated Flue Gas Concentration (mg/m^3) Option 1 (100% Natural Gas Combustion)	Estimated Flue Gas Concentration (mg/m^3) Option 2 (90% C&D /C&I Timber and 10% Natural Gas)	Estimated Flue Gas Concentration (mg/m^3) Option 3 (90% RDF and 10% Natural Gas) (1)
Product Combustion Stack 1 (PCS 1)			
Total Particulates (50 mg/m^3)	2.5	2.3	2.4
Oxides of Nitrogen (NO_X) (350 mg/m^3)	94	99	170
Sulfur dioxide (SO_2) (n.a.)	42	46	29
Carbon Monoxide (CO) (125 mg/m^3)	16	21	5
Hydrogen Fluoride (HF) (50 mg/m^3)	8	8	8
Hydrogen Chloride (HCl) (100 mg/m^3)	2	2	11
Total VOCs (40 mg/m^3)	1.6	0.3	n.a.[1]
Polychlorinated Dioxins and Furans (PCDD/F) – TEQ (0.1 ng/m^3)	0.02	0.03	0.02
Type 1 and Type 2 substances (in aggregate) (1 mg/m^3)	0.01	0.3	0.8
Cadmium (0.2 mg/m^3)	0.0005	0.002	0.03
Mercury (0.2 mg/m^3)	0.002	0.002	0.02
Cooling Air Stack 1 (CA 1)			
Total Particulates (50 mg/m^3)	3.0	2.9	2.9

(1) As per Section 2.1.3.6 – Organic Compounds of the Chapter 2.1 Refuse Combustion, though organic compounds are released from refuse derived fuel combustion, emphasis has been laid on dioxin and furan emissions and as-such no emission n factors have been provided for organic compounds

Table 15: LWA Estimated Flue Gas Concentrations– Stage 2 – All Fuel Combustion Options

Pollutant and corresponding Group 6 Emission Standards	Estimated Flue Gas Concentration (mg/m³) (1) Option 1 (100% Natural Gas Combustion)	Estimated Flue Gas Concentration (mg/m³) (1) Option 2 (90% C&D /C&I Timber and 10% Natural Gas)	Estimated Flue Gas Concentration (mg/m³) (1) Option 3 (90% RDF and 10% Natural Gas)
Product Combustion Stack 1 (PCS 1)			
Total Particulates (50 mg/m³)	2.5	2.3	2.4
Oxides of Nitrogen (NO_X) (350 mg/m³)	94	99	170
Sulfur dioxide (SO_2) (n.a.)	42	46	29
Carbon Monoxide (CO) (125 mg/m³)	16	21	5
Hydrogen Fluoride (HF) (50 mg/m³)	8	8	8
Hydrogen Chloride (HCl) (100 mg/m³)	2	2	11
Total VOCs (40 mg/m³)	1.6	0.3	n.a.[2]
Polychlorinated Dioxins and Furans (PCDD/F) – TEQ (0.1 ng/m³)	0.02	0.03	0.02
Type 1 and Type 2 substances (in aggregate) (1 mg/m³)	0.01	0.3	0.8
Cadmium (0.2 mg/m³)	0.0005	0.002	0.03
Mercury (0.2 mg/m³)	0.002	0.002	0.02
Cooling Air Stack 1 (CA 1)			
Total Particulates (50 mg/m³)	3.0	2.9	2.9
Product Combustion Stack 1 (PCS 2)			
Total Particulates (50 mg/m³)	2.5	2.3	2.4
Oxides of Nitrogen (NO_X) (350 mg/m³)	94	99	170
Sulfur dioxide (SO_2) (n.a.)	42	46	29

Pollutant and corresponding Group 6 Emission Standards	Estimated Flue Gas Concentration (mg/m^3) (1) Option 1 (100% Natural Gas Combustion)	Estimated Flue Gas Concentration (mg/m^3) (1) Option 2 (90% C&D /C&I Timber and 10% Natural Gas)	Estimated Flue Gas Concentration (mg/m^3) (1) Option 3 (90% RDF and 10% Natural Gas)
Carbon Monoxide (CO) (125 mg/m^3)	16	21	5
Hydrogen Fluoride (HF) (50 mg/m^3)	8	8	8
Hydrogen Chloride (HCl) (100 mg/m^3)	2	2	11
Total VOCs (40 mg/m^3)	1.6	0.3	n.a.[2]
Polychlorinated Dioxins and Furans (PCDD/F) – TEQ (0.1 ng/m^3)	0.02	0.03	0.02
Type 1 and Type 2 substances (in aggregate) (1 mg/m^3)	0.01	0.3	0.8
Cadmium (0.2 mg/m^3)	0.0005	0.002	0.03
Mercury (0.2 mg/m^3)	0.002	0.002	0.02
Cooling Air Stack 1 (CA 1)			
Total Particulates (50 mg/m^3)	3.0	2.9	2.9

(1) Reference conditions defined as dry, 273.15K, 101.3kPa and 7% O_2 and 11% O_2 for dioxins and furans

(2) As per Section 2.1.3.6 – Organic Compounds of the Chapter 2.1 Refuse Combustion, though organic compounds are released from refuse derived fuel combustion, emphasis has been laid on dioxin and furan emissions and as-such no emission n factors have been provided for organic compounds

6.2 LWA Fugitive Particulate Emissions

Fugitive particulate emission sources corresponding to Stage 1 and Stage 2 LWA operations are listed below. The sources have been identified based on process description details provided to Airlabs by Brickworks (refer **Figure 9**)

- Loading and Unloading Operations via Front End Loader (FEL);
- Material Handling / Conveying Activities;
- Loading Fired Material Stockpiles from the Rotary Kiln;
- Crushing and Grinding Operations;
- Loading Product Stockpiles;
- FEL loading Product Stockpiles to Trucks;
- Heavy Vehicle Haulage on Gravel Surfaces; and
- Wind Erosion from Raw and Product Stockpiles.

To quantify TSP and PM_{10} emissions from the aforementioned sources, reference was drawn to the following EET's:

- National Pollutant Inventory (NPI) , *Emission Estimation Technique Manual for Bricks, Ceramics & Clay Product Manufacturing*, Environment Australia, August 1998;
- National Pollutant Inventory (NPI) , *Emission Estimation Technique Manual for Mining*, Version 3.1, Australian Government – Department of Sustainability, Environment, Water, Population & Communities, January 2012;
- AP-42 Emission Factors, *Chapter 11.3 Bricks and Structural Clay Product Manufacturing*, United States Environmental Protection Agency (US-EPA 1997);
- AP-42 Emission Factors, *Chapter 11.19.2 Crushed Stone Processing and Pulverised Mineral Processing*, United States Environmental Protection Agency (US-EPA 2004);
- AP-42 Emission Factors, *Chapter 13.2.2 Unpaved Roads*, United States Environmental Protection Agency (US-EPA 2006a); and
- AP-42 Emission Factors, *Chapter 13.2.4 Aggregate Handling and Storage Piles*, United States Environmental Protection Agency (US-EPA 2006b)

TSP and PM_{10} emissions associated with Stage 1 and Stage 2 operations are summarised in **Table 16** and **Table 17**. Emission rates have been quantified based on emission factors corresponding to specific activity, activity details (e.g. amount of materials handled, vehicle kilometres travelled, stockpile footprint areas etc.) and control measures for dust mitigation (refer **Appendix A** for further details). It is to be noted that the moisture content of the raw material (clay/shale) for existing and proposed LWA operations would be approximately 13% which would considerably limit the potential for airborne fugitive dust emissions.

Table 16: TSP and PM_{10} Emissions Inventory – Stage 1 Operations

Activity	TSP Emissions (kg/year)	PM_{10} Emissions (kg/year)
Truck Dumping Raw Material	6	3
Front End Loader (FEL) Loading Raw Material to Feeder	39	19
Conveying to Primary Crusher	12	6
Primary Crushing	174	77
Conveying to Mill Building	12	6
Mill Building Operations – Grinding, Front End Loader (FEL) and Storage Operations	806	74
Material Conveyed to New Extruder Facility	8	4
Material Handling Operations Inside New Extruder Facility	405	162
Conveying Fired Stockpiles from Kilns	27	13
Loading Fired Stockpiles	27	13
Crushing and Screening Operations	122	54
Loading Product Stockpile – 1	7	3
Loading Product Stockpile – 2	7	3
Loading Product Stockpile – 3	7	3
Loading Product Stockpile – 4	7	3
Front End Loader (FEL) Loading Product Stockpiles to Truck	27	13
Heavy Vehicle Haulage on Gravel Surfaces	3,267	922
Wind Erosion – Existing Stockpile – 1	677	338
Wind Erosion – Existing Stockpile – 2	170	85
Wind Erosion – Existing Stockpile – 3	612	306
Wind Erosion – Fired Stockpile	521	260
Wind Erosion – Product Stockpile – 1	130	65
Wind Erosion – Product Stockpile – 2	130	65
Wind Erosion – Product Stockpile – 3	130	65
Wind Erosion – Product Stockpile – 4	130	65
Total Emissions	**7,460**	**2,628**

Table 17: TSP and PM_{10} Emissions Inventory – Stage 2 Operations

Activity	TSP Emissions (kg/year)	PM_{10} Emissions (kg/year)
Truck Dumping Raw Material	6	3
Front End Loader (FEL) Loading Raw Material to Feeder	67	32
Conveying to Primary Crusher	20	9
Primary Crushing	296	131
Conveying to Mill Building	20	9
Mill Building Operations – Grinding, Front End Loader (FEL) and Storage Operations	1,369	126
Material Conveyed to New Extruder Facility	16	8
Material Handling Operations Inside New Extruder Facility	810	324
Conveying Fired Stockpiles from Kilns	55	26
Loading Fired Stockpiles	55	26
Crushing and Screening Operations	243	108
Loading Product Stockpile – 1	14	6
Loading Product Stockpile – 2	14	6
Loading Product Stockpile – 3	14	6
Loading Product Stockpile – 4	14	6
Front End Loader (FEL) Loading Product Stockpiles to Truck	55	26
Heavy Vehicle Haulage on Gravel Surfaces	4,298	1,213
Wind Erosion – Existing Stockpile – 1	677	338
Wind Erosion – Existing Stockpile – 2	170	85
Wind Erosion – Existing Stockpile – 3	612	306
Wind Erosion – Fired Stockpile	521	260
Wind Erosion – Product Stockpile – 1	130	65
Wind Erosion – Product Stockpile – 2	130	65
Wind Erosion – Product Stockpile – 3	130	65
Wind Erosion – Product Stockpile – 4	130	65
Total Emissions	**9,864**	**3,317**

6.3 Plant 2 – Existing Operations

Emissions from existing brick making operations at Plant 2 include the following:

- Flue gas emissions from the existing brick kiln stack; and
- Fugitive particulate emissions with respect to existing Plant 2 operations.

It is to be noted that brick making operations at Plant 2 have been non-functional since 2007, however, operations have re-commenced in 2015. As no recent stack emissions monitoring data from Plant 2 is available, reference has been made to stack emissions data from the adjacent Plant 1 kiln stack. Airlabs undertake regular stack emission testing at Plant 1 and emissions data from the most recent testing undertaken by Airlabs in 2014 has been used to estimate Plant 2 stack emissions. Stack parameters corresponding to Plant 1 (e.g. stack diameter, exit velocity etc.) have been referenced from the emission testing report undertaken in November 2007 at Plant 1 by Stephenson Environmental Management Australia.

Fugitive particulate emissions have been estimated based on existing activity details at Plant 2, production capacities and the EET manuals as listed in **Section 6.2.** Existing sources of air pollution associated with Plant 2 operations are listed in **Table 18** and the Plant 2 brick kiln stack emissions and fugitive emissions presented in **Table 19** and **Table 20** respectively.

Table 18: Sources and Pollutants Associated with Existing Plant 2 Operations

Source	Type	Associated Pollutants
Plant 2 Brick Kiln Stack	Stack Emissions (Point Source)	Particulates, NO_2, SO_2, CO, HF, HCl, Volatile Organic Compounds (VOCs), Metals
Trucks Unloading Raw Material	Fugitive Emissions	Particulates
Loading and Unloading Operations via Front End Loader (FEL)	Fugitive Emissions	Particulates
Material Handling / Conveying Activities	Fugitive Emissions	Particulates
Crushing and Grinding Operations	Fugitive Emissions	Particulates
Heavy Vehicle Haulage on Gravel Surfaces	Fugitive Emissions	Particulates
Wind Erosion from Raw and Product Stockpiles	Fugitive Emissions	Particulates

Table 19: Plant 2 Brick Kiln Stack Emissions Inventory

Pollutant	Emission Rate (g/sec) (1)
Total Particulates	0.23
Oxides of Nitrogen (NO_X)	0.95
Sulfur dioxide (SO_2)	2.5
Hydrogen Fluoride (HF)	0.45
Hydrogen Chloride (HCl)	0.95
Benzene	0.01
Toluene	0.004
Chloromethane (Methyl Chloride)	0.011
Chloromethane (Ethyl Chloride)	0.0025
Antimony	1.4E-06
Arsenic	1.2E-04
Chromium	2.8E-04
Cobalt	9.3E-05
Lead	9.8E-05
Manganese	0.0025
Mercury	0.0004
Nickel	0.004

(1) Emission rates referenced from Airlabs, 2014

Table 20: TSP and PM_{10} Emissions Inventory – Plant 2 – Existing Operations

Activity	TSP Emissions (kg/year)	PM_{10} Emissions (kg/year)
Truck Dumping Raw Material	6	3
Front End Loader (FFL) Loading Raw Material to Feeder	12	6
Conveying to Primary Crusher	4	2
Primary Crushing	53	23
Conveying to Mill Building	4	2
Mill Building Operations – Grinding, Front End Loader (FEL) and Storage Operations	244	22
Heavy Vehicle Haulage on Gravel Surfaces	2,235	631
Wind Erosion – Existing Stockpile – 1	677	338
Wind Erosion – Existing Stockpile – 2	170	85
Wind Erosion – Existing Stockpile – 3	612	306
Wind Erosion – Existing Stockpile – 4	290	145
Wind Erosion – Existing Stockpile – 5	193	97
Total TSP Emissions	**4,499**	**1,660**

6.4 Plant 1 – Existing Operations

As mentioned in **Section 5.2.8**, the current Scope of Work for this assessment excludes assessing impacts from Plant 1. However, as no air quality monitoring is undertaken by Brickworks and taking into consideration that Plant 1 is located adjacent to Plant 2, emission rates have been quantified for Plant 1 in order to comprehensively determine cumulative air quality impacts within the near-field region.

Similar to Plant 2, the main sources of air emissions associated with Plant 1 are the flue gas emissions from the existing brick kiln stack and fugitive particulate emissions generated from Plant 1 activities. As mentioned earlier, Airlabs undertake regular stack emission testing at Plant 1 and as-such, emissions data from the most recent testing undertaken in 2014 has been used for quantifying Plant 1 stack emissions (refer **Table 19**).

No information on fugitive particulate matter emissions corresponding to Plant 1 is available. As-such, Airlabs have conservatively assumed that the fugitive particulate matter emissions for Plant 1 will be similar Plant 2 (**Table 20**). This assumption is considered to be valid, considering the operational similarities between Plant 1 and Plant 2.

6.5 Construction Emissions

Construction activities for the Project will be undertaken in a staged approach as shown below:

- Construction Stage 1: Dewatering of the existing dam. The water will be treated prior to discharge into Eastern Creek;
- Construction Stage 2: Excavation and treatment of saturated material at the base of the dam which is unsuitable for subgrade of the proposed basins;
- Construction Stage 3: Construction of new basin embankments using compacted fill from Stockpile No.2. The basins will then be operational for use as sediment control measures during bulk earthworks on the wider site;
- Construction Stage 4: Excavation of the existing bund south of the existing factory for use as fill across the site;
- Construction Stage 5: Controlled filling of the crusher/screener pad, main stockpile pad and access road; and
- Construction Stage 6: Controlled filling of the crusher/screener pad, main stockpile pad and access road

Construction Stages 1 to 4 comprise site preparation activities, which primarily include cut, fill and drainage works. Earthworking / construction activities pertaining to Stage 5 correspond to Production Stage 1 (300,000 tpa) and Stage 6 activities correspond to Production Stage 2 (300,000 tpa in addition to Stage 1)

Construction based activities which have a potential to generate dust emissions include:

- Earthwork operations such as excavation and topsoil stripping;
- Handling of spoil and structural fill material;
- Wind erosion from exposed areas and stockpiles;
- Wheel generated dust from haulage on paved roads, unpaved roads or other work areas.

Based on information provided by Brickworks, equipment likely to generate dust emissions during specific stages of construction are identified and presented in **Table 21**.

Table 21: Construction Stages and Associated Sources of Dust Generation

Construction Stages	Associated Equipment
Stage 1 to Stage 4 - Site preparation (Cut, Fill and Drainage works)	1 x Excavators 1 x Back Hoe 1 x Dump truck 1 x Roller 1 x Dozer 1 x Scraper 1 x Grader 1 x Trencher 1 x Water truck
Stage 5 – Production Stage 1	1 x Concrete truck 1 x Articulated truck 1 x Dump truck 1 x Water truck
Stage 6 – Production Stage 2	Same as Stage 5

Given that construction activities are progressive in nature and considering the proximity of the nearest sensitive receptor (0.5km from the facility boundary), the potential for these activities to adversely impact local air quality is unlikely. Additionally dust emissions during construction activities would take place sporadically over a larger area and this would significantly limit the potential for any adverse off-site impacts. Though, it is unlikely that there would be any significant off-site dust impacts arising from construction activities for Production Stage 1 and Production Stage 2, Brickworks are proposing the following dust mitigation measures.

Table 22: Construction Dust Mitigation Measures

Source of Dust	Mitigation Measure	Timing
General	Identify dust generating activities and inform site personnel about location of nearby sensitive receptors.	Throughout construction
	Identify adverse weather conditions (dry and high wind blowing from dust source to sensitive receptors) and halt dust emitting activities if visible dust impacts are identified at sensitive receptors.	Throughout construction
Handling of spoil and structural fill material	Minimise drop height for material handling equipment.	Throughout construction
Wind generated dust from stockpiles and exposed areas	Apply watering through water trucks or sprinklers.	As required
	Progressive staging of dust generating activities throughout the day to avoid concurrent dust emission.	Throughout construction
	Minimise exposed area if possible.	Throughout

Source of Dust	Mitigation Measure	Timing
		construction
	Minimise amount of material stockpiled if possible.	Throughout construction
Wheel generated dust during hauling	Restrict vehicle movement to haul routes that are watered regularly.	Throughout construction
	Watering of unpaved haul roads.	As required
	Cleaning of haul roads.	As required
	Speed restrictions	Throughout construction

Combustion of diesel or petrol fuels (from vehicle movements and mobile machinery) could generate emissions of particulate matter, CO, SO_2, NO_X and VOCs. Based on the relatively small amount of fuel burning during the construction phase, emissions from vehicle exhaust and mobile machinery are not likely to cause adverse impacts on surrounding sensitive receptors.

7. DISPERSION MODELLING METHODOLOGY

7.1 Modelling Overview

In order to predict impacts at the identified sensitive receptors (**Table 2**) from the emissions inventoried in **Section 6**, air dispersion modelling was undertaken using the combination of the following mathematical models TAPM and CALMET / CALPUFF.

- **TAPM**: The Air Pollution Model (TAPM) is a prognostic meteorological model that generates three-dimensional (3D) meteorological data and air pollution concentrations;
- **CALMET**: CALMET is the meteorological pre-processor for the dispersion model CALPUFF, Using geophysical information and observed/simulated surface and upper air data as inputs, hourly wind fields and temperature fields are generated on a three-dimensional (3-D) gridded modelling domain. Associated two-dimensional (2-D) fields such as mixing height, surface characteristics, and dispersion properties are also included in the field produced by CALMET (SRC, 2000);
- **CALPUFF**: CALPUFF is the dispersion model that calculates the dispersion of plumes within the three-dimensional (3D) meteorological field calculated by CALMET. CALPUFF is a non-steady state US-EPA approved dispersion model which “advects” puffs of material emitted from modelled sources, simulating dispersion and transformation processes along the way. In doing so, it typically uses the wind fields generated by CALMET. Temporal and spatial variations in the meteorological fields selected are explicitly incorporated in the resulting distribution of puffs throughout a simulation period (SRC, 2011)

7.2 Dispersion Meteorology

Meteorological mechanisms govern the generation, dispersion, transformation and eventual removal of pollutants from the atmosphere. The local meteorology at the site plays a significant role in understanding the pollutant transport and dispersion mechanisms, and in order to adequately characterise the local meteorological conditions, information is needed on key parameters such as prevailing wind regime, mixing depth, atmospheric stability, ambient temperatures, rainfall and relative humidity. The following sections outline the methodology for characterising the local meteorological conditions at the Project Site.

7.2.1 TAPM

Three-dimensional (3D) prognostic meteorological data was predicted for the Project Site using the Commonwealth Scientific and Industrial Research Organisation (CSIRO) developed The Air Pollution Model (TAPM) V4.0.5. TAPM is a prognostic model which is used to predict three-dimensional (3D) meteorological data and air pollution concentrations.

The model predicts a time-series dataset comprising of parameters like wind speed, wind direction, temperature, pressure, water vapour, cloud, rain, mixing heights, atmospheric stability classes which are essential for dispersion modelling. The software allows users to generate synthetic observations by referencing in-built databases (e.g. terrain information, synoptic scale meteorological observations, vegetation and soil type etc.) which are subsequently used in generating site-specific hourly meteorological observations.

Additionally, the software also allows for assimilating local meteorological observations through nudging. As on-site meteorological monitoring is not undertaken at the Project Site, hourly average weather monitoring data was sourced from the nearest BoM Automatic Weather Station (BoM – AWS), which is the Horsley Park Equestrian Centre AWS (Station No: 067119), which is located approximately 2.5km south south west (SSW) of the Project Site. The AWS has been operational since 1997 and measures all key meteorological parameters such as wind speed, wind direction, temperature, relative humidity etc. in hourly time-steps. Meteorological data was obtained for the last five (5) years (2010-2014) from the AWS and analysed to determine a representative year for use in the dispersion model. **Appendix C** provides an analysis of the meteorological data from 2010-2014 at the BoM Horsley Park AWS. Based on the analysis, 2014 was considered to be a representative year, as the data compares well with the previous years and no distinct anomalies have been identified for the 2014 dataset. Additionally, flue gas emission rates for the existing Plant 1 and Plant 2 operations have been referenced from emission testing that was undertaken in 2014 (Airlabs, 2014) and as-such, meteorological data from the 2014 calendar year was considered for the modelling.

For the Project, TAPM simulation was run for the calendar year 2014 and was setup using four (4) nested 25 x 25 grids, (30km, 10km, 3km and 1km) centred on latitude 33°, 49.5' south, longitude 150°, 52' east, which is within the Project Site. Thirty (30) vertical levels were used with the lowest level being 10m and the highest level being 8km. Hourly average, wind speed and wind direction observations from the BoM Horsley Park AWS for the corresponding year were assimilated into the model, via the data assimilation function.

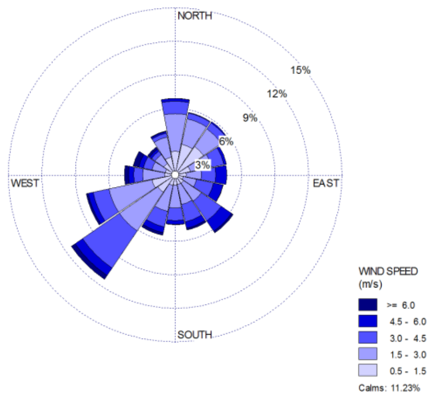
7.2.2 CALMET

As mentioned earlier, CALMET is the meteorological pre-processor for the dispersion model CALPUFF. For the integration of TAPM output into CALMET, the CALTAPM utility program was used which converts TAPM output into a CALMET compatible format. The meteorological modelling domain for CALMET for the calendar year 2014 consisted of a grid extending 20km east-west and 20km north-south, with a grid spacing of 250m. The meteorological grid domain was located in the centre of the Plant 2 facility bearing Easting coordinates 302824m and Northing coordinates 6255126m, located in the Universal Transverse Mercator (UTM) Zone 56.

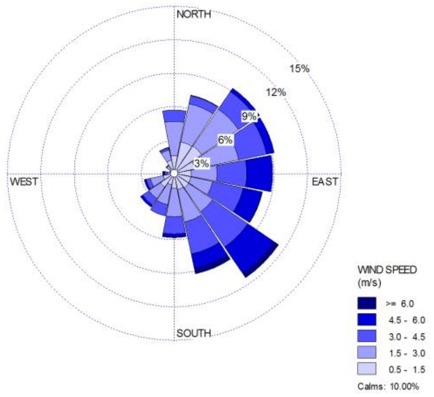
CALMET was run in 'No-Observation' (No-Obs) mode as the predicted prognostic data from TAPM included observations from the BoM Horsley Park Centre AWS, via the data assimilation function. The CALMET model settings were in accordance with the '*Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia*' (OEH, 2011). As per this document, the No-Obs mode is the preferred method for regulatory screening modelling as long as good quality prognostic data is available, which is the case for this Project. The radius of influence of terrain (TERRAD) was estimated to be 4km based on the methodology provided in *Section 3.2.3 Choosing a value for*

TERRAD (OEH, 2011). The output from the CALMET model is shown below in the form of wind roses in **Figure 11**.

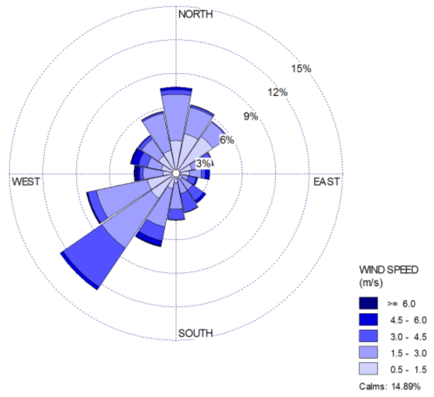
Figure 11: Annual and Seasonal Wind Roses for 2014 – CALMET Predictions



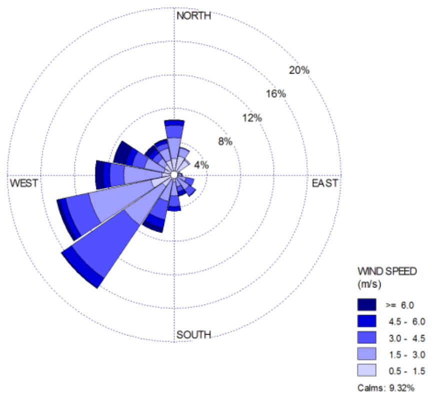
Annual



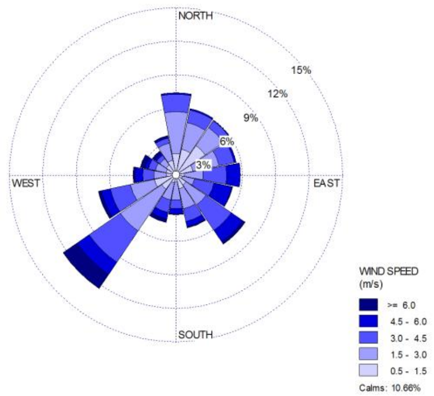
Summer



Autumn



Winter



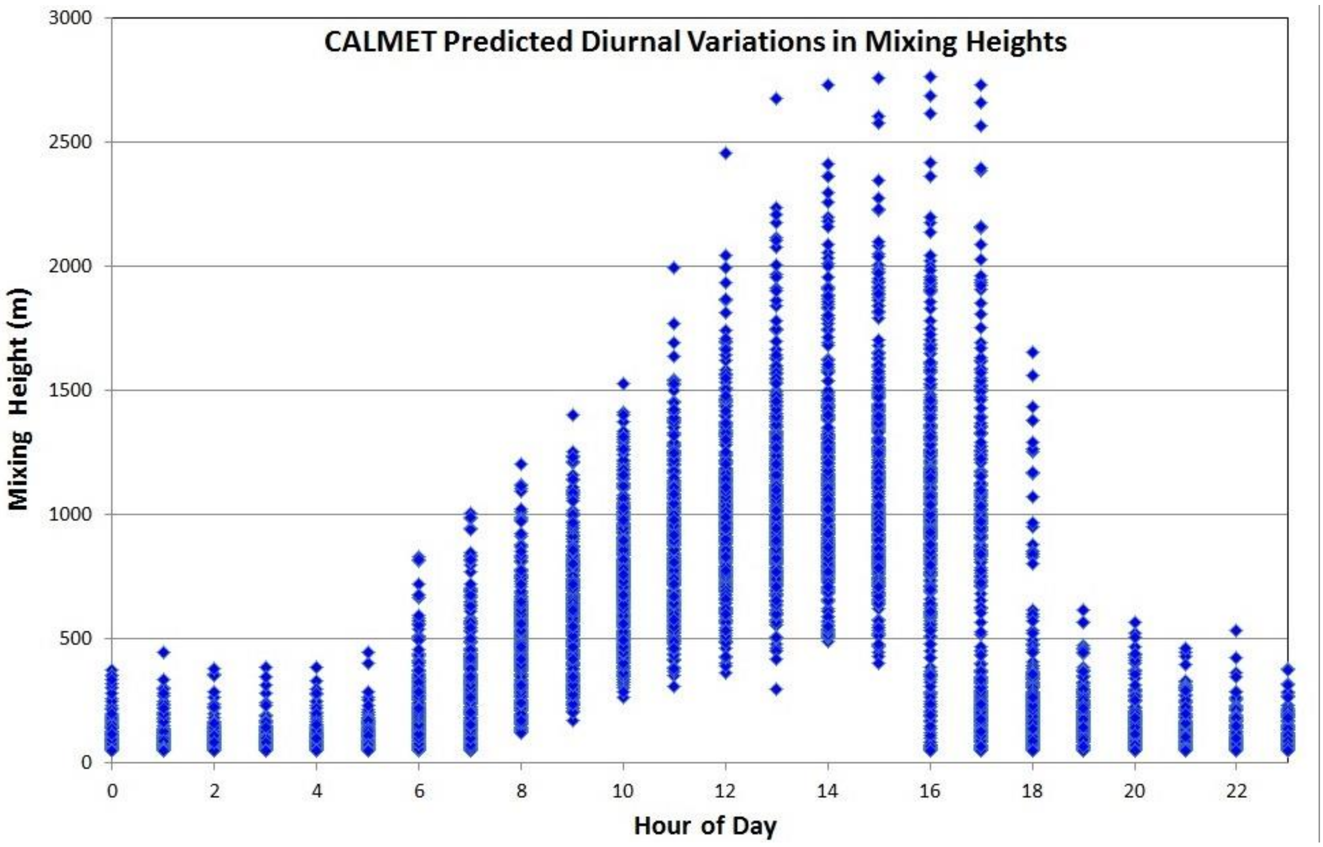
Spring

From the wind roses illustrated in **Figure 11**, the following observations are made:

- Prevailing winds on an annual basis are predominantly from the west south western and south western sector, with these sectors cumulatively contributing to approximately 20% of the annual wind flow;
- Seasonal variation is observed in the wind patterns as majority of the winds during autumn and winter season are from the west south western and south-western sector, whereas during summer, winds are prevalent from the eastern, north-eastern and south-eastern quadrants and during spring, wind distribution tends to be a lot more varied;
- The area is characterised by light to moderate wind speeds (1.5-5.5 m/sec) for about 60% of the time, whereas high winds (>5.5m/sec) occur for approximately 3.5% of the total time. The average wind speed for the 2014 calendar year was 2.3 m/sec;

Diurnal variations in the mixing heights predicted by the CALMET model are illustrated in **Figure 12**. It is observed that the mixing height gradually increases during the morning hours after sunrise and is typically at the highest during mid to later afternoon and then showing a gradual decrease after sunset.

Figure 12: CALMET Predicted Diurnal Variation in Mixing Heights – 2014



7.3 CALPUFF Model Configuration

The CALPUFF model domain was set as a sub-set of the CALMET model domain, with the sampling grid extending 12.5km east-west and 12.5km north-south with a grid spacing of 250m, similar to the CALMET grid spacing settings, with no nesting factors. Additionally, ground level concentrations have also been predicted at identified sensitive residential receptors (**Table 2**)

Buildings in the vicinity of the sources play a major role in pollutant dispersion as they may create zones of strong turbulence and enhance downward mixing resulting in higher ground-level concentrations. For the Project, the building downwash effects were determined using the US Building Input Program – Plume Rise Model Enhancements (BPIP -PRIME) which is a utility program built into the CALPUFF dispersion model.

All other CALPUFF model settings were referenced from the Generic *Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia*' (OEH, 2011). A sample CALPUFF model file is presented in **Appendix B**.

7.4 Source Parameters

Sources associated with existing and proposed operations have been categorised as either stack emissions or fugitive emissions. Stack parameters for existing and proposed operations which have been incorporated into the CALPUFF model are summarised in **Table 23**

Table 23: Stack Parameters – Existing and Proposed Operations

Stack Parameters	Existing Plant 1 Kiln Stack	Existing Plant 2 Kiln Stack	Proposed Product Combustion Stack 1 (PCS 1) – Stage 1	Proposed Cooling Air Stack (CA 1) – Stage 1	Proposed Product Combustion Stack 2 (PCS 2) – Stage 2	Proposed Cooling Air Stack (CA 2) – Stage 2
Coordinates – Easting (m)	302023	302801	302944	302819	302944	302819
Coordinates – Northing (m)	6255241	6255028	6255005	6255005	6254985	6254985
Height (m)	30	16	37	28	37	28
Diameter (m)	1.6	1.4	1.43	1.47	1.43	1.47
Temperature (C/K)	150/423	175/448	95/368	145/418	95/368	145/418
Exit Velocity (m/sec)	10	14.7 (a)	14.9 (b)	13.2 (c)	14.9 (b)	13.2 (c)
Rate of Release	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous

(a) Exit velocity referenced from Stephenson Environmental, November 2007

(b) Exit velocity determined from stack diameter of 1.43m and a volumetric flow rate of 86,316 m3/hour (actual flow) (information provided by Brickworks)

(c) Exit velocity determined from stack diameter of 1.47m and a volumetric flow rate of 80,942 m3/hour (actual flow) (information provided by Brickworks)

For modelling fugitive dust sources, each dust generating activity (refer **Table 16, Table 17, Table 20**) was represented by a series of volume sources which would be active from 6AM to 6PM seven (7) days of the week, except for wind erosion sources (e.g. wind erosion from stockpiles) which were assigned a continuous rate of release.

It is to be noted that Brickworks typically operate on a five (5) day working-week cycle, however, in order to account for unscheduled weekend activities, which could generate fugitive particulate emissions; it was conservatively assumed that particulate matter emissions corresponding to all fugitive dust sources would be generated seven (7) days of the week across the entire year. For

Plant 1, as no information is available about specific operations, fugitive particulate emissions for Plant 1 (similar to Plant 2, refer **Table 20**) were modelled as a single volume source. As mentioned earlier, accounting for emissions from Plant 1 is considered to be a very conservative option as the Prospect monitoring station will incorporate contribution from Plant 1 and subsequently the contribution from Plant 1 will be added to the background air quality data to predict cumulative concentrations.

7.5 Modelled Scenarios

To comprehensively determine air quality impacts associated with existing and proposed operations at the Project Site, the following modelling scenarios were developed:

- **Existing Operations** – Plant 1 and Plant 2 – stack emissions and fugitive particulate emissions;
- **Stage 1 Operation** – Existing operations and Stage 1 stack emissions (PCS 1 and CA 1) and fugitive particulate emissions. Furthermore, in order to determine impacts from the different fuel combustion options, Stage 1 operations were sub-divided into the following:
    - **Stage 1 Option 1**: Combustion of 100% Natural Gas;
    - **Stage 1 Option 2**: Combustion of 90% Construction & Demolition (C&D) / Construction and Industrial (C&I) Timbers and 10% Natural Gas (Preferred choice of fuel for Brickworks); and
    - **Stage 1 Option 3**: Combustion of 90% Refuse Derived Fuel (RDF) – typically comprising municipal and industrial waste and 10% Natural Gas
- **Stage 2 Operations** – Existing and Stage 1 operations and Stage 2 stack emissions (PCS 2 and CA 2) and fugitive particulate emissions. Furthermore, in order to determine impacts from the different fuel combustion options, Stage 2 operations were sub-divided into the following:
    - **Stage 2 Option 1**: Combustion of 100% Natural Gas;
    - **Stage 2 Option 2**: Combustion of 90% Construction & Demolition (C&D) / Construction and Industrial (C&I) Timbers and 10% Natural Gas (Preferred choice of fuel for Brickworks); and
    - **Stage 2 Option 3**: Combustion of 90% Refuse Derived Fuel (RDF) – typically comprising municipal and industrial waste and 10% Natural Gas

8. RESULTS AND DISCUSSION

Ground level incremental (Project related) and cumulative pollutant concentrations predicted at each of the identified sensitive residential receptors (**Table 2**) for all the modelled scenarios (**Section 7.5**) are presented in this section. For the convenience of readers, predicted concentrations for key air pollutants have been tabulated followed by predicted concentrations for speciated VOCs and speciated metals. Incremental and cumulative concentration isopleths for key pollutants corresponding to Stage 2 Option 2 (preferred choice of fuel) operations are presented in **Appendix D**. Predicted concentrations for some of the pollutants are extremely low, and as-such, have been reported using scientific notation. A few examples of scientific notation are shown below:

0.001	1E-03	0.01	1E-02
0.1	1E-01	1	1E+00

Table 24: Predicted Incremental and Cumulative Ground Level Concentrations – Existing Operations

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Total suspended particulates (TSP), annual average incremental concentrations (μg/ m³)	0.53	0.61	0.49	0.48	0.41
Total suspended particulates (TSP), annual average cumulative concentrations (μg/ m³) (Criteria: 90 μg/ m³)	44.5	44.6	44.5	44.5	44.4
Particulate matter less than 10 microns (PM_{10}), highest 24-hour average incremental concentrations (μg/ m³)	4.2	6.1	5.1	3.4	3.1
Particulate matter less than 10 microns (PM_{10}), highest 24-hour average cumulative concentrations (μg/ m³) (Criteria: 50 μg/ m³)	24.2	26.1	25.1	20.4	20.1
Particulate matter less than 10 microns (PM_{10}), annual average incremental concentrations (μg/ m³)	0.7	0.8	0.7	0.6	0.5
Particulate matter less than 10 microns (PM_{10}), annual average cumulative concentrations (μg/ m³) (Criteria: 30 μg/ m³)	18.7	18.8	18.7	18.6	18.5
Deposited dust, annual average incremental levels (g/m²/month)	0.05	0.05	0.04	0.04	0.04
Deposited dust, annual average cumulative levels (g/m²/month) (Criteria: 4 g/m²/month)	2.1	2.1	2.1	2.1	2.1
Hydrogen fluoride (HF), highest 24-hour average incremental concentrations (μg/ m³) (Criteria: 2.9 μg/ m³)	0.8	0.8	0.7	1.1	1.0
Hydrogen fluoride (HF), highest 7-days average incremental concentrations (μg/ m³) (Criteria: 1.7 μg/ m³)	0.3	0.4	0.3	0.3	0.3

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Hydrogen fluoride (HF), monthly average incremental concentrations (µg/ m^3) (Criteria: 0.84 µg/ m^3)	0.24	0.22	0.21	0.20	0.17
Hydrogen fluoride (HF), highest 90-days incremental concentrations (µg/ m^3) (Criteria: 0.5 µg/ m^3)	0.2	0.2	0.2	0.2	0.1
Hydrogen chloride (HCl), highest 1-hour average incremental concentrations (mg/ m^3) (Criteria: 0.14 mg/m^3)	0.01	0.01	0.01	0.01	0.01
Nitrogen dioxide (NO_2), highest 1-hour average incremental concentrations (µg/ m^3)	8.4	10.6	11.6	14.3	11.4
Nitrogen dioxide (NO_2), highest 1-hour average cumulative concentrations (µg/ m^3) (Criteria: 246 µg/ m^3)	96	99	100	102	99
Nitrogen dioxide (NO_2), annual average incremental concentrations (µg/ m^3)	0.2	0.2	0.2	0.2	0.2
Nitrogen dioxide (NO_2), annual average cumulative concentrations (µg/ m^3) (Criteria: 62 µg/ m^3)	42.2	42.2	42.2	42.2	42.2
Sulphur dioxide (SO_2), highest 10-minutes average incremental concentrations (µg/ m^3)	36.6	46.1	50.4	62.1	49.3
Sulphur dioxide (SO_2), highest 10-minutes average cumulative concentrations (µg/ m^3) (Criteria: 712 µg/ m^3)	119	129	133	145	132
Sulphur dioxide (SO_2), highest 1-hour average incremental concentrations (µg/ m^3)	22.2	28.0	30.6	37.7	29.9
Sulphur dioxide (SO_2), highest 1-hour average cumulative concentrations (µg/ m^3) (Criteria: 570 µg/ m^3)	72	78	81	88	80
Sulphur dioxide (SO_2), highest 24-hour average incremental concentrations (µg/ m^3)	4.6	4.4	4.0	5.9	5.3

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Sulphur dioxide (SO_2), highest 24-hour average cumulative concentrations (μg/ m^3) (Criteria: 228 μg/ m^3)	55	54	54	56	55
Sulphur dioxide (SO_2), annual average incremental concentrations (μg/ m^3)	0.6	0.6	0.6	0.6	0.6
Sulphur dioxide (SO_2), annual average cumulative concentrations (μg/ m^3) (Criteria: 60 μg/ m^3)	7.6	7.6	7.6	7.6	7.6
Speciated VOCs					
Benzene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.029 mg/m^3)	9E-05	1E-04	1E-04	2E-04	1E-04
Chloroethane, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 48 mg/m^3)	2E-05	3E-05	3E-05	4E-05	3E-05
Chloromethane, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 1.9 mg/m^3)	9E-05	1E-04	1E-04	2E-04	1E-04
Toluene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.36 mg/m^3)	4E-05	4E-05	5E-05	6E-05	54E-05
Speciated Metals					
Antimony, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.009 mg/m^3)	1E-08	2E-08	2E-08	2E-08	2E-08
Arsenic, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.00009 mg/m^3)	1E-06	1E-06	1E-06	2E-06	1E-06
Chromium VI, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.00009 mg/m^3)	3E-06	3E-06	3E-06	4E-06	3E-06
Lead, annual average incremental concentrations (μg/ m^3) (Criteria: 0.5 μg/m^3)	2.2E-05	2.3E-05	2.2E-05	2.3E-05	2.2E-05

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Manganese, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.018 mg/m^3)	2E-05	3E-05	3E-05	4E-05	3E-05
Mercury, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.0018 mg/m^3)	3E-06	4E-06	4E-06	6E-06	4E-06
Nickel (Ni), highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.00018 mg/m^3)	3E-05	4E-05	4E-05	6E-05	4E-05

Table 25: Predicted Incremental and Cumulative Ground Level Concentrations – Existing and Stage 1 Operations – Option 1 (100% Natural Gas)

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Total suspended particulates (TSP), annual average incremental concentrations (µg/ m^3)	0.57	0.67	0.56	0.66	0.57
Total suspended particulates (TSP), annual average cumulative concentrations (µg/ m^3) (Criteria: 90 µg/ m^3)	44.6	44.7	44.6	44.7	44.6
Particulate matter less than 10 microns (PM_{10}), highest 24-hour average incremental concentrations (µg/ m^3)	5.1	6.5	5.7	4.0	3.7
Particulate matter less than 10 microns (PM_{10}), highest 24-hour average cumulative concentrations (µg/ m^3) (Criteria: 50 µg/ m^3)	25.1	26.5	25.7	21	20.7
Particulate matter less than 10 microns (PM_{10}), annual average incremental concentrations (µg/ m^3)	0.8	0.9	0.8	0.7	0.6
Particulate matter less than 10 microns (PM_{10}), annual average cumulative concentrations (µg/ m^3) (Criteria: 30 µg/ m^3)	18.8	18.9	18.8	18.7	18.6
Deposited dust, annual average incremental levels (g/m^2/month)	0.05	0.06	0.05	0.06	0.05
Deposited dust, annual average cumulative levels (g/m^2/month) (Criteria: 4 g/m^2/month)	2.1	2.2	2.1	2.2	2.1
Hydrogen fluoride (HF), highest 24-hour average incremental concentrations (µg/ m^3) (Criteria: 2.9 µg/ m^3)	0.9	0.9	0.8	1.5	1.3
Hydrogen fluoride (HF), highest 7-days average incremental concentrations (µg/ m^3) (Criteria: 1.7 µg/ m^3)	0.4	0.4	0.4	0.4	0.4

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Hydrogen fluoride (HF), monthly average incremental concentrations (µg/ m^3) (Criteria: 0.84 µg/ m^3)	0.26	0.23	0.23	0.29	0.26
Hydrogen fluoride (HF), highest 90-days incremental concentrations (µg/ m^3) (Criteria: 0.5 µg/ m^3)	0.2	0.2	0.2	0.2	0.2
Hydrogen chloride (HCl), highest 1-hour average incremental concentrations (mg/ m^3) (Criteria: 0.14 mg/m^3)	0.01	0.01	0.01	0.01	0.01
Nitrogen dioxide (NO_2), highest 1-hour average incremental concentrations (µg/ m^3)	14.3	12.4	17.8	35.1	34.9
Nitrogen dioxide (NO_2), highest 1-hour average cumulative concentrations (µg/ m^3) (Criteria: 246 µg/ m^3)	102	100	106	123	123
Nitrogen dioxide (NO_2), annual average incremental concentrations (µg/ m^3)	0.3	0.3	0.3	0.6	0.6
Nitrogen dioxide (NO_2), annual average cumulative concentrations (µg/ m^3) (Criteria: 62 µg/ m^3)	42.3	42.3	42.3	42.6	42.6
Sulphur dioxide (SO_2), highest 10-minutes average incremental concentrations (µg/ m^3)	37.5	46.7	50.4	76.3	65.3
Sulphur dioxide (SO_2), highest 10-minutes average cumulative concentrations (µg/ m^3) (Criteria: 712 µg/ m^3)	120	129	133	159	148
Sulphur dioxide (SO_2), highest 1-hour average incremental concentrations (µg/ m^3)	22.7	28.3	30.6	46.2	39.6
Sulphur dioxide (SO_2), highest 1-hour average cumulative concentrations (µg/ m^3) (Criteria: 570 µg/ m^3)	73	78	81	96	90
Sulphur dioxide (SO_2), highest 24-hour average incremental concentrations (µg/ m^3)	4.9	4.7	4.2	8.1	6.9

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Sulphur dioxide (SO_2), highest 24-hour average cumulative concentrations (µg/ m^3) (Criteria: 228 µg/ m^3)	55	55	54	58	57
Sulphur dioxide (SO_2), annual average incremental concentrations (µg/ m^3)	0.6	0.6	0.6	0.8	0.8
Sulphur dioxide (SO_2), annual average cumulative concentrations (µg/ m^3) (Criteria: 60 µg/ m^3)	7.6	7.6	7.6	7.8	7.8
Carbon monoxide (CO), highest 15-minutes average incremental concentrations (mg/ m^3)	0.003	0.002	0.003	0.006	0.007
Carbon monoxide (CO), highest 15-minutes average cumulative concentrations (mg/ m^3) (Criteria: 100 mg/ m^3)	4.1	4.1	4.1	4.1	4.1
Carbon monoxide (CO), highest 1-hour average incremental concentrations (mg/ m^3)	0.002	0.001	0.002	0.004	0.004
Carbon monoxide (CO), highest 1-hour average cumulative concentrations (mg/ m^3) (Criteria: 30 mg/ m^3)	2.5	2.5	2.5	2.5	2.5
Carbon monoxide (CO), highest 8-hour average incremental concentrations (mg/ m^3)	0.001	0.001	0.001	0.002	0.002
Carbon monoxide (CO), highest 8-hour average cumulative concentrations (mg/ m^3) (Criteria: 30 mg/ m^3)	1.5	1.5	1.5	1.5	1.5
Polycyclic aromatic hydrocarbons (PAHs) as Benzo(a)pyrene (BaP), highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.0004 mg/m^3)	2E-08	2E-08	3E-08	6E-08	5E-08
Dioxins and furans, highest 1-hour average incremental concentrations (mg/m^3) TEQ (Criteria: 2.0E-09 mg/m^3)	1.2E-13	1.3E-13	1.5E-13	3.1E-13	2.9E-13
Speciated VOCs					

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Acetone, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 22 mg/m^3)	3E-05	3E-05	4E-05	7E-05	7E-05
Benzene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.029 mg/m^3)	1E-04	1E-04	2E-04	3E-04	3E-04
Carbon disulphide, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.07 mg/m^3)	7E-07	8E-07	9E-07	2E-06	2E-06
Chloroethane, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 48 mg/m^3)	3E-08	3E-08	3E-08	7E-08	6E-08
Chloromethane, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 1.9 mg/m^3)	7E-05	8E-05	1E-04	2E-04	2E-04
Ethyl benzene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 8 mg/m^3)	7E-07	8E-07	1E-06	2E-06	2E-06
Phenol, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.02 mg/m^3)	1E-06	2E-06	2E-06	4E-06	4E-06
Styrene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.12 mg/m^3)	3E-07	4E-07	4E-07	9E-07	8E-07
Tetrachloroethylene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 3.5 mg/m^3)	5E-08	5E-08	6E-08	1E-07	1E-07
Toluene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.36 mg/m^3)	5E-05	6E-05	7E-05	1E-04	1E-04
Xylene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.19 mg/m^3)	2E-06	2E-06	3E-06	5E-06	5E-06
Speciated Metals					
Antimony, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.009 mg/m^3)	9E-09	1E-08	1E-08	2E-08	2E-08

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Arsenic, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.00009 mg/m^3)	9E-07	1E-06	1E-06	2E-06	2E-06
Beryllium, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.000004 mg/m^3)	7E-10	8E-10	9E-10	2E-09	2E-09
Cadmium, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.000018 mg/m^3)	3E-08	3E-08	4E-08	8E-08	7E-08
Chromium III highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.009 mg/m^3)	5E-09	5E-09	6E-09	1E-08	1E-08
Chromium VI, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.00009 mg/m^3)	2E-06	2E-06	3E-06	5E-06	5E-06
Copper, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.018 mg/m^3)	3E-09	3E-09	4E-09	8E-09	7E-09
Lead, annual average incremental concentrations ($\mu g/m^3$) (Criteria: 0.5 $\mu g/m^3$)	1.8E-05	2.0E-05	2.0E-05	3.0E-05	3.1E-05
Manganese, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.018 mg/m^3)	2E-05	2E-05	2E-05	5E-05	4E-05
Mercury, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.0018 mg/m^3)	3E-06	3E-06	3E-06	7E-06	7E-06
Nickel (Ni), highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.00018 mg/m^3)	3E-05	3E-05	3E-05	7E-05	6E-05

Table 26: Predicted Incremental and Cumulative Ground Level Concentrations – Existing and Stage 1 Operations – Option 2 (90% Timber &10% Natural Gas)

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Total suspended particulates (TSP), annual average incremental concentrations (µg/ m^3)	0.57	0.67	0.56	0.66	0.57
Total suspended particulates (TSP), annual average cumulative concentrations (µg/ m^3) (Criteria: 90 µg/ m^3)	44.6	44.7	44.6	44.7	44.6
Particulate matter less than 10 microns (PM_{10}), highest 24-hour average incremental concentrations (µg/ m^3)	5.1	6.5	5.7	4.0	3.7
Particulate matter less than 10 microns (PM_{10}), highest 24-hour average cumulative concentrations (µg/ m^3) (Criteria: 50 µg/ m^3)	25.1	26.5	25.7	21	20.7
Particulate matter less than 10 microns (PM_{10}), annual average incremental concentrations (µg/ m^3)	0.8	0.9	0.8	0.7	0.6
Particulate matter less than 10 microns (PM_{10}), annual average cumulative concentrations (µg/ m^3) (Criteria: 30 µg/ m^3)	18.8	18.9	18.8	18.7	18.6
Deposited dust, annual average incremental levels (g/m^2/month)	0.05	0.06	0.05	0.06	0.05
Deposited dust, annual average cumulative levels (g/m^2/month) (Criteria: 4 g/m^2/month)	2.1	2.2	2.1	2.2	2.1
Hydrogen fluoride (HF), highest 24-hour average incremental concentrations (µg/ m^3) (Criteria: 2.9 µg/ m^3)	0.9	0.9	0.8	1.5	1.3
Hydrogen fluoride (HF), highest 7-days average incremental concentrations (µg/ m^3) (Criteria: 1.7 µg/ m^3)	0.4	0.4	0.4	0.4	0.4
Hydrogen fluoride (HF), monthly average incremental	0.26	0.23	0.23	0.29	0.26

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	**DR2**	**DR3**	**DR4**	**DR5**
concentrations (μg/ m³) (Criteria: 0.84 μg/ m³)					
Hydrogen fluoride (HF), highest 90-days incremental concentrations (μg/ m³) (Criteria: 0.5 μg/ m³)	0.2	0.2	0.2	0.2	0.2
Hydrogen chloride (HCl), highest 1-hour average incremental concentrations (mg/ m³) (Criteria: 0.14 mg/m³)	0.01	0.01	0.01	0.01	0.01
Nitrogen dioxide (NO_2), highest 1-hour average incremental concentrations (μg/ m³)	14.3	12.4	17.8	35.1	34.9
Nitrogen dioxide (NO_2), highest 1-hour average cumulative concentrations (μg/ m³) (Criteria: 246 μg/ m³)	102	100	106	123	123
Nitrogen dioxide (NO_2), annual average incremental concentrations (μg/ m³)	0.3	0.3	0.3	0.6	0.6
Nitrogen dioxide (NO_2), annual average cumulative concentrations (μg/ m³) (Criteria: 62 μg/ m³)	42.3	42.3	42.3	42.6	42.6
Sulphur dioxide (SO_2), highest 10-minutes average incremental concentrations (μg/ m³)	37.8	46.8	50.4	78.3	67.6
Sulphur dioxide (SO_2), highest 10-minutes average cumulative concentrations (μg/ m³) (Criteria: 712 μg/ m³)	120	129	133	161	150
Sulphur dioxide (SO_2), highest 1-hour average incremental concentrations (μg/ m³)	22.9	28.4	30.6	47.4	41.0
Sulphur dioxide (SO_2), highest 1-hour average cumulative concentrations (μg/ m³) (Criteria: 570 μg/ m³)	73	78	81	97	91
Sulphur dioxide (SO_2), highest 24-hour average incremental concentrations (μg/ m³)	5.0	4.7	4.3	8.4	6.9

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Sulphur dioxide (SO_2), highest 24-hour average cumulative concentrations (µg/ m³) (Criteria: 228 µg/ m³)	55	55	54	58	57
Sulphur dioxide (SO_2), annual average incremental concentrations (µg/ m³)	0.6	0.6	0.6	0.8	0.7
Sulphur dioxide (SO_2), annual average cumulative concentrations (µg/ m³) (Criteria: 60 µg/ m³)	7.6	7.6	7.6	7.8	7.8
Carbon monoxide (CO), highest 15-minutes average incremental concentrations (mg/ m³)	0.004	0.003	0.004	0.008	0.009
Carbon monoxide (CO), highest 15-minutes average cumulative concentrations (mg/ m³) (Criteria: 100 mg/ m³)	4.1	4.1	4.1	4.1	4.1
Carbon monoxide (CO), highest 1-hour average incremental concentrations (mg/ m³)	0.002	0.002	0.003	0.005	0.006
Carbon monoxide (CO), highest 1-hour average cumulative concentrations (mg/ m³) (Criteria: 30 mg/ m³)	2.5	2.5	2.5	2.5	2.5
Carbon monoxide (CO), highest 8-hour average incremental concentrations (mg/ m³)	0.001	0.001	0.002	0.003	0.003
Carbon monoxide (CO), highest 8-hour average cumulative concentrations (mg/ m³) (Criteria: 30 mg/ m³)	1.5	1.5	1.5	1.5	1.5
Polycyclic aromatic hydrocarbons (PAHs) as Benzo(a)pyrene (BaP), highest 1-hour average incremental concentrations (mg/m³) (Criteria: 0.0004 mg/m³)	8E-06	9E-06	1E-05	2E-05	2E-05
Dioxins and furans, highest 1-hour average incremental concentrations (mg/m³) TEQ (Criteria: 2.0E-09 mg/m³)	1.6E-12	1.8E-12	2.1E-12	4.2E-12	4.0E-12
Speciated VOCs					

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Acrylonitrile, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.008 mg/m^3)	2E-07	3E-07	3E-07	6E-07	6E-07
Acetone, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 22 mg/m^3)	9E-06	1E-05	1E-05	2E-05	2E-05
Benzene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.029 mg/m^3)	8E-05	9E-05	1E-04	2E-04	2E-04
Carbon disulphide, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.07 mg/m^3)	3E-07	3E-07	4E-07	8E-07	7E-07
Chloroethane, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 48 mg/m^3)	2E-05	2E-05	2E-05	2E-05	2E-05
Chloroform, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.9 mg/m^3)	4E-09	5E-09	6E-09	1E-08	1E-08
Chloromethane, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 1.9 mg/m^3)	7E-05	8E-05	1E-04	2E-04	2E-04
Ethyl benzene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 8 mg/m^3)	2E-07	2E-07	3E-07	5E-07	5E-07
Methylene chloride, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 3.19 mg/m^3)	1E-07	1E-07	1E-07	3E-07	3E-07
Phenol, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.02 mg/m^3)	1E-06	1E-06	2E-06	3E-06	3E-06
Styrene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.12 mg/m^3)	4E-08	4E-08	5E-08	1E-07	1E-07
Tetrachloroethylene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 3.5 mg/m^3)	9E-09	1E-08	1E-08	2E-08	2E-08
Toluene, highest 1-hour average incremental concentrations	3E-05	4E-05	4E-05	8E-05	8E-05

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
(mg/m^3) (Criteria: 0.36 mg/m^3)					
Xylene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.19 mg/m^3)	7E-07	8E-07	9E-07	2E-06	2E-06
1,1,1-Trichloroethane, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 12.5 mg/m^3)	4E-09	5E-09	6E-09	1E-08	1E-08
Speciated Metals					
Antimony, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.009 mg/m^3)	9E-09	1E-08	1E-08	2E-08	2E-09
Arsenic, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.00009 mg/m^3)	9E-07	1E-06	1E-06	2E-06	2E-06
Beryllium, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.000004 mg/m^3)	7E-10	8E-10	9E-10	2E-09	2E-09
Cadmium, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.000018 mg/m^3)	1E-07	1E-07	1E-07	3E-07	2E-07
Chromium III highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.009 mg/m^3)	6E-08	7E-08	8E-08	2E-07	2E-07
Chromium VI, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.00009 mg/m^3)	2E-06	2E-06	3E-06	5E-06	5E-06
Copper (Cu), highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.018 mg/m^3)	1E-07	2E-07	2E-07	4E-07	4E-07
Lead, annual average incremental concentrations (µg/ m^3) (Criteria: 0.5 µg/m^3)	2.2E-05	2.4E-05	2.4E-05	3.6E-05	3.7E-05
Manganese, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.018 mg/m^3)	4E-05	4E-05	5E-05	1E-05	9E-05

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Mercury, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.0018 mg/m^3)	3E-06	3E-06	3E-06	7E-06	7E-06
Nickel (Ni), highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.00018 mg/m^3)	3E-05	3E-05	3E-05	7E-05	6E-05

Table 27: Predicted Incremental and Cumulative Ground Level Concentrations – Existing and Stage 1 Operations – Option 3 (90% RDF &10% Natural Gas)

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Total suspended particulates (TSP), annual average incremental concentrations (μg/ m³)	0.57	0.67	0.56	0.66	0.57
Total suspended particulates (TSP), annual average cumulative concentrations (μg/ m³) (Criteria: 90 μg/ m³)	44.6	44.7	44.6	44.7	44.6
Particulate matter less than 10 microns (PM_{10}), highest 24-hour average incremental concentrations (μg/ m³)	5.1	6.5	5.7	4.0	3.7
Particulate matter less than 10 microns (PM_{10}), highest 24-hour average cumulative concentrations (μg/ m³) (Criteria: 50 μg/ m³)	25.1	26.5	25.7	21	20.7
Particulate matter less than 10 microns (PM_{10}), annual average incremental concentrations (μg/ m³)	0.8	0.9	0.8	0.7	0.6
Particulate matter less than 10 microns (PM_{10}), annual average cumulative concentrations (μg/ m³) (Criteria: 30 μg/ m³)	18.8	18.9	18.8	18.7	18.6
Deposited dust, annual average incremental levels (g/m²/month)	0.05	0.06	0.05	0.06	0.05
Deposited dust, annual average cumulative levels (g/m²/month) (Criteria: 4 g/m²/month)	2.1	2.2	2.1	2.2	2.1
Hydrogen fluoride (HF), highest 24-hour average incremental concentrations (μg/ m³) (Criteria: 2.9 μg/ m³)	0.9	0.9	0.8	1.5	1.3
Hydrogen fluoride (HF), highest 7-days average incremental concentrations (μg/ m³) (Criteria: 1.7 μg/ m³)	0.4	0.4	0.4	0.4	0.4

Pollutant, Averaging Period and Units	**Predicted Ground Level Concentrations**				
	DR1	**DR2**	**DR3**	**DR4**	**DR5**
Hydrogen fluoride (HF), monthly average incremental concentrations (µg/ m^3) (Criteria: 0.84 µg/ m^3)	0.26	0.23	0.23	0.29	0.26
Hydrogen fluoride (HF), highest 90-days incremental concentrations (µg/ m^3) (Criteria: 0.5 µg/ m^3)	0.2	0.2	0.2	0.2	0.2
Hydrogen chloride (HCl), highest 1-hour average incremental concentrations (mg/ m^3) (Criteria: 0.14 mg/m^3)	0.01	0.01	0.01	0.02	0.01
Nitrogen dioxide (NO_2), highest 1-hour average incremental concentrations (µg/ m^3)	22	18.8	26.3	51	52.9
Nitrogen dioxide (NO_2), highest 1-hour average cumulative concentrations (µg/ m^3) (Criteria: 246 µg/ m^3)	110	107	114	139	141
Nitrogen dioxide (NO_2), annual average incremental concentrations (µg/ m^3)	0.3	0.3	0.3	0.6	0.6
Nitrogen dioxide (NO_2), annual average cumulative concentrations (µg/ m^3) (Criteria: 62 µg/ m^3)	42.3	42.3	42.3	42.6	42.6
Sulphur dioxide (SO_2), highest 10-minutes average incremental concentrations (µg/ m^3)	36.9	46.5	50.4	72.2	60.7
Sulphur dioxide (SO_2), highest 10-minutes average cumulative concentrations (µg/ m^3) (Criteria: 712 µg/ m^3)	119	129	133	155	143
Sulphur dioxide (SO_2), highest 1-hour average incremental concentrations (µg/ m^3)	22.4	28.2	30.6	43.8	36.8
Sulphur dioxide (SO_2), highest 1-hour average cumulative concentrations (µg/ m^3) (Criteria: 570 µg/ m^3)	72	78	81	94	87
Sulphur dioxide (SO_2), highest 24-hour average incremental concentrations (µg/ m^3)	4.8	4.7	4.2	7.6	6.8

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Sulphur dioxide (SO_2), highest 24-hour average cumulative concentrations (µg/ m^3) (Criteria: 228 µg/ m^3)	55	55	54	58	57
Sulphur dioxide (SO_2), annual average incremental concentrations (µg/ m^3)	0.6	0.6	0.6	0.7	0.7
Sulphur dioxide (SO_2), annual average cumulative concentrations (µg/ m^3) (Criteria: 60 µg/ m^3)	7.6	7.6	7.6	7.7	7.7
Carbon monoxide (CO), highest 15-minutes average cumulative concentrations (mg/ m^3) (Criteria: 100 mg/ m^3)	0.001	0.001	0.001	0.002	0.002
Carbon monoxide (CO), highest 1-hour average incremental concentrations (mg/ m^3)	4.1	4.1	4.1	4.1	4.1
Carbon monoxide (CO), highest 1-hour average incremental concentrations (mg/ m^3)	0.001	0.001	0.001	0.001	0.001
Carbon monoxide (CO), highest 1-hour average cumulative concentrations (mg/ m^3) (Criteria: 30 mg/ m^3)	2.5	2.5	2.5	2.5	2.5
Carbon monoxide (CO), highest 8-hour average incremental concentrations (mg/ m^3)	0.0004	0.0003	0.0004	0.001	0.001
Carbon monoxide (CO), highest 8-hour average cumulative concentrations (mg/ m^3) (Criteria: 30 mg/ m^3)	1.5	1.5	1.5	1.5	1.5
Dioxins and Furans, highest 1-hour average incremental concentrations (mg/m^3) TEQ (Criteria: 2.0E-09 mg/m^3)	1.5E-12	1.7E-12	2.0E-12	4.0E-12	3.8E-12
Speciated Metals					
Antimony, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.009 mg/m^3)	9E-09	1E-08	1E-08	2E-08	2E-08
Arsenic, highest 1-hour average incremental concentrations	2E-06	2E-06	3E-06	5E-06	5E-06

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
(mg/m^3) (Criteria: 0.00009 mg/m^3)					
Cadmium, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.000018 mg/m^3)	2E-06	2E-06	2E-06	4E-06	4E-06
Chromium VI, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.00009 mg/m^3)	5E-06	5E-06	6E-06	1E-05	1E-05
Lead, annual average incremental concentrations ($\mu g/ m^3$) (Criteria: 0.5 $\mu g/m^3$)	1.1E-03	1.1E-03	1.1E-03	1.8E-03	1.8E-03
Manganese, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.018 mg/m^3)	2E-05	2E-05	2E-05	5E-05	4E-05
Mercury, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.0018 mg/m^3)	4E-06	4E-06	5E-06	1E-05	9E-06
Nickel (Ni), highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.00018 mg/m^3)	3E-05	3E-05	3E-05	7E-05	7E-05

Table 28: Predicted Incremental and Cumulative Ground Level Concentrations – Existing, Stage 1 and Stage 2 Operations – Option 1 (100% Natural Gas)

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Total suspended particulates (TSP), annual average incremental concentrations (μg/ m³)	0.6	0.69	0.59	0.77	0.68
Total suspended particulates (TSP), annual average cumulative concentrations (μg/ m³) (Criteria: 90 μg/ m³)	44.6	44.7	44.6	44.8	44.7
Particulate matter less than 10 microns (PM_{10}), highest 24-hour average incremental concentrations (μg/ m³)	5.3	6.8	6.1	4.7	4.4
Particulate matter less than 10 microns (PM_{10}), highest 24-hour average cumulative concentrations (μg/ m³) (Criteria: 50 μg/ m³)	25.3	26.8	26.1	21.7	15.4
Particulate matter less than 10 microns (PM_{10}), annual average incremental concentrations (μg/ m³)	0.8	0.9	0.8	0.8	0.7
Particulate matter less than 10 microns (PM_{10}), annual average cumulative concentrations (μg/ m³) (Criteria: 30 μg/ m³)	18.8	18.9	18.8	18.8	18.7
Deposited dust, annual average incremental levels (g/m²/month)	0.05	0.06	0.05	0.07	0.06
Deposited dust, annual average cumulative levels (g/m²/month) (Criteria: 4 g/m²/month)	2.2	2.2	2.1	2.2	2.2
Hydrogen fluoride (HF), highest 24-hour average incremental concentrations (μg/ m³) (Criteria: 2.9 μg/ m³)	1.0	0.9	0.9	1.8	1.5
Hydrogen fluoride (HF), highest 7-days average incremental concentrations (μg/ m³) (Criteria: 1.7 μg/ m³)	0.4	0.4	0.4	0.5	0.5

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Hydrogen fluoride (HF), monthly average incremental concentrations (μg/ m^3) (Criteria: 0.84 μg/ m^3)	0.28	0.26	0.26	0.36	0.34
Hydrogen fluoride (HF), highest 90-days incremental concentrations (μg/ m^3) (Criteria: 0.5 μg/ m^3)	0.2	0.2	0.2	0.3	0.3
Hydrogen chloride (HCl), highest 1-hour average incremental concentrations (mg/ m^3) (Criteria: 0.14 mg/m^3)	0.01	0.01	0.01	0.02	0.01
Nitrogen dioxide (NO_2), highest 1-hour average incremental concentrations (μg/ m^3)	23.7	21.0	31.6	55.7	58.7
Nitrogen dioxide (NO_2), highest 1-hour average cumulative concentrations (μg/ m^3) (Criteria: 246 μg/ m^3)	112	109	120	144	147
Nitrogen dioxide (NO_2), annual average incremental concentrations (μg/ m^3)	0.4	0.5	0.5	1.0	1.0
Nitrogen dioxide (NO_2), annual average cumulative concentrations (μg/ m^3) (Criteria: 62 μg/ m^3)	42.4	42.5	42.5	43.0	43.0
Sulphur dioxide (SO_2), highest 10-minutes average incremental concentrations (μg/ m^3)	39.6	47.2	50.4	90.3	81.
Sulphur dioxide (SO_2), highest 10-minutes average cumulative concentrations (μg/ m^3) (Criteria: 712 μg/ m^3)	122	130	133	173	164
Sulphur dioxide (SO_2), highest 1-hour average incremental concentrations (μg/ m^3)	24	28.6	30.6	54.7	49.4
Sulphur dioxide (SO_2), highest 1-hour average cumulative concentrations (μg/ m^3) (Criteria: 570 μg/ m^3)	74	79	81	105	99
Sulphur dioxide (SO_2), highest 24-hour average incremental concentrations (μg/ m^3)	5.5	5.0	4.7	9.8	7.7

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Sulphur dioxide (SO_2), highest 24-hour average cumulative concentrations (µg/ m^3) (Criteria: 228 µg/ m^3)	55	55	55	60	58
Sulphur dioxide (SO_2), annual average incremental concentrations (µg/ m^3)	0.7	0.7	0.7	0.9	0.9
Sulphur dioxide (SO_2), annual average cumulative concentrations (µg/ m^3) (Criteria: 60 µg/ m^3)	7.7	7.7	7.7	7.9	7.9
Carbon monoxide (CO), highest 15-minutes average incremental concentrations (mg/ m^3)	0.006	0.005	0.007	0.012	0.014
Carbon monoxide (CO), highest 15-minutes average cumulative concentrations (mg/ m^3) (Criteria: 100 mg/ m^3)	4.1	4.1	4.1	4.1	4.1
Carbon monoxide (CO), highest 1-hour average incremental concentrations (mg/ m^3)	0.003	0.003	0.004	0.007	0.008
Carbon monoxide (CO), highest 1-hour average cumulative concentrations (mg/ m^3) (Criteria: 30 mg/ m^3)	2.5	2.5	2.5	2.5	2.5
Carbon monoxide (CO), highest 8-hour average incremental concentrations (mg/ m^3)	0.002	0.002	0.003	0.004	0.005
Carbon monoxide (CO), highest 8-hour average cumulative concentrations (mg/ m^3) (Criteria: 30 mg/ m^3)	1.5	1.5	1.5	1.5	1.5
Polycyclic aromatic hydrocarbons (PAHs) as Benzo(a)pyrene (BaP), highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.0004 mg/m^3)	5E-08	4E-08	7E-08	1E-07	1E-07
Dioxins and furans, highest 1-hour average incremental concentrations (mg/m^3) TEQ (Criteria: 2.0E-09 mg/m^3)	2.7E-13	2.4E-13	3.7E-13	6.6E-13	6.7E-13
Speciated VOCs					

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Acetone, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 22 mg/m^3)	6E-05	6E-05	9E-05	2E-04	2E-04
Benzene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.029 mg/m^3)	2E-04	2E-04	3E-04	5E-04	5E-04
Carbon disulphide, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.07 mg/m^3)	2E-06	1E-06	2E-06	4E-06	4E-06
Chloroethane, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 48 mg/m^3)	4E-05	3E-05	5E-05	9E-05	9E-05
Chloromethane, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 1.9 mg/m^3)	8E-05	7E-05	1E-04	2E-04	2E-04
Ethyl benzene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 8 mg/m^3)	2E-06	1E-06	2E-06	4E-06	4E-06
Phenol, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.02 mg/m^3)	3E-06	3E-06	4E-06	8E-06	8E-06
Styrene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.12 mg/m^3)	8E-07	7E-07	1E-06	2E-06	2E-06
Tetrachloroethylene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 3.5 mg/m^3)	1E-07	9E-08	1E-07	3E-07	3E-07
Toluene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.36 mg/m^3)	9E-05	8E-05	1E-04	2E-04	2E-04
Xylene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.19 mg/m^3)	5E-06	4E-06	6E-06	1E-05	1E-05
Speciated Metals					
Antimony, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.009 mg/m^3)	1E-08	1E-08	1E-08	3E-08	3E-08

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Arsenic, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.00009 mg/m^3)	1E-06	9E-07	1E-06	3E-06	3E-06
Beryllium, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.000004 mg/m^3)	2E-09	1E-09	2E-09	4E-09	4E-09
Cadmium, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.000018 mg/m^3)	7E-08	6E-08	9E-08	2E-07	2E-07
Chromium III highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.009 mg/m^3)	1E-08	1E-08	1E-08	3E-08	3E-08
Chromium VI, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.00009 mg/m^3)	2E-06	2E-06	3E-06	6E-06	6E-06
Copper, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.018 mg/m^3)	7E-09	6E-09	9E-09	2E-08	2E-08
Lead, annual average incremental concentrations (μg/ m^3) (Criteria: 0.5 μg/m^3)	1.E7-05	1.9E-05	2E-05	3.4E-05	3.5E-05
Manganese, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.018 mg/m^3)	2E-05	2E-05	3E-05	5E-05	5E-05
Mercury, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.0018 mg/m^3)	3E-06	3E-06	4E-06	8E-06	8E-06
Nickel (Ni), highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.00018 mg/m^3)	3E-05	3E-05	4E-05	7E-05	7E-05

Table 29: Predicted Incremental and Cumulative Ground Level Concentrations – Existing, Stage 1 and Stage 2 Operations – Option 2 (90% Timber &10% Natural Gas)

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Total suspended particulates (TSP), annual average incremental concentrations (µg/ m³)	0.6	0.69	0.59	0.77	0.68
Total suspended particulates (TSP), annual average cumulative concentrations (µg/ m³) (Criteria: 90 µg/ m³)	44.6	44.7	44.6	44.8	44.7
Particulate matter less than 10 microns (PM_{10}), highest 24-hour average incremental concentrations (µg/ m³)	5.3	6.8	6.1	4.7	4.4
Particulate matter less than 10 microns (PM_{10}), highest 24-hour average cumulative concentrations (µg/ m³) (Criteria: 50 µg/ m³)	25.3	26.8	26.1	21.7	15.4
Particulate matter less than 10 microns (PM_{10}), annual average incremental concentrations (µg/ m³)	0.8	0.9	0.8	0.8	0.7
Particulate matter less than 10 microns (PM_{10}), annual average cumulative concentrations (µg/ m³) (Criteria: 30 µg/ m³)	18.8	18.9	18.8	18.8	18.7
Deposited dust, annual average incremental levels (g/m²/month)	0.05	0.06	0.05	0.07	0.06
Deposited dust, annual average cumulative levels (g/m²/month) (Criteria: 4 g/m²/month)	2.2	2.2	2.1	2.2	2.2
Hydrogen fluoride (HF), highest 24-hour average incremental concentrations (µg/ m³) (Criteria: 2.9 µg/ m³)	1.0	0.9	0.9	1.8	1.5
Hydrogen fluoride (HF), highest 7-days average incremental concentrations (µg/ m³) (Criteria: 1.7 µg/ m³)	0.4	0.4	0.4	0.5	0.5

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Hydrogen fluoride (HF), monthly average incremental concentrations (μg/ m^3) (Criteria: 0.84 μg/ m^3)	0.28	0.26	0.26	0.36	0.34
Hydrogen fluoride (HF), highest 90-days incremental concentrations (μg/ m^3) (Criteria: 0.5 μg/ m^3)	0.2	0.2	0.2	0.3	0.3
Hydrogen chloride (HCl), highest 1-hour average incremental concentrations (mg/ m^3) (Criteria: 0.14 mg/m^3)	0.01	0.01	0.01	0.02	0.01
Nitrogen dioxide (NO_2), highest 1-hour average incremental concentrations (μg/ m^3)	23.7	21.0	31.6	55.7	58.7
Nitrogen dioxide (NO_2), highest 1-hour average cumulative concentrations (μg/ m^3) (Criteria: 246 μg/ m^3)	112	109	120	144	147
Nitrogen dioxide (NO_2), annual average incremental concentrations (μg/ m^3)	0.4	0.5	0.5	1.0	1.0
Nitrogen dioxide (NO_2), annual average cumulative concentrations (μg/ m^3) (Criteria: 62 μg/ m^3)	42.4	42.5	42.5	43.0	43.0
Sulphur dioxide (SO_2), highest 10-minutes average incremental concentrations (μg/ m^3)	40.2	47.4	50.4	94.3	86.1
Sulphur dioxide (SO_2), highest 10-minutes average cumulative concentrations (μg/ m^3) (Criteria: 712 μg/ m^3)	123	130	133	177	169
Sulphur dioxide (SO_2), highest 1-hour average incremental concentrations (μg/ m^3)	24.4	28.7	30.6	57.2	52.2
Sulphur dioxide (SO_2), highest 1-hour average cumulative concentrations (μg/ m^3) (Criteria: 570 μg/ m^3)	74	79	81	107	102
Sulphur dioxide (SO_2), highest 24-hour average incremental concentrations (μg/ m^3)	5.6	5.1	4.9	10.3	8.1

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Sulphur dioxide (SO_2), highest 24-hour average cumulative concentrations (μg/ m³) (Criteria: 228 μg/ m³)	56	55	55	60	58
Sulphur dioxide (SO_2), annual average incremental concentrations (μg/ m³)	0.6	0.7	0.7	1.0	1.0
Sulphur dioxide (SO_2), annual average cumulative concentrations (μg/ m³) (Criteria: 60 μg/ m³)	7.6	7.7	7.7	8.0	8.0
Carbon monoxide (CO), highest 15-minutes average incremental concentrations (mg/ m³)	0.007	0.007	0.009	0.016	0.018
Carbon monoxide (CO), highest 15-minutes average cumulative concentrations (mg/ m³) (Criteria: 100 mg/ m³)	4.1	4.1	4.1	4.1	4.1
Carbon monoxide (CO), highest 1-hour average incremental concentrations (mg/ m³)	0.005	0.004	0.006	0.01	0.011
Carbon monoxide (CO), highest 1-hour average cumulative concentrations (mg/ m³) (Criteria: 30 mg/ m³)	2.5	2.5	2.5	2.5	2.5
Carbon monoxide (CO), highest 8-hour average incremental concentrations (mg/ m³)	0.003	0.002	0.003	0.006	0.007
Carbon monoxide (CO), highest 8-hour average cumulative concentrations (mg/ m³) (Criteria: 30 mg/ m³)	1.5	1.5	1.5	1.5	1.5
Polycyclic aromatic hydrocarbons (PAHs) as Benzo(a)pyrene (BaP), highest 1-hour average incremental concentrations (mg/m³) (Criteria: 0.0004 mg/m³)	2E-05	2E-05	2E-05	4E-05	4E-05
Dioxins and furans, highest 1-hour average incremental concentrations (mg/m³) TEQ (Criteria: 2.0E-09 mg/m³)	3.7E-12	3.3E-12	5.1E-12	9.2E-12	9.3E-12
Speciated VOCs					

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Acrylonitrile, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.008 mg/m^3)	5E-07	5E-07	7E-07	1E-06	1E-06
Acetone, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 22 mg/m^3)	2E-05	2E-05	3E-05	5E-05	5E-05
Benzene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.029 mg/m^3)	1E-04	1E-04	1E-04	3E-04	3E-04
Carbon disulphide, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.07 mg/m^3)	7E-07	6E-07	9E-07	2E-06	2E-06
Chloroethane, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 48 mg/m^3)	2E-05	2E-05	3E-05	5E-05	5E-05
Chloroform, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.9 mg/m^3)	1E-08	9E-09	1E-08	3E-08	3E-08
Chloromethane, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 1.9 mg/m^3)	8E-05	7E-05	1E-04	2E-04	2E-04
Ethyl benzene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 8 mg/m^3)	5E-07	4E-07	6E-07	1E-06	1E-06
Methylene chloride, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 3.19 mg/m^3)	3E-07	2E-07	3E-07	6E-07	6E-07
Phenol, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.02 mg/m^3)	3E-06	2E-06	4E-06	7E-06	7E-06
Styrene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.12 mg/m^3)	9E-08	8E-08	1E-07	2E-07	2E-07
Tetrachloroethylene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 3.5 mg/m^3)	2E-08	2E-08	3E-08	5E-08	5E-08
Toluene, highest 1-hour average incremental concentrations	4E-05	4E-05	6E-05	1E-04	1E-04

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
(mg/m^3) (Criteria: 0.36 mg/m^3)					
Xylene, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.19 mg/m^3)	2E-06	1E-06	2E-06	4E-06	4E-06
1,1,1-Trichloroethane, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 12.5 mg/m^3)	1E-08	9E-09	1E-08	3E-08	3E-08
Speciated Metals					
Antimony, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.009 mg/m^3)	1E-08	1E-08	1E-08	3E-08	3E-08
Arsenic, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.00009 mg/m^3)	1E-06	9E-07	1E-06	3E-06	3E-06
Beryllium, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.000004 mg/m^3)	2E-09	1E-09	2E-09	4E-09	4E-09
Cadmium, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.000018 mg/m^3)	2E-07	2E-07	3E-07	6E-07	6E-07
Chromium III highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.009 mg/m^3)	1E-07	1E-07	2E-07	4E-07	4E-07
Chromium VI, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.00009 mg/m^3)	2E-06	2E-06	3E-06	6E-06	6E-06
Copper (Cu), highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.018 mg/m^3)	3E-07	3E-07	5E-07	8E-07	8E-07
Lead, annual average incremental concentrations (µg/ m^3) (Criteria: 0.5 µg/m^3)	2.4E-05	2.6E-05	2.E8-05	4.7E-05	4.9E-05
Manganese, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.018 mg/m^3)	6E-05	6E-05	9E-05	2E-04	2E-04

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Mercury, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.0018 mg/m^3)	3E-06	3E-06	4E-06	8E-06	8E-06
Nickel (Ni), highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.00018 mg/m^3)	3E-05	3E-05	4E-05	7E-05	7E-05

Table 30: Predicted Incremental and Cumulative Ground Level Concentrations – Existing, Stage 1 and Stage 2 Operations – Option 3 (90% RDF &10% Natural Gas)

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Total suspended particulates (TSP), annual average incremental concentrations (μg/ m³)	0.6	0.69	0.59	0.77	0.68
Total suspended particulates (TSP), annual average cumulative concentrations (μg/ m³) (Criteria: 90 μg/ m³)	44.6	44.7	44.6	44.8	44.7
Particulate matter less than 10 microns (PM_{10}), highest 24-hour average incremental concentrations (μg/ m³)	5.3	6.8	6.1	4.7	4.4
Particulate matter less than 10 microns (PM_{10}), highest 24-hour average cumulative concentrations (μg/ m³) (Criteria: 50 μg/ m³)	25.3	26.8	26.1	21.7	15.4
Particulate matter less than 10 microns (PM_{10}), annual average incremental concentrations (μg/ m³)	0.8	0.9	0.8	0.8	0.7
Particulate matter less than 10 microns (PM_{10}), annual average cumulative concentrations (μg/ m³) (Criteria: 30 μg/ m³)	18.8	18.9	18.8	18.8	18.7
Deposited dust, annual average incremental levels (g/m²/month)	0.05	0.06	0.05	0.07	0.06
Deposited dust, annual average cumulative levels (g/m²/month) (Criteria: 4 g/m²/month)	2.2	2.2	2.1	2.2	2.2
Hydrogen fluoride (HF), highest 24-hour average incremental concentrations (μg/ m³) (Criteria: 2.9 μg/ m³)	1.0	0.9	0.9	1.8	1.5
Hydrogen fluoride (HF), highest 7-days average incremental concentrations (μg/ m³) (Criteria: 1.7 μg/ m³)	0.4	0.4	0.4	0.5	0.5

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Hydrogen fluoride (HF), monthly average incremental concentrations (μg/ m^3) (Criteria: 0.84 μg/ m^3)	0.28	0.26	0.26	0.36	0.34
Hydrogen fluoride (HF), highest 90-days incremental concentrations (μg/ m^3) (Criteria: 0.5 μg/ m^3)	0.2	0.2	0.2	0.3	0.3
Hydrogen chloride (HCl), highest 1-hour average incremental concentrations (mg/ m^3) (Criteria: 0.14 mg/m^3)	0.01	0.01	0.01	0.02	0.02
Nitrogen dioxide (NO_2), highest 1-hour average incremental concentrations (μg/ m^3)	38.6	34.1	50.5	87.4	94.9
Nitrogen dioxide (NO_2), highest 1-hour average cumulative concentrations (μg/ m^3) (Criteria: 246 μg/ m^3)	127	122	139	175	183
Nitrogen dioxide (NO_2), annual average incremental concentrations (μg/ m^3)	0.6	0.7	0.7	1.5	1.6
Nitrogen dioxide (NO_2), annual average cumulative concentrations (μg/ m^3) (Criteria: 62 μg/ m^3)	42.6	42.7	42.7	43.5	43.6
Sulphur dioxide (SO_2), highest 10-minutes average incremental concentrations (μg/ m^3)	38.4	46.7	50.4	82.2	72.3
Sulphur dioxide (SO_2), highest 10-minutes average cumulative concentrations (μg/ m^3) (Criteria: 712 μg/ m^3)	121	129	133	165	155
Sulphur dioxide (SO_2), highest 1-hour average incremental concentrations (μg/ m^3)	23.3	28.3	30.6	49.8	43.8
Sulphur dioxide (SO_2), highest 1-hour average cumulative concentrations (μg/ m^3) (Criteria: 570 μg/ m^3)	73	78	81	100	94
Sulphur dioxide (SO_2), highest 24-hour average incremental concentrations (μg/ m^3)	5.1	4.9	4.5	8.8	7.1

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
Sulphur dioxide (SO_2), highest 24-hour average cumulative concentrations (μg/ m^3) (Criteria: 228 μg/ m^3)	55	55	54	59	57
Sulphur dioxide (SO_2), annual average incremental concentrations (μg/ m^3)	0.6	0.7	0.7	0.8	0.8
Sulphur dioxide (SO_2), annual average cumulative concentrations (μg/ m^3) (Criteria: 60 μg/ m^3)	7.6	7.7	7.7	7.8	7.8
Carbon monoxide (CO), highest 15-minutes average incremental concentrations (mg/ m^3)	0.002	0.002	0.002	0.004	0.005
Carbon monoxide (CO), highest 15-minutes average cumulative concentrations (mg/ m^3) (Criteria: 100 mg/ m^3)	4.1	4.1	4.1	4.1	4.1
Carbon monoxide (CO), highest 1-hour average incremental concentrations (mg/ m^3)	0.001	0.001	0.001	0.002	0.003
Carbon monoxide (CO), highest 1-hour average cumulative concentrations (mg/ m^3) (Criteria: 30 mg/ m^3)	2.5	2.5	2.5	2.5	2.5
Carbon monoxide (CO), highest 8-hour average incremental concentrations (mg/ m^3)	0.001	0.001	0.001	0.001	0.002
Carbon monoxide (CO), highest 8-hour average cumulative concentrations (mg/ m^3) (Criteria: 30 mg/ m^3)	1.5	1.5	1.5	1.5	1.5
Dioxins and furans, highest 1-hour average incremental concentrations (mg/m^3) TEQ (Criteria: 2.0E-09 mg/m^3)	3.5E-12	3.1E-12	4.8E-12	8.7E-12	8.8E-12
Speciated Metals					
Antimony, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.009 mg/m^3)	1E-08	1E-08	1E-08	3E-08	3E-08
Arsenic, highest 1-hour average incremental concentrations	4E-06	3E-06	5E-06	9E-06	9E-06

Pollutant, Averaging Period and Units	Predicted Ground Level Concentrations				
	DR1	DR2	DR3	DR4	DR5
(mg/m^3) (Criteria: 0.00009 mg/m^3)					
Cadmium, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.000018 mg/m^3)	4E-06	4E-06	5E-06	1E-05	1E-05
Chromium VI, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.00009 mg/m^3)	9E-06	8E-06	1E-05	2E-05	2E-05
Lead, annual average incremental concentrations ($\mu g/ m^3$) (Criteria: 0.5 $\mu g/m^3$)	1.9E-03	2.2E-03	2.3E-03	3.9E-03	4.0E-03
Manganese, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.018 mg/m^3)	2E-05	2E-05	3E-05	5E-05	5E-05
Mercury, highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.0018 mg/m^3)	5E-06	5E-06	7E-06	1E-05	1E-05
Nickel (Ni), highest 1-hour average incremental concentrations (mg/m^3) (Criteria: 0.00018 mg/m^3)	3E-05	3E-05	4E-05	8E-05	8E-05

Based on the results presented in **Table 24** to **Table 30** and the concentration isopleths in **Appendix D**, the following observations are made:

- Predicted ground level incremental (Project related) and cumulative concentrations for all pollutants comply with their respective assessment criteria for all the modelled scenarios at all identified sensitive receptors. A summary of the modelled results is presented in **Table 31**.
- Of the modelled scenarios – highest concentrations are observed for Stage 2 LWA operations – which include existing operations at Plant 1 and Plant 2 and Stage 1 and Stage 2 LWA operations. Predicted concentrations from Stage 2 operations are considered to be highly conservative as the modelling has been based on the assumption that all stacks (Plant 1, Plant 2, PCS 1, PCS 2, CA 1 and CA 2) would be emitting pollutants simultaneously during the worst-case meteorological conditions. Similarly, for fugitive dust impacts, TSP and PM_{10} emissions have been quantified for existing Plant 1 and Plant 2 operations and added to the background concentrations, despite acknowledging that air quality levels measured at the Prospect monitoring station would have incorporated contributions from both Plant 1 and existing operations at Plant 2. Concentration isopleths presented in **Appendix D** correspond to Stage 2 LWA operations as they are considered to have the highest impacts among all modelled scenarios;
- Upon analysis of the predicted incremental and cumulative concentrations for each pollutant against their respective assessment criteria, the 24-hour average hydrogen fluoride (HF) impacts have been identified to be the significant pollutant across all modelled scenarios. The highest incremental 24-hour average HF concentration predicted across all sensitive receptors for Stage 2 operations is 1.8 $\mu g/m^3$, which complies with the assessment criteria of 2.9 $\mu g/m^3$ (approximately 62% of the assessment criteria). It is to be noted that no significant variance in predicted HF concentrations has been observed for the different fuel combustion options in each of the modelled scenarios;
- From the isopleths presented in **Appendix D**, it is observed that the predicted maximum 24-hour HF concentrations for existing, Stage 1 and Stage 2 LWA operations marginally exceed the relevant assessment criteria beyond the Plant 2 site boundary. However, it can be seen from the isopleths (**Figure D-9** to **Figure D-11**) that these reported exceedances are not at any of the identified sensitive receptors (**Table 2**). According to the National Goals for Fluoride in Ambient Air and Forage (ANZECC, 1990), the aim of ambient fluoride goals is to protect sensitive vegetation and specialised land uses. As per information provided by Brickworks, it is very unlikely that the areas where the predicted HF concentrations exceed the limit are considered to be areas sensitive to vegetation or specialised land areas (e.g. orchids, vineyards etc.). Upon further investigation of the predicted 24-hour average HF concentrations for existing operations and Stage 1 and Stage 2 LWA operations, it is observed that compliance is achieved for 99% of the entire year (i.e. no predicted exceedances beyond the Plant 2 site boundary for 99% of the year) for each of these modelled scenarios. Taking into consideration the findings from this analysis, it is considered that there would not be any adverse impacts on the surrounding environment associated with HF emissions from existing and proposed Stage 1 and Stage 2 LWA operations;
- Incremental impacts – especially for polycyclic aromatic hydrocarbons (PAHs) (expressed as benzo(a)pyrene), dioxins and furans – TEQ, speciated volatile organic compounds (VOCs) and metals predicted across identified sensitive receptors are relatively low in comparison with their respective assessment criteria for all modelled scenarios;
- For pollutants where cumulative concentrations have been determined (e.g. TSP, PM_{10}, NO_2, SO_2 etc.) it is observed that the Project's contributions (incremental concentrations) to the total concentrations (cumulative concentrations) are relatively minimal when compared with the corresponding background concentrations.

- With regards to predicted NO_2 concentrations, it was conservatively assumed that 100% of the NO_X emissions released would be converted to NO_2;
- Based on the modelling results, it is observed that there would not be any adverse air quality impacts associated with the existing and proposed operations at the Project Site.

Table 31: Summary of Modelled Results at Identified Sensitive Receptors – All Scenarios – All Fuel Combustion Options

Modelled Scenario	DR1	DR2	DR3	DR4	DR5
	Compliance with relevant assessment criteria for all modelled pollutants				
Existing Operations	✓	✓	✓	✓	✓
Existing and Stage 1 Operations (300,000 tpa) – Option 1 (100% Natural Gas)	✓	✓	✓	✓	✓
Existing and Stage 1 Operations (300,000 tpa) – Option 2 (90% C&D/C&I Timber and 10% Natural Gas) – *Preferred choice of fuel*	✓	✓	✓	✓	✓
Existing and Stage 1 Operations (300,000 tpa) – Option 3 (90% RDF and 10% Natural Gas)	✓	✓	✓	✓	✓
Existing and Stage 2 Operations (600,000 tpa - includes 300,000 tpa of Stage 1 Operations) – Option 1 (100% Natural Gas)	✓	✓	✓	✓	✓
Existing and Stage 2 Operations (600,000 tpa - includes 300,000 tpa of Stage 1 Operations) – Option 2 (90% C&D/C&I Timber and 10% Natural Gas) – *Preferred choice of fuel*	✓	✓	✓	✓	✓
Existing and Stage 2 Operations (600,000 tpa - includes 300,000 tpa of Stage 1 Operations) – Option 3 (90% RDF and 10% Natural Gas)	✓	✓	✓	✓	✓

9. RECOMMENDATIONS

Results from the dispersion modelling demonstrate that compliance would be achieved for all pollutants from existing operations at Plant 1 and Plant 2 and the proposed LWA manufacturing operations at all identified sensitive receptors. However, in order to effectively manage air emissions from all sources, the following recommendations are made:

- Air pollution control measures proposed by Brickworks for reducing flue gas emissions generated from LWA manufacturing include – baghouse for controlling particulate emissions and metals, wet scrubber for reducing acid gas concentrations and RTO for effectively minimising VOC and CO emissions. These proposed control measures are to be designed and managed / maintained effectively to ensure that the estimated control efficiencies (**Table 11**) are achieved at all times and that the emission levels comply with the Group 6 emission standards;

Control measures for reducing fugitive particulate emissions from existing and proposed operations include:

- *Watering of unpaved / gravel surfaces* – currently implemented and will be undertaken for proposed Stage 1 and Stage 2 LWA operations;
- *Speed restriction* – Speed restrictions are implemented (40 km/hour), especially on unpaved, gravel surfaces to minimise wheel-generated dust for existing and proposed Stage 1 and Stage 2 LWA operations;
- *Water sprays* – currently implemented for stockpiles and crushing / grinding operations and will be undertaken for proposed Stage 1 and Stage 2 operations; and
- *Enclosed infrastructures* – Existing material handling infrastructure near the Primary Crusher area and Mill Building area is currently enclosed

10. CONCLUSIONS

Airlabs Environmental Pty Ltd (Airlabs) have been commissioned by McKenzie Group Pty Ltd (McKenzie Group), on behalf of Brickworks NSW Pty Ltd (Brickworks) undertake an Air Quality Impact Assessment (AQIA) in relation to the proposed State Significant Development (SSD) Application pertaining to the Light Weight Aggregate (LWA) Project (the Project) which will be developed at Plant 2 of the existing Brickworks site at 780 Wallgrove Road, Horsley Park, NSW.

The Project is divided into two (2) stages – Stage 1 and Stage 2. Stage 1 of the Project comprises LWA production volumes of 300,000 tonnes per annum (tpa). An additional 300,000 tpa of LWA production is forecasted for Stage 2, which would potentially commence approximately five (5) years after commencement of Stage 1, therefore, the combined LWA production volumes for the Project comprising Stage 1 and Stage 2 operations would be 600,000 tpa. Brickworks are also investigating the feasibility of using different types of fuels in the proposed rotary kilns and have identified three (3) specific fuel combinations which include:

- 100% Natural Gas;
- 90% Construction & Demolition (C&D) / Construction and Industrial (C&I) Timbers and 10% Natural Gas; and
- 90% Refuse Derived Fuel (RDF) – typically comprising municipal and industrial waste and 10% Natural Gas

Flue gas emissions and fugitive particulate matter emissions associated with existing brick manufacturing operations and proposed Stage 1 and Stage 2 LWA operations at Plant 2 were identified to be the key sources of air pollution.

To minimise flue gas emissions generated from LWA operations, Brickworks are proposing a set of air pollution control measures for both Stage 1 and Stage 2 operations incorporating BAT measures, including baghouse for controlling particulate emissions and metals, wet scrubber for reducing acid gas concentrations and RTO for effectively minimising VOC and CO emissions. In order to determine the impacts associated with each fuel source type, pollutant emission rates were estimated by using emission factors, and similarly emission factors were utilised for determining fugitive particulate matter emissions.

To predict ground-level concentrations at identified sensitive receptors from existing and proposed operations, air dispersion modelling was undertaken using the combination of the following mathematical models TAPM and CALMET / CALPUFF. To comprehensively determine air quality impacts associated with existing and proposed operations and for the different fuel combustion options, modelling scenarios were developed.

From the modelled results, it is observed that the predicted concentrations for all modelled pollutants comply with their respective assessment criteria for all the modelled scenarios at all identified sensitive receptors. For the pollutants where cumulative concentrations have been determined it is observed that the Project's contributions to the total concentrations are relatively minimal when compared with the corresponding background concentrations. Predicted maximum 24-hour average HF concentrations marginally exceed the assessment criteria (for existing operations and Stage 1 and Stage 2 LWA operations) at areas beyond the Plant 2 site boundary, but, not at any of the identified sensitive receptors. Based on the discussion presented in **Section 8**, it is unlikely that there would be any adverse impacts on the surrounding environment associated with HF emissions from existing and proposed Stage 1 and Stage 2 LWA operations.

Based on implementation of BAT air pollution control measures and achieving compliance with Group 6 emission standards and ambient air quality limits through dispersion modelling, it is observed that there would not be any adverse air quality impacts associated with the LWA Project.

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US-EPA (1997) AP-42 Emission Factors – Chapter 11.3 Bricks and Structural Clay Product Manufacturing

US-EPA (2004) AP-42 Emission Factors – Chapter 11.19.2 Crushed Stone Processing and Pulverised Mineral Processing

US-EPA (2006a) AP-42 Emission Factors – Chapter 13.2.2 Unpaved Roads

US-EPA (2006b) AP-42 Emission Factors – Chapter 13.2.4 Aggregate Handling and Storage Piles

12. GLOSSARY

ANZECC	Australian and New Zealand Environment Council
Airlabs	Airlabs Environmental Pty Ltd
Approved Methods	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW
ASME	American Society of Mechanical Engineers
AQIA	Air Quality Impact Assessment
AWS	Automatic Weather Station
BaP	Benzo (a) Pyrene
BAT	Best Available Technology
BoM	Bureau of Meteorology
BPM	Best Practice Measures
CA	Cooling Air Stack
CALMET	Meteorological processor of the CALPUFF model
CALPUFF	Non-steady state US-EPA approved air dispersion model
C&D	Construction and Demolition
C&I	Construction and Industrial
CO	Carbon monoxide
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEC	Department of Environment and Conservation
DUTP	Department of Urban and Transport Planning
DR	Discrete Receptor
EET	Emission Estimation Technique
EIS	Environmental Impact Statement
EPA	Environmental Protection Authority
EPL	Environmental Protection Licence
FEL	Front End Loader
HF	Hydrogen fluoride
HCl	Hydrogen chloride
LGA	Local Government Area
LOI	Loss on Ignition
LWA	Light Weight Aggregate
MGA	Map Grid of Australia
mg/m^3	Milligram per cubic metre (concentration units)
ng/m^3	Nanogram per cubic metre (concentration units)
NO_X	Oxides of Nitrogen
NO_2	Nitrogen dioxide

NPI	National Pollutant Inventory
NSW	New South Wales
O_3	Ozone
PAHs	Polycyclic Aromatic Hydrocarbons
POEO	Protection of the Environment Operations
POP	Proof of Performance
PCDD/F	Polychlorinated Dioxins and Furans
PCS	Product Combustion Stack
$PM_{2.5}$	Particulate matter less than 2.5 microns in diameter
PM_{10}	Particulate matter less than 10 microns in diameter
RDF	Refuse Derived Fuel
RH	Relative Humidity
RTO	Regenerative Thermal Oxidiser
SEAR	Secretary Environmental Assessment Requirements
SO_2	Sulfur dioxide
SPCC	State Pollution Control Commission
SRC	Sigma Research Corporation
SSD	State Significant Development
SW	South West
TERRAD	The Radius of Influence of Terrain
TEQ	Toxic Equivalent
TOC	Total Organic Carbon
the Project	Brickworks, Light Weight Aggregate Project
the Project Site	Plant 2, Brickworks, Horsley Park, NSW
tpa	Tonnes per annum
TSP	Total Suspended Particulates
UTM	Universal Transverse Mercator
US-EPA	United States – Environmental Protection Agency
VOCs	Volatile Organic Compounds
WSW	West South West
μ	Micrometre / Microns
$\mu g/m^3$	Microgram per cubic metre (concentration units)

APPENDIX A – EMISSION ESTIMATION DETAILS

Proposed Product Combustion Stack (PCS) and Cooling Air (CA) Stack

Emission Factors for Natural Gas Combustion

List of Pollutants	Emission Factor (kg/tonne)	Reference Source
Total Particulates	0.458	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Sulfur dioxide (SO_2)	0.39 *(based on low sulfur content)*	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Oxides of Nitrogen (NO_X)	0.175	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Carbon Monoxide (CO)	0.6	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Hydrogen Fluoride (HF)	0.295	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Hydrogen Chloride (HCl)	0.085	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Acetone	0.00085	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Benzene	0.00145	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Carbon disulphide	2.15E-05	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Chloroethane	0.000235	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Ethylbenzene	2.20E-05	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Xylene	6.25E-05	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Phenol	4.30E-05	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Styrene	1.00E-05	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Tetrachloroethylene	1.40E-06	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Toluene	0.0008	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Polycyclic Aromatic Hydrocarbons (PAHs) - *kg/tonne of fuel combusted*	1.38E-05	NPI - EET, Combustion in Boilers, December 2011

List of Pollutants	Emission Factor (kg/tonne)	Reference Source
Polychlorinated Dioxins and Furans (PCDD/F) - TEQ - *kg/tonne of fuel combusted*	1.07E-10	NPI - EET, Combustion in Boilers, December 2011
Arsenic	1.55E-05	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Beryllium	2.10E-07	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Cadmium - *kg/tonne of fuel combusted*	2.38E-05	NPI - EET, Combustion in Boilers, December 2011
Chromium (III) - *kg/tonne of fuel combusted*	3.03E-05	NPI - EET, Combustion in Boilers, December 2011
Copper dust - *kg/tonne of fuel combusted*	1.84E-05	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Manganese	1.45E-04	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Mercury	3.75E-06	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Lead - *kg/tonne of fuel combusted*	1.08E-05	NPI - EET, Combustion in Boilers, December 2011
Nickel - *kg/tonne of fuel combusted*	4.54E-05	NPI - EET, Combustion in Boilers, December 2011

Emission Factors for Sawdust Combustion

List of Pollutants	Emission Factor (kg/tonne)	Reference Source
Total Particulates	0.447	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Sulfur dioxide (SO_2)	0.435	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Oxides of Nitrogen (NO_X)	0.185	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Carbon Monoxide (CO)	0.8	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Hydrogen Fluoride (HF)	0.295	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Hydrogen Chloride (HCl)	0.085	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Acrylonitrile	7.5E-06	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Acetone	1.95E-04	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Benzene	2.6E-04	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Carbon disulphide	7.8E-06	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Chloroform	1.5E-07	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Ethylbenzene	4.25E-06	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Methylene Chloride	3.75E-06	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Xylene	1.64E-05	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Phenol	3.6E-05	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Styrene	2.2E-07	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Tetrachloroethylene	1.5E-07	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Toluene	5.5E-05	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Trichloroethane	1.5E-07	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Polycyclic Aromatic Hydrocarbons (PAHs) -	1.78E-03	NPI - EET, Combustion in Boilers, December 2011

List of Pollutants	Emission Factor (kg/tonne)	Reference Source
kg/tonne of fuel combusted		
Polychlorinated Dioxins and Furans (PCDD/F) - TEQ - *kg/tonne of fuel combusted*	5.29E-10	NPI - EET, Combustion in Boilers, December 2011
Arsenic	1.55E-05	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Beryllium	2.1E-07	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Cadmium - *kg/tonne of fuel combusted*	2.79E-05	NPI - EET, Combustion in Boilers, December 2011
Chromium (III) - *kg/tonne of fuel combusted*	1.43E-04	NPI - EET, Combustion in Boilers, December 2011
Chromium (VI) - *kg/tonne of fuel combusted*	2.38E-05	NPI - EET, Combustion in Boilers, December 2011
Copper dust - *kg/tonne of fuel combusted*	3.33E-04	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Manganese	0.0065	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Mercury	3.75E-06	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Lead - *kg/tonne of fuel combusted*	3.26E-04	NPI - EET, Combustion in Boilers, December 2011
Nickel - *kg/tonne of fuel combusted*	2.24E-04	NPI - EET, Combustion in Boilers, December 2011

Emission Factors for Refuse Derived Fuel (RDF)

List of Pollutants	Emission Factor (kg/tonne of RDF combusted)	Reference Source
Total Particulates	0.447	US-EPA, AP-42, Chapter 2.1 – Refuse Combustion, October 1996
Sulfur dioxide (SO_2)	1.95	US-EPA, AP-42, Chapter 2.1 – Refuse Combustion, October 1996
Oxides of Nitrogen (NO_X)	2.5	US-EPA, AP-42, Chapter 2.1 – Refuse Combustion, October 1996
Carbon Monoxide (CO)	0.96	US-EPA, AP-42, Chapter 2.1 – Refuse Combustion, October 1996
Hydrogen Fluoride (HF)	0.295	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Hydrogen Chloride (HCl)	3.5	NPI-EET - Bricks, Ceramics and Clay Product Manufacturing, June 1998
Polychlorinated Dioxins and Furans (PCDD/F) - TEQ - *kg/tonne of fuel combusted*	0.4	Sources of Dioxins and Furans in Australia, 2002
Arsenic	0.003	US-EPA, AP-42, Chapter 2.1 – Refuse Combustion, October 1996
Cadmium	0.004	US-EPA, AP-42, Chapter 2.1 – Refuse Combustion, October 1996
Chromium (VI)	0.007	US-EPA, AP-42, Chapter 2.1 – Refuse Combustion, October 1996
Mercury	0.003	US-EPA, AP-42, Chapter 2.1 – Refuse Combustion, October 1996
Lead	0.1	US-EPA, AP-42, Chapter 2.1 – Refuse Combustion, October 1996
Nickel	0.002	US-EPA, AP-42, Chapter 2.1 – Refuse Combustion, October 1996

Fugitive Emission Estimation Details

For quantifying TSP and PM_{10} emissions from fugitive dust sources, reference was drawn to the following EET's for determining particulate emission factors:

- National Pollutant Inventory (NPI) , *Emission Estimation Technique Manual for Bricks, Ceramics & Clay Product Manufacturing*, Environment Australia, August 1998;
- National Pollutant Inventory (NPI) , *Emission Estimation Technique Manual for Mining*, Version 3.1, Australian Government – Department of Sustainability, Environment, Water, Population & Communities, January 2012;
- AP-42 Emission Factors, *Chapter 11.3 Bricks and Structural Clay Product Manufacturing*, United States Environmental Protection Agency (US-EPA 1997);
- AP-42 Emission Factors, *Chapter 11.19.2 Crushed Stone Processing and Pulverised Mineral Processing*, United States Environmental Protection Agency (US-EPA 2004);
- AP-42 Emission Factors, *Chapter 13.2.2 Unpaved Roads*, United States Environmental Protection Agency (US-EPA 2006a); and
- AP-42 Emission Factors, *Chapter 13.2.4 Aggregate Handling and Storage Piles*, United States Environmental Protection Agency (US-EPA 2006b)

TSP and PM_{10} Emission Factor Equations

Activity	Emission Factor Equations	Variables	Control Efficiency	Source
Front End Loader (FEL)	**EF** = k x 0.0016 x ((U/2.2$^{1.8}$)/(M/2)$^{1.4}$) kg/tonne	k_{TSP} = 0.74, k_{PM10} = 0.35, U = wind speed (m/s), M = moisture content (%)	no controls applied	US-EPA AP-42, 13.2.4
Truck Loading/Unloading material	**EF** = k x 0.0016 x ((U/2.2$^{1.8}$)/(M/2)$^{1.4}$) kg/tonne	k_{TSP} = 0.74, k_{PM10} = 0.35, U = wind speed (m/s), M = moisture content (%)	no controls applied	US-EPA AP-42, 13.2.4
Crushing Operations	$\mathbf{EF_{TSP}}$ = 0.0027 kg/tonne, $\mathbf{EF_{PM10}}$ = 0.0012 kg/tonne		enclosed facilities 70% water sprays 50%	US-EPA, AP-42, 11.19.2
Grinding and Screening Operations	$\mathbf{EF_{TSP}}$ = 0.0125 kg/tonne, $\mathbf{EF_{PM10}}$ = 0.00115 kg/tonne		enclosed facilities 70% water sprays 50%	US-EPA, AP-42, 11.3

Activity	Emission Factor Equations	Variables	Control Efficiency	Source
Haulage on Unpaved Roads	**EF** = k x $(s/12)^{0.7}$ * $(W/3)^{0.45}$ x 0.2819 x (365-p/365) kg/vkt	k_{TSP} = 4.9, k_{PM10} = 1.5, s = silt content (%) W = Vehicle Gross Mass p = number of days in a year with rainfall greater than 0.25mm	watering twice a day 55% 40km/hour speed restriction 40%	US-EPA AP-42, 13.2.2
Material Handling / Conveying / Loading-Unloading Operations	**EF** = k x 0.0016 x $((U/2.2^{1.8})/(M/2)^{1.4})$ kg/tonne	k_{TSP} = 0.74, k_{PM10} = 0.35, U = wind speed (m/s), M = moisture content (%)	enclosed conveyors 70% water sprays 50%	NPI, Mining V3.1
Wind Erosion	**EF** = 1.9 x (s/1.5) x 365 x (365-p/235) x (f/15) kg/ha/year	s = silt content (%) p = number of days in a year with rainfall greater than 0.25mm f = % of time wind speed is greater than 5.4m/sec	wind breaks – 30% watering stockpiles – 50% existing Stockpile 1 and 2 have a thick crust on them , have a high moisture content (~10%) and are not that actively disturbed – 95% (NSW EPA, 2011)	NPI, Mining V3.1

TSP Emissions Inventory – Existing Operations – Plant 2

Existing Operations - Plant 2 - TSP																	
Activity	**TSP Emissions (kg/year)**	**Intensity**	**Units**	**TSP Emission Factor**	**Units**	**Variable 1**	**Units**	**Variable 2**	**Units**	**Variable 3**	**Units**	**Variable 4**	**Units**	**Variable 5**	**Units**	**Control Efficiency**	**Units**
Truck Dumping Raw Material (65,000 tpa)	6	65,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Front End Loader (FEL) Loading Raw Material to Feeder	12	130,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Conveying to Primary Crusher	4	130,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %							70	% Control
Primary Crushing	53	130,000	tonnes per annum	0.0027	kg/t											85	% Control
Conveying to Mill Building	4	130,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %							70	% Control
Mill Building Operations - Grinding, FEL and Storage Operation	244	130,000	tonnes per annum	0.0125	kg/t											85	% Control
Heavy Vehicle Haulage on Gravel Surfaces	2,235	65,000	tonnes per annum	0.14	kg/t	50	tonnes/load	1.8	km/return trip	3.8	kg/vkt	8	% silt content	65	Avg GVM (tonnes	75	% Control
Wind Erosion - Existing Stockpile - 1	677	14.7	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					95	% Control
Wind Erosion - Existing Stockpile - 2	170	3.7	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					95	% Control
Wind Erosion - Existing Stockpile - 3	612	1.9	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					65	% Control
Wind Erosion - Existing Stockpile - 4	290	0.9	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					65	% Control
Wind Erosion - Existing Stockpile - 5	193	0.6	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					65	% Control
TOTAL TSP EMISSIONS (kg/yr)	**4,499**																

PM_{10} Emissions Inventory – Existing Operations – Plant 2

Existing Operations - Plant 2 - PM10																	
Activity	**PM10 Emissions**	**Intensity**	**Units**	**PM10 Emission Factor**	**Units**	**Variable 1**	**Units**	**Variable 2**	**Units**	**Variable 3**	**Units**	**Variable 4**	**Units**	**Variable 5**	**Units**	**Control Efficiency**	**Units**
Truck Dumping Raw Material (65,000 tpa)	3	65,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Front End Loader (FEL) Loading Raw Material to Feeder	6	130,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Conveying to Primary Crusher	2	130,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %							70	% Control
Primary Crushing	23	130,000	tonnes per annum	0.0012	kg/t											85	% Control
Conveying to Mill Building	2	130,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %							70	% Control
Mill Building Operations - Grinding, FEL and Storage Operation	22	130,000	tonnes per annum	0.00115	kg/t											85	% Control
Heavy Vehicle Haulage on Gravel Surfaces	631	65,000	tonnes per annum	0.04	kg/t	50	tonnes/load	1.8	km/return trip	1.1	kg/vkt	8	% silt content	65	Avg GVM (tonnes	75	% Control
Wind Erosion - Existing Stockpile - 1	338	14.7	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					95	% Control
Wind Erosion - Existing Stockpile - 2	85	3.7	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					95	% Control
Wind Erosion - Existing Stockpile - 3	306	1.9	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					65	% Control
Wind Erosion - Existing Stockpile - 4	145	0.9	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					65	% Control
Wind Erosion - Existing Stockpile - 5	97	0.6	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					65	% Control
TOTAL PM10 EMISSIONS (kg/yr)	**1,660**																

TSP Emissions Inventory – Existing and Stage 1 Operations

Emissions Inventory - Existing and Stage 1 Operations - TSP

Activity	TSP Emissions (	Intensity - Stage	Units	TSP Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Control Efficie	Units
Truck Dumping Raw Material (65,000 tpa)	6	65,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
FEL Loading Raw Material to Feeder	39	430,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Conveying to Primary Crusher	12	430,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %							70	% Control
Primary Crushing	174	430,000	tonnes per annum	0.0027	kg/t											85	% Control
Conveying to Mill Building	12	430,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %							70	% Control
Mill Building Operations - Grinding, FEL and Storage Operation	806	430,000	tonnes per annum	0.0125	kg/t											85	% Control
Material Conveyed to New Extruder Facility	8	300,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %							70	% Control
Material Handling Operations inside New Extruder Facility	405	300,000	tonnes per annum	0.0045	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %							70	% Control
Conveying Fired Stockpiles from Kilns	27	300,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Loading Fired Stockpiles	27	300,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Crushing and Screening Operations	122	300,000	tonnes per annum	0.0027	kg/t											85	% Control
Loading Product Stockpile - 1	7	75,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Loading Product Stockpile - 2	7	75,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Loading Product Stockpile - 3	7	75,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Loading Product Stockpile - 4	7	75,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
FEL Loading Product Stockpiles to Truck	27	300,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Heavy Vehicle Haulage on Gravel Surfaces - Unpaved Road - 1	3,267	95,000	tonnes per annum	0.14	kg/t	50	tonnes/load	1.8	km/return trip	3.8	kg/vkt	8	% silt content	65	Avg GVM (tonnes	75	% Control
Wind Erosion - Existing Stockpile - 1	677	14.7	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					95	% Control
Wind Erosion - Existing Stockpile - 2	170	3.7	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					95	% Control
Wind Erosion - Existing Stockpile - 3	612	1.9	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					65	% Control
Wind Erosion - Fired Stockpile	521	1.13	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					50	% Control
Wind Erosion - Product Stockpile - 1	130	0.28	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					50	% Control
Wind Erosion - Product Stockpile - 2	130	0.28	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					50	% Control
Wind Erosion - Product Stockpile - 3	130	0.28	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					50	% Control
Wind Erosion - Product Stockpile - 4	130	0.28	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					50	% Control
TOTAL TSP EMISSIONS (kg/yr)	**7,460**																

PM_{10} Emissions Inventory – Existing and Stage 1 Operations

Emissions Inventory - Existing and Stage 1 Operations - PM10

Activity	PM10 Emissions	Intensity - Stage	Units	PM10 Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Control Efficie	Units
Truck Dumping Raw Material (65,000 tpa)	3	65,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
FEL Loading Raw Material to Feeder	19	430,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Conveying to Primary Crusher	6	430,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %							70	% Control
Primary Crushing	77	430,000	tonnes per annum	0.0012	kg/t											85	% Control
Conveying to Mill Building	6	430,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %							70	% Control
Mill Building Operations - Grinding, FEL and Storage Operation	74	430,000	tonnes per annum	0.00115	kg/t											85	% Control
Material Conveyed to New Extruder Facility	4	300,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %							70	% Control
Material Handling Operations inside New Extruder Facility	162	300,000	tonnes per annum	0.0018	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %							70	% Control
Conveying Fired Stockpiles from Kilns	13	300,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Loading Fired Stockpiles	13	300,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Crushing and Screening Operations	54	300,000	tonnes per annum	0.0012	kg/t											85	% Control
Loading Product Stockpile - 1	3	75,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Loading Product Stockpile - 2	3	75,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Loading Product Stockpile - 3	3	75,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Loading Product Stockpile - 4	3	75,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
FEL Loading Product Stockpiles to Truck	13	300,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Heavy Vehicle Haulage on Gravel Surfaces - Unpaved Road - 1	922	95,000	tonnes per annum	0.04	kg/t	50	tonnes/load	1.8	km/return trip	1.1	kg/vkt	8	% silt content	65	Avg GVM (tonnes	75	% Control
Wind Erosion - Existing Stockpile - 1	338	14.7	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					95	% Control
Wind Erosion - Existing Stockpile - 2	85	3.7	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					95	% Control
Wind Erosion - Existing Stockpile - 3	306	1.9	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					65	% Control
Wind Erosion - Fired Stockpile	260	1.13	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					50	% Control
Wind Erosion - Product Stockpile - 1	65	0.28	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					50	% Control
Wind Erosion - Product Stockpile - 2	65	0.28	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					50	% Control
Wind Erosion - Product Stockpile - 3	65	0.28	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					50	% Control
Wind Erosion - Product Stockpile - 4	65	0.28	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					50	% Control
TOTAL PM10 EMISSIONS (kg/yr)	**2,628**																

TSP Emissions Inventory – Existing, Stage 1 and Stage 2 Operations

Emissions Inventory - Existing, Stage 1 and Stage 2 Operations - TSP

Activity	TSP Emissions (	Intensity - Stage	Units	TSP Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Control Efficien	Units
Truck Dumping Raw Material (65,000 tpa)	6	65,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
FEL Loading Raw Material to Feeder	67	730,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Conveying to Primary Crusher	20	730,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %							70	% Control
Primary Crushing	296	730,000	tonnes per annum	0.0027	kg/t											85	% Control
Conveying to Mill Building	20	730,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %							70	% Control
Mill Building Operations - Grinding, FEL and Storage Operation	1,369	730,000	tonnes per annum	0.0125	kg/t											85	% Control
Material Conveyed to New Extruder Facility	16	600,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %							70	% Control
Material Handling Operations inside New Extruder Facility	810	600,000	tonnes per annum	0.0045	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %							70	% Control
Conveying Fired Stockpiles from Kilns	55	600,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Loading Fired Stockpiles	55	600,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Crushing and Screening Operations	243	600,000	tonnes per annum	0.0027	kg/t											85	% Control
Loading Product Stockpile - 1	14	150,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Loading Product Stockpile - 2	14	150,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Loading Product Stockpile - 3	14	150,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Loading Product Stockpile - 4	14	150,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
FEL Loading Product Stockpiles to Truck	55	600,000	tonnes per annum	0.0001	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Heavy Vehicle Haulage on Gravel Surfaces - Unpaved Road - 1	4,298	125,000	tonnes per annum	0.14	kg/t	50	tonnes/load	1.8	km/return trip	3.8	kg/vkt	8	% silt content	65	Avg GVM (tonnes	75	% Control
Wind Erosion - Existing Stockpile - 1	677	14.7	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					95	% Control
Wind Erosion - Existing Stockpile - 2	170	3.7	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					95	% Control
Wind Erosion - Existing Stockpile - 3	612	1.9	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					65	% Control
Wind Erosion - Fired Stockpile	521	1.13	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					50	% Control
Wind Erosion - Product Stockpile - 1	130	0.28	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					50	% Control
Wind Erosion - Product Stockpile - 2	130	0.28	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					50	% Control
Wind Erosion - Product Stockpile - 3	130	0.28	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					50	% Control
Wind Erosion - Product Stockpile - 4	130	0.28	ha	920	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					50	% Control
TOTAL TSP EMISSIONS (kg/yr)	**9,364**																

PM_{10} Emissions Inventory – Existing, Stage 1 and Stage 2 Operations

Emissions Inventory - Existing, Stage 1 and Stage 2 Operations - PM10

Activity	PM10 Emissions	Intensity - Stage	Units	PM10 Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Control Efficien	Units
Truck Dumping Raw Material (65,000 tpa)	3	65,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
FEL Loading Raw Material to Feeder	32	730,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Conveying to Primary Crusher	9	730,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %							70	% Control
Primary Crushing	131	730,000	tonnes per annum	0.0012	kg/t											85	% Control
Conveying to Mill Building	9	730,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %							70	% Control
Mill Building Operations - Grinding, FEL and Storage Operation	126	730,000	tonnes per annum	0.00115	kg/t											85	% Control
Material Conveyed to New Extruder Facility	8	600,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %							70	% Control
Material Handling Operations inside New Extruder Facility	324	600,000	tonnes per annum	0.0018	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %							70	% Control
Conveying Fired Stockpiles from Kilns	26	600,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Loading Fired Stockpiles	26	600,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Crushing and Screening Operations	108	600,000	tonnes per annum	0.0012	kg/t											85	% Control
Loading Product Stockpile - 1	6	150,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Loading Product Stockpile - 2	6	150,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Loading Product Stockpile - 3	6	150,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Loading Product Stockpile - 4	6	150,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
FEL Loading Product Stockpiles to Truck	26	600,000	tonnes per annum	0.00004	kg/t	1.1	average (windspeed /2.2)^1.3 in (m/sec)	13	moisture content in %								
Heavy Vehicle Haulage on Gravel Surfaces - Unpaved Road - 1	1,213	125,000	tonnes per annum	0.04	kg/t	50	tonnes/load	1.8	km/return trip	1.1	kg/vkt	8	% silt content	65	Avg GVM (tonnes	75	% Control
Wind Erosion - Existing Stockpile - 1	338	14.7	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					95	% Control
Wind Erosion - Existing Stockpile - 2	85	3.7	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					95	% Control
Wind Erosion - Existing Stockpile - 3	306	1.9	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					65	% Control
Wind Erosion - Fired Stockpile	260	1.13	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					50	% Control
Wind Erosion - Product Stockpile - 1	65	0.28	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					50	% Control
Wind Erosion - Product Stockpile - 2	65	0.28	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					50	% Control
Wind Erosion - Product Stockpile - 3	65	0.28	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					50	% Control
Wind Erosion - Product Stockpile - 4	65	0.28	ha	460	kg/ha/yr	5.5	silt content %	46	(p)	4.0	(f)					50	% Control
TOTAL PM10 EMISSIONS (kg/yr)	**3,317**																

APPENDIX B – SAMPLE CALPUFF MODEL FILE

```
Brickworks_Run2A4


---------------- Run title (3 lines) ------------------------------------------

                    CALPUFF MODEL CONTROL FILE
                    --------------------------

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output File Names

--------------
Default Name  Type          File Name
------------  ----          ---------
CALMET.DAT    input    * METDAT - *
    or
ISCMET.DAT    input    * ISCDAT - *
    or
PLMMET.DAT    input    * PLMDAT - *
    or
PROFILE.DAT   input    * PRFDAT - *
SURFACE.DAT   input    * SFCDAT - *
RESTARTB.DAT  input    * RSTARTB - *
--------------------------------------------------------------------------------
CALPUFF.LST   output   ! PUFLST - CALPUFF.LST !
CONC.DAT      output   ! CONDAT - CONC.DAT !
DFLX.DAT      output   ! DFDAT - DFLX.DAT !
WFLX.DAT      output   ! WFDAT - WFLX.DAT !

VISB.DAT      output   * VISDAT - *
TK2D.DAT      output   * T2DDAT - *
RHO2D.DAT     output   * RHODAT - *
RESTARTE.DAT  output   * RSTARTE - *
--------------------------------------------------------------------------------
Emission Files
--------------
PTEMARB.DAT   input    * PTDAT - *
VOLEMARB.DAT  input    * VOLDAT - *
BAEMARB.DAT   input    * ARDAT - *
LNEMARB.DAT   input    * LNDAT - *
--------------------------------------------------------------------------------
Other Files
-----------
OZONE.DAT     input    * OZDAT - *
VD.DAT        input    * VDDAT - *
CHEM.DAT      input    * CHEMDAT - *
AUX           input    * AUXEXT - *
(Extension added to METDAT filename(s) for files
 with auxiliary 2D and 3D data)
H2O2.DAT      input    * H2O2DAT - *
NH3Z.DAT      input    * NH3ZDAT - *
HILL.DAT      input    * HILDAT - *
HILLRCT.DAT   input    * RCTDAT - *
COASTLN.DAT   input    * CSTDAT - *
```

```
COASTLN.DAT   input    * CSTDAT - *
FLUXBDY.DAT   input    * BDYDAT - *
BCON.DAT      input    * BCNDAT - *
DEBUG.DAT     output   * DEBUG - *
MASSFLX.DAT   output   * FLXDAT - *
MASSBAL.DAT   output   * BALDAT - *
FOG.DAT       output   * FOGDAT - *
RISE.DAT      output   * RISDAT - *
PFTRAK.DAT    output   * TRKDAT - *
--------------------------------------------------------------------------------
All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
         T = lower case      ! LCFILES = F !
         F = UPPER CASE
NOTE: (1) file/path names can be up to 132 characters in length


Provision for multiple input files
----------------------------------
     Number of CALMET.DAT Domains (NMETDOM)
                                Default: 1       ! NMETDOM = 1 !

     Number of CALMET.DAT files (NMETDAT)
     (Total for ALL Domains)
                                Default: 1       ! NMETDAT = 4 !

     Number of PTEMARB.DAT files for run (NPTDAT)
                                Default: 0       ! NPTDAT = 0 !

     Number of BAEMARB.DAT files for run (NARDAT)
                                Default: 0       ! NARDAT = 0 !

     Number of VOLEMARB.DAT files for run (NVOLDAT)
                                Default: 0       ! NVOLDAT = 0 !

!END!

-------------
Subgroup (0a)
-------------
  Provide a name for each CALMET domain if NMETDOM > 1
  Enter NMETDOM lines.
                                           a,b
Default Name             Domain Name
------------             ------------
* DOMAINLIST = *


  The following CALMET.DAT filenames are processed in sequence
  if NMETDAT > 1

  Enter NMETDAT lines, 1 line for each file name.

                                            a,c,d
Default Name  Type          File Name
```

```
* DOMAINLIST - *


  The following CALMET.DAT filenames are processed in sequence
  if NMETDAT > 1

  Enter NMETDAT lines, 1 line for each file name.

                                     a,c,d
Default Name  Type           File Name
------------  ----           ---------
 none         input    ! METDAT=..\Brickworks\CALMET_2014-01-01-00-0000-2014-04-02-00-0000.DAT     !  !END!
 none         input    ! METDAT=..\Brickworks\CALMET_2014-04-02-00-0000-2014-07-02-00-0000.DAT     !  !END!
 none         input    ! METDAT=..\Brickworks\CALMET_2014-07-02-00-0000-2014-10-02-00-0000.DAT     !  !END!
 none         input    ! METDAT=..\Brickworks\CALMET_2014-10-02-00-0000-2014-12-31-23-0000.DAT     !  !END!

-------------
    a
     The name for each CALMET domain and each CALMET.DAT file is treated
     as a separate input subgroup and therefore must end with an input
     group terminator.
    b
     Use DOMAIN1= to assign the name for the outermost CALMET domain.
     Use DOMAIN2= to assign the name for the next inner CALMET domain.
     Use DOMAIN3= to assign the name for the next inner CALMET domain, etc.
      --------------------------------------------------------------------
      |    When inner domains with equal resolution (grid-cell size)     |
      |    overlap, the data from the FIRST such domain in the list will |
      |    be used if all other criteria for choosing the controlling    |
      |    grid domain are inconclusive.                                 |
      --------------------------------------------------------------------
    c
     Use METDAT1= to assign the file names for the outermost CALMET domain.
     Use METDAT2= to assign the file names for the next inner CALMET domain.
     Use METDAT3= to assign the file names for the next inner CALMET domain, etc.
    d
     The filenames for each domain must be provided in sequential order


-------------
Subgroup (0b)
-------------

  The following PTEMARB.DAT filenames are processed in sequence if NPTDAT>0
  (Each file contains a subset of the sources, for the entire simulation)

Default Name  Type           File Name
------------  ----           ---------
* PTDATLIST - *


-------------
Subgroup (0c)
-------------
```

```
  The following BAEMARB.DAT filenames are processed in sequence if NARDAT>0
  (Each file contains a subset of the sources, for the entire simulation)

Default Name  Type          File Name
------------  ----          ---------
* ARDATLIST = *


-------------
Subgroup (0d)
-------------

  The following VOLEMARB.DAT filenames are processed in sequence if NARDAT>0
  (Each file contains a subset of the sources, for the entire simulation)

Default Name  Type          File Name
------------  ----          ---------
* VOLDATLIST = *

--------------------------------------------------------------------------------

INPUT GROUP: 1 -- General run control parameters
--------------

    Option to run all periods found
    in the met. file     (METRUN)   Default: 0       ! METRUN = 0 !

         METRUN = 0 - Run period explicitly defined below
         METRUN = 1 - Run all periods in met. file

     Starting date:    Year   (IBYR)  --    No default   ! IBYR = 2014 !
                       Month  (IBMO)  --    No default   ! IBMO = 1 !
                       Day    (IBDY)  --    No default   ! IBDY = 1 !
     Starting time:    Hour   (IBHR)  --    No default   ! IBHR = 0 !
                       Minute (IBMIN) --    No default   ! IBMIN = 0 !
                       Second (IBSEC) --    No default   ! IBSEC = 0 !

     Ending date:      Year   (IEYR)  --    No default   ! IEYR = 2014 !
                       Month  (IEMO)  --    No default   ! IEMO = 12 !
                       Day    (IEDY)  --    No default   ! IEDY = 31 !
     Ending time:      Hour   (IEHR)  --    No default   ! IEHR = 23 !
                       Minute (IEMIN) --    No default   ! IEMIN = 0 !
                       Second (IESEC) --    No default   ! IESEC = 0 !

     (These are only used if METRUN = 0)

     Base time zone:          (ABTZ)  --    No default   ! ABTZ = UTC+1000 !
      (character*8)
     The modeling domain may span multiple time zones.  ABTZ defines the
     base time zone used for the entire simulation.  This must match the
     base time zone of the meteorological data.
     Examples:
         Los Angeles, USA          = UTC-0800
         New York, USA             = UTC-0500
```

continued….

APPENDIX C –HORSLEY PARK AWS METEOROLOGY ANALYSIS – 2010 - 2014

Figure C-1: Annual and Seasonal Wind Roses for 2010 – BOM Horsley Park Equestrian Centre AWS

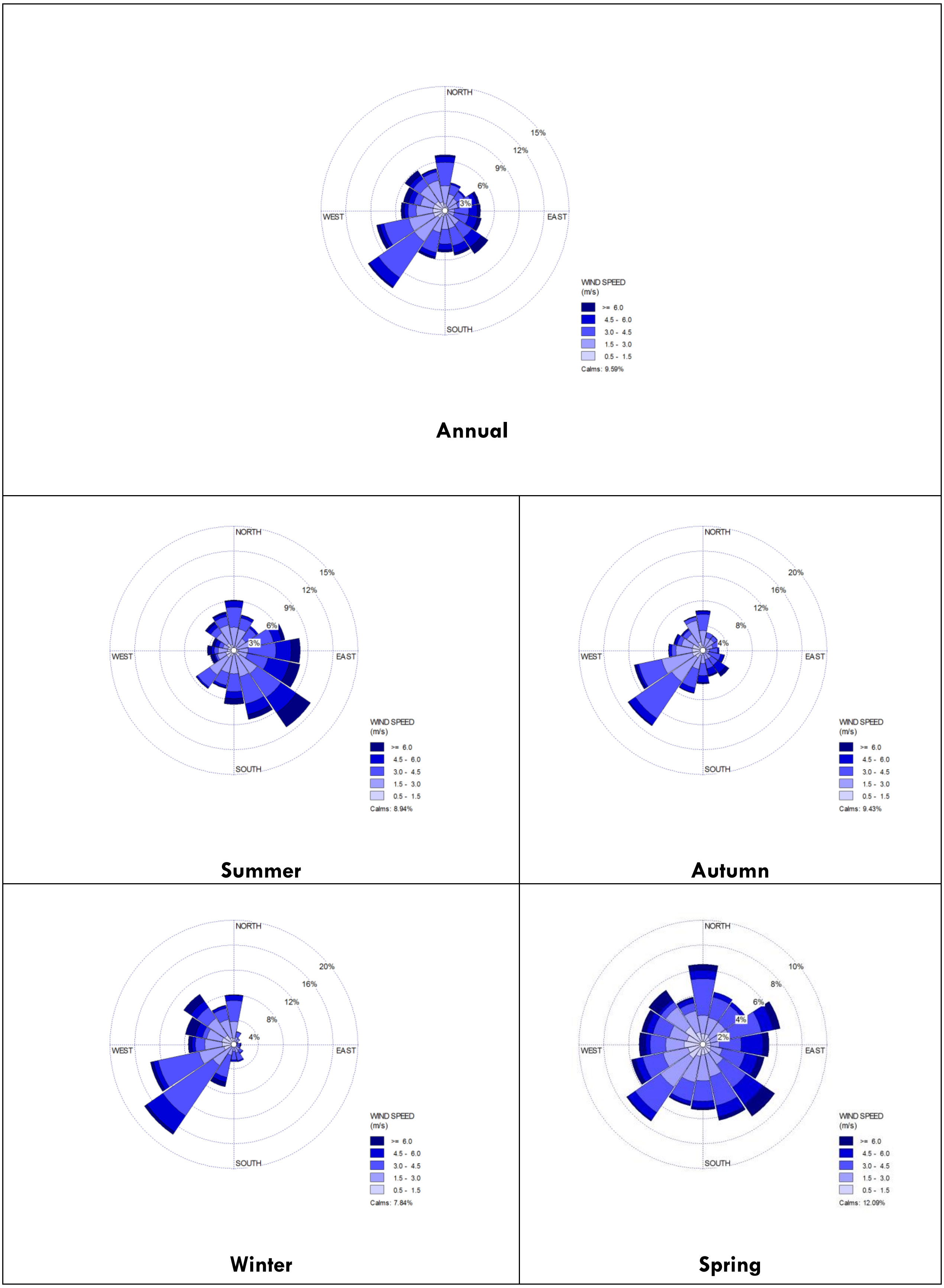
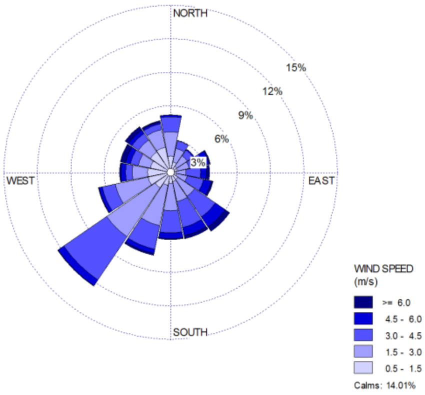
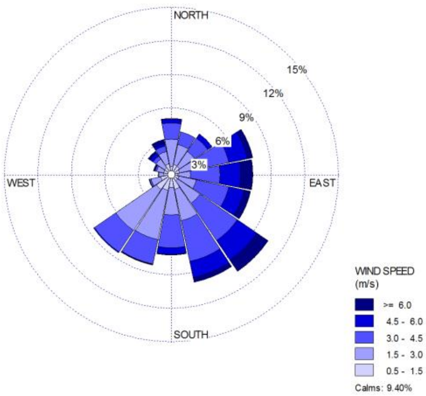


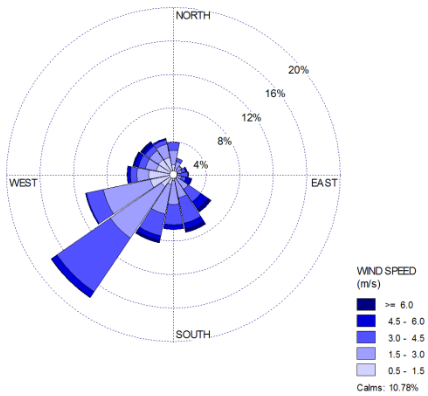
Figure C-2: Annual and Seasonal Wind Roses for 2011 – BOM Horsley Park Equestrian Centre AWS



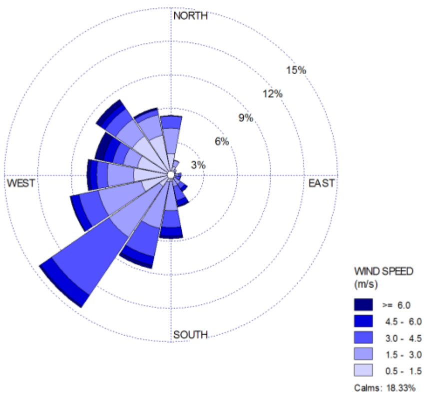
Annual



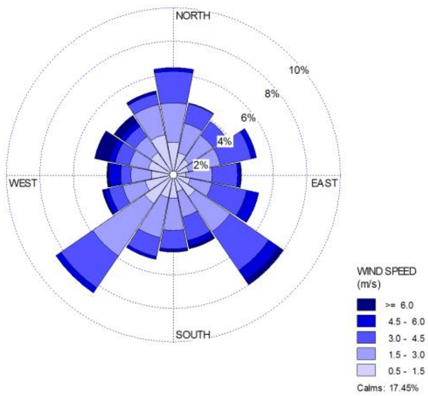
Summer



Autumn



Winter



Spring

Figure C-3: Annual and Seasonal Wind Roses for 2012 – BOM Horsley Park Equestrian Centre AWS

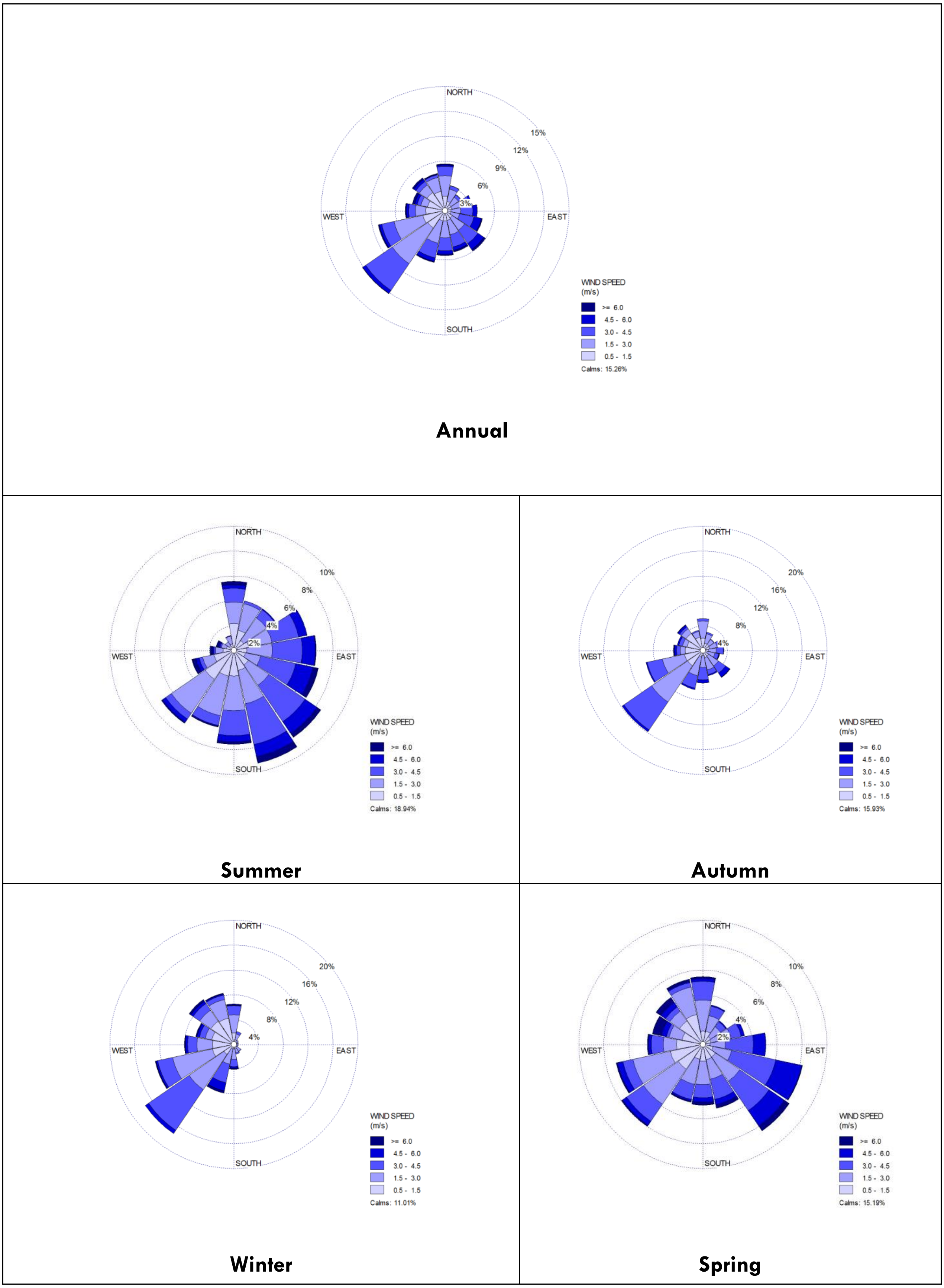
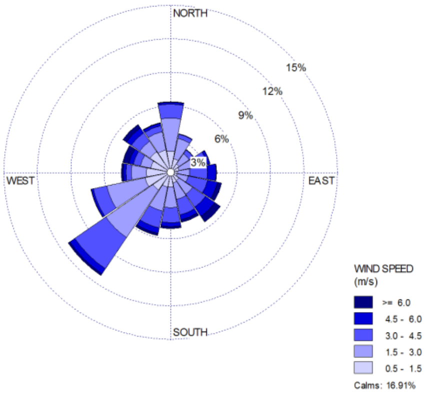
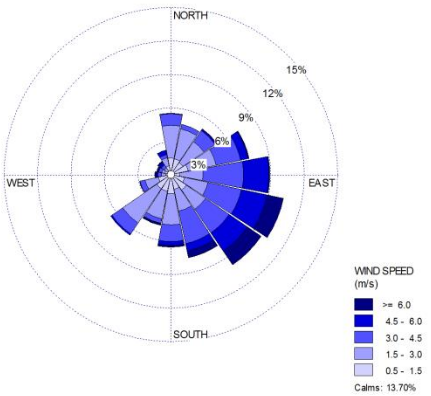


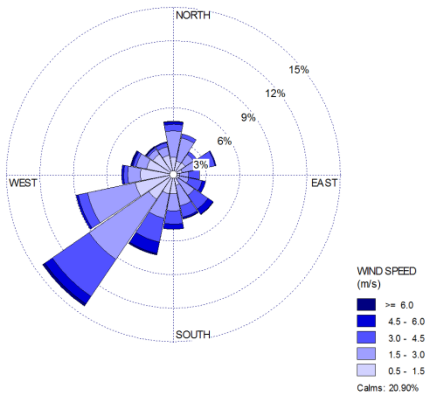
Figure C-4: Annual and Seasonal Wind Roses for 2013 – BOM Horsley Park Equestrian Centre AWS



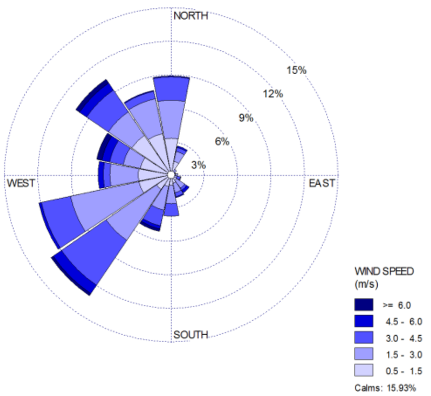
Annual



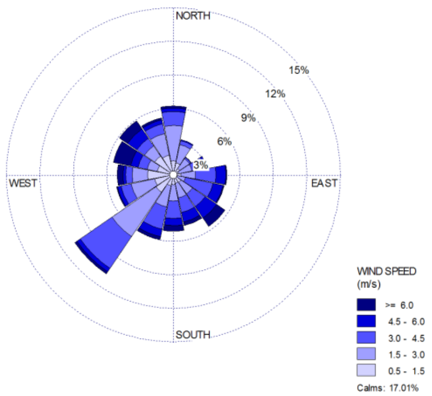
Summer



Autumn

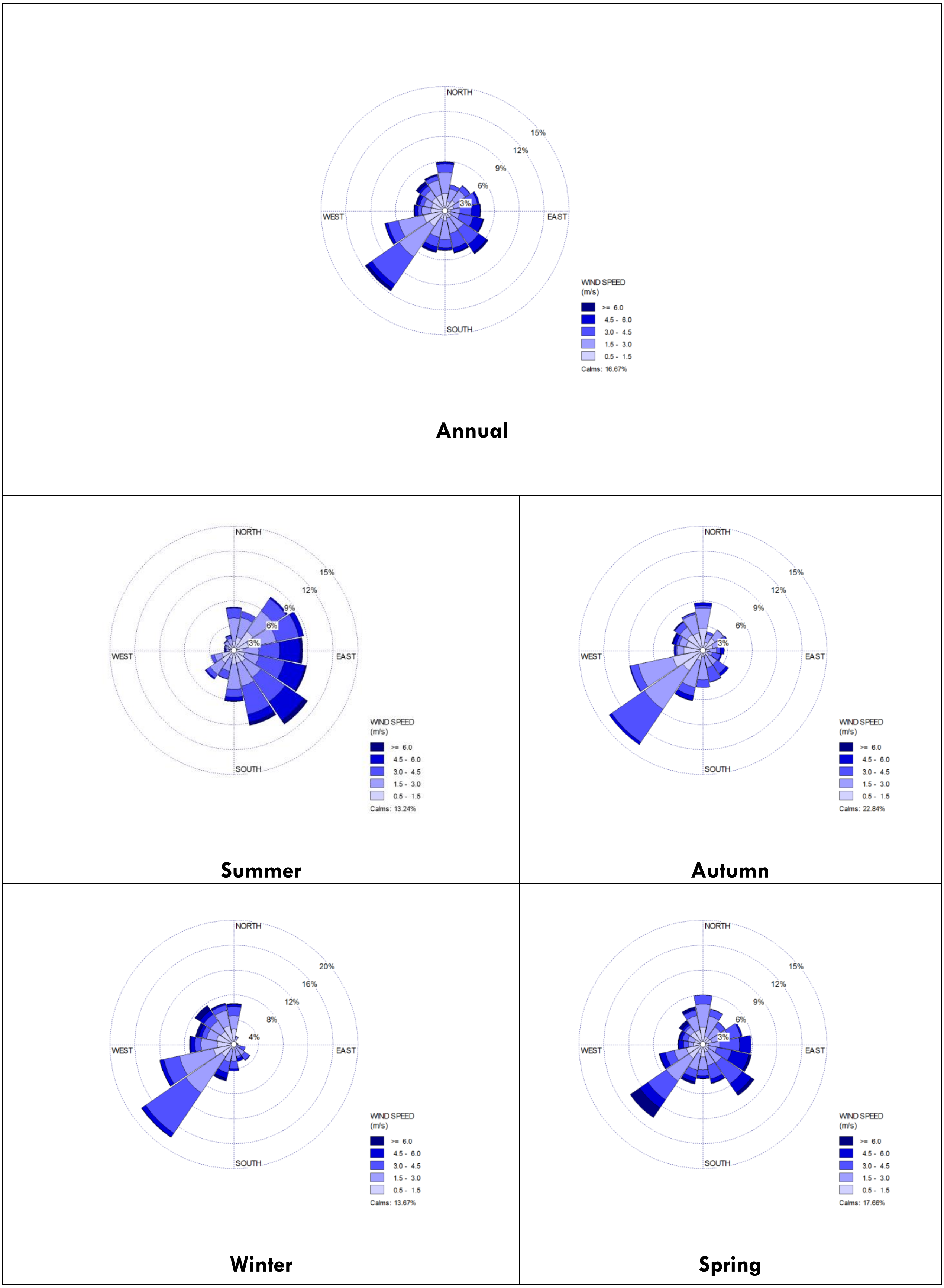


Winter



Spring

Figure C-5: Annual and Seasonal Wind Roses for 2014 – BOM Horsley Park Equestrian Centre AWS



APPENDIX D – CONCENTRATION ISOPLETHS

Figure D-1: Stage 2 Operations, Option 2 – Annual Average TSP Incremental Concentrations (µg/m³)

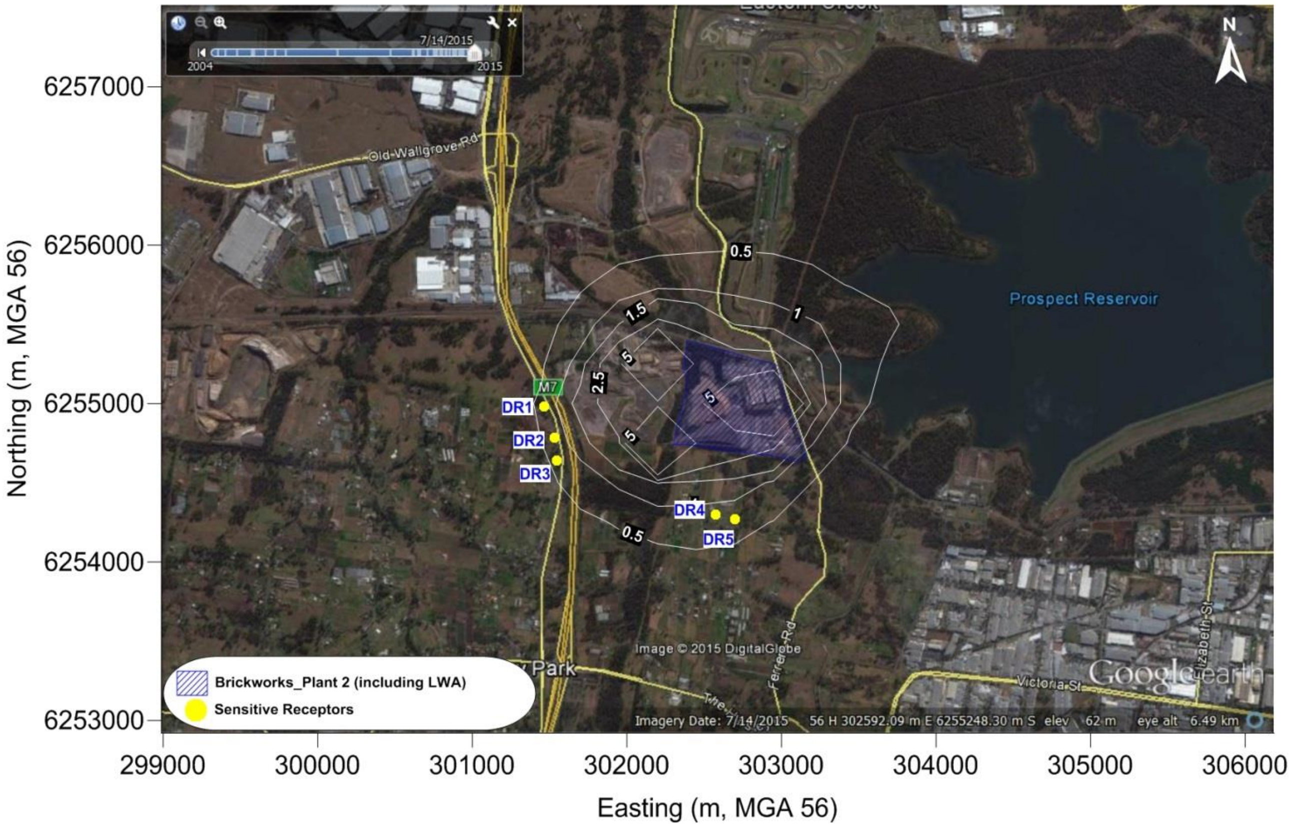


Figure D-2: Stage 2 Operations, Option 2 – Annual Average TSP Cumulative Concentrations (µg/m³) (Criteria: 90 µg/m³)

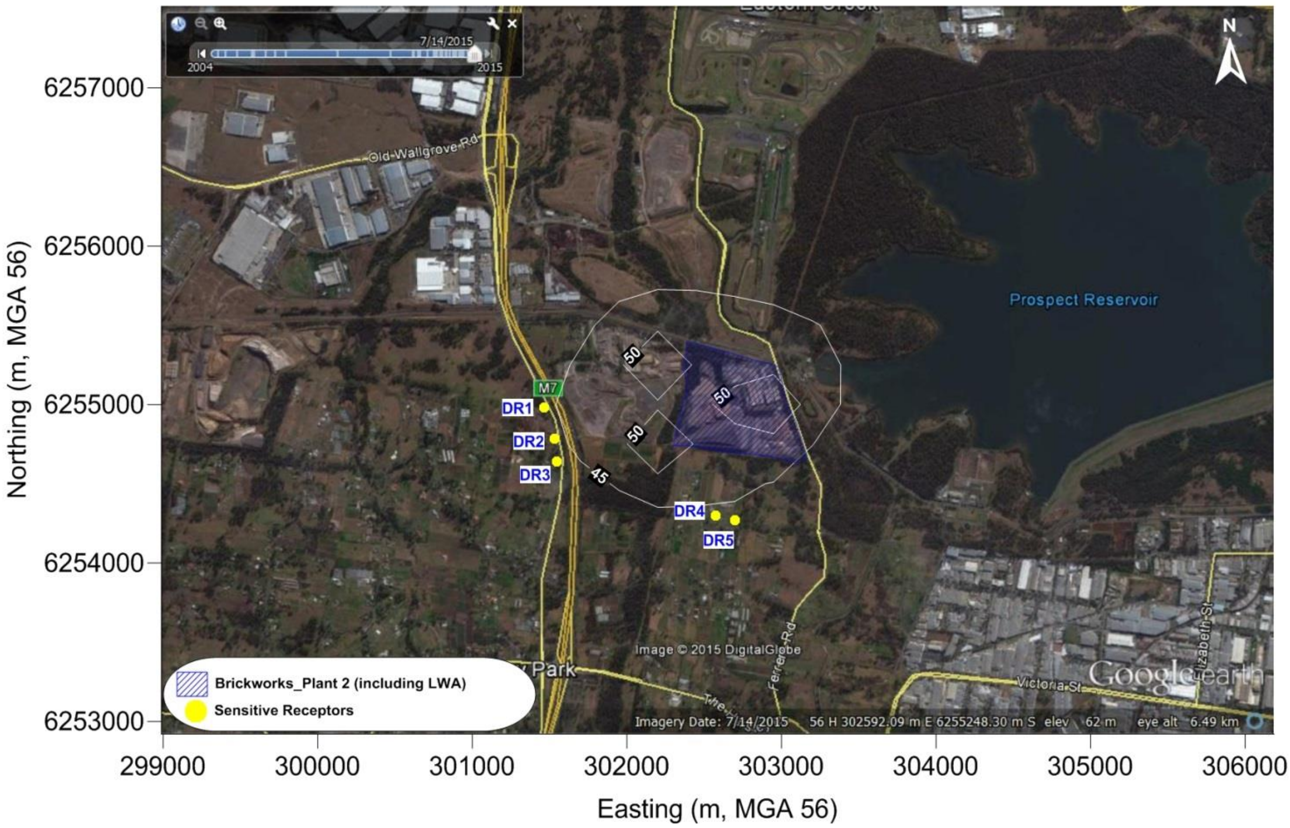


Figure D-3: Stage 2 Operations, Option 2 – 24-hour Average Maximum PM_{10} Incremental Concentrations ($\mu g/m^3$)

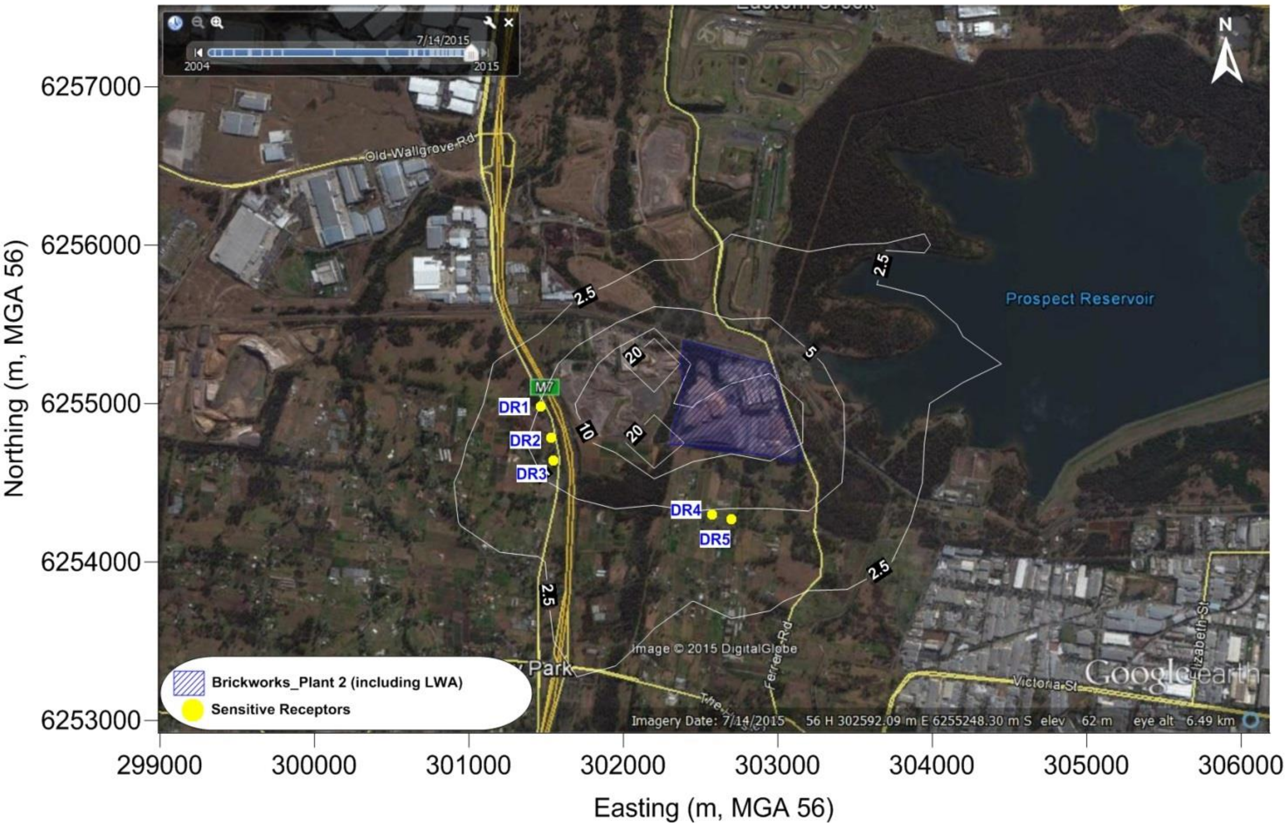


Figure D-4: Stage 2 Operations, Option 2 – 24-hour Average Maximum PM_{10} Cumulative Concentrations ($\mu g/m^3$) (Criteria: 50 $\mu g/m^3$)

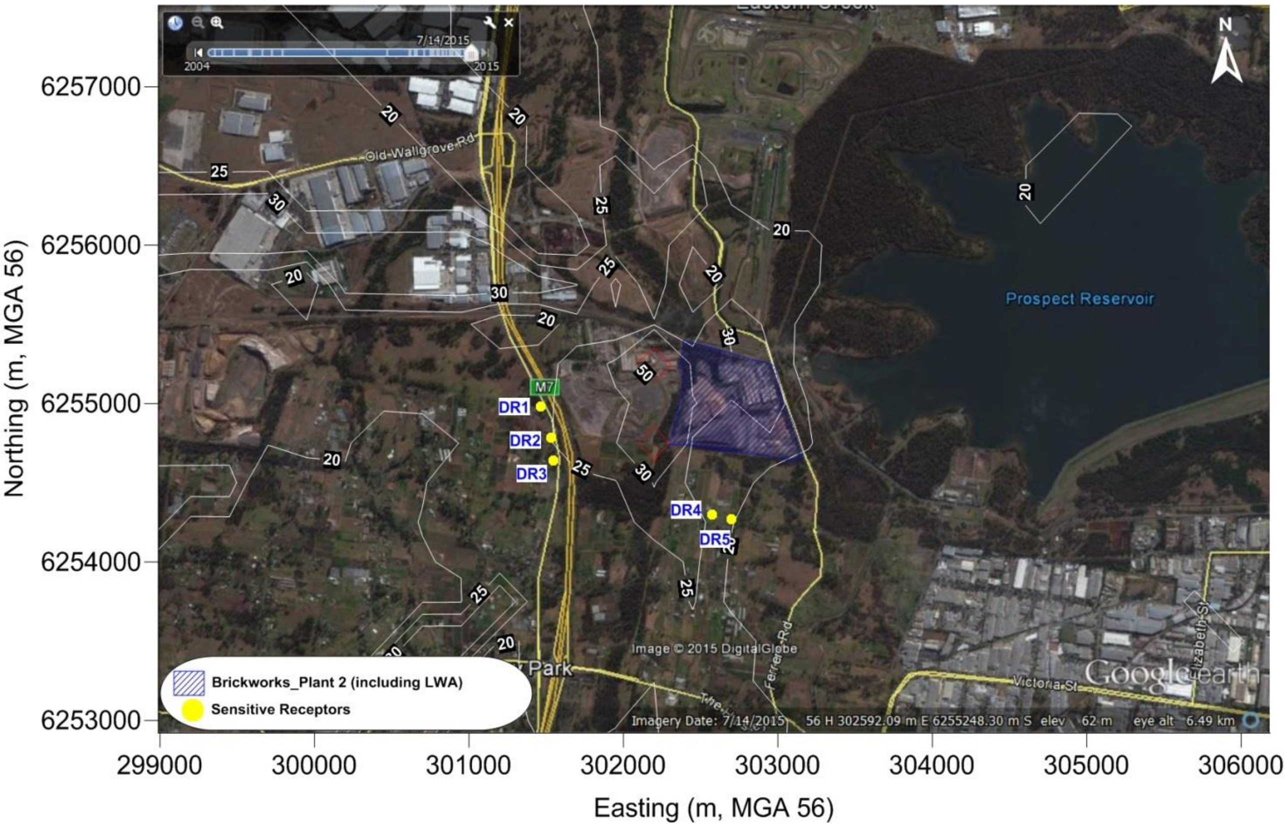


Figure D-5: Stage 2 Operations, Option 2 – Annual Average PM_{10} Incremental Concentrations (µg/m³)

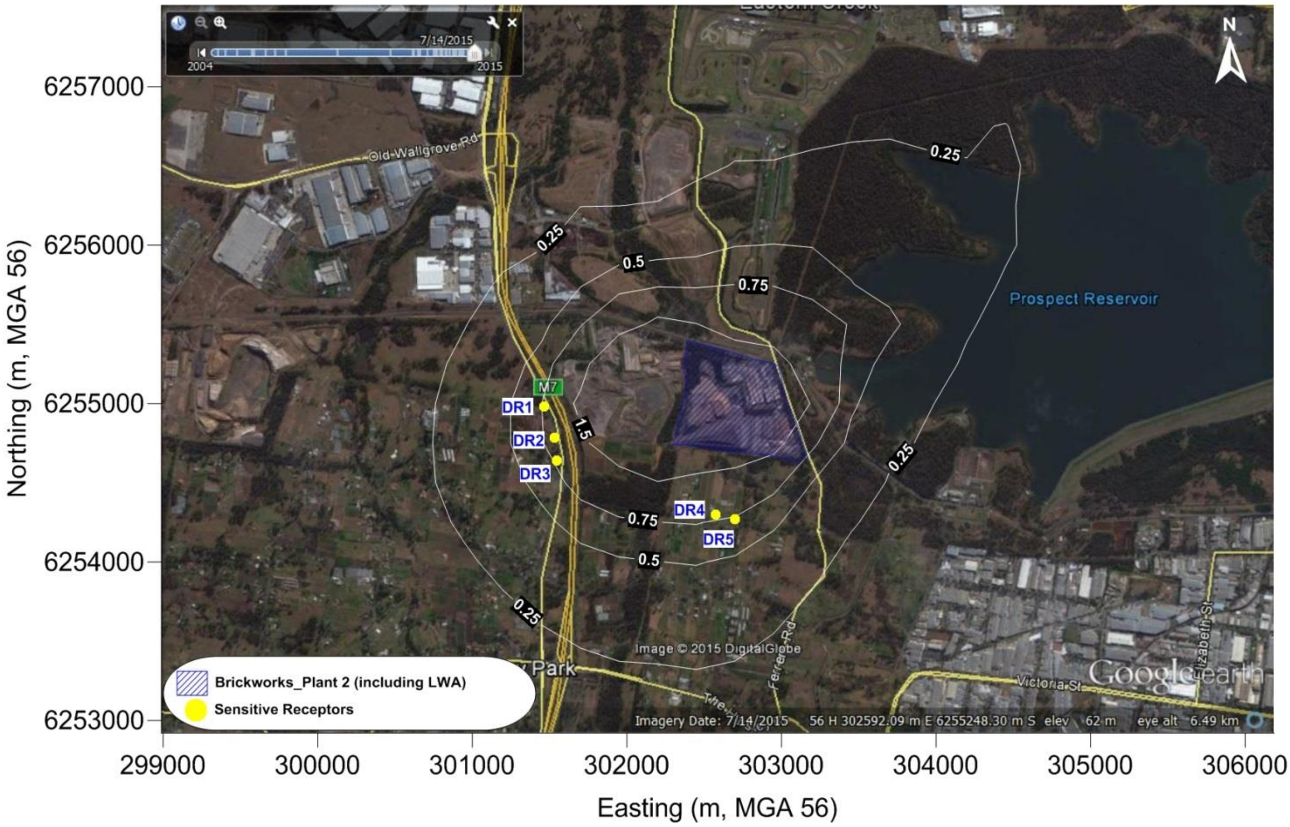


Figure D-6: Stage 2 Operations, Option 2 – Annual Average PM_{10} Cumulative Concentrations (µg/m³) (Criteria: 30 µg/m³)

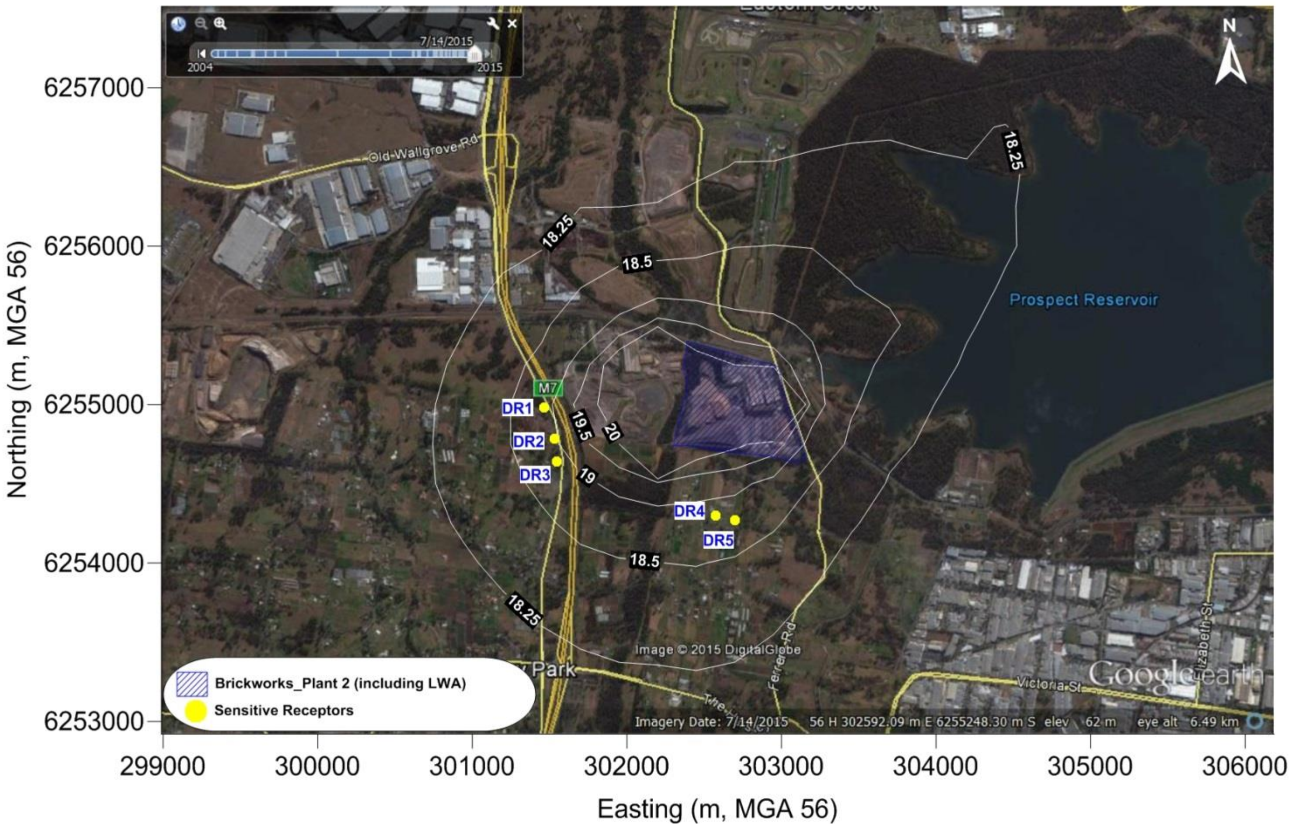


Figure D-7: Stage 2 Operations, Option 2 – Annual Average Incremental Deposited Dust Levels (g/m²/month)

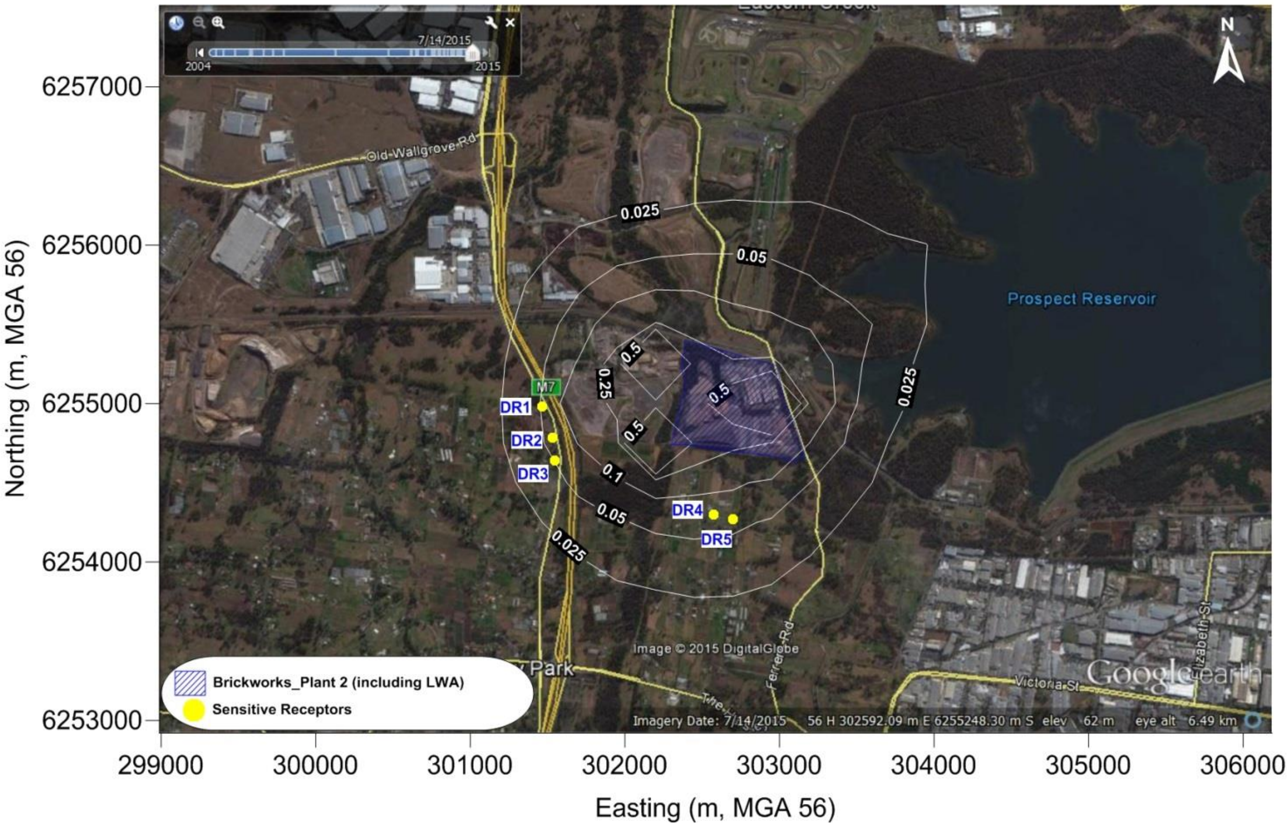


Figure D-8: Stage 2 Operations, Option 2 – Annual Average Cumulative Deposited Dust Levels (g/m²/month) (Criteria: 4g/m²/month)

Figure D-9: Stage 2 Operations, Option 2 – 24-hour Average Maximum HF Incremental Concentrations (µg/m³) (Criteria: 2.9µg/m³)

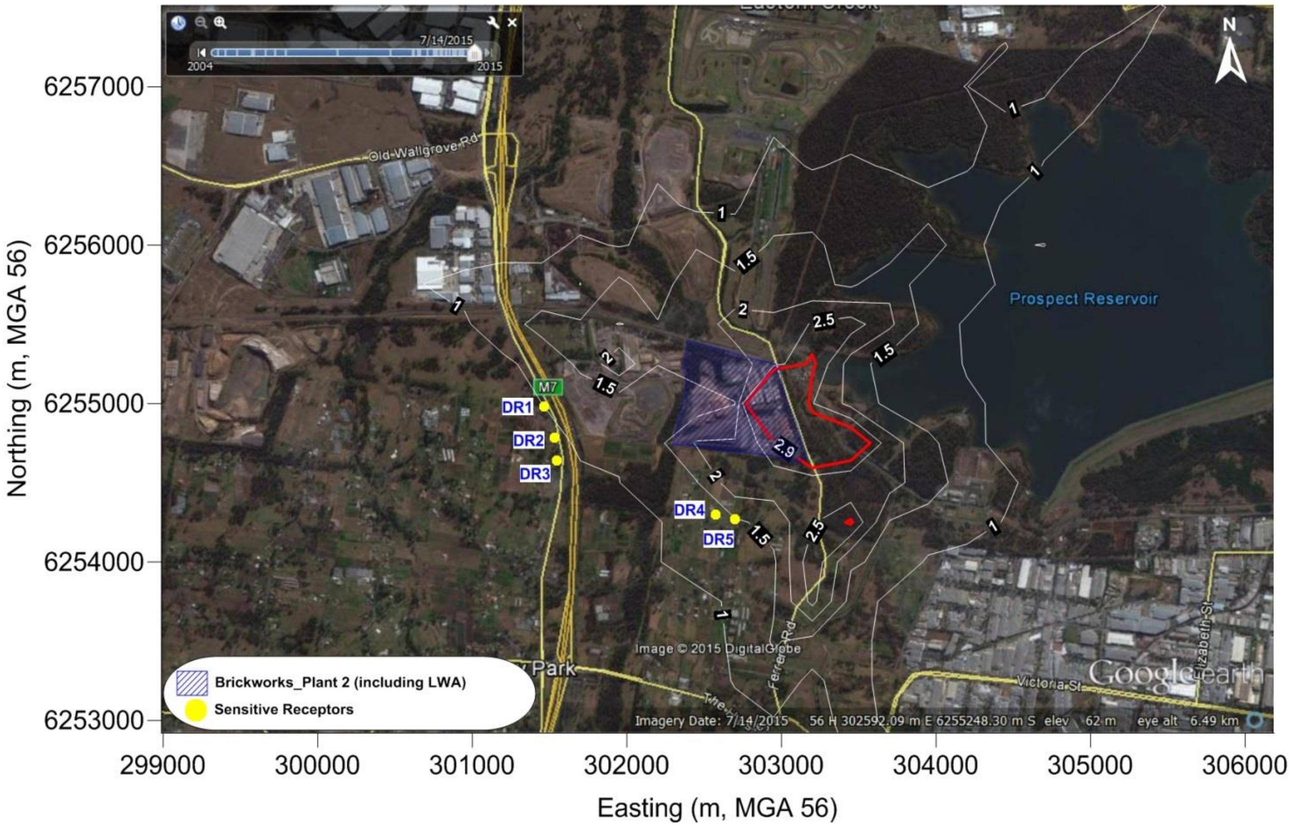


Figure D-10: Stage 1 Operations, Option 2 – 24-hour Average Maximum HF Incremental Concentrations (µg/m³) (Criteria: 2.9µg/m³)

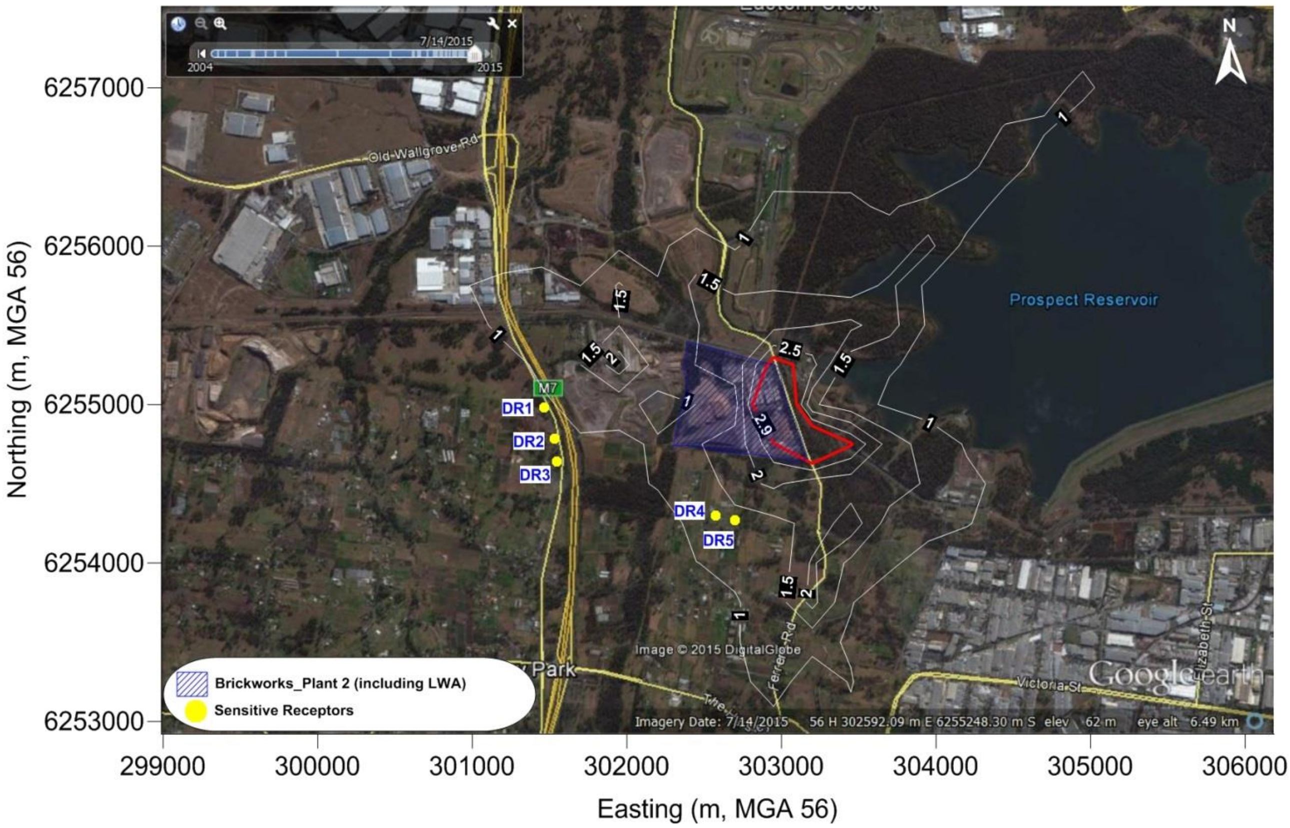


Figure D-11: Existing Operations – 24-hour Average Maximum HF Incremental Concentrations ($\mu g/m^3$) (Criteria: $2.9\mu g/m^3$)

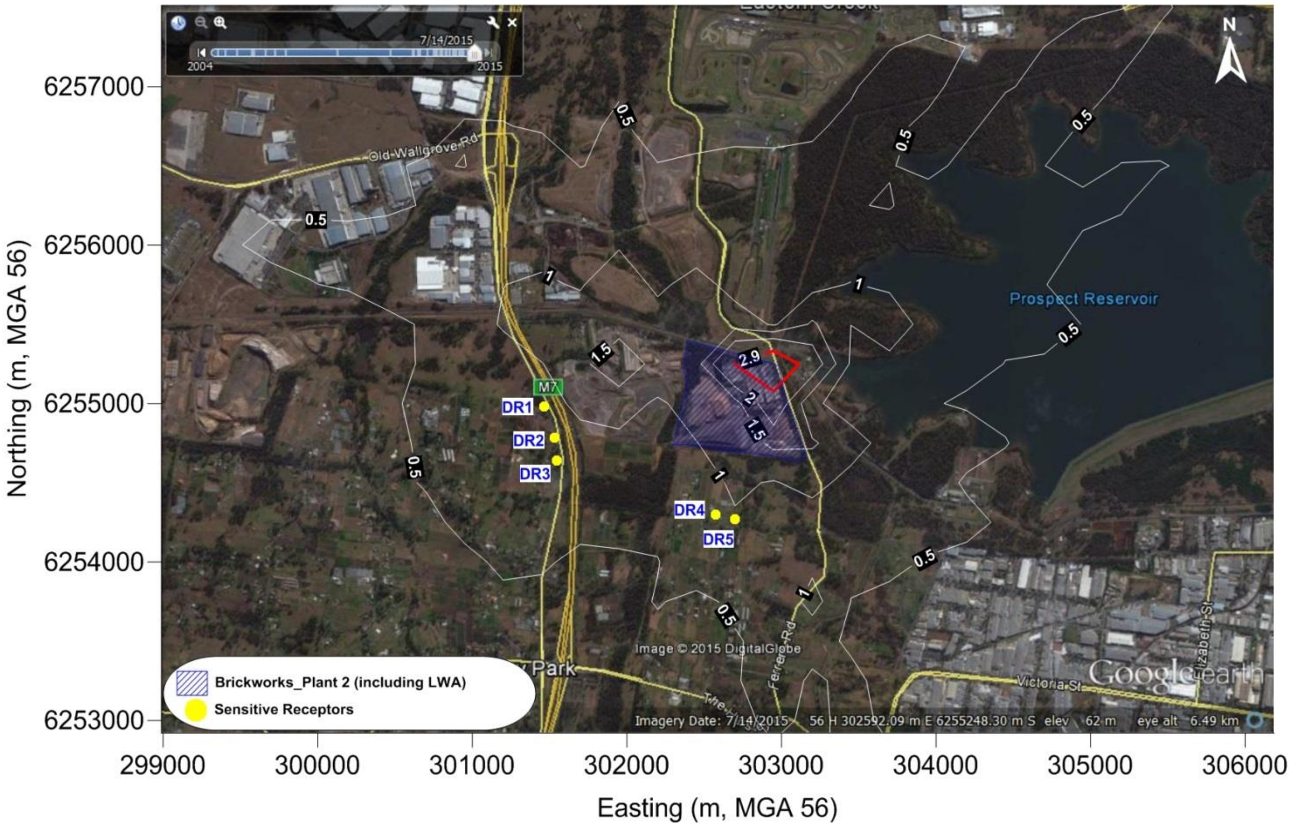


Figure D-12: Stage 2 Operations, Option 2 – 7-day Average Maximum HF Incremental Concentrations ($\mu g/m^3$) (Criteria: $1.7\mu g/m^3$)

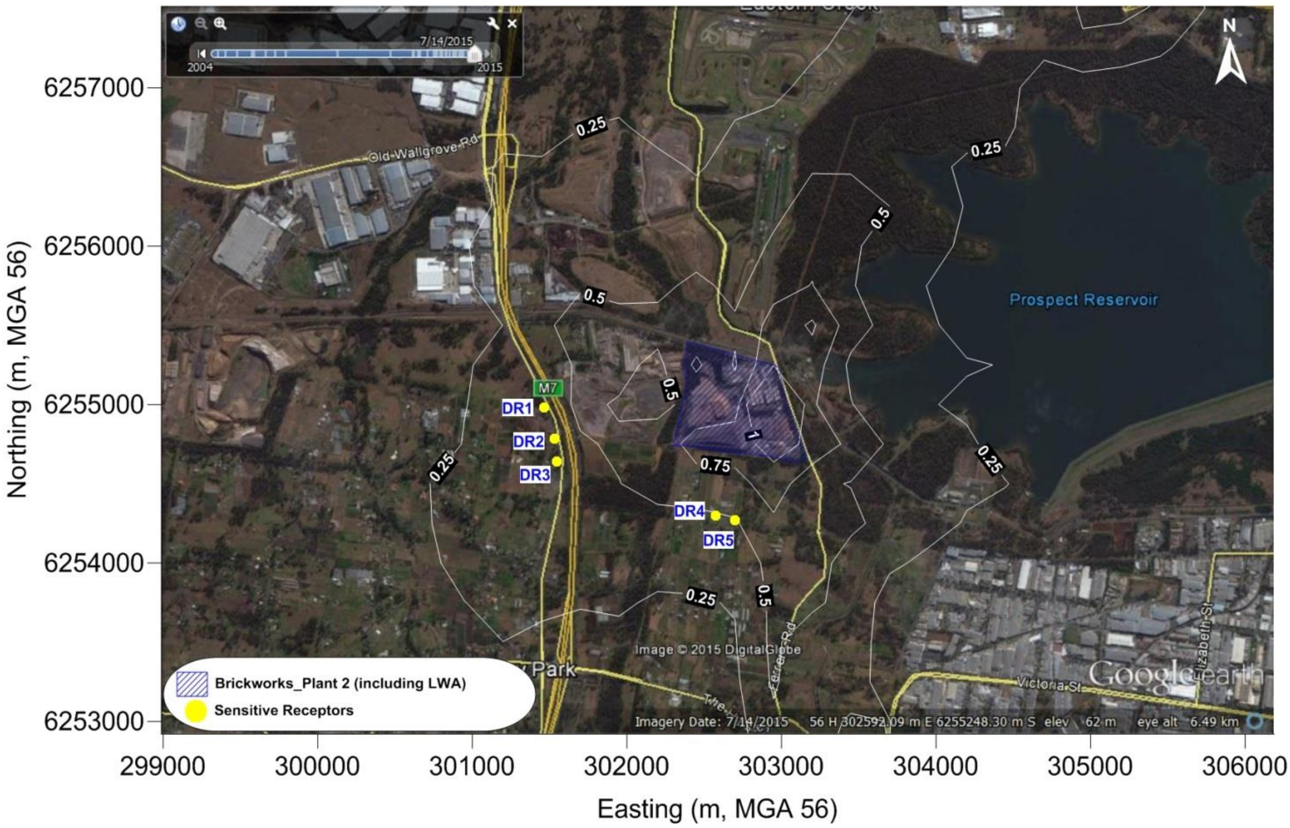


Figure D-13: Stage 1 Operations, Option 2 – 7-day Average Maximum HF Incremental Concentrations (µg/m³) (Criteria: 1.7µg/m³)

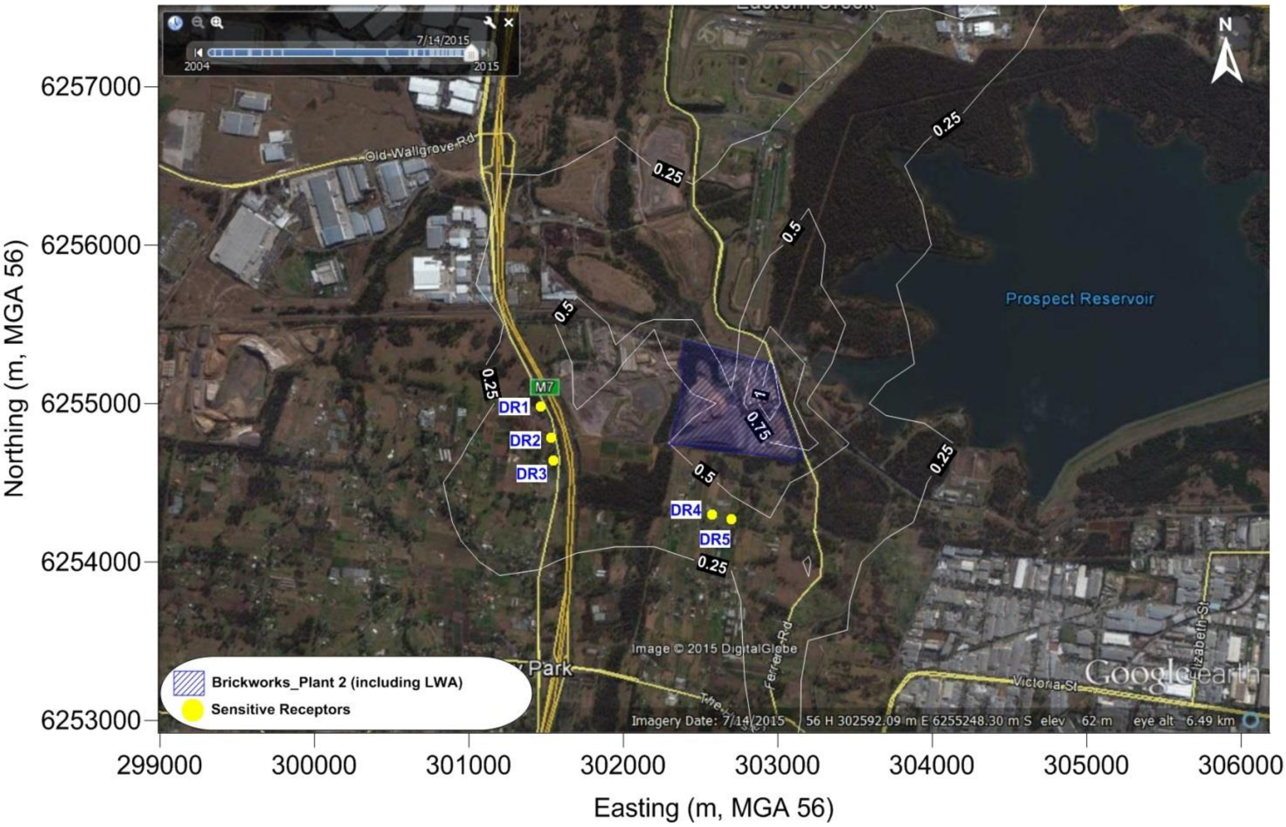


Figure D-14: Existing Operations – 7-day Average Maximum HF Incremental Concentrations (µg/m³) (Criteria: 1.7µg/m³)

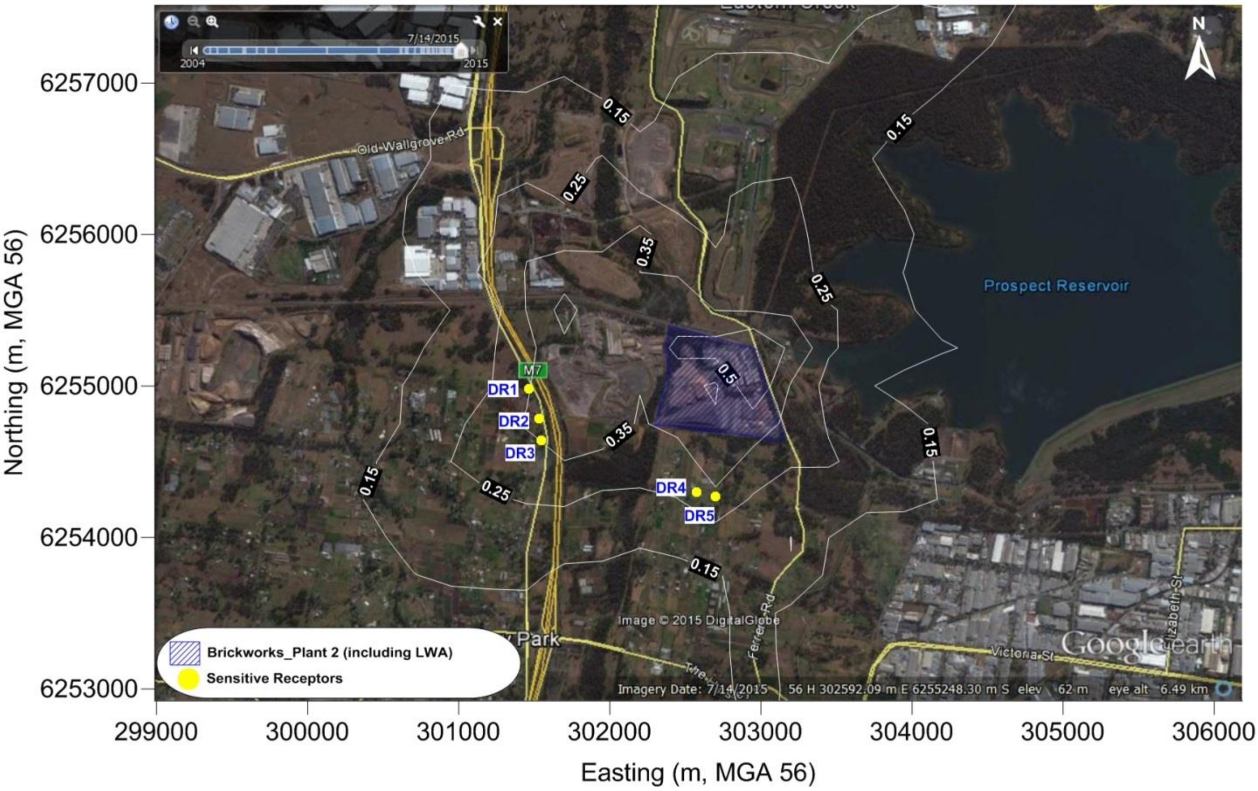


Figure D-15: Stage 2 Operations, Option 2 – 30-day Average Maximum HF Incremental Concentrations (µg/m³) (Criteria: 0.84µg/m³)

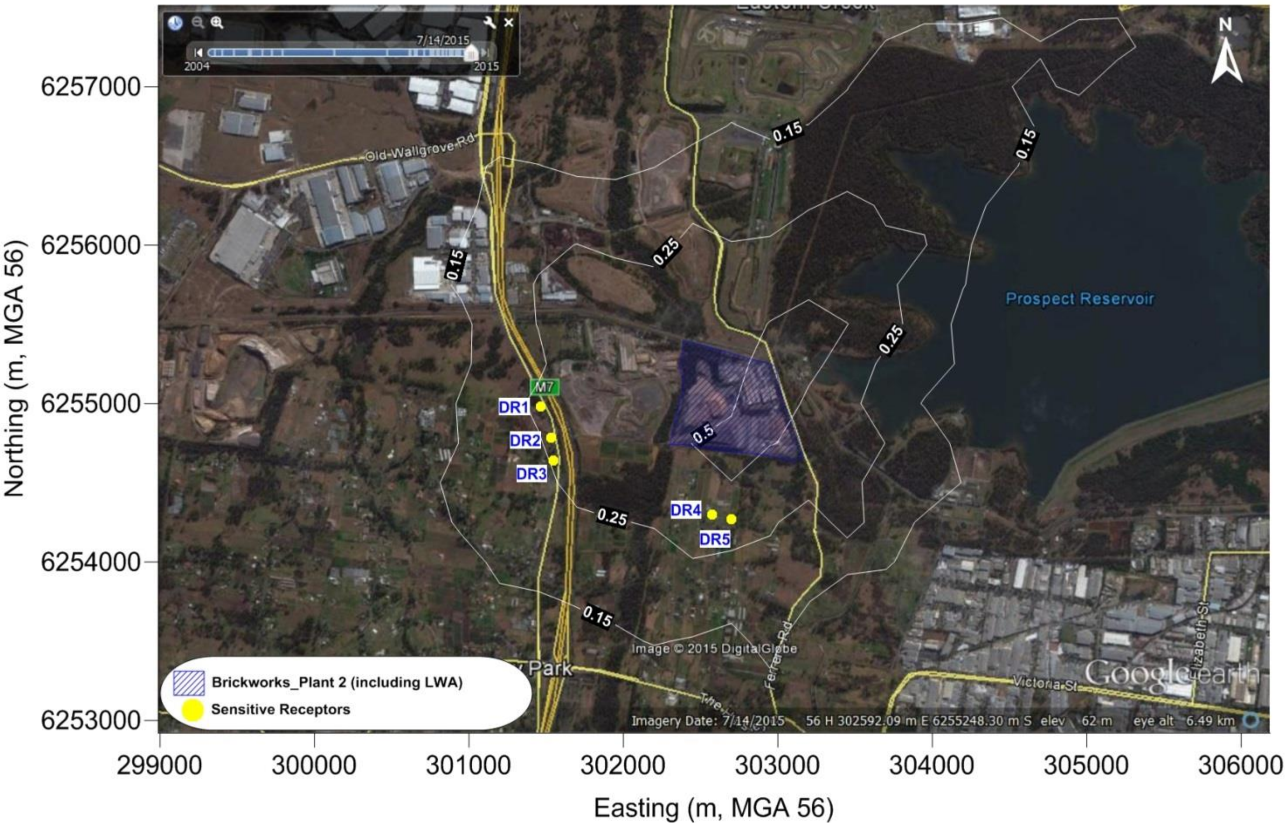


Figure D-16: Stage 1 Operations, Option 2 – 30-day Average Maximum HF Incremental Concentrations (µg/m³) (Criteria: 0.84µg/m³)

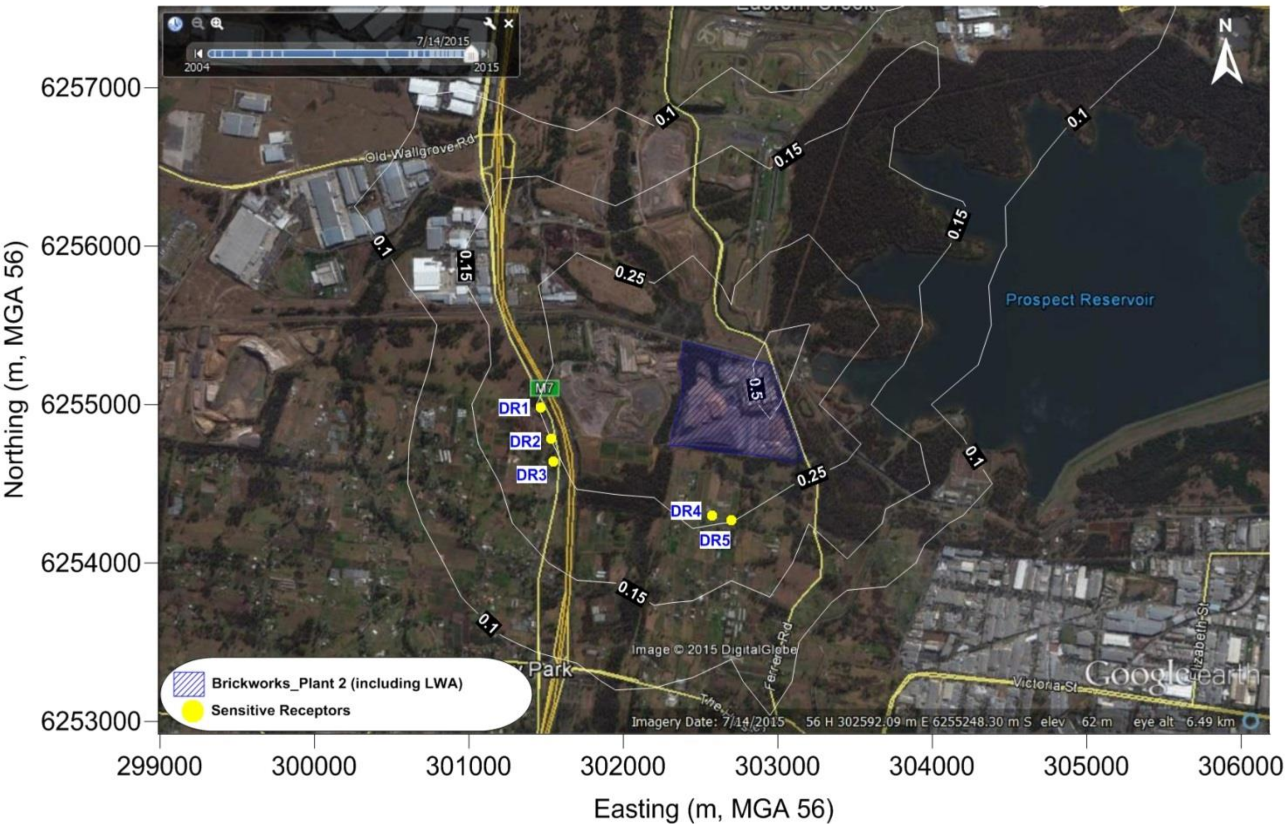


Figure D-17: Existing Operations – 30-day Average Maximum HF Incremental Concentrations (µg/m³) (Criteria: 0.84µg/m³)

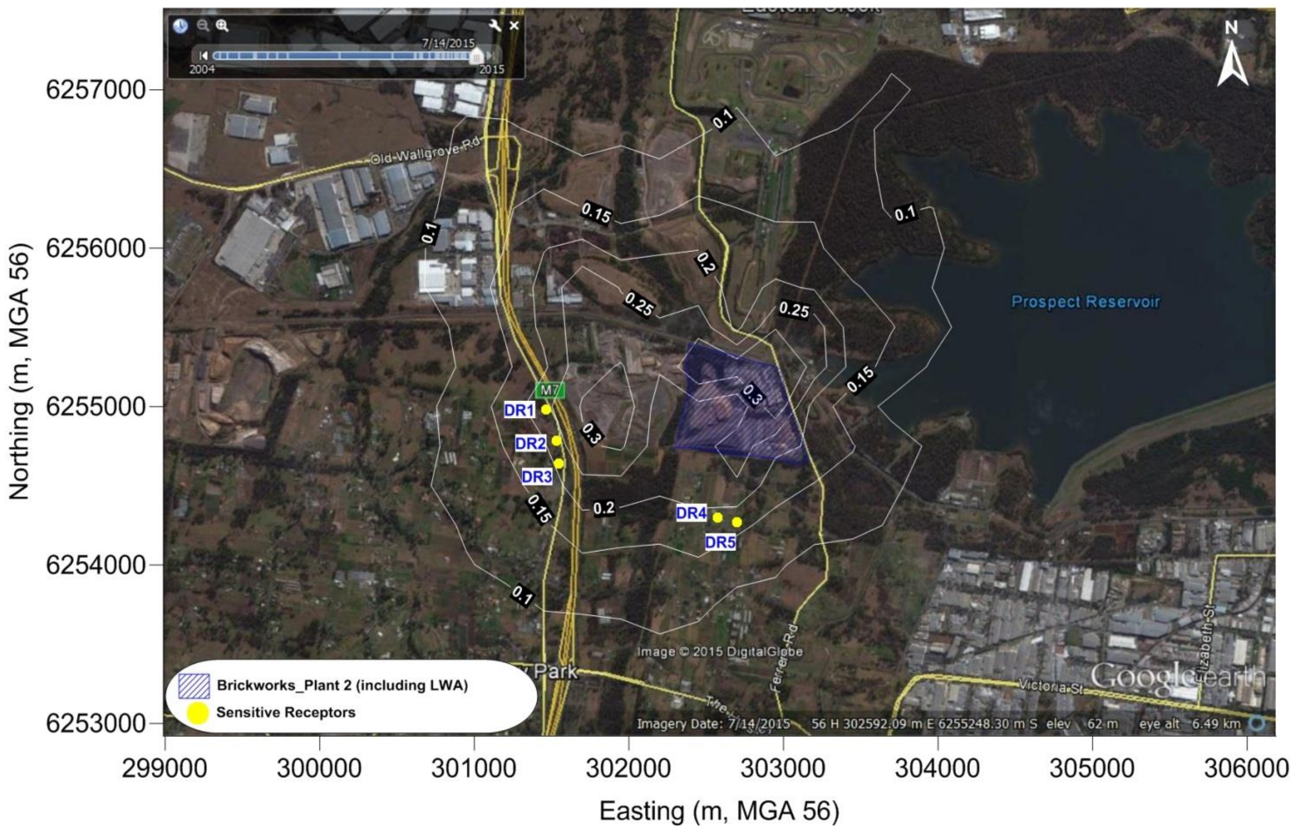


Figure D-18: Stage 2 Operations, Option 2 – 90-day Average Maximum HF Incremental Concentrations (µg/m³) (Criteria: 0.5µg/m³)

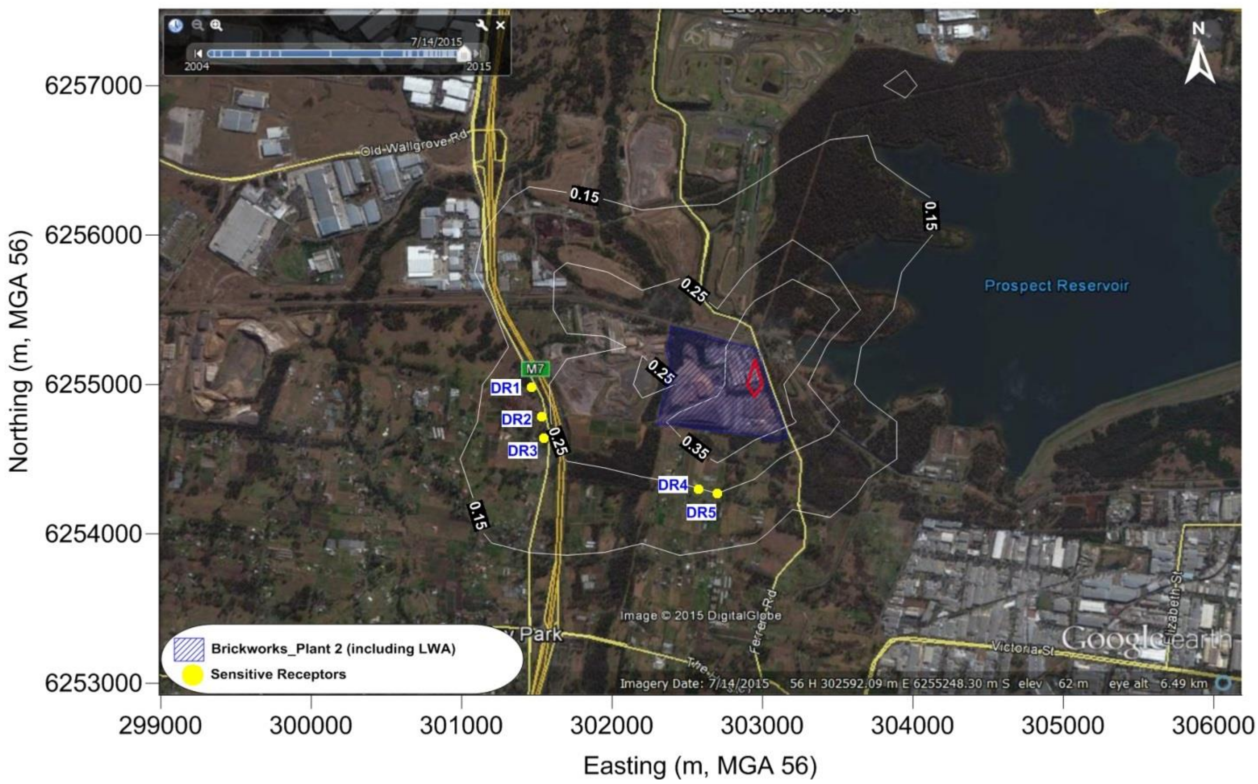


Figure D-19: Stage 1 Operations, Option 2 – 90-day Average Maximum HF Incremental Concentrations (µg/m³) (Criteria: 0.5µg/m³)

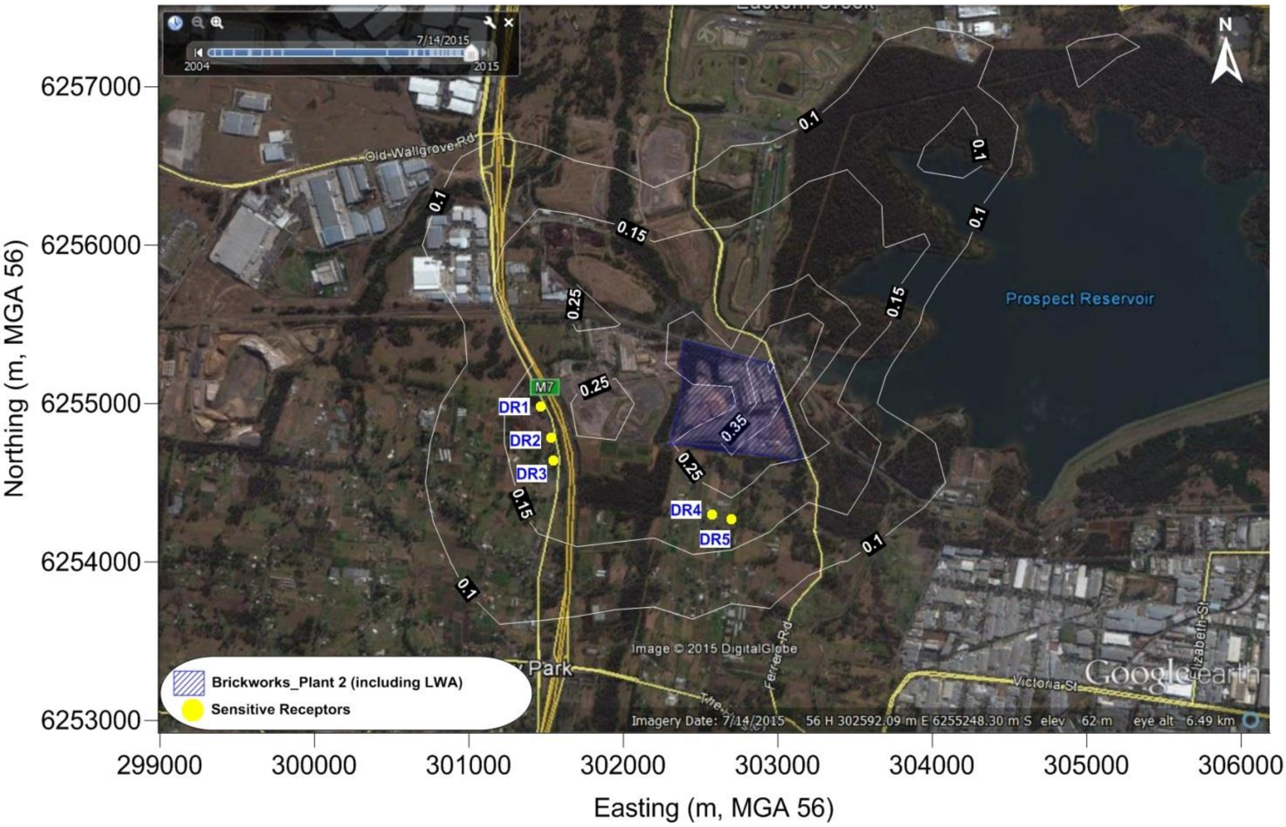


Figure D-20: Existing Operations – 90-day Average Maximum HF Incremental Concentrations (µg/m³) (Criteria: 0.5µg/m³)

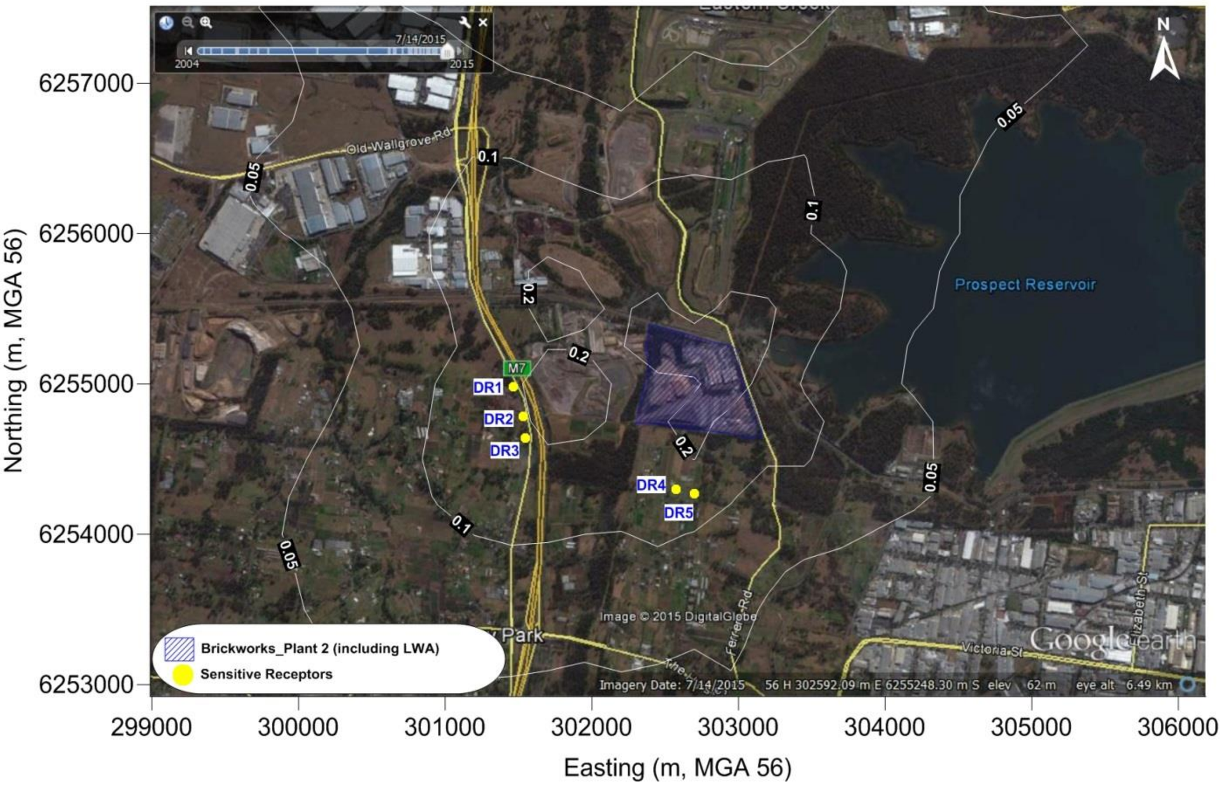


Figure D-21: Stage 2 Operations, Option 2 – 1-hour Average Maximum NO_2 Incremental Concentrations (µg/m³)

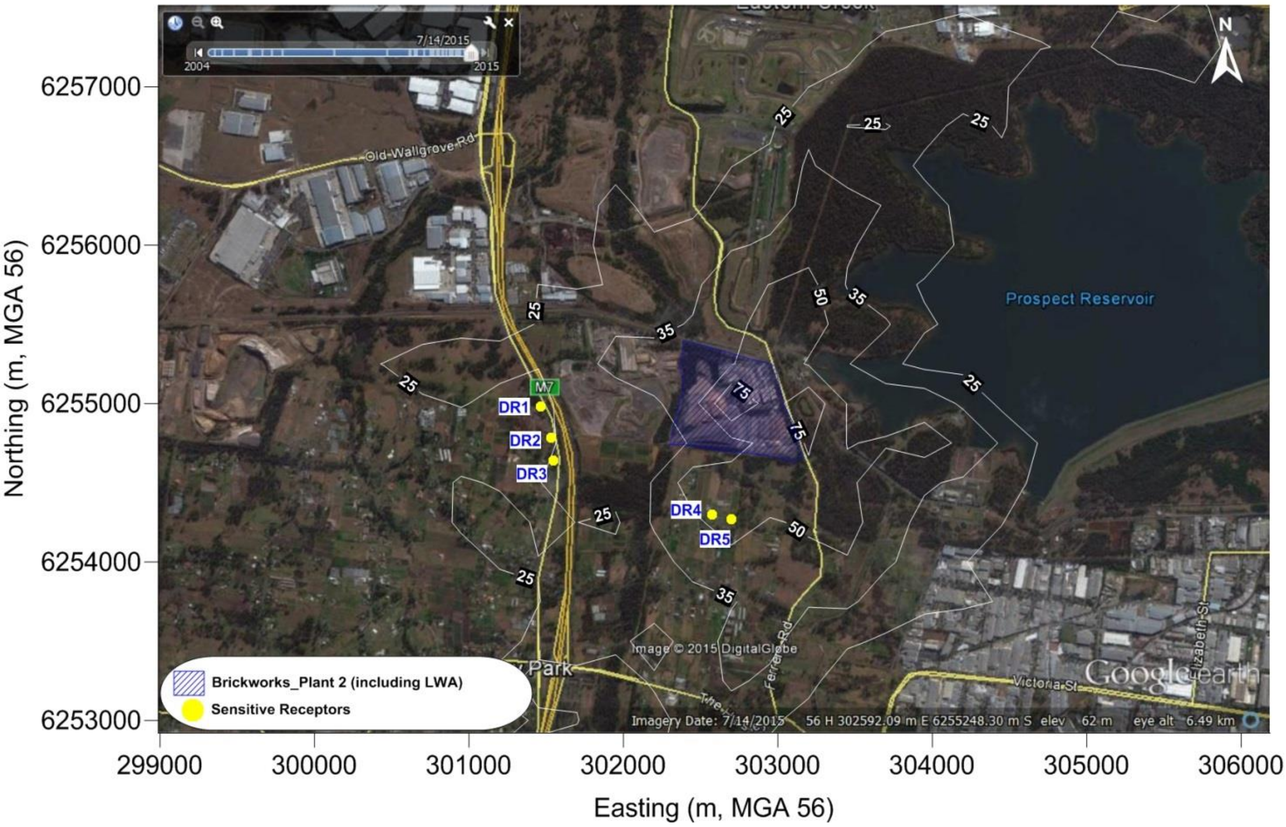


Figure D-22: Stage 2 Operations, Option 2 – 1-hour Average Maximum NO_2 Cumulative Concentrations (µg/m³) (Criteria: 246µg/m³)

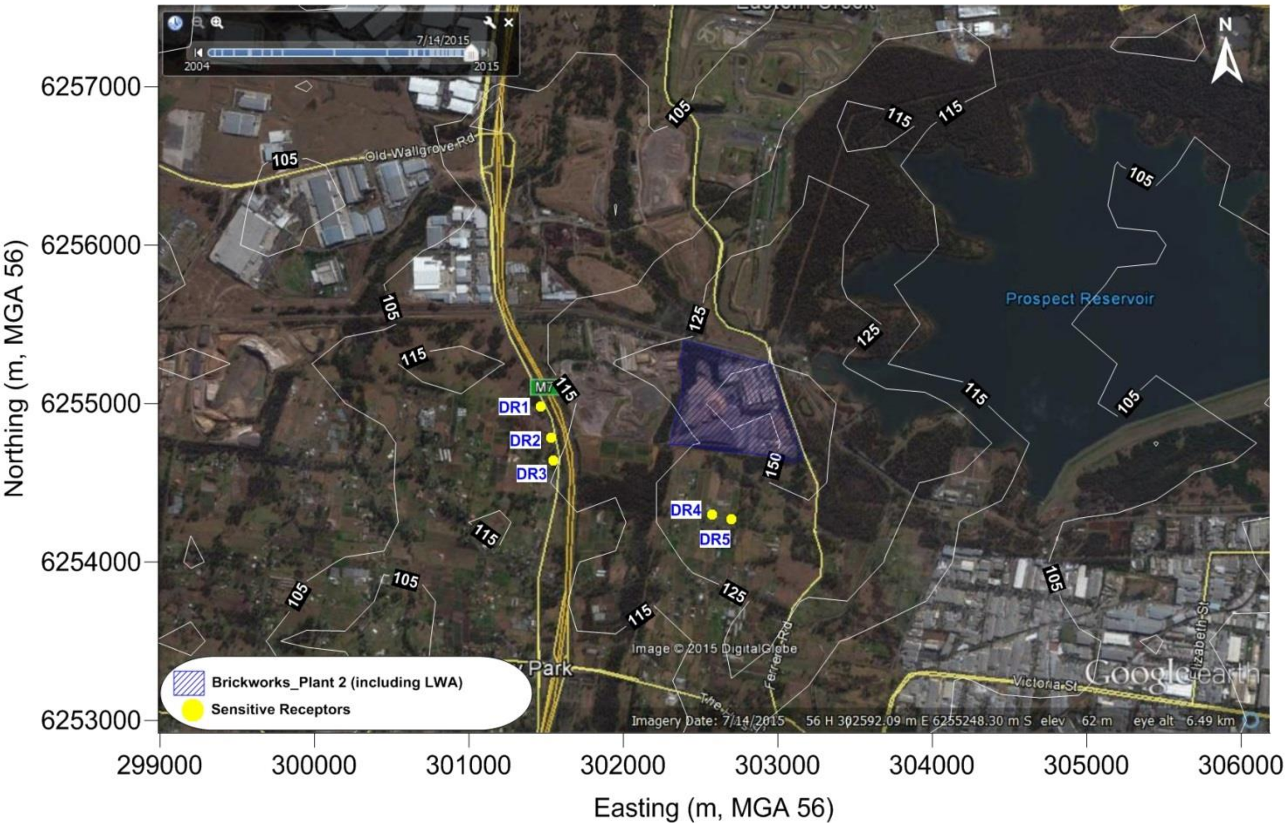


Figure D-23: Stage 2 Operations, Option 2 – Annual Average NO_2 Incremental Concentrations (μg/m³)

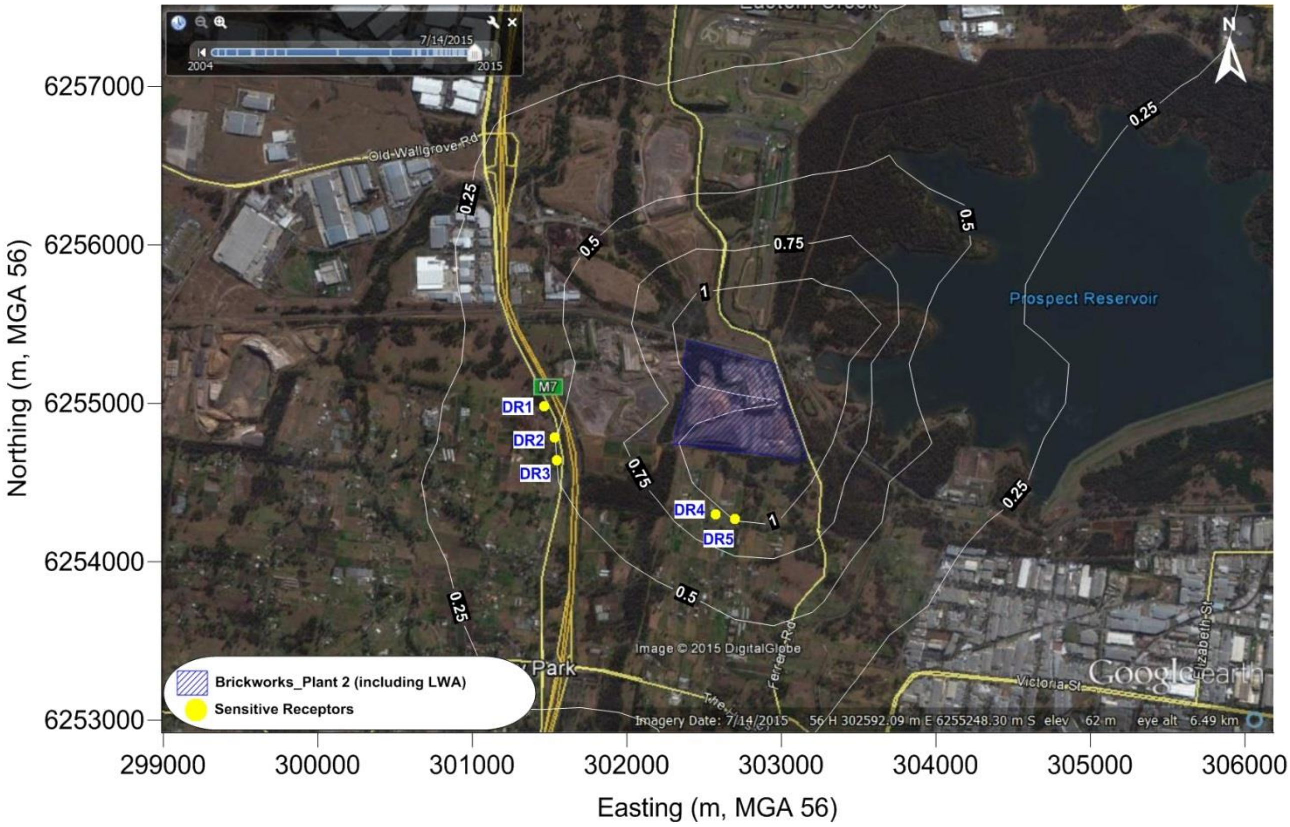


Figure D-24: Stage 2 Operations, Option 2 – Annual Average NO_2 Cumulative Concentrations (μg/m³) (Criteria: 62μg/m³)

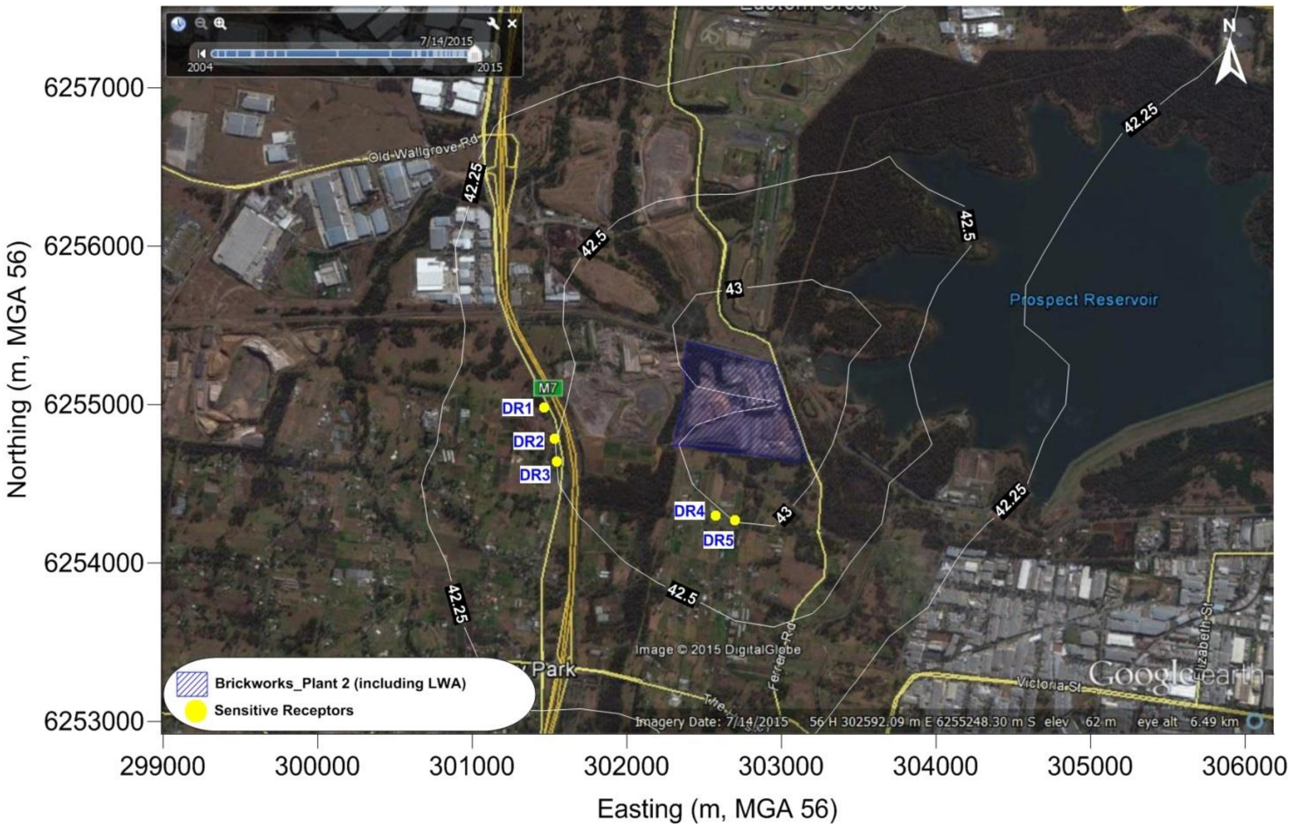


Figure D-25: Stage 2 Operations, Option 2 – 10-minute Average Maximum SO_2 Incremental Concentrations ($\mu g/m^3$)

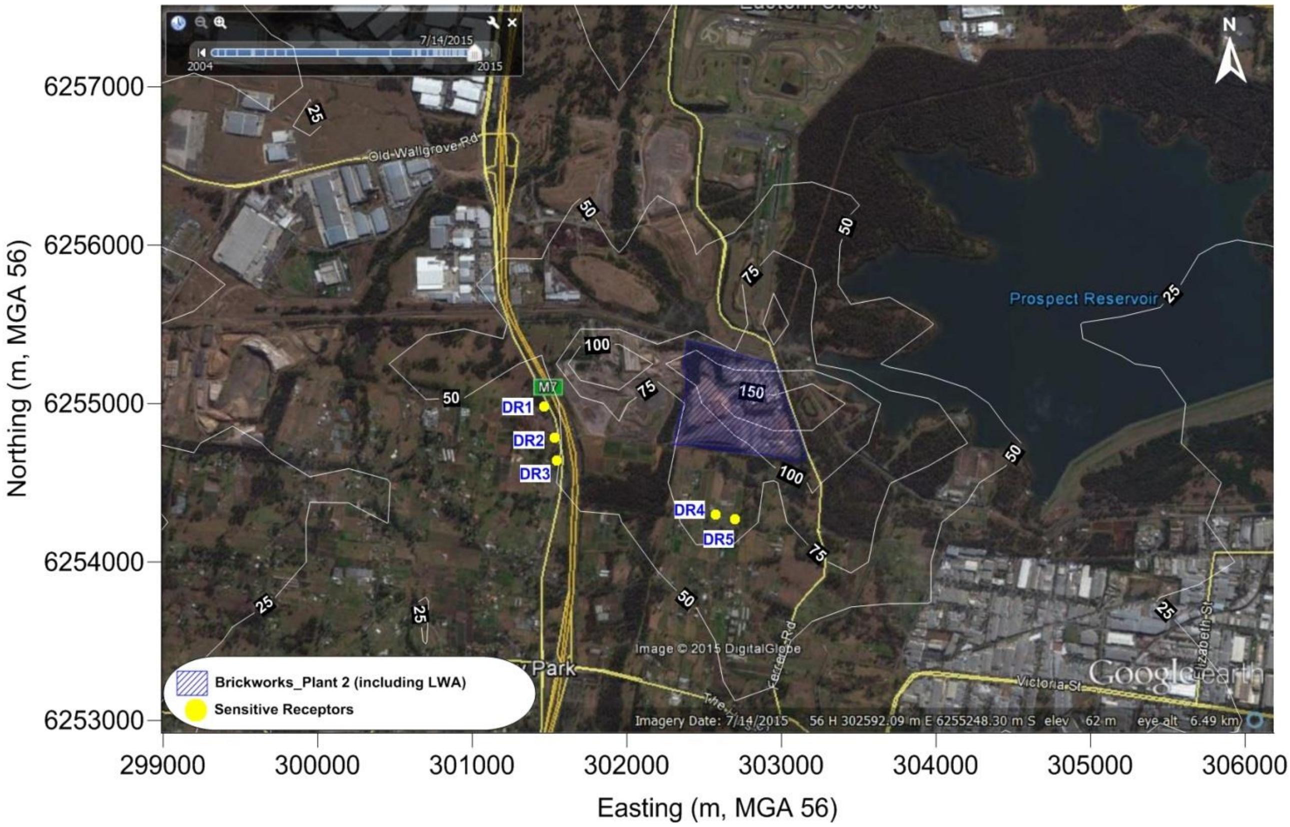


Figure D-26: Stage 2 Operations, Option 2 – 10-minute Average Maximum SO_2 Cumulative Concentrations ($\mu g/m^3$) (Criteria: $712\mu g/m^3$)

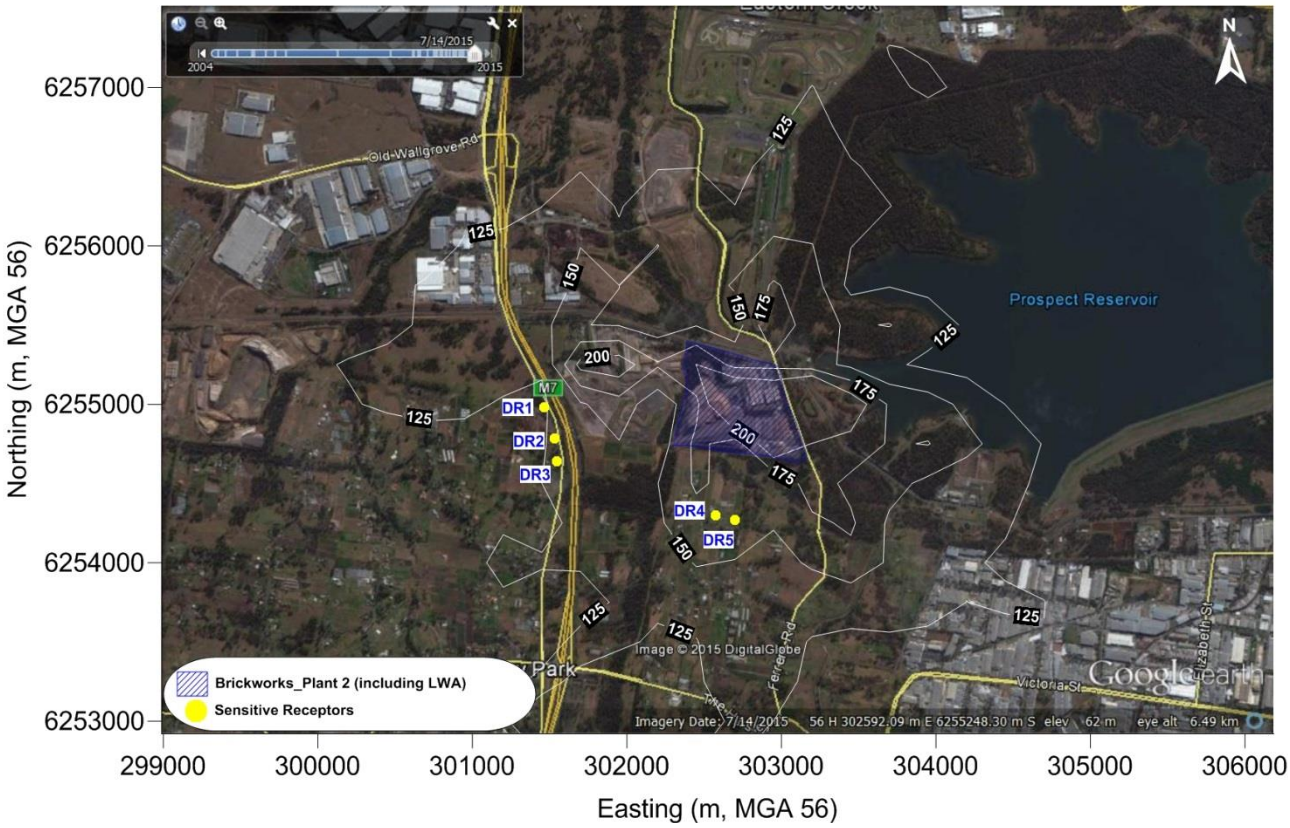


Figure D-27: Stage 2 Operations, Option 2 – 1-hour Average Maximum SO_2 Incremental Concentrations (µg/m³)

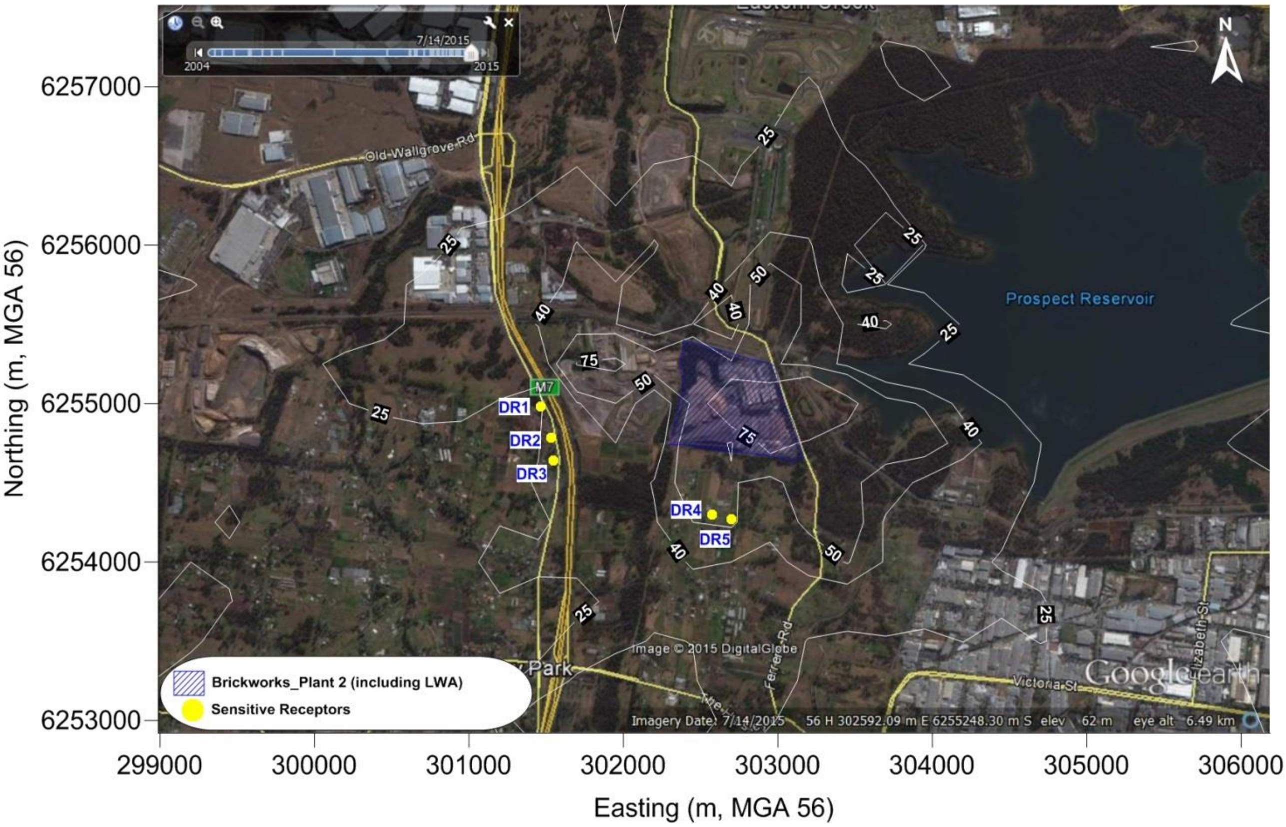


Figure D-28: Stage 2 Operations, Option 2 – 1-hour Average Maximum SO_2 Cumulative Concentrations (µg/m³) (Criteria: 570µg/m³)

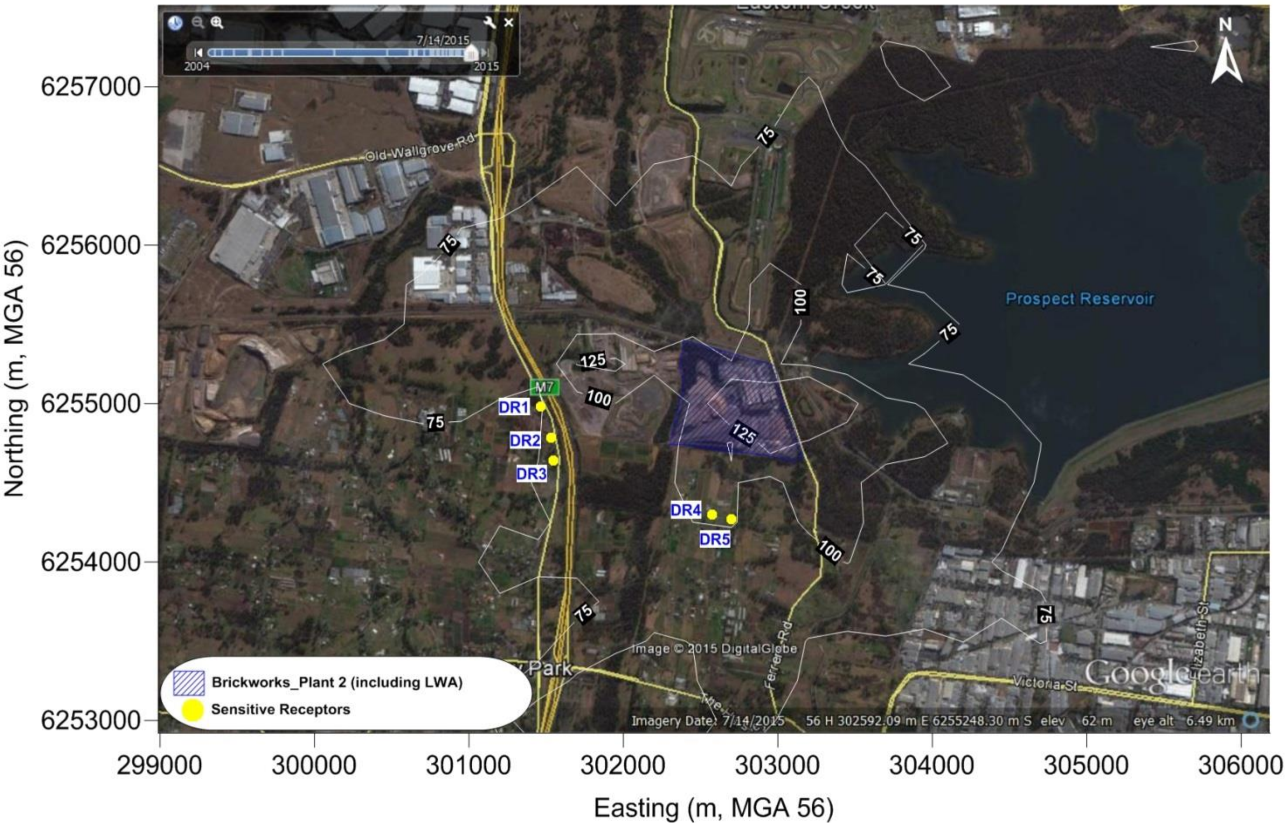


Figure D-29: Stage 2 Operations, Option 2 – 24-hour Average Maximum SO_2 Incremental Concentrations (μg/m³)

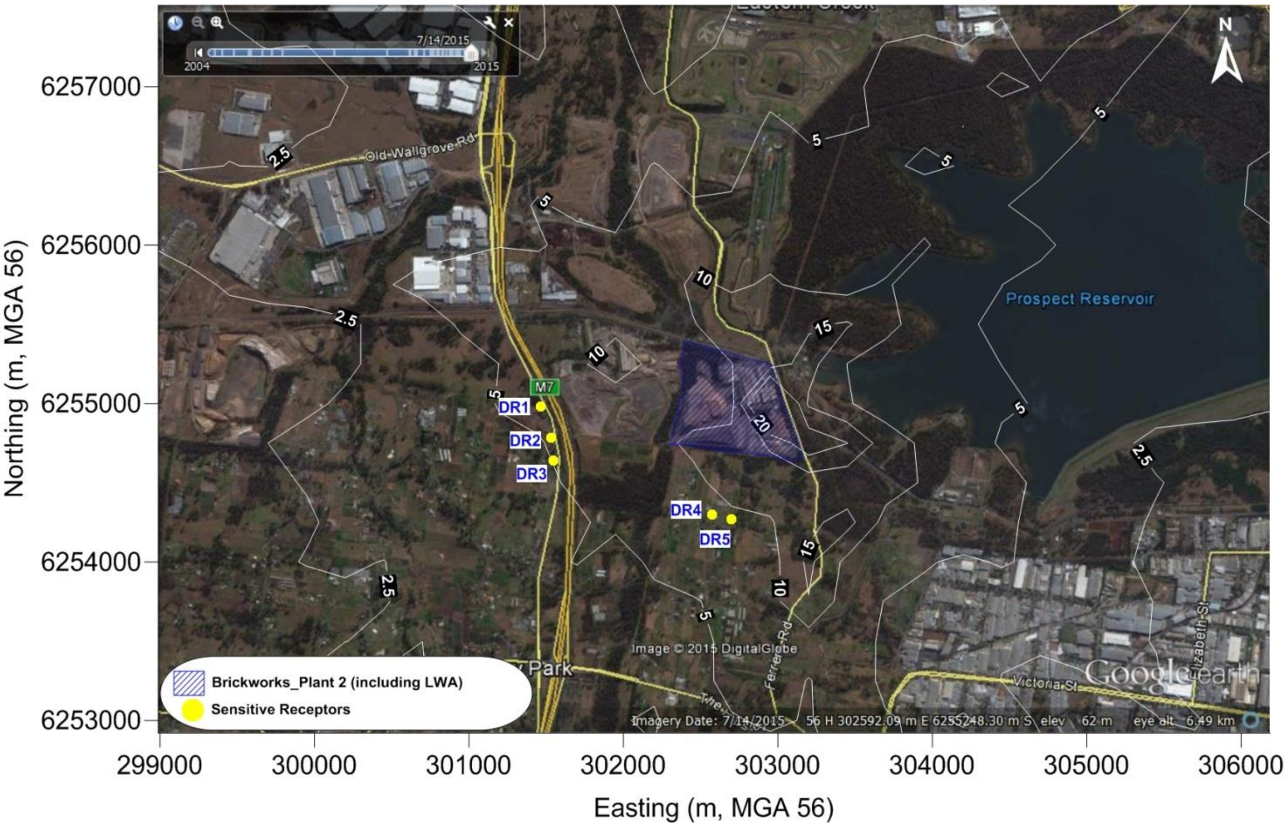


Figure D-30: Stage 2 Operations, Option 2 – 24-hour Average Maximum SO_2 Cumulative Concentrations (μg/m³) (Criteria: 228μg/m³)

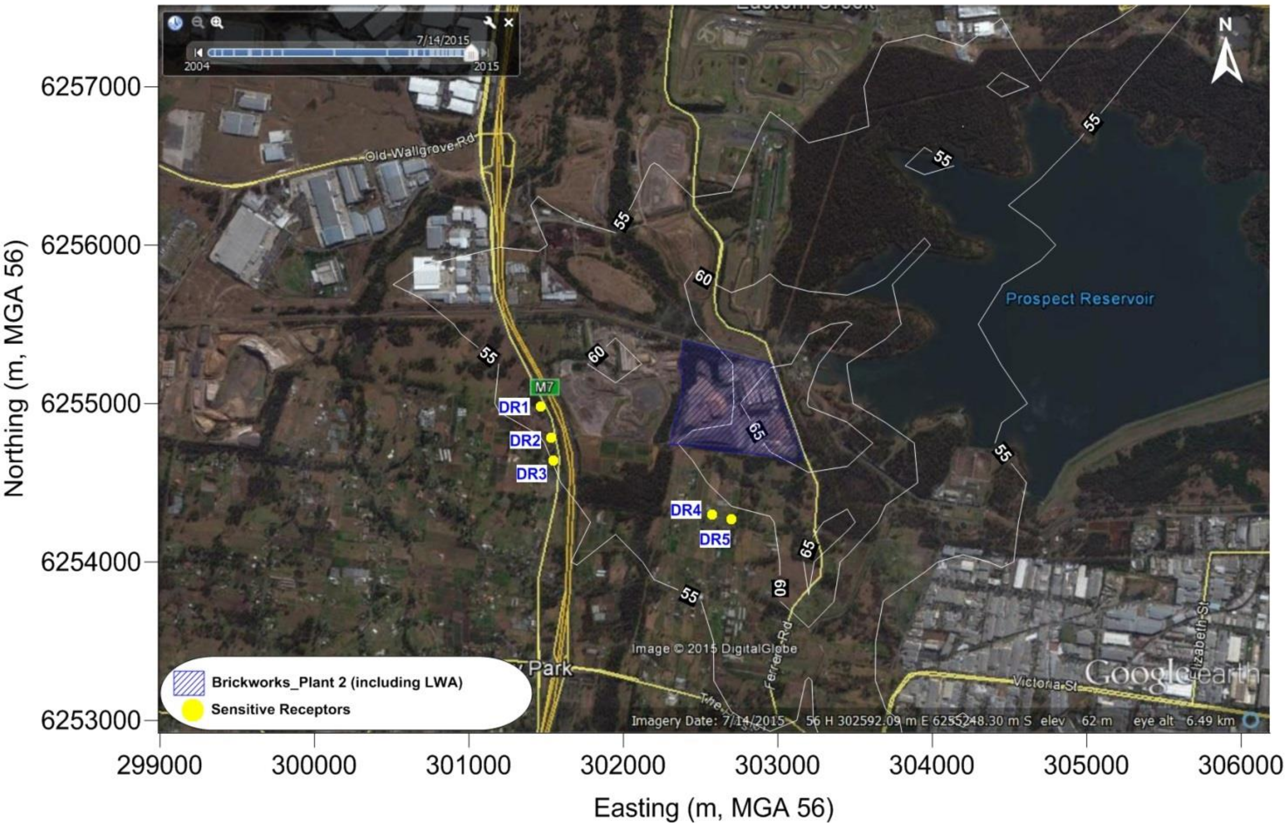


Figure D-31: Stage 2 Operations, Option 2 – Annual Average SO_2 Incremental Concentrations (µg/m³)

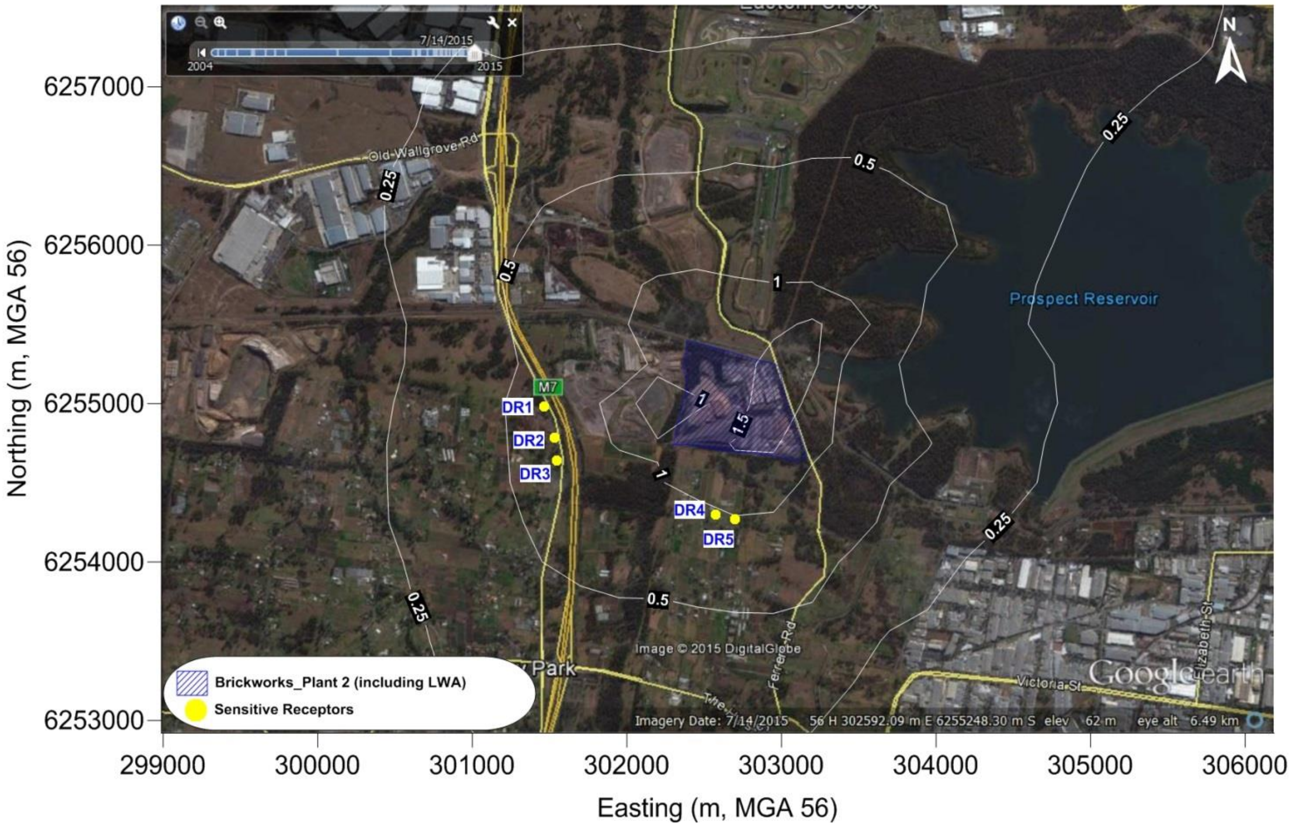


Figure D-32: Stage 2 Operations, Option 2 – Annual Average SO_2 Cumulative Concentrations (µg/m³) (Criteria: 60µg/m³)

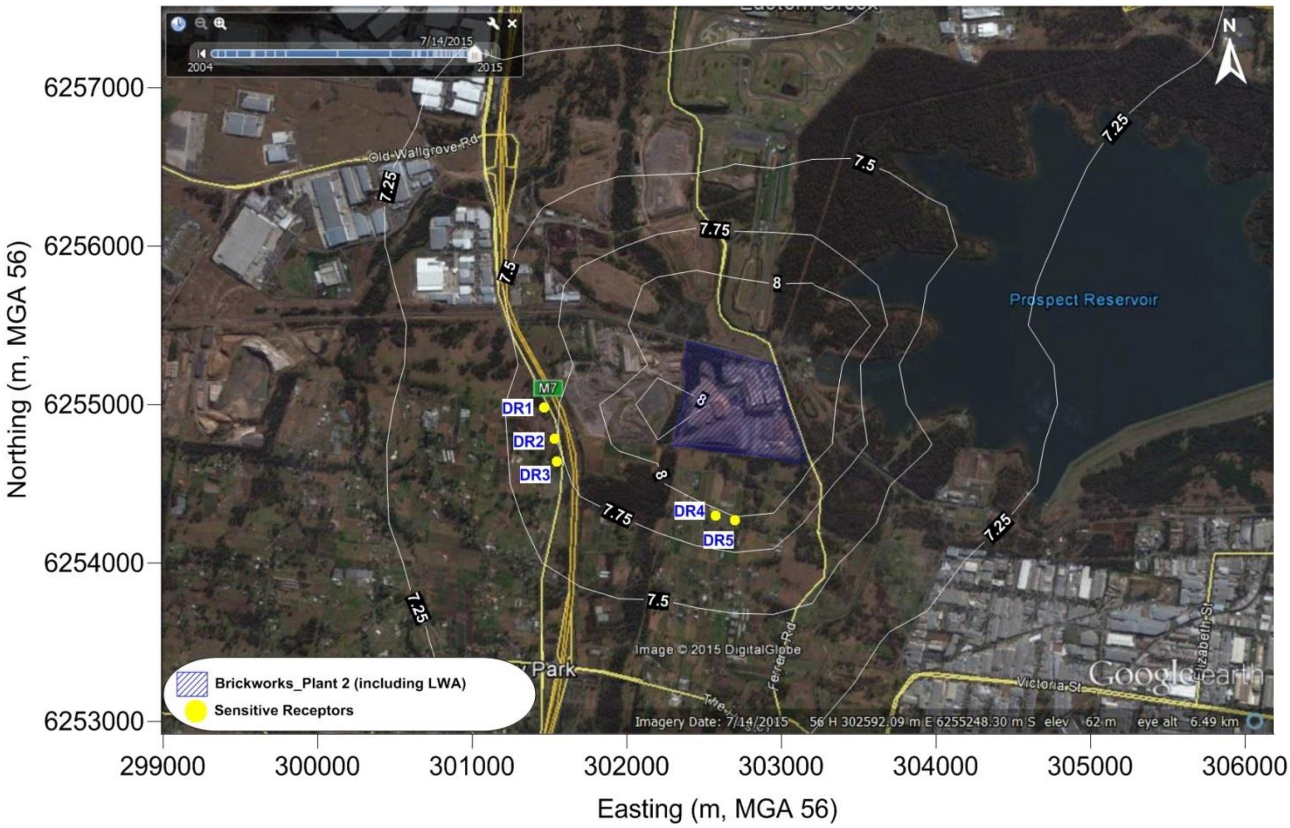


Figure D-33: Stage 2 Operations, Option 2 – 1-hour Average Maximum PAH (as BaP) Incremental Concentrations (mg/m³) (Criteria: 0.0004mg/m³)

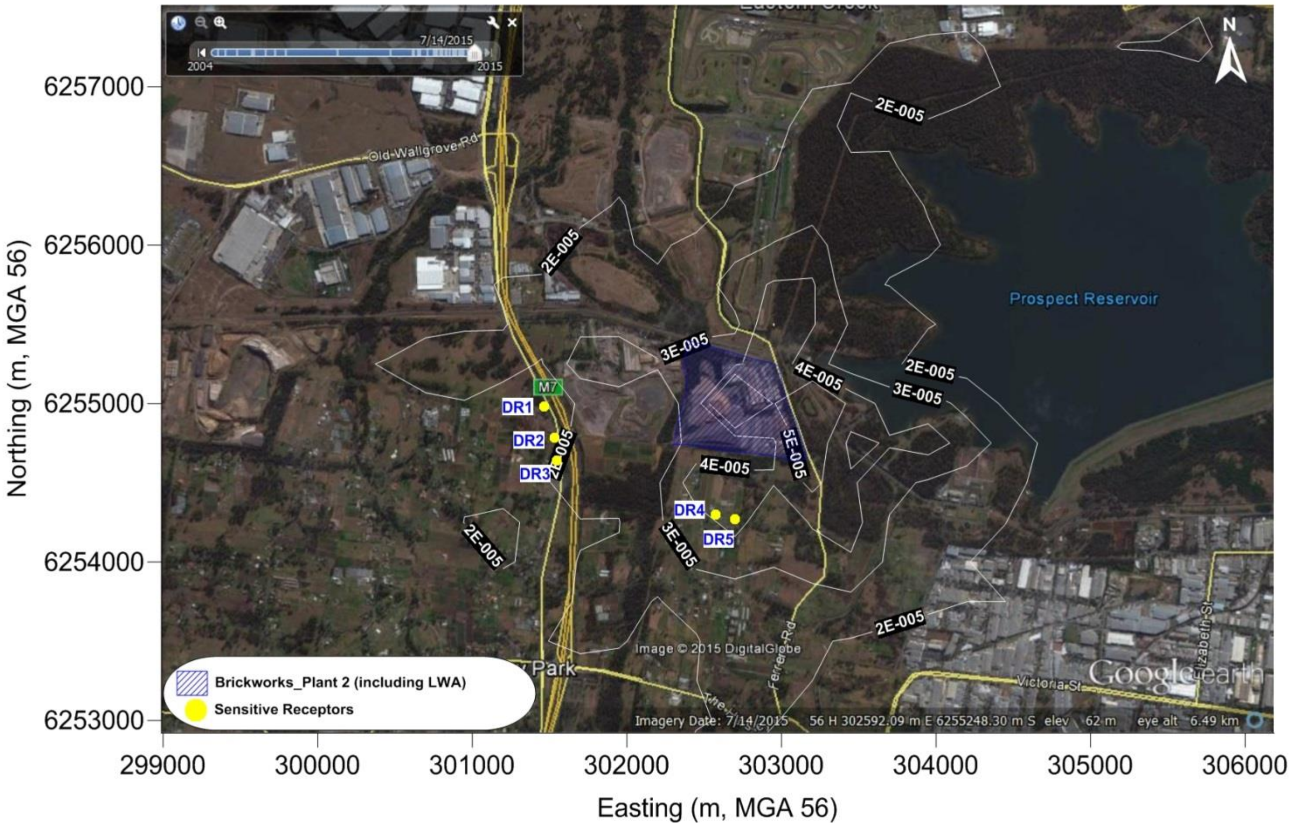


Figure D-34: Stage 2 Operations, Option 2 – 1-hour Average Maximum Dioxins and Furans (TEQ) Incremental Concentrations (mg/m³) (Criteria: 2E-09mg/m³)

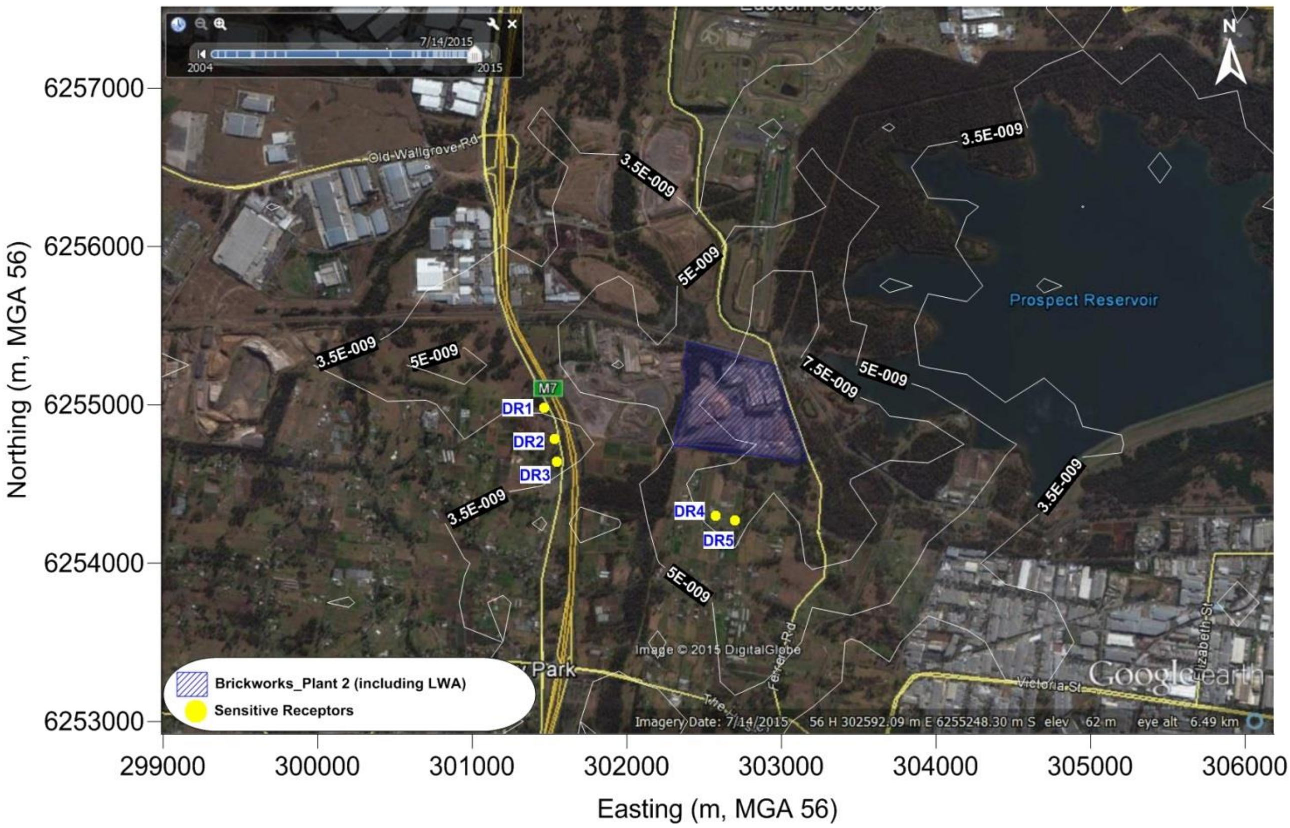


Figure D-35: Stage 2 Operations, Option 2 – 1-hour Average Maximum Benzene Incremental Concentrations (mg/m³) (Criteria: 0.029mg/m³)

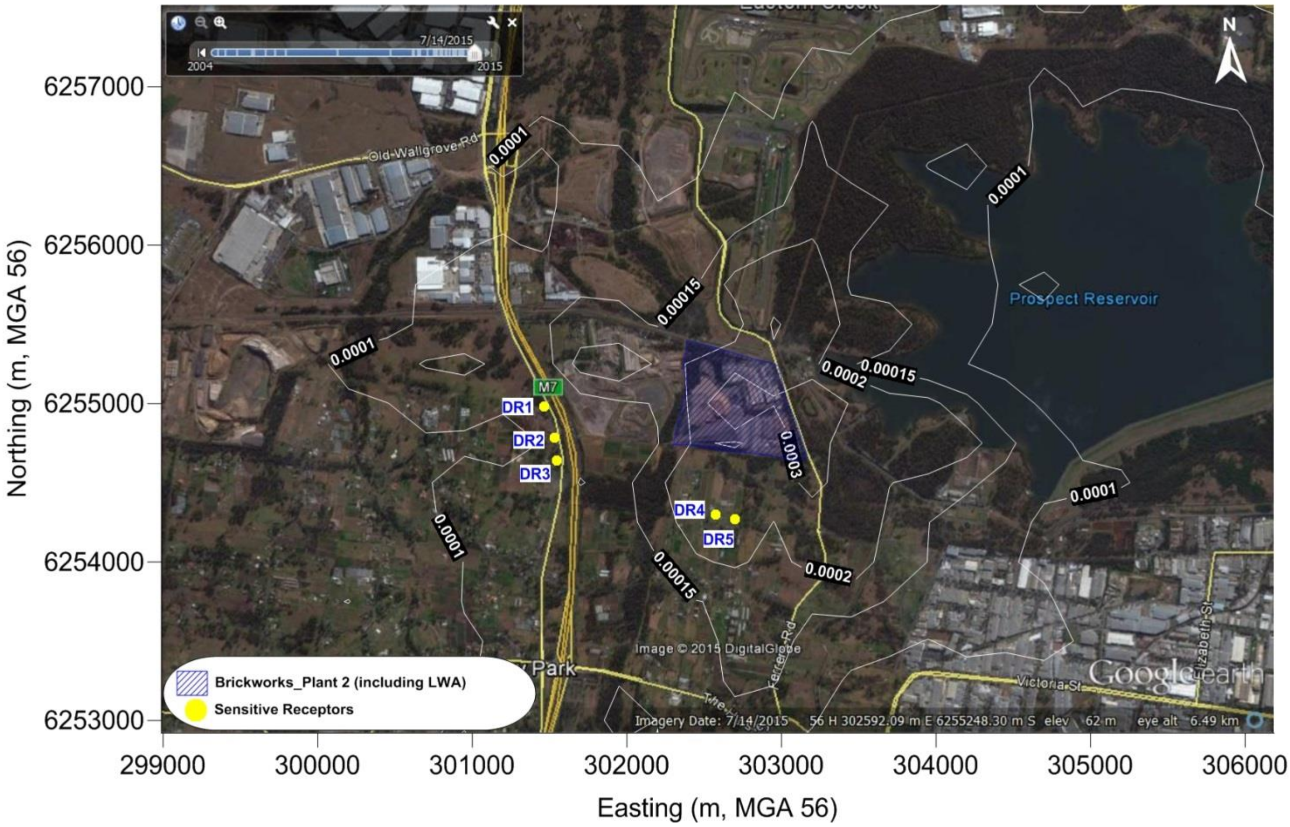
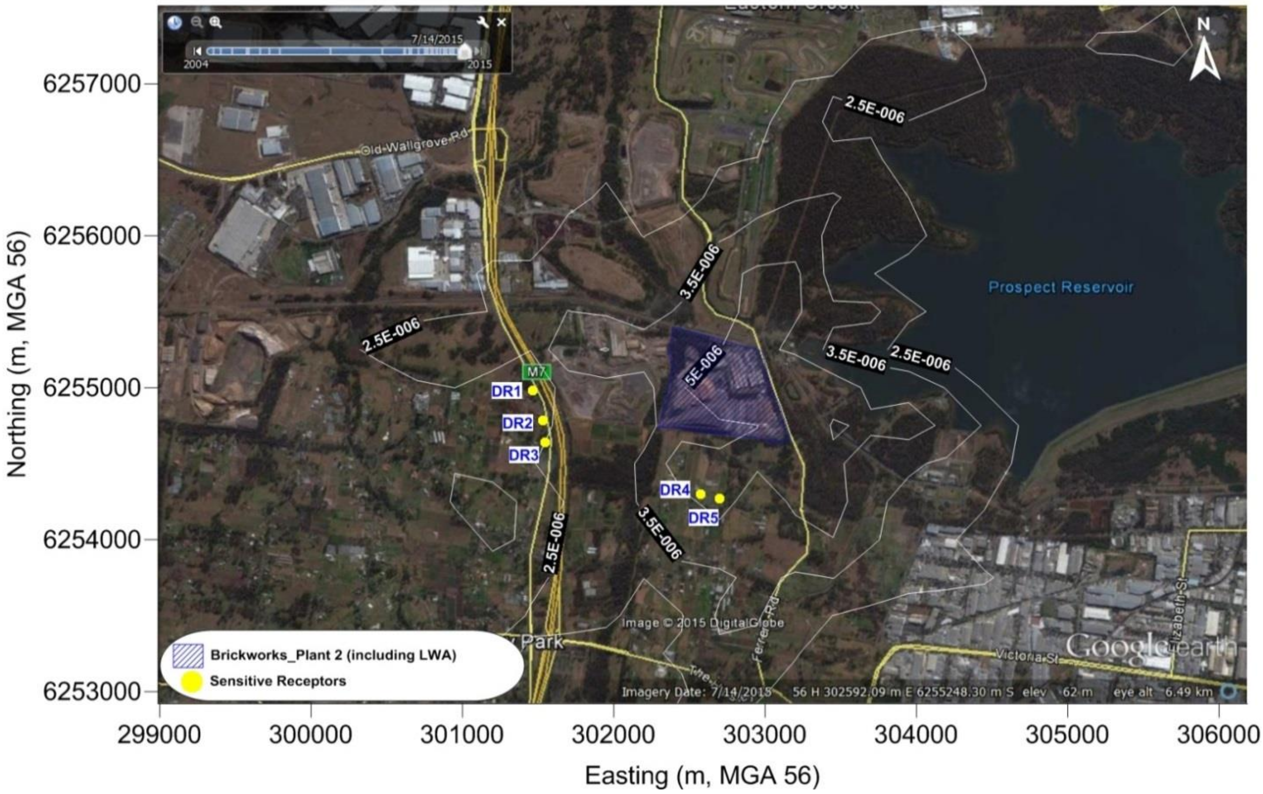


Figure D-36: Stage 2 Operations, Option 2 – 1-hour Average Maximum Chromium VI Incremental Concentrations (mg/m³) (Criteria: 9E-05mg/m³)



APPENDIX E – AIRLABS ENVIRONMENTAL CORRESPONDENCE WITH NSW-EPA

On the 12th of August, 2015, Mr. Abhilash Aitharaju (Abhi), Principal Air Quality Consultant from Airlabs Environmental Pty Ltd contacted Ms. Jacqueline Roberts – Operations Officer – Sydney Industry Section, NSW-EPA to discuss the Lightweight Aggregate (LWA) Air Quality Impact Assessment (AQIA). The aim of this exercise was to brief NSW-EPA about the methodology and the findings of the LWA-AQIA before a submission was made. During the telephone conversation, Ms. Jacqueline advised the Consultant that any discussion pertaining to the AQIA would be initiated post submission, and as-such, Airlabs are submitting the AQIA for Public Exhibition.