Report

Hillview Hard Rock Quarry

Air Quality Impact Assessment and Greenhouse Gases

Prepared for:

Coastwide Materials Pty Ltd c/- ADW Johnson Pty Limited

Prepared by:

Advitech Pty Limited

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Endorsements

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1. Introduction

Advitech Pty Limited was engaged by ADW Johnson Pty Limited (ADW Johnson) on behalf of Coastwide Materials Pty Limited (Coastwide Materials). ADW Johnson is compiling an Environmental Impact Statement (EIS) for the proposed Hillview Hard Rock Quarry (Hillview Quarry) project. The EIS must meet the minimum form and content requirements as prescribed by Part 8 of the *Environmental Planning and Assessment Regulation 2021* (EP&A Regulation) and must have regard to the *State Significant Guidelines.* As such, this Air Quality Impact Assessment (AQIA) supports the EIS, completed in accordance with the Planning Secretary's environmental assessment requirements (SEARs).

In addition, Advitech were requested to perform an assessment of the greenhouse gas (GHG) emissions resulting from the construction and operation phases for Hillview Quarry. The GHG assessment had been included in this AQIA.

It should be noted that this report was prepared by Advitech Pty Limited for Coastwide Materials Pty Ltd c/- ADW Johnson Pty Limited ('the customer') in accordance with the scope of work and specific requirements agreed between Advitech and the customer. This report was prepared with background information, terms of reference and assumptions agreed with the customer. The report is not intended for use by any other individual or organisation and as such, Advitech will not accept liability for use of the information contained in this report, other than that which was intended at the time of writing.

2. Background and Objectives

2.1 Project Background – Hillview Hard Rock Quarry

Coastwide Materials is proposing to develop and operate a hard rock quarry within the Richmond Valley and off The Bucketts Way, at 67 Maytoms Lane, approximately 2.5 km southwest of the locality of Booral NSW (the Site). A site layout plan map is provided in **Figure 1**. The proposed project plans to extract and process up to 1.5 million tonnes (t) of hard rock per annum, for a projected lifespan of 30 years.

The proposed works will include, through specific 'stages' (and refer to following notes):

- Construction and operation of a new hard rock quarry, including constructing of associated site infrastructure and amenities;
- Transport of materials off-site via public roads; and
- Progressive rehabilitation of the quarry.

Once operational, typical site operations will include:

- Extracting sand and sandstone with an excavator or front end loader;
- Loading Moxy type articulated dump trucks and transporting won material to the on-site processing plant;
- Screening and washing sand prior to stockpiling; and
- Loading product onto road trucks for transport off site.

The Site's hours of operation (once the site becomes operational, refer to the note below) are:

- Extraction and processing activities: Monday to Saturday, 6am-10pm;
- Internal product transfers to stockpiles: Monday to Saturday, 6am-12am (midnight);
- Haulage from and to the development site: Monday to Saturday, 7am-6pm;
- Drilling and Blasting activities: Monday to Friday, 9am-4pm; and
- Maintenance activities: 24 hours a day, 7 days a week.

Note: for the construction stages, Advitech have assumed slightly different days and hours of operation, refer to Section 4.5.1 below.

Figure 1: Site Layout Plan, as prepared by Groundwork Plus

2.1.1 Proposed Development Stages and Further Operational Stages

Throughout this document, the construction and operation 'components' are referred to as:

- Construction component – Stages One to Four inclusive; and
- Operations component – Stages Five to Seven inclusive.

A brief summary of each 'stage' is:

- Stage One (construction) - Commence Haul Road Construction from Maytoms Lane to Processing Pad;
- Stage Two (construction) – Increase processing pad and continue slot and haul road, develop southwards. Commence intersection and Maytoms Lane upgrade;
- Stage Three (construction) – Finalise processing pad, haul road to Maytoms Lane. Complete intersection and Maytoms Lane upgrade. Commence internal haul road to 158 mRL pad;
- Stage Four (construction) – Continue internal haul road construction and 1058 mRL Run of mine (ROM) pad;
- Stage Five (operations) – Extraction commences at the top of the hill;
- Stage Six (operations) – Extraction continues down the eastern face; and
- Stage Seven – Final landform.

At the time of compiling this report, Advitech was advised that the main equipment to be operated at the Site (and across both construction and operations):

- 'Caterpillar D10' Bulldozer;
- 'Komatsu PC450' 45 Tonne Excavator;
- 'Premier' Blast Drill;
- 'PC360' Excavators (2);
- 'HW 400' Haul Trucks;
- 'HM 400' Water Carts (2);
- 'Lippmann 1300j' mobile jaw crusher;
- 'Lippmann L620R' Scalping Screen;
- 'Lippmann 400c' Cone Crusher;
- Stockpile conveyors (4 maximum);
- 'Caterpillar 14m' Grader;
- Front End Loader; and
- Sand Processing Plant

Other minor equipment and vehicles are presumed to be required to operate and access the Site, e.g. maintenance vehicles, and vehicles used by employees.

The quarry will be subject to typical daily and weekly quarrying activities such as excavating, crushing, washing and stockpiling of material as well as removing and transporting prepared product and using the internal access road to the Bucketts Way. The extracted material will be delivered off-site.

The facility proposes to have capacity to operate six (6) days per week excluding Sundays and public holidays. The process is such that, aside from extracted sand based (i.e. clean sand, red sand and sandstone) material, no other material will need to be removed from the Site. An indication of the extraction and processing areas is shown in **Figure 1** above.

2.2 Site Description and Surrounding Areas

The proposed Hillview Quarry (the 'Site' referred to in this report) is located at 67 Maytoms Lane, approximately 2.5 km southwest of the locality of Booral within the New South Wales (NSW) rural mid-coast region. The Site is largely situated within Lot 62 DP95029 and Lot 63 DP95029 with the Mid-Coast local government area (LGA) on land zoned RU2 Rural Landscape. The Site is approximately 400 hectares (ha) in total area, and the total footprint of the quarry will be approximately 48 hectares. The haul road will follow the existing Maytoms Lane, and it will be upgraded to accommodate the required haul trucks.

The quarry is proposed to be located in a rural area. Receiving environments west of the Site are largely forested, while terrain to the south, east and north is largely farmland. Isolated residences are located in both the forest and farmland areas. The Eden Creek waterway also runs approximately 1.5 km east of the Site.

2.3 Secretary's Environmental Assessment Requirements

This report forms part of an EIS submission, which must comply with the requirements of clauses 6 and 7 of the Environmental Planning and Assessment Regulation 2021, and which addresses environmental considerations identified in the SEARs relevant to air quality.

The SEARs notes, the following requirements for an air quality assessment including:

- *A detailed assessment of potential construction and operational impacts, in accordance with the **Approved Methods for Modelling and Assessment of Air Pollutants in NSW**, and with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10}, and having regard to the **Voluntary Land Acquisition and Mitigation Policy**;*

- *An assessment of potential dust and other emissions generated from processing, operational activities, and transportation of quarry products;*
- *Reasonable and feasible mitigation measures to minimise dust and emissions; and*
- *Monitoring and management measures, in particular, real-time air quality monitoring.*

In addition, the SEARs make a reference to another type of air emission: odour; which is referenced within Noise and blasting issues:

> "*A detailed assessment of the likely blasting impacts of the development (including noise, vibrations, overpressure, visual and odour), …* "

Although odour is not mentioned within the Air Quality section of the SEARs, Advitech have assessed odour by a qualitative, desktop approach in **Section 7** of this report. Other emissions such as oxides of nitrogen (NO_X) were not modelled but were assessed by qualitative methods in **Section 7** of this report.

Further, the air emission "dust" is also referred to as "particulate matter" throughout this report and are considered as the same type of air emission. The use of the term "particulate matter" is required for comparing results with assessment criteria and as shown in this report.

The SEARs also makes reference to assessing cumulative impacts:

> "*consideration of the potential cumulative impacts due to other developments in the vicinity (completed, underway or proposed)*"

This AQIA addresses the cumulative air for dust impacts by incorporating background concentrations as shown in Section 4.2.

2.4 Sensitive Receptors

Nearest potentially affected receptors (also referred to receivers in this report) are presented in **Figure 2**. The residences and small neighbouring businesses are located in Booral, along The Bucketts Way etc. The area surrounding the proposed development site is described as RU2 Rural Landscape, as per the 'Great Lakes Local Environmental Plan 2014'. **Table 1** provides further details the location of the receptors (all private residences) including their coordinates.

Figure 2: Sensitive Receptors

Table 1: Sensitive Receptor Locations

Receptor ID	Location / Address	Easting UTM (m)	Northing UTM (m)	Receptor Type
R1	635 Carlton Road	396690	6403261	Private Residence
R2	58 Julia Road	397211	6402458	Private Residence
R3	190 Julia Road	397905	6403332	Private Residence
R4	180 Gunns Gully Road	399095	6401043	Private Residence
R5	1803 The Bucketts Way	400755	6402362	Private Residence
R6	28 Blueberry Ln	400805	6402744	Private Residence
R7	1895 The Bucketts Way	400671	6403244	Private Residence
R8	13 Lemon Grove Road	400999	6403370	Private Residence
R9	1927 The Bucketts Way	400720	6403562	Private Residence
R10	1950 The Bucketts Way	401282	6403763	Private Residence
R11	1953 The Bucketts Way	400777	6403769	Private Residence
R12	2035 The Bucketts Way	400628	6404155	Private Residence
R13	2069 The Bucketts Way	400821	6404824	Private Residence
R14	6 Isaacs Road	401052	6404856	Private Residence
R15	2117 The Bucketts Way	401110	6405351	Private Residence
R16	35 Booral-washpool Road	400965	6405772	Private Residence
R17	59 Booral-washpool Road	400834	6406018	Private Residence
R18	29A Booral-washpool Road	400224	6406212	Private Residence
R19	29B Booral-washpool Road	399956	6405885	Private Residence
R20	400 Washpool Creek Road	398482	6407474	Private Residence
R21	House immediately north of R11 (1953 The Bucketts Way)	400754	6403850	Private Residence

3. Meteorological and Air Quality

3.1 Bureau of Meteorology Data

To determine the most representative 12-month calendar period required for modelling air emissions from the Hillview facility, historical Bureau of Meteorology (BoM) climate data at the Paterson (Tocal) Automatic Weather Station (061250) was reviewed and as obtained from Reference 1.

Table 2: Bureau of Meteorology (BoM) Climate Data History for Paterson (061250).

Year	Temperature (°C)				Rainfall (mm)	
	Maximum year average	Difference from long term average	Minimum year average	Difference from long term average	Yearly total	Percentage of long-term average
2016	25.3	+1.3	12.8	+0.7	991	105%
2017	25.4	+0.1	12.7	+0.6	834	88%
2018	25.1	-0.2	12.5	+0.4	914	96%
2019	26.4	+1.1	12.4	+0.3	544	57%
2020	24.2	-1.1	12.8	+0.7	1175	124%

A review of BoM climate and wind rose data suggest the years with the least deviation from the long-term average climate statistics are years 2016 and 2018. As a result of the review of climatic data (refer to **Table 2**) and wind rose data (Figure 3), this report has adopted the year 2018 for air dispersion modelling purposes. The years 2021, 2022 or 2023 were also assessed, however these years were considered unsuitable for this air dispersion modelling (and for the Paterson location) due to either:

- Incomplete data sets; or
- Deviations in key parameters, that were greater than those shown in Table 2.

3.2 CALMET Air Dispersion Modelling

Air dispersion modelling requires the creation of a three-dimensional (3D) CALMET meteorological data file that represents the weather and climate for the region (domain) modelled. In brief, CALMET is a meteorological model currently developed by Exponent Inc. that develops hourly (or sub-hourly) wind and other meteorological fields on a 3D gridded modelling domain. Associated two dimensional (2D) fields such as mixing height, surface characteristics, and dispersion properties are also included in the file produced by CALMET. The final time varying wind field thus reflects the influences of local topography and land uses.

Compilation of a 2018 three-dimensional (3D) for the Booral area representative of the proposed site was obtained from the following data sources:

- Mesoscale Prognostic Weather Research and Forecasting (WRF) Model for 2018;
- NSW DECC 2007 Land Use NSW; and
- Terrain data set with SRTM1 30 m resolution topography data.

The Weather Research and Forecasting (WRF) Model is a next generation mesoscale numerical weather prediction system designed for both atmospheric research and operational forecasting applications. It features two dynamic cores, a data assimilation system, and software architecture supporting parallel computation and system extensibility. The model serves a wide range of meteorological applications across scales from tens of metres to thousands of kilometres.

The generated 3D meteorological file used in this report was developed using the "no observations" mode in CALMET. The WRF wind field was used as an initial guess in CALMET which was subsequently used to generate its wind. The initial wind was then adjusted to account for the kinematic and thermal effects of terrain and land use on wind.

Figure 3 shows the frequency of wind speed and direction for each season during the 2018 calendar year extracted from the CALMET generated file. The CALMET seasonal wind roses predict that the predominant winds are from a northerly direction in summer and spring months and west, northeast and north directions in the autumn and winter months.

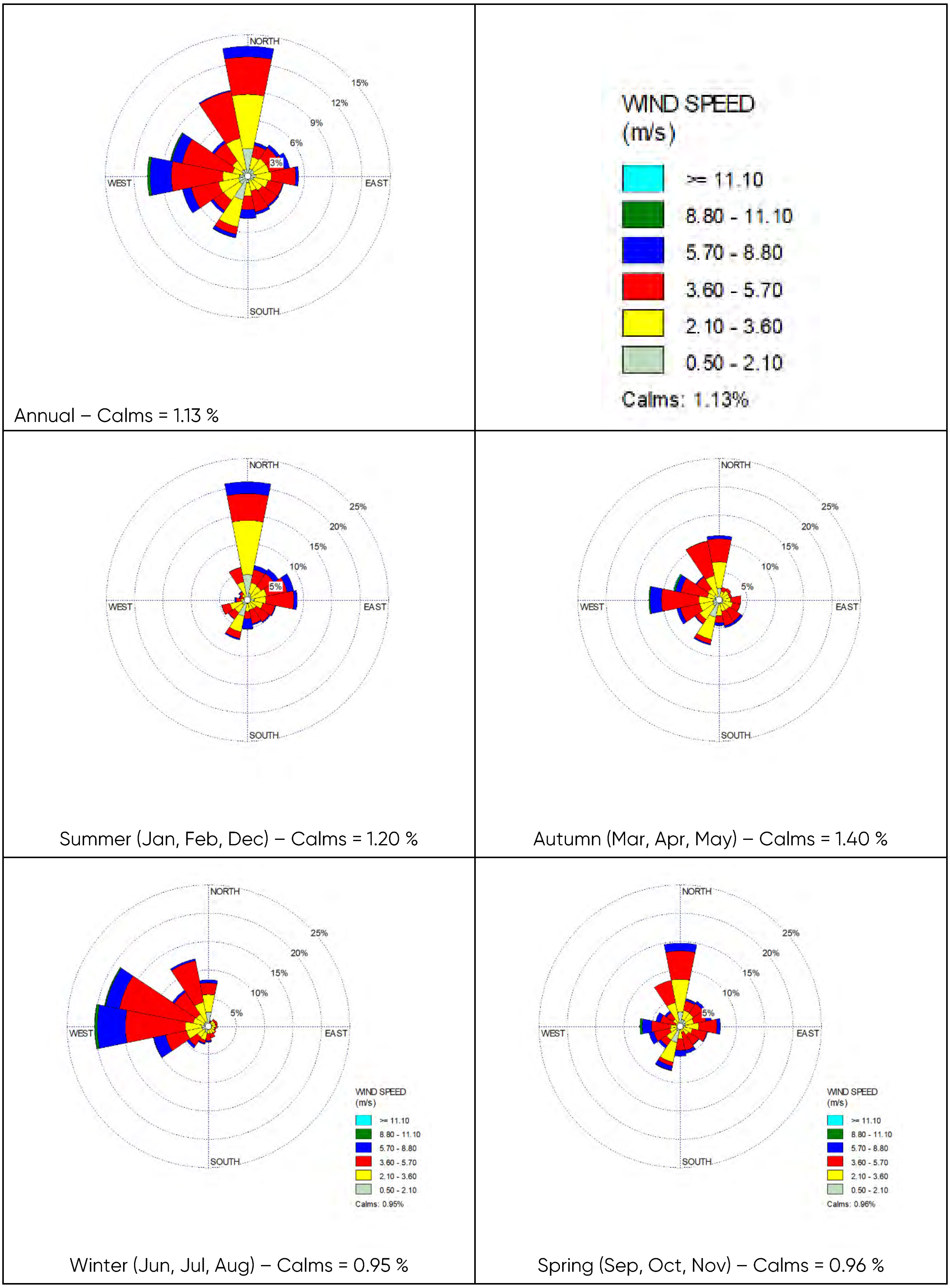

Figure 3: CALMET Hillview Quarry Site Seasonal Wind Roses

3.3 Air Quality Guidelines

The NSW Environment Protection Agency (EPA) specify the impact assessment criteria in the publication *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*, 2022 (Reference 2). The relevant sections from this publication are reproduced below in **Table 3** which presents the ground level concentration (GLC) criteria for each applicable air pollutant.

Table 3: NSW EPA Impact Assessment Criteria (obtained from Reference 2)

Substance	Averaging Period	Maximum (ambient) concentration	Units
TSP[a]	Annual	90	µg/m³
PM_{10}[b]	24 hours	50	µg/m³
	Annual	25	µg/m³
$PM_{2.5}$[c]	24 hours	25	µg/m³
	Annual	8	µg/m³
Deposited Dust[d]	Annual	2[e]	g/m²/month
		4[f]	g/m²/month

Notes:

[a] Total suspended particulates

[b] Particulate matter with an aerodynamic diameter less than 10 µm

[c] Particulate matter with an aerodynamic diameter less than 2.5 µm

[d] Dust is assessed as insoluble solids as defined by AS 3580.10.1

[e] Maximum increase in deposited dust level

[f] Maximum total deposited dust level

4. Modelling Approach and Methodology

4.1 Background Air Quality (Particulates)

Assessment of background air quality data has been undertaken for the airshed surrounding the proposed Hillview operations.

The NSW Department of Planning and Environment (DPE) operate an air quality monitoring program that collects accurate real-time measurements of ambient level pollutants at 28 monitoring sites within the air quality monitoring network (AQMN), located around the greater metropolitan area of Sydney, the Illawarra, the Lower Hunter and selected rural sites around NSW. The nearest monitoring stations to the Hillview site is Beresfield, located approximately 42 km southeast of the site and was chosen for its similar proximity to the coast, elevation and data availability (and refer to note below Table 4 for reference to elevated background concentrations for annual $PM_{2.5}$).

A Level 1 (screening) assessment of particulate background concentrations has been prepared for the pollutants listed in **Table 4** for the 2018 monitoring year to correspond with the meteorological data (and as obtained from Reference 2).

The Level 1 assessment has assumed a worst-case background concentration by using the maximum reported value (and from the averaging period used).

Table 4: Background Air Quality

Pollutant	Background Concentration	Units	Averaging Time
TSP[a]	43.2	µg/m^3	Annual
PM_{10}	varies	µg/m^3	24 hours
	21.6	µg/m^3	Annual
$PM_{2.5}$	varies	µg/m^3	24 hours
	7.5 (refer to note b).	µg/m^3	Annual

a Assumed from annual average PM_{10} background concentration (TSP = 2 x PM_{10}).

b Adopted from Wallsend station. The annual background concentration obtained for Beresfield was 8.7 µg/m^3 , which is already above the annual criteria of 8 µg/m^3. The Wallsend station is 10km to the southeast of the Beresfield station and considered an appropriate choice for annual background $PM_{2.5}$ concentrations for this assessment.

The maximum reported PM_{10} (24 hour) and $PM_{2.5}$ (annual) background concentrations for the 2018 monitoring period were 149.1 µg/m^3 and 8.7 µg/m^3 respectively which are above the respective NSW EPA impact assessment criteria as shown in Table 3. As such, a Level 2 contemporaneous assessment of these background concentrations is required to understand the cumulative impact of the proposed development. **Figure 4** displays the PM_{10} and $PM_{2.5}$ 24-hour average background concentrations for 2018 and indicates exceedances of the NSW EPA impact assessment criteria (for PM_{10}).

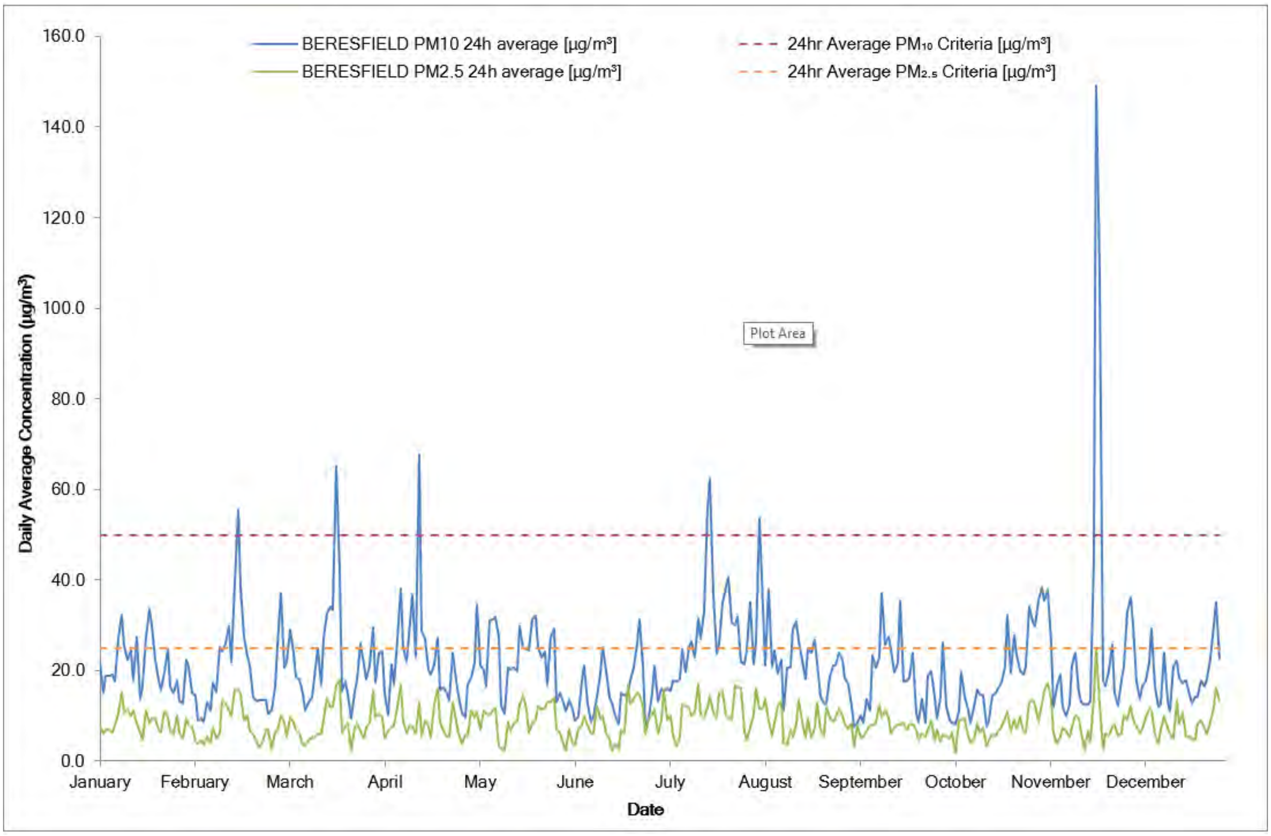

Figure 4: Daily Particulate Matter Concentrations for Beresfield 2018 (PM_{10} and $PM_{2.5}$)

Advitech notes that monitoring for dust deposition commenced in year 2016 at two (2) locations near the Site (at the Site gate and near a house, Reference 4), and results of the depositional monitoring are consistent with background dust levels observed in rural areas of NSW.

4.2 Cumulative Impacts

In addition, the 2018 calendar year was also adopted to conservatively represent the background level for dust emissions at the project site and its surrounding areas, and for the purposes of assessing cumulative air impacts. Further, there are no other commercial operations in the surrounding vicinity that may generate significant dust emissions and affect the outcomes of this cumulative assessment. In this AQIA, Advitech adopted the "surrounding vicinity" in this assessment to be within approximately 4 km of the site boundaries, which also encapsulates all sensitive receptors.

Advitech considered the potential dust impacts from an approved quarry ('Deep Creek Quarry' which will be located to the south of the Hillview site) for the purposes of the cumulative assessment. The dust impacts from the approved Deep Creek Quarry were not included in this cumulative assessment for the following reasons:

- There are aspects associated with the Deep Creek quarry operations that could affect dust emissions in the regional air environment. The influence, and the extent of those aspects on cumulative air impacts is unknown; and
- It was outside the scope of this assessment to predict dust emission levels from the Deep Creek Quarry (by way of, for example dispersion modelling) for the purposes of incorporating those emissions within the cumulative impacts. The predictions would need to incorporate the lateral distance between the proposed Hillview site and the Deep Creek Quarry (at least 6km based on information within Google Earth). It should be noted that this lateral distance is outside the "surrounding vicinity" (within approximately 4 km of the site boundaries) adopted by Advitech for this AQIA.

4.3 Meteorological Model Configuration

Table 5 details the parameters used in the meteorological modelling to drive the CALMET model. The nearest Bureau of Meteorology (BOM) observational station the Site is approximately 41 km south-east of the Site. After comparison of the local observational data with regional observational data, Advitech considered the local data suitable for meteorological modelling. Therefore, the CALMET model was undertaken in 'Hybrid' mode using prognostic MM5 data with both local and regional meteorological observations.

Table 5: CALMET Meteorological Parameters used in this Report

Identifier	Descriptor	Comment
	Grid spacing	4 km
	Year of analysis	2018
	Time step	hourly
CALMET (Version 7)	Meteorological grid domain	10 km x 10 km
	Meteorological grid origin (SW corner)	393951 m, 6399547 m
	Meteorological grid resolution	0.20 km
	TERRAD value (radius of influence)	5 km
	Cell Face Heights	0, 20, 40, 80, 160, 320, 640, 1000, 1500, 2000, 2500, 3000, 4000

4.4 Dispersion Modelling Configuration

CALPUFF is an advanced non-steady-state meteorological and air quality modelling system distributed by the Atmospheric Studies Group at TRC Solutions. The model advects 'puffs' of material emitted from modelled sources, simulating the dispersion and transformation processes along the way. The model has been adopted by the US Environmental Protection Agency (US EPA) in its guideline on air quality models. CALPUFF uses the 3D wind fields generated by CALMET with the primary output files from CALPUFF processed in CALPOST to produce time-based concentration or deposition fluxes evaluated at selected receiver locations.

Particulate concentrations were simulated for a regular Cartesian receiver grid covering a 10 km by 10 km computational domain, set within the CALMET modelling domain with a grid resolution of 0.2 km.

Section 4.5 outlines the assumptions made for the AQIA. **Appendix A** contains critical parameters required for the CALPUFF dispersion model.

4.5 Air Dispersion Model

The Hillview operations are to proceed as per the project description outlined in **Section** 2.3, The modelling scenario (a 'worst-case') has been undertaken on the assumption basis presented in **Section 4.5.**

Dispersion modelling has been undertaken for the entire 2018 calendar year. The modelling scenario for operations was conservatively assumed to be operating at a typical production rate for 16 hours a day and for the operational 'days' shown in this report.

The modelling scenario for construction was conservatively assumed to include site activities operating for five (5) days per week and 12 hours per day (Monday to Friday inclusive). In addition, the construction stages adopted for the modelling were the most conservative: Stages Two and Three, as outlined in the next section.

4.6 Air Dispersion Modelling Assumptions

Assumptions used in the computation of GLCs and deposition for particulates using the CALPUFF dispersion model are listed below:

4.6.1 General

The following assumptions have been applied to the dispersion modelling of the Hillview quarry:

- Site operational hours for the construction stage were assumed to be less than those for the operational stage (16 hours per day). Advitech assumed that construction equipment would be operating between Monday to Friday inclusive, and for 12 hours per day, and 100% of the time. The actual operating times will be less than 100%;
- Options within CALPUFF modelling reflect the *NSW OEH Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System guidelines* (*Reference* 5)*;*
- Silt content of the Site was assumed to be 6.4%;
- Both dry and wet deposition were modelled;
- Appropriate emission factors from the relevant Emission Estimation Technique (EET) Manual (References 6 and 7) have been applied to all quarry emission sources, and applying AP-42 Pollutant Emission Factors (Reference 8);
- The operating times for the construction and operation are as shown previously in this report;
- Quarry extraction area is as per Conceptual Final Landform document provided by the owner;

- The sand processing plant was not modelled for dust emissions. Generally, the materials are wet or moist when handled, and process emissions are generally negligible.
- The following emission controls were assumed (and percentage reduction in emission based on References 6 &7 shown in brackets):
  - Water carts for the suppression of dust on haul and access roads (75%);
  - Watering for open areas (other than haul and access roads) and exposed stockpile surfaces, to suppress dust including from wind erosion (50%); and
  - Dust collector used for drilling operations (50%);
- The area exposed (i.e. not sealed) for the processing pad and stockpiles, was assumed to be 1 ha (10,000 m^2) maximum for conservative purposes, based and drawings supplied to Advitech and assumed dimensions of equipment located within the pad. This assumption was used for modelling both the construction and operations scenarios.
- As advised by the client, 300 holes (maximum) will be drilled for a blast event. Advitech assumed 1.5 m spacings for the drill holes (from Reference 9) and based on an equilateral and square drill patten this yielded 17 holes by 17 hole with a side length of 19 m. These dimensions also yielded the "blast area" required for dispersion modelling.
- Dust emissions from conveyors were assumed to be negligible.
- Advitech modelled for dust components and two (2) scenarios: construction and operations;
- The maximum extraction rate used for the operational modelling scenario was based on the information provided by ADW and the owner - up to 1.5 million tonnes (t) in stage 5 of hard rock per annum, and for the 'worst case' maximum operating times (100%) ;
- The maximum extraction rate used for the construction modelling scenario was based on the information provided by ADW and the owner. For conservative purposes, Advitech adopted stages 2 and 3 (combined) - up to 1 166 000 m^3 of hard rock that is surplus assumed for production. This amount was obtained from 1 09 000 m^3 (Stages Two and Three combined) of "cut volume" that will be dozed, drilled, blasted, loaded and hauled, less 43 000 m^3 to be used as fill during the construction of the Site. Based on a maximum rhyolite density of 2.7 tonne/m^3 (to be conservative) this yields 3 148 200 tonnes (t), and Advitech were advised that Stages Two and Three will take two (2) years to complete. For the purposes of modelling, Advitech converted this tonnage to an annual basis (1 574 100 t).
- For dust deposition modelling, default factors were applied: geometric mass mean diameter (GMMD) of 12.8 µm for TSP, 7 µm for PM_{10} and 1.8 µm for $PM_{2.5}$; with geometric standard deviation (GSD) of 1.7 µm for TSP and 1.3 µm for PM_{10} and 0.2 µm for $PM_{2.5}$ respectively was applied;
- A $PM_{2.5}$ to PM_{10} ratio of 0.15 and 0.1 has been applied to material handling and wheel generated emission sources respectively (Reference 8);
- Wheel generated dust from haul trucks within the quarry extraction area were modelled as multiple line volume sources in CALPUFF. Particulate emissions were equally divided between the haul truck sources;
- Constant emission rates were applied in the modelling for all sources, except for blasting and drilling. The blasting and drilling dust emission sources were allocated time varying emissions rates, due to the non-constant nature of these activities. Blasting assumed to only occur twice a month, and at 12 noon on a weekday during that fortnightly period. Drilling (required for blasting) was assumed to occur on a day prior to the blasting, in the hours of 6 am to 4 pm (inclusive)within the same fortnightly period as the blasting;
- Haul trucks that are taking their products off site will have their loads covered;

- Maytoms Lane will be sealed, therefore dust emissions from road movements along this access were excluded from the modelling;
- The entire nominated quarry extraction area is assumed to be blasted over the course of the quarry life. The blasting frequency was advised to Advitech as two (2) blasts per month; and
- Modelling of other dust emission sources outside of the proposed site and in the local area, e.g the proposed 'Deep Creek' quarry to the south of the site, were not included in the air modelling.

4.7 Emission Sources

The activities associated with the proposed operations with the potential to generate dust are:

- Operation of haul trucks within the quarry (and creation of wheel generated dust);
- Blasting and drilling operations within the proposed quarry extraction area;
- Operation of a dozer, front-end loader and excavator within the extraction area;
- Operation of the grader, primary crusher, secondary crusher and screens;
- Wind erosion from stockpiled quarry materials; and
- Wind erosion of "open" areas within the Site, i.e. unsealed sections.

Details of each emission source for operations (Stage Five) and construction (Stages Two and Three combined) are given in **Tables 6A** and **6B** respectively. The emission factors used to calculate and estimate the respective emission rates are based on the following techniques and References (and please refer to the assumptions):

- Emission Estimation Technique (EET) Manual for Mining - Version 3.1 (Reference 6);
- Emission Estimation Technique (EET) Manual for Mining - Version 3.1 (Reference 7)
- AP-42 Air Pollutant Emission Factors 1 (Reference 8); and
- (for blasting emissions only) Dyno Nobel Explosives Engineers' Guide (Reference 9);

Emissions from these manuals and references are based on typical air emissions for coal mining, metalliferous mining operations and crushed stone processing. The emission factors have been applied to the quarry operation and can be considered as a conservative estimate.

Table 6A: Hillview Quarry – *Operations* (Stage Five) Emission Sources

Emitter Name	Emission Factor [1,2]			Modelled Days (Days)	Modelled Working Hours (hours / day)	Emission Rate [2] (g/s)			Modelled Location		
	TSP	PM_{10}	Units			TSP	PM_{10}	$PM_{2.5}$	Easting (m)	Northing (m)	Ground Elevation (m)
Grader	0.19	0.085	kg/VKT[4]	290	16	0.096	0.043	0.006	398577.6	6404664.56	163
Drill	0.59	0.31	kg/hole	290	16	0.072	0.038	0.006	398534	6404666	185
Dozer	6.05	1.38	kg/h	290	16	1.679	0.383	0.058	398765.99	6404438.65	189
Excavators[6] (2x)	0.025	0.012	kg/t	290	16	2.245	1.078	0.323	398765.99	6404727.65	158
Primary Crusher (jaw)	0.0027	0.0012	kg/t	290	16	0.243	0.108	0.016	399016	6404988	141
Secondary crusher (cone)	0.0027	0.0012	kg/t	290	16	0.243	0.108	0.016	398975	6404844.83	135
Screening	0.01	0.004	kg/t	290	16	1.123	0.386	0.058	398940	6404858	137
Wind erosion from exposed land and stockpiles	0.4	0.2	kg/ha/h	290	24	0.056	0.028	0.004	398776	6404721	149
Blasting	0.47	0.243	kg/blast	290	16	0.130	0.067	0.010	398537	6404692	184

Haul truck – internal haul road	4.23	1.25	kg/VKT	290	16	1.901 – 3.803 [5]	0.562-1.124 [5]	0.056-0.112 [5]	varies, depending on segment	varies, depending on segment	varies, depending on segment

Notes: 1 $PM_{2.5}$ was obtained from a $PM_{2.5}$ to PM_{10} ratio, depending on the type of operation.

2 While equipment is operating.

3 Shaded cells indicate that an emission reduction was applied to the rate (e.g. by water suppression or duct collection), refer to Assumptions section of this report.

4 Vehicle Kilometres Travelled.

5 Rate varied depending on the haul road segment (3 segments modelled).

6 Loader is included in the excavator activities and rates.

7 All results expressed in grams per second (g/s). For the modelling, rates for areas sources were converted to $g/(m^2.s)$

Table 6B: Hillview Quarry – *Construction* (Stages Two and Three combined) Emission Sources

Emitter Name	Emission Factor [1,2]			Modelled Days (Days)	Modelled Working Hours (hours / day)	Emission Rate [7]			Modelled Location		
	TSP	PM_{10}	Units			TSP	PM_{10}	$PM_{2.5}$	Easting (m)	Northing (m)	Ground Elevation (m)
Grader	0.19	0.085	kg/VKT	260	12	0.125	0.056	0.008	398577.6	6404664.56	163
Drill	0.59	0.31	kg/hole	260	16	0.072	0.038	0.006	398534	6404666	185
Dozer	6.05	1.38	kg/h	260	12	1.679	0.383	0.058	398765.99	6404438.65	189
Excavators[6] (2x)	0.025	0.012	kg/t	260	12	3.504	1.682	0.505	398765.99	6404727.65	158

Emitter Name	Emission Factor [1,2]			Modelled Days (Days)	Modelled Working Hours (hours / day)	Emission Rate [7]			Modelled Location		
	TSP	PM_{10}	Units			TSP	PM_{10}	$PM_{2.5}$	Easting (m)	Northing (m)	Ground Elevation (m)
Primary Crusher (jaw)	0.0027	0.0012	kg/t	260	12	0.378	0.168	0.025	399016	6404988	141
Secondary crusher (cone)	0.0027	0.0012	kg/t	260	12	0.378	0.168	0.025	398975	6404844.83	135
Screening	0.01	0.004	kg/t	260	12	2.335	0.803	0.121	398940	6404858	137
Wind erosion from exposed land and stockpiles	0.4	0.2	kg/ha/h	260	24	0.056	0.028	0.004	398776	6404721	149
Blasting	0.47	0.243	kg/blast	260	1	0.130	0.067	0.010	398537	6404692	184
Haul truck – internal haul road	4.23	1.25	kg/VKT	260	12	1.527 – 3.055 [5]	0.451-0.902 [5]	0.045-0.090 [5]	varies, depending on segment	varies, depending on segment	varies, depending on segment

Notes: 1 $PM_{2.5}$ was obtained from a $PM_{2.5}$ to PM_{10} ratio, depending on the type of operation.

2 While equipment is operating

3 Shaded cells indicate that an emission reduction was applied to the rate (e.g. by water suppression or duct collection), refer to Assumptions section of this report

4 Vehicle Kilometres Travelled.

5 Rate varied depending on the haul road segment (3 segments modelled).

6 Loader is included in the excavator activities and rates.

7 All results expressed in grams per second (g/s). For the modelling, rates for areas sources were converted to g/(m^2.s)

5. Dispersion Modelling Results

5.1 Construction Phase Modelling Scenario

The predicted concentrations at selected sensitive receivers of PM_{10}, $PM_{2.5}$,TSP and Dust Deposition for the Hillview facility are presented in **the following sections.**

The subsequent modelling of particulate impacts on sensitive receivers are shown in **Section 5.1.1.** to **Section 5.1.4**. Contour plots for each assessment criteria are presented in **Appendix B.**

5.1.1 Annual Average PM_{10}, $PM_{2.5}$ and TSP

The predicted total (cumulative) concentrations at selected sensitive receivers of the annual average PM_{10}, $PM_{2.5}$ and TSP for the Hillview facility are presented in **Table 7.**

Table 7: Predicted Cumulative Annual Averages PM_{10}, $PM_{2.5}$ and TSP at Sensitive Receivers (Worst Case)

Receiver	Predicted Annual Average PM_{10} Increment + Background (µg/m³)	Predicted Annual Average $PM_{2.5}$ Increment + Background (µg/m³)	Predicted Annual Average TSP Increment + Background (µg/m³)
Background Concentration (µg/m³)	21.6	7.5	43.2
R1	22.2	7.6	45.2
R2	22.2	7.6	45.2
R3	23.6	7.5	50.1
R4	22.1	7.5	44.7
R5	22.0	7.5	44.4
R6	22.0	7.5	44.5
R7	22.1	7.5	44.7
R8	22.1	7.5	44.7
R9	22.1	7.5	44.9
R10	22.2	7.6	45.1
R11	22.1	7.6	45.1
R12	22.6	7.6	46.4
R13	21.9	7.8	47.3
R14	22.4	7.7	45.3
R15	22.4	7.6	45.8
R16	22.6	7.6	46.3
R17	22.7	7.7	46.5
R18	23.4	7.8	49.1
R19	23.6	7.9	44.4
R20	21.9	7.7	47.9
R21	22.2	7.6	45.2

The annual average PM_{10}, $PM_{2.5}$ and TSP impact assessment criteria are not exceeded at any sensitive receivers.

According to the NSW EPA guidance, no additional assessment of annual average PM_{10}, $PM_{2.5}$ and TSP is required.

5.1.2 24 Hour Average PM_{10}

The predicted incremental and total (cumulative) concentrations at selected sensitive receivers of the 24-hour average PM_{10} maximum increment for the Hillview site are presented in **Table 8**.

Table 8: Maximum Impact of 24-Hour PM_{10}

Receiver	Hillview Quarry Maximum Predicted Increment (µg/m³)	Maximum Background Concentration (µg/m³)[1]	Total, cumulative (µg/m³)
R1	5.7	41.9	47.6
R2	3.7		45.6
R3	13.5		**55.4**
R4	3.3		45.2
R5	7.1		49.0
R6	7.3		49.2
R7	5.9		47.8
R8	6.7		48.6
R9	6.5		48.4
R10	1.2		43.1
R11	7.2		49.1
R12	12.4		**54.3**
R13	10.7		**52.6**
R14	7.8		49.7
R15	5.1		47.0
R16	9.3		**51.2**
R17	7.0		48.9
R18	16.0		**57.9**
R19	27.8		**69.7**
R20	16.2		**58.1**
R21	8.1		**50.0**

Notes:

[1] Background concentrations above the impact assessment criteria of 50 µg/m³ were discounted. Therefore, the next highest value under the criteria (41.9 µg/m³) was used.

The exceedances at nearby sensitive receivers of the 24-hour average PM_{10} concentration presented in the above Table are likely a result of an elevated background PM_{10} concentration. A Level 2 contemporaneous impact and background assessment is required to determine any additional exceedances as a result of the proposed operation.

A summary of the 24-hour average PM_{10} contemporaneous impact and background assessment (Level 2 Assessment) for identified sensitive receivers are presented in **Table 9**.

Table 9: Summary of the 24-Hour Average PM_{10} Contemporaneous Impact and Background - Construction

Date	PM_{10} 24-hour average (µg/m³)				Date	PM_{10} 24-hour average (µg/m³)			
	Highest Background	Predicted Increment – Hillview Quarry *construction*	Receiver	Total		Background	Highest Predicted Increment – Hillview Quarry *construction*	Receiver	Total
22/11/2018	**149.1**	2.1	R12	**151.2**	2/04/2018	24.0	27.8	R19	**51.8**
23/11/2018	**109.3**	4.2	R13	**113.5**	1/01/2018	21.9	27.1	R19	49.0
15/04/2018	**67.6**	4.8	R13	**72.4**	12/08/2018	11.3	24.4	R19	35.7
19/03/2018	**65.2**	3.5	R19	**68.7**	20/05/2018	24.8	24.3	R19	49.1
19/07/2018	**62.3**	4.2	R12	**66.5**	29/09/2018	19.9	23.4	R19	43.3
18/07/2018	**55.7**	5.7	R12	**61.4**	9/06/2018	12.8	23.3	R19	36.1
15/02/2018	**55.6**	5.2	R19	**60.8**	14/01/2018	13.7	23.2	R19	36.9
4/08/2018	**53.7**	3.8	R13	**57.5**	31/01/2018	14.9	23.0	R19	37.9
21/11/2018	44.0	1.7	R7	45.7	10/10/2018	14.3	20.4	R19	34.7
20/03/2018	41.9	7.5	R12	49.4	8/09/2018	13.7	20.1	R19	33.8
25/07/2018	40.6	3.6	R15	44.2	30/11/2018	17.7	19.5	R19	37.2
14/02/2018	39.2	2.9	R3	42.1	1/07/2018	21.0	18.8	R19	39.8
16/02/2018	38.8	6.0	R19	44.8	23/12/2018	12.6	16.5	R19	29.1
4/11/2018	38.5	8.0	R20	46.5	12/02/2018	29.8	16.2	R20	46.0

Date	PM$_{10}$ 24-hour average (µg/m^3)				Date	PM$_{10}$ 24-hour average (µg/m^3)			
	Highest Background	Predicted Increment – Hillview Quarry *construction*	Receiver	Total		Background	Highest Predicted Increment – Hillview Quarry *construction*	Receiver	Total
24/07/2018	38.4	3.8	R12	42.2	30/09/2018	14.2	16.0	R19	30.2
9/04/2018	38.2	5.2	R20	43.4	7/10/2018	8.1	15.9	R19	24.0
7/08/2018	38.0	6.7	R13	44.7	15/01/2018	16.6	15.9	R19	32.5
6/11/2018	38.0	6.9	R19	44.9	7/11/2018	26.2	15.4	R19	41.6
20/07/2018	37.2	2.0	R15	39.2	9/10/2018	19.5	14.9	R19	34.4
1/03/2018	37.1	11.1	R19	48.2	6/10/2018	8.3	14.8	R19	23.1
13/09/2018	37.1	12.9	R20	**50.0**	2/01/2018	14.9	14.7	R19	29.6
13/04/2018	36.7	2.0	R12	38.7	27/10/2018	23.4	14.3	R20	37.7
3/12/2018	36.2	9.3	R16	45.5	12/07/2018	25.3	14.2	R19	39.5
19/09/2018	35.4	5.5	R19	40.9	1/06/2018	13.1	13.8	R19	26.9
3/11/2018	35.3	8.8	R19	44.1	31/10/2018	34.2	13.6	R19	47.8

Eight (8) exceedances displayed in Table **9** have been discounted due to a background concentration greater than the impact assessment criteria. There are additional exceedances of the 24 hour PM$_{10}$ impact assessment criteria at nearby sensitive receivers:

- A concentration of 50.0 (µg/m^3), at receptor R20 on 1/9/2018. This is considered a marginal exceedance by Advitech; and

A concentration of 51.8 (µg/m^3), at receptor R19 on 2/4/2018. This is considered a slight exceedance by Advitech. These are discussed further in this report.

5.1.3 24 Hour Average $PM_{2.5}$

The predicted incremental and total (cumulative) concentrations at selected sensitive receivers of the 24-hour average $PM_{2.5}$ for the proposed operations are presented in **Table 10**.

Table 10: Predicted Maximum 24-Hour Average $PM_{2.5}$ at Sensitive Receivers

Receiver	Hillview Quarry Maximum Predicted Increment (µg/m³)	Maximum Background Concentration (µg/m³)[1]	Total, cumulative (µg/m³)
R1	1.1	17.7	18.8
R2	0.7		18.5
R3	2.2		19.9
R4	0.6		18.3
R5	1.1		18.8
R6	1.1		18.8
R7	1.0		18.7
R8	1.5		19.2
R9	1.5		19.2
R10	1.9		19.6
R11	1.3		19.0
R12	1.8		19.5
R13	1.6		19.3
R14	1.2		18.9
R15	1.1		18.8
R16	1.3		19.0
R17	1.1		18.8
R18	2.2		19.9
R19	4.6		22.3
R20	3.3		21.0
R21	1.4		19.1

Modelling indicates that there are no exceedances of the 24 hour $PM_{2.5}$ ambient air quality guideline value (25.0 µg/m³) at nearby sensitive receivers shown in **Table 10,** and as such a contemporaneous impact and background Level 2 Assessment for 24 hour $PM_{2.5}$ is not required. According to the NSW EPA guidance, mitigation measures or emission controls that reduce emissions are not required for this dust component.

5.1.4 Dust Deposition

The predicted annual average dust deposition rates at selected sensitive receivers for the proposed operation are presented in Table 11.

Table 11: Predicted Dust Deposition at Sensitive Receivers

Receivers	Subject Site Maximum Predicted Increment (g/m²/month)	Impact Assessment Criteria
R1	<0.1	
R2	<0.1	
R3	0.2	
R4	<0.1	
R5	<0.1	
R6	<0.1	
R7	<0.1	
R8	<0.1	
R9	<0.1	
R10	<0.1	
R11	<0.1	2 g/m²/month
R12	0.1	
R13	0.2	
R14	0.1	
R15	0.1	
R16	0.1	
R17	0.1	
R18	0.2	
R19	0.3	
R20	<0.1	
R21	<0.1	

As shown in Table 11, there are no annual average dust deposition results that exceed the impact criteria, and no further analysis is required.

5.2 Operations Phase Modelling Scenario

The predicted concentrations at selected sensitive receivers of PM_{10}, $PM_{2.5}$, TSP and Dust Deposition for the Hillview facility are presented in **the following sections.**

The subsequent modelling of particulate impacts on sensitive receivers are shown in **Section 5.2.1.** to **Section 5.2.4.** Contour plots for each assessment criteria are presented in **Appendix B.**

5.2.1 Annual Average PM10, PM2.5 and TSP

The predicted total (cumulative) concentrations at selected sensitive receivers of the annual average PM_{10}, $PM_{2.5}$ and TSP for the Hillview facility are presented in **Table 12.**

Table 12: Predicted Annual Average PM_{10}, $PM_{2.5}$ and TSP at Sensitive Receivers (Worst Case)

Receiver	Predicted Annual Average PM_{10} Increment + Background (µg/m³)	Predicted Annual Average $PM_{2.5}$ Increment + Background (µg/m³)	Predicted Annual Average TSP Increment + Background (µg/m³)
Background Concentration (µg/m³)	21.6	7.5	43.2
R1	22.2	7.6	45.2
R2	22.2	7.6	45.2
R3	23.6	7.8	50.0
R4	22.0	7.6	44.6
R5	22.0	7.6	44.3
R6	22.0	7.6	44.5
R7	22.0	7.6	44.6
R8	22.0	7.6	44.6
R9	22.1	7.6	44.8
R10	22.2	7.6	45.0
R11	22.2	7.6	45.0
R12	22.6	7.6	46.3
R13	22.9	7.7	47.1
R14	22.5	7.6	46.2
R15	22.6	7.6	45.7
R16	22.6	7.6	46.3
R17	22.6	7.6	46.5
R18	23.4	7.7	49.1

Receiver	Predicted Annual Average PM_{10} Increment + Background (µg/m³)	Predicted Annual Average $PM_{2.5}$ Increment + Background (µg/m³)	Predicted Annual Average TSP Increment + Background (µg/m³)
Background Concentration (µg/m³)	21.6	7.5	43.2
R19	24.2	7.9	54.9
R20	22.9	7.7	47.5
R21	22.2	7.6	45.1

As shown in Table 12, the annual average PM_{10}, $PM_{2.5}$ and TSP impact assessment criteria are not exceeded at any sensitive receivers. According to the NSW EPA guidance, no additional assessment of annual average PM_{10}, $PM_{2.5}$ and TSP is required.

5.2.2 24 Hour Average PM_{10}

The predicted incremental and total (cumulative) concentrations at selected sensitive receivers of the 24-hour average PM_{10} maximum increment for the Hillview Quarry are presented in **Table 13**.

Table 13: Maximum Impact of 24-Hour PM_{10}

Receiver	Hillview Quarry Maximum Predicted Increment (µg/m³)	Maximum Background Concentration (µg/m³)[1]	Total, cumulative (µg/m³)
R1	5.1		47.0
R2	3.8		45.7
R3	1.2		43.1
R4	3.1		45.0
R5	6.8		48.7
R6	6.7		48.6
R7	5.6		47.5
R8	5.7		47.6
R9	5.4		47.3
R10	12.1	41.9	**54.0**
R11	7.4		49.3
R12	12.2		**54.1**
R13	10.5		**52.4**
R14	8.0		49.9
R15	4.8		46.7
R16	9.9		**51.8**
R17	7.4		49.3
R18	1.4		43.3
R19	2.6		44.5

Receiver	Hillview Quarry Maximum Predicted Increment (μg/m³)	Maximum Background Concentration (μg/m³)[1]	Total, cumulative (μg/m³)
R20	1.7		43.6
R21	8.2		**50.1**

Notes:

[1] Background concentrations above the impact assessment criteria of 50 μg/m³ were discounted. Therefore, the next highest value under the criteria (41.9 μg/m³) was used.

The exceedances at nearby sensitive receivers of the 24-hour average PM_{10} concentration presented in the **Table 13** (highlighted in bold) are likely a result of an elevated background PM_{10} concentration. A Level 2 contemporaneous impact and background assessment is required to determine any additional exceedances as a result of the proposed operation.

A summary of the 24-hour average PM_{10} contemporaneous impact and background assessment (Level 2 Assessment) for identified sensitive receivers are presented in **Table 14**.

Table 14: Summary of the 24-Hour Average PM_{10} Contemporaneous Impact and Background- Operations

PM_{10} 24-hour average (µg/m³)					PM_{10} 24-hour average (µg/m³)				
Date	Highest Background	Predicted Increment – Hillview Quarry *operations*	Receiver	Total	Date	Background	Highest Predicted Increment – Hillview Quarry *operations*	Receiver	Total
22/11/2018	**149.1**	2.1	R13	**151.2**	2/04/2018	24.0	25.5	R19	49.5
23/11/2018	**109.3**	3.9	R13	**113.2**	29/09/2018	19.9	24.7	R19	44.6
15/04/2018	**67.6**	4.5	R13	**72.1**	20/05/2018	24.8	23.0	R19	47.8
19/03/2018	**65.2**	3.8	R19	**69.0**	31/01/2018	14.9	22.8	R19	37.7
19/07/2018	**62.3**	3.9	R12	**66.2**	14/01/2018	13.7	22.7	R19	36.4
18/07/2018	**55.7**	5.4	R12	**61.1**	12/08/2018	11.3	21.9	R19	33.2
15/02/2018	**55.6**	6.3	R19	**61.9**	8/09/2018	13.7	21.6	R19	35.3
4/08/2018	**53.7**	3.2	R13	**56.9**	1/01/2018	21.9	21.5	R19	43.4
21/11/2018	44.0	1.5	R7	45.5	9/06/2018	12.8	21.1	R19	33.9
20/03/2018	41.9	8.4	R12	**50.3**	30/09/2018	14.2	18.9	R19	33.1
25/07/2018	40.6	3.1	R15	43.7	23/12/2018	12.6	18.8	R19	31.4
14/02/2018	39.2	3.0	R19	42.2	10/10/2018	14.3	18.5	R19	32.8
16/02/2018	38.8	5.8	R19	44.6	1/07/2018	21.0	18.1	R19	39.1
4/11/2018	38.5	7.6	R20	46.1	2/01/2018	14.9	17.1	R19	32.0

Date	PM10 24-hour average (µg/m³)				Date	PM10 24-hour average (µg/m³)			
	Highest Background	Predicted Increment – Hillview Quarry *operations*	Receiver	Total		Background	Highest Predicted Increment – Hillview Quarry *operations*	Receiver	Total
24/07/2018	38.4	3.4	R12	41.8	15/01/2018	16.6	16.9	R19	33.5
9/04/2018	38.2	4.9	R20	43.1	27/10/2018	23.4	16.7	R20	40.1
7/08/2018	38.0	7.2	R13	45.2	12/02/2018	29.8	16.0	R20	45.8
6/11/2018	38.0	7.1	R19	45.1	30/11/2018	17.7	15.6	R19	33.3
20/07/2018	37.2	1.9	R15	39.1	19/06/2018	8.1	15.1	R19	23.2
1/03/2018	37.1	12.1	R19	49.2	13/05/2018	10.5	15.0	R19	25.5
13/09/2018	37.1	12.8	R20	49.9	6/10/2018	8.3	14.7	R19	23.0
13/04/2018	36.7	1.8	R12	38.5	1/06/2018	13.1	14.7	R19	27.8
3/12/2018	36.2	9.9	R16	46.1	14/05/2018	20.5	14.6	R19	35.1
19/09/2018	35.4	5.3	R19	40.7	7/10/2018	8.1	14.2	R19	22.3
3/11/2018	35.3	8.2	R19	43.5	7/11/2018	26.2	13.9	R19	40.1

Eight (8) exceedances displayed in **Table 14** (highlighted in bold) have been discounted due to a background concentration greater than the impact assessment criteria.

There is one (1) additional exceedance of the 24 hour PM_{10} impact assessment criteria at nearby sensitive receivers:

A concentration of 50.3 (µg/m³), at receptor R12 on 20/3/2018. This is considered by Advitech to be a marginal exceedance. This is discussed further in this report.

5.2.3 24 Hour Average $PM_{2.5}$

The predicted incremental and total (cumulative) concentrations at selected sensitive receivers of the 24-hour average $PM_{2.5}$ for the proposed operations are presented in **Table 15**.

Table 15: Predicted Maximum 24-Hour Average $PM_{2.5}$ at Sensitive Receivers

Receiver	Hillview Quarry Maximum Predicted Increment (µg/m³)	Maximum Background Concentration (µg/m³)[1]	Total, cumulative (µg/m³)
R1	0.8	17.7	18.5
R2	0.5		18.2
R3	1.8		**19.5**
R4	0.4		18.1
R5	0.9		18.6
R6	0.9		18.6
R7	0.8		18.5
R8	1.0		17.7
R9	1.0		17.7
R10	1.6		19.3
R11	1.1		18.8
R12	1.6		19.3
R13	1.3		19.0
R14	1.0		18.7
R15	0.8		18.5
R16	1.2		18.9
R17	0.9		18.6
R18	1.8		19.5
R19	3.6		21.3
R20	2.6		20.3
R21	1.2		18.9

Modelling indicates that there are no exceedances of the 24 hour $PM_{2.5}$ ambient air quality guideline value (25.0 µg/m³) at nearby sensitive receivers in **Table 15,** and as such a contemporaneous impact and background Level 2 Assessment for 24 hour $PM_{2.5}$ is not required. According to the NSW EPA guidance, mitigation measures or emission controls that reduce emissions are not required for this dust component.

5.2.4 Dust Deposition

The predicted annual average dust deposition rates at selected sensitive receivers for the proposed operation are presented in **Table 16**.

Table 16: Predicted Dust Deposition at Sensitive Receivers

Receivers	Subject Site Maximum Predicted Increment (g/m^2/month)	Impact Assessment Criteria
R1	<0.1	2 g/m^2/month
R2	<0.1	
R3	<0.1	
R4	<0.1	
R5	<0.1	
R6	<0.1	
R7	<0.1	
R8	<0.1	
R9	<0.1	
R10	<0.1	
R11	0.1	
R12	0.2	
R13	0.1	
R14	<0.1	
R15	<0.1	
R16	0.1	
R17	0.1	
R18	0.2	
R19	0.3	
R20	<0.1	
R21	<0.1	

As shown in **Table 16**, there are no annual average dust deposition results that exceed the impact criteria, and no further analysis is required.

6. Summary of Air Modelling Results and Discussion

Some initial exceedances of dust impact criteria for the dust component PM_{10}, 24 hour averaging period were discounted due to a background concentration greater than the impact assessment criteria.

The results of the cumulative air assessment (dust modelling combined with background concentrations) for the proposed Hillview quarry operations showed minor exceedances of the NSW EPA assessment criterion for the dust component PM_{10}, 24 hour averaging period, and following a Level 2 analysis:

- *Construction component* (two (2) exceedances):
  - A concentration of 50.0 ($\mu g/m^3$), at receptor R20, located approximately 2.3 km to the north – northwest of the proposed quarry operations. This result is considered by Advitech to be a marginal exceedance; and
  - A concentration of 51.8 ($\mu g/m^3$), at receptor R19 located approximately 1.0 km to the northeast of the proposed quarry operations. This result is considered by Advitech to be a slight exceedance.
- *Operations component* (one (1) exceedance): A concentration of 50.3 ($\mu g/m^3$), at receptor R12 located approximately 1.4 km to the southeast of the proposed quarry operations. This result is considered by Advitech to be a marginal exceedance and due to the high background concentration (41.9 $\mu g/m^3$, which represents 84% of the criteria).

It should be noted that the exceedances were obtained whilst incorporating many conservative assumptions into the modelling including machinery operating for 100% of the time, which is unlikely in practice. Section 9 outlines recommendations for achieving compliance for the PM_{10}, 24 hour averaging period criteria.

All of the other NSW EPA criteria for dust components were satisfied, for both the construction and operations components of the project, and using conservative assumptions:

- $PM_{2.5}$ 24 hour averaging period;
- $PM_{2.5}$ annual hour averaging period;
- PM_{10} annual averaging period;
- TSP annual averaging period; and
- Deposited Dust, annual averaging period.

Further, the levels of dust particles (as PM_{10}) predicted from this project are unlikely to reach the guideline levels for health impacts as shown in The National Environment Protection Measure for Ambient Air (Air NEPM, Reference 12) both during the construction and operations. This finding is based on:

- The overall favourable results of the cumulative modelling for 24 hour averaging and annual averaging periods; and
- The limited number of exceedances, at limited locations and using many conservative assumptions.

It should be noted that the NEPM (Reference 12) is aiming to change the $PM_{2.5}$ criteria in 2025, to the following (lower) levels:

- 24 hour averaging period - 20 $\mu g/m^3$; and
- Annual averaging period - 7 $\mu g/m^3$.

The levels of dust particles (as PM2.5) predicted from this project are unlikely to reach the guideline levels for health impacts as shown in The National Environment Protection Measure for Ambient Air (Air NEPM, Reference 12) both during the construction and operations.

7. Other Air Emissions

For air quality impacts (and excluding the GHG assessment) this AQA primarily focused on particular matter (i.e. dust) components, and the dispersion modelling of those components. The following outlines Advitech's review of air emissions other than particulate matter, and by using a desktop approach.

7.1 Odour and Nitrogen Dioxide

Advitech conducted a desktop review of odour emissions associated with blasting operations at the Hillview site, and for both construction and operations.

Air emissions from blasting can contain nitrogen dioxide (NO_2) which has a pungent odour character.

Odours generated from blasting operations (both during construction and operations) are unlikely to be at adverse levels impacts at the nearest sensitive receptors, and are also unlikely to cause a complaint for the following reasons:

- The frequency of the blasts (two (2) per month);
- The duration of the blasts; and
- The lateral distance between a blast and the nearest residences. The minimum distance between the blast and a residence is 1 km, which is considered by Advitech to be satisfactory for the reduction of odour emissions to acceptable levels at the residences.

As such, Advitech considered it unnecessary to evaluate either odour or nitrogen dioxide emissions further, for example by way of air dispersion modelling.

Odours from other air emission sources e.g. vehicle exhausts were considered to be insignificant due to the low odour emission rates for those exhausts and the lateral distance between the exhausts and the nearest residences.

The air emission concentrations of nitrogen dioxide generated from the project are unlikely to exceed the guideline level for health impacts (Reference 12). As a result, a cumulative assessment of odour and nitrogen dioxide emissions (i.e. project increment plus background concentrations) was considered unnecessary.

7.2 Other Air Emissions

Emissions other than dust, odour and nitrogen dioxide and from the proposed quarry operations were assessed by way of desktop assessment (and not air dispersion modelling).

These "other" air emissions that could be potentially generated from quarry operations are:

- Products of fuel combustion and emitted to air via machinery exhausts (e.g. excavators, haul trucks) – volatile organic compounds (VOC) (e.g. benzene, formaldehyde), oxides of nitrogen, carbon monoxide (CO), sulfur dioxide (SO_2); and
- Leakages from equipment.

None of these emissions produced from the Hillview quarry operations are likely to exceed the relevant NSW EPA assessment criteria at the nearest residences, due to the low air emission rates for those exhausts and the lateral distances between the exhausts and the nearest residences.

The air emission concentrations levels of "other" emissions such as sulfur dioxide generated from the project are unlikely to exceed guideline levels for health impacts (Reference 12). As a result, a cumulative assessment of these other air emissions (i.e. project increment plus background concentrations) was considered unnecessary.

8. Conclusions and Recommendations – Air Quality Impact Assessment (AQIA)

Advitech modelled two (2) scenarios and assessed the potential particulate (dust) impacts to sensitive receivers for the proposed Hillview Hard Rock Quarry (Hillview Quarry) project; one detailing the construction of the quarry and the other detailing operations. Both scenarios used 'worst case', conservative assumptions. A cumulative assessment approach was incorporated for all dust components, which included the predicted incremental increases in dust (performed by way of dispersion modelling) and the ambient background concentrations for dust.

The results of the CALPUFF modelling indicate that the construction and operation of the Quarry will result in incremental increases in particulate matter and dust deposition at surrounding sensitive receivers.

These increases were predicted to result in exceedances of the NSW EPA assessment criteria for the PM_{10} dust component, 24 hour averaging period and for both the construction and operations scenarios, and whilst conducting a 'cumulative' assessment (modelling results plus background concentrations).

A 'Level 2' analysis including the assessment of cumulative air quality impacts for PM_{10} (24 hour averaging period) indicates that quarry operations will be primarily below NSW EPA guidelines. Any exceedances that may occur will be:

- Either at; or slightly exceeding the guideline for PM_{10} 24 hour averaging period (50.0 $\mu g/m^3$);
- At a limited number of receivers in the vicinity of the quarry; and
- Likely attributed to elevated background concentrations rather than significant incremental contribution from the proposed quarry development.

In addition, the exceedances were obtained whilst incorporating many conservative assumptions into the modelling including machinery operating for 100% of the time, which is unlikely to happen in practice. Based on this assumption and other considerations incorporated into the conservative modelling approach adopted by Advitech, the exceedances are unlikely to occur on a regular basis. Additional dust mitigation measures at the quarry operations, if implemented by the site owner, should further reduce the likelihood of dust exceedances at sensitive receivers in the vicinity, such as residences.

Advitech recommends the following dust management measures to be implemented, in order mitigate the potential dust impacts from the quarry and both during construction and operations:

- An air quality management plan (AQMP) to ensure effective management and measurement of particulate emissions;
- Dust monitoring near impacted sensitive receptors; in conjunction with reactive management of adverse dust levels by site management. Advitech notes that monitoring for dust *deposition* commenced in year 2016 at two (2) locations near the Site (at the Site gate and near a house, Reference 4), however the monitoring network and capabilities should be expanded to include:
  - Monitoring of the dust fractions that may result in health-related impacts (from the inhalation of fine particulates), e.g PM_{10} and at:
  - The locations where exceedances occurred in this assessment modelling, which are:
    - Receptor R12: 2035 The Bucketts Way;
    - Receptor R19: 29B Booral-Washpool Road; and
    - Receptor R20: 400 Washpool Creek Road.
- Enforce a maximum speed of 40 km/h on unsealed haul and internal roads;
- Apply water sprays on trafficable areas (approx. rate 2 $L/m^2/h$) as required during normal operations;

- Increase water sprays (greater than 2 L/m²/h) during periods of peak export to roads; and
- Apply water sprays or other suitable alternative on processing plant and equipment to maintain material in a moistened state.

Advitech also recommends that the owner of the Site investigates additional dust controls on the equipment, and for the machinery that was shown to contribute the highest proportions of dust e.g. the excavators.

Emissions other than dust were assessed by Advitech to be insignificant at the receivers as a result of the proposed Hillview quarry operations. These emissions, which can be generated from activities such as blasting and operation of machinery are:

- Odour;
- Oxides of nitrogen (NOx) including nitrogen dioxide (NO_2);
- Volatile organic compounds (VOC) (for example benzene, formaldehyde emitted from vehicle exhausts);
- Carbon monoxide (CO); and
- Sulfur dioxide (SO_2).

As such, emissions other than dust did not require assessment by detailed qualitative methods such as air dispersion modelling.

The levels of air emissions predicted from this project are unlikely to reach the guideline levels for health impacts as shown in The National Environment Protection Measure for Ambient Air (Air NEPM, Reference 12) both during the construction and operations, and these air emissions are:

- Dust particles as PM_{10} ;
- Dust particles as $PM_{2.5}$;
- Nitrogen dioxide (NO_2);
- Carbon monoxide (CO); and
- Sulfur dioxide (SO_2).

A limited number of PM_{10} exceedances were obtained at a limited number of locations, and by using very conservative assumptions.

9. Greenhouse Gas (GHG) Assessment

The purpose of this section of the report is to provide an assessment of the greenhouse gas (GHG) emissions resulting from the construction and operation phases for Hillview Quarry. Emissions have been calculated showing annual and total overall predicted emissions for both phases of the project and a GHG inventory has been produced.

9.1 Scopes of the GHG Emissions

The GHG Protocol defines three (3) scopes of emissions to ensure that single emission sources are not counted twice within the supply chain. The emission estimates contained in this report include GHG emissions related to both direct (Scope 1) and indirect (Scope 3) emissions as defined in Table 17 below.

Table 17: GHG emissions scope definitions (Reference 10)

Principle	Description
Scope 1	Direct GHG emissions occur from sources that are owned or controlled by the company, for example, emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc.; emissions from chemical production in owned or controlled process equipment.
Scope 2	Indirect emissions from the generation of purchased electricity consumed by the company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organisational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated.
Scope 3	All indirect emissions (not included in scope 2) that are a consequence of the activities of the company but occur from sources not owned or controlled by the company. Some examples of scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services.

Scope 2 emissions have been excluded from this assessment, as electricity will be produced and consumed on site by way of generators and therefore electricity will not be purchased for any stage of the Site operations (i.e. construction, operations, or rehabilitation). The inclusion of Scope 3 emissions in this assessment provides a holistic view of the environmental impacts of the project.

Activities and potential emissions sources which have not been included in the GHG assessment have been detailed in the exclusions shown in this report.

9.2 GHG Emissions

The GHG inventory produced for this assessment is inclusive of the following GHG emissions covered by the United Nations Framework Convention on Climate Change (UNFCCC) Reporting Guidelines and which were operationalised by the Kyoto Protocol (and as outlined in Reference 10):

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous dioxide (N_2O)
- Sulphur hexafluoride (SF_6)
- Perfluorocarbons (PFCs)
- Hydrofluorocarbons (HFCs)

While all the above-mentioned GHG's have been considered, GHG's relating to the project are primarily limited to CO_2, CH_4 and N_2O. GHG emissions not covered by the Kyoto Protocol, e.g. CFCs, NOx, etc. shall not be included in estimated Scope 1 GHG emissions for this project.

9.3 GHG Assessment Boundaries

The following information was used to estimate the greenhouse gas emissions from the Site:

- The project plans to extract and process up to 1.5 million tonnes (t) of hard rock per annum, for a projected lifespan of 30 years.
- The hours of operation of the Site will be in accordance with the details shown earlier in this report (also refer to the assumptions).
- The project will progress over seven (7) 'stages' including construction, operation, and final landform. For the purposes of simplifying GHG calculations, the following components and time periods were used:
  - Construction – this incorporated Stages 1 to 4 inclusive; and over a period of approximately 2 years from project commencement; and
  - Operations – Stages 5 to 7; and 30 years until the end of life for the quarry.
- The machinery and equipment used in Construction and Operations will be as shown in the following notes.

9.4 Exclusions

Certain activities and potential emissions sources have not been included in the produced GHG inventory (please see following comments). The emissions sources and the reason these were excluded from the GHG Inventory are listed in Table 18.

Table 18: Emission Source Data Exclusions

Emission Source	Scope	Description	Reason(s) for exclusion
Combustion of fuel for energy	1	Small quantities of fuel such as petrol and LPG (i.e. not being used for equipment in construction and operations).	Fuel quantities, and emissions expected to be small compared with emissions generated from equipment using diesel, e.g. haul trucks.
Equipment and office refrigerants	1	Refrigerant leakages	Emissions from leakages from Hydrofluorocarbon and Perfluorocarbon gases are expected to be very small and infrequent.
Industrial Processes	1	Emissions associated with clearing vegetation.	Emissions are expected to be very small compared with the primary emissions e.g. emissions generated from equipment using diesel, e.g. haul trucks.
Electrical equipment		Sulphur hexafluoride emissions from high voltage switchgear	Emissions are expected to be very small compared with the primary emissions
Blasting locations	1	Emissions associated with blasting (during construction and operations)	Emissions are expected to be very small compared with the primary emissions e.g. emissions generated from equipment using diesel, e.g. haul trucks, due to the frequency and duration of the blasting events.
Entire Facility (Grid Electricity)	2	Emissions from the generation of purchased electricity, or, steam, heating or cooling consumed by the facility	Electricity will not be purchased – equipment requiring electricity will be powered by generators. No emissions expected from any steam, heating, or cooling processes.
Entire Facility	1 & 3	Emissions from the potential GHG: sulphur hexafluoride	No sources of this GHG compound are expected during either construction or operations.
Entire Facility	1 & 3	Emissions from the potential GHG's: hydrofluorocarbons and perfluorocarbons.	No sources of these GHG compound are expected during either construction or operations.
Maintenance Activities	1 & 3	Emissions associated with the cleaning and maintenance of equipment (e.g. solvents, oils, lubricants, etc.)	Emissions are expected to be very small compared with the primary emissions
Solid waste	3	Wastes to landfill: solid, and general wastes	No wastes delivered as "product"; and information on general waste (e.g. wastes from employees on site) is unknown.
Business travel	3	Employees travelling for business purposes.	Travel information is unknown.
Employee travel	3	Employees travelling for business purposes.	Travel information is unknown.

9.5 Methodology

The methodologies used to estimate the GHG emissions (GHG Inventory) attributable to the construction and operation of the project are in alignment with GHG Protocol Corporate Accounting and Reporting Standard (GHG Protocol), The National Greenhouse and Energy Reporting (NGER) scheme, and information provided by the Site owner and ADW Johnson.

9.5.1 Assumptions

The following assumptions were used in the estimation of the GHG emission calculations:

- The fuel type for all machinery, including generators was assumed to be diesel.
- The use of a Front-End Loader within the quarry was assumed to be included in 'excavator' activities (and subsequent emission calculations).
- For the purposes of consistency and providing conservative GHG emissions, Advitech assumed that all equipment was operating 100% of the time for the following components:
  - Construction – five (5) days per week (Monday to Friday), 12 hours per day, 52 weeks per year. This yielded 3 120 hours per year (maximum) for each machine. Two (2) years of construction maximum; and
  - Operations (extraction) – six (6) days per week (Monday to Saturday),16 hours per day, 52 weeks per year. This yielded 5 000 hours per year (maximum) for each machine.
- Advitech assumed that four (4) larger generators will be located within the Ste will be for providing power to conveyor belts, and two (2) smaller and mobile generators will be located within the Site for providing power to smaller equipment.
- Advitech assumed that delivery of diesel and explosives would be sourced from within the Hunter Valley area. In order to calculate the (Scope 3) 'upstream' emissions from the Site, the following assumptions were also used:
  - The quantities of diesel required for both construction and operations - *for machinery use, not explosives* were based on the diesel amounts derived during the Scope 1 emissions calculations (refer to Section 7.3.1 following), assuming 1 hour travelling time to deliver the products, and fuel consumption obtained from commercial product information for type of fuel delivery trucks expected to be used;
  - The quantities of diesel required for both construction and operations - *for the delivery of explosives* were based on both the fuel consumption obtained from commercial product information for type of fuel delivery trucks expected to be used, and the additional assumptions:
    - Construction component (project stages 1 to 4 inclusive)– maximum of six (6) blasting events across two (2) years; and
    - Operations component (project Stage 5 and onwards) – 24 blasting events per year (from 2 blasting event per month).
- Based on advice provided to Advitech from ADW, transport off site for the quarry products will service markets located 60 km from the Site and within the Hunter Valley (on average). In order to calculate the (Scope 3) 'downstream' emissions from the Site, the yearly consumption of diesel was based on 178 truck movements leaving the Site within an 11-hour day, assuming 1 hour travelling time to deliver the products, and fuel consumption obtained from commercial product information for the haulage trucks to be used.
- Fuel usage associated with rehabilitation works (via the use of machinery) was considered to be minimal compared with the fuel usage for the major activities at the Site, for both construction and operation stages; and
- Potential GHG emissions from blasting emissions e.g. CO_2 were considered insignificant compared with emissions from vehicle exhausts, due to the infrequency and duration of the blasting events.

9.5.2 Calculations

In our study's methodology, the quantification and standardisation of emissions related to the Hillview Quarry project have been undertaken. Both direct (Scope 1) and indirect (Scope 3) emissions were converted into a unified metric, the carbon dioxide equivalent (CO_2-e), to facilitate the comparison of emissions from diverse sources. This metric allows for the aggregation of all greenhouse gas (GHG) emissions into CO_2-e, using carbon dioxide as the baseline for comparison. The adoption of emission factors is central to this process, enabling the precise conversion of specific activities into their CO_2-e impacts.

For Scope 1 emissions, which capture the direct emissions from the project site, emission factors were specifically sourced from the National Greenhouse and Energy Reporting (NGER) measurement determination of 2008. This approach guarantees that the calculation of direct emissions from operations, such as fuel use and quarry processing activities, adheres to established and regulatory-endorsed guidelines. These factors are instrumental in calculating the CO_2-e emissions per unit of activity at the emission source.

Data on fuel consumption for each piece of machinery and vehicle on site was collected from both commercial product information and the Australian Bureau of Statistics (ABS) fuel consumption data by vehicle class. This data underpins the accurate calculation of Scope 1 emissions throughout a two (2)-year construction phase, as detailed in **Appendix C**.

The GHG emissions based in fuel usage during transportation and stationary machinery operation are obtained using the following equation (Ref 8):

Emissions for Hillview project (tCO_2e) =	Quantity of fuel used [kL] x the energy content factor of the fuel [GJ/m^3] x emission factor (for the fuel type) kg [CO_2e/GJ]) / 1000 [kg/tonne]

For Scope 3 emissions, which include indirect emissions such as the transportation of materials to the Site and the operation of stationary machinery, a consistent methodology with Scope 1 was applied, centring on fuel consumption data. Notably, the emission factors for fuel used on site, integral to calculating Scope 3 emissions, were derived from the National Greenhouse Account (NGA) factors report 2023. This ensures a comprehensive assessment of emissions, incorporating the latest insights into the emissions embedded in the supply chain of diesel fuel to the Site.

The calculations for both Scope 1 and Scope 3 emissions, along with a detailed GHG inventory, are presented in Appendix C. This segment not only provides a summary of the calculated emissions but also explores potential opportunities for reducing the GHG footprint of the Hillview Quarry project. By employing this refined methodology, the study aims to deliver an accurate and contemporary evaluation of the project's GHG impact, aligning with modern environmental standards and advancing towards sustainable development objectives.

Further, the accepted terminology is shown below for liquid fuel (Reference 10) and therefore applicable to the diesel fuel supplied to, and used within the facility:

The scope 3 liquid fuel emission factors published in the National Greenhouse Accounts Factors are intended to represent 'well-to-pump' emissions.

The calculation method utilised in this analysis separately addresses the following seven components of Australia's well-to-pump liquid fuel emissions:

- Upstream (including all supply chain emissions prior to refining)
  - Crude oil extracted within Australia for use in Australian refineries
  - Crude oil extracted overseas for use in Australian refineries
  - Crude oil extracted within Australia for use in overseas refineries
  - Crude oil extracted overseas for use in overseas refineries
- Midstream (refining)
  - Refining of petroleum products within Australia
  - Refining of petroleum products overseas
- Downstream (distribution)
  - Shipping of refined petroleum products from overseas refineries to Australia.

The calculation tables for Scope 1 and Scope 3 emissions are shown in **Appendix C.** The following sections outline the GHG inventory, summary of the results and GHG emission reduction opportunities.

9.6 Greenhouse Gas Emissions Inventory

The GHG emission inventory includes construction and operation activities to provide an overview of the impact of the project during its full life cycle. The majority of emissions are from operating site equipment.

The GHG inventory of the Site includes:

- Emissions associated with fuel usage for construction of the Site, intended for quarry operations (Scope 1)
- Emissions associated with fuel usage for powering generators for powering the site office; conveyor belts, and minor ancillary equipment (Scope 1)
- Emissions associated with fuel usage for the operation of the site, i.e. extraction of products within the quarry (Scope 1)
- Emissions associated with fuel usage for the operation of the site - haulage of product to the site boundary (Scope 1)
- Emissions associated with providing fuel and explosives to the site (Scope 3, 'upstream' emissions); and
- Emissions associated with fuel usage for haulage of product from the site boundary to customer locations (Scope 3, 'downstream' emissions).
- Scope 3 Emissions that are due to fuel used at the Site (construction and operations) and due to supplying fuel 'upstream'.

9.6.1 Construction

Emissions associated with construction have been broken down by various construction activities. The estimates have been based on 2 years of construction activities (total for all stages of construction). The overall construction emissions by activity source are displayed in **Table 19**.

Table 19: Construction emissions breakdown by activity sources

Activity	Scope 1 (t CO_2-e)	Scope 2 (t CO_2-e)	Scope 3 (t CO_2-e)	Total (t CO_2-e)
Liquid fuel (diesel) consumption	4,617.9	-	1,117.0	5,734.9
Upstream liquid fuel (diesel) consumption	-	-	10.1	10.1
Total	**4,617.9**		**1,127.1**	**5,745.0**

Total GHG emissions from construction for the project have been estimated to be 5 745.0 t CO_2e, with approximately 80% of total emissions being attributed to the haulage vehicles and machinery used on site (Scope 1).

The scope 1 GHG emissions also equate to approximately 2 873 t CO_2e per year, during the construction component. The Hillview 'project' will not trigger the compulsory reporting under the NGER Act (Reference 11) 25 kilotonnes (kt) of CO_2e per year or production or consumption of 100 terajoules (TJ) of energy); for the construction component (2-years duration).

9.6.2 Operations

Emissions associated with the operations of the quarry have been broken down by various operation activities. The estimates have been based on 30-year operation activities. The overall operation emissions by activity source are displayed in **Table 20**.

Table 20: Operations emissions breakdown by activity sources

Activity	Scope 1	Scope 2	Scope 3	Total (t CO2e)
Liquid fuel (diesel) consumption	170,180.4	-	32,423.2	202,603.5
Upstream liquid fuel (diesel) consumption	-	-	237.5	237.5
Downstream liquid fuel (diesel) consumption	-	-	90,549.3	90,549.3
Total	**170,80.4**			**293,390.3**

Total GHG emissions from operations of the project have been estimated to be 293,390.3 t CO_2e, with approximately 65% of total emissions being attributed to the haulage vehicles and machinery used on site (Scope 1).

The Scope 1 GHG emissions also equate to approximately 9,780 t CO_2e per year, for the operations component. The Hillview 'project' will not trigger the compulsory reporting under the NGER Act (Reference 11) 8.25 kt of CO2-e per year or production or consumption of 100 TJs of energy); for the operations component (30-years duration).

9.6.3 Project Total GHG Inventory

The total GHG emission amounts are based on conservative assumptions, and maximum operating conditions over the expected life of the quarry. The results are summarised in **Table 21** below.

Table 21: Total GHG Emissions from the Hillview Project

Scope	Activity	Total Emissions (t CO_2e)
Scope 1	*Diesel Fuel*: Mobile machinery used on site and use of blast drill; use of generators; haulage vehicles (within site)	174,789
Scope 3	*Upstream and downstream Diesel Fuel*: Haulage to and from site	91,923
Scope 3	*Diesel Fuel on site due to supply upstream:* Mobile machinery used on site and use of blast drill; use of generators; haulage vehicles (within site)	32,423
	TOTAL GHG EMISSIONS	299,135

The Hillview project is expected to generate approximately 299,123 t of CO_2-e of GHG emissions over the project "life", including two (2) years of construction, followed by 30 years of quarry operations. Operating on-site equipment is the primary source of GHG emissions, and from Scope 1, 'direct' emissions (and primarily from the operational period of the quarry). This total GHG amount is also based on conservative assumptions, and maximum operating conditions over the expected life of the quarry.

9.7 Emission Reduction Opportunities

This greenhouse gas assessment shows the Hillview Quarry project breakdown of GHG emissions via machinery use and transportation. Reduction of emissions from these sources will result in a net reduction of GHG emissions and economic savings due to reduced fuel use.

The greenhouse inventory for the Hillview Project indicates that over 90% of their GHG emissions are Scope 1 emissions generated from equipment on site (including generators to supply power on site). Thus, reductions in emissions and costs may be made by ensuring that the equipment is utilised at maximum efficiency. For example, the equipment and machinery should be serviced regularly.

Reductions in emissions and costs for haulage vehicles can also be made for the Hillview Project, by ensuring that haulage vehicles are utilised at maximum efficiency. Data collection and trends on trip numbers, load weights and fuel consumption may assist the implementation of efficient haulage practice.

Route planning is a low budget means of achieving immediate reductions in fuel consumption and thus GHG emissions. Reduction measures include:

- Choice of route which avoids constant uphill and downhill driving or city driving with many stops and starts which may increase fuel consumption by more than 50%.
- Avoidance of driving into a headwind as an additional 10 m/s may increase fuel consumption by 18%.
- Choice of roads with reduced rolling surfaces as increased rolling resistance may increase fuel consumption by 10-20%
- Avoidance of additional stops: A stop every 10 km increases fuel consumption by approximately 35%.
- The use of a Global Positioning System (GPS) may improve choice of route to ensure the most direct and efficient route is chosen.
- Lowering the speed from 90 km/h to 80 km/h can reduce fuel consumption by six (6)%; and
- Regular servicing on vehicles.

Longer term high-cost outlay mitigation measures include the consideration of alternative fuels for haulage vehicles. LPG/diesel mixes claim to reduce fuel usage by up to 20% but require retrofit of existing transportation fleet at high cost. Consideration of alternative fuel vehicles may be appropriate when the current fleet is updated. Similarly, LPG vehicle options may be considered when fleet vehicles are upgraded.

General Mitigation measures to reduce Scope 1 emissions include:

- Review energy usage equipment – consideration should be given to the life cycle cost advantages of using energy efficient equipment.
- Review operational initiatives such as turning off idle equipment and workshop/office appliances;
- Review settings of air conditioning equipment if appropriate in office building; and
- Review the use of automatic lighting in amenity and meeting rooms.

The objective of these mitigation measures is to seek further opportunity to reduce GHG emissions, although cost savings are also a likely result of instituting and exploring energy efficient alternatives.

10. References

The following information was used in the preparation of this report:

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Appendix A

Parameters for Calpuff

Table 22 : Summary of CALPUFF modelling parameters applied

Parameter	Value Used	Comment
Dry deposition modelled (MDRY)	1	Dry deposition was modelled. Geometric mass mean diameters applied to each dust component are presented in Section 4.5.1.
Chemical transformation	0	Chemical transformation was not modelled
Method used to compute dispersion coefficients (MDISP)	2 (dispersion coefficients from internally calculated sigma v, sigma w using micrometeorological variables)	As recommended by the NSW Generic Guidance and Optimum Model Settings for CALPUFF.
Default minimum turbulence velocities sigma-v for each stability class over land and over water (m/s) (SVMIN)	0.2 m/s for all stability classes	As recommended by the NSW Generic Guidance and Optimum Model Settings for CALPUFF.
Emission Sources	12 Sources total, comprising: ▪ 3 area sources; ▪ 6 volume sources; and ▪ 3 line volume sources (segments for haul truck movements, and individual volume sources within each segment varied between 10 to 18)	Constant emission rates for all sources, except for blasting and drilling, which were allocated time varying emissions rates

Notes: CALPUFF input parameters not listed in the table are set as default values.

For additional details, refer to the following details extracted from the CALPUFF program extracted by Advitech. The parameter for the construction scenario is shown first; followed by the parameters for the operations scenario.

CALPUFF Parameters

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INPUT GROUP: 0 -- Input and Output File Names		
Parameter	**Description**	**Value**
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET.DAT
PUFLST	CALPUFF output list file (CALPUFF.LST)	CALPUFF.LST
CONDAT	CALPUFF output concentration file (CONC.DAT)	CONC.DAT
DFDAT	CALPUFF output dry deposition flux file (DFLX.DAT)	DFLX.DAT
WFDAT	CALPUFF output wet deposition flux file (WFLX.DAT)	WFLX.DAT
LCFILES	Lower case file names (T = lower case, F = upper case)	F
NMETDOM	Number of CALMET.DAT domains	1
NMETDAT	Number of CALMET.DAT input files	1
NPTDAT	Number of PTEMARB.DAT input files	0
NARDAT	Number of BAEMARB.DAT input files	0
NVOLDAT	Number of VOLEMARB.DAT input files	0
NFLDAT	Number of FLEMARB.DAT input files	0
NRDDAT	Number of RDEMARB.DAT input files	0
NLNDAT	Number of LNEMARB.DAT input files	0

INPUT GROUP: 1 -- General Run Control Parameters		
Parameter	**Description**	**Value**
METRUN	Run all periods in met data file? (0 = no, 1 = yes)	0
IBYR	Starting year	2018
IBMO	Starting month	1
IBDY	Starting day	1
IBHR	Starting hour	0
IBMIN	Starting minute	0
IBSEC	Starting second	0
IEYR	Ending year	2019
IEMO	Ending month	1
IEDY	Ending day	1
IEHR	Ending hour	0
IEMIN	Ending minute	0
IESEC	Ending second	0
ABTZ	Base time zone	UTC+1000
NSECDT	Length of modeling time-step (seconds)	3600
NSPEC	Number of chemical species modeled	3
NSE	Number of chemical species to be emitted	3
ITEST	Stop run after SETUP phase (1 = stop, 2 = run)	2

INPUT GROUP: 1 -- General Run Control Parameters		
Parameter	**Description**	**Value**
MRESTART	Control option to read and/or write model restart data	0
NRESPD	Number of periods in restart output cycle	0
METFM	Meteorological data format (1 = CALMET, 2 = ISC, 3 = AUSPLUME, 4 = CTDM, 5 = AERMET)	1
MPRFFM	Meteorological profile data format (1 = CTDM, 2 = AERMET)	1
AVET	Averaging time (minutes)	60
PGTIME	PG Averaging time (minutes)	60
IOUTU	Output units for binary output files (1 = mass, 2 = odour, 3 = radiation)	1

INPUT GROUP: 2 -- Technical Options		
Parameter	**Description**	**Value**
MGAUSS	Near field vertical distribution (0 = uniform, 1 = Gaussian)	1
MCTADJ	Terrain adjustment method (0 = none, 1 = ISC-type, 2 = CALPUFF-type, 3 = partial plume path)	3
MCTSG	Model subgrid-scale complex terrain? (0 = no, 1 = yes)	0
MSLUG	Near-field puffs modeled as elongated slugs? (0 = no, 1 = yes)	0
MTRANS	Model transitional plume rise? (0 = no, 1 = yes)	1
MTIP	Apply stack tip downwash to point sources? (0 = no, 1 = yes)	1
MRISE	Plume rise module for point sources (1 = Briggs, 2 = numerical)	1
MTIP_FL	Apply stack tip downwash to flare sources? (0 = no, 1 = yes)	0
MRISE_FL	Plume rise module for flare sources (1 = Briggs, 2 = numerical)	2
MBDW	Building downwash method (1 = ISC, 2 = PRIME)	1
MSHEAR	Treat vertical wind shear? (0 = no, 1 = yes)	0
MSPLIT	Puff splitting allowed? (0 = no, 1 = yes)	0
MCHEM	Chemical transformation method (0 = not modeled, 1 = MESOPUFF II, 2 = User-specified, 3 = RIVAD/ARM3, 4 = MESOPUFF II for OH, 5 = half-life, 6 = RIVAD w/ISORROPIA, 7 = RIVAD w/ISORROPIA CalTech SOA)	0
MAQCHEM	Model aqueous phase transformation? (0 = no, 1 = yes)	0
MLWC	Liquid water content flag	1
MWET	Model wet removal? (0 = no, 1 = yes)	1
MDRY	Model dry deposition? (0 = no, 1 = yes)	1
MTILT	Model gravitational settling (plume tilt)? (0 = no, 1 = yes)	0
MDISP	Dispersion coefficient calculation method (1= PROFILE.DAT, 2 = Internally, 3 = PG/MP, 4 = MESOPUFF II, 5 = CTDM)	2
MTURBVW	Turbulence characterization method (only if MDISP = 1 or 5)	3
MDISP2	Missing dispersion coefficients method (only if MDISP = 1 or 5)	3
MTAULY	Sigma-y Lagrangian timescale method	0
MTAUADV	Advective-decay timescale for turbulence (seconds)	0
MCTURB	Turbulence method (1 = CALPUFF, 2 = AERMOD)	1
MROUGH	PG sigma-y and sigma-z surface roughness adjustment? (0 = no, 1 = yes)	0
MPARTL	Model partial plume penetration for point sources? (0 = no, 1 = yes)	1

INPUT GROUP: 2 -- Technical Options		
Parameter	**Description**	**Value**
MPARTLBA	Model partial plume penetration for buoyant area sources? (0 = no, 1 = yes)	0
MTINV	Strength of temperature inversion provided in PROFILE.DAT? (0 = no - compute from default gradients, 1 = yes)	0
MPDF	PDF used for dispersion under convective conditions? (0 = no, 1 = yes)	0
MSGTIBL	Sub-grid TIBL module for shoreline? (0 = no, 1 = yes)	0
MBCON	Boundary conditions modeled? (0 = no, 1 = use BCON.DAT, 2 = use CONC.DAT)	0
MSOURCE	Save individual source contributions? (0 = no, 1 = yes)	0
MFOG	Enable FOG model output? (0 = no, 1 = yes - PLUME mode, 2 = yes - RECEPTOR mode)	0
MREG	Regulatory checks (0 = no checks, 1 = USE PA LRT checks)	0

INPUT GROUP: 3 -- Species List		
Parameter	**Description**	**Value**
CSPEC	Species included in model run	PM10
CSPEC	Species included in model run	PM2.5
CSPEC	Species included in model run	TSP

INPUT GROUP: 4 -- Map Projection and Grid Control Parameters		
Parameter	**Description**	**Value**
PMAP	Map projection system	UTM
FEAST	False easting at projection origin (km)	0.0
FNORTH	False northing at projection origin (km)	0.0
IUTMZN	UTM zone (1 to 60)	56
UTMHEM	Hemisphere (N = northern, S = southern)	S
RLAT0	Latitude of projection origin (decimal degrees)	0.00N
RLON0	Longitude of projection origin (decimal degrees)	0.00E
XLAT1	1st standard parallel latitude (decimal degrees)	30S
XLAT2	2nd standard parallel latitude (decimal degrees)	60S
DATUM	Datum-region for the coordinates	WGS-84
NX	Meteorological grid - number of X grid cells	50
NY	Meteorological grid - number of Y grid cells	50
NZ	Meteorological grid - number of vertical layers	10
DGRIDKM	Meteorological grid spacing (km)	0.2
ZFACE	Meteorological grid - vertical cell face heights (m)	0.0, 20.0, 40.0, 80.0, 160.0, 320.0, 640.0, 1200.0, 2000.0, 3000.0, 4000.0
XORIGKM	Meteorological grid - X coordinate for SW corner (km)	393.9510
YORIGKM	Meteorological grid - Y coordinate for SW corner (km)	6399.5470
IBCOMP	Computational grid - X index of lower left corner	1

INPUT GROUP: 4 -- Map Projection and Grid Control Parameters		
Parameter	**Description**	**Value**
JBCOMP	Computational grid - Y index of lower left corner	1
IECOMP	Computational grid - X index of upper right corner	50
JECOMP	Computational grid - Y index of upper right corner	50
LSAMP	Use sampling grid (gridded receptors) (T = true, F = false)	T
IBSAMP	Sampling grid - X index of lower left corner	1
JBSAMP	Sampling grid - Y index of lower left corner	1
IESAMP	Sampling grid - X index of upper right corner	50
JESAMP	Sampling grid - Y index of upper right corner	50
MESHDN	Sampling grid - nesting factor	1

INPUT GROUP: 5 -- Output Options		
Parameter	**Description**	**Value**
ICON	Output concentrations to CONC.DAT? (0 = no, 1 = yes)	1
IDRY	Output dry deposition fluxes to DFLX.DAT? (0 = no, 1 = yes)	1
IWET	Output wet deposition fluxes to WFLX.DAT? (0 = no, 1 = yes)	1
IT2D	Output 2D temperature data? (0 = no, 1 = yes)	0
IRHO	Output 2D density data? (0 = no, 1 = yes)	0
IVIS	Output relative humidity data? (0 = no, 1 = yes)	0
LCOMPRS	Use data compression in output file (T = true, F = false)	T
IQAPLOT	Create QA output files suitable for plotting? (0 = no, 1 = yes)	1
IPFTRAK	Output puff tracking data? (0 = no, 1 = yes use timestep, 2 = yes use sampling step)	0
IMFLX	Output mass flux across specific boundaries? (0 = no, 1 = yes)	0
IMBAL	Output mass balance for each species? (0 = no, 1 = yes)	0
INRISE	Output plume rise data? (0 = no, 1 = yes)	0
ICPRT	Print concentrations? (0 = no, 1 = yes)	0
IDPRT	Print dry deposition fluxes? (0 = no, 1 = yes)	0
IWPRT	Print wet deposition fluxes? (0 = no, 1 = yes)	0
ICFRQ	Concentration print interval (timesteps)	1
IDFRQ	Dry deposition flux print interval (timesteps)	1
IWFRQ	Wet deposition flux print interval (timesteps)	1
IPRTU	Units for line printer output (e.g., 3 = ug/m**3 - ug/m**2/s, 5 = odor units)	3
IMESG	Message tracking run progress on screen (0 = no, 1 and 2 = yes)	2
LDEBUG	Enable debug output? (0 = no, 1 = yes)	F
IPFDEB	First puff to track in debug output	1
NPFDEB	Number of puffs to track in debug output	1000
NN1	Starting meteorological period in debug output	1
NN2	Ending meteorological period in debug output	10

INPUT GROUP: 6 -- Subgrid Scale Complex Terrain Inputs		
Parameter	**Description**	**Value**
NHILL	Number of terrain features	0
NCTREC	Number of special complex terrain receptors	0
MHILL	Terrain and CTSG receptor data format (1= CTDM, 2 = OPTHILL)	2
XHILL2M	Horizontal dimension conversion factor to meters	1.0
ZHILL2M	Vertical dimension conversion factor to meters	1.0
XCTDMKM	X origin of CTDM system relative to CALPUFF system (km)	0.0
YCTDMKM	Y origin of CTDM system relative to CALPUFF system (km)	0.0

INPUT GROUP: 9 -- Miscellaneous Dry Deposition Parameters		
Parameter	**Description**	**Value**
RCUTR	Reference cuticle resistance (s/cm)	30
RGR	Reference ground resistance (s/cm)	10
REACTR	Reference pollutant reactivity	8
NINT	Number of particle size intervals for effective particle deposition velocity	9
IVEG	Vegetation state in unirrigated areas (1 = active and unstressed, 2 = active and stressed, 3 = inactive)	1

INPUT GROUP: 11 -- Chemistry Parameters		
Parameter	**Description**	**Value**
MOZ	Ozone background input option (0 = monthly, 1 = hourly from OZONE.DAT)	1
BCKO3	Monthly ozone concentrations (ppb)	80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00
MNH3	Ammonia background input option (0 = monthly, 1 = from NH3Z.DAT)	0
MAVGNH3	Ammonia vertical averaging option (0 = no average, 1 = average over vertical extent of puff)	1
BCKNH3	Monthly ammonia concentrations (ppb)	10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00
RNITE1	Nighttime SO2 loss rate (%/hr)	0.2
RNITE2	Nighttime NOx loss rate (%/hr)	2
RNITE3	Nighttime HNO3 loss rate (%/hr)	2
MH2O2	H2O2 background input option (0 = monthly, 1 = hourly from H2O2.DAT)	1
BCKH2O2	Monthly H2O2 concentrations (ppb)	1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00
RH_ISRP	Minimum relative humidity for ISORROPIA	50.0
SO4_ISRP	Minimum SO4 for ISORROPIA	0.4
BCKPMF	SOA background fine particulate (ug/m**3)	1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00

INPUT GROUP: 11 -- Chemistry Parameters		
Parameter	**Description**	**Value**
OFRAC	SOA organic fine particulate fraction	0.15, 0.15, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.15
VCNX	SOA VOC/NOX ratio	50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00
NDECAY	Half-life decay blocks	0

INPUT GROUP: 12 -- Misc. Dispersion and Computational Parameters		
Parameter	**Description**	**Value**
SYTDEP	Horizontal puff size for time-dependent sigma equations (m)	550
MHFTSZ	Use Heffter equation for sigma-z? (0 = no, 1 = yes)	0
JSUP	PG stability class above mixed layer	5
CONK1	Vertical dispersion constant - stable conditions	0.01
CONK2	Vertical dispersion constant - neutral/unstable conditions	0.1
TBD	Downwash scheme transition point option (<0 = Huber-Snyder, 1.5 = Schulman-Scire, 0.5 = ISC)	0.5
IURB1	Beginning land use category for which urban dispersion is assumed	10
IURB2	Ending land use category for which urban dispersion is assumed	19
ILANDUIN	Land use category for modeling domain	20
Z0IN	Roughness length for modeling domain (m)	.25
XLAIIN	Leaf area index for modeling domain	3.0
ELEVIN	Elevation above sea level (m)	.0
XLATIN	Meteorological station latitude (deg)	-999.0
XLONIN	Meteorological station longitude (deg)	-999.0
ANEMHT	Anemometer height (m)	10.0
ISIGMAV	Lateral turbulence format (0 = read sigma-theta, 1 = read sigma-v)	1
IMIXCTDM	Mixing heights read option (0 = predicted, 1 = observed)	0
XMXLEN	Slug length (met grid units)	1
XSAMLEN	Maximum travel distance of a puff/slug (met grid units)	1
MXNEW	Maximum number of slugs/puffs release from one source during one time step	99
MXSAM	Maximum number of sampling steps for one puff/slug during one time step	99
NCOUNT	Number of iterations used when computing the transport wind for a sampling step that includes gradual rise	2
SYMIN	Minimum sigma-y for a new puff/slug (m)	1
SZMIN	Minimum sigma-z for a new puff/slug (m)	1
SZCAP_M	Maximum sigma-z allowed to avoid numerical problem in calculating virtual time or distance (m)	5000000
SVMIN	Minimum turbulence velocities sigma-v (m/s)	0.2, 0.2, 0.2, 0.2, 0.2, 0.2, 0.2, 0.2, 0.2, 0.2, 0.2, 0.2

INPUT GROUP: 12 -- Misc. Dispersion and Computational Parameters		
Parameter	**Description**	**Value**
SWMIN	Minimum turbulence velocities sigma-w (m/s)	0.2, 0.12, 0.08, 0.06, 0.03, 0.016, 0.2, 0.12, 0.08, 0.06, 0.03, 0.016
CDIV	Divergence criterion for dw/dz across puff (1/s)	0, 0
NLUTIBL	TIBL module search radius (met grid cells)	4
WSCALM	Minimum wind speed allowed for non-calm conditions (m/s)	0.5
XMAXZI	Maximum mixing height (m)	3000
XMINZI	Minimum mixing height (m)	50
TKCAT	Emissions scale-factors temperature categories (K)	265., 270., 275., 280., 285., 290., 295., 300., 305., 310., 315.
PLX0	Wind speed profile exponent for stability classes 1 to 6	0.07, 0.07, 0.1, 0.15, 0.35, 0.55
PTG0	Potential temperature gradient for stable classes E and F (deg K/m)	0.02, 0.035
PPC	Plume path coefficient for stability classes 1 to 6	0.5, 0.5, 0.5, 0.5, 0.35, 0.35
SL2PF	Slug-to-puff transition criterion factor (sigma-y/slug length)	10
FCLIP	Hard-clipping factor for slugs (0.0 = no extrapolation)	0
NSPLIT	Number of puffs created from vertical splitting	3
IRESPLIT	Hour for puff re-split	0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0
ZISPLIT	Minimum mixing height for splitting (m)	100
ROLDMAX	Mixing height ratio for splitting	0.25
NSPLITH	Number of puffs created from horizontal splitting	5
SYSPLITH	Minimum sigma-y (met grid cells)	1
SHSPLITH	Minimum puff elongation rate (SYSPLITH/hr)	2
CNSPLITH	Minimum concentration (g/m**3)	0
EPSSLUG	Fractional convergence criterion for numerical SLUG sampling integration	0.0001
EPSAREA	Fractional convergence criterion for numerical AREA source integration	1E-006
DSRISE	Trajectory step-length for numerical rise integration (m)	1.0
HTMINBC	Minimum boundary condition puff height (m)	500
RSAMPBC	Receptor search radius for boundary condition puffs (km)	10
MDEPBC	Near-surface depletion adjustment to concentration (0 = no, 1 = yes)	1

INPUT GROUP: 13 -- Point Source Parameters		
Parameter	**Description**	**Value**
NPT1	Number of point sources	0
IPTU	Units used for point source emissions (e.g., 1 = g/s)	1
NSPT1	Number of source-species combinations with variable emission scaling factors	0

INPUT GROUP: 13 -- Point Source Parameters		
Parameter	**Description**	**Value**
NPT2	Number of point sources in PTEMARB.DAT file(s)	0

INPUT GROUP: 14 -- Area Source Parameters		
Parameter	**Description**	**Value**
NAR1	Number of polygon area sources	3
IARU	Units used for area source emissions (e.g., 1 = g/m**2/s)	1
NSAR1	Number of source-species combinations with variable emission scaling factors	9
NAR2	Number of buoyant polygon area sources in BAEMARB.DAT file(s)	0

INPUT GROUP: 15 -- Line Source Parameters		
Parameter	**Description**	**Value**
NLN2	Number of buoyant line sources in LNEMARB.DAT file	0
NLINES	Number of buoyant line sources	0
ILNU	Units used for line source emissions (e.g., 1 = g/s)	1
NSLN1	Number of source-species combinations with variable emission scaling factors	0
NLRISE	Number of distances at which transitional rise is computed	6

INPUT GROUP: 16 -- Volume Source Parameters		
Parameter	**Description**	**Value**
NVL1	Number of volume sources	48
IVLU	Units used for volume source emissions (e.g., 1 = g/s)	1
NSVL1	Number of source-species combinations with variable emission scaling factors	144
NVL2	Number of volume sources in VOLEMARB.DAT file(s)	0

INPUT GROUP: 17 -- FLARE Source Control Parameters (variable emissions file)		
Parameter	**Description**	**Value**
NFL2	Number of flare sources defined in FLEMARB.DAT file(s)	0

INPUT GROUP: 18 -- Road Emissions Parameters		
Parameter	**Description**	**Value**
NRD1	Number of road-links sources	0
NRD2	Number of road-links in RDEMARB.DAT file	0
NSFRDS	Number of road-links and species combinations with variable emission-rate scale-factors	0

INPUT GROUP: 19 -- Emission Rate Scale-Factor Tables		
Parameter	**Description**	**Value**
NSFTAB	Number of emission scale-factor tables	7

INPUT GROUP: 20 -- Non-gridded (Discrete) Receptor Information		
Parameter	**Description**	**Value**
NREC	Number of discrete receptors (non-gridded receptors)	21
NRGRP	Number of receptor group names	0

CALPUFF Parameters

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INPUT GROUP: 0 -- Input and Output File Names		
Parameter	**Description**	**Value**
METDAT	CALMET gridded meteorological data file (CALMET.DAT)	CALMET.DAT
PUFLST	CALPUFF output list file (CALPUFF.LST)	CALPUFF.LST
CONDAT	CALPUFF output concentration file (CONC.DAT)	CONC.DAT
DFDAT	CALPUFF output dry deposition flux file (DFLX.DAT)	DFLX.DAT
WFDAT	CALPUFF output wet deposition flux file (WFLX.DAT)	WFLX.DAT
LCFILES	Lower case file names (T = lower case, F = upper case)	F
NMETDOM	Number of CALMET.DAT domains	1
NMETDAT	Number of CALMET.DAT input files	1
NPTDAT	Number of PTEMARB.DAT input files	0
NARDAT	Number of BAEMARB.DAT input files	0
NVOLDAT	Number of VOLEMARB.DAT input files	0
NFLDAT	Number of FLEMARB.DAT input files	0
NRDDAT	Number of RDEMARB.DAT input files	0
NLNDAT	Number of LNEMARB.DAT input files	0

INPUT GROUP: 1 -- General Run Control Parameters		
Parameter	**Description**	**Value**
METRUN	Run all periods in met data file? (0 = no, 1 = yes)	0
IBYR	Starting year	2018
IBMO	Starting month	1
IBDY	Starting day	1
IBHR	Starting hour	0
IBMIN	Starting minute	0
IBSEC	Starting second	0
IEYR	Ending year	2019
IEMO	Ending month	1
IEDY	Ending day	1
IEHR	Ending hour	0
IEMIN	Ending minute	0
IESEC	Ending second	0
ABTZ	Base time zone	UTC+1000
NSECDT	Length of modeling time-step (seconds)	3600
NSPEC	Number of chemical species modeled	3
NSE	Number of chemical species to be emitted	3
ITEST	Stop run after SETUP phase (1 = stop, 2 = run)	2

INPUT GROUP: 1 -- General Run Control Parameters		
Parameter	**Description**	**Value**
MRESTART	Control option to read and/or write model restart data	0
NRESPD	Number of periods in restart output cycle	0
METFM	Meteorological data format (1 = CALMET, 2 = ISC, 3 = AUSPLUME, 4 = CTDM, 5 = AERMET)	1
MPRFFM	Meteorological profile data format (1 = CTDM, 2 = AERMET)	1
AVET	Averaging time (minutes)	60
PGTIME	PG Averaging time (minutes)	60
IOUTU	Output units for binary output files (1 = mass, 2 = odour, 3 = radiation)	1

INPUT GROUP: 2 -- Technical Options		
Parameter	**Description**	**Value**
MGAUSS	Near field vertical distribution (0 = uniform, 1 = Gaussian)	1
MCTADJ	Terrain adjustment method (0 = none, 1 = ISC-type, 2 = CALPUFF-type, 3 = partial plume path)	3
MCTSG	Model subgrid-scale complex terrain? (0 = no, 1 = yes)	0
MSLUG	Near-field puffs modeled as elongated slugs? (0 = no, 1 = yes)	0
MTRANS	Model transitional plume rise? (0 = no, 1 = yes)	1
MTIP	Apply stack tip downwash to point sources? (0 = no, 1 = yes)	1
MRISE	Plume rise module for point sources (1 = Briggs, 2 = numerical)	1
MTIP_FL	Apply stack tip downwash to flare sources? (0 = no, 1 = yes)	0
MRISE_FL	Plume rise module for flare sources (1 = Briggs, 2 = numerical)	2
MBDW	Building downwash method (1 = ISC, 2 = PRIME)	1
MSHEAR	Treat vertical wind shear? (0 = no, 1 = yes)	0
MSPLIT	Puff splitting allowed? (0 = no, 1 = yes)	0
MCHEM	Chemical transformation method (0 = not modeled, 1 = MESOPUFF II, 2 = User-specified, 3 = RIVAD/ARM3, 4 = MESOPUFF II for OH, 5 = half-life, 6 = RIVAD w/ISORROPIA, 7 = RIVAD w/ISORROPIA CalTech SOA)	0
MAQCHEM	Model aqueous phase transformation? (0 = no, 1 = yes)	0
MLWC	Liquid water content flag	1
MWET	Model wet removal? (0 = no, 1 = yes)	1
MDRY	Model dry deposition? (0 = no, 1 = yes)	1
MTILT	Model gravitational settling (plume tilt)? (0 = no, 1 = yes)	0
MDISP	Dispersion coefficient calculation method (1= PROFILE.DAT, 2 = Internally, 3 = PG/MP, 4 = MESOPUFF II, 5 = CTDM)	2
MTURBVW	Turbulence characterization method (only if MDISP = 1 or 5)	3
MDISP2	Missing dispersion coefficients method (only if MDISP = 1 or 5)	3
MTAULY	Sigma-y Lagrangian timescale method	0
MTAUADV	Advective-decay timescale for turbulence (seconds)	0
MCTURB	Turbulence method (1 = CALPUFF, 2 = AERMOD)	1
MROUGH	PG sigma-y and sigma-z surface roughness adjustment? (0 = no, 1 = yes)	0
MPARTL	Model partial plume penetration for point sources? (0 = no, 1 = yes)	1

INPUT GROUP: 2 -- Technical Options		
Parameter	**Description**	**Value**
MPARTLBA	Model partial plume penetration for buoyant area sources? (0 = no, 1 = yes)	0
MTINV	Strength of temperature inversion provided in PROFILE.DAT? (0 = no - compute from default gradients, 1 = yes)	0
MPDF	PDF used for dispersion under convective conditions? (0 = no, 1 = yes)	0
MSGTIBL	Sub-grid TIBL module for shoreline? (0 = no, 1 = yes)	0
MBCON	Boundary conditions modeled? (0 = no, 1 = use BCON.DAT, 2 = use CONC.DAT)	0
MSOURCE	Save individual source contributions? (0 = no, 1 = yes)	0
MFOG	Enable FOG model output? (0 = no, 1 = yes - PLUME mode, 2 = yes - RECEPTOR mode)	0
MREG	Regulatory checks (0 = no checks, 1 = USE PA LRT checks)	0

INPUT GROUP: 3 -- Species List		
Parameter	**Description**	**Value**
CSPEC	Species included in model run	PM10
CSPEC	Species included in model run	PM2.5
CSPEC	Species included in model run	TSP

INPUT GROUP: 4 -- Map Projection and Grid Control Parameters		
Parameter	**Description**	**Value**
PMAP	Map projection system	UTM
FEAST	False easting at projection origin (km)	0.0
FNORTH	False northing at projection origin (km)	0.0
IUTMZN	UTM zone (1 to 60)	56
UTMHEM	Hemisphere (N = northern, S = southern)	S
RLAT0	Latitude of projection origin (decimal degrees)	0.00N
RLON0	Longitude of projection origin (decimal degrees)	0.00E
XLAT1	1st standard parallel latitude (decimal degrees)	30S
XLAT2	2nd standard parallel latitude (decimal degrees)	60S
DATUM	Datum-region for the coordinates	WGS-84
NX	Meteorological grid - number of X grid cells	50
NY	Meteorological grid - number of Y grid cells	50
NZ	Meteorological grid - number of vertical layers	10
DGRIDKM	Meteorological grid spacing (km)	0.2
ZFACE	Meteorological grid - vertical cell face heights (m)	0.0, 20.0, 40.0, 80.0, 160.0, 320.0, 640.0, 1200.0, 2000.0, 3000.0, 4000.0
XORIGKM	Meteorological grid - X coordinate for SW corner (km)	393.9510
YORIGKM	Meteorological grid - Y coordinate for SW corner (km)	6399.5470
IBCOMP	Computational grid - X index of lower left corner	1

INPUT GROUP: 4 -- Map Projection and Grid Control Parameters		
Parameter	**Description**	**Value**
JBCOMP	Computational grid - Y index of lower left corner	1
IECOMP	Computational grid - X index of upper right corner	50
JECOMP	Computational grid - Y index of upper right corner	50
LSAMP	Use sampling grid (gridded receptors) (T = true, F = false)	T
IBSAMP	Sampling grid - X index of lower left corner	1
JBSAMP	Sampling grid - Y index of lower left corner	1
IESAMP	Sampling grid - X index of upper right corner	50
JESAMP	Sampling grid - Y index of upper right corner	50
MESHDN	Sampling grid - nesting factor	1

INPUT GROUP: 5 -- Output Options		
Parameter	**Description**	**Value**
ICON	Output concentrations to CONC.DAT? (0 = no, 1 = yes)	1
IDRY	Output dry deposition fluxes to DFLX.DAT? (0 = no, 1 = yes)	1
IWET	Output wet deposition fluxes to WFLX.DAT? (0 = no, 1 = yes)	1
IT2D	Output 2D temperature data? (0 = no, 1 = yes)	0
IRHO	Output 2D density data? (0 = no, 1 = yes)	0
IVIS	Output relative humidity data? (0 = no, 1 = yes)	0
LCOMPRS	Use data compression in output file (T = true, F = false)	T
IQAPLOT	Create QA output files suitable for plotting? (0 = no, 1 = yes)	1
IPFTRAK	Output puff tracking data? (0 = no, 1 = yes use timestep, 2 = yes use sampling step)	0
IMFLX	Output mass flux across specific boundaries? (0 = no, 1 = yes)	0
IMBAL	Output mass balance for each species? (0 = no, 1 = yes)	0
INRISE	Output plume rise data? (0 = no, 1 = yes)	0
ICPRT	Print concentrations? (0 = no, 1 = yes)	0
IDPRT	Print dry deposition fluxes? (0 = no, 1 = yes)	0
IWPRT	Print wet deposition fluxes? (0 = no, 1 = yes)	0
ICFRQ	Concentration print interval (timesteps)	1
IDFRQ	Dry deposition flux print interval (timesteps)	1
IWFRQ	Wet deposition flux print interval (timesteps)	1
IPRTU	Units for line printer output (e.g., 3 = ug/m**3 - ug/m**2/s, 5 = odor units)	3
IMESG	Message tracking run progress on screen (0 = no, 1 and 2 = yes)	2
LDEBUG	Enable debug output? (0 = no, 1 = yes)	F
IPFDEB	First puff to track in debug output	1
NPFDEB	Number of puffs to track in debug output	1000
NN1	Starting meteorological period in debug output	1
NN2	Ending meteorological period in debug output	10

INPUT GROUP: 6 -- Subgrid Scale Complex Terrain Inputs		
Parameter	**Description**	**Value**
NHILL	Number of terrain features	0
NCTREC	Number of special complex terrain receptors	0
MHILL	Terrain and CTSG receptor data format (1= CTDM, 2 = OPTHILL)	2
XHILL2M	Horizontal dimension conversion factor to meters	1.0
ZHILL2M	Vertical dimension conversion factor to meters	1.0
XCTDMKM	X origin of CTDM system relative to CALPUFF system (km)	0.0
YCTDMKM	Y origin of CTDM system relative to CALPUFF system (km)	0.0

INPUT GROUP: 9 -- Miscellaneous Dry Deposition Parameters		
Parameter	**Description**	**Value**
RCUTR	Reference cuticle resistance (s/cm)	30
RGR	Reference ground resistance (s/cm)	10
REACTR	Reference pollutant reactivity	8
NINT	Number of particle size intervals for effective particle deposition velocity	9
IVEG	Vegetation state in unirrigated areas (1 = active and unstressed, 2 = active and stressed, 3 = inactive)	1

INPUT GROUP: 11 -- Chemistry Parameters		
Parameter	**Description**	**Value**
MOZ	Ozone background input option (0 = monthly, 1 = hourly from OZONE.DAT)	1
BCKO3	Monthly ozone concentrations (ppb)	80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00
MNH3	Ammonia background input option (0 = monthly, 1 = from NH3Z.DAT)	0
MAVGNH3	Ammonia vertical averaging option (0 = no average, 1 = average over vertical extent of puff)	1
BCKNH3	Monthly ammonia concentrations (ppb)	10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00
RNITE1	Nighttime SO2 loss rate (%/hr)	0.2
RNITE2	Nighttime NOx loss rate (%/hr)	2
RNITE3	Nighttime HNO3 loss rate (%/hr)	2
MH2O2	H2O2 background input option (0 = monthly, 1 = hourly from H2O2.DAT)	1
BCKH2O2	Monthly H2O2 concentrations (ppb)	1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00
RH_ISRP	Minimum relative humidity for ISORROPIA	50.0
SO4_ISRP	Minimum SO4 for ISORROPIA	0.4
BCKPMF	SOA background fine particulate (ug/m**3)	1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00

INPUT GROUP: 11 -- Chemistry Parameters		
Parameter	Description	Value
OFRAC	SOA organic fine particulate fraction	0.15, 0.15, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.15
VCNX	SOA VOC/NOX ratio	50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00
NDECAY	Half-life decay blocks	0

INPUT GROUP: 12 -- Misc. Dispersion and Computational Parameters		
Parameter	Description	Value
SYTDEP	Horizontal puff size for time-dependent sigma equations (m)	550
MHFTSZ	Use Heffter equation for sigma-z? (0 = no, 1 = yes)	0
JSUP	PG stability class above mixed layer	5
CONK1	Vertical dispersion constant - stable conditions	0.01
CONK2	Vertical dispersion constant - neutral/unstable conditions	0.1
TBD	Downwash scheme transition point option (<0 = Huber-Snyder, 1.5 = Schulman-Scire, 0.5 = ISC)	0.5
IURB1	Beginning land use category for which urban dispersion is assumed	10
IURB2	Ending land use category for which urban dispersion is assumed	19
ILANDUIN	Land use category for modeling domain	20
Z0IN	Roughness length for modeling domain (m)	.25
XLAIIN	Leaf area index for modeling domain	3.0
ELEVIN	Elevation above sea level (m)	.0
XLATIN	Meteorological station latitude (deg)	-999.0
XLONIN	Meteorological station longitude (deg)	-999.0
ANEMHT	Anemometer height (m)	10.0
ISIGMAV	Lateral turbulence format (0 = read sigma-theta, 1 = read sigma-v)	1
IMIXCTDM	Mixing heights read option (0 = predicted, 1 = observed)	0
XMXLEN	Slug length (met grid units)	1
XSAMLEN	Maximum travel distance of a puff/slug (met grid units)	1
MXNEW	Maximum number of slugs/puffs release from one source during one time step	99
MXSAM	Maximum number of sampling steps for one puff/slug during one time step	99
NCOUNT	Number of iterations used when computing the transport wind for a sampling step that includes gradual rise	2
SYMIN	Minimum sigma-y for a new puff/slug (m)	1
SZMIN	Minimum sigma-z for a new puff/slug (m)	1
SZCAP_M	Maximum sigma-z allowed to avoid numerical problem in calculating virtual time or distance (m)	5000000
SVMIN	Minimum turbulence velocities sigma-v (m/s)	0.2, 0.2, 0.2, 0.2, 0.2, 0.2, 0.2, 0.2, 0.2, 0.2, 0.2, 0.2

INPUT GROUP: 12 -- Misc. Dispersion and Computational Parameters		
Parameter	**Description**	**Value**
SWMIN	Minimum turbulence velocities sigma-w (m/s)	0.2, 0.12, 0.08, 0.06, 0.03, 0.016, 0.2, 0.12, 0.08, 0.06, 0.03, 0.016
CDIV	Divergence criterion for dw/dz across puff (1/s)	0, 0
NLUTIBL	TIBL module search radius (met grid cells)	4
WSCALM	Minimum wind speed allowed for non-calm conditions (m/s)	0.5
XMAXZI	Maximum mixing height (m)	3000
XMINZI	Minimum mixing height (m)	50
TKCAT	Emissions scale-factors temperature categories (K)	265., 270., 275., 280., 285., 290., 295., 300., 305., 310., 315.
PLX0	Wind speed profile exponent for stability classes 1 to 6	0.07, 0.07, 0.1, 0.15, 0.35, 0.55
PTG0	Potential temperature gradient for stable classes E and F (deg K/m)	0.02, 0.035
PPC	Plume path coefficient for stability classes 1 to 6	0.5, 0.5, 0.5, 0.5, 0.35, 0.35
SL2PF	Slug-to-puff transition criterion factor (sigma-y/slug length)	10
FCLIP	Hard-clipping factor for slugs (0.0 = no extrapolation)	0
NSPLIT	Number of puffs created from vertical splitting	3
IRESPLIT	Hour for puff re-split	0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0
ZISPLIT	Minimum mixing height for splitting (m)	100
ROLDMAX	Mixing height ratio for splitting	0.25
NSPLITH	Number of puffs created from horizontal splitting	5
SYSPLITH	Minimum sigma-y (met grid cells)	1
SHSPLITH	Minimum puff elongation rate (SYSPLITH/hr)	2
CNSPLITH	Minimum concentration (g/m**3)	0
EPSSLUG	Fractional convergence criterion for numerical SLUG sampling integration	0.0001
EPSAREA	Fractional convergence criterion for numerical AREA source integration	1E-006
DSRISE	Trajectory step-length for numerical rise integration (m)	1.0
HTMINBC	Minimum boundary condition puff height (m)	500
RSAMPBC	Receptor search radius for boundary condition puffs (km)	10
MDEPBC	Near-surface depletion adjustment to concentration (0 = no, 1 = yes)	1

INPUT GROUP: 13 -- Point Source Parameters		
Parameter	**Description**	**Value**
NPT1	Number of point sources	0
IPTU	Units used for point source emissions (e.g., 1 = g/s)	1
NSPT1	Number of source-species combinations with variable emission scaling factors	0

INPUT GROUP: 13 -- Point Source Parameters		
Parameter	**Description**	**Value**
NPT2	Number of point sources in PTEMARB.DAT file(s)	0

INPUT GROUP: 14 -- Area Source Parameters		
Parameter	**Description**	**Value**
NAR1	Number of polygon area sources	3
IARU	Units used for area source emissions (e.g., 1 = g/m**2/s)	1
NSAR1	Number of source-species combinations with variable emission scaling factors	9
NAR2	Number of buoyant polygon area sources in BAEMARB.DAT file(s)	0

INPUT GROUP: 15 -- Line Source Parameters		
Parameter	**Description**	**Value**
NLN2	Number of buoyant line sources in LNEMARB.DAT file	0
NLINES	Number of buoyant line sources	0
ILNU	Units used for line source emissions (e.g., 1 = g/s)	1
NSLN1	Number of source-species combinations with variable emission scaling factors	0
NLRISE	Number of distances at which transitional rise is computed	6

INPUT GROUP: 16 -- Volume Source Parameters		
Parameter	**Description**	**Value**
NVL1	Number of volume sources	48
IVLU	Units used for volume source emissions (e.g., 1 = g/s)	1
NSVL1	Number of source-species combinations with variable emission scaling factors	144
NVL2	Number of volume sources in VOLEMARB.DAT file(s)	0

INPUT GROUP: 17 -- FLARE Source Control Parameters (variable emissions file)		
Parameter	**Description**	**Value**
NFL2	Number of flare sources defined in FLEMARB.DAT file(s)	0

INPUT GROUP: 18 -- Road Emissions Parameters		
Parameter	**Description**	**Value**
NRD1	Number of road-links sources	0
NRD2	Number of road-links in RDEMARB.DAT file	0
NSFRDS	Number of road-links and species combinations with variable emission-rate scale-factors	0

INPUT GROUP: 19 -- Emission Rate Scale-Factor Tables		
Parameter	**Description**	**Value**
NSFTAB	Number of emission scale-factor tables	8

INPUT GROUP: 20 -- Non-gridded (Discrete) Receptor Information		
Parameter	**Description**	**Value**
NREC	Number of discrete receptors (non-gridded receptors)	21
NRGRP	Number of receptor group names	0

Appendix B

Modelling contours

Legend for all figures:

- Contour labels are in units of µg/m^3
- Approximate project boundary:
- Sensitive Receivers:

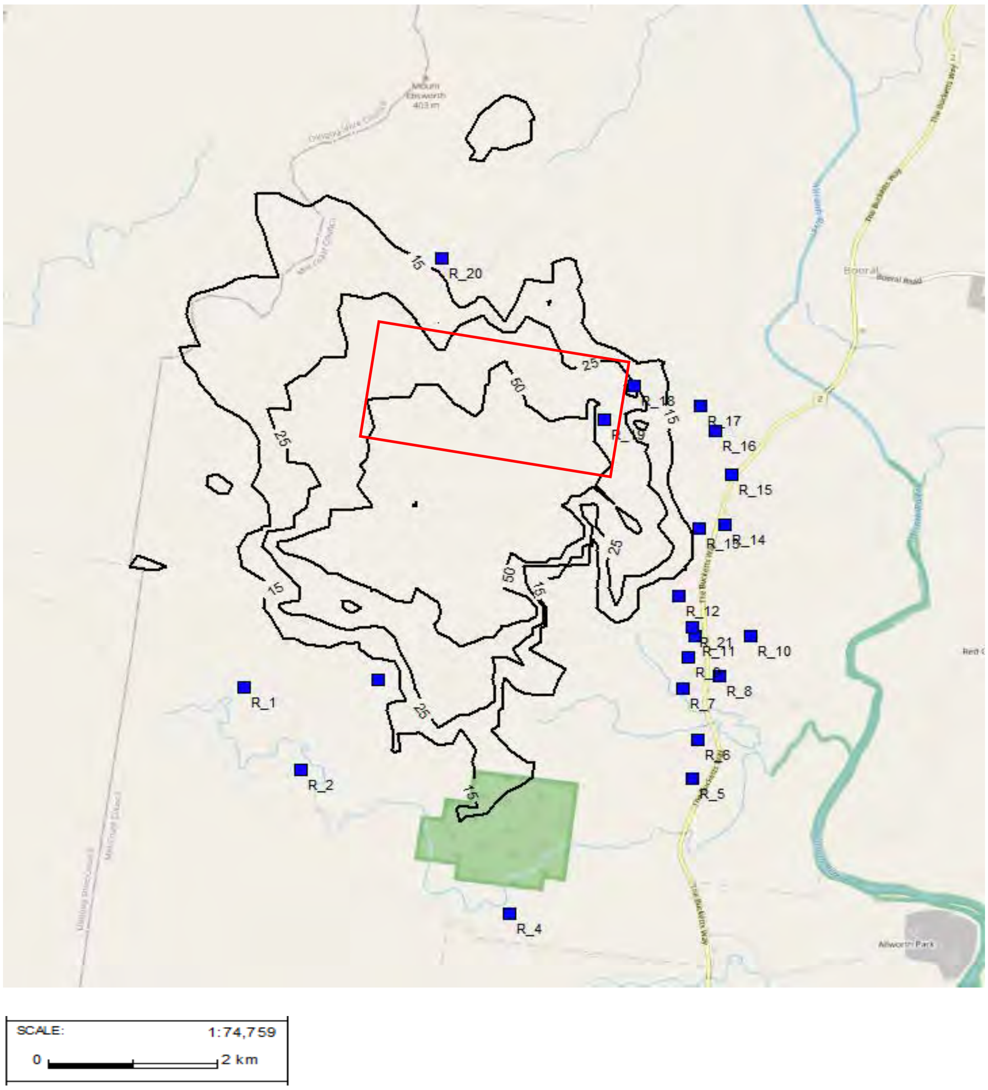


Figure 5: 100th Percentile 24-hour Average PM_{10} Concentration (Construction Scenario), Contour labels =15,25,50 µg/m^3

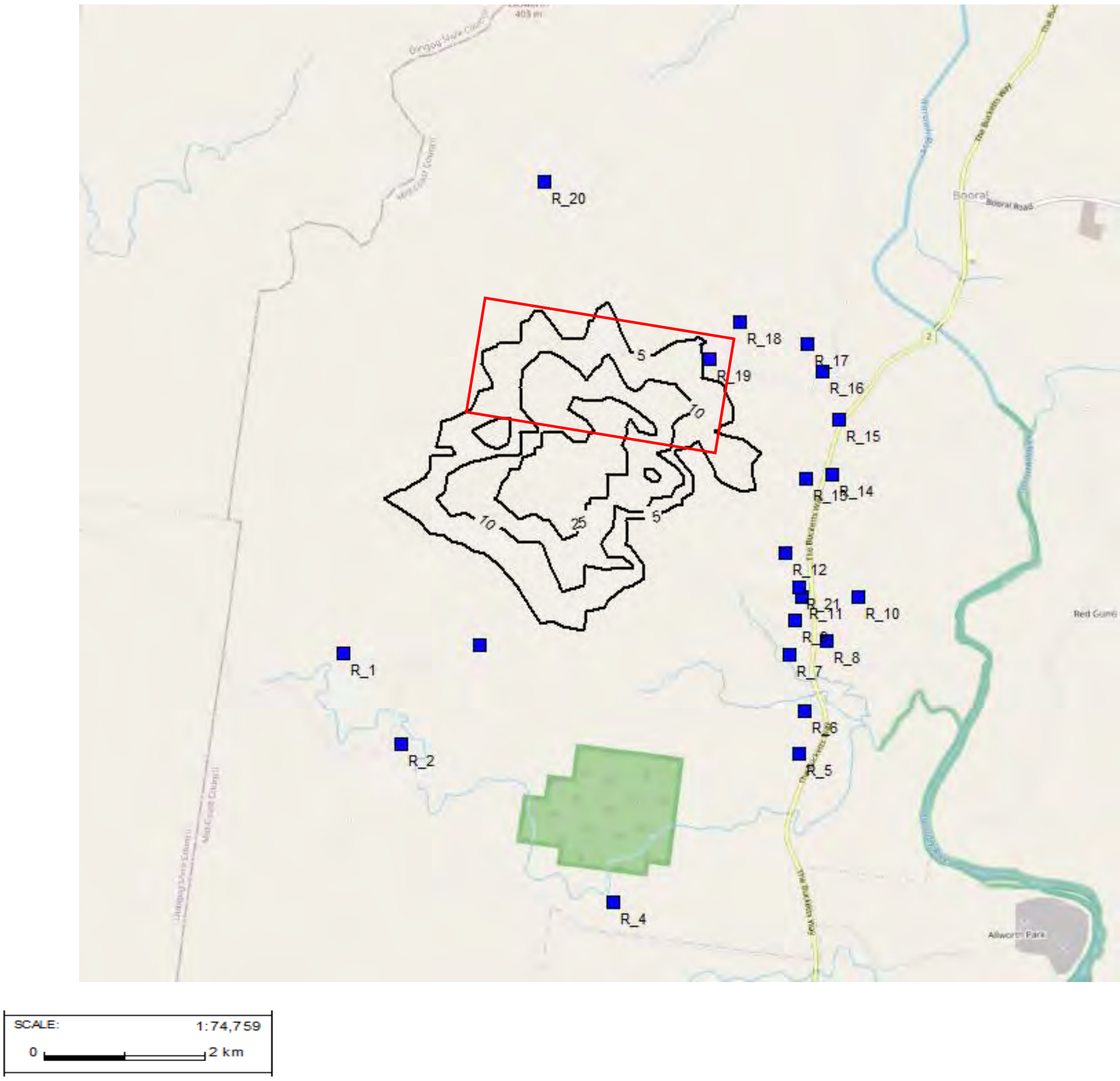


Figure 6: 100th Percentile Annual Average PM_{10} Concentration (Construction Scenario), Contour labels =5,10,25 μg/m^3

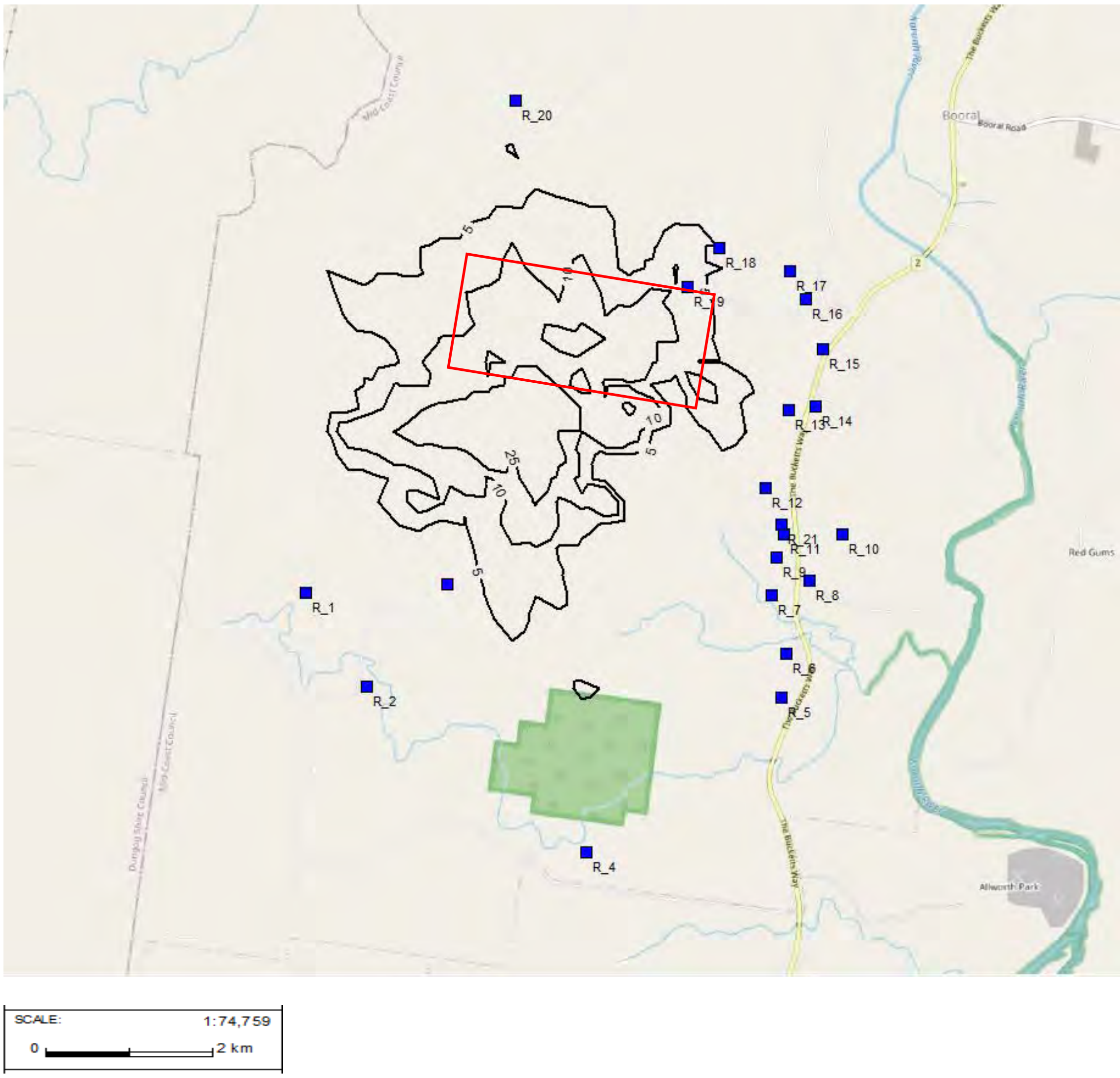


Figure 7: 100th Percentile 24 hour Average $PM_{2.5}$ Concentration (Construction scenario), Contour labels =5,10,25 µg/m^3

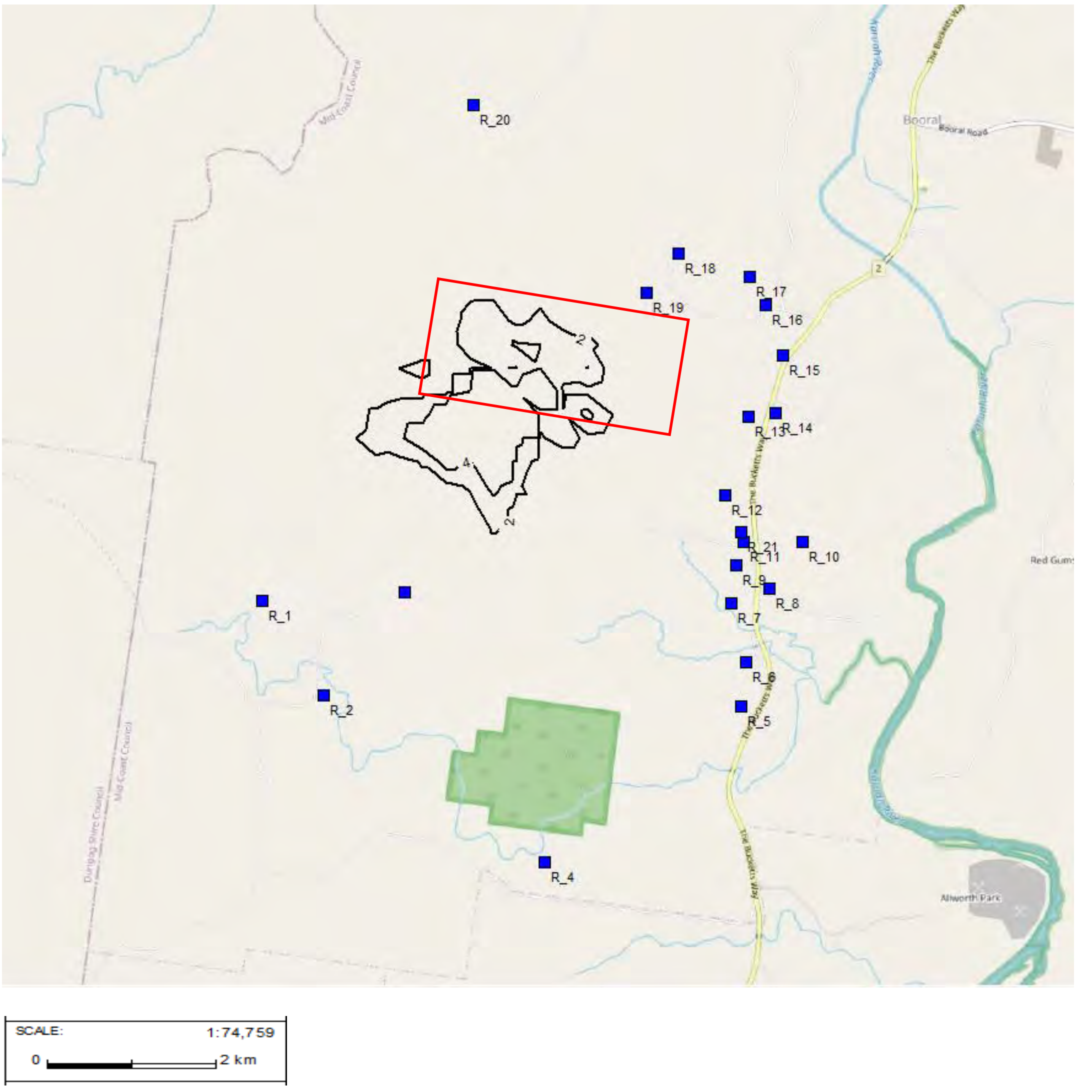


Figure 8: 100th Percentile Annual Average $PM_{2.5}$ Concentration (Construction scenario), Contour labels =1,2 μg/m³

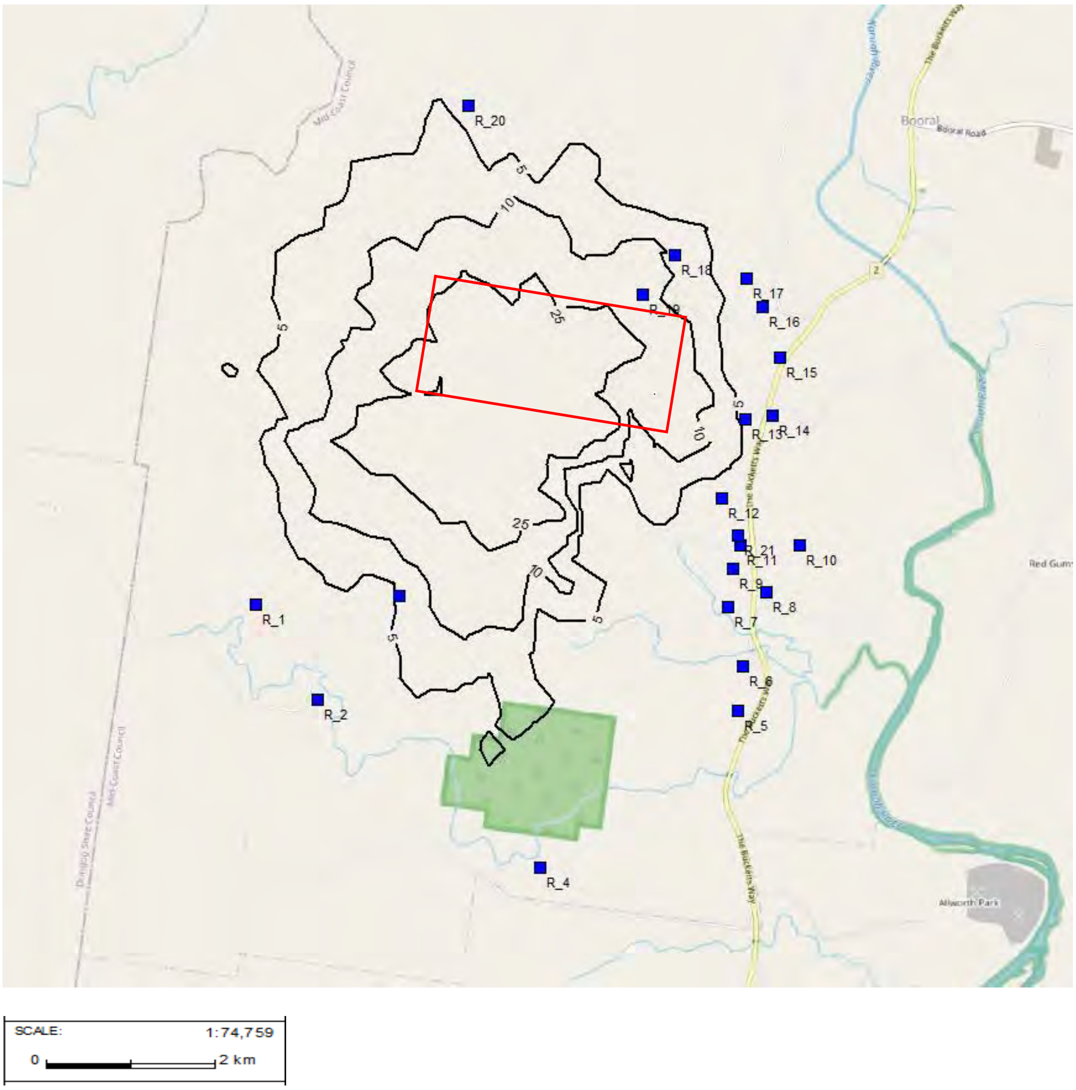


Figure 9: 100th Percentile Annual Average TSP Concentration (Construction scenario), Contour labels = 5,10,25 µg/m^3

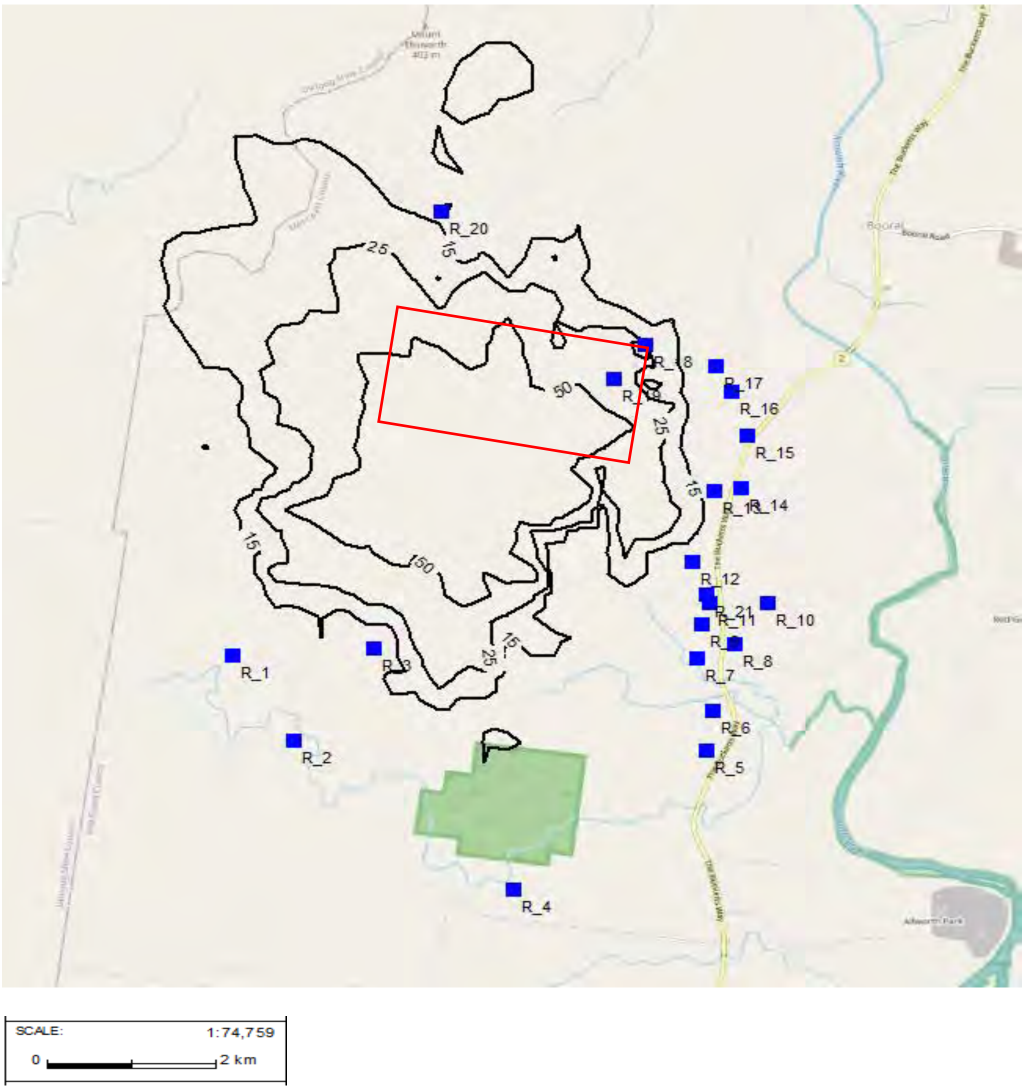


Figure 10: 100th Percentile 24-hour Average PM_{10} Concentration (Operations Scenario), Contour labels =5,10,25 µg/m^3

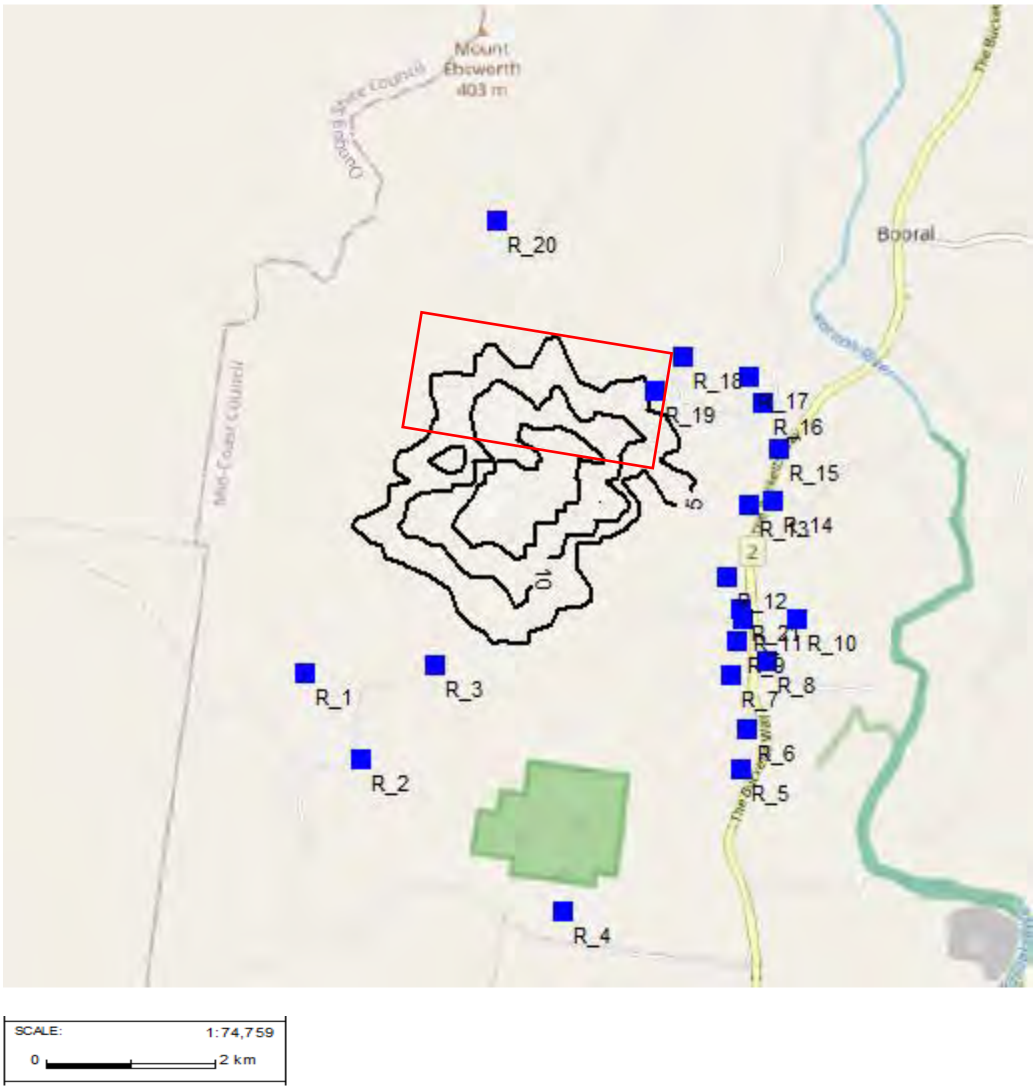


Figure 11: 100th Percentile Annual Average PM_{10} Concentration (Operations Scenario)

(Contour labels =5,10,25 µg/m³)

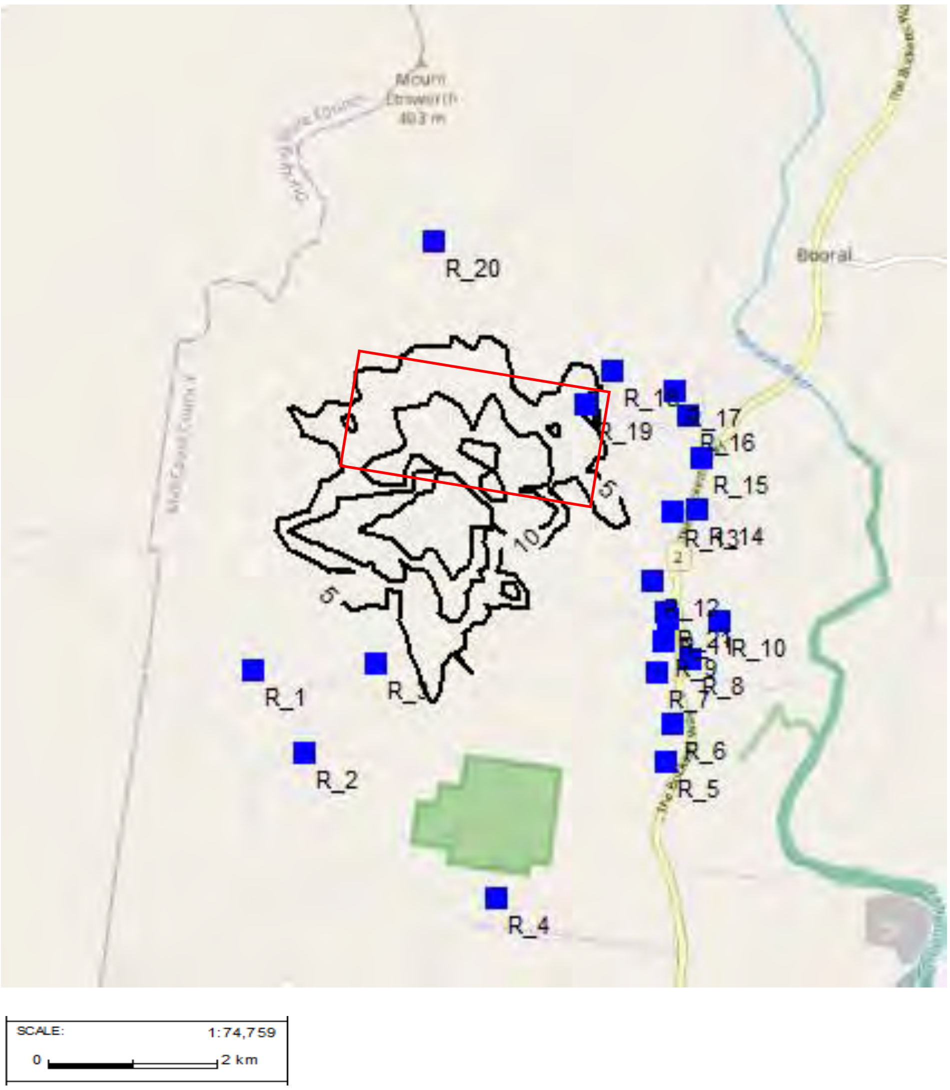
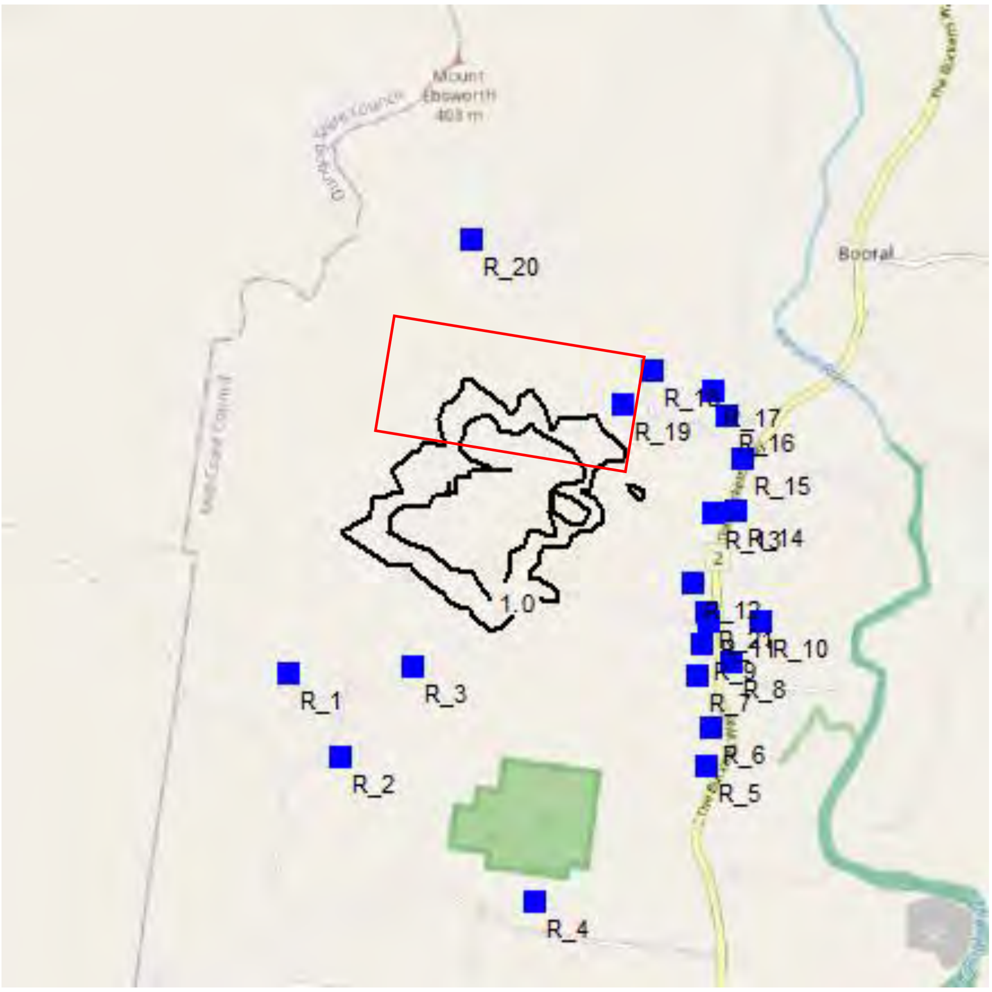


Figure 12: 100th Percentile 24 hour Average $PM_{2.5}$ Concentration (Operations scenario), Contour labels =5,10,25 µg/m³



SCALE: 1:74,759
0 2 km

Figure 13: 100th Percentile Annual Average $PM_{2.5}$ Concentration (Operations scenario), Contour labels =1,2 µg/m^3

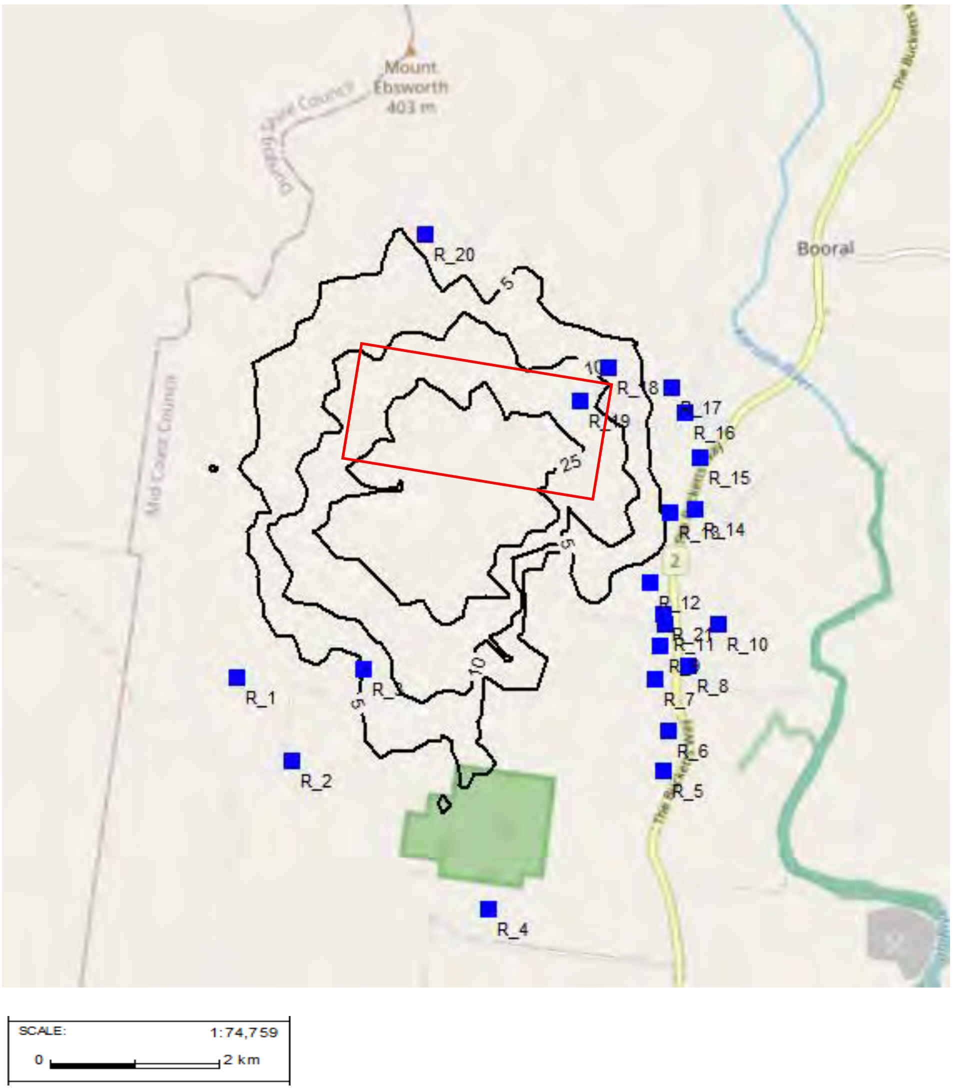


Figure 14: 100th Percentile Annual Average TSP Concentration (Operations scenario),contour labels =5,10,25 μg/m³

Appendix C

Greenhouse Gas Calculation Results

Table 23 - Calculation of Scope 1 GHG Emissions from Fuel Use (Construction)

Equipment	Total Fuel Use 2 year construction period (kL)	Energy Content Factor (GJ/kL)	Emission factors[1] (kg CO_2e/GJ)	Emissions total for 2-year construction period (t CO_2e)
D10 Dozer CAT	436.8	38.6	70.2	1183.6
Komatsu PC450 45 Tonne Excavator	187.2	38.6	70.2	507.2
Blast Drill (Premier)	7.0	38.6	70.2	18.8
PC360 Excavator	187.2	38.6	70.2	507.2
HW 400 Haul Trucks (total for 2x)	112.3	38.6	70.2	304.4
HM 400 Water Cart	112.3	38.6	70.2	304.4
Lippmann 1300j mobile jaw crusher	124.8	38.6	70.2	338.2
Lippmann L620R Scalping Screen	124.8	38.6	70.2	338.2
Lippmann 400c Cone Crusher	124.8	38.6	70.2	338.2
Cat 14m Grader	99.8	38.6	70.2	270.6
Generators for stockpile conveyors (total for 4x, stages 3 &4 only)	93.6	38.6	70.2	253.6
Mobile generators (total for 2 x)	31.2	38.6	70.2	169.0
Sand Processing Plant (stages 3 &4 only)	31.2	38.6	70.2	84.5
	TOTAL Scope 1 emissions			4,617.9

Notes:

1: GHG emission factors sourced from Ref 8. The factors shown are for 'combined gases' for the GHG compounds: CO_2, CH_4 and N_2O

The calculation of GHG Emissions for Scope 1 emissions associated with operations (total project life across 30 years of the life of the quarry) are presented in Table 24.

Table 24: Calculation of Scope 1 GHG Emissions from Fuel Use (Operations)

Equipment	Annual Fuel Use (kL)	Energy Content Factor (GJ/kL)	Emission factors[1] (kg CO_2e/GJ)	Emissions Total for 30-year life (t CO_2e)
D10 Dozer CAT	350	38.6	70.2	28,452.1
Komatsu PC450 45 Tonne Excavator	150	38.6	70.2	12,193.7
Blast Drill (Premier)	3.5	38.6	70.2	280.9
PC360 Excavator	150	38.6	70.2	12,193.7
HW 400 Haul Trucks (total for 2x)	180	38.6	70.2	14,632.5
HM 400 Water Cart (RL 158m)	90	38.6	70.2	7,316.2
HM 400 Water Cart (other areas)	90	38.6	70.2	,7316.2
Lippmann 1300j mobile jaw crusher	100	38.6	70.2	8,129.2
Lippmann L620R Scalping Screen	100	38.6	70.2	8,129.2
Lippmann 400c Cone Crusher	100	38.6	70.2	8,129.2
Cat 14m Grader	80	38.6	70.2	6,503.3
Generators for stockpile conveyors (total for 4x)	150	38.6	70.2	48,775.0
Mobile generators (total for 2 x)	50	38.6	70.2	4,064.6
Sand Processing Plant	50	38.6	70.2	4,064.6
			TOTAL	170,180.4

Scope 3 Emissions

The calculation of **upstream and downstream Scope 3 emissions** associated with construction (2 years total duration for all 'stages') and operations (total across 30 years of the life of the quarry) are presented in Table 25.

Table 25: Calculation of indirect Scope 3 GHG Emissions from Fuel Use – due to construction and operations within the Site (upstream and downstream)

Equipment	Total Fuel Use (kL)	Energy Content Factor (GJ/kL)	Emission factors[2] (kg CO_2e/GJ)	Total Emissions (t CO_2e)
Construction – upstream only [1]				
Fuel tanker truck to supply diesel and construction materials to site	3.4	38.6	70.4	9.1
Blast Drill (Premier) Fuel tanker truck to supply explosives to site	0.4	38.6	70.4	1.0
Operations – upstream				
Fuel tanker truck to supply diesel to site	72.9	38.6	70.4	198.1
Fuel tanker truck to supply explosives to site	10.8	38.6	70.4	29.3
Operations – downstream				
HW 400 Haul Trucks – delivery of products off site	96.1	38.6	70.4	90 549.4
			TOTAL SCOPE 3 EMISSIONS	90 787.0

Notes:

1: For GHG calculations, Advitech assumed that extracted products will not be taken off site until the operations commence (Stage 5 onwards), therefore no 'downstream' GHG emissions during construction.

2: Emission factors for Scope 3 are different to those for Scope 1 (Ref 8)

The direct Scope 3 GHG emissions for the Hillview site are predominantly associated with haulage vehicles to the Site (supplying diesel) and from the Site (removing products and delivering to customers).

The calculation of GHG Emissions for Scope 3 emissions associated with construction (two (2) year period) and from supplying diesel 'upstream', are presented in Table 26.

Table 26: Calculation of Scope 3 GHG Emissions from Fuel Use – *construction*

Equipment	Total Fuel Use 2 year construction period (kL)	Energy Content Factor (GJ/kL)	Emission factors[1] (kg CO_2e/GJ)	Emissions total for 2-year construction period (t CO_2e)
D10 Dozer CAT	436.8	38.6	17.3	291.7
Komatsu PC450 45 Tonne Excavator	187.2	38.6	17.3	125.0
Blast Drill (Premier)	7.0	38.6	17.3	4.7
PC360 Excavator	187.2	38.6	17.3	125.0
HW 400 Haul Trucks (total for 2x)	112.3	38.6	17.3	75.0
HM 400 Water Cart	112.3	38.6	17.3	75.0
Lippmann 1300j mobile jaw crusher	124.8	38.6	17.3	83.3
Lippmann L620R Scalping Screen	124.8	38.6	17.3	83.3
Lippmann 400c Cone Crusher	124.8	38.6	17.3	83.3
Cat 14 m Grader	99.8	38.6	17.3	66.6
Generators for stockpile conveyors (total for 4x, stages 3 &4 only)	93.6	38.6	17.3	62.5
Mobile generators (total for 2x)	31.2	38.6	17.3	20.8
Sand Processing Plant (stages 3 & 4 only)	31.2	38.6	17.3	20.8
			TOTAL	1 117.0

Notes:

[1:] GHG emission factors sourced from Ref 8. The factors shown are for 'combined gases' for the GHG compounds: CO_2, CH_4 and N_2O

The calculation of GHG Emissions for Scope 3 emissions associated with operations and from supplying diesel 'upstream' (30 year period) are presented in Table 27.

Table 27: Calculation of Scope 3 GHG Emissions from Fuel Use – *operations*

Equipment	Annual Fuel Use (kL)	Energy Content Factor (GJ/kL)	Emission factors[1] (kg CO_2e/GJ)	Emissions Total for 30-year life (t CO_2e)
D10 Dozer CAT	350	38.6	17.3	7 011.7
Komatsu PC450 45 Tonne Excavator	150	38.6	17.3	3 005.0
Blast Drill (Premier)	3.5	38.6	17.3	69.2
PC360 Excavator	150	38.6	17.3	3 005.0
HW 400 Haul Trucks (total for 2x)	180	38.6	17.3	3 606.0
HM 400 Water Cart (RL 158 m)	90	38.6	17.3	1 803.0
HM 400 Water Cart (other areas)	90	38.6	17.3	1 803.0
Lippmann 1300j mobile jaw crusher	100	38.6	17.3	2 003.3
Lippmann L620R Scalping Screen	100	38.6	17.3	2 003.3
Lippmann 400c Cone Crusher	100	38.6	17.3	2 003.3
Cat 14 m Grader	80	38.6	17.3	1 602.7
Generators for stockpile conveyors (total for 4x)	150	38.6	17.3	3 005.0
Mobile generators (total for 2x)	50	38.6	17.3	500.8
Sand Processing Plant	50	38.6	17.3	1001.7
			TOTAL	32 423.2