Air Quality Assessment Report

Sancrox Quarry Expansion Project

2 December 2020

Project No.: 0418291

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ERM

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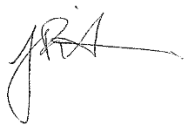

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CONTENTS

List of Tables

List of Figures

EXECUTIVE SUMMARY

Environmental Resources Management Australia Pty Ltd (ERM) has been commissioned by Hanson Construction Materials Pty Ltd (Hanson) to undertake specialist air quality assessment (AQIA) to inform the Environmental Impact Statement (EIS) for the proposed Sancrox Quarry Extension Project (the 'Proposed Project').

This revised AQIA has been produced to address comments provided by the NSW EPA on the original AQIA as part of regulatory submissions during public exhibition. The AQIA approach, as well as the Proposed Project, has been altered accordingly. The greenhouse gas component of the assessment has not been updated since the original AQIA and as such is not included within this revised document.

The site is located on Lot 2 DP 574308, Lot 353 DP 754434, Lot 1 DP 704890 and Lot 1 DP 720807, Sancrox Road, Sancrox, 8km west of Port Macquarie, within the Port Macquarie Hastings Council (PMHC) Local Government Area (LGA) on the Mid North Coast of New South Wales (NSW).

Current operations at the site primarily include the extraction and crushing of high quality aggregate materials (rhyolite) for concrete and asphalt, sealing aggregates, road bases and select fill to both the private and government sectors. Current extraction rate at the site is 185,000 tonnes per annum (tpa).

The Proposed Project involves the following:

- Extending the approved extraction boundary by approximately 52 hectares;
- Extending the quarry life by ten years (from 20 to 30 years);
- Increasing the annual production limit from 185,000 tpa to 530,000 tpa;
- Introducing a maximum daily limit of 2,600 tonnes per day (tpd);
- Constructing and operating a concrete batching plant producing 20,000m^3 of concrete product per annum;
- Constructing and operating a concrete recycling facility processing 20,000 tpa;
- Typical operations will be between 5am and 10pm;
- Increasing quarry operations to 24 hours per day, 7 days per week for a maximum of 20 days per year;
- Transporting material off-site via public roads; and
- Constructing and operating an asphalt plant producing 50,000 tpa.

This updated AQIA is to accompany the Response to Submission report that includes a revised quarry plan including staging.

The following scope of works has been undertaken:

- Assessment of potential for ambient air quality impacts and greenhouse gas emissions from construction and operation of the Proposed Project;
- Provision of mitigation measures to minimise impacts to the surrounding land use; and
- Recommendations for ambient monitoring to ensure compliance with legislation.

It should be noted that the estimation of GHG emissions from the Project was limited to Scope 1 and Scope 2 emissions. The GHG inventory stated within the original AQIA is anticipated to reduce as a result of the reduced throughput now sought within the Proposed Project.

The primary emissions from the sources considered in this assessment are total suspended particulate (TSP), particulate matter less than 10 and 2.5 micrometres in aerodynamic diameter (PM_{10} and $PM_{2.5}$ respectively) and deposited dust.

Concrete batching and asphalt plants have the potential to emit additional species. All potential species emitted to atmosphere from these sources were identified through consideration of published emission factor databases for these sources.

The criteria for all the emitted species were established through consideration of the following legislation and guidelines:

- POEO Clean Air Regulation 2010 (New South Wales Government, 2017);
- Approved Methods for the Assessment of Air Pollutants in NSW (State of NSW and Environment Protection Authority, 2016);
- National Environment Protection Measures (Australian Government, 2016);
- Other international legislations:
  - Ontario Regulation 419/06: Air Pollution – Local Air Quality (Government of Ontario, 2017);
- Protocol for Environmental Management: Mining and Extractive Industries (Environment Protection Authority Victoria, 2007).

Initially, a screening assessment was undertaken for the species other than particulate matter, using the 'UK Air emissions risk assessment for your environmental permit' guidance (UK Guidance). The species that could not be screened out using the criteria provided in the UK Guidance were further considered through the use of atmospheric dispersion modelling.

Atmospheric dispersion modelling was undertaken using the CALPUFF dispersion model for a representative year (2014). The dispersion modelling was completed using site-specific meteorology predicted using a two-step process:

- Prognostic modelling using TAPM (developed by CSIRO); and
- Diagnostic modelling using CALMET (the meteorological pre-processor for the CALPUFF dispersion model).

The configuration of the emission sources within the CALPUFF dispersion model comprised a combination of volume, point and road sources.

The assessment of ambient air quality impacts identified that:

- The cumulative annual mean concentrations of PM_{10} are below the Approved Methods criterion at all sensitive receptors;
- Contemporaneous analysis identified that the cumulative (background plus Proposed Project contributions) 24-hour average PM_{10} concentrations predict an exceedance of the Approved Methods Criterion at receptor R13 when operating under maximum daily throughput scenario over a 24-hour period. However, when the hours are reduced to operate between 5am and 10pm with the same maximum daily throughput compliance is demonstrated at R13.
- It is anticipated that the probability of meteorological conditions conducive to causing an exceedance at receptor R13 occurring during the proposed 20 days of 24-hour operations is low. It is thus considered that this risk may be mitigated by provision of additional dust management planning and controls prior to 24-hour operations, as documented within the site Air Quality Management Plan.
- The cumulative annual mean concentrations of $PM_{2.5}$ are below the Approved Methods criterion at all sensitive receptors;
- The predicted concentrations for all other species are below the adopted criteria at all sensitive receptor locations.

This assessment considered reasonable and feasible mitigation measures to minimise the emissions from the proposed activities at the site and provided recommendations for ambient monitoring to ensure compliance with legislation.

The following mitigation measures have been included to minimise the emissions from the proposed activities:

- Roads which are likely to remain unchanged throughout the Project stages and to be frequently used by machinery, will be sealed using asphalt and swept daily to minimise wheel-generated dust emissions;
- Full dust extraction system for drilling;
- Utilisation of water sprays during truck rear dumping;
- The use of mobile sprinkler systems during the operation of front end loaders (FELs);
- Dust suppression measures such as water sprays in place at the crushers and screeners;
- Water sprays used on all conveyor transfer points;
- The conveyor loading to be enclosed by a shroud;
- Unsealed haul roads are to apply a dust suppressant;
- Water sprays to be utilised to minimise wind erosion from stockpiles, as required;
- The dry product delivered to the concrete batching, concrete recycling and asphalt plants to be stored in aggregate storage bins enclosed on three sides. The aggregate storage bins to be fitted with water sprays;
- Cement and cement supplement to be delivered to the concrete batching plant and pneumatically fed;
- Concrete batching loading point to be enclosed with all particulate matter emissions generated by the facility captured by one bag filter located above the pan mixer;
- Concrete recycling facility out-loading to be directly to processed material storage bins enclosed on three sides. The recycled concrete storage bins to be fitted with water sprays;
- Vapour balancing system to be installed for the delivery of bitumen at the asphalt plant;
- Asphalt plant will be totally enclosed. All particulate matter emissions generated at the plant will be captured by one fabric filter associated with the natural-gas fired dryer; and
- Vapour recovery system to be employed for transfer of asphalt to trucks.

It is recommended that the Site additionally employs real-time ambient air quality monitoring system. This will allow staff to identify when additional mitigation measures are to be implemented to minimise impact from the onsite activities.

1. INTRODUCTION

1.1 Background

Environmental Resources Management Australia Pty Ltd (ERM) has been commissioned by Hanson Construction Materials Pty Ltd (Hanson) to undertake specialist air quality assessment (AQIA) to inform the Environmental Impact Statement (EIS) for the proposed Sancrox Quarry Extension Project (the 'Proposed Project'). The site is located on Lot 2 DP 574308, Lot 353 DP 754434, Lot 1 DP 704890 and Lot 1 DP 720807, Sancrox Road, Sancrox, 8km west of Port Macquarie, within the Port Macquarie Hastings Council (PMHC) Local Government Area (LGA) on the Mid North Coast of New South Wales (NSW).

Current operations at the site primarily include the extraction and crushing of high quality aggregate materials (rhyolite) for concrete and asphalt, sealing aggregates, road bases and select fill to both the private and government sectors. Current extraction rate at the site is 185,000 tonnes per annum (tpa).

The Proposed Project involves the following:

- Extending the approved extraction boundary by approximately 52 hectares;
- Extending the quarry life by ten years (from 20 to 30 years);
- Increasing the annual production limit from 185,000 tpa to 530,000 tpa;
- Introducing a maximum daily limit of 2,600 tonnes per day (tpd);
- Constructing and operating a concrete batching plant producing 20,000m3 per annum;
- Constructing and operating a concrete recycling facility processing 20,000 tpa;
- Typical operations will be between 5am and 10pm;
- Increasing truck movements and equipment loading to 24 hours per day, 7 days per week for a maximum of 20 days per year;
- Increasing quarry operations to 24 hours per day, 7 days per week for a maximum of 20 days per year;
- Transporting material off-site via public roads; and
- Constructing and operating an asphalt plant producing 50,000 tpa.

This updated AQIA is to accompany the Response to Submission report that includes a revised quarry plan including staging.

1.2 Secretary Environmental Assessment Requirements (SEARS)

This AQIA has been prepared in accordance with the latest version of the Secretary's Environmental Assessment Requirements (SEARs) for the preparation of an EIS for the Sancrox Quarry Extension Project (Department of Planning and Environment, 2017). In relation to air quality the following has been required:

- A detailed assessment of potential construction and operational impacts, in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (State of NSW and Environment Protection Authority, 2016), 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 (NSW Government, 2018);
- 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.

1.3 Scope of Works

To address the SEARs for the preparation of an EIS for the Sancrox Quarry Extension Project (Department of Planning and Environment, 2017), ERM undertook the following scope of works:

- Assessment of potential for ambient air quality impacts and greenhouse gas emissions from construction and operation of the Proposed Project;
- Provision of mitigation measures to minimise impacts to the surrounding land use; and
- Recommendations for ambient monitoring to ensure compliance with legislations.

2. SITE AND PROCESS DESCRIPTION

2.1 Site Location

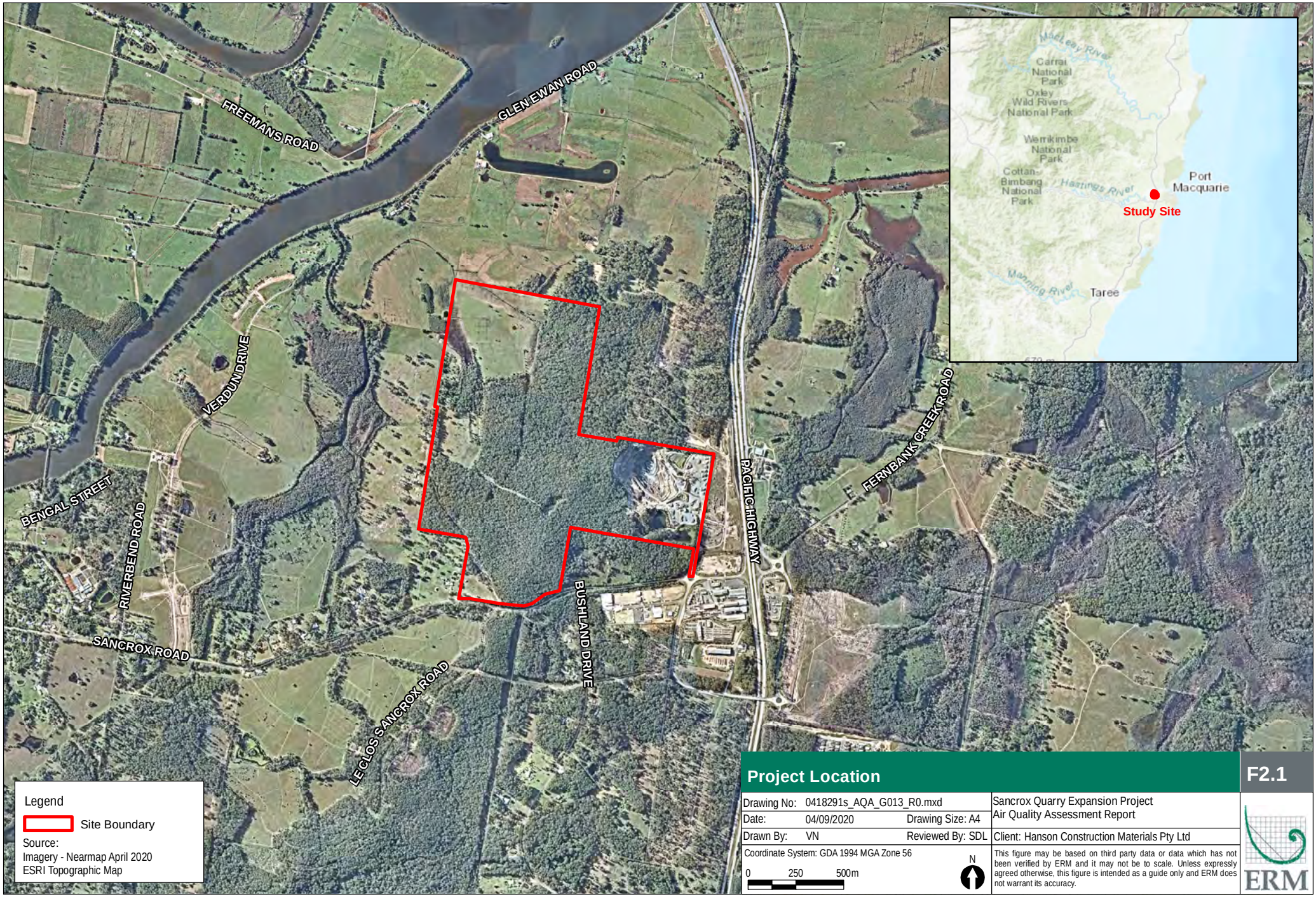
The Proposed Project is located on Sancrox Road, Sancrox, approximately 8km west of Port Macquarie, within the PMHC LGA on the NSW Mid North Coast (refer Figure 2.1) (the site). Access to the site is gained via a sealed road which runs off Sancrox Road located to the southeast of the site. The total area of the Project is approximately 52 hectares. The closest residences to the site are located approximately 50m to the western boundary and 130 metres to the northern boundary of the Site.

2.1.1 Site Layout

The building west of the main access road serves as the site office and staff amenities block. A workshop and materials storage shed is located next to the site office. The weighbridge is also located on the access road near the site office.

The processing plant is proposed to be relocated approximately 300 metres south-west of the current location. A new stockpile area is proposed to be located to the west of the new processing plant location. A concrete recycling facility is proposed to be located immediately west of the new processing plant location and immediately east of the new stockpile area. Concrete batching facility is proposed to be located to the north of the old processing plant location, and asphalt plant is proposed to be located to the east of the new processing plant location.

It is proposed that roads which are likely to remain unchanged throughout the stages of the Project and to be frequently used by machinery, are sealed using asphalt and swept daily to minimise wheel-generated dust emissions. Figure 2-2 presents the site layout and both sealed and unsealed roads. Figure 2-3 shows the Quarry staging over the operational period.



Project Location

F2.1

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Date:	04/09/2020	Drawing Size: A4	
Drawn By:	VN	Reviewed By: SDL	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

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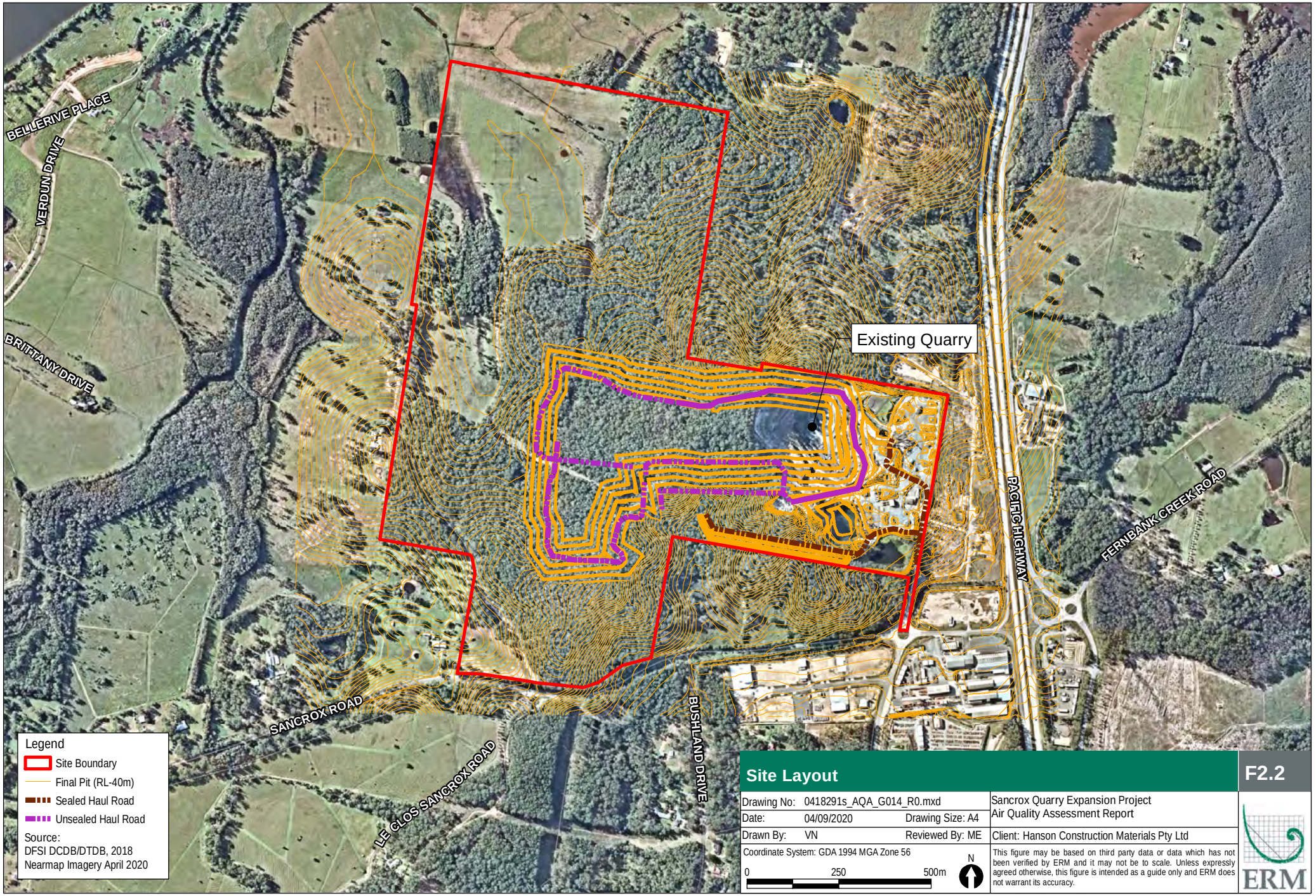
BELLERIVE PLACE
VERDUN DRIVE
BRITTANY DRIVE
Existing Quarry
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
Legend
Site Boundary
Final Pit (RL-40m)
Sealed Haul Road
Unsealed Haul Road
Source:
DFSI DCDB/DTDB, 2018
Nearmap Imagery April 2020
Site Layout
F2.2
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Date: 04/09/2020
Drawing Size: A4
Drawn By: VN
Reviewed By: ME
Coordinate System: GDA 1994 MGA Zone 56
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Sancrox Quarry Expansion Project
Air Quality Assessment Report
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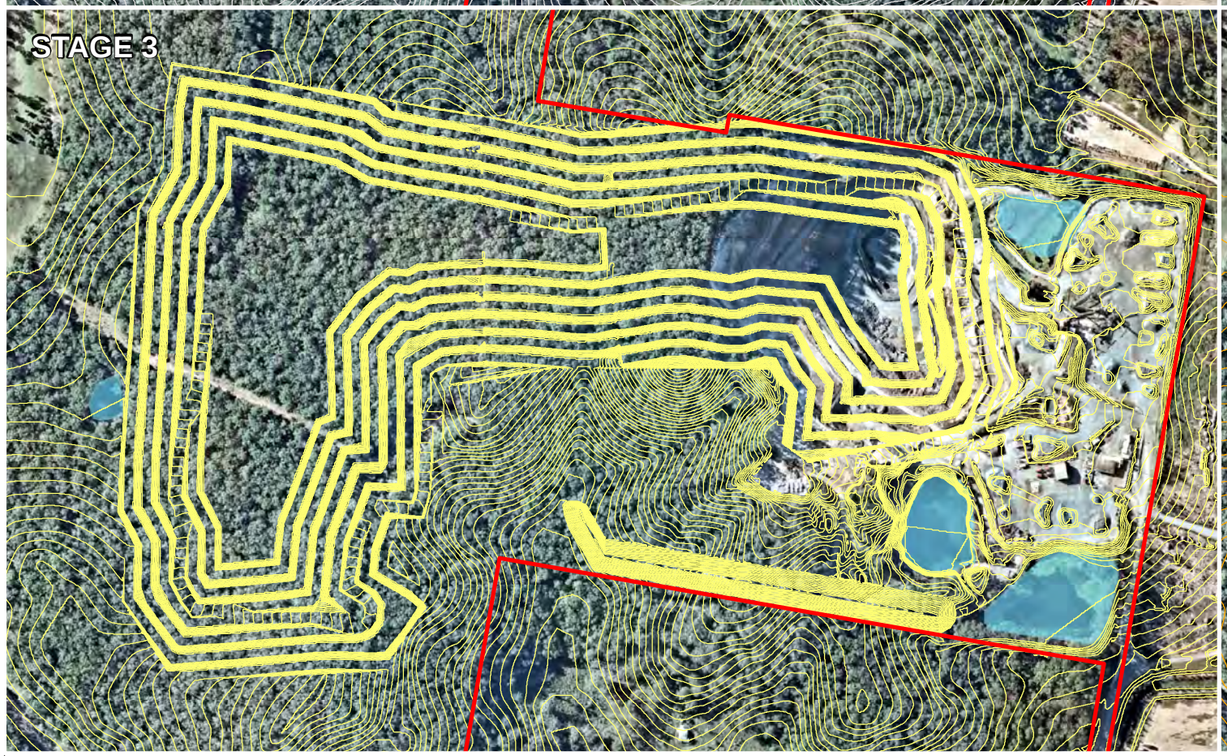

Legend

Existing Property Ownership
Lot Boundary
Road Network
Watercourses

Quarry Staging:
Stage 1 (RL-30m)
Stage 2 (RL-30m)
Stage 3 (RL-30m)
Stage 4 (RL-40m)

Source:
Spatial Data: DFSI DCDB, DTDB 2017
Imagery Data: nearmap April 2020

Quarry Staging

F 2.3

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Date:	04/09/2020	Drawing Size: A4	
Drawn By:	LT	Reviewed By: ME	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

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2.1.2 Sensitive Receptors

Sensitive receptors are locations where the general population is likely to be exposed to the resultant ground level concentrations from the atmospheric emissions. The Approved Methods defines these as:

> "A location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area" (State of NSW and Environment Protection Authority, 2016).

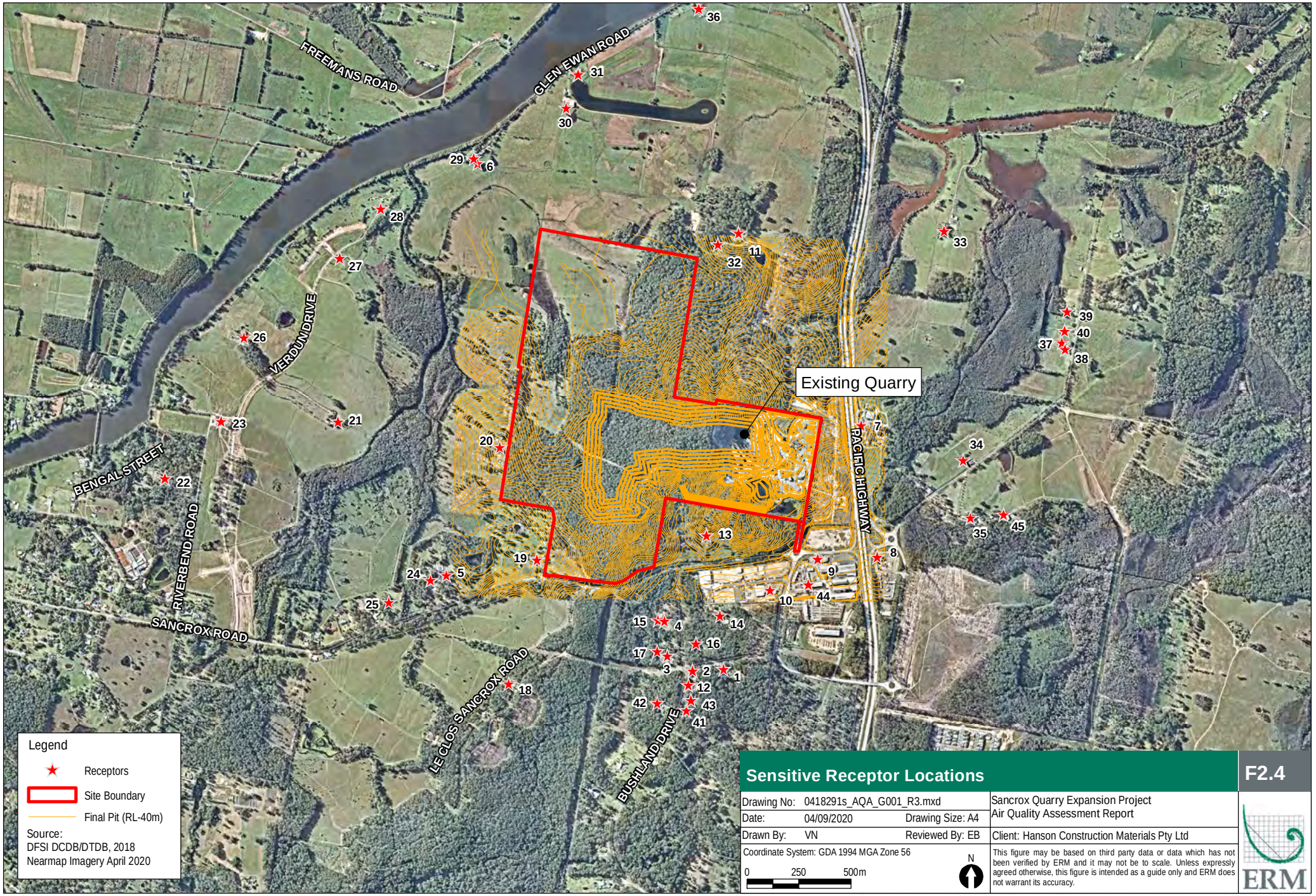
Forty five sensitive receptors have been identified on the basis of proximity to Site from all directions. In addition, the assessment has undertaken atmospheric dispersion modelling over a grid of 12 km by 12 km with a spatial resolution of 150 m. The results on the modelled grid are then interpolated and contoured to provide predicted concentrations for all other sensitive receptors not specifically included in the dispersion model, but within the modelled area. The locations of the specific sensitive receptors included in the model are provided in Table 2-1 and Figure 2-4.

A review of the location of all sensitive receptors was completed to identify if any additional receptors are required to be added to address locations of any future receptors. The spatial distribution of the current 45 receptors is considered to appropriately reflect the existing and potential future sensitive receptors in the vicinity. Potential future sensitive receptors located further afield, in particular to the southeast, than the existing sensitive receptor list are anticipated to be exposed to reduced air quality impacts compared to the existing receptor located closer to the Proposed Project.

Table 2-1: Modelled specific sensitive receptors surrounding the Site (MGA Zone 55S)

Sensitive receptor	X (m)	Y (m)
1	482552	6520977
2	482404	6520969
3	482281	6521042
4	482236	6521212
5	481222	6521428
6	481371	6523402
7	483212	6522146
8	483289	6521515
9	483004	6521505
10	482775	6521355
11	482624	6523068
12	482382	6520901
13	482469	6521618
14	482535	6521234
15	482268	6521208
16	482420	6521099
17	482233	6521062
18	481521	6520908
19	481656	6521502

Sensitive receptor	X (m)	Y (m)
20	481477	6522042
21	480704	6522163
22	479872	6521891
23	480141	6522165
24	481146	6521405
25	480946	6521299
26	480251	6522566
27	480711	6522947
28	480906	6523185
29	481353	6523426
30	481795	6523669
31	481855	6523829
32	482524	6523013
33	483609	6523077
34	483701	6521979
35	483736	6521703
36	482434	6524144
37	484174	6522543
38	484191	6522511
39	484200	6522692
40	484189	6522599
41	482372	6520779
42	482234	6520814
43	482395	6520827
44	482960	6521383
45	483894	6521719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RIVERBEND ROAD
SANCROX ROAD
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BUSHLAND DRIVE
PACIFIC HIGHWAY
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Legend
Receptors
Site Boundary
Final Pit (RL-40m)
Source:
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2.2 Process Description

2.2.1 Quarry Operations

Benches are developed by ripping, drilling and blasting. Ripped or blasted rock is loaded and then transported to either the processing plant, or transported directly off-site to market. The approximate split of material transported directly off-site is reportedly 10% with 90% transported to the processing area. The 90% of material to be taken to the processing plant is loaded to trucks using two excavators and hauled from the working face to the processing plant.

The processing plant reduces the size of feed rock by crushing. Screens are used to separate the material into various sizes and product types. Blending of materials will be undertaken to achieve required product specifications and quality control. It has been assumed in the AQIA that rock delivered to the processing plant is placed directly in to the feed hopper for processing. Conveyors transfer product from the screening area to stockpiles of various sizes.

The processed product is either loaded directly from stockpiles to delivery trucks by front-end loaders (FEL) or moved to a stockpile storage area to the west of the processing plant. It was considered that the proposed quantity of the material will require operation of two FELs around processing plant and stockpile area. The delivery trucks, loaded using FELs, leave the site via the weighbridge.

2.2.2 Concrete Recycling Plant

Concrete for recycling will be delivered from offsite using truck-and-dog type trucks to the aggregate storage bins located at the concrete recycling facility. The delivered concrete will be fed to a mobile primary crusher using one of the FELs in the vicinity of the processing plant and stockpile area. The concrete will be processed to the desired size and outloaded directly to the product storage bins prior to be taken offsite for the use as a recycled road base.

2.2.3 Concrete Batching Plant

Operations of the concrete batching plant require materials including coarse aggregate, sand, cement and cement supplement. The coarse aggregate component will be obtained from the rock processed at the processing plant, and will be delivered to the concrete batching plant from the stockpile area using the same trucks used to move material from the quarry floor. Sand will be delivered from offsite to the concrete batching plant using road trucks. Cement and cement supplement will be delivered to the concrete batching plant and pneumatically fed. The central mix concrete product will be loaded to the agitator trucks, which will take the concrete offsite for application. The concrete batching plant will be enclosed with one bag filter fitted above the pan mixer to mitigate particulate matter emissions from the facility.

2.2.4 Asphalt Plant

Operations of the asphalt plant require high quality aggregate and bitumen. The aggregate for asphalt production will be obtained from the processing plant and will be delivered directly to the aggregate storage bins at the asphalt plant. The produced asphalt will be loaded in truck-and-dog-type trucks and taken offsite via the weighbridge. As part of asphalt plant, one fully enclosed pug mill will be located on site. It is understood that vapour balancing system will be installed for the delivery of bitumen on site and vapour recovery system will be employed for transfer of asphalt to trucks to minimise odour and dust emissions. Moreover, the asphalt plant will be totally enclosed and particulate matter emissions will be mitigated using one fabric filter associated with the natural-gas fired dryer.

3. LEGISLATION AND GUIDELINES

3.1 Air Quality

Within New South Wales (NSW), the protection of local air quality standards is considered in the following policy documents:

- Protection of the Environment Operations (Clean Air) Regulation 2010 (New South Wales Government, 2017);
- Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales (State of NSW and Environment Protection Authority, 2016); and

In addition, NSW has committed to complying with the National Environment Protection (Ambient Air Quality) Measure (Australian Government, 2016).

3.1.1 POEO Clean Air Regulation 2010

The Protection of the Environment Operations (Clean Air) Regulation (2010) (the POEO Clean Air) (New South Wales Government, 2017) is the main legislative and regulatory instrument for air quality in NSW. With respect to industrial emissions, the POEO Clean Air defines:

- the meaning of a scheduled premises;
- groupings of activities and plant, based on commencement date of operation;
- allowable stack emission concentrations for a variety of industries based on the defined group; and
- requirements for the testing and assessment of emissions from existing and proposed industry.

The POEO Clean Air provides emission limits for point (stack) sources only. In relation to the proposed development, the concrete batching plant and the asphalt plant will have associated stacks. The remainder of operations at the facility will result in fugitive emissions not controlled under emission standards within the POEO Clean Air.

Table 3 1 provides the emission limits adopted in this assessment for the bag filter at the concrete batching plant.

Table 3-1: Emission limits for bag filters at the concrete batching plant adopted from the Schedule 3, POEO Clean Air Regulation (New South Wales Government, 2017)

Emitted Species	Concentration	Reference conditions
Solid Particles	20 mg/m^3	Dry, 273 K, 101.3 kPa
Type 1 substances and Type 2 substances (in aggregate)	1 mg/m^3	Dry, 273 K, 101.3 kPa
Cadmium individually	0.2 mg/m^3	Dry, 273 K, 101.3 kPa

Note: Type 1 substance means the elements antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements. Type 2 substance means the elements beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or any compound containing one or more of those elements.

No specific emission limits are set by the POEO Regulation for asphalt plants, therefore this assessment considered emission limits set in Schedule 4 for general activities and plant. Table 3 2 provides the emission limits adopted in this assessment for the bag filter at the asphalt plant.

Table 3-2: Emission limits for asphalt plant adopted from the Schedule 4, POEO Clean Air Regulation (New South Wales Government, 2017)

Emitted Species	Concentration	Reference conditions[1]
Solid Particles	20 mg/m^3	Dry, 273 K, 101.3 kPa, 3% O_2
NO_2	350 mg/m^3	Dry, 273 K, 101.3 kPa, 3% O_2
Type 1 substances and Type 2 substances (in aggregate)	1 mg/m^3	Dry, 273 K, 101.3 kPa, 3% O_2
Cadmium or mercury individually	0.2 mg/m^3	Dry, 273 K, 101.3 kPa, 3% O_2
Volatile organic compounds, as n-propane	40 mg/m^3 VOCs or 125 mg/m^3 CO	Dry, 273 K, 101.3 kPa, 3% O_2

1 Reference conditions are based on fuel burning equipment using gas

Note: Type 1 substance means the elements antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements. Type 2 substance means the elements beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or any compound containing one or more of those elements. Volatile organic compound (VOC) means any chemical compound that: (a) is based on carbon chains or rings, and (b) contains hydrogen, and (c) has a vapour pressure greater than 2mm of mercury (0.27 kPa) at 25°C and 101.3 kPa, and includes any such compound containing oxygen, nitrogen or other elements, but does not include methane, carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.

3.1.2 Approved Methods for the Assessment of Air Pollutants in NSW

The Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales (Approved Methods) (NSW Department of Primary Industry and Environment (DPIE), 2016) is referred to in Part 5 of the POEO Regulation 2010. The Approved Methods provides the statutory methods for modelling and assessing emissions to atmosphere from stationary sources in the state.

The regulation also provides ground level assessment criteria against which results of dispersion modelling are assessed. Table 3-3 shows the criteria for particulate matter considered in this assessment.

Table 3-3: Impact Assessment Criteria for particulate matter (NSW DPIE, 2016)

Species	Averaging Period	Criterion
TSP	Annual	90 µg/m^3
PM_{10}	24 hour	50 µg/m^3
	Annual	25 µg/m^3
$PM_{2.5}$	24 hour	25 µg/m^3
	Annual	8 µg/m^3
Deposited Dust	Annual	2[1] g/m^2/month 4[2] g/m^2/month

1. Maximum increase in deposited dust level
2. Maximum total deposited dust level

In addition to particulate matter the concrete batching plant emissions include metals as specified in AP-42 Section 11.12 (United States Environmental Protection Agency, 2006). Emissions from the dryer at the asphalt plant in addition to particulate matter emissions also include carbon monoxide (CO), Nitrogen dioxide (NO_2), sulfur dioxide (SO_2), organic species, metals and general odour (United States Environmental Protection Agency, 2004). Table 3-4 presents the criteria for these additional species as contained in the Approved Methods.

Table 3-4: Approved methods criteria for other species considered in this assessment

Species	Averaging period	Criterion (µg/m^3)
NO2	1 hour	246
	Annual	62
CO	15 min	100,000
	1 hour	30,000
	8 hour	10,000
SO2	10 min	712
	1 hour	570
	24 hour	228
	Annual	60
Benzene	1 hour	29
Ethylbenzene	1 hour	8,000
Formaldehyde	1 hour	20
n-Hexane	1 hour	3200
Methyl chloroform	1 hour	12,500
Polycyclic aromatic hydrocarbon (PAH) as benzo[a]pyrene	1 hour	0.4
Toluene	1 hour	360
Xylene	1 hour	190
n-Pentane	1 hour	33,000
Asphalt petroleum fumes	1 hour	90
Antimony and compounds	1 hour	9
Arsenic and compounds	1 hour	0.09
Barium (soluble compound)	1 hour	9
Cadmium and cadmium compounds	1 hour	0.018
Chromium III compounds	1 hour	9
Copper fumes	1 hour	3.7
Chromium VI compounds	1 hour	0.09
Lead	Annual	0.5
Manganese and compounds	1 hour	18
Mercury organic	1 hour	0.18
Nickel and nickel compounds	1 hour	0.18
Silver soluble compounds (as Ag)	1 hour	0.18

For the assessment of complex mixtures of odours, the Approved Methods adopts a statistical approach, dependent on the population size. As the population increases the proportion of sensitive individuals is also likely to increase, indicating that more stringent criterion is required. The Approved Methods use an equation to provide acceptable odour criteria as a function of affected population (Table 3-5).

Table 3-5: Acceptable Impact Assessment Criteria for Complex Mixtures of Air Pollutants (OU) for Various Population Sizes

Population of Affected Community	Impact Assessment Criteria for Complex Mixtures of Air Pollutants (OU)
Urban (>2000) and/or schools and hospitals	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
~2 (Single Rural Residence)	7.0
1. (State of NSW and Environment Protection Authority, 2016)	

Given that there will be very few residences potentially impacted by odour, an assessment criterion of 6 OU has been selected in this instance.

3.1.3 Other Legislation

For species considered in this AQIA and not included in Approved Methods, the criteria were sourced from Ontario Regulation 419/06: Air Pollution – Local Air Quality (Government of Ontario, 2017) as provided in Table 3-6.

Table 3-6: Criteria sourced from Ontario Regulation 419/06 (Government of Ontario, 2017)

Species	Averaging period	Criterion (µg/m3)
n-Heptane	30 minutes	33,000
	24 hour	11,000
Zinc	30 minutes	100
	24 hour	120

3.1.4 Protocol for Environmental Management Mining and Extractive Industries

Ryolite is an igneous, volcanic rock, which is typically silica rich. During blasting, crushing and mechanical handling of material, there is potential that a portion of the particulate matter released will be comprised of crystalline silica. Respirable crystalline silica has the potential to cause silicosis.

The Approved Methods does not contain standards for respirable crystalline silica. ERM has therefore adopted the approach outlined by the Victorian Protocol for Environmental Management for the Mining and Extractive Industries (Mining PEM), which is an incorporated document to Victoria's State Environment Protection Policy for Air Quality Management.

The Mining PEM provides an assessment criterion for respirable crystalline silica (expressed as $PM_{2.5}$ of 3 µg/m^3 as an annual average). This criterion was adopted in this assessment.

4. EXISTING ENVIRONMENT

4.1 General Meteorological Conditions

Local meteorology plays a major role in determining the location and the degree of off-site impacts of activities proposed to be carried out at the site. Air dispersion modelling requires information about the dispersion characteristics of the area. In particular, data is required on wind direction, wind speed, temperature, atmospheric stability and mixing height. This meteorological data is outlined in the following Sections.

4.2 Climate

Long-term climate data is available from the Bureau of Meteorology (BoM) weather station located in Port Macquarie (Airport), approximately 3.5 km east of the site. Table 4-1 presents temperature, humidity and rainfall statistics from this weather station for the period 1995 to 2018, which consists of monthly average 9am and 3pm readings. Monthly averages of maximum and minimum temperatures are also presented. Rainfall data consists of mean monthly rainfall and the average number of rain days per month. Overall, the local area is characterised by:

- Annual average rainfall of 1,428.2 mm;
- Average maximum temperature of 27.7°C in January;
- Average minimum temperature of 6.4°C in July;
- Average maximum 9am humidity of 83% in March; and
- Average minimum 3pm humidity of 52% in August.

4.3 Typical Wind Conditions

Figure 4-1 provides the predicted wind roses (see Section 7.2) showing the frequency of strength and direction of winds for five recent years (2012 to 2016 inclusive) at the Site. The data has been divided to show annual trends.

The wind roses indicate that typically winds at the subject Site are:

- Most frequently westerly, south-westerly and northerly;
- Occur moderately from the north-western and north-eastern directions;
- Low percentage of winds from the southern direction;
- Rarely from the east; and
- From approximately 6.7% to 11.4% calm conditions (less than 0.5 m/sec).

Based on the available meteorological data from the Port Macquarie (Airport) BoM station, 2014 was selected as a representative year for dispersion modelling.

Table 4-1: Climate Data for Port Macquarie Station obtained from Bureau of Meteorology

Statistic Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Start Year	End Year
Mean maximum temperature (°C)	27.7	27.6	26.4	24.2	21.6	19.5	18.8	20.3	22.7	24.1	25.2	26.8	23.7	1995	2018
Mean minimum temperature (°C)	18.4	18.4	17.0	13.9	10.4	8.3	6.4	6.7	9.4	12.0	15.2	16.9	12.8	1995	2018
Mean rainfall (mm)	150.8	165.5	176.0	139.0	114.4	140.6	61.9	66.6	59.3	75.1	153.9	114.7	1428.2	1995	2018
Mean 9am temperature (°C)	23.3	22.6	20.8	19.5	16.1	13.3	12.3	14.0	17.7	20.1	20.7	22.6	18.6	1995	2010
Mean 9am relative humidity (%)	76	82	83	76	76	78	75	68	64	64	73	72	74	1995	2010
Mean 9am wind speed (km/h)	13.0	12.3	11.5	12.3	12.5	11.5	11.9	12.6	13.6	14.7	14.0	13.6	12.8	1995	2010
Mean 3pm temperature (° C)	26.1	26.0	24.9	22.5	20.1	18.2	17.5	18.7	20.5	21.9	23.1	24.9	26.1	1995	2010
Mean 3pm relative humidity (%)	65	66	65	64	61	60	55	52	56	59	65	64	61	1995	2010
Mean 3pm wind speed (km/h)	22.4	21.6	20.1	17.3	15.3	14.9	16.0	19.0	21.0	22.2	22.5	22.3	19.6	1995	2010

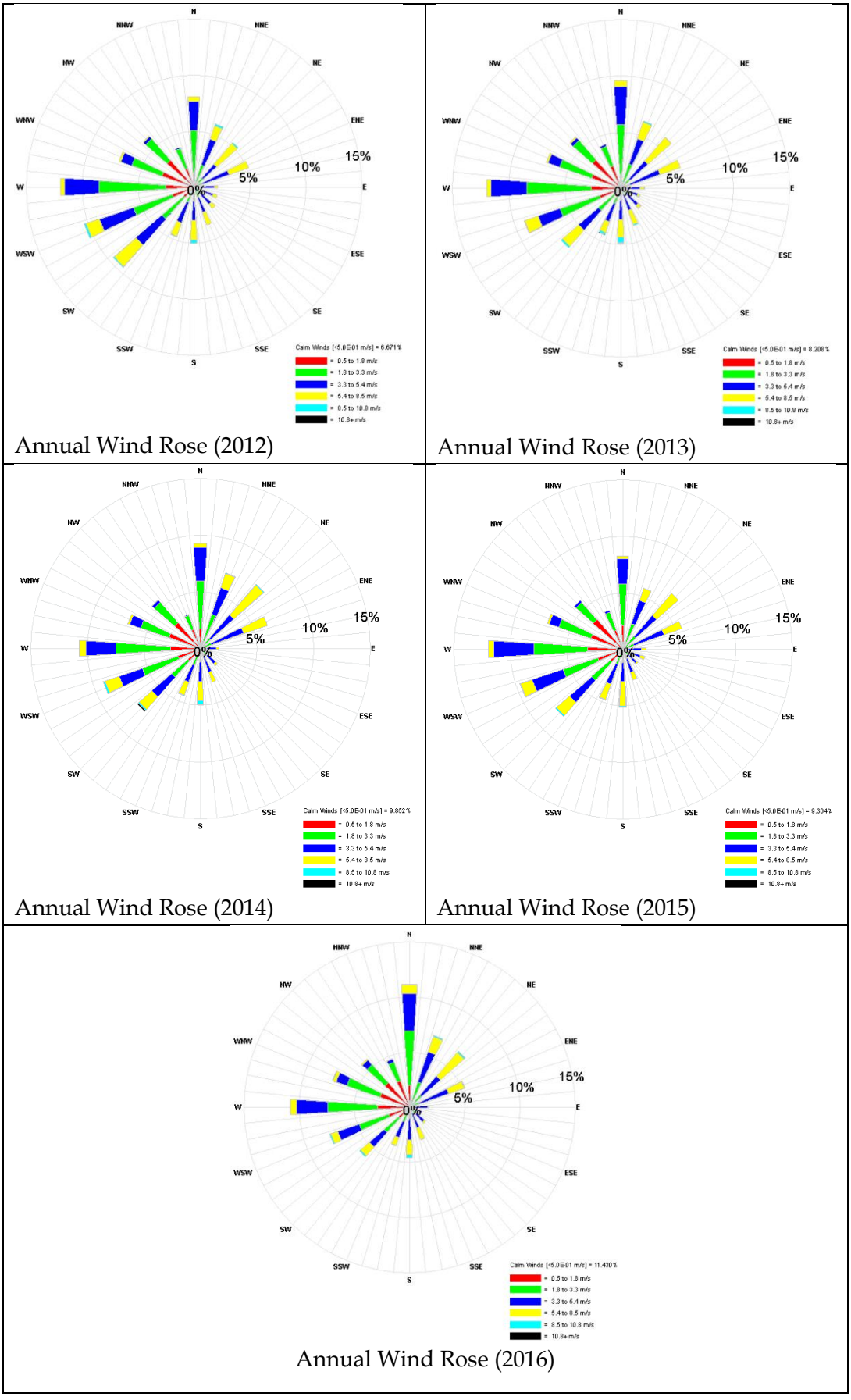

Figure 4-1: Site-Specific annual wind roses (2012-2016)

4.4 Atmospheric Stability

Atmospheric stability is one of the key parameters that effects dispersion and dilution of emissions away from source. In essence it describes the degree of thermal and mechanical mixing of the atmosphere that occurs due to wind and thermal heating. Higher stability of the atmosphere typically results in poor dispersion conditions and higher ground level concentrations, whilst unstable atmospheres typically have the opposite impact.

Typically, these atmospheric conditions occur under the following conditions:

- Category A – Very sunny and very windy conditions;
- Category B – Very sunny but less windy conditions;
- Category C – Moderately sunny and moderately windy conditions;
- Category D – The hours around sunrise and sunset in addition to overcast conditions;
- Category E, F and G – Mostly clear or clear night time conditions with decreasing wind speed.

Figure 4-2 shows the predicted frequency of stability categories at the Site. Stability categories have been predicted using the methodology outlined in Section 7.1.

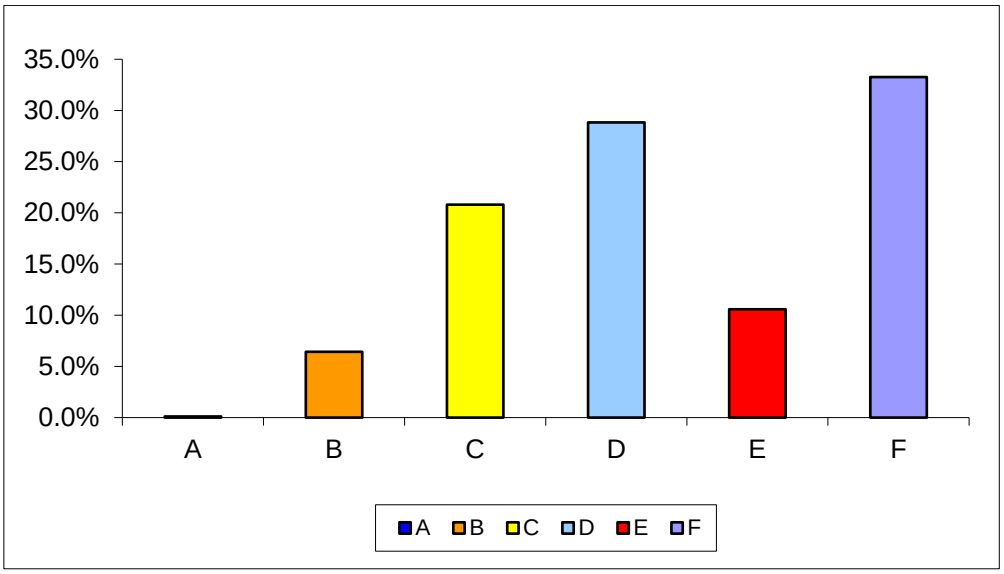

Figure 4-2: Frequency of Atmospheric Stability Categories predicted for the Site

4.5 Existing Ambient Air Quality

Background air quality is a measure of the existing air quality in the absence of the project activity. The background air quality is due to sources (natural or man-made) other than the site. It is important to consider background air quality when considering cumulative impacts on sensitive receptors in the area.

A desktop review of the National Pollutant Inventory (NPI) of reported emissions from fixed and mobile sources in the vicinity of the site was also undertaken to obtain an indication of existing industries in the project area. There are no facilities within the Port Macquarie region reporting emissions of particulate matter under the NPI reporting scheme with the exception of the subject site. The proposed operation of this site and proposed increase in activity is included in this air quality assessment.

In June 2018 an air quality monitoring station was installed by DPIE at Port Macquarie, located approximately 5.5 km to the east of the Site. This monitoring station measures PM_{10}, $PM_{2.5}$, CO, SO_2 and NO_2. However, at the time that the original AQIA (ERM, 2019) sufficient data was not yet available for a suitable background dataset to be determine. For this reason, data was relied upon from Wyong and was considered suitable as it was also from a coastal area and located outside of Newcastle.

A review of the respective monitoring datasets is provided in the following sections.

4.5.1 Particulate Matter

4.5.1.1 Port Macquarie

Table 4-2 provides the maximum measured 24 hour concentrations for PM_{10} and $PM_{2.5}$ as measured at Port Macquarie monitoring station from its installation in June 2018.

An important consideration of particulate matter measurements is the influence of bushfires and dust storms on elevated measurements. A series of severe bushfire impacted the east coast of Australia including the Port Macquarie region during 2019 and early 2020. The data has therefore been presented with and without bushfires influences for the available period (June 2018 to June 2020).

Table 4-2: Maximum measured 24 hour average and annual mean concentrations for PM_{10} and $PM_{2.5}$ at Port Macquarie

Species	Averaging Period	2018		2019		2020		2018 - 2020		Goal
		With fires	Without fires	With fires	Without fires	With fires	Without fires	With fires	Without fires	
PM_{10}	24 Hour Mean	38	38	481	87	250	37	481	87	50
	90^{th} percentile	14	14	79	35	28	28	52	29	n/a
	70^{th} percentile	12	12	47	28	19	18	28	20	n/a
	Annual Mean	9	9	41	22	17	14	26	15	25
$PM_{2.5}$	24 Hour Mean	5	5	443	71	221	22	443	71	25
	90^{th} percentile	8	8	51	21	12	10	33	15	n/a
	70^{th} percentile	6	6	29	15	7	7	13	9	n/a
	Annual Mean	5	5	26	11	8	5	15	7	8

4.5.1.2 Wyong

Table 4-2 provides the maximum measured 24 hour concentrations for PM_{10} and $PM_{2.5}$ as measured at Wyong for the years presented within the original AQIA (2012-2016).

Table 4-3: Maximum measured 24 hour average and annual mean concentrations (µg/m^3) for PM_{10} and $PM_{2.5}$, as measured at Wyong for 2012 to 2016

Species	Averaging Period	Year					Criterion
		2012	2013	2014	2015	2016	
PM_{10}	24 Hour Mean	37.4	70.2	41.9	58.6	46.0	50
	Annual Mean	16.6	16.6	15.1	14.9	15.2	25
$PM_{2.5}$	24 Hour Mean	14.7	55.8	19.7	13.2	19.8	25
	Annual Mean	6.7	6.7	5.5	5.2	5.7	8

In view that a contemporaneous, annual data set is not available for Port Macquarie, additional analysis has been completed to demonstrate the Wyong dataset is suitably conservative for the estimation of background PM values.

A box and whisker plot has been prepared in Figure 4-3 for the Wyong 2014 dataset (the modelled year) along with the Wyong data that aligns with the time period available for the Port Macquarie data. When comparing these data sets (and particularly the latter two datasets), it can be seen that the Wyong data is anticipated to provide a conservative estimate of background when compared to data gathered at Port Macquarie.

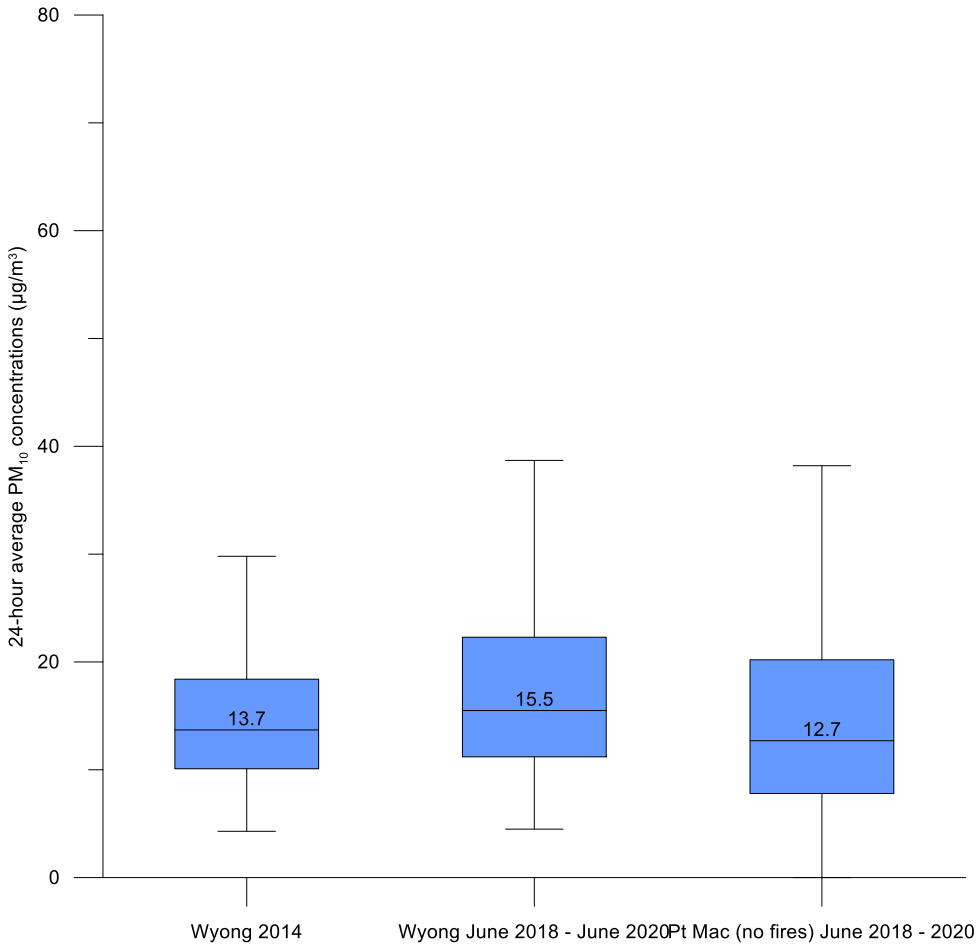

Figure 4-3: Box and whisker plot of Wyong and Port Macquarie annual monitoring data

Note: The centreline of the box indicates the median value. The left side of the box indicates the lower quartile and the right indicates the upper quartile. The far left and far right error bars indicate the minimum and maximum of the values measured.

4.5.2 Total Suspended Particulate

No measurements are taken at Port Macquarie for Total Suspended Particulate (TSP). Consequently, for this assessment, the annual mean TSP concentration has conservatively been assumed to be double the annual mean PM_{10} concentration for the modelled each year.

4.5.3 Dust Deposition

There is no dust deposition monitoring program currently undertaken in the vicinity of the site. No public information regarding background dust deposition rates in the region.

Criteria for dust deposition, specified in the Approved Methods allows an annual mean deposition rate of 4g/m^2/month, with no more than 2g/m^2/month above background.

In the absence of site specific monitoring data, and as shown in Table 3-3, a Porposed Project increment of 2g/m^2/month has been adopted to evaluate this parameter.

4.5.4 Nitrogen Dioxide

Table 4 3 provides the maximum measured 1 hour and annual mean concentrations for NO_2 as measured at Wyong for the modelled years. These values have been used in the Level 1 assessment as described in Section 8.3.

Table 4-4: Maximum measured 1 hour average and annual mean NO_2 concentrations NO_2 as measured at Wyong for 2012 to 2016

Species	Averaging Period	Year					Criterion
		2012	2013	2014	2015	2016	
NO_2	1 Hour Mean	59.5	84.1	69.8	65.7	94.4	246
	Annual Mean	7.8	10.3	10.2	9.3	9.7	62

5. ATMOSPHERIC EMISSIONS INVENTORY

The operations of the Project have been analysed and estimates of particulate matter (PM) emissions for the key PM generating activities have been made. Emissions inventories have been prepared for two scenarios, a typical day and a maximum day.

5.1 Particle size categories

Emission rates of TSP, PM_{10} and $PM_{2.5}$ have been calculated using emission factors developed both within NSW and by the US EPA. Modelling of TSP, PM_{10} and $PM_{2.5}$ was undertaken using the particle size specific inventories and was assumed to emit and deposit from the plume in accordance with the deposition rate appropriate for particles with an aerodynamic diameter equal to the geometric mean of the particle size range.

5.2 Particulate matter emissions

Estimates of emissions for each source were developed on an hourly time step taking into account activities that would take place at that location. Thus, for each source, for each hour, an emission rate was determined which depended on the level of activity and the wind speed. Dust generating activities were represented by a series of volume sources situated according to the location of activities. Two emissions scenarios were investigated:

1. ‘Typical day’ operations, based on an annual average quarry throughput of 530,000 tpa.
2. ‘Maximum day’ operations, based on a daily quarry throughput of 2,600 tpd.

Through iterative modelling an additional scenario has been evaluated. The default ‘Maximum day’ scenario is based on 24 operating hours per day. In reality, this is only sought to be permitted on 20-days per year. A second ‘Maximum day’ scenario has then been evaluated adopting the typical day operational hours of 5am to 10pm (‘Maximum day – restricted hours’).

The locations of the volume sources, used to represent the Site activities, are shown in Appendix A. Information on the point sources is provided in Section 6.4.

The information used for developing the inventories has been based on the operational descriptions and drawings and used to determine haul road distances and routes, activity operating hours, truck sizes and other details that are necessary to estimate dust emissions.

It is acknowledged that the quarry staging (refer Figure 2-3). Given that the quarry stages get progressively closer to off-site sensitive receptors, the final quarry stage (Stage 4) has been evaluated in this assessment so as to represent a ‘reasonable worst-case’.

Not every activity will occur at each source location and some source locations will see significantly more activities than others.

It is also noted that iterative modelling was completed, showing that the most significant contributor to particulate matter concentrations, in particular R13, were haul road emissions. Therefore additional controls, in the form of chemical dust suppressant application to all unsealed haul roads was applied.

Table 5-1 presents the emissions inventory by activity for the different particle size fractions for both the typical and maximum day scenarios.

Table 5-1: Estimated TSP, PM_{10} and $PM_{2.5}$ emissions for the Proposed Project

Activity	TSP Emissions (kg/y)	PM_{10} Emissions (kg/y)		$PM_{2.5}$ Emissions (kg/y)	
	Typical day	Typical day	Maximum day	Typical day	Maximum day
QUARRY - Drilling rock [1]	22	12	n/a	1	n/a
QUARRY - Blasting rock	178	93	1,127	5	65
QUARRY - Excavators on Quarry Floor	291	137	246	21	37
QUARRY - Truck Rear Dumping	78	37	66	6	10
QUARRY - FELS	291	137	246	21	37
QUARRY - Primary crushing	286	129	231	24	43
QUARRY - Secondary crushing	179	80	231	15	43
QUARRY - Tertiary crushing	143	64	144	12	27
QUARRY - Primary screening	525	176	316	12	21
QUARRY - Primary screening	328	110	316	7	21
QUARRY - Conveyor Transfer Points (2)	23	11	19	2	3
QUARRY - Conveyor Drop Points (8)	11	5	10	1	1
QUARRY - Rock Truck - Loaded, Onsite (unsealed)	10,302	2,908	5,207	291	521
QUARRY - Rock Truck - Unloaded, Onsite (unsealed)	5,768	1,628	2,915	163	292
QUARRY - Truck and dog - Loaded, Direct to market (unsealed)	1,096	309	554	31	55
QUARRY - Truck and dog - Unloaded, Direct to market (unsealed)	442	125	223	12	22
QUARRY - Rock Truck - Loaded, Onsite (sealed)	2452	692	1239	69	124
QUARRY - Rock Truck - Unloaded, Onsite (sealed)	1,719	485	869	49	87
QUARRY - Truck and dog - Loaded, Direct to market (sealed)	252	71	127	7	13
QUARRY - Truck and dog - Unloaded, Direct to market (sealed)	132	37	67	4	7
WE - Stockpiles and conveyors (STP1-STP10)	964	482	482	72	72
WE - Stockpiles and conveyors (STP11)	18	9	9	1	1

Activity	TSP Emissions (kg/y)	PM_{10} Emissions (kg/y)		$PM_{2.5}$ Emissions (kg/y)	
	Typical day	Typical day	Maximum day	Typical day	Maximum day
WE - Stockpiles and conveyors (STP12)	9	4	4	1	1
WE - Stockpiles and conveyors (STP13)	13	7	7	1	1
WE - Stockpiles and conveyors (STP14)	9	4	4	1	1
WE - Stockpiles and conveyors (STP15)	9	4	4	1	1
WE - Stockpiles and conveyors (STP16)	13	7	7	1	1
WE - Stockpiles and conveyors (STP17)	9	4	4	1	1
WE - Stockpiles and conveyors (STP18)	9	4	4	1	1
WE - Stockpiles and conveyors (STP19)	26	13	13	2	2
WE - Pit	1,862	931	931	140	140
CRP - Truck Rear Dumping	12	6	6	1	1
CRP - Crushing	12	5	5	1	1
CRP - Truck and dog - Delivery of Dry Products	91	26	26	3	3
CRP - Truck and dog - Delivery of Dry Products (loaded)	91	26	26	1	3
CRP - Truck and dog - Delivery of Dry Products (unloaded)	48	13	13	1	1
CBP - Coarse Aggregate - Truck Rear Dumping	13	6	6	0	1
CBP - Sand - Truck Rear Dumping	3	1	1	0	0
CBP - Transfer of Aggregate	4	2	2	0	0
CBP - Transfer of Sand	1	0	0	3	0
CBP - Loaded weight of a truck and dog - coarse aggregate	100	28	28	1	3
CBP - Unloaded weight of a truck and dog - coarse aggregate	52	15	15	2	1
CBP - Loaded weight of a truck and dog - Sand	76	22	22	1	2
CBP - Unloaded weight of a truck and dog - Sand	40	11	11	1	1
CBP - Loaded weight of Tanker - cement and cement supplement brought onsite	44	12	12	1	1

Activity	TSP Emissions (kg/y)	PM_{10} Emissions (kg/y)		$PM_{2.5}$ Emissions (kg/y)	
	Typical day	Typical day	Maximum day	Typical day	Maximum day
CBP - Unloaded weight of Tanker - cement and cement supplement brought onsite	28	8	8	9	1
CBP - Loaded weight of Agitator truck - product taken offsite	310	88	88	6	9
CBP - Unloaded weight of Agitator truck - product taken offsite	201	57	57	0	6
AP - Bitumen Delivery and Storage	0	0	0	0	0
AP - High quality aggregate delivery and storage	0	0	0	0	0
AP - Truck Load Out	0	0	0	0	0
AP - Loaded weight of Tanker - bitumen delivery	19	5	5	0	0
AP - Unloaded weight of Tanker - bitumen delivery	12	3	3	4	0
AP - Loaded weight of a truck and dog - asphalt to market	164	40	40	2	4
AP - Unloaded weight of a truck and dog - asphalt to market	86	21	21	1	2
Mixer Loading with bag filter	5	2	3	2	3
Dryer with bag filter	581	67	95	67	95
TOTAL EMISSIONS	**29,359**	**9,157**	**16,091**	**1,079**	**1,785**

Notes: 1. Drilling will not occur on the same day as blasting.

5.3 Other emissions

The concrete batching and asphalt plants emissions include metals as specified in AP-42 Section 11.1 and Section 11.12 (United States Environmental Protection Agency, 2006) (United States Environment Protection Agency, 2011). Table 5-2 presents the emission rates considered in this assessment for these additional species.

Table 5-2: Emission rates for other species considered in this assessment

Species	Concrete Batching Plant Bag filter emission rate (g/sec)[1]	Asphalt dryer Bag Filter emission rate (g/sec unless specified otherwise)[2]
NO_x	-	0.02
CO	-	0.1
SO_2	-	0.003
Benzene	-	0.0003
Ethylbenzene	-	0.0002
Formaldehyde	-	0.002
Hexane	-	0.0007
Methyl chloroform	-	0.00004
Polycyclic aromatic hydrocarbon (PAH) as benzo[a]pyrene	-	0.00015
Toluene	-	0.0001
Xylene	-	0.0002
n-Heptane	-	0.007
n-Pentane	-	0.0002
Antimony and compounds	-	$1.4x10^{-7}$ **
Arsenic and compounds	$2.2x10^{-7}$ *	$4.4x10^{-7}$ **
Barium (soluble compound)	-	$4.6x10^{-7}$ **
Cadmium and cadmium compounds	$5.3x10^{-10}$ *	$3.2x10^{-7}$ **
Total Chromium	$9.4x10^{-8}$ *	$4.5x10^{-6}$ **
Copper fumes	-	$2.5x10^{-6}$ **
Chromium VI compounds	-	$2.6x10^{-7}$ **
Lead	$2.7x10^{-8}$ *	$4.9x10^{-7}$ **
Manganese and compounds	$2.8x10^{-6}$ *	$6.1x10^{-6}$ **
Mercury	-	$2.7x10^{-7}$ **
Nickel and nickel compounds	$1.8x10^{-7}$ *	0.00005
Silver soluble compounds (as Ag)	-	$3.8x10^{-7}$ **
Zinc	-	$4.8x10^{-5}$ **
Odour	-	43,333.3 (OU/sec)***

1.Calculated using emission factors obtained from AP-42 Section 11.12 (United States Environmental Protection Agency, 2006)

2.Calculated using emission factors obtained from Section 11.1 (United States Environmental Protection Agency, 2004).

** Calculated for the total concrete mix production of 20,000 m^3 (47,200 tpa), averaged over the year*

*** Calculated for the total asphalt production (50,000 tpa), averaged over the year*

**** Calculated using odour emission rate of 1,040,000 OU m^3/min (GHD, 2008)*

5.4 Screening Assessment

Prior to dispersion modelling, a screening assessment was undertaken to determine whether all emissions from the proposed operation were likely to result in material impact to ambient air quality.

It was considered that as the proposed development had multiple sources of particulate matter, these emissions should automatically be considered in the air quality assessment. The asphalt and concrete batching plants are the only potential onsite sources of metals, combustion products and organic species, and these emissions were therefore taken forward to screening.

The screening assessment adopted guidance published in the United Kingdom, 'Air emissions risk assessment for your environmental permit guidance' (UK Department for Environment, Food and Rural Affairs Environment Agency, 2016). The approach uses conservative dispersion factors to determine the likely maximum contribution to ground level concentrations. Where the maximum concentration is below specific thresholds the species is excluded from further assessment. The details of the screening assessment are provided in Appendix B. The following species could not be screened out and therefore were included, in addition to particulate matter, in the dispersion modelling:

- Oxides of nitrogen (NO_x);
- Formaldehyde;
- Polycyclic aromatic hydrocarbons (PAH);
- Nickel; and
- Odour.

Emission rates for these species used in dispersion modelling are those provided in Table 5-2.

6. DISPERSION MODELLING ASSESSMENT

6.1 Modelling Methodology

This assessment has used the NSW EPA-endorsed CALPUFF dispersion model, in conjunction with generation of time-varying meteorological fields using the CALMET meteorological pre-processor.

CALPUFF is a multi-layer, multi-species non-steady state puff dispersion model that can simulate the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal (Scire, 2000). The model contains algorithms for near-source effects such as building downwash, partial plume penetration, sub-grid scale interactions as well as longer-range effects such as pollutant removal, chemical transformation, vertical wind shear and coastal interaction effects. The model employs dispersion equations based on a Gaussian distribution of pollutants across the puff and takes into account the complex arrangement of emissions from point, area, volume, and line sources.

6.2 Metrological Modelling

Meteorological modelling was completed for the calendar year 2014. As identified in Section 4.3, 2014 is considered a representative meteorological data set for dispersion modelling.

Meteorological modelling was undertaken through a two-step process:

- Prognostic modelling using TAPM (developed by CSIRO); and
- Diagnostic modelling using CALMET (the meteorological pre-processor for the CALPUFF dispersion model).

6.2.1 TAPM

Initially, the prognostic meteorological model TAPM was run to provide surface and upper air data either missing, or not collected, at the nearest Bureau of Meteorology Station (Port Macquarie Airport).

TAPM was run using the following parameters:

- Four nests of 30 km, 10 km, 3km, and 1 km;
- Grid centre of 31°26’ S, 152°49’ E (MGA Zone 55 482712mE, 6522001mS);
- Grid of 25 x 25 cells;
- Observation file for observations from Port Macquarie meteorological station with area of influence of 5 km with 4 layers of the atmosphere influenced by the readings; and
- 25 vertical levels (10 m, 25 m, 50 m, 100 m, 150 m, 200 m, 250 m, 300 m, 400 m, 500 m, 600 m, 750 m, 1000 m, 1250 m, 1500 m, 1750 m, 2000 m, 2500 m, 3000 m, 3500 m, 4000 m, 5000 m, 6000 m, 7000 m and 8000 m).

6.2.2 CALMET

The setup of CALMET was completed in accordance with published guidance using a combination of observational and prognostic data (Barclay & Scire, 2011).

TAPM output was extracted at location 487712m E, 6533001m S (MGA Zone 55), and was used to generate a pseudo observation station for surface and upper air data within the modelled grid. For the surface data only where data was missing from Port Macquarie records for a particular hour was the data was included from the TAPM generated surface information file.

The CALMET model was set up using the system default settings with the exception of those shown in Table 7 1. Figure 7.1 shows meteorological grid extent used in the dispersion modelling.

Table 6-1: Non-standard settings selected in CALMET

Parameter	Setting
Period Modelled	January 1 2014 to 31 December 2014
UTM Zone	55 South
Grid south-west corner (MGA Zone 54)	470.483 km E, 6510.225 km N
Grid Spacing	150 m
Grid points	160 X 160
Cell face heights (m)	0, 20, 30, 40, 50, 70, 90, 100, 250, 500, 1000, 1500, 2000
Coriolis Frequency	7.5×10^{-5}
Bias adjustment for cell face heights	-1 , -1 , -.75 , -.75 , -.5 , -.25, 0 , 5 , 1 , 1 , 1 , 1
Terrad (km)[1]	0.5
RMAX 1 (km) [1]	7.5
RMAX2 (km) [1]	15.0
RMAX3 (km) [1]	30
RMIN (km) [1]	0.15
R1 (km) [1]	6.0
R2 (km) [1]	12.0
Surface Observation Station location	Port Macquarie (487.218km E, 6522.346km S),
Upper air observation (TAPM) location	487.712 km E, 6533.001 km S
Terrain data	ELVIS Elevation Information System (Australian Government Geoscience Australia, 2017)
Land use data	Catchment Scale Land Use of Australia (Department of Agriculture, 2016)

1.Selected in accordance with (Barclay & Scire, 2011)

Figure 7 1 Meteorological Grid extent used in the Dispersion Modelling

6.3 Dispersion Model Receptors

A Cartesian grid was set-up with the south west corner positioned at 476408 m E, 6516150 m N and grid receptors at regularly spaced intervals of 150m, covering an area of 12 km by 12 km.

Discrete receptors were chosen to represent nearby sensitive receptors described in Section 2.1.2

6.4 Emission Parameters

The configuration of the emission sources within the CALPUFF dispersion model comprised a combination of volume and point sources.

Dust generating activities were represented by a series of volume sources situated according to the location of activities with uniform application of sigma y of 10 metres and sigma z of 2 metres. Table 6-2 provides emission source parameters for point sources included in the dispersion model.

The locations of the volume sources, used to represent the Site along with the equation inputs, are shown in Appendix A.

Table 6-2: Emission source parameters for point sources used in the dispersion modelling

Source Name	X (m)	Y (m)	Stack height (m)	Base Elevation (m)	Stack Diameter (m)	Exit Velocity (m/sec)	Exit Temperature (deg. K)
ASPHALT	482657	6521845	5.0[2]	25.9	4.3[2]	0.85[2,3]	435.9[1]
C_BATCH	482938	6522122	5.0[4]	25.9	12.0[4]	0.025[4]	313.15[4]

1. Adopted from AP-42 Asphalt mix temperature (United States Environmental Protection Agency, 2004)

2. Adopted from technical data specification for Benninghoven Asphalt Mixing Plants (A Wirtgen Group Company, n.d.)

3. Converted from 28,000 Nm3/hour, using temperature of 435.928 K and stack diameter of 4.3 metres.

4. Assumed, given information from a similar type of facility (Environmental Resources Management Australia Pty Ltd, 2017)

6.4.1 Respirable Crystalline Silica

Rhyolite is a fine-grained volcanic rock of granitic composition, which contains medium silica content (as compared to basalt and granite). Several site-specific occupational dust samples were analysed by Workplace Environment Consultants in 2018. The results of the analysis shows that the 'respirable silica' fraction of the total 'respirable dust' to be between 5% and 14%.

For this assessment, the silica composition value within the respirable ($PM_{2.5}$) particle size fraction has been conservatively assumed to comprise 14%.

The predicted annual average concentrations of respirable crystalline silica were derived from $PM_{2.5}$ annual average concentrations as required by adopted assessment criterion (see Section 3.1.5).

6.4.2 Odour

Odour is generated from the asphalt plant. The structure of the asphalt plant has the potential to generate wake effect on the stack emissions. In accordance with the Approved Methods, the 1-hour average predicted odour concentration was converted to peak ground level concentration using factor 2.3 for wake-effected point source (State of NSW and Environment Protection Authority, 2016)

7. MODELLING RESULTS

7.1 Introduction

The modelling predictions for the Proposed Project are presented in the sections below. The contour plots are indicative of the concentrations that could potentially be reached under the conditions modelled. It is important to note that the isopleth figures are presented to provide a visual representation of the predicted impacts. To produce the contours, it is necessary to make interpolations between predicted concentrations, and as a result the contours will not always match exactly with predicted impacts at any specific location.

In the case of maximum 24-hour average concentrations, it is also important to note that individual contour plots do not represent one moment in time, but rather the maximum 24-hour average that could potentially occur at a sensitive receptor over the period of a year.

As discussed in Section 5.2, two emissions scenarios were developed:

1. 'Typical day' operations, based on an annual average quarry throughput of 530,000 tpa.
2. 'Maximum day' operations, based on a daily quarry throughput of 2,600 tpd.

The results analysis has taken into account an additional scenario, where the 'Maximum day' operations are split into operating either with the proposed (20-days per year) at 24 hours a day or by adopting the typical day operational hours of 5am to 10pm.

7.2 Predicted PM_{10} Concentrations

Table 7-1 provides the incremental (results shown in brackets) and cumulative results of the PM_{10} predicted concentrations. A daily varying background file, representing Wyong data from 2014 (refer Section 4.5.1) was used in the applying an appropriate background concentration.

All receptors are shown to comply with the DPIE impact assessment criterion for the 24-hour and annual averaging periods with the Proposed Project operating under typical day operations and maximum day when hours are limited to 5am to 10pm.

When operating at 24-hour operations, one receptor (R13) was predicted to exceed the DPIE impact assessment criterion of 50µg/m^3 using the maximum day scenario and operating for 24 hours a day.

Additional analysis has been completed for R13 (maximum day, 24-hour operations) in accordance with Table 11.3 of the Approved Methods (DPIE, 2016) and is shown in Table 7-2.

Table 7-1: Predicted cumulative PM_{10} concentrations

Receptor ID	Predicted PM_{10} Concentrations (µg/m^3) Maximum impact (increment)		
	24 Hour Average		Annual
	Maximum day (5am – 10am)	Maximum day (24 hours)	Typical day
1	42.7 (3.9)	43.0 (3.5)	15.7 (0.6)
2	42.7 (4.0)	42.9 (3.5)	15.7 (0.6)
3	43.5 (4.8)	43.8 (5.8)	16 (0.9)
4	44.5 (6.8)	44.8 (8.0)	16.4 (1.3)
5	42.2 (4.4)	42.1 (3.5)	15.4 (0.3)
6	41.9 (1.0)	41.9 (0.7)	15.2 (0.1)
7	43.3 (11.3)	43.7 (12.7)	16.4 (1.3)
8	42.2 (3.9)	42.8 (6.3)	15.7 (0.6)
9	43.2 (6.2)	44.6 (8.7)	16.1 (1)

Receptor ID	Predicted PM_{10} Concentrations ($\mu g/m^3$) Maximum impact (increment)		
	24 Hour Average		Annual
	Maximum day (5am – 10am)	Maximum day (24 hours)	Typical day
10	43.5 (5.1)	44 (7.1)	16.1 (1)
11	42.2 (2.8)	42.1 (2.7)	15.4 (0.3)
12	42.7 (3.3)	42.9 (3.2)	15.6 (0.5)
13	49.0 (21.4)	**52.1** (28.5)	18.9 (3.8)
14	43.5 (5.4)	44 (5.6)	16.1 (1)
15	44.4 (7.2)	44.7 (8.0)	16.4 (1.3)
16	42.9 (5.8)	43.2 (5.1)	15.9 (0.8)
17	43.8 (4.8)	44.2 (5.2)	16 (0.9)
18	42.2 (2.7)	42.1 (2.7)	15.5 (0.4)
19	43.2 (7.1)	42.8 (6.2)	16 (0.9)
20	42.3 (8.8)	42.2 (6.5)	15.5 (0.4)
21	42 (1.5)	42.0 (1.0)	15.2 (0.1)
22	41.9 (0.8)	41.9 (0.5)	15.1 (<0.1)
23	42 (1.2)	41.9 (0.8)	15.1 (<0.1)
24	42.2 (4.0)	42.1 (3.2)	15.3 (0.2)
25	42.1 (2.2)	42 (1.8)	15.2 (0.1)
26	41.9 (0.9)	41.9 (0.9)	15.1 (<0.1)
27	42 (1.2)	41.9 (0.7)	15.1 (<0.1)
28	41.9 (1.1)	41.9 (0.8)	15.1 (<0.1)
29	41.9 (1.0)	41.9 (0.7)	15.2 (0.1)
30	41.9 (1.0)	41.9 (1.1)	15.2 (0.1)
31	41.9 (0.9)	41.9 (0.7)	15.2 (0.1)
32	42.2 (3.5)	42.1 (2.9)	15.5 (0.4)
33	42.6 (1.5)	42.8 (1.8)	15.3 (0.2)
34	42.1 (4.2)	42.1 (5.9)	15.6 (0.5)
35	42.1 (2.6)	42.1 (5.0)	15.6 (0.5)
36	41.9 (0.7)	41.9 (0.6)	15.2 (0.1)
37	42 (1.6)	42 (2.7)	15.3 (0.2)
38	42.0 (1.7)	42 (2.6)	15.3 (0.2)
39	42.0 (1.8)	42 (2.1)	15.3 (0.2)
40	42.0 (1.6)	42 (2.6)	15.3 (0.2)
41	42.6 (2.3)	42.7 (2.2)	15.5 (0.4)
42	42.9 (2.7)	43.2 (2.7)	15.6 (0.5)
43	42.6 (2.7)	42.8 (2.6)	15.6 (0.5)
44	42.8 (4.8)	43.5 (7.1)	15.9 (0.8)
45	42 (2.1)	42.0 (4.0)	15.5 (0.4)
Criterion	50	50	25

1. Results without brackets are cumulative (inclusive of background) predictions. Incremental predictions are shown in brackets.

2. Maximum day (24-hour) predictions are representative of 24-hour operations, which in reality will only be permitted for up to 20 days annually.

Table 7-2: Level 2 Assessment of PM_{10} at R13 for maximum day, 24-hour operations

Date	PM_{10} 24-hour average ($\mu g/m^3$)			Date	PM_{10} 24-hour average ($\mu g/m^3$)		
	Background	Predicted increment	Total		Background	Highest predicted increment	Total
02/01/2014	41.9	7.9	49.8	10/05/2014	10.4	28.5	38.9
18/12/2014	41.1	8.8	49.9	20/05/2014	11.3	25.3	36.6
10/02/2014	39.2	12.9	**52.1**	14/03/2014	13.9	24.4	38.3
17/12/2014	37.3	2.9	40.2	09/08/2014	17.0	24.1	41.1
06/10/2014	36.9	13.7	**50.6**	08/07/2014	10.9	22.7	33.6
30/12/2014	35.8	2.8	38.6	18/05/2014	9.0	21.9	30.9
31/10/2014	35.5	12.1	47.6	10/04/2014	11.1	21.8	32.9
30/10/2014	35.1	7.8	42.9	01/04/2014	11.3	21.7	33
03/01/2014	33.7	2.0	35.7	23/03/2014	21.1	21.2	42.3
06/01/2014	33	2.2	35.2	06/03/2014	29.2	21.1	**50.3**

7.3 Predicted $PM_{2.5}$ Concentrations

Table 7-3 provides the incremental (results shown in brackets) and cumulative results of the $PM_{2.5}$ predicted concentrations. A daily varying background file, representing Wyong data from 2014 (refer Section 4.5.1) was used in the applying an appropriate background concentration.

All receptors are shown to comply with the DPIE impact assessment criterion for the 24-hour and annual averaging periods when operating under both typical and maximum day (24/7) operations.

Table 7-3: Predicted $PM_{2.5}$ concentrations

Receptor ID	Predicted $PM_{2.5}$ Concentrations ($\mu g/m^3$) Maximum impact (increment)		
	24 Hour Average		Annual
	Maximum day (5am – 10am)	Maximum day (24 hours)	Typical day
1	19.7 (2.4)	20.2 (2.3)	5.6 (0.1)
2	19.8 (2.5)	20.2 (2.2)	5.6 (0.1)
3	19.8 (2.8)	20.4 (2.4)	5.6 (0.1)
4	20 (3.3)	20.7 (3.1)	5.7 (0.2)
5	19.8 (0.8)	19.8 (0.7)	5.5 (<0.1)
6	19.7 (0.3)	19.7 (0.2)	5.5 (<0.1)
7	19.7 (2.3)	20.1 (2.5)	5.7 (0.2)
8	19.7 (1.1)	20.1 (1.7)	5.6 (0.1)
9	19.7 (1.2)	20.4 (1.9)	5.6 (0.1)
10	19.8 (1.7)	20.5 (2.3)	5.6 (0.1)
11	19.7 (0.9)	19.7 (0.7)	5.6 (0.1)
12	19.8 (2.3)	20.1 (1.9)	5.6 (0.1)
13	20.4 (5)	21.9 (6.7)	6 (0.5)
14	19.8 (2.6)	20.4 (2.8)	5.7 (0.2)
15	19.9 (3.3)	20.6 (3.1)	5.7 (0.2)
16	19.8 (3)	20.4 (2.8)	5.6 (0.1)
17	19.9 (2.8)	20.4 (2.4)	5.6 (0.1)
18	19.9 (1.3)	19.9 (1)	5.6 (0.1)
19	19.9 (2.2)	20.1 (1.9)	5.6 (0.1)
20	19.7 (2.9)	19.8 (2.2)	5.6 (0.1)
21	19.7 (0.6)	19.7 (0.4)	5.5 (<0.1)
22	19.7 (0.2)	19.7 (0.2)	5.5 (<0.1)
23	19.7 (0.3)	19.7 (0.2)	5.5 (<0.1)
24	19.7 (0.7)	19.8 (0.7)	5.5 (<0.1)
25	19.7 (0.4)	19.8 (0.4)	5.5 (<0.1)
26	19.7 (0.3)	19.7 (0.2)	5.5 (<0.1)
27	19.7 (0.4)	19.7 (0.3)	5.5 (<0.1)
28	19.7 (0.3)	19.7 (0.2)	5.5 (<0.1)
29	19.7 (0.3)	19.7 (0.2)	5.5 (<0.1)
30	19.7 (0.2)	19.7 (0.2)	5.5 (<0.1)
31	19.7 (0.2)	19.7 (0.2)	5.5 (<0.1)
32	19.7 (1)	19.8 (0.8)	5.6 (0.1)
33	19.7 (0.5)	19.7 (0.5)	5.5 (<0.1)
34	19.7 (0.8)	19.8 (1.3)	5.6 (0.1)
35	19.7 (0.8)	19.9 (1.5)	5.6 (0.1)
36	19.7 (0.2)	19.7 (0.1)	5.5 (<0.1)
37	19.7 (0.3)	19.7 (0.4)	5.5 (<0.1)
38	19.7 (0.3)	19.7 (0.4)	5.5 (<0.1)
39	19.7 (0.3)	19.7 (0.4)	5.5 (<0.1)
40	19.7 (0.3)	19.7 (0.4)	5.5 (<0.1)

Receptor ID	Predicted $PM_{2.5}$ Concentrations ($\mu g/m^3$) Maximum impact (increment)		
	24 Hour Average		Annual
	Maximum day (5am – 10am)	Maximum day (24 hours)	Typical day
41	19.7 (1.9)	20 (1.5)	5.6 (0.1)
42	19.8 (2)	20.1 (1.6)	5.6 (0.1)
43	19.7 (2)	20.1 (1.7)	5.6 (0.1)
44	19.7 (1.2)	20.3 (1.9)	5.6 (0.1)
45	19.7 (0.6)	19.8 (1.1)	5.6 (0.1)
Criterion	25	25	8

1. Results without brackets are cumulative (inclusive of background) predictions. Incremental predictions are shown in brackets.

2. Maximum day predictions are representative of 24-hour operations, which in reality will only be permitted for up to 20 days annually.

7.4 Predicted Concentrations for all Other Species

Table 7-4 provides the predicted concentrations for all species other than PM_{10} and $PM_{2.5}$ included in the dispersion modelling against the adopted criteria. The results for these species included in the dispersion modelling are below the adopted criteria at all sensitive receptor locations.

Table 7-4: Predicted concentrations for all species included in the dispersion modelling

Receptor ID	Predicted TSP (µg/m^3) Maximum impact (increment)	Predicted Silica (µg/m^3) Maximum impact	Predicted Dust Deposition (g/m^2/month) Maximum impact (increment)	Predicted NO_2 (µg/m^3) Maximum impact (increment)		Predicted Formaldehyde (µg/m^3) Maximum impact	Predicted PAH (µg/m^3) Maximum impact	Predicted Nickel (µg/m^3) Maximum impact	Predicted Odour (OU/m^3) Maximum impact
	Annual Mean	Annual Mean	Annual Mean	Annual Mean	1 Hour Mean	1 Hour Mean	1 Hour Mean	1 Hour Mean	Nose Response Time
1	30.7 (0.5)	<0.1	2 (<0.1)	10.3 (<0.1)	70.4 (<0.1)	0.08	<0.01	<0.01	1.5
2	30.8 (0.6)	<0.1	2 (<0.1)	10.3 (<0.1)	70.3 (<0.1)	0.06	<0.01	<0.01	1.2
3	31.2 (1)	<0.1	2 (<0.1)	10.3 (<0.1)	70.2 (<0.1)	0.05	<0.01	<0.01	0.9
4	32 (1.8)	<0.1	2 (<0.1)	10.3 (<0.1)	70.1 (<0.1)	0.04	<0.01	<0.01	1.1
5	30.6 (0.4)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (0.1)	0.02	<0.01	<0.01	0.3
6	30.3 (0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.1)	0.01	<0.01	<0.01	0.2
7	32.9 (2.7)	<0.1	2 (<0.1)	10.3 (<0.1)	70.1 (0.1)	0.04	<0.01	<0.01	1.2
8	31.1 (0.9)	<0.1	2 (<0.1)	10.3 (<0.1)	70.2 (0.1)	0.05	<0.01	<0.01	0.9
9	31.8 (1.6)	<0.1	2 (<0.1)	10.3 (<0.1)	70.1 (0.1)	0.03	<0.01	<0.01	0.7
10	31.7 (1.5)	<0.1	2 (<0.1)	10.3 (<0.1)	70.1 (0.1)	0.04	<0.01	<0.01	0.8
11	30.7 (0.5)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (0.1)	0.03	<0.01	<0.01	0.7

Receptor ID	Predicted TSP (µg/m^3) Maximum impact (increment)	Predicted Silica (µg/m^3) Maximum impact	Predicted Dust Deposition (g/m^2/month) Maximum impact (increment)	Predicted NO_2 (µg/m^3) Maximum impact (increment)		Predicted Formaldehyde (µg/m^3) Maximum impact	Predicted PAH (µg/m^3) Maximum impact	Predicted Nickel (µg/m^3) Maximum impact	Predicted Odour (OU/m^3) Maximum impact
	Annual Mean	Annual Mean	Annual Mean	Annual Mean	1 Hour Mean	1 Hour Mean	1 Hour Mean	1 Hour Mean	Nose Response Time
12	30.7 (0.5)	<0.1	2 (<0.1)	10.3 (<0.1)	70.2 (0.1)	0.06	<0.01	<0.01	1.1
13	37.6 (7.4)	0.1	2.2 (0.2)	10.3 (<0.1)	70.4 (0.1)	0.07	<0.01	<0.01	2.1
14	31.4 (1.2)	<0.1	2 (<0.1)	10.3 (<0.1)	70.1 (0.1)	0.04	<0.01	<0.01	1.0
15	31.9 (1.7)	<0.1	2 (<0.1)	10.3 (<0.1)	70.1 (0.1)	0.04	<0.01	<0.01	1.1
16	31.1 (0.9)	<0.1	2 (<0.1)	10.3 (<0.1)	70.3 (0.1)	0.06	<0.01	<0.01	1.0
17	31.4 (1.2)	<0.1	2 (<0.1)	10.3 (<0.1)	70.1 (0.1)	0.04	<0.01	<0.01	0.9
18	30.7 (0.5)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (0.1)	0.03	<0.01	<0.01	0.7
19	31.6 (1.4)	<0.1	2.1 (0.1)	10.3 (<0.1)	70.1 (0.1)	0.03	<0.01	<0.01	0.7
20	30.6 (0.4)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (0.1)	0.02	<0.01	<0.01	0.2
21	30.3 (0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.2)	0.01	<0.01	<0.01	0.1
22	30.2 (<0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.2)	0.01	<0.01	<0.01	0.1
23	30.2 (<0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.2)	0.01	<0.01	<0.01	0.1

Receptor ID	Predicted TSP (µg/m^3) Maximum impact (increment)	Predicted Silica (µg/m^3) Maximum impact	Predicted Dust Deposition (g/m^2/month) Maximum impact (increment)	Predicted NO_2 (µg/m^3) Maximum impact (increment)		Predicted Formaldehyde (µg/m^3) Maximum impact	Predicted PAH (µg/m^3) Maximum impact	Predicted Nickel (µg/m^3) Maximum impact	Predicted Odour (OU/m^3) Maximum impact
	Annual Mean	Annual Mean	Annual Mean	Annual Mean	1 Hour Mean	1 Hour Mean	1 Hour Mean	1 Hour Mean	Nose Response Time
24	30.5 (0.3)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (0.2)	0.02	<0.01	<0.01	0.3
25	30.4 (0.2)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.2)	0.02	<0.01	<0.01	0.3
26	30.2 (<0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.2)	0.01	<0.01	<0.01	0.1
27	30.3 (0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.1)	0.01	<0.01	<0.01	0.1
28	30.3 (0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.1)	0.01	<0.01	<0.01	0.1
29	30.3 (0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.1)	0.01	<0.01	<0.01	0.2
30	30.3 (0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.1)	0.01	<0.01	<0.01	0.2
31	30.3 (0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.1)	0.02	<0.01	<0.01	0.2
32	30.8 (0.6)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (0.1)	0.03	<0.01	<0.01	0.8
33	30.5 (0.3)	<0.1	2 (<0.1)	10.3 (<0.1)	70.1 (0.1)	0.04	<0.01	<0.01	0.6
34	31 (0.8)	<0.1	2 (<0.1)	10.3 (<0.1)	70.1 (0.1)	0.04	<0.01	<0.01	0.8
35	30.8 (0.6)	<0.1	2 (<0.1)	10.3 (<0.1)	70.4 (0.1)	0.07	<0.01	<0.01	1.1

Receptor ID	Predicted TSP (µg/m^3) Maximum impact (increment)	Predicted Silica (µg/m^3) Maximum impact	Predicted Dust Deposition (g/m^2/month) Maximum impact (increment)	Predicted NO_2 (µg/m^3) Maximum impact (increment)		Predicted Formaldehyde (µg/m^3) Maximum impact	Predicted PAH (µg/m^3) Maximum impact	Predicted Nickel (µg/m^3) Maximum impact	Predicted Odour (OU/m^3) Maximum impact
	Annual Mean	Annual Mean	Annual Mean	Annual Mean	1 Hour Mean	1 Hour Mean	1 Hour Mean	1 Hour Mean	Nose Response Time
36	30.3 (0.1)	<0.1	2 (<0.1)	10.3 (<0.1)	69.9 (0.1)	0.01	<0.01	<0.01	0.3
37	30.5 (0.3)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (0.1)	0.03	<0.01	<0.01	0.5
38	30.5 (0.3)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (0.1)	0.03	<0.01	<0.01	0.5
39	30.5 (0.3)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (<0.1)	0.03	<0.01	<0.01	0.5
40	30.5 (0.3)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (<0.1)	0.03	<0.01	<0.01	0.5
41	30.6 (0.4)	<0.1	2 (<0.1)	10.3 (<0.1)	70.2 (<0.1)	0.05	<0.01	<0.01	1
42	30.8 (0.6)	<0.1	2 (<0.1)	10.3 (<0.1)	70.1 (0.1)	0.04	<0.01	<0.01	0.8
43	30.6 (0.4)	<0.1	2 (<0.1)	10.3 (<0.1)	70.2 (<0.1)	0.05	<0.01	<0.01	1.1
44	31.4 (1.2)	<0.1	2 (<0.1)	10.3 (<0.1)	70 (<0.1)	0.03	<0.01	<0.01	0.7
45	30.7 (0.5)	<0.1	2 (<0.1)	10.3 (<0.1)	70.3 (<0.1)	0.07	<0.01	<0.01	0.8
Criteria	**90**	**3**	**2**	**62**	**246**	**20**	**0.4**	**0.18**	**6.5**

8. MITIGATION MEASURES

This air quality impact assessment has considered reasonable and feasible mitigation measures to minimise the emissions from the proposed activities at the site. The mitigation measures considered in this assessment include:

- Roads which are likely to remain unchanged throughout the Project stages and to be frequently used by machinery, will be sealed using asphalt and swept daily to minimise wheel-generated dust emissions;
- Full dust extraction system for drilling;
- Utilisation of water sprays during truck rear dumping;
- The use of mobile sprinkler systems during the operation of front end loaders (FELs);
- Dust suppression measures such as water sprays in place at the crushers and screeners;
- Water sprays used on all conveyor transfer points;
- The conveyor loading to be enclosed by a shroud;
- Unsealed haul roads are to apply a dust suppressant;
- Water sprays to be utilised to minimise wind erosion from stockpiles, as required;
- The dry product delivered to the concrete batching, concrete recycling and asphalt plants to be stored in aggregate storage bins enclosed on three sides. The aggregate storage bins to be fitted with water sprays;
- Cement and cement supplement to be delivered to the concrete batching plant and pneumatically fed;
- Concrete batching loading point to be enclosed with all particulate matter emissions generated by the facility captured by one bag filter located above the pan mixer;
- Concrete recycling facility out-loading to be directly to processed material storage bins enclosed on three sides. The recycled concrete storage bins to be fitted with water sprays;
- Vapour balancing system to be installed for the delivery of bitumen at the asphalt plant;
- Asphalt plant will be totally enclosed. All particulate matter emissions generated at the plant will be captured by one fabric filter associated with the natural-gas fired dryer; and
- Vapour recovery system to be employed for transfer of asphalt to trucks.

9. MONITORING AND MANAGEMENT MEASURES

It is recommended that in addition to management measures described in Section 8, the Site employs real-time ambient air quality monitoring system. This will allow staff to identify when additional mitigation measures are to be implemented to minimise impact from the onsite activities.

Given the proximity of Receptor 13 to the site boundary and moderate occurrence of winds from the north-western and north-eastern directions (Figure 4-1), it is recommended that one real-time monitor is placed along the southern boundary of the Site to monitor conditions when the Site is upwind of R13. Another monitor may be placed along the northern boundary to obtain the background PM concentration under these conditions (i.e. northerly winds).

As noted above, contemporaneous analysis identified that the cumulative (background plus Proposed Project contributions) 24-hour average PM_{10} concentrations predict an exceedance of the Approved Methods Criterion at receptor R13 when operating under maximum daily throughput scenario over a 24-hour period. However, when the hours are reduced to operate between 5am and 10pm with the same maximum daily throughput compliance is demonstrated at R13.

It is anticipated that the probability of meteorological conditions conducive to causing an exceedance at receptor R13 occurring during the proposed 20 days of 24-hour operations is low. It is thus considered that this risk may be mitigated by provision of additional dust management planning and controls prior to 24-hour operations, as documented within the site Air Quality Management Plan.

Table 9-1 provides recommendations for the environmental management to ensure minimisation of air quality impact to the surrounding land use as a result of construction activities.

Table 9-1 Recommendations for the environmental management plan

Item	Mitigation/ Management/Control Measure	Trigger/Timing	Responsibility
Clearing, Site Preparation and Excavation			
1	Modify working practices by limiting clearing, stripping and spoil handling during periods of adverse weather (hot, dry and windy conditions) and when dust is seen leaving the site.	When visible dust is being generated	Supervisors, Construction Manager
2	Limit the extent of clearing of vegetation and topsoil to the designated footprint required for construction and appropriate staging of any clearing.	During construction works planning stage	Construction Manager
3	All disturbed areas where trees and other vegetation are removed are to be stabilised and or revegetated/ rehabilitated in accordance with the contractual requirements as soon as practical following final land shaping	After final land shaping	Supervisors, Construction Manager
4	Minimise the exposure of fill and excavated material to active work fronts.	Ongoing	Supervisors
5	Use water sprays as a suppressant during road construction, when movement of materials generates visible dust.	When visible dust is being generated.	Supervisors, Construction Manager
6	Minimise drop heights for material transport to prevent dust dispersal.	Ongoing	Supervisors
7	Maintain all construction equipment, machinery and vehicles to ensure optimal performance which would minimise exhaust emissions.	Ongoing	Supervisors
8	Minimise idling of construction equipment, machinery and vehicles to no more than 5 minutes to minimise exhaust emissions.	Ongoing	Supervisors
9	Plan construction methodology to ensure capacity of construction equipment, machinery and vehicles is fully utilised.	During construction works planning stage	Construction Manager
Haulage and Heavy Plant and Equipment Movements			
10	Modifying work practices during periods of high winds and/or dry conditions by limiting scraper/ grader activity.	Ongoing	Supervisors
11	All vehicles on-site will be confined to a designated route with a speed limit of 30 km/hr enforced.	Ongoing	Supervisors
12	All unsealed haul roads will be sealed with a chemical suppressant.	Ongoing	Supervisors
13	Trips and trip distances will be controlled and reduced where possible, for example by coordinating delivery and removal of materials to avoid unnecessary trips.	Ongoing	Supervisors, Construction Manager

Item	Mitigation/ Management/Control Measure	Trigger/Timing	Responsibility
14	All trucks delivering fill or leaving the site with spoil material will have their load covered.	Ongoing	Supervisors
15	No idling of vehicles unless power is required for unloading or cooling for the occupant of vehicle on days of high temperature.	Ongoing	Supervisors
Wind Erosion			
16	Wind erosion from exposed ground will be limited by avoiding unnecessary vegetation and topsoil clearing and limiting to the minimum footprint required.	Ongoing	Supervisors, Manager
17	Wind erosion from temporary stockpiles will be limited by minimising the number of work faces on stockpiles, minimising the number of stockpiles and through covering or temporary stabilisation (compaction of surface, water sprays, seeding, veneering) of the stockpiles.	Ongoing	Supervisors, Manager
Dust monitoring			
18	Visual checks for excessive dust generation will be undertaken daily during construction	Ongoing	Supervisors, Manager

10. CONCLUSIONS

ERM was engaged by Hanson to undertake specialist assessments to inform the EIS for the proposed Sancrox Quarry Extension Project. This updated AQIA is to accompany the Response to Submission report that includes a revised quarry plan including staging and undertook the following scope of works:

- Assessment of potential for ambient air quality impacts and greenhouse gas emissions from construction and operation of the Project;
- Provision of mitigation measures to minimise impacts to the surrounding land use; and
- Recommendations for ambient monitoring to ensure compliance with legislation.

The assessment of ambient air quality impacts identified that:

- The cumulative annual mean concentrations of PM_{10} are below the Approved Methods criterion at all sensitive receptors;
- Contemporaneous analysis identified that the cumulative (background plus Proposed Project contributions) 24-hour average PM_{10} concentrations predict an exceedance of the Approved Methods Criterion at receptor R13 when operating under maximum daily throughput scenario over a 24-hour period. However, when the hours are reduced to operate between 5am and 10pm with the same maximum daily throughput compliance is demonstrated at R13.
- It is anticipated that the probability of meteorological conditions conducive to causing an exceedance at receptor R13 occurring during the proposed 20 days of 24-hour operations is low. It is thus considered that this risk may be mitigated by provision of additional dust management planning and controls prior to 24-hour operations, as documented within the site Air Quality Management Plan.
- The cumulative annual mean concentrations of $PM_{2.5}$ are below the Approved Methods criterion at all sensitive receptors;
- The predicted concentrations for all other species are below the adopted criteria at all sensitive receptor locations.

This assessment considered reasonable and feasible mitigation measures to minimise the emissions from the proposed activities at the site and provided recommendations for ambient monitoring.

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APPENDIX A AIR QUALITY EMISSION ESTIMATION

Table A 1: TSP emissions for Typical day operations

ACTIVITY	Scenario 2 (Stage 5) TSP Emissio	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 3	Units	Variable 4	Units	Control	Units	Control measure
QUARRY - Drilling rock	22	3750	holes/y	0.59	kg/hole											99	% control	Full dust extraction system, Section B.1.1
QUARRY - Blasting rock	178	30	blasts/y	5.94	kg/blast	900	Area of									0	% control	n/a. Section 6.2.2
QUARRY - Excavators on Quarry Floor	291	530000	t/y	0.00055	kg/t	1.67	average of	5	moisture content (%)							0	% control	n/a
QUARRY - Truck Rear Dumping	78	477000	t/y	0.00055	kg/t	1.67	average of	5	moisture content (%)							70	% control	70% from water sprays, per NPI
QUARRY - FELS	291	530000	t/y	0.00055	kg/t	1.67	average of	5	moisture content (%)							0	% control	n/a
QUARRY - Primary crushing	286	477000	t/y	0.0006	kg/t											0	% control	no control discussed in report
QUARRY - Secondary crushing	179	298125	t/y	0.0006	kg/t											0	% control	no control discussed in report
QUARRY - Tertiary crushing	143	238500	t/y	0.0006	kg/t											0	% control	no control discussed in report
QUARRY - Primary screening	525	477000	t/y	0.0011	kg/t											0	% control	Wet emission factor used
QUARRY - Primary screening	328	298125	t/y	0.0011	kg/t											0	% control	Wet emission factor used
QUARRY - Conveyor Transfer Points (2)	23	954000	t/y	0.00024	kg/t	1.67	average of	9	moisture content (%)							90	% control	90% control from water sprays
QUARRY - Conveyor Drop Points (8)	11	477000	t/y	0.00024	kg/t	1.67	average of	9	moisture content (%)							90	% control	90% control from water sprays
QUARRY - Rock Truck - Loaded, Onsite (unsealed)	10,302	477000	t/y	0.13498	kg/t	37	t/load	68	vehicle gross mass (t)	1.129	km	4.413	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Rock Truck - Unloaded, Onsite (unsealed)	5,768	477000	t/y	0.07558	kg/t	37	t/load	31	vehicle gross mass (t)	0.902	km	3.093	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Truck and dog - Loaded, Direct to market (unsealed)	1,096	53000	t/y	0.12921	kg/t	32	t/load	43	vehicle gross mass (t)	1.17	km	3.582	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Truck and dog - Unoaded, Direct to market (unsealed)	442	53000	t/y	0.05211	kg/t	32	t/load	10	vehicle gross mass (t)	0.902	km	1.874	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Rock Truck - Loaded, Onsite (sealed)	2,452	477000	t/y	0.05141	kg/t	37	t/load	68	vehicle gross mass (t)	0.43	km	4.413	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Rock Truck - Unloaded, Onsite (sealed)	1,719	477000	t/y	0.03603	kg/t	37	t/load	31	vehicle gross mass (t)	0.43	km	3.093	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Truck and dog - Loaded, Direct to market (sealed)	252	53000	t/y	0.04749	kg/t	32	t/load	43	vehicle gross mass (t)	0.43	km	3.582	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Truck and dog - Unoaded, Direct to market (sealed)	132	53000	t/y	0.02484	kg/t	32	t/load	10	vehicle gross mass (t)	0.43	km	1.874	kg/VKT	8.0	% silt content	90	% control	Sealed
WE - Stockpiles and converyors (STP1-STP10)	964	2.2	ha	0.1	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP11)	18	0.04	ha	0.1	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP12)	9	0.02	ha	0.1	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP13)	13	0.03	ha	0.1	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP14)	9	0.02	ha	0.1	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP15)	9	0.02	ha	0.1	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP16)	13	0.03	ha	0.1	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP17)	9	0.02	ha	0.1	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP18)	9	0.02	ha	0.1	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP19)	26	0.06	ha	0.1	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Pit	1,862	8.500	ha	0.1	kg/ha/h	8760	h									75	% control	Only 25% of area susceptable to WE at any one time.
CRP - Truck Rear Dumping	12	20000	t/y	0.00198	kg/t	1.67	average of	2	moisture content (%)							70	% control	70% from water sprays, per NPI
CRP - Crushing	12	20000	t/y	0.0006	kg/t											0	% control	no control discussed in report
CRP - Truck and dog - Delivery of Dry Products (loaded)	91	20000	t/y	0.04561	kg/t	32	t/load	43	vehicle gross mass (t)	0.41	km	3.582	kg/VKT	8	% silt content	90	% control	Sealed
CRP - Truck and dog - Delivery of Dry Products (unloaded)	48	20000	t/y	0.02386	kg/t	32	t/load	10	vehicle gross mass (t)	0.41	km	1.874	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Coarse Aggregate - Truck Rear Dumpings	13	21868	t/y	0.00198	kg/t	1.67	average of	2	moisture content (%)							70	% control	70% from water sprays, per NPI
CBP - Sand - Truck Rear Dumping	3	16750	t/y	0.00055	kg/t	1.67	average of	5	moisture content (%)							70	% control	70% from water sprays, per NPI
CBP - Transfer of Aggregate	4	21868	t/y	0.00198	kg/t	1.67	average of	2	moisture content (%)							90	% control	90% control from water sprays
CBP - Transfer of Sand	1	16750	t/y	0.00055	kg/t	1.67	average of	5	moisture content (%)							90	% control	90% control from water sprays
CBP - Loaded weight of a truck and dog - coarse aggregate	100	21868	t/y	0.04561	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	3.582	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of a truck and dog - coarse aggregate	52	21868	t/y	0.02386	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	1.874	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of a truck and dog - Sand	76	16750	t/y	0.04561	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	3.582	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of a truck and dog - Sand	40	16750	t/y	0.02386	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	1.874	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of Tanker - cement and cement supplement brought onsit	44	6617	t/y	0.06575	kg/t	20	t/load	32	vehicle gross mass (t)	0.413	km	3.152	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of Tanker - cement and cement supplement brought on:	28	6617	t/y	0.04260	kg/t	20	t/load	12	vehicle gross mass (t)	0.413	km	2.042	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of Agitator truck - product taken offsite	310	47200	t/y	0.06575	kg/t	20	t/load	32	vehicle gross mass (t)	0.413	km	3.152	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of Agitator truck - product taken offsite	201	47200	t/y	0.04260	kg/t	20	t/load	12	vehicle gross mass (t)	0.413	km	2.042	kg/VKT	8	% silt content	90	% control	Sealed
AP - Bitumen Delivery and Storage	-															100	% control	Vapour recover system
AP - High quality aggregate delivery and storage	-															100	% control	Already covered as source : One of the FELs located around the processing plant andstockpile area will b
AP - Truck Load Out	-															100	% control	Vapour recover system
AP - Loaded weight of Tanker - bitumen delivery	19	4000	t/y	0.04733	kg/t	20	t/load	32	vehicle gross mass (t)	0.48	km	1.940	kg/VKT	4	% silt content	90	% control	Sealed
AP - Unloaded weight of Tanker - bitument delivery	12	4000	t/y	0.03067	kg/t	20	t/load	12	vehicle gross mass (t)	0.48	km	1.257	kg/VKT	4	% silt content	90	% control	Sealed
AP - Loaded weight of a truck and dog - asphalt to market	164	50000	t/y	0.03284	kg/t	32	t/load	43	vehicle gross mass (t)	0.48	km	2.205	kg/VKT	4	% silt content	90	% control	Sealed
AP - Unloaded weight of a truck and dog - asphalt to market	86	50000	t/y	0.01718	kg/t	32	t/load	10	vehicle gross mass (t)	0.48	km	1.153	kg/VKT	4	% silt content	90	% control	Sealed
TOTAL TSP EMISSIONS	**28,772**																	

Table A 2: PM_{10} emissions for Typical day operations

ACTIVITY	Scenario 2 (Stage 5) TSP Emissions (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 3	Units	Variable 4	Units	Control	Units	Control measure
QUARRY - Drilling rock	12	3750	holes/y	0.3068	kg/hole											99	% control	Full dust extraction system, Section B.1.1
QUARRY - Blasting rock	93	30	blasts/y	3.0888	kg/blast	900	Area of blast in square metres									0	% control	n/a. Section 6.2.2
QUARRY - Excavators on Quarry Floor	137	530000	t/y	0.00026	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							0	% control	n/a
QUARRY - Truck Rear Dumping	37	477000	t/y	0.00026	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							70	% control	70% from water sprays, per NPI
QUARRY - FELS	137	530000	t/y	0.00026	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							0	% control	n/a
QUARRY - Primary crushing	129	477000	t/y	0.00027	kg/t											0	% control	no control discussed in report
QUARRY - Secondary crushing	80	298125	t/y	0.00027	kg/t											0	% control	no control discussed in report
QUARRY - Tertiary crushing	64	238500	t/y	0.00027	kg/t											0	% control	no control discussed in report
QUARRY - Primary screening	176	477000	t/y	0.00037	kg/t											0	% control	Wet emission factor used
QUARRY - Primary screening	110	298125	t/y	0.00037	kg/t											0	% control	Wet emission factor used
QUARRY - Conveyor Transfer Points (2)	11	954000	t/y	0.00011	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	9	moisture content (%)							90	% control	90% control from water sprays
QUARRY - Conveyor Drop Points (8)	5	477000	t/y	0.00011	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	9	moisture content (%)							90	% control	90% control from water sprays
QUARRY - Rock Truck - Loaded, Onsite (unsealed)	2,908	477000	t/y	0.03810	kg/t	37	t/load	68	vehicle gross mass (t)	1.129	km	1.246	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Rock Truck - Unloaded, Onsite (unsealed)	1,628	477000	t/y	0.02133	kg/t	37	t/load	31	vehicle gross mass (t)	0.902	km	0.873	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Truck and dog - Loaded, Direct to market (unsealed)	309	53000	t/y	0.03647	kg/t	32	t/load	43	vehicle gross mass (t)	1.17	km	1.011	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Truck and dog - Unoaded, Direct to market (unsealed)	125	53000	t/y	0.01471	kg/t	32	t/load	10	vehicle gross mass (t)	0.902	km	0.529	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Rock Truck - Loaded, Onsite (sealed)	692	477000	t/y	0.01451	kg/t	37	t/load	68	vehicle gross mass (t)	0.43	km	1.246	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Rock Truck - Unloaded, Onsite (sealed)	485	477000	t/y	0.01017	kg/t	37	t/load	31	vehicle gross mass (t)	0.43	km	0.873	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Truck and dog - Loaded, Direct to market (sealed)	71	53000	t/y	0.01341	kg/t	32	t/load	43	vehicle gross mass (t)	0.43	km	1.011	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Truck and dog - Unoaded, Direct to market (sealed)	37	53000	t/y	0.00701	kg/t	32	t/load	10	vehicle gross mass (t)	0.43	km	0.529	kg/VKT	8.0	% silt content	90	% control	Sealed
WE - Stockpiles and converyors (STP1-STP10)	482	2.2	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP11)	9	0.04	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP12)	4	0.02	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP13)	7	0.03	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP14)	4	0.02	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP15)	4	0.02	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP16)	7	0.03	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP17)	4	0.02	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP18)	4	0.02	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP19)	13	0.06	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Pit	931	8.500	ha	0.05	kg/ha/h	8760	h									75	% control	Only 25% of area susceptable to WE at any one time.
CRP - Truck Rear Dumping	6	20000	t/y	0.00094	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							70	% control	70% from water sprays, per NPI
CRP - Crushing	5	20000	t/y	0.00027	kg/t											0	% control	no control discussed in report
CRP - Truck and dog - Delivery of Dry Products	26	20000	t/y	0.01288	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	1.011	kg/VKT	8	% silt content	90	% control	Sealed
CRP - Truck and dog - Delivery of Dry Products	13	20000	t/y	0.00674	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.529	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Coarse Aggregate - Truck Rear Dumpings	6	21868	t/y	0.00094	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							70	% control	70% from water sprays, per NPI
CBP - Sand - Truck Rear Dumping	1	16750	t/y	0.00026	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							70	% control	70% from water sprays, per NPI
CBP - Transfer of Aggregate	2	21868	t/y	0.00094	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							90	% control	90% control from water sprays
CBP - Transfer of Sand	0	16750	t/y	0.00026	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							90	% control	90% control from water sprays
CBP - Loaded weight of a truck and dog - coarse aggregate	28	21868	t/y	0.01288	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	1.011	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of a truck and dog - coarse aggregate	15	21868	t/y	0.00674	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.529	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of a truck and dog - Sand	22	16750	t/y	0.01288	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	1.011	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of a truck and dog - Sand	11	16750	t/y	0.00674	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.529	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of Tanker - cement and cement supplement brought onsit	12	6617	t/y	0.01856	kg/t	20	t/load	32	vehicle gross mass (t)	0.413	km	0.890	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of Tanker - cement and cement supplement brought on	8	6617	t/y	0.01203	kg/t	20	t/load	12	vehicle gross mass (t)	0.413	km	0.577	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of Agitator truck - product taken offsite	88	47200	t/y	0.01856	kg/t	20	t/load	32	vehicle gross mass (t)	0.413	km	0.890	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of Agitator truck - product taken offsite	57	47200	t/y	0.01203	kg/t	20	t/load	12	vehicle gross mass (t)	0.413	km	0.577	kg/VKT	8	% silt content	90	% control	Sealed
AP - Bitumen Delivery and Storage	-															100	% control	Vapour recover system
AP - High quality aggregate delivery and storage	-															100	% control	Already covered as source : One of the FELs located around the processing plant andstockpile area will b
AP - Truck Load Out	-															100	% control	Vapour recover system
AP - Loaded weight of Tanker - bitumen delivery	5	4000	t/y	0.01163	kg/t	20	t/load	32	vehicle gross mass (t)	0.483	km	0.477	kg/VKT	4	% silt content	90	% control	Sealed
AP - Unloaded weight of Tanker - bitument delivery	3	4000	t/y	0.00754	kg/t	20	t/load	12	vehicle gross mass (t)	0.483	km	0.309	kg/VKT	4	% silt content	90	% control	Sealed
AP - Loaded weight of a truck and dog - asphalt to market	40	50000	t/y	0.00807	kg/t	32	t/load	43	vehicle gross mass (t)	0.483	km	0.542	kg/VKT	4	% silt content	90	% control	Sealed
AP - Unloaded weight of a truck and dog - asphalt to market	21	50000	t/y	0.00422	kg/t	32	t/load	10	vehicle gross mass (t)	0.483	km	0.283	kg/VKT	4	% silt content	90	% control	Sealed
TOTAL TSP EMISSIONS	**9,088**																	

Table A 3: $PM_{2.5}$ emissions for Typical day operations

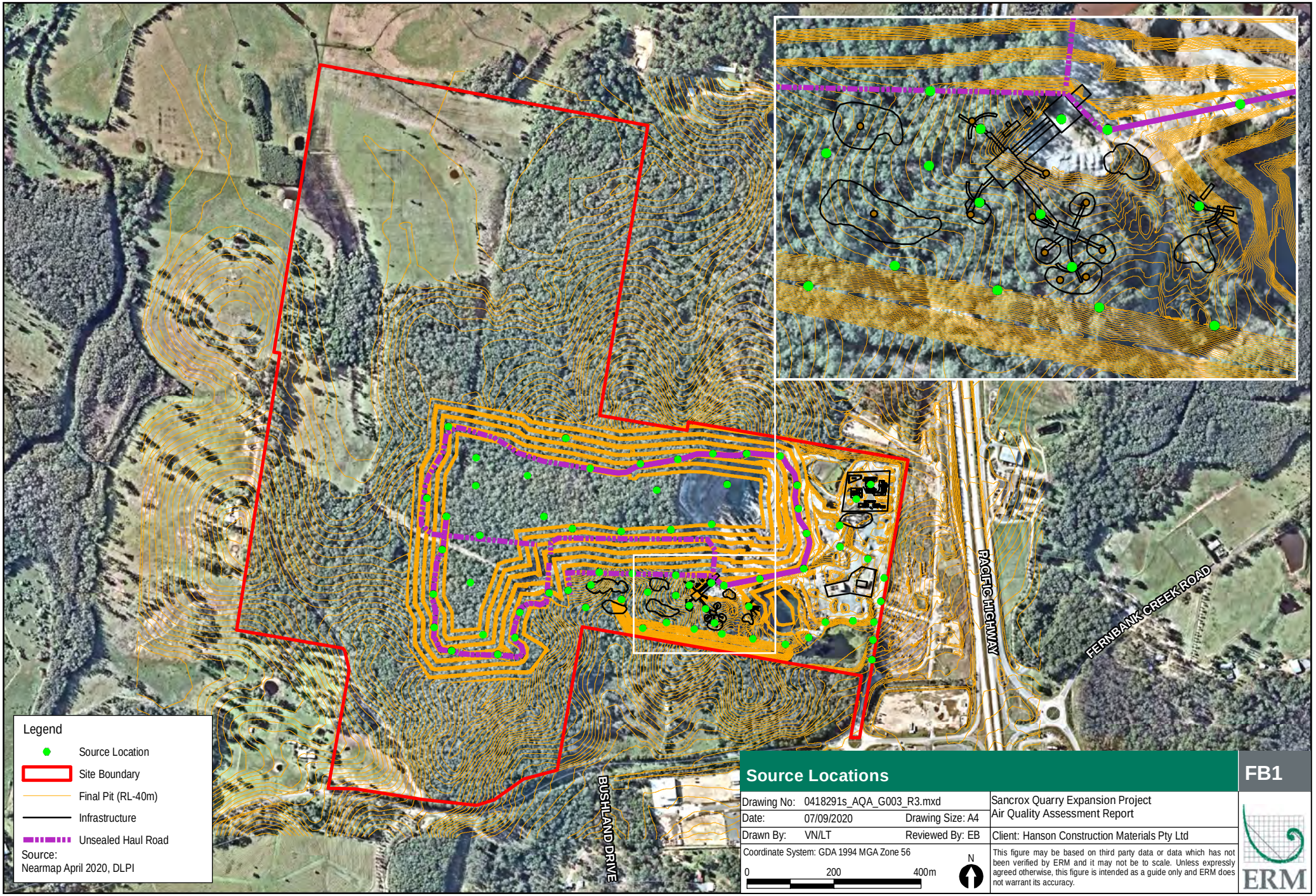
ACTIVITY	Scenario 2 (Stage 5) TSP Emissions (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 3	Units	Variable 4	Units	Control	Units	Control measure
QUARRY - Drilling rock	1	3750	holes/y	0.0177	kg/hole											99	% control	Full dust extraction system, Section B.1.1
QUARRY - Blasting rock	5	30	blasts/y	0.1782	kg/blast	900	Area of blast in square metres									0	% control	n/a. Section 6.2.2
QUARRY - Excavators on Quarry Floor	21	530000	t/y	0.00004	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							0	% control	n/a
QUARRY - Truck Rear Dumping	6	477000	t/y	0.00004	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							70	% control	70% from water sprays, per NPI
QUARRY - FELS	21	530000	t/y	0.00004	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							0	% control	n/a
QUARRY - Primary crushing	24	477000	t/y	0.00005	kg/t											0	% control	no control discussed in report
QUARRY - Secondary crushing	15	298125	t/y	0.00005	kg/t											0	% control	no control discussed in report
QUARRY - Tertiary crushing	12	238500	t/y	0.00005	kg/t											0	% control	no control discussed in report
QUARRY - Primary screening	12	477000	t/y	0.000025	kg/t											0	% control	Wet emission factor used
QUARRY - Primary screening	7	298125	t/y	0.000025	kg/t											0	% control	Wet emission factor used
QUARRY - Conveyor Transfer Points (2)	2	954000	t/y	0.00002	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	9	moisture content (%)							90	% control	90% control from water sprays
QUARRY - Conveyor Drop Points (8)	1	477000	t/y	0.00002	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	9	moisture content (%)							90	% control	90% control from water sprays
QUARRY - Rock Truck - Loaded, Onsite (unsealed)	291	477000	t/y	0.00381	kg/t	37	t/load	68	vehicle gross mass (t)	1.129	km	0.125	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Rock Truck - Unloaded, Onsite (unsealed)	163	477000	t/y	0.00213	kg/t	37	t/load	31	vehicle gross mass (t)	0.902	km	0.087	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Truck and dog - Loaded, Direct to market (unsealed)	31	53000	t/y	0.00365	kg/t	32	t/load	43	vehicle gross mass (t)	1.17	km	0.101	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Truck and dog - Unoaded, Direct to market (unsealed)	12	53000	t/y	0.00147	kg/t	32	t/load	10	vehicle gross mass (t)	0.902	km	0.053	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Rock Truck - Loaded, Onsite (sealed)	69	477000	t/y	0.00145	kg/t	37	t/load	68	vehicle gross mass (t)	0.43	km	0.125	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Rock Truck - Unloaded, Onsite (sealed)	49	477000	t/y	0.00102	kg/t	37	t/load	31	vehicle gross mass (t)	0.43	km	0.087	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Truck and dog - Loaded, Direct to market (sealed)	7	53000	t/y	0.00134	kg/t	32	t/load	43	vehicle gross mass (t)	0.43	km	0.101	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Truck and dog - Unoaded, Direct to market (sealed)	4	53000	t/y	0.00070	kg/t	32	t/load	10	vehicle gross mass (t)	0.43	km	0.053	kg/VKT	8.0	% silt content	90	% control	Sealed
WE - Stockpiles and converyors (STP1-STP10)	72	2.2	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP11)	1	0.04	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP12)	1	0.02	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP13)	1	0.03	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP14)	1	0.02	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP15)	1	0.02	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP16)	1	0.03	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP17)	1	0.02	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP18)	1	0.02	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP19)	2	0.06	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Pit	140	8.500	ha	0.0075	kg/ha/h	8760	h									75	% control	Only 25% of area susceptable to WE at any one time.
CRP - Truck Rear Dumping	1	20000	t/y	0.00014	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							70	% control	70% from water sprays, per NPI
CRP - Crushing	1	20000	t/y	0.00005	kg/t											0	% control	no control discussed in report
CRP - Truck and dog - Delivery of Dry Products	3	20000	t/y	0.00129	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	0.101	kg/VKT	8	% silt content	90	% control	Sealed
CRP - Truck and dog - Delivery of Dry Products	1	20000	t/y	0.00067	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.053	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Coarse Aggregate - Truck Rear Dumpings	1	21868	t/y	0.00014	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							70	% control	70% from water sprays, per NPI
CBP - Sand - Truck Rear Dumping	0	16750	t/y	0.00004	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							70	% control	70% from water sprays, per NPI
CBP - Transfer of Aggregate	0	21868	t/y	0.00014	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							90	% control	90% control from water sprays
CBP - Transfer of Sand	0	16750	t/y	0.00004	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							90	% control	90% control from water sprays
CBP - Loaded weight of a truck and dog - coarse aggregate	3	21868	t/y	0.00129	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	0.101	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of a truck and dog - coarse aggregate	1	21868	t/y	0.00067	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.053	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of a truck and dog - Sand	2	16750	t/y	0.00129	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	0.101	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of a truck and dog - Sand	1	16750	t/y	0.00067	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.053	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of Tanker - cement and cement supplement brought onsit	1	6617	t/y	0.00186	kg/t	20	t/load	32	vehicle gross mass (t)	0.413	km	0.089	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of Tanker - cement and cement supplement brought on	1	6617	t/y	0.00120	kg/t	20	t/load	12	vehicle gross mass (t)	0.413	km	0.058	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of Agitator truck - product taken offsite	9	47200	t/y	0.00186	kg/t	20	t/load	32	vehicle gross mass (t)	0.413	km	0.089	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of Agitator truck - product taken offsite	6	47200	t/y	0.00120	kg/t	20	t/load	12	vehicle gross mass (t)	0.413	km	0.058	kg/VKT	8	% silt content	90	% control	Sealed
AP - Bitumen Delivery and Storage	-															100	% control	Vapour recover system
AP - High quality aggregate delivery and storage	-															100	% control	Already covered as source : One of the FELs located around the processing plant andstockpile area will b
AP - Truck Load Out	-															100	% control	Vapour recover system
AP - Loaded weight of Tanker - bitumen delivery	0	4000	t/y	0.00116	kg/t	20	t/load	32	vehicle gross mass (t)	0.483	km	0.048	kg/VKT	4	% silt content	90	% control	Sealed
AP - Unloaded weight of Tanker - bitument delivery	0	4000	t/y	0.00075	kg/t	20	t/load	12	vehicle gross mass (t)	0.483	km	0.031	kg/VKT	4	% silt content	90	% control	Sealed
AP - Loaded weight of a truck and dog - asphalt to market	4	50000	t/y	0.00081	kg/t	32	t/load	43	vehicle gross mass (t)	0.483	km	0.054	kg/VKT	4	% silt content	90	% control	Sealed
AP - Unloaded weight of a truck and dog - asphalt to market	2	50000	t/y	0.00042	kg/t	32	t/load	10	vehicle gross mass (t)	0.483	km	0.028	kg/VKT	4	% silt content	90	% control	Sealed
TOTAL TSP EMISSIONS	**1,010**																	

Table A 4: PM_{10} emissions for Maximum day operations

ACTIVITY	Scenario 2 (Stage 5) TSP Emissions (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 3	Units	Variable 4	Units	Control	Units	Control measure
QUARRY - Drilling rock	-	45625	holes/y	0.3068	kg/hole											100	% control	Drilling will not occur on the same day as a blast.
QUARRY - Blasting rock	1,127	365	blasts/y	3.0888	kg/blast	900	Area of blast in square metres									0	% control	n/a. Section 6.2.2
QUARRY - Excavators on Quarry Floor	246	949000	t/y	0.00026	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							0	% control	n/a
QUARRY - Truck Rear Dumping	66	854100	t/y	0.00026	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							70	% control	70% from water sprays, per NPI
QUARRY - FELS	246	949000	t/y	0.00026	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							0	% control	n/a
QUARRY - Primary crushing	231	854100	t/y	0.00027	kg/t											0	% control	no control discussed in report
QUARRY - Secondary crushing	231	854100	t/y	0.00027	kg/t											0	% control	no control discussed in report
QUARRY - Tertiary crushing	144	533813	t/y	0.00027	kg/t											0	% control	no control discussed in report
QUARRY - Primary screening	316	854100	t/y	0.00037	kg/t											0	% control	Wet emission factor used
QUARRY - Primary screening	316	854100	t/y	0.00037	kg/t											0	% control	Wet emission factor used
QUARRY - Conveyor Transfer Points (2)	19	1708200	t/y	0.00011	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	9	moisture content (%)							90	% control	90% control from water sprays
QUARRY - Conveyor Drop Points (8)	10	854100	t/y	0.00011	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	9	moisture content (%)							90	% control	90% control from water sprays
QUARRY - Rock Truck - Loaded, Onsite (unsealed)	5,207	854100	t/y	0.03810	kg/t	37	t/load	68	vehicle gross mass (t)	1.129	km	1.246	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Rock Truck - Unloaded, Onsite (unsealed)	2,915	854100	t/y	0.02133	kg/t	37	t/load	31	vehicle gross mass (t)	0.902	km	0.873	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Truck and dog - Loaded, Direct to market (unsealed)	554	94900	t/y	0.03647	kg/t	32	t/load	43	vehicle gross mass (t)	1.17	km	1.011	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Truck and dog - Unoaded, Direct to market (unsealed)	223	94900	t/y	0.01471	kg/t	32	t/load	10	vehicle gross mass (t)	0.902	km	0.529	kg/VKT	8.0	% silt content	84	% control	Chemical supressant
QUARRY - Rock Truck - Loaded, Onsite (sealed)	1,239	854100	t/y	0.01451	kg/t	37	t/load	68	vehicle gross mass (t)	0.43	km	1.246	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Rock Truck - Unloaded, Onsite (sealed)	869	854100	t/y	0.01017	kg/t	37	t/load	31	vehicle gross mass (t)	0.43	km	0.873	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Truck and dog - Loaded, Direct to market (sealed)	127	94900	t/y	0.01341	kg/t	32	t/load	43	vehicle gross mass (t)	0.43	km	1.011	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Truck and dog - Unoaded, Direct to market (sealed)	67	94900	t/y	0.00701	kg/t	32	t/load	10	vehicle gross mass (t)	0.43	km	0.529	kg/VKT	8.0	% silt content	90	% control	Sealed
WE - Stockpiles and converyors (STP1-STP10)	482	2.2	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP11)	9	0.04	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP12)	4	0.02	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP13)	7	0.03	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP14)	4	0.02	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP15)	4	0.02	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP16)	7	0.03	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP17)	4	0.02	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP18)	4	0.02	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP19)	13	0.06	ha	0.05	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Pit	931	8.500	ha	0.05	kg/ha/h	8760	h									75	% control	Only 25% of area susceptable to WE at any one time.
CRP - Truck Rear Dumping	6	20000	t/y	0.00094	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							70	% control	70% from water sprays, per NPI
CRP - Crushing	5	20000	t/y	0.00027	kg/t											0	% control	no control discussed in report
CRP - Truck and dog - Delivery of Dry Products	26	20000	t/y	0.01288	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	1.011	kg/VKT	8	% silt content	90	% control	Sealed
CRP - Truck and dog - Delivery of Dry Products	13	20000	t/y	0.00674	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.529	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Coarse Aggregate - Truck Rear Dumpings	6	21868	t/y	0.00094	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							70	% control	70% from water sprays, per NPI
CBP - Sand - Truck Rear Dumping	1	16750	t/y	0.00026	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							70	% control	70% from water sprays, per NPI
CBP - Transfer of Aggregate	2	21868	t/y	0.00094	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							90	% control	90% control from water sprays
CBP - Transfer of Sand	0	16750	t/y	0.00026	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							90	% control	90% control from water sprays
CBP - Loaded weight of a truck and dog - coarse aggregate	28	21868	t/y	0.01288	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	1.011	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of a truck and dog - coarse aggregate	15	21868	t/y	0.00674	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.529	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of a truck and dog - Sand	22	16750	t/y	0.01288	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	1.011	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of a truck and dog - Sand	11	16750	t/y	0.00674	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.529	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of Tanker - cement and cement supplement brought onsit	12	6617	t/y	0.01856	kg/t	20	t/load	32	vehicle gross mass (t)	0.413	km	0.890	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of Tanker - cement and cement supplement brought on	8	6617	t/y	0.01203	kg/t	20	t/load	12	vehicle gross mass (t)	0.413	km	0.577	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of Agitator truck - product taken offsite	88	47200	t/y	0.01856	kg/t	20	t/load	32	vehicle gross mass (t)	0.413	km	0.890	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of Agitator truck - product taken offsite	57	47200	t/y	0.01203	kg/t	20	t/load	12	vehicle gross mass (t)	0.413	km	0.577	kg/VKT	8	% silt content	90	% control	Sealed
AP - Bitumen Delivery and Storage	-															100	% control	Vapour recover system
AP - High quality aggregate delivery and storage	-															100	% control	Already covered as source : One of the FELs located around the processing plant andstockpile area will b
AP - Truck Load Out	-															100	% control	Vapour recover system
AP - Loaded weight of Tanker - bitumen delivery	5	4000	t/y	0.01163	kg/t	20	t/load	32	vehicle gross mass (t)	0.483	km	0.477	kg/VKT	4	% silt content	90	% control	Sealed
AP - Unloaded weight of Tanker - bitument delivery	3	4000	t/y	0.00754	kg/t	20	t/load	12	vehicle gross mass (t)	0.483	km	0.309	kg/VKT	4	% silt content	90	% control	Sealed
AP - Loaded weight of a truck and dog - asphalt to market	40	50000	t/y	0.00807	kg/t	32	t/load	43	vehicle gross mass (t)	0.483	km	0.542	kg/VKT	4	% silt content	90	% control	Sealed
AP - Unloaded weight of a truck and dog - asphalt to market	21	50000	t/y	0.00422	kg/t	32	t/load	10	vehicle gross mass (t)	0.483	km	0.283	kg/VKT	4	% silt content	90	% control	Sealed
TOTAL TSP EMISSIONS	**15,993**																	

Table A 5: $PM_{2.5}$ emissions for Maximum day operations

ACTIVITY	Scenario 2 (Stage 5) TSP Emissions (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 3	Units	Variable 4	Units	Control	Units	Control measure
QUARRY - Drilling rock	-	45625	holes/y	0.0177	kg/hole											100	% control	Drilling will not occur on the same day as a blast.
QUARRY - Blasting rock	65	365	blasts/y	0.1782	kg/blast	900	Area of blast in square metres									0	% control	n/a. Section 6.2.2
QUARRY - Excavators on Quarry Floor	37	949000	t/y	0.00004	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							0	% control	n/a
QUARRY - Truck Rear Dumping	10	854100	t/y	0.00004	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							70	% control	70% from water sprays, per NPI
QUARRY - FELS	37	949000	t/y	0.00004	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							0	% control	n/a
QUARRY - Primary crushing	43	854100	t/y	0.00005	kg/t											0	% control	no control discussed in report
QUARRY - Secondary crushing	43	854100	t/y	0.00005	kg/t											0	% control	no control discussed in report
QUARRY - Tertiary crushing	27	533813	t/y	0.00005	kg/t											0	% control	no control discussed in report
QUARRY - Primary screening	21	854100	t/y	0.000025	kg/t											0	% control	Wet emission factor used
QUARRY - Primary screening	21	854100	t/y	0.000025	kg/t											0	% control	Wet emission factor used
QUARRY - Conveyor Transfer Points (2)	3	1708200	t/y	0.00002	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	9	moisture content (%)							90	% control	90% control from water sprays
QUARRY - Conveyor Drop Points (8)	1	854100	t/y	0.00002	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	9	moisture content (%)							90	% control	90% control from water sprays
QUARRY - Rock Truck - Loaded, Onsite (unsealed)	521	854100	t/y	0.00381	kg/t	37	t/load	68	vehicle gross mass (t)	1.129	km	0.125	kg/VKT	8.0	% silt content	84	% control	Assumes Level 2 watering.
QUARRY - Rock Truck - Unloaded, Onsite (unsealed)	292	854100	t/y	0.00213	kg/t	37	t/load	31	vehicle gross mass (t)	0.902	km	0.087	kg/VKT	8.0	% silt content	84	% control	Assumes Level 2 watering.
QUARRY - Truck and dog - Loaded, Direct to market (unsealed)	55	94900	t/y	0.00365	kg/t	32	t/load	43	vehicle gross mass (t)	1.17	km	0.101	kg/VKT	8.0	% silt content	84	% control	Assumes Level 2 watering.
QUARRY - Truck and dog - Unoaded, Direct to market (unsealed)	22	94900	t/y	0.00147	kg/t	32	t/load	10	vehicle gross mass (t)	0.902	km	0.053	kg/VKT	8.0	% silt content	84	% control	Assumes Level 2 watering.
QUARRY - Rock Truck - Loaded, Onsite (sealed)	124	854100	t/y	0.00145	kg/t	37	t/load	68	vehicle gross mass (t)	0.43	km	0.125	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Rock Truck - Unloaded, Onsite (sealed)	87	854100	t/y	0.00102	kg/t	37	t/load	31	vehicle gross mass (t)	0.43	km	0.087	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Truck and dog - Loaded, Direct to market (sealed)	13	94900	t/y	0.00134	kg/t	32	t/load	43	vehicle gross mass (t)	0.43	km	0.101	kg/VKT	8.0	% silt content	90	% control	Sealed
QUARRY - Truck and dog - Unoaded, Direct to market (sealed)	7	94900	t/y	0.00070	kg/t	32	t/load	10	vehicle gross mass (t)	0.43	km	0.053	kg/VKT	8.0	% silt content	90	% control	Sealed
WE - Stockpiles and converyors (STP1-STP10)	72	2.2	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP11)	1	0.04	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP12)	1	0.02	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP13)	1	0.03	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP14)	1	0.02	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP15)	1	0.02	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP16)	1	0.03	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP17)	1	0.02	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP18)	1	0.02	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Stockpiles and conveyors (STP19)	2	0.06	ha	0.0075	kg/ha/h	8760	h									50	% control	50% control from use of water sprays
WE - Pit	140	8.500	ha	0.0075	kg/ha/h	8760	h									75	% control	Only 25% of area susceptable to WE at any one time.
CRP - Truck Rear Dumping	1	20000	t/y	0.00014	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							70	% control	70% from water sprays, per NPI
CRP - Crushing	1	20000	t/y	0.00005	kg/t											0	% control	no control discussed in report
CRP - Truck and dog - Delivery of Dry Products	3	20000	t/y	0.00129	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	0.101	kg/VKT	8	% silt content	90	% control	Sealed
CRP - Truck and dog - Delivery of Dry Products	1	20000	t/y	0.00067	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.053	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Coarse Aggregate - Truck Rear Dumpings	1	21868	t/y	0.00014	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							70	% control	70% from water sprays, per NPI
CBP - Sand - Truck Rear Dumping	0	16750	t/y	0.00004	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							70	% control	70% from water sprays, per NPI
CBP - Transfer of Aggregate	0	21868	t/y	0.00014	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)							90	% control	90% control from water sprays
CBP - Transfer of Sand	0	16750	t/y	0.00004	kg/t	1.67	average of (wind speed/2.2)^1.3 in m/s	5	moisture content (%)							90	% control	90% control from water sprays
CBP - Loaded weight of a truck and dog - coarse aggregate	3	21868	t/y	0.00129	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	0.101	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of a truck and dog - coarse aggregate	1	21868	t/y	0.00067	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.053	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of a truck and dog - Sand	2	16750	t/y	0.00129	kg/t	32	t/load	43	vehicle gross mass (t)	0.413	km	0.101	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of a truck and dog - Sand	1	16750	t/y	0.00067	kg/t	32	t/load	10	vehicle gross mass (t)	0.413	km	0.053	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of Tanker - cement and cement supplement brought onsit	1	6617	t/y	0.00186	kg/t	20	t/load	32	vehicle gross mass (t)	0.413	km	0.089	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of Tanker - cement and cement supplement brought on	1	6617	t/y	0.00120	kg/t	20	t/load	12	vehicle gross mass (t)	0.413	km	0.058	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Loaded weight of Agitator truck - product taken offsite	9	47200	t/y	0.00186	kg/t	20	t/load	32	vehicle gross mass (t)	0.413	km	0.089	kg/VKT	8	% silt content	90	% control	Sealed
CBP - Unloaded weight of Agitator truck - product taken offsite	6	47200	t/y	0.00120	kg/t	20	t/load	12	vehicle gross mass (t)	0.413	km	0.058	kg/VKT	8	% silt content	90	% control	Sealed
AP - Bitumen Delivery and Storage	-															100	% control	Vapour recover system
AP - High quality aggregate delivery and storage	-															100	% control	Already covered as source : One of the FELs located around the processing plant andstockpile area will b
AP - Truck Load Out	-															100	% control	Vapour recover system
AP - Loaded weight of Tanker - bitumen delivery	0	4000	t/y	0.00116	kg/t	20	t/load	32	vehicle gross mass (t)	0.483	km	0.048	kg/VKT	4	% silt content	90	% control	Sealed
AP - Unloaded weight of Tanker - bitument delivery	0	4000	t/y	0.00075	kg/t	20	t/load	12	vehicle gross mass (t)	0.483	km	0.031	kg/VKT	4	% silt content	90	% control	Sealed
AP - Loaded weight of a truck and dog - asphalt to market	4	50000	t/y	0.00081	kg/t	32	t/load	43	vehicle gross mass (t)	0.483	km	0.054	kg/VKT	4	% silt content	90	% control	Sealed
AP - Unloaded weight of a truck and dog - asphalt to market	2	50000	t/y	0.00042	kg/t	32	t/load	10	vehicle gross mass (t)	0.483	km	0.028	kg/VKT	4	% silt content	90	% control	Sealed
TOTAL TSP EMISSIONS	**1,688**																	


PACIFIC HIGHWAY
FERNBANK CREEK ROAD
BUSHLAND DRIVE
Legend
Source Location
Site Boundary
Final Pit (RL-40m)
Infrastructure
Unsealed Haul Road
Source:
Nearmap April 2020, DLPI
Source Locations
FB1
Drawing No: 0418291s_AQA_G003_R3.mxd
Date: 07/09/2020
Drawing Size: A4
Drawn By: VN/LT
Reviewed By: EB
Coordinate System: GDA 1994 MGA Zone 56
0
200
400m
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Sancrox Quarry Expansion Project
Air Quality Assessment Report
Client: Hanson Construction Materials Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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APPENDIX B SCREENING ASSESSMENT

B1 SCREENING ASSESSMENT

There are a number of species of metals, combustion related emissions and organic compounds that have the potential to be released from both the concrete batching and asphalt plants. The emissions from these sources are small, and therefore a screening assessment was completed to determine which sources and species should be taken forward to dispersion modelling. It should be noted that particulate matter from these sources was not subject to the screening method, as it was considered that given the contribution from other sources at the Site, additional emissions from these sources should be included in the cumulative assessment.

The screening assessment for the concrete batching and asphalt plants was undertaken in accordance with UK 'Air emissions risk assessment for your environmental permit guidance' (UK Department for Environment, Food and Rural Affairs Environment Agency, 2016) using emission rates provided in Table 5-2. The Guidance provides dispersion factors expressed as µg/m^3/g/sec for a variety of release heights and averaging periods (Table B1) (UK Department for Environment, Food and Rural Affairs Environment Agency, 2016).Body Text style. Used as the general text throughout.

Table B1: Dispersion factors provided in the Air Emissions Risk Assessment for your Environmental Permit Guidance (UK Department for Environment, Food and Rural Affairs Environment Agency, 2016)

Effective height of release in metres	Annual dispersion factor	Monthly dispersion factor	Hourly dispersion factor
0	148	529	3900
10	32	33.7	580
20	4.6	6.2	161
30	1.7	2.3	77
50	0.52	0.68	31
70	0.24	0.31	16
100	0.11	0.13	8.6
150	0.048	0.052	4
200	0.023	0.026	2.3

The release height of bag filter at the concrete batching facility was assumed to be 5 metres based on the information from a similar type of facility (Environmental Resources Management Australia Pty Ltd, 2017). The release height of the point source at the asphalt plant of 5 metres was adopted based on the technical data specification for Benninghoven Asphalt Mixing Plants (A Wirtgen Group Company, n.d.).

A linear interpolation method was used to derive the dispersion factor for the height of 5 metres using the dispersion factors in Table B1 (Equation B 1). The relevant dispersion factors are provided in Table B2.

Equation B 1 Linear interpolation of dispersion factors provided in the Air Emissions Risk Assessment for your Environmental Permit Guidance (UK Department for Environment, Food and Rural Affairs Environment Agency, 2016)

$$\mathrm{DF}_{n+1} = \frac{(H_{n+1} - H_n)(DF_{n+2} - DF_n)}{(H_{n+2} - H_n)} + DF_n$$

Where:
DF_n and DF_{n+2} are dispersion factors provided in the Guidance in µg/m^3/g/sec
DF_{n+1} is the dispersion factor required in µg/m^3/g/sec
H_n and H_{n+2} are the associated effective heights of release in metres; and
H_{n+1} is the required release height in metres.

Table B2: Dispersion factors adopted in the assessment

Averaging period	Dispersion factor (µg/m^3/g/sec)[1]
10 minute	2,375[5]
15 minute	2,224[3]
30 minute	1,907[5]
1 hour	1,660
8 hour	1,162[4]
24 hour	979[2]
Annual	58

1. The dispersion factors presented in Table are subject to interpolation of the dispersion factors provided in the Guidance;

2. 24 hour dispersion factor was derived from the hourly dispersion factor using factor of 0.59 as recommended in the Guidance;

3. 15 minute dispersion factor was derived from the hourly dispersion factor using factor of 1.34 as recommended in the Guidance;

4. 8 hour dispersion factor was derived from the hourly dispersion factor using factor of 0.7 as recommended in the Guidance;

5. Conversion of 1 hour model results to 10 minute and 30 minute averages has been undertaken using the peak to mean ratio as described in Victorian EPA Publication 1551 (Environment Protection Authority Victoria, 2013).

Equation B-2, contained within the Guidance, was used to combine the emission rates in Table 5-2 with the dispersion factors in Table B2 to provide the estimated maximum short-term and long-term ground level concentrations attributed to each source.

Equation B 2 Estimation environmental concentrations for the species

$$EC = ER \times DF$$

Where:
EC is the environmental concentration of the species in micrograms per cubic meter
ER is emission rate in gram per second
DF is dispersion factor in micrograms per cubic metre per gram per second

Table provides short-term and long-term environmental concentrations for species emitted from concrete batching plant.

Table B3: Short-term and long-term contribution to environmental concentrations for species emitted from concrete batching plant

	Concentration (ug/m^3)	Criterion (ug/m^3)	Percent (%)
Arsenic	0.0004	0.09	0.4
Cadmium	$8.8x10^{-7}$	0.018	0.0
Chromium	0.0002	0.09	0.2
Lead	$1.6x10^{-6}$	0.5	0.0
Manganese	0.005	18	0.0
Nickel	0.0003	0.18	0.2

The Guidance outlines that the following criteria must be met in order to screen out species that result in an insignificant contribution to ambient air quality and for which no further assessment is required (UK Department for Environment, Food and Rural Affairs Environment Agency, 2016):

- The estimated short-term environmental concentration is less than 10% of the short-term environmental standard; and
- The estimated long-term environmental concentration is less than 1% of the long-term environmental standard.

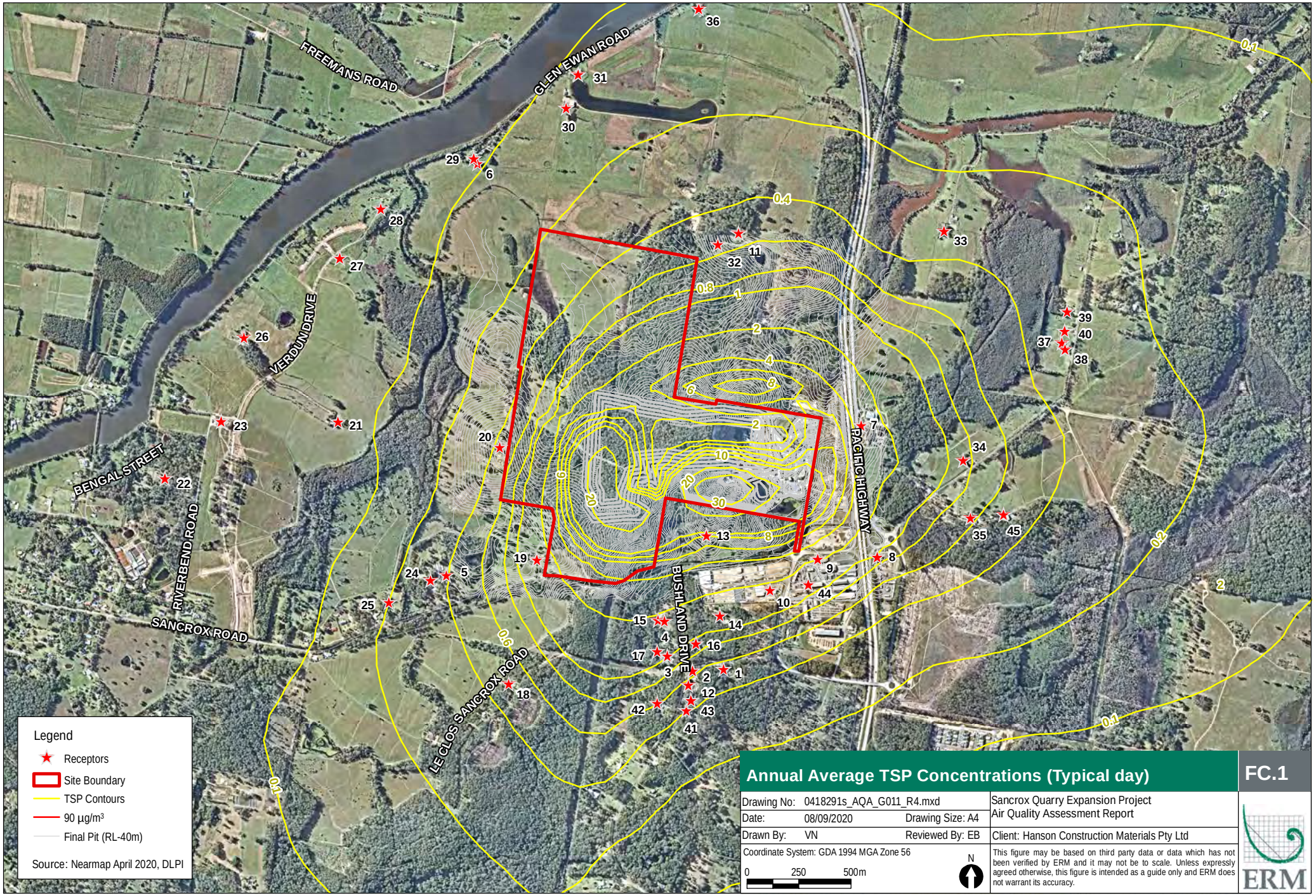
Table B4 indicates that the total short-term environmental concentrations related to the batching plant are below 10 percent of the relevant criteria for all species and the total long-term environmental concentrations are below one percent of the relevant criteria for all species. It is therefore considered that emissions from the concrete batching facility are not likely to be significant contributors to ambient air quality concentrations and no further assessment is required. It should be also considered that dispersion factors in the Guidance result in a very conservative assessment and the environmental concentrations for the species in reality will be much lower than presented in Table B4.

- Table B4 provides short-term and long-term environmental concentrations for species emitted from asphalt plant. Table B4 indicates that the total short-term environmental concentrations are below 10 percent of the relevant criteria for all species, except for NO_2, formaldehyde, PAH and nickel, and the total long-term environmental concentrations are below one percent of the relevant criteria for all species, except for NO_2. Only NO_2, formaldehyde, PAH and nickel were included in the dispersion modelling and no further assessment was required for any other species contained in Table B4 It should be also considered that dispersion factors in the Guidance result in a very conservative assessment and the environmental concentrations for the species in reality will be much lower than presented in Table B4.

Table B4: Short-term and long-term contribution to environmental concentrations for species emitted from asphalt plant

Species	Averaging period	Concentration (ug/m^3)	Criterion (ug/m^3)	Percent (%)
NO_2	1 hour	34.2	246	**13.91**
	Annual	1.2	62	**1.93**
Formaldehyde	1 hour	4.1	20	**20.40**
PAH	1 hour	0.3	0.4	**62.51**
Nickel	1 hour	0.1	0.18	**46.06**
CO	15 min	229.2	100000	0.23
	1 hour	171.1	30000	0.57
	8 hour	119.7	10000	1.20
SO_2	10 min	6.4	712	0.90
	1 hour	4.5	570	0.78
	24 hour	2.6	228	1.16
	Annual	0.2	60	0.26
Benzene	1 hour	0.5	29	1.77
Ethylbenzene	1 hour	0.3	8000	0.00
Hexane	1 hour	1.2	3200	0.04
Methyl chloroform	1 hour	0.1	12500	0.00
Toluene	1 hour	0.2	360	0.05
Xylene	1 hour	0.3	190	0.14
Heptane	30 min	16.6	33000	0.05
n-Pentane	1 hour	0.3	33000	0.00
Antimony	1 hour	0.0002	9	0.00
Arsenic	1 hour	0.0007	0.09	0.82
Barium	1 hour	0.008	9	0.08
Cadmium	1 hour	0.0005	0.018	3.00
Chromium	1 hour	0.007	9	0.08
Copper	1 hour	0.004	3.7	0.11
Hexavalent Chromium	1 hour	0.0006	0.09	0.66
Lead	Annual	0.00003	0.5	0.01
Manganese	1 hour	0.0101	18	0.06
Mercury	1 hour	0.0004	0.18	0.25
Silver	1 hour	0.0006	0.18	0.35
Zinc	30 min	0.09	100	0.09
	24 hour	0.05	120	0.04
Asphalt petroleum fumes	1 hour	6.9	90	7.66

APPENDIX C CONTOUR PLOTS


FREEMANS ROAD
GLEN EWAN ROAD
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
PACIFIC HIGHWAY
Legend
Receptors
Site Boundary
TSP Contours
90 µg/m³
Final Pit (RL-40m)
Source: Nearmap April 2020, DLPI
Annual Average TSP Concentrations (Typical day)
FC.1
Drawing No: 0418291s_AQA_G011_R4.mxd
Date: 08/09/2020
Drawing Size: A4
Drawn By: VN
Reviewed By: EB
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Air Quality Assessment Report
Client: Hanson Construction Materials Pty Ltd
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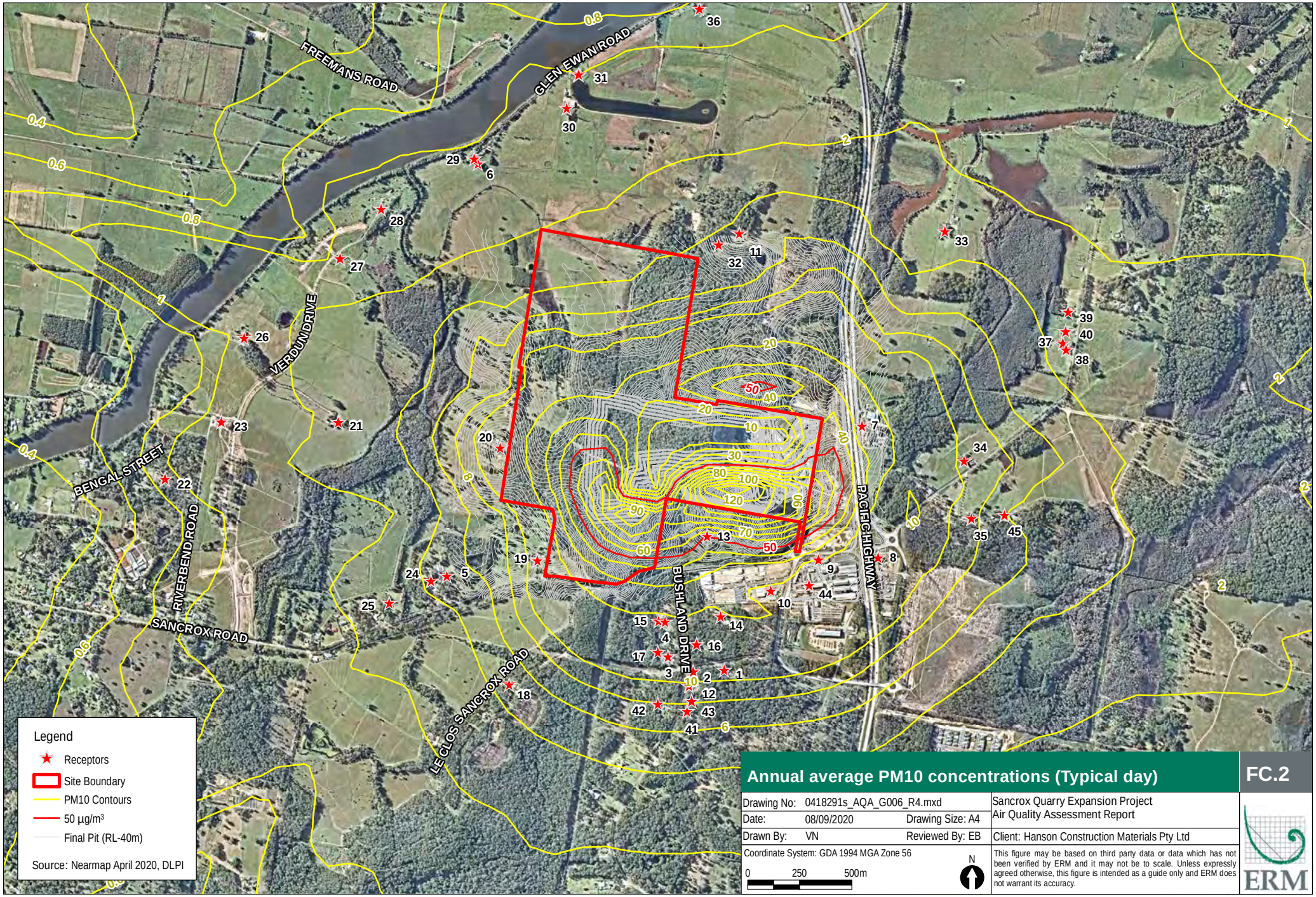
ERM



Annual average PM10 concentrations (Typical day)

FC.2

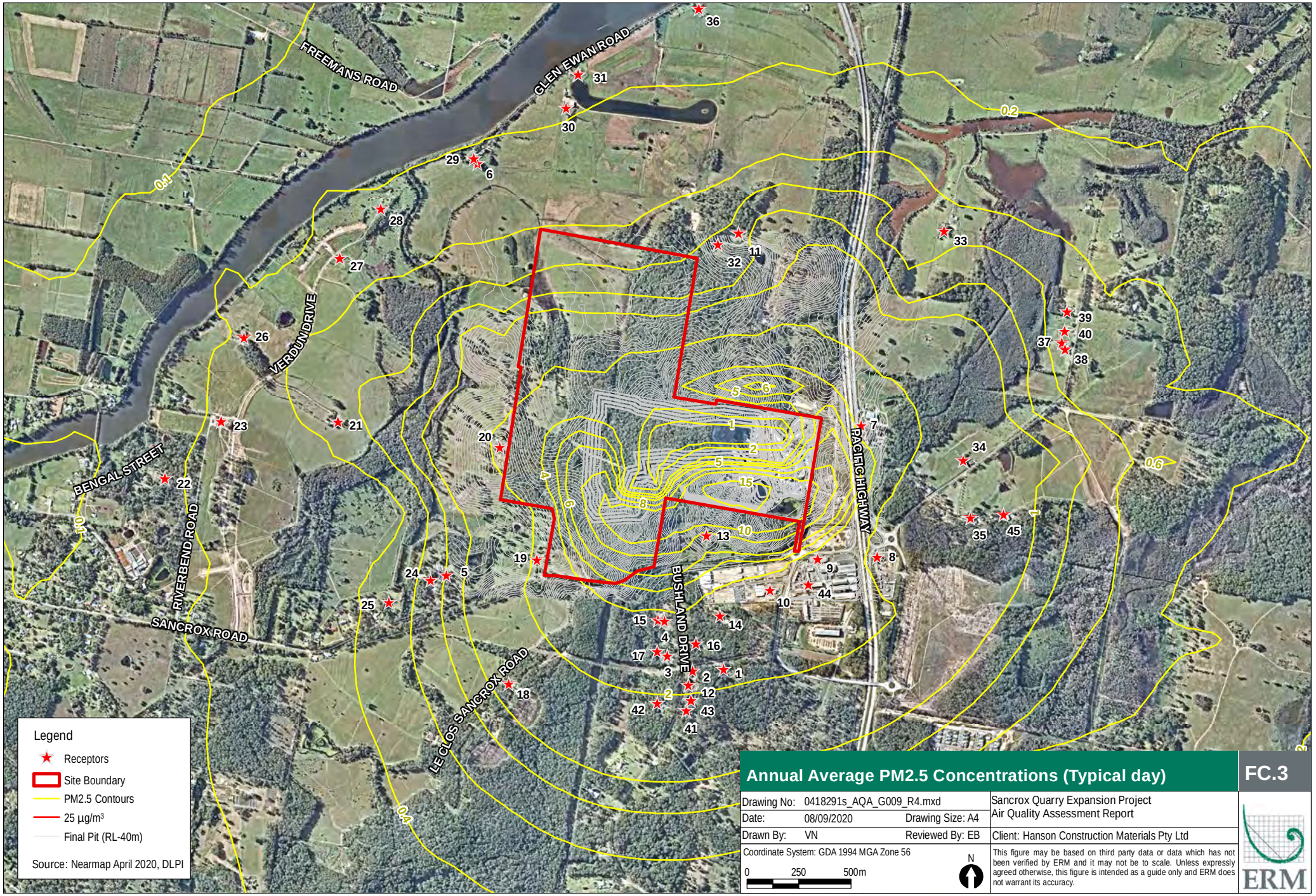
Drawing No:	0418291s_AQA_G006_R4.mxd		Sancrox Quarry Expansion Project Air Quality Assessment Report
Date:	08/09/2020	Drawing Size: A4	
Drawn By:	VN	Reviewed By: EB	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 250 500m

N

ERM


FREEMANS ROAD
GLEN EWAN ROAD
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
BUSHLAND DRIVE
LE CLOS SANCROX ROAD
PACIFIC HIGHWAY
Legend
Receptors
Site Boundary
PM2.5 Contours
25 µg/m³
Final Pit (RL-40m)
Source: Nearmap April 2020, DLPI
Annual Average PM2.5 Concentrations (Typical day)
FC.3
Drawing No: 0418291s_AQA_G009_R4.mxd
Date: 08/09/2020
Drawing Size: A4
Drawn By: VN
Reviewed By: EB
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Air Quality Assessment Report
Client: Hanson Construction Materials Pty Ltd
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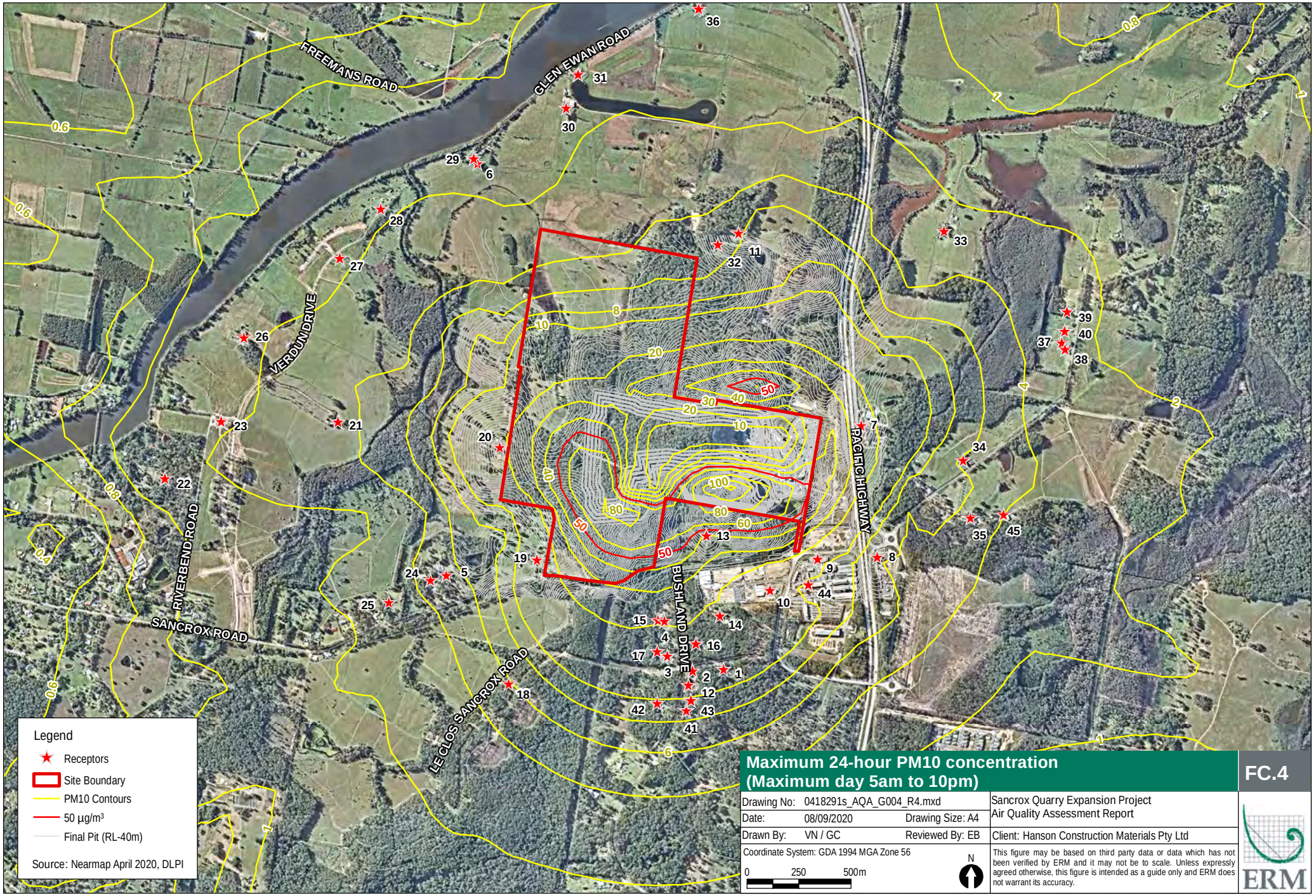
ERM


FREEMANS ROAD
GLEN EWAN ROAD
VERDUN DRIVE
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
PACIFIC HIGHWAY
Legend
Receptors
Site Boundary
PM10 Contours
50 µg/m³
Final Pit (RL-40m)
Source: Nearmap April 2020, DLPI
Maximum 24-hour PM10 concentration
(Maximum day 5am to 10pm)
FC.4
Drawing No: 0418291s_AQA_G004_R4.mxd
Date: 08/09/2020
Drawing Size: A4
Drawn By: VN / GC
Reviewed By: EB
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Air Quality Assessment Report
Client: Hanson Construction Materials Pty Ltd
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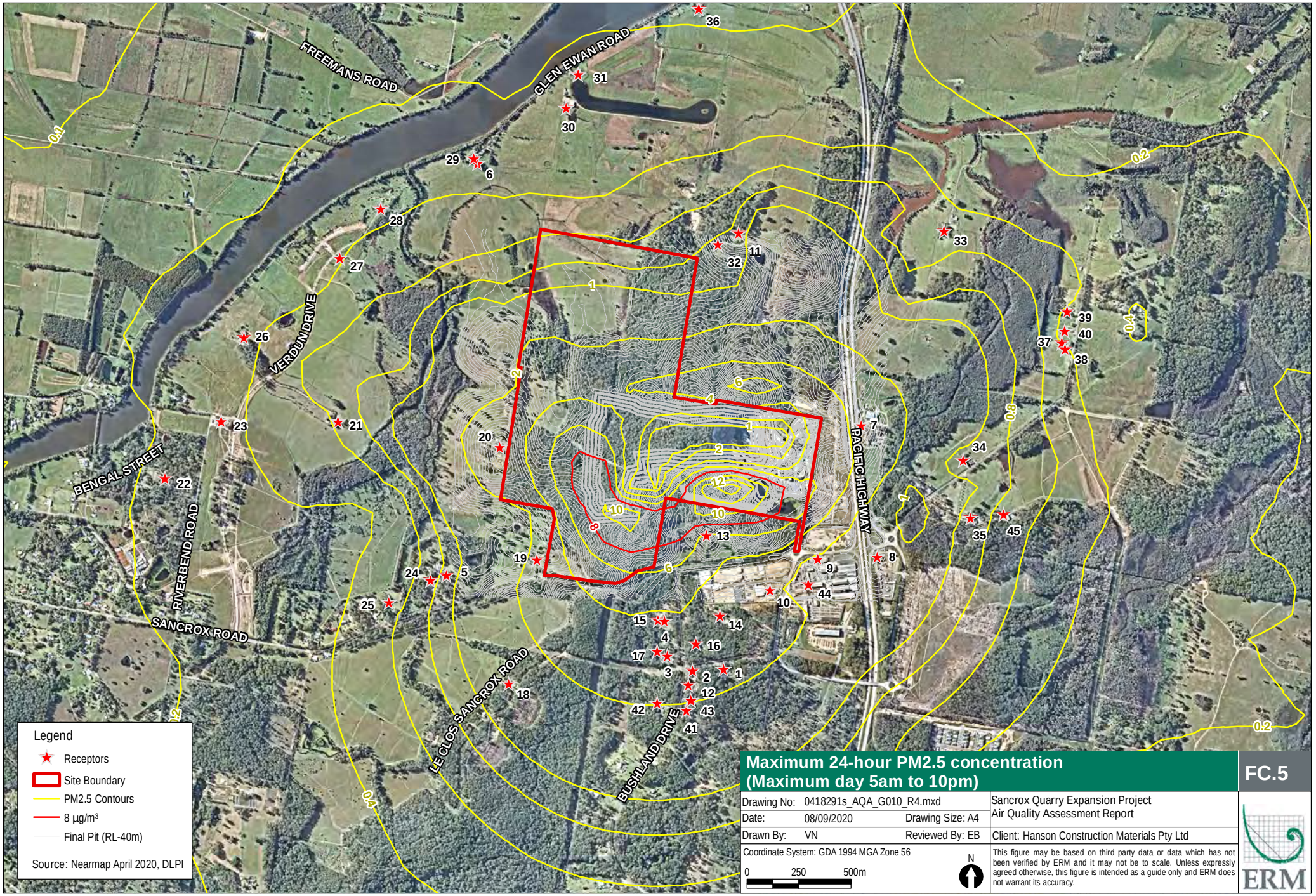
FREEMANS ROAD
GLEN EWAN ROAD
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
PACIFIC HIGHWAY
Legend
Receptors
Site Boundary
PM2.5 Contours
8 µg/m³
Final Pit (RL-40m)
Source: Nearmap April 2020, DLPI
Maximum 24-hour PM2.5 concentration
(Maximum day 5am to 10pm)
FC.5
Drawing No: 0418291s_AQA_G010_R4.mxd
Date: 08/09/2020
Drawing Size: A4
Drawn By: VN
Reviewed By: EB
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Air Quality Assessment Report
Client: Hanson Construction Materials Pty Ltd
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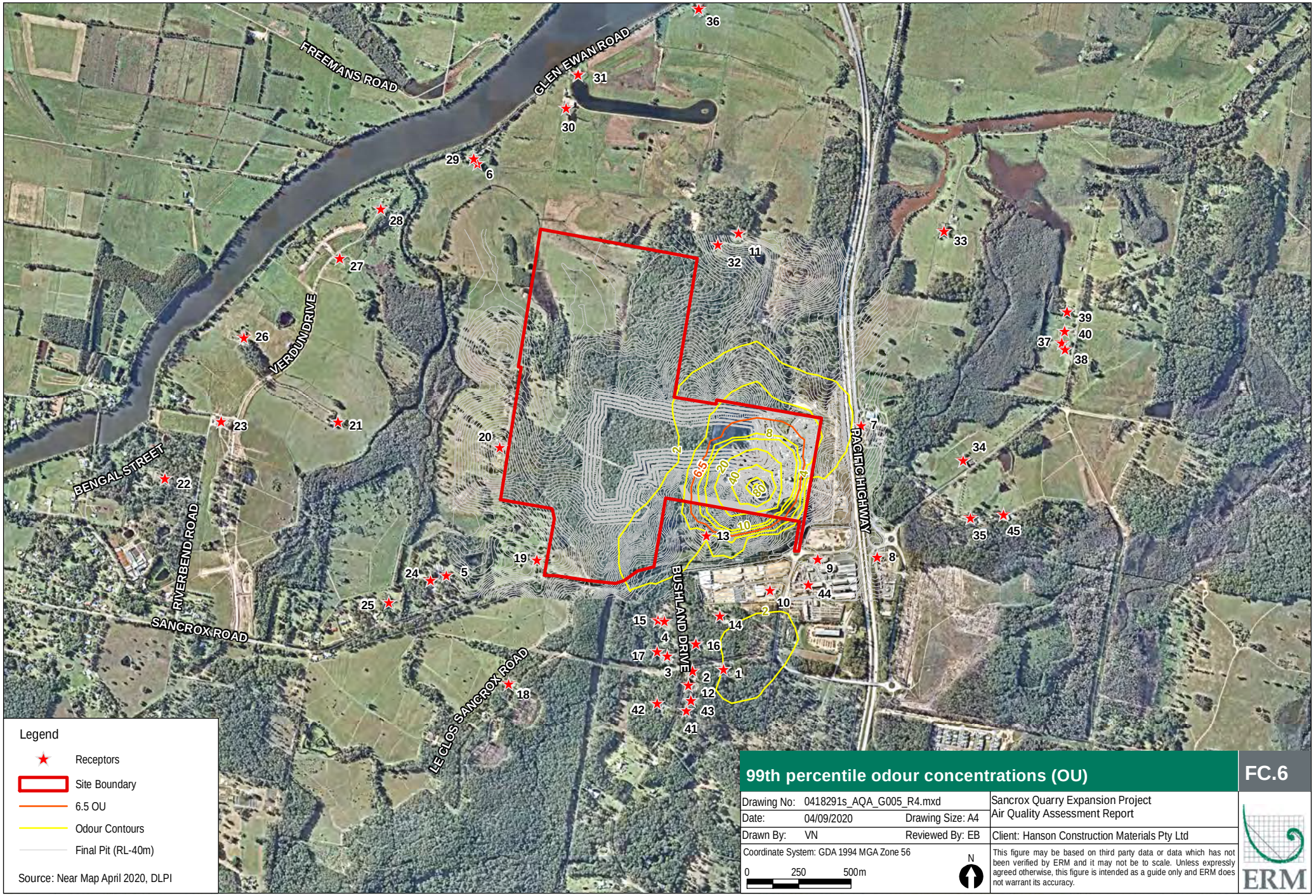
FREEMANS ROAD
GLEN EWAN ROAD
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
BUSHLAND DRIVE
LE CLOS SANCROX ROAD
PACIFIC HIGHWAY
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6.5
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4
10
Legend
Receptors
Site Boundary
6.5 OU
Odour Contours
Final Pit (RL-40m)
Source: Near Map April 2020, DLPI
99th percentile odour concentrations (OU)
FC.6
Drawing No: 0418291s_AQA_G005_R4.mxd
Date: 04/09/2020
Drawing Size: A4
Drawn By: VN
Reviewed By: EB
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Air Quality Assessment Report
Client: Hanson Construction Materials Pty Ltd
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