Geotechnical Risk Assessment Tables

Requirement for Geotechnical Assessment as part of WP / WPV

ERR document '*Geotechnical guideline for terminal and rehabilitated slopes, Extractive Industry projects'* (September 2020) provides quarry and mine operators with guidance on the criteria that will determine the level of assessment required to support the Work Plan or Work Plan Variation application.

The framework for assessing the requirements for a Geotechnical Assessment is described in Section 2 of the above document and presented in Figure D1 below as a flow chart.

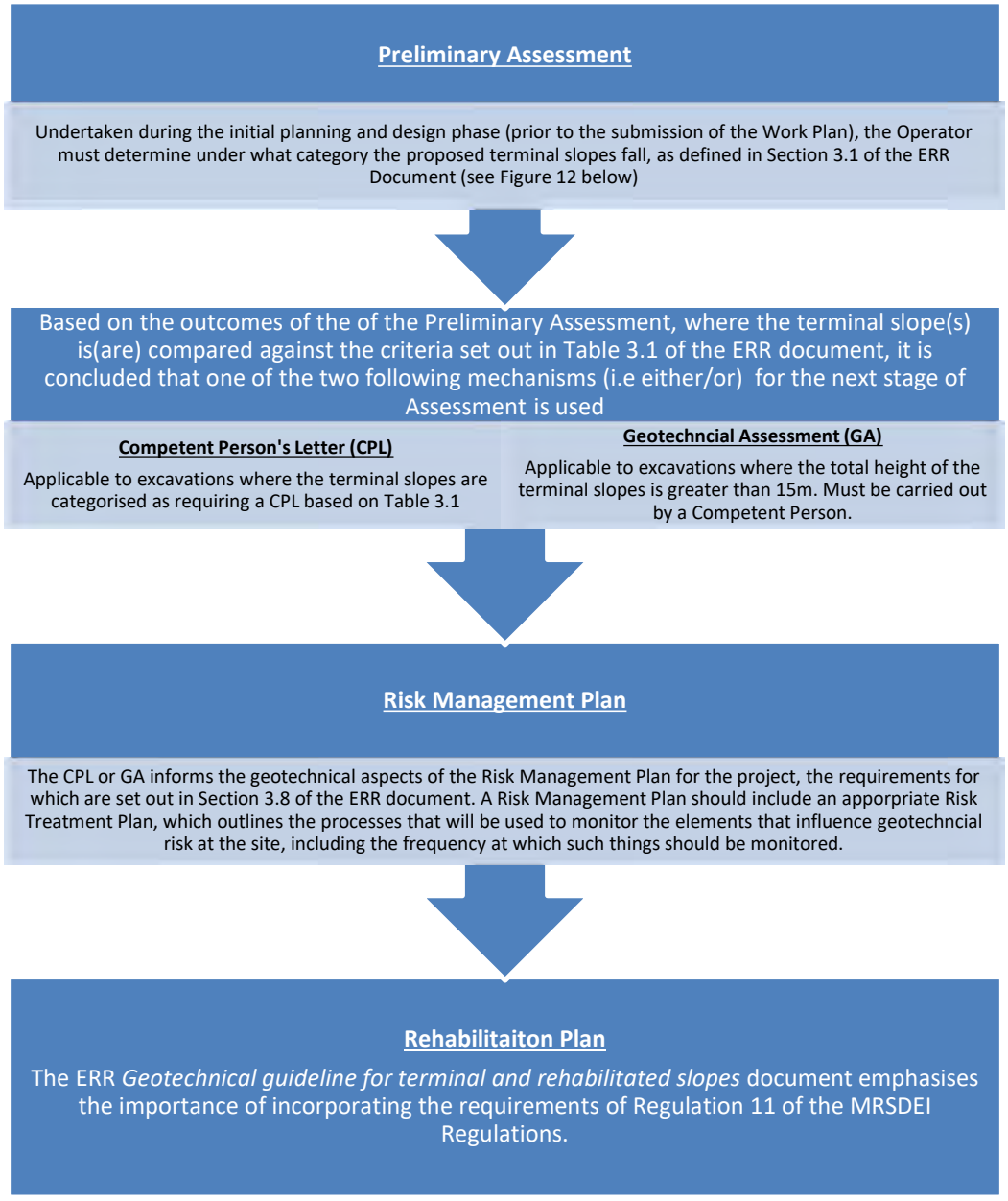

Figure D1: Flow chart representation of Section 2, ERR document *Geotechnical guideline for terminal and rehabilitated slopes, Extractive Industry projects'* (September 2020)

	Hard rock (buffer greater than 20m plus final depth of excavation) [1]	Hard rock (buffer less than 20m plus final depth of excavation)	Soft rock - flatter than or equal to 1V:3H [2]	Soft rock – steeper than 1V:3H
Total Height: >15m	Geotechnical Assessment	Geotechnical Assessment	Geotechnical Assessment	Geotechnical Assessment
Total Height: 5-15m	None, but requires public safety measures in rehabilitation plan	Competent Person's Letter	None [3]	Competent Person's Letter
Total Height: 0-5m	None	None	None	None

1 Consideration of buffer between extraction limit and work authority boundary to remain intact. For 5m high slope, this would be a 25m buffer. For a 10m high slope, this would be a 30m wide buffer. For a 15m high slope this means a 35m buffer. This allows space for terminal slopes to be reprofiled if necessary, to achieve a safe and stable slope without impacting on the 20m minimum allowed buffer. **2** The slope configuration of 1V:3H considered due to the fact that revegetation and maintenance of rehabilitation slopes are improved at such an angle. **3** Where final landform is a lake or the site is considered as a floodplain quarry, a geotechnical assessment is required.

Figure D2: Extract of Table 3.1 from ERR Document *Geotechnical guideline for terminal and rehabilitated slopes, Extractive Industry projects'* (September 2020)

Based upon the proposed height of the terminal batters, it was determined that a Geotechnical Assessment is required to support the Work Plan Variation that is to be submitted by Hanson in relation to the site of quarry.

Geotechnical Assessment Process

Competent Person

The Geotechnical Assessment must be performed by a Competent Person, defined as follows in section 3.2 of the ERR geotechnical guideline document as follows:

- 'Competent Person's Letters' and 'Geotechnical Assessments' must be prepared by a "Competent Person", defined as a qualified geotechnical engineer able to competently and professionally undertake the task.
- A Competent Person must be either a full member or fellow of a recognised professional organisation (RPO), such as AusIMM or Engineers Australia.

CMW has nominated the following as its Competent Person(s):

- Dr John V. Smith, Principal Engineering Geologist, BAppSc, BEng, PhD, FIEAust CPEng RPEQ NER, MAusIMM.
- Mr Peter Corr, Principal Engineering Geologist, BSc (Hons), CompIEAust; and
- Mr John McCaffrey, Principal Geotechnical Engineer, BEng (Hons) Civil, BSc Geophysics & Applied Mathematics, MBA, CPEng

Assessment Rationale

The rationale for the geotechnical assessment is consistent with the Geotechnical Assessment approach prescribed in ERR document '*Geotechnical guideline for terminal and rehabilitated slopes, Extractive Industry projects'* (September 2020). This geotechnical risk assessment process is summarised below in Figure D3, which presents an extract from the aforementioned document.

Figure D3: Extract from ERR Document *Geotechnical guideline for terminal and rehabilitated slopes, Extractive Industry projects'* (September 2020) – Figure 2.

Hazard Identification

Further to the geotechnical walkover and desktop study, the key conceptual Hazards associated with the project were identified to be:

Rotational failure under gravity. The selection of representative material properties and the factors of safety considered provide protection against this form of failure occurring in slopes following the recommendations in this report. The assessment of this hazard included the potential occurrence of a s*eismic event*. If an earthquake were to occur with the high end of the seismic peak ground acceleration modelled failure of the slopes constructed according to the recommendations in this report are not expected to fail. The method of modelling known as 'pseudo-static' does not account for the fluctuation of acceleration during an earthquake. The fluctuation of acceleration (if great enough) typically causes increments of damage or movement on a slope even if the factor of safety is exceeded, rather than causing complete failure.

Slumping or heave at the deepest part of the slope due to high water pressure. Extraction of material to the proposed depth has the risk that high groundwater pressure or pressure gradients lead to unexpected behaviour of exposed materials. These behaviours may be influenced by local variations in material properties – for example a thin layer of low hydraulic gradient material (e.g. carbonaceous sand) may heave due to pressure build-up below it during excavation.

The two hazards outlined above are dependent on the ground conditions encountered which may differ from those observed in boreholes in the previous investigations:

- The ground conditions and geotechnical material properties:
    - particularly effective cohesion, c', and effective angle of friction, ϕ', and
- Groundwater level and the effect of groundwater on c' and ϕ';
- Surface water management and the effect on c' and ϕ'; and
- Slope geometry.

To assess these elements in the context of the overarching objective of maintaining a safe, stable and sustainable terminal face so as to reduce the likelihood of a slope failure where the Risk Consequence is an intolerable Risk to Life and/or Property, further investigation was required.

The geotechnical study was therefore designed to recover data from locations and depths that would be meaningful in helping define the Risk Likelihood component of the Hazards perceived to be associated with Hanson's proposed pit design. The Initial Risk Ratings that are the product of the perceived Consequence(s) and the investigated Likelihood(s) can then be examined, and appropriate mitigation measures or controls discussed.

Qualitative Risk Assessment

Risk Assessment Process

Risk assessment and management principles can be interpreted as answering the following questions:

- What are the issues? (SCOPE DEFINITION).
- What might happen? (HAZARD IDENTIFICATION).
- How likely is it? (LIKELIHOOD).
- What damage or injury might result? (SEVERITY / CONSEQUENCE).
- How important is it? (RISK EVALUATION).

- What can be done? (RISK TREATMENT).

The risk is the combination of the likelihood and the consequences of exposure to the hazard in question. All these factors are considered when evaluating a risk and deciding whether treatment is required. These risk management principles can be applied to any activity.

The risk terms are defined by a matrix that brings together different combinations of likelihood and consequence. Risk matrices help communicate the results of risk assessment, rank risks, set priorities and develop transparent approaches to decision making.

Risk Assessment Matrix

The hazards relevant to the proposed quarry have been assessed with respect to the ground conditions and the anticipated method of extraction outlined in the sections above using the DJPR document Preparation of Work Plans and Work Plan Variations, Guideline for Extractive Industry Projects V1.3 December 2020, Appendix A qualitative risk assessment matrix, presented as Figure D4 below.

Likelihood	**Almost Certain**	Medium	High	Very High	Very High	Very High
	Likely	Medium	Medium	High	Very High	Very High
	Possible	Low	Medium	Medium	High	Very High
	Unlikely	Low	Low	Medium	High	High
	Rare	Low	Low	Medium	Medium	High
		Insignificant	**Minor**	**Moderate**	**Major**	**Critical**
		Consequence				

Figure D4: Risk Assessment Matrix, Extract from Preparation of Work Plans and Work Plan Variations, Guideline for Extractive Industry Projects V1.3 December 2020

Likelihood

With respect to assessing the likelihood or chance of the risk occurring, the qualitative definitions used by CMW for this project are provided in Figure D5 for each likelihood classification.

Likelihood	Description	Probability of event occurring
Almost certain	The risk event is expected to occur in most circumstances	**> 90%**
Likely	The risk event is expected to occur in some common circumstances	**70-90%**
Possible	The risk event might occur in some circumstances	**30-70%**
Unlikely	The risk event could occur in some uncommon circumstances, as this is known to occur at comparable sites	**5-30%**
Rare	Highly unlikely, but the risk event may occur in exceptional circumstances, as may have occurred at comparable sites	**< 5%**

Figure D5: Qualitative Hazard Likelihood Definitions Table A3, Extract from Appendix A of DJPR 2020 Preparation of Work Plan, etc.

Qualitative Severity / Consequence

In terms of determining the consequence or severity of the natural hazard occurring, the qualitative definitions used by CMW for this project are provided in Figure D6, Qualitative Hazard Consequence Definitions.

Risk Rating Acceptability: Inherent Risk versus Residual Risk

The Preparation of Work Plans and Work Plan Variations, Guideline for Extractive Industry Projects V1.3 December 2020 document defines the acceptability of Risk Ratings. Figure D7 presents these definitions.

Risk level	Description
Very High	Totally unacceptable level of risk. Control measures must be put in place to reduce the risk to lower levels.
High	Generally unacceptable level of risk. Control measures must be put in place to reduce the risk to lower levels or seek specific guidance from ERR.
Medium	May be acceptable provided the risk has been minimised as far as reasonably practicable.
Low	Acceptable level of risk provided the risk cannot be eliminated.
Eliminated	The risk is eliminated.

Figure D7: Risk Rating acceptability definitions, DJPR 2020

It is inferred that the acceptability definitions are applicable to both Inherent and Residual Risk Ratings. The Inherent Risk Ratings for the Hazards perceived to be part of the proposed quarry were assessed as Medium to High.

The Risk Assessment presented in Table D1 demonstrates that the Inherent Risks can be controlled to the extent that a number are reduced to Residual Risk Ratings of Low to Medium. CMW believes that in the context of the proposed quarry, the Residual Risk Ratings have been reduced as far as is reasonably practicable.

Consequence	Critical	Major	Moderate	Minor	Insignificant	
Consequence for " any member of the public" – public health, safety, amenity and Aboriginal heritage	**Public health and safety** Fatalities, injuries or illnesses due to exposure to a hazard.	Fatalities, life-threatening injuries or illnesses or injuries resulting in permanent disablement. Public exposed to a severely debilitating chronic health impact or life-threatening hazard.	Injuries or illness requiring surgery or resulting in long-term disablement. Public exposed to a hazard that results in hospitalisation for treatment from injury or illness.	Injuries or illness requiring treatment by a physician or hospitalisation. Public exposed to a hazard that results in injuries or health effects requiring treatment by a physician.	Injuries or illness requiring first aid treatment. Public exposed to a hazard that could cause injuries or adverse health effects requiring first aid treatment.	Injury or ailment that does not require medical or first aid treatment.
Consequences for " land, property and infrastructure " *beyond the boundary of the licence or work authority area*	**Land and land uses** Loss of production from primary production land or loss of annual-seasonal primary production. Environmental damage to National Park, other conservation reserve or other public land.	Permanent loss of production from primary production land >10 ha. Loss of annual-seasonal primary production from >100 ha of land. Irreversible or long-term environmental damage (with rehabilitation taking years or longer) to >1 ha of National Park or other conservation reserve.	Permanent loss of production from primary production land <10 ha. Loss of annual-seasonal primary production from 10-100 ha of land. Irreversible or long-term environmental damage to <1 ha of National Park or other conservation reserve or to ≥10 ha of other public land. Reversible damage to ≥1 ha of National Park or other conservation reserve or to ≥10 ha of other public land.	Loss of annual-seasonal primary production from <10 ha of land. Short-term (days-weeks). Disruption to 10-100 ha of primary production land. Reversible damage to <1 ha of National Park or other conservation reserve or to <10 ha of other public land.	Minor damage to agricultural land or public land not requiring active rehabilitation. Temporary and small-scale disruption to agricultural production (days, 1-10 ha)	Total damage to private or public property or infrastructure <$1k.
	Public and private property Damage to private or public property or infrastructure or loss of income	Total damage >$10 million. Total loss of value of private property equivalent to >$10 million.	Total damage $1-10 million. Total loss of value of private property equivalent to $1-10 million.	Total damage $50k-$1 million. Total loss of value of private property equivalent to $50k-$1 million.	Total damage $1-50k. Total loss of value of private property equivalent to $1-50k.	Total damage <$1k. Total loss of value of private property equivalent to <$1k.
	Services provided by infrastructure Negative impact to important community services (e.g. transport, energy, health, telecommunications, education, water)	Services suspended or significantly disrupted for extended period (weeks or longer).	Services suspended or significantly disrupted for days or experiencing minor disruptions for long periods (weeks or longer).	Services suspended or significantly disrupted for up to 1 day or experiencing minor disruptions for weeks.	Services suspended or significantly disrupted for short period (hours).	Services maintained but experiencing minor disruptions or delays.

Figure D6: Relevant extract from Qualitative Hazard Consequence Definitions, DJPR 2020 Preparation of Work Plan

Qualitative Risk Assessment Results

The results of our qualitative risk assessment are presented in Table D1. Colours have been applied to the Risk Ratings in Table D1 for ease of review.

Table D1: Hazard Risk Assessment Results – Proposed Pit Design. (DJPR, 2020, Preparation of Work Plans and Work Plan Variations: Guideline for Extractive Industry Projects)

ID	Perceived Hazard Associated with Proposed Pit Design	Description	Phase	Receptors	Inherent Risk			Control Measures	Performance Standards	Residual Risk			Aspect to be Monitored/Managed	Monitoring and on-going Management
					Likelihood	Consequence	Risk Rating			Likelihood	Consequence	Risk Rating		
1a	Rotational failure of exposed face at northern boundary prior to clay buttress and diversion of waterway	Large (e.g. full slope height) arc-shaped failure surface developing in slope at the northern face. Depth is limited by presence of existing waterway. Include consideration of seismic hazard.	O	1	Unlike.	Major	Med.	The selection of representative material properties and the factors of safety considered provide protection against this form of failure occurring in slopes following the recommendations in this report. Inspection of slope geometry in comparison to recommended slope geometry. Inspection of slope face and crest for cracking and related signs of distress. Limit sand extraction depth at northern margin to allow installation of clay batter (and waterway diversion) Place clay buttress such that sand excavation faces are exposed over a limited face length and for a limited time.	A	Rare	Minor	Low	Signs of instability	Records of regular inspections of faces and crests according to GCMP
1b	Rotational failure or buttress sliding of exposed face at northern boundary after clay buttress	Large (e.g. full slope height) arc-shaped failure surface developing in slope at the northern face at maximum depth after waterway diversion. Include consideration of seismic hazard.	O	1	Unlike.	Major	Med.	The presence of the buttress is expected to permit early detection of incipient failure by monitoring the occurrence of cracking. Monitoring of water pressure is required to confirm design conditions are present during excavation.	A	Rare	Minor	Low	Quality control of construction, Signs of instability	Record evidence that clay batter constructed according to Specifications. Records of regular inspections of faces and crests according to GCMP.
2a	Settlement/subsidence due to excessive water table depression prior to buttress placement	Movement of adjacent land, beyond buffer zone if excessive settlement occurs. In particular, northern boundary – Westernport Road.	O	1	Poss.	Mod.	Med.	Buffer zone of 20 m must be maintained from crest of upper batter slope to edge of the property – do not over-excavate. Pit design geometry must be adhered to as long as material and groundwater behaviour continue to present and behave as modelled. Observations to be made throughout excavation with a record of any implied change in material c' through the change of batter angle recorded and a Geotechnical	A	Rare	Mod.	Med.	Signs of instability	Records of regular inspections of crests and road condition according to GCMP

ID	Perceived Hazard Associated with Proposed Pit Design	Description	Phase	Receptors	Inherent Risk			Control Measures	Performance Standards	Residual Risk			Aspect to be Monitored/Managed	Monitoring and on-going Management
					Likelihood	Consequence	Risk Rating			Likelihood	Consequence	Risk Rating		
								Engineer contacted for advice where deemed necessary. Ongoing survey of pit geometry in order to 1) mark-out the designed pit geometry to avoid over excavation and 2) to record the as-built geometry as excavation continues. Medium residual risk managed in GCMP						
2b	Settlement/subsidence due to excessive water table depression after buttress placement	Movement of adjacent land, beyond buffer zone if excessive settlement occurs. In particular, northern boundary – Westernport Road.	O	1	Unlike.	Mod.	Med.	Monitor condition of road and batters and crest for settlement.	A	Rare	Minor	Low	Signs of instability	Records of regular inspections of crests and road condition according to GCMP
3	Waterway diversion failure	Excessive infiltration leading to loss of stream flow and increasing water pressure in slope.	O	2	Unlike.	Major	Med.	Locate the waterway diversion on the clay buttress so that a thick zone of clay provides a hydraulic barrier. Ensure construction/materials specification for batter and substrate of diversion channel are appropriate.	A, B	Rare	Minor	Low	Quality control of construction, Signs of excess infiltration	Record evidence that clay batter constructed according to Specifications.
4	Slumping or heave at operational slope toe	Excavation cuts an unstable slope geometry with effect of high water pressure in ground.	O	1	Unlike.	Major	Med.	Monitor water table/piezometric head in aquifers Monitor dredge operation and boom arm extents to conform to overall recommended slope gradient. Ground control management plan to include observations and responses to incipient water pressure failure effects. Medium residual risk managed in GCMP	A	Rare	Mod.	Med.	Signs of instability	Records of regular inspections of faces and excavation toe condition according to GCMP, including methods to constrain dredge advance toward terminal faces
5	Slope failure of batters during operation and rehabilitation due to erosion	Tunnel/piping erosion leading to slope and crest collapse degrading the slope condition	O-R	1	Unlike.	Mod.	Med.	The clay batter protects the erodible sand faces. Grassy vegetation provides good erosion protection in this climatic location.	A	Rare	Minor	Low	Quality control of construction, Signs of erosion	Record evidence that clay batter constructed according to Specifications. Monitor according to GCMP.
6	Slope failure of embankments impounding water or solid waste during	Embankment fails and impounded water or solid waste released to adjacent pit area	O-R	3	Unlike.	Major	High	Existing embankments assessed based on site investigation data. Proposed embankments designed according to material properties determined during site	A, C	Rare	Major	Med.	Quality control of construction, Signs of excess infiltration	Record evidence that clay batter constructed according to Specifications.

ID	Perceived Hazard Associated with Proposed Pit Design	Description	Phase	Receptors	Inherent Risk			Control Measures	Performance Standards	Residual Risk			Aspect to be Monitored/Managed	Monitoring and on-going Management
					Likelihood	Consequence	Risk Rating			Likelihood	Consequence	Risk Rating		
	operation or rehabilitation due to erosion							investigation. Construction specification for compaction and materials selection.						Monitor according to GCMP.

Phases: O=Operational, R=rehabilitation

Receptors:

1) Damage to adjacent roads causing long-term reconstruction cost and/or short-term danger to motorists - Westernport Road, Milners Road;

2) Un-named water course east and west of site losing water flow – affecting aquatic habitat

3) Internal site activities only

Performance Standards:

A) ERR Geotechnical Guidelines

B) Melbourne Water requirements

C) ANCOLD (2012, 2019) tailings guidelines

The ground control management plan (GCMP) contains monitoring and measurement procedures devised to achieve the performance standards

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1 INTRODUCTION

1.1 General

This specification has been prepared by CMW Geosciences (CMW) on behalf of Hanson Construction Materials (Hanson) in relation to the proposed formation of a waterway diversion at Yannathan sand quarry.

1.2 Description of Works

This specification has been prepared to provide guidance on the filling requirements for the formation of a waterway diversion south of Westernport Road, Yannathan. Existing sand pits on the southern parts of the site have been excavated and it is intended to expand the operation to extract sand from the northern part of the site.

The waterway is intended to connect the natural waterway on the west to the existing previous waterway diversion to the east. The hydrological design of the waterway is to be completed by others.

The method of excavation of sand includes stripping of near-surface clay soils and the placement of these soils against the excavated face as a buttress. CMW understand that clay buttressing has been used at the site throughout much of its operational history. The inter-related purposes of the clay buttressing include the following:

- Optimising handling of clay overburden
- Maintaining stability of slopes
- Reducing ingress of groundwater
- Establishing terminal slopes for rehabilitation

In addition to these purposes, the northern buttress is expected to form part of the base of the waterway diversion.

This specification provides guidance on key areas of compliance for the backfill operations including:

- Identifying zones of the backfill where specifications vary;
- Suitable and unsuitable materials for filling;
- Preparation of interfaces with natural ground;
- Placement and compaction of materials;
- Conformance, monitoring and testing; and
- Documentation of works performed.

1.3 Waterway Diversion

The following report on the waterway was provided for this study:

ENGENY, December 2021, Geomorphic Assessment, Hanson Construction Materials Yannathan Quarry, V1259_003_REP_001_2

The driver for that report was stated as ‘a geomorphic assessment has been requested by Melbourne Water as a key part of the proposed channel realignment for the expansion of quarry activities.’

‘The re-aligned channel has a longitudinal grade of approximately 1 in 400 to ensure that it can tie into the existing channel at the downstream end.’

The conceptual layout of the proposed waterway diversion was shown to be along the northern boundary of the site. The extent of works related to the diversion is shown as 58m wide. The works of the diversion are shown to be approximately 20m from the northern property boundary. These works include a 20m wide central horizontal section flanked by bunds to maintain freeboard in high

flows. In the conceptual design the existing bund along the northern boundary is incorporated into the works.

The Engeny report notes 'that this concept design is subject to change based on outcomes of this geomorphic assessment and discussions with Melbourne Water and Hanson.'

1.4 Geotechnical Implications

It is understood that Hanson propose to extract sand up to the northern boundary. Such extraction requires a 20m wide buffer zone between the property boundary and the excavation crest. Hanson intend to place a 30m wide clay buttress on slopes including the northern boundary.

It is noted that the conceptual design of the waterway diversion by Engeny would require an additional 28m of buttress width to accommodate the width of the designed works. Therefore, the geotechnical assessments have been conducted on the basis of a 20m wide buffer and a 58m wide clay buttress.

A material balance of clay overburden on the site and the volume of clay buttress has not been conducted. Initial observations are that clay is abundant on the site and is expected to allow construction of a clay buttress as has been conducted at other parts of the Yannathan operations.

These fill specifications outline the material characteristics and construction methodologies required for the clay buttress to have the required stability and permeability (hydraulic conductivity) to form all or part of the substrate of the proposed waterway diversion.

These fill specifications must be reconsidered at each stage of the waterway diversion design.

1.5 Clay Materials Onsite

According to the log of borehole LL13 in the northeast corner of the property the materials in Table 1 are present. The upper 0.5m may contain vegetation roots and other organic material that may make it unsuitable as fill. The lower part of the clay is transitional from clay to sand. Therefore, this borehole profile represents approximately a 4m thickness of clay that would be suitable as clay fill. These depths are based on a single borehole and are likely to vary across the excavation area.

Table 1. Summary of clay materials description in borehole LL13

Depth (m bgl)	Classification	Description
0-2.5	Silty CLAY	Medium plasticity, light grey to light brown, trace silt, moist, soft
2.5-3.2	CLAY	Grey to brown, medium to high plasticity, moist, soft
3.2-4.0	Silty CLAY	Medium to low plasticity, grey to brown, moist soft
4.0-4.5	CLAY	Medium to high plasticity, grey to brown, moist, soft
4.5-4.8	Sandy CLAY	Low plasticity, light grey to tan brown, moist, soft
4.8-11.0	Clayey SAND	Fine to medium grained, light brown to grey, moist to wet

2 DEFINITIONS

Batter: The uniform side slope of a cut or a fill.

Batter Point: The intersection of the batter with the natural surface disregarding any batter rounding.

Buttress: Material which has been placed at an excavated slope face to provide slope stability.

Catch Drain: An open cut surface drain above a cut batter or below a fill batter to intercept and divert surface water to drainage outlets.

Clay: Fine-grained soil, typically with cohesive properties and low permeability. A material with properties above the 'A line' on the Plasticity Index (PI) / Liquid Limit (LL) graph per Table 10 and Figure 5 in AS 1726 (2017).

Cut Excavation below the natural surface level after removal of topsoil.

Cut Floor Level: The level of the formation in a cut after completion of excavation

Diversion: A constructed waterway which replaces a natural waterway.

Fill: The disturbed material which is re-compacted to form a buttress or embankment.

Geotechnical Engineer: A geotechnical specialist consultant providing advice on an ongoing basis in relation to ground risk.

Hydraulic conductivity: A parameter measuring 'permeability' of soil to the transmission of water, typically in units m/s.

Infiltration: The movement of water from an exposed surface through soil under gravity.

Overburden: Material overlying the sand resource which is not intended for processing – typically clay

Silt: A material with properties below the 'A line' on the Plasticity Index (PI) / Liquid Limit (LL) graph per Table 10 and Figure 5 in AS 1726 (2017).

Slimes: The clay and silt component of a sand deposit removed during processing.

Subcontractor: The earthworks Subcontractor engaged to manage the site, including Site Preparation, Backfill Materials, Fill Construction, Conformance and Monitoring.

Superintendent: Client-appointed representative providing oversight of the Subcontractor's activities. It is the pivotal role in Change Management, acting as the coordinator of all stakeholders involved in the backfilling process.

Surface Drain: An open drain to collect and drain surface water to drainage outlets.

Surplus Material: Material which is surplus to the total quantity of material required.

Topsoil: A layer of fertile, organic soil immediately below natural surface or placed to the finished formation level outside areas to be paved.

Waterway: A general term for a landform along which water flows, including a channel and overflow plain.

Unsuitable Material: Material that is not suitable for the specified use as fill.

3 RELEVANT STANDARDS

AS1726: 1993 and 2017 Geotechnical Site Investigations

AS1289: 2000 Methods of testing soils for engineering purposes – various Parts

4 FILL ZONES

CMW understand that the excavation in the northern part of the site will be initially from a nominal existing ground elevation of approximately 25 mRL to no deeper than 9 mRL. This would be a maximum face height of 16 m at this stage of excavation.

There is a 20 m buffer zone between the property boundary and any excavation.

The depth of excavation is constrained by the distance between the buffer zone and the existing waterway which must be preserved until the waterway diversion is constructed. An adequate temporary buffer zone between the existing waterway channel and excavation is required. Such a buffer zone may require verification prior to acceptance by regulators (Melbourne Water).

Fill from the excavation floor to 4 m below the existing current ground level is referred to here as Zone A of the buttress (Figure 1).

The 4 m of fill from the top of Zone A to the existing current ground level is referred to here as Zone B of the buttress (Figure 1). The interface between natural ground and Zone B is referred to as the upper interface (Figure 1).

Zone A is intended to represent the zone in which the buttress provides physical stability of the slope. Zone B is intended to represent the zone in which the required hydraulic conductivity can be achieved to form a barrier to excessive infiltration.

Achieving adequate hydraulic conductivity in Zone B involves the following:

1. Selection of material to be clays which can have an acceptably low hydraulic conductivity and low erosion potential. Treatment with lime can be used to stabilise clays in Zone B if considered necessary.
2. Placement of material with correct compaction to optimise the hydraulic conductivity.
3. Provide sufficient thickness of compacted clay that shrinkage cracking in extensive dry weather would not breach the integrity of the barrier.
4. Ensure that the interface between natural soil and fill is not a zone of excessive infiltration.

CMW understand that the buttress will be constructed from overburden clays stripped from the site as the excavation progresses.

Deeper excavation would be undertaken after the waterway diversion and buttress are in place.

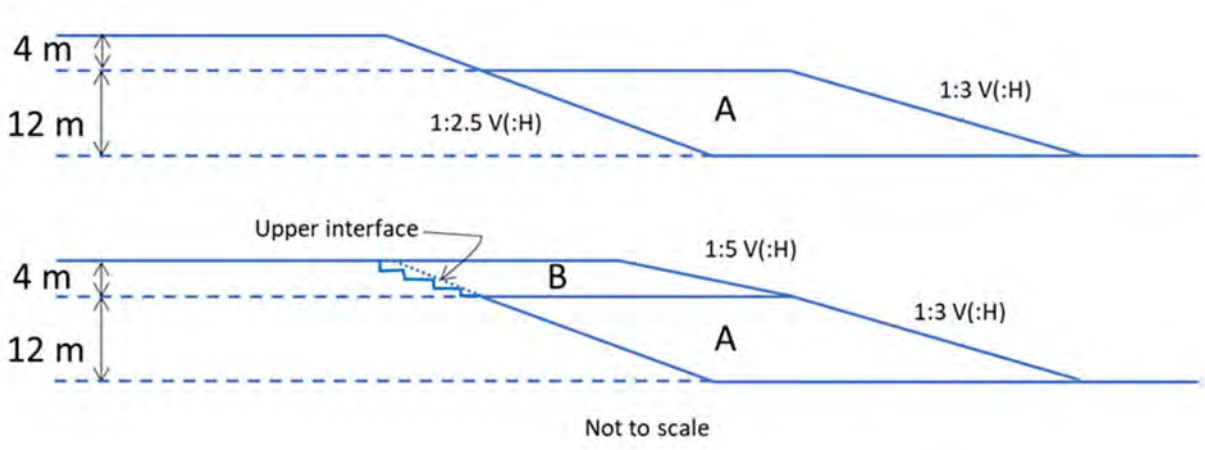

Figure 1: Schematic illustration of the proposed zones of the buttress fill

4.1 Site Preparation

4.1.1 General

This section specifies the requirements for preparation of the site prior to the commencement of any fill. The fill is to be placed on an excavated bench. Prior to placement of clay buttress fill the bench surface should be free of loose sand or soil.

4.2 Zone A

4.2.1 Overview

The Zone A fill specification is equivalent to the current buttress fill methodology at Yannathan sand quarry.

4.2.2 Site Excavation and Trimming

(a) **General**

Site excavation shall be excavation within the limits of the batters, open and underground drainage and any approved borrow areas from within the Site and shall include the handling of excavated material to the point of disposal.

(b) **Catch Drains and Batter Rounding**

The excavation which formed the bench on which the batter is constructed is expected to have catch drains in place. The adequacy of these drains to protect the buttress construction from water inflow should be checked and amended according to the specification below if required.

The Subcontractor shall construct catch drains where required for the temporary collection and diversion of surface runoff or as otherwise agreed to by the Superintendent.

Temporary catch drains and batter rounding at the top of cut batters shall be constructed at the commencement of the cutting excavation where deemed necessary or subsequently with cause.

(c) **Material Category**

Prior to commencing excavation in any area and during excavation work, the Superintendent and the Subcontractor shall inspect each type of material encountered and agree on the category for the re-use of excavated material.

(d) **Excavation Operations**

The Subcontractor shall conduct its operations such that the area outside the limits of the excavation is not unduly disturbed. Any falls or slips of material that occur shall be removed and the area treated to prevent recurrence.

If any area on cut batters becomes unstable or unsafe, the Subcontractor shall install suitable measures to restrict access to the area, e.g. the erection of warning signs and fencing, as appropriate. The affected area shall be inspected and assessed by a Geotechnical Engineer, and made safe prior to excavation proceeding in the affected area.

(e) **Surface Finish of Cut and Fill Batters**

The surface of cut and fill batters to be topsoiled shall be textured by scarifying or horizontal grooving. No material shall be transported offsite, where such material can be used within the designed earthworks under the Contract.

4.2.3 Borrow Excavations

Borrow excavations are not anticipated within the Site and are not permitted without the prior approval of the Superintendent.

Where the Superintendent's approval is obtained, the Subcontractor shall be responsible for obtaining all other necessary permits and approvals prior to the commencement of borrow excavation and subsequent conformance of the material sourced in line with the remainder of this specification.

4.2.4 Groundwater

Where significant groundwater or seepage is encountered the Subcontractor shall record this.

A Groundwater Management Plan shall be used as the reference document for management of groundwater during the clay buttress construction operation.

4.2.5 Slimes

Slimes must not be incorporated in the clay buttress construction.

4.2.6 Fill Material, Construction and Record Keeping

The fill material, its placement and the records kept of such will conform with the requirements of this specification. The Superintendent will regularly review the records for the purposes of ensuring ongoing conformance.

4.2.7 Monitoring Points

Monitoring points shall be installed at regular intervals within the fill to monitor the ongoing settlement of the fill. This is critical in ensuring that a stable elevation is achieved for construction of the waterway diversion.

(b) **Location of Monitoring Points**

The Subcontractor shall establish a series of monitoring points on the cut floor of the excavation and in the subsequent fill layers. The monitoring points shall be installed at fill height intervals not greater that 33% of the final fill thickness. By way of example in a 15m thick fill, monitoring points would be installed at the base of the fill and then at fill thickness intervals no greater than 5m.

At each level in the fill where monitoring is established there shall be a minimum of at least 1 point for every 10,000m^2 of area. The location and number of monitoring points shall be agreed with the Superintendent. Each point shall be given a unique identifier.

(c) **Monitoring Point Arrangement**

Each monitoring point shall comprise a 20mm thick steel plate measuring 1m x 1m. A welded steel coupling point shall be located in the centre of the plate to allow connection of a length of 25mm deformed steel bar.

The monitoring point shall be installed level and in full contact with the cut or filled area. Where the surface is not flat levelling sand or similar should be used to level the surface before locating the plate. Once the plate is positioned it should be surveyed such that it can be located in position to a horizontal accuracy of 10cm and a vertical accuracy of 1cm.

A 3m starter bar shall be attached to the plate and the length to the top of the bar from the surface of the plate confirmed. Using the survey information and bar measurement the location of the top of the bar shall be confirmed and recorded following each

installation. The starter bar shall be sleeved in a length of 50mm class 18 PVC with the top of the bar a minimum of 100mm above the sleeve.

Sufficient lengths of steel plates, 25mm deformed steel bar and couplers and PVC pipe shall be located on site. These materials will be required for future points on subsequent layers and bar extensions to existing monitoring points as the fill platform is constructed.

Bar extensions will be added incrementally in advance of the next planned fill lift. The height by which the bar extension is increased will be determined by the Contractor with the following advisories:

- Prominent enough to be seen from HV plant and therefore avoided;
- High enough so as to limit the frequency of required extensions vs lifts

(d) **Protection of Monitoring Points**

After construction of a monitoring point the Subcontractor shall place material over and around the plate and starter bar to create a mound approximately 1.5m high and 3m diameter.

As the fill platform is constructed the bunding should be raised to provide a visual and physical barrier to working plant. Other means of delineating and protecting the monitoring points shall be discussed and agreed with the Superintendent as required.

The Subcontractor shall undertake filling operations so as not to disturb or destroy monitoring points.

(e) **Monitoring Point Clusters**

As subsequent monitoring points are added to the network it is preferable that the points higher in the fill are located in close proximity to lower points. The clustering of monitoring points will reduce the spread of points across the fill platform and limit the amount of bunded area.

(f) **Surveying of Monitoring Points**

The top of each monitoring point bar shall be surveyed at intervals not exceeding 3 months. The information shall be provided within 48 hours to the Superintendent for review.

4.3 Zone A Records Required

In addition to the existing construction documentation requirements, the following would be required as a minimum:

Table 2: Minimum Record Requirements

Record Type	Coverage	Interval	Information Required
Starting surface condition	Across base of pit, as per Section 4.2	Before fill is placed	Record of surface preparation Any treatment measures required Confirm absence of ponded water
Monitoring Point Installation	As per Section 4.2.7	At time of installation	Unique identifier Survey levels of plate Start bar length Top of bar location

Record Type	Coverage	Interval	Information Required
Monitoring Point Extension	As per Section 4.2.7	As required	Unique identifier Survey levels of top of bar (existing) Length of extension bar Top of bar location (extended)
Monitoring Point Survey	As per Section 4.2.7	Every 3 months if bar hasn't been extended in that 3-month period	Unique identifier Survey of top of bar

5 HOLD POINT: ZONE A TO ZONE B

The timing of a transition from Zone A to Zone B shall be determined by the Superintendent.

If the requirements of Zone A have not been met, or there is insufficient evidence to support that they have been met, then Zone B shall not be progressed and the site owner may be required to adjust its plans for end use accordingly. This is due to the fact that any attempts made to enhance the requirements of the filling regime (i.e. move to Zone B) without evidence of the adequate adherence to the requirements of the Zone A specification, any such Zone B effort and expense would be compromised by the inherent uncertainty (i.e. unrecorded/wholly uncontrolled and unmonitored) status of the Zone A fill thickness, whatever that thickness may be.

Where the Superintendent and / or its specialist geotechnical advisors are satisfied that the Zone A requirements have been met and that the records and behaviour of the fill thickness produced as a result of the Zone A filling allow for a meaningful assessment of settlement behaviours, Zone B can be progressed to with relative confidence.

5.1 Zone B

5.1.1 General

The items covered in Zone A, specification Sections 4.2 shall also be observed in Zone B if deemed necessary by the superintendent. The applicability is likely to be a reflection of the time or hiatus between the excavation stages and the recorded behaviour of the filled mass that is achieved in Zone A.

5.1.2 Fill Acceptance

The fill material used in Zone B shall be clay of a consistent plasticity and grainsize range. During stripping of clay overburden at the site, clay with low sand content should be stockpiled for the intended use as Zone B fill. One standard compaction test should be conducted for each 5000 m^3 of stockpiled material intended for use as Zone B fill.

These tests will inform the optimum moisture content, lift thickness and compaction regime for the Zone B fill. It is noted that Zone B will incorporate a landform for the waterway diversion that is expected to include a central channel and adjacent bunds.

Conformance of fill material will be required prior to placement in Zone B. This will be the responsibility of the Subcontractor and will be recorded using the minimum documentation requirements stated in this specification.

5.1.3 Geotechnical Material Classification

Materials approved for use in Zone B shall be clay as defined in Section 2 and Section 5.1.2. The presence of a trace amount of sand is acceptable.

5.1.4 Unsuitable Materials

"Unsuitable Material" is defined as material which is unsuitable for use as Zone B fill. It includes clay material which:

- Contains more than a trace amount of sand (as defined in AS 1726 , 2017).
- Contains organic material in the form of roots etc.
- Is derived from slimes from sand processing.

5.1.5 Stockpiles

Stockpiles shall be maintained in a neat, well-shaped state capable of shedding water. Materials shall be spread as soon as practicable.

Wherever possible material types shall not be mixed or the mixed material will need to be reclassified.

5.2 Fill Construction

5.2.1 Assessment & Treatment of Existing Surface

Prior to the placement of fill in a new area, the Subcontractor must arrange for a joint inspection of the ground surface with the Superintendent for the purpose of confirming the suitability of fill material.

The Subcontractor shall not commence placing any fill on the prepared areas until the area (top of Zone A and interface with natural clay soil) has been reviewed by the Superintendent.

The review will be undertaken in the form of a visual assessment. Proof rolling may be required at the top of Zone A to confirm it represents a stable foundation for Zone B.

5.2.2 Fill Construction

Fill material must be placed and compacted uniformly in layers in accordance with Table 3.

Table 3: Fill Construction

Material Class	Loose Layer Thickness (mm)	Compacted Layer Thickness (mm)	Moisture Control Compacted	Construction Observations
CLAY	250 to 300	200 to 250	OMC ± 2%	After placement material should not rut and be able to pass proof roll. Surface should be level. Minimum shear strength of 50kPa after placement and compaction should be achieved.

5.2.3 General Placement Notes

Fill material shall generally be placed and spread in uniform layers and shall be compacted to meet the specified requirements for the location and type of material being placed, as far as practicable.

Each layer of fill shall be keyed into the layer above by creation of a textured surface.

Materials within particular fill layers should comprise uniform materials throughout that layer thickness. Where materials may be different, for example from different stockpiles, they should be placed on top of each other and not beside each other as per the arrangement in Figure 1.

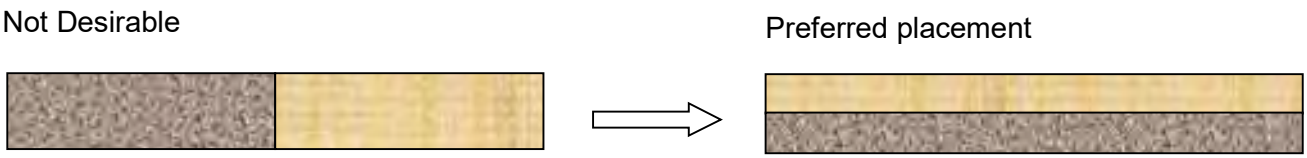

Figure 1: Layered vs Pockets / Preferred vs Not Desirable

During the placement of fill material the surface of each layer shall be kept generally horizontal. A gradient of approximately 2% toward the pit should be maintained so that water does not pond on the fill surface.

Prior to the cessation of work each day, the top of the fill shall be shaped and compacted to minimise damage resulting from wet weather, as far as practicable.

The Subcontractor shall establish a procedure to verify that compacted layers do not exceed the specified maximum thickness. Verification records must provide evidence of measurements taken at least every three layers in consistent locations across the filled areas.

5.2.4 Slimes

The Subcontractor shall ensure that slimes shall not be incorporated into the buttress fill.

5.2.5 Placement Adjacent to Natural Soil

Where a fill is to be constructed adjacent to the interface with the natural ground, the interface should be stepped rather than forming a single planar interface. This can be achieved by cutting a vertical face of approximately 0.5m height prior to the placement of each two lifts.

5.2.6 Proof Rolling

Proof rolling is the process of identifying any unsuitable material by moving heavy plant over the subgrade or existing surface and observing the resultant deformation in the underlying material. Material which is observed to move excessively under the loading of the plant is deemed to be inadequately compacted.

Where practicable, proof rolling must:

a. in fill, cover all of the existing underlying material which will be covered by fill;
b. be undertaken on a surface before the placement of overlying fill layers; and
c. be undertaken prior to any hauling over the prepared area.

The plant must move at walking pace (between 3 and 10 km/h) when undertaking proof rolling.

Except for small areas, proof rolling must be undertaken by a minimum of 3 passes of heavy plant which complies with the following:

a. a pneumatic multi-wheel roller with a mass > 24t; or
b. a fully loaded tandem truck or water cart of minimum 10 kl capacity which:
    a) has ground contact pressure under either the front or rear wheels of not less than 450 kPa per tyre;
    b) has a ground contact area which is not less than 0.035 m2 per tyre, and
    c) follows a rolling pattern that ensures the entire ground surface is subject to the specified number of passes.

5.2.7 Preparation of Final Earthworks Surfaces

The top of the fill shall be prepared to level and shape to produce a smooth, hard, tightly bound surface, free from local depressions. The top surface of Zone B shall conform to the design of the water way diversion requirements.

5.2.8 Topsoiling

Topsoil shall not be placed over fill areas until the Subcontractor has confirmed with the Superintendent that placement may commence. Topsoil shall be placed and levelled but not compacted. Topsoil on batters shall be placed so as to prevent rilling. The surface level of topsoil shall match the finished surface level.

All fill areas within the limits of the site, including batter roundings but excluding cut batters steeper than 1.5 to 1 (horizontal to vertical), and any other area disturbed by the Subcontractor's operations, shall be topsoiled to the following thicknesses measured normal to the slope:

(a) batters with slopes of 2 to 1 (horizontal to vertical) or steeper - 50 mm minimum

(b) tree and shrub plantation bed areas other than (a) above - 100 mm minimum

(c) all other areas - 75 mm minimum.

5.3 Conformance

The Subcontractor shall undertake the following conformance activities as works are ongoing.

(a) **Excavation Batters**

During fill placement works any batters shall be trimmed to a batter angle no greater than 1H:1V. Where a batter height is greater than 3m the Subcontractor shall provide the Superintendent with evidence of review of the batter stability by a suitably qualified geo-professional, including the risk assessment associated with such and the proposed controls. A location specific safe method of working around that batter will then be established

(b) **Cut Floor Level Acceptance**

Before placing materials on the cut floor of any pit the Subcontractor shall prepare the surface for inspection by the Superintendent including meeting the requirements of Section 4.

(c) **Control of Ground and Surface Water**

Before commencing fill works the Subcontractor shall provide to the Superintendent the means of controlling water across the filled surface. Uncontrolled movement and ponding of water on the filled surface shall be prevented at all times.

The Subcontractor shall provide the Superintendent with the proposed method of water control and where necessary disposal. Where appropriate such water may be used with the Superintendent’s permission for the control of dust and moisture conditioning of fill materials.

(d) **Confirming Material Class**

All materials for use as fill are to be classified in accordance with the requirements of this specification. Mixing of material classes is to be avoided wherever possible.

Stockpiling of materials to facilitate construction of fill layers is acceptable provided that the Subcontractor meets the requirements of this specification.

(e) **Material Placement**

The Subcontractor shall be responsible for ensuring that the appropriate plant is available to meet the material placement requirements presented in this specification.

Where the Subcontractor is unable to meet the requirements of this specification (in particular the placement of dissimilar materials) the Constructor shall seek approval from the Superintendent before placing materials.

Prior to the placement of new fill layers over existing layers the Subcontractor shall meet the requirements of this specification. Sufficient notice shall be given to the Superintendent to allow observation of these works as required.

5.3.1 Testing & Monitoring

5.3.1.1 Conformance Testing Required

To be confirmed by the Site Owner to the Contractor depending upon level of conformance required beyond Zone A.

5.3.1.2 Monitoring Points

(a) **Location of Monitoring Points**

The Subcontractor shall establish a series of monitoring points on the cut floor of the excavation and in the subsequent fill layers. The monitoring points shall be installed at fill height intervals not greater that 20% of the final fill thickness. By way of example in a 20m thick fill monitoring points would be installed at the base of the fill and then at fill thickness intervals no greater than 4m.

At each level in the fill where monitoring is established there shall be a minimum of 4 points or at least 1 point for every 10,000m^2 of area. The location and number of monitoring points shall be agreed with the Superintendent. Each point shall be given a unique identifier.

(b) **Monitoring Point Arrangement**

Each monitoring point shall comprise a 20mm thick steel plate measuring 1m x 1m. A welded steel coupling point shall be located in the centre of the plate to allow connection of a length of 25mm deformed steel bar.

The monitoring point shall be installed level and in full contact with the cut or filled area. Where the surface is not flat levelling sand or similar should be used to level the surface before locating the plate. Once the plate is positioned it should be surveyed such that it can be located in position to a horizontal accuracy of 10cm and a vertical accuracy of 1cm.

A 3m starter bar shall be attached to the plate and the length to the top of the bar from the surface of the plate confirmed. Using the survey information and bar measurement the location of the top of the bar shall be confirmed and recorded following each installation. The starter bar shall be sleeved in a length of 50mm class 18 PVC with the top of the bar a minimum of 100mm above the sleeve.

Sufficient lengths of steel plates, 25mm deformed steel bar and couplers and PVC pipe shall be located on site. These materials will be required for future points on subsequent layers and bar extensions to existing monitoring points as the fill platform is constructed.

Bar extensions will be added incrementally in advance of the next planned fill lift. The height by which the bar extension is increased will be determined by the Contractor with the following advisories:

- Prominent enough to be seen from HV plant and therefore avoided;
- High enough so as to limit the frequency of required extensions vs lifts

(c) **Protection of Monitoring Points**

After construction of a monitoring point the Subcontractor shall place material over and around the plate and starter bar to create a mound approximately 1.5m high and 3m diameter.

As the fill platform is constructed the bunding should be raised to provide a visual and physical barrier to working plant. Other means of delineating and protecting the monitoring points shall be discussed and agreed with the Superintendent as required.

The Subcontractor shall undertake filling operations so as not to disturb or destroy monitoring points.

(d) **Monitoring Point Clusters**

As subsequent monitoring points are added to the network it is preferable that the points higher in the fill are located in close proximity to previous lower points. The clustering of monitoring points will reduce the spread of points across the fill platform and limit the amount of bunded area.

(e) **Surveying of Monitoring Points**

The top of each monitoring point bar shall be surveyed at intervals not exceeding 3 months. The information shall be provided within 48 hours to the Superintendent for review.

5.3.2 Documentation

5.3.2.1 Record Keeping

The Subcontractor shall agree with the Superintendent the means of storing, transmitting and the form of record for all of the data required for this project.

Copies of all records shall be kept by the Subcontractor accessible to site for review by site personnel. A copy of the documentation produced each month shall be forward by the 5th day of the following month to the Client or saved to a shared computer drive as directed by the Superintendent.

5.3.2.2 Records Required

The Subcontractor shall keep the records listed in Table 3

Table 3: Zone B Record Types Required

Record Type	Coverage	Interval	Information Required
Starting surface condition	Across base of pit	Before fill is placed	Record of surface preparation Observations from proof rolling Any treatment measures required
Fill placed location	Days production	Daily	Map (or equivalent) showing areas of placement Class of fill placed in each area Compacted layer thickness
Fill placed location	Quarterly production	Quarterly	Aerial topographic survey
Fill placed test results	Areas as per section 5	Timing as per section 5	Results of testing
Surface confirmation before fill layer construction	As per section 5	As per section 5	Record of surface preparation Observations from proof rolling Any treatment measures required
Monitoring Point Install	As per section 5	At time of installation	Unique identifier Survey levels of plate Start bar length

Record Type	Coverage	Interval	Information Required
			Top of bar location
Monitoring Point Extension	As per section 5	As required	Unique identifier Survey levels of top of bar (existing) Length of extension bar Top of bar location (extended)
Monitoring Point Survey	As per section 5	Every 3 months if bar hasn't been extended in that 3-month period	Unique identifier Survey of top of bar

5.3.3 Document and Record Review

The superintendent will review the documents and records kept by the Subcontractor on a monthly basis.

The Subcontractor will prepare an executive summary report for the Superintendent's review as part of the overall monthly document and record review.

In the event of a recorded non-conformance, the Superintendent will be notified within 24hrs by the Subcontractor and prior to additional filling being undertaken in the area of the non-conformance. The Superintendent will investigate the non-conformance and provide direction on the proposed corrective action as appropriate. At the discretion of the superintendent, the corrective action may be discussed with the Subcontractor. Once confirmed, the corrective action will be issued in writing as an instruction to the Subcontractor.

6 CONTEXT

This document has been prepared for use by Hanson in relation to works at the site described above in accordance with generally accepted consulting practice. No other warranty, expressed or implied, is made as to the professional advice included in this report. Use of this report by parties other than Hanson is at their risk as it may not contain sufficient information for any other purposes.

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15 December 2023

PROPOSED SAND QUARRY EXPANSION, YANNATHAN, VICTORIA

870-910 WESTERNPORT ROAD

YANNATHAN, VICTORIA 3984

GROUND CONTROL MANAGEMENT PLAN (GCMP)

Hanson Construction Materials, c/o Ricardo Energy, Environment and Planning

MEL2022-0033AC Rev A

MEL2022-0033AC		
Date	**Revision**	**Comments**
9 June 2022	A	For Ricardo / Hanson Comment
1 September 2022	A	Amended according to Rev 2 Geotechnical Assessment Report
2 June 2023	A	Amended after CPT study
15 December 2023	A	Amended according to updated Geotechnical Assessment Report

- (*) Revision status defined in Section 2.3

	Name	Signature	Position
Prepared by	John Smith		Senior Geotechnical Engineer
Reviewed by	John McCaffrey		Senior Principal Geotechnical Engineer

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Table of Contents

1 INTRODUCTION 1

1.1 General 1
1.2 Project Appreciation 1
1.3 Relevant Documents 2
1.4 Risk Based Approach 2

2 GCMP REVIEW, DOCUMENT CONTROL & ROLES 3

2.1 General 3
2.2 GCMP Review Schedule 3
2.3 Document Control 4
2.4 Roles & Responsibilities 5

3 SAFE PLANNING & DESIGN 6

4 GEOTECHNICAL ASSESSMENT 8

5 FAILURE MODES 8

6 PROPOSED PIT GEOMETRY 8

6.1 Upper Slope 9
6.2 Lower Slopes 9
6.3 Backfilling 12

7 IMPLEMENTATION 12

7.1 General 12
7.2 Communication, Training & Competence 13
7.2.1 General 13
7.2.2 Training / Competence 13
7.3 Conformance of Design 14
7.3.1 Observations 14
7.3.2 Survey 14
7.3.3 Groundwater Monitoring 15
7.3.4 Proximity Controls 16
7.3.5 Site Security 16
7.3.6 Recording of Failures 16
7.4 GCMP Reporting 16
7.5 Supervision 17
7.5.1 Review of Conformance Data 17
7.5.2 GCMP Auditing 17
7.6 Managing Unstable Ground 17
7.6.1 Trigger Action Response Plan for unplanned movement 18
7.7 Emergency Response 19

8 LIMITATIONS AND CLOSURE 19

1 INTRODUCTION

1.1 General

This Ground Control Management Plan (GCMP) is intended to provide guidance on managing ground stability at the proposed zone of quarrying expansion at Westernport Road Yannathan. Activities covered in the plan include from the point of commencement of extraction through to completion of rehabilitation.

The purpose of the document is to provide clear guidance to those operating the site in relation to:

- The planned extent and geometry of extraction at the site;
- The geological and geotechnical factors influencing stability and how these have been analysed;
- The Hazards associated with these factors;
- The Risk Assessment outcomes relating to each factor and the Controls required to mitigate the Risks, including the processes through which the controls will be applied;
- Who is responsible for implementing and recording the various aspects of Risk Control and monitoring their effectiveness throughout the life of the quarry;
- Monitoring the critical parameters used in the assessment of Risk and Controls, including the frequency and extent of such;
- The inherent limitations in the predictive modelling of ground risk, the dynamic nature of the extractive process and how change is to be managed at the site; and
- Emergency response procedures and dealing with unstable ground.

1.2 Project Appreciation

Hanson currently operates a series of pits within the existing Yannathan Sand Quarry boundary. CMW understands that the approved geographical extent and relative-level depth limit will be defined by a variation to the Work Authority conditions, under which the quarry is managed. Hanson intends to advance extraction into the site, which lies immediately to the north of its existing quarrying operation, as shown in Figure 1.

Figure 1: Zone of expansion (orange) north of existing quarrying operations

1.3 Relevant Documents

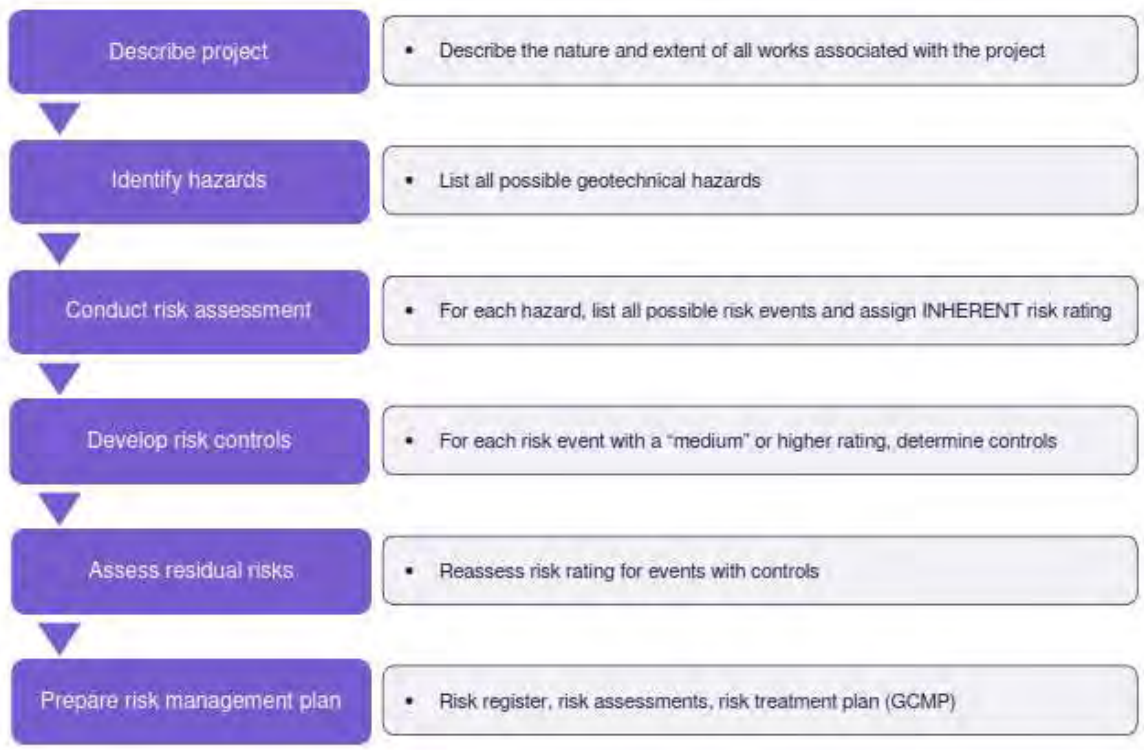
The following documents have been used in the development of this GCMP:

- Preparation of Work Plans & Work Plan Variation Guideline, DEDJTR 2020 (Earth Resources Regulations [ERR])
- Geotechnical guideline for terminal and rehabilitated slopes, Extractive Industry projects, ERR Sept. 2020
- Guidelines of Open Pit Design, Read & Stacey, 2009
- MEL2022-0033 AB Rev 1, Geotechnical Investigation and Risk Assessment, CMW Geosciences, May 2022; and
- VIC: Occupational Safety and Health Act 2004

1.4 Risk Based Approach

In the creation of this document, a risk-based approach has been used, following the ERRs recommended process whereby this document forms the Risk Treatment Plan. An extract of the ERR process is present in Figure 2 below.

Figure 2: Extract from *Geotechnical guideline for terminal and rehabilitated slopes, Extractive Industry projects'* (Sept. 2020) – Figure 2 [derivative of DEDJTR 2020 Work Plan Guideline, Appendix A]



2 GCMP REVIEW, DOCUMENT CONTROL & ROLES

2.1 General

The GCMP is not a static document and will require continual review to ensure that the document remains effective for the life cycle of the quarry.

If a change is required, it must be reviewed for geotechnical compliance in line with the model used for this geotechnical risk assessment and GCMP. Changes could include but not be exclusive to:

- Change to method of extraction;
- Change in the assumed material properties (i.e. different materials noted to assumed);
- Change in the expected performance of temporary and final batter arrangements; and
- Change to the design groundwater level.

2.2 GCMP Review Schedule

From the point of initial implementation, which shall be before commencement of extraction in the zone of expansion, the entire GCMP must be reviewed on an annual basis as a minimum, or 'with cause' at greater frequency. This review should include but not be exclusive to a review of the Geotechnical Risk Assessment. Examples of 'with cause' are:

- Prior to a change in extraction methodology;

- After a rainfall event that the Quarry Manager or Quarry Supervisor determines to be significant enough to change the conditions under which the original risk assessment and GCMP was made, thereby warranting a review of the GCMP – for guidance, a recorded rainfall event of 50 mm or more (within 3 days duration) would be considered significant;
- Changes to the planned waterway diversion construction, location or condition;
- If a change in the behaviour and/or geotechnical properties of the material being extracted is noted during extraction;
- If groundwater level is found to be different to that assumed in the geotechnical analysis in the terminal face condition or during normal extraction procedures;
- A seismic event occurs which is in exceedance of the values used in the geotechnical analysis;
- At the Quarry Manager's discretion.

2.3 Document Control

The format and naming convention that should be used for document revisions is presented below in Table 1:

Table 1: GCMP document control

Document Title	**Document Ref.**	**Comments**
Initial GCMP established prior to commencement of extractions	MEL2022-0033 AC Rev 0	-
1st revision for comment and approval	MEL2022-0033 AC Rev A	The decision on which Parties are to be involved in review and approval shall be made by the Quarry Manager, as shown in Table 2 below.
1st completed revision upon receipt of approval(s)	MEL2022-0033 AC Rev 1	
2nd revision for comment and approval	MEL2022-0033 AC Rev B	
2nd completed revision upon receipt of approval(s)	MEL2022-0033 AC Rev 2	
3rd revision for comment and approval	MEL2022-0033 AC Rev C	
Second completed revision upon receipt of approval(s)	MEL2022-0033 AC Rev 3	
and so on.		

2.4 Roles & Responsibilities

Table 2: GCMP Roles and Responsibilities	
Role	**Task / Responsibility**
Quarry Manager	Ensure that all site operatives are briefed on the requirements of the Geotechnical Risk Assessment and Ground Control Management Plan (GCMP) Implementation, updating and periodic review of the GCMP at Yannathan. Day to day application of the GCMP. Communication of the GCMP. Delegation of tasks under the GCMP to the relevant stakeholders. Ensure that extraction plans, processes and activities do not exceed the limits described in this document. Ensure that all required monitoring and surveying is actioned appropriately. Ensure that the staff who operate in the area subject to the GCMP are audited on a monthly basis. The audit could include a review of the monitoring records and a set period of observation (e.g. 1 hr) by the Quarry Supervisor or Quarry Manager of the activity undertaken during that time within the work zone, with a view to visually confirming conformance to the GCMP. Ensure that the Geotechnical Risk Assessment and Ground Control Management Plan are reviewed annually or with cause (e.g. change in conditions or change in methodology) to confirm ongoing relevance. Ensure reporting is undertaken in line with the recommendations of the geotechnical risk assessment and the GCMP.
Excavator Operators	Daily pre-start and end of shift inspections for surface cracking in the area extending from the working face crest to 15m back from crest of working face. Ongoing monitoring of the face throughout the day for signs of collapse (e.g. cracking at crest, bulging or slumping of face materials, increased water outflows). Daily pre-start, end of shift and ongoing observation of surface water at crest.
Dozer Operators	Daily pre-start and end of shift inspections for surface cracking in the area extending from the working face crest to 15m back from crest of working face Daily pre-start, end of shift and ongoing observation of surface water at crest.
Hanson Geologist	Assessment and review of any factual data presented by the others on this list. Assessment of any observed changes in face conditions or tension cracks at crest. Assessment of hydrogeological (groundwater) changes observed in monitoring wells, waterway diversion or excavated faces.

Table 2: GCMP Roles and Responsibilities	
Role	**Task / Responsibility**
Sales Loader Operator, Leading Hand or Quarry Supervisor	Regular daily observation by Sales Loader Operator, Leading Hand or Quarry Supervisor of the material being produced, paying particular attention to a reduction of fines component. A notable reduction in fines component is to be reported immediately to the Quarry Supervisor for action and the occurrence recorded Daily Tool-Box Talk to determine which of the named roles takes the responsibility for that shift. This should be documented.
Geotechnical Engineer / Engineering Geologist	Assessment / modelling of observed material performance and confirmation of slope angles and FOS against failure as a function of material parameters at intervals to be determined by the Quarry Manager as required.

3 SAFE PLANNING & DESIGN

The general process used for developing and implementing safe quarry planning and design at the site is presented below in the flow chart below (Figure 2).

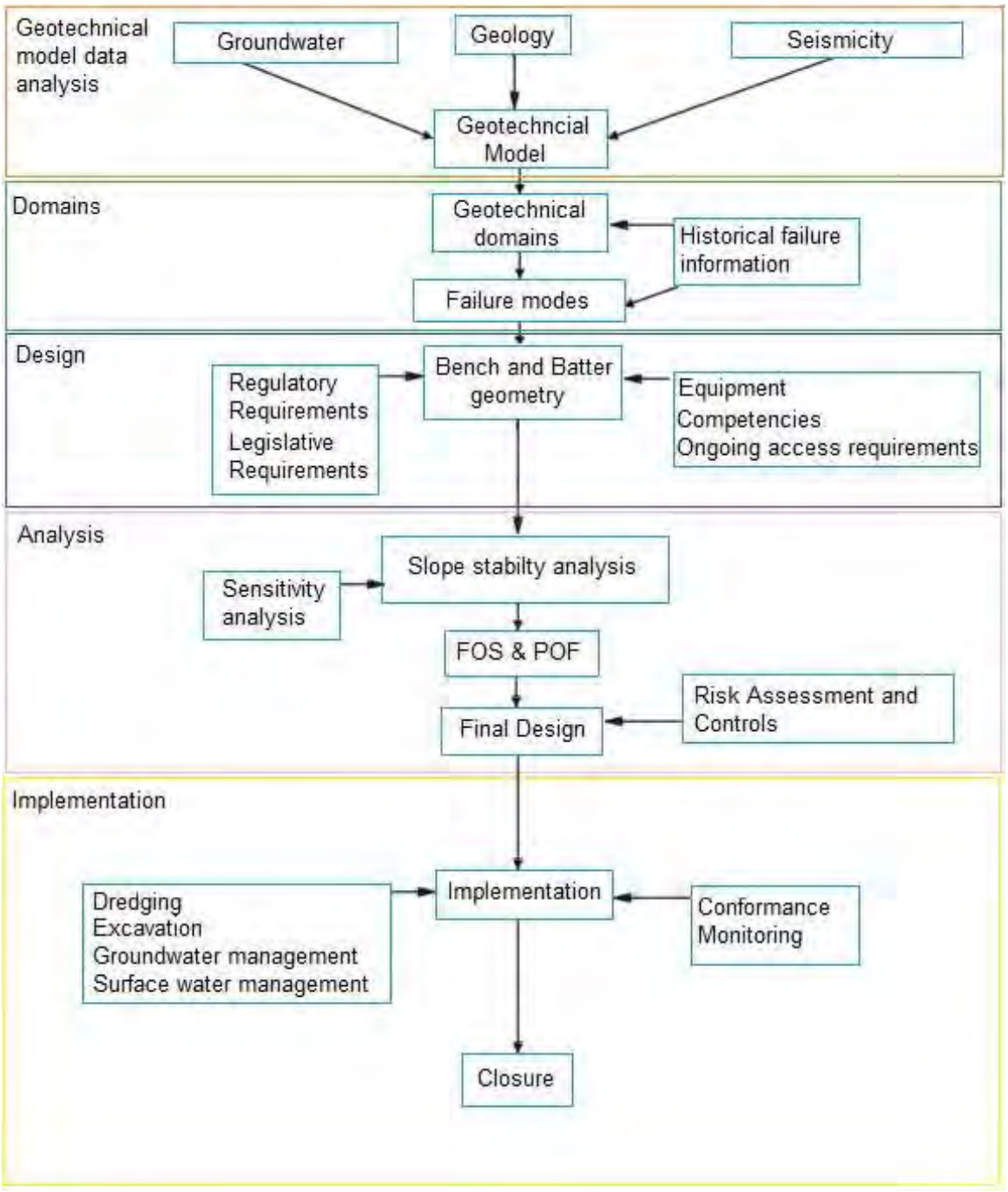


Figure 2: Safe Planning & Design Process

4 GEOTECHNICAL ASSESSMENT

The most recent version of the geotechnical assessment document CMW reference - MEL2022-0033 AE provides the information on which this GCMP is based. That report contains a review of the geological and geotechnical conditions at the site, a risk assessment for the site and a fill specification for the waterway diversion.

5 FAILURE MODES

At exposed faces of sand and/or clay the circular, rotational mechanism at a range of scales is likely to be the main process of potential failure (Figure 3A). After the placement of clay buttresses groundwater pressure is applied to the clay-sand interfaces and has the potential to induce sliding into the pit (Figure 3B). After the placement of the clay buttress and excavation to levels below the buttress base, a failure mechanism combining the rotational and sliding modes could develop.

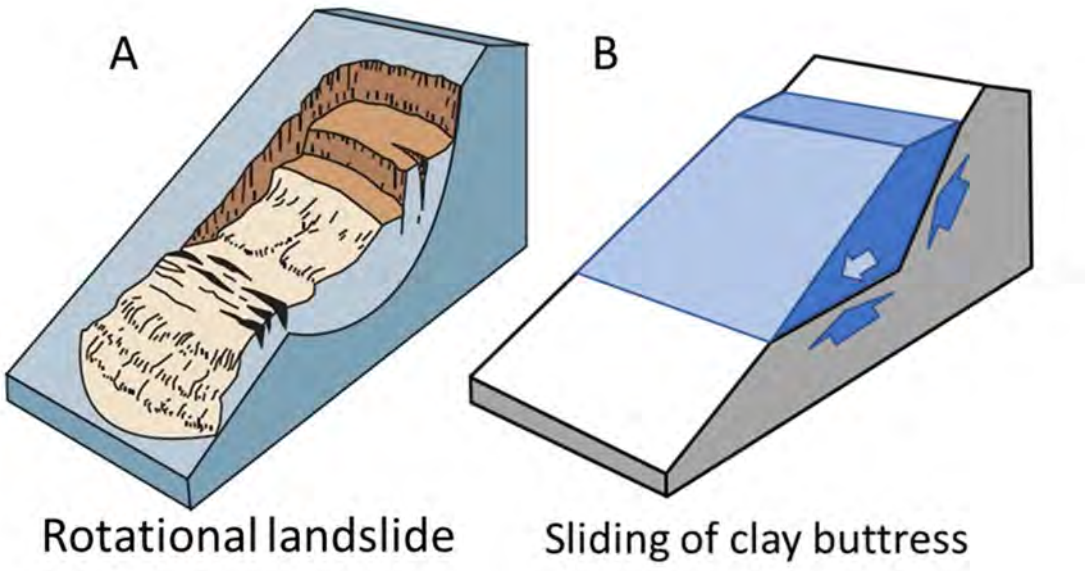


Figure 3: A) Illustration of the rotational landslide failure mechanism, AGS 2007C Practice Note Guidelines of Landslide Risk Assessment. B) Illustration of potential sliding of clay buttress under the influence of water pressure

6 PROPOSED PIT GEOMETRY

Due to the need to construct a waterway diversion, the excavation will occur in two main stages comprising an upper slope, which will include formation of the clay buttress and the waterway diversion, and a lower slope that will be formed when excavation accesses the area presently occupied by the natural waterway.

Based on the slope features outlined above, the excavation can be considered to comprise an upper slope and a lower slope. The main slope features are illustrated in Figure 4. The slope geometries

analysed are illustrated in Figure 5. Buttressing of the lower slope can be conducted in a series of stages.

The initial excavation is limited in size by the temporary preservation of the existing water way. The distance between the northern property boundary and the existing waterway varies along the length of the northern boundary. The distance is at its maximum in the centre of the proposed excavation and minimum at the west and east ends of the excavation. The initial excavation is also affected by the width of buffer zone required for the existing waterway and the width of the pit floor required for operational requirements. These features are illustrated schematically in Figure 5.

6.1 Upper Slope

The upper slope is considered to be the part of the face which is excavated to the depth at which the clay buffer would be installed. This depth may vary but is inferred to be similar to the depth of excavation of the existing pits at the site at 9m RL. This depth is approximately 16 m below the typical ground elevation in the northern part of the site.

A bench may be constructed at the top of the sand (i.e. below the clay) to facilitate vehicle movement. These slope faces would be exposed temporarily as clay overburden will be placed as a clay buttress.

- A slope angle/gradient of 1:2.5 (V:H) for excavated slopes is recommended.
- A slope angle/gradient of 1:3 (V:H) for the upper face of the clay buttress slopes is recommended. It is understood that the upper face for rehabilitation will be 1:5 (V:H) to the final pit water level which is expected to be in the vicinity of 24 m RL.
- The width of the upper surface of the clay buttress should be a minimum of 30 m but is required to be wider along the northern perimeter, according to the design of the waterway diversion. The current waterway diversion design provided requires 58m width at the top of the clay buttress.

The buttress is to be formed progressively as overburden clay is stripped from other parts of the site.

6.2 Lower Slopes

The lower slopes are to be excavated by dredging. Stability analysis indicates that a slope of 1:2 (V:H) is adequately stable for slopes in sand below the pond water level. This analysis is based on material properties of zero cohesion and 38^{o} friction angle as derived from this investigation.

Dredging equipment typically utilises rotational movements of a suction boom such that concave faces in the horizontal and vertical faces are formed. The recommended slope gradient may be achieved by forming benches in the excavation process. Ensuring the gradient is not over steepened requires careful placement of tethering lines and control of excavation face locations.

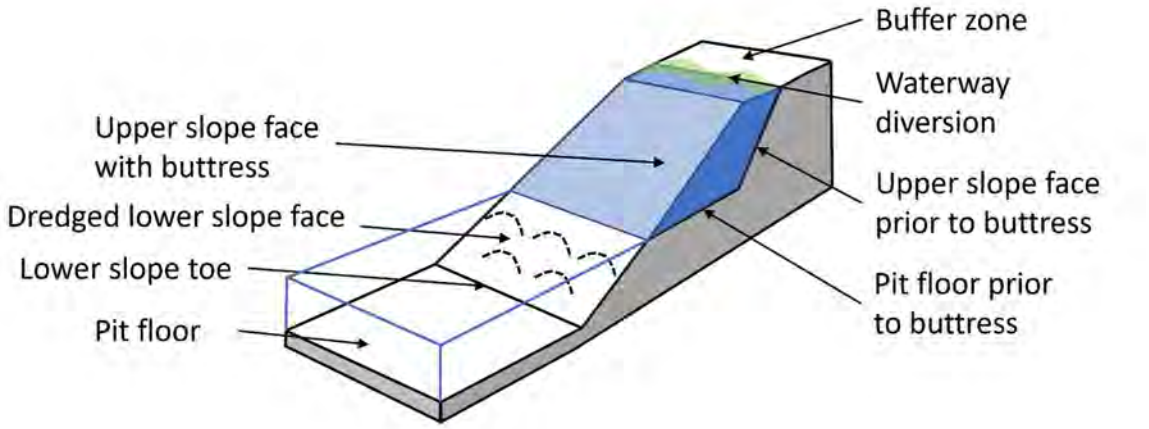
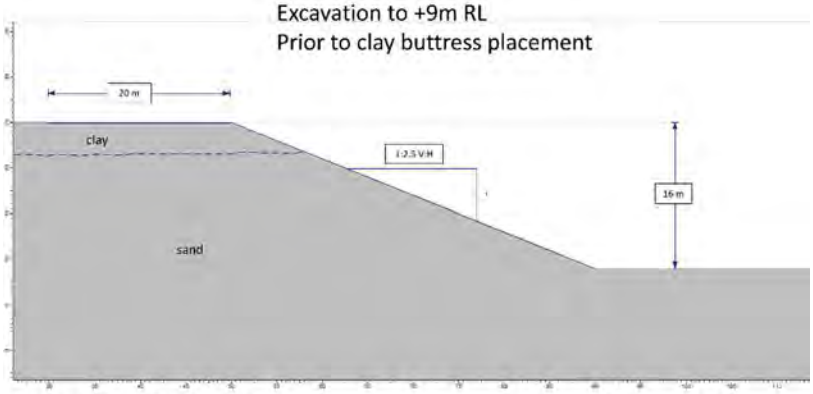


Figure 4: Annotated schematic illustration of the proposed pit slope features

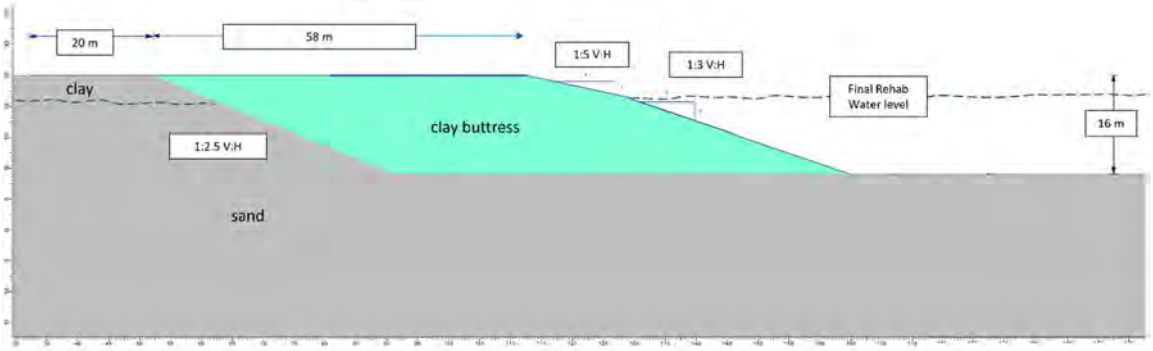
Excavation to +9m RL
Prior to clay buttress placement



Natural clay-sand boundary depth varies

Excavation to +9m RL
With clay buttress placed for waterway diversion

Waterway diversion
in place



Natural clay-sand boundary depth varies

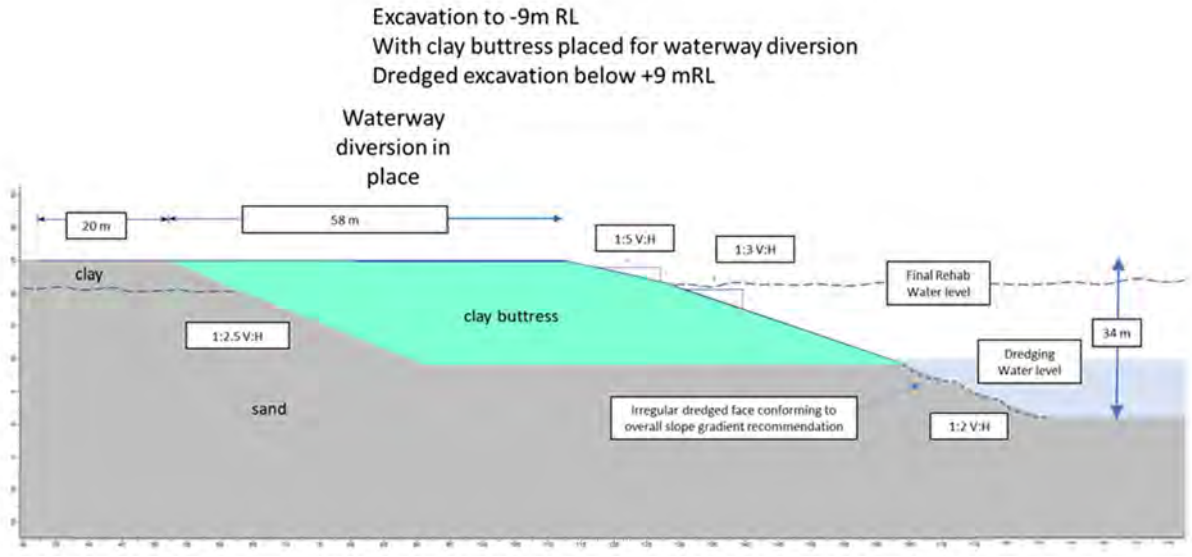


Figure 5: Illustrative geometry of slopes at three stages of slope excavation (as annotated). The waterway diversion requires 58m width of the buttress top. The minimum buttress width is 30 m. Limitations and context of the recommendations are in the Geotechnical Assessment report and noted in this GCMP

6.3 Backfilling

The rehabilitation plan for the site is understood to involve a void or voids in the area of the main extraction pits which will be allowed to refill with water to create waterbodies. The central part of the site, which currently contains the processing area and pits being refilled with the dried slimes, is currently being revegetated with native vegetation which will continue through the time of the proposed expanded operation.

It is understood that only the backfilling in the waterway diversion area needs to be controlled to achieve specified compactions.

7 IMPLEMENTATION

7.1 General

A phased excavation approach shall be undertaken during construction to confirm the design assumptions remain consistent with the materials and other ground conditions encountered during quarrying operations. A phased excavation approach comprises the following:

- Initial excavation in the northern part of the area of proposed extraction. This may commence at the western end of the site. This excavation must occur between the northern buffer zone and existing waterway. A buffer of minimum 10m should be left between the southern part of the initial excavation and the centreline of the waterway.
- As clay is stripped from the site it will be placed in a buttress against the western and northern faces. The specifications for the clay fill used in the buttress are outlined in

Appendix E of the most recent version of the Geotechnical Assessment report (CMW reference - MEL2022-0033AE).

- The waterway diversion can be constructed at the top of the buttressed slope. The presence of the waterway, and seepage from it, has been considered in the stability analysis. A preliminary design for the waterway diversion has been reviewed for this version of the GCMP. Future detailed designs of the waterway diversion and its location should trigger reviews of this GCMP. It is assumed that the waterway construction project will have its own design requirements and construction controls including surveying of the flow gradient to ensure successful hydrological performance.
- Groundwater movement through the ground in the existing quarry will be moderated by the presence of the clay buttress as demonstrated in previous excavations at the site. This groundwater control is expected to be effective in the initial phase of excavation. It is proposed that deeper excavation will take place without placement of a buttress below the initial pit floor level (approx. +9m RL). If a high level of water flow occurs through the sand face it has the potential to: 1) destabilise the slope, 2) cause flooding in the pit and 3) cause excessive drawdown of the water table outside the property boundary. Monitoring of the water inflow rate by 1) recorded observations and 2) pumping records and monitoring of the drawdown of the water table in wells at the property boundary are required to assess the groundwater impact on excavation below the initial pit floor level.
- A visual screen earth bund has been in place along the northern edge of the property. The earth bund can be retained or another earth bund can be constructed along the northern edge of the property during the expansion project.

7.2 Communication, Training & Competence

7.2.1 General

This GCMP will be communicated to all operatives that will be involved in activities in the zone of excavation. This will occur as part of a site-specific induction for the Yannathan site. The operatives will be given a copy of the GCMP to read, then asked a series of key questions derived from the GCMP to ensure conformance to the plan and awareness of the design assumptions will be achieved.

7.2.2 Training / Competence

For each of the named roles in Table 2, GCMP Roles and Responsibilities, Section 2.4 of this document, Hanson will establish the minimum competencies required to discharge that role.

These will take into account the regulative and legislative requirements for the operation of certain plant, as well as the experienced-based-practice component of Hanson's in-house approach to Verification of Competence.

Beyond the general requirements stated above, project-specific training in the requirements of the GCMP will be given, including orientation in the Safe Work Methods Statements / JHAs that are to be developed for the planned works by Hanson.

7.3 Conformance of Design

7.3.1 Observations

Site monitoring shall be undertaken on an ongoing basis during extraction by observational methods in the first instance. Observations should be made of the working face, from a safe distance, and the working crest, also from a safe distance. The observations in the area immediately adjacent to the active face should be made at the start and end of each shift and recorded. Further observations should be made in the event of heavy rain or any variance from the conditions / methodology assumed in the geotechnical risk assessment.

Face/batter/berm inspections should consider a number of elements, including:

- Tension cracking at or within a short distance (15m) of the crest;
- Loss of material from the crest or face;
- Observed signs of dredging causing undercutting at the toe of the face beyond the gradients described in sections above;
- Excessive spalling/fragmentation/breaking down of material;
- Excessive rilling/water erosion of the face;
- Excessive local ponding of water in parts of the area planned for or occupied by the waterway diversion.

The recorded outcomes of the observations should be collated and assessed by the Quarry Manager. It is recommended that the Quarry Manager seeks advice from a geotechnical specialist where variances from the anticipated conditions are recorded. The Roles and responsibilities associated with such are presented in Table 2.

The above observations provide a means through which any change in geological conditions can be readily inferred. The presence of lignite or coal is not anticipated in the expansion area. If these materials are encountered a geotechnical engineer should be consulted.

It is advised that an ongoing photographic record of the extraction process be kept by the operatives undertaking the work, even if that record is to simply prove the negative with respect to observed movement or failure.

7.3.2 Survey

Survey stakes should be placed to mark out the crest of the 20m buffer zone prior to the commencement of excavation in the zone of expansion. These markers should be monitored (surveyed for X, Y and Z) on a monthly basis to provide a baseline data set against which movement at the crest can be subsequently monitored.

A spot level topographic survey within the buffer zone should be undertaken every month during extraction and continue at this frequency until full rehabilitation of the pit is achieved.

Topographic survey of the formed batters and benches will be required on a monthly basis in order to ensure that the actual geometry does not exceed the design model.

It is recommended that a drone survey is flown of the entire area of excavation every two months, including up to 20m beyond the edge of the property to visually assess for evidence of movement beyond the site margin.

An ongoing survey drawing and/or database should be maintained with all of the above information for the life cycle of the quarry.

Surveying of dredge tethering locations and bathymetric surveys are required to monitor the extent of sand extraction at terminal faces.

7.3.3 Groundwater Monitoring

There are five (5) groundwater monitoring locations around the zone of proposed expansion area as shown in Figure 6.

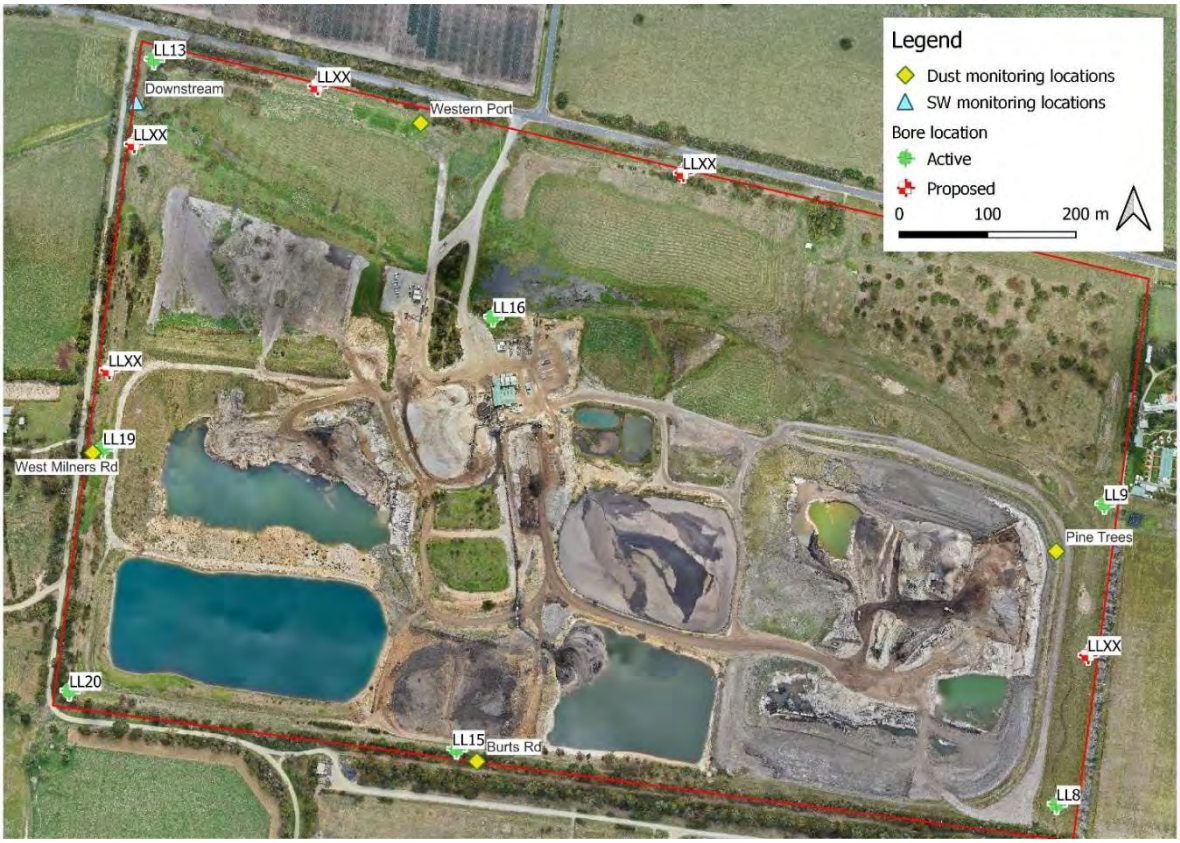


Figure 6: Groundwater monitoring bore plan

The groundwater level in each of these wells shall be monitored on a weekly basis or with cause, and the data collated in a spreadsheet format or similar for the Quarry Manager's review.

Where groundwater levels are observed to change beyond the design level assumed in modelling, the Quarry Manager shall seek geotechnical advice. A dynamic risk assessment of the impact of any groundwater level change may be required.

7.3.4 Proximity Controls

The integrity of any fencing / barriers preventing access or restricting proximity to the toe or the crest for Hanson's site operatives should be assessed on a daily basis. Any warning signage should be checked to ensure it is visible and fit for the intended purpose.

7.3.5 Site Security

The integrity of the external perimeter fencing that secures the entire site and prevents unauthorised access should be confirmed on a daily basis by the Hanson Supervisor.

Motion-activated security alerts for unauthorised entry should be considered, with a 24hr point of contact assigned in the event that such an alert is triggered. The point of contact should be located no more than 30mins from the site.

7.3.6 Recording of Failures

The term failure refers to movement of ground, particularly downslope movement of material at an excavated slope face. A minor failure can indicate that the material is behaving in a manner different to that on which the slope design has relied.

Where a failure does occur, however minor, it is crucial that the observations relating to this are recorded in order that a growing understanding of the site-specific conditions that trigger failures can be developed.

Where failures occur, these shall be investigated by the Quarry Manager and specialist geotechnical advice sought.

7.4 GCMP Reporting

As part of the GCMP, reporting will be required, the frequency and detail of which shall be determined by the Quarry Manager where such frequency or detail is not prescribed within this document.

This reporting will typically involve an extension of the geotechnical risk assessment provided above, whereby hazards have been identified, risk assessed and then observed and monitored for efficacy of controls and any changes to conditions. This information should be summarised in a Geotechnical Site Log, comprising the following information:

- Hazard / near-miss / safety suggestion description and date (e.g. for the hazards discussed above, the date of the site walkover would be considered the hazard identification date);
- Location on the site in the form of X, Y and Z or annotated on an aerial photo or site plan;
- Description of the hazard and a photograph where appropriate;
- Risk rating derived from the risk matrix in the Geotechnical Assessment or according to Hanson's Internal Risk Management Program, examples of which can be provided by Hanson for review upon request;
- Controls to reduce the risk to an acceptable level;
- Residual risk rating; and

- Any comments on additional controls or other observations that have been made.

7.5 Supervision

7.5.1 Review of Conformance Data

The Quarry Manager shall, on a monthly basis as a minimum, review all data gathered and reports submitted in relation to the zone of extraction.

Where concerns exist with the veracity of the data set or where the data set suggests a possible uncontrolled ground risk, the Quarry Manager will undertake a risk assessment in order to establish controls.

Where appropriate the Quarry Manager should seek specialist geotechnical advice in assessing identified uncontrolled ground risks.

7.5.2 GCMP Auditing

In order to ensure compliance with the Geotechnical Risk Assessment and Design and the GCMP, those working in the area to which it applies will be audited on its content and application. The understanding of the site risk by Hanson staff could be assessed using short interviews discussing the risk assessment presented in the Geotechnical Assessment MEL2022-0033 AB Rev 0 and the conformance requirements outlined above.

The audit could include a review of the monitoring records and a set period of observation (e.g. 1 hr) by the Quarry Supervisor or Quarry Manager of the activity undertaken during that time within the work zone, with a view to visually confirming conformance to the GCMP.

An audit should be performed every month. Non-conformances should be recorded and corrective action proposed and implemented by the Quarry Manager.

Where required, the advice of a geotechnical specialist should be sought.

7.6 Managing Unstable Ground

The terms unstable ground and ground instability refer to conditions where processes such as cracking, bulging or down-slope movements are observed. The term covers signs of incipient failure and areas where previous failure has occurred.

Based on the ongoing collection of conformance data, where ground is deemed to be unstable or is becoming unstable, a dynamic risk assessment shall be undertaken and the appropriate controls determined.

For example, where slopes are deemed to have been over-steepened relative to their stable condition, material will be placed back in front of the slope to reduce slope angle and increase toe weight so as to prevent further failure. Such material is referred to as a buttress. The action may be within the delegated authority level of the excavator operatives if said operative is in a position to safely risk assess and action the required response. Careful instruction and confirmation of understanding of SWMS/JHAs, in which the management of unstable ground is risk assessed, is required for all operatives that will be working within the zone of extraction.

Given the proximity to private properties and public roads it is critical that an active response is made to any perceived unstable ground.

Where tension cracking or other evidence of potential failure appears, there may not be sufficient time to conduct a dynamic risk assessment. In this event and if safe to do so, the placement of additional weight at the slope toe will likely be the most effective response to arrest or slow any failure in most cases. This is based on the mechanisms of failure identified as being most likely at the site.

In the management of unstable ground, it should be recognised that prevention is always better than cure. Diligence in the review and assessment of the conformance observations and data recorded should reduce the likelihood of significantly unstable ground developing to the point where such dynamic decision making is required.

7.6.1 Trigger Action Response Plan for unplanned movement

Where apparent unplanned movement (observed or surveyed) is recorded, all works shall cease in that area (to be defined as the zone of apparent movement +30m in all directions) and a Geotechnical Engineer will be engaged to undertake a dynamic risk assessment and determine whether further remedial action is required. Where movement could impact on the adjacent properties or roads, the relevant land-owners will be contacted immediately by the Quarry Manager and informed of the potential instability, along with a recommended zone of exclusion (the zone of apparent movement +30m in all directions).

Site staff shall be similarly notified of the exclusion zone (the zone of apparent movement +30m in all directions) via radio and/or other means as appropriate to effect the immediate cessation of work in that zone and will not re-enter until remediation strategy has been devised and executed. The presence of workers within the zone of observed movement as part of the remediation plan will be dynamically risk assessed based on the conditions at the time.

Where an observed zone of movement could threaten the integrity of a site boundary, work at that location will cease immediately and the Quarry Manager shall be contacted. In this event, it is likely that buttressing of the zone of movement will be required using placed material.

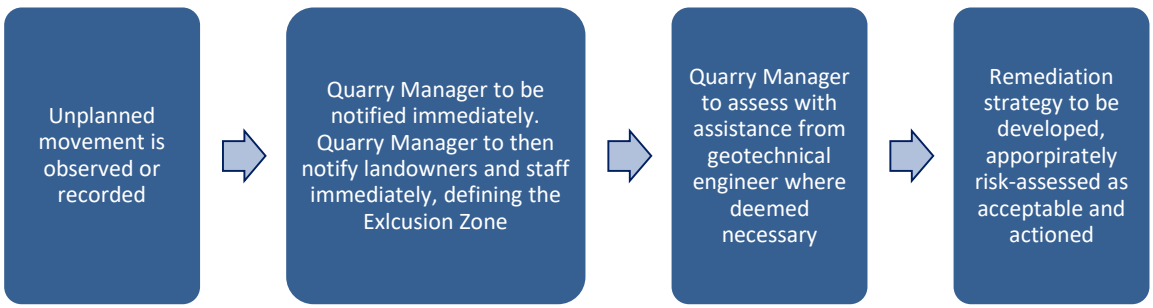


Figure 6: Trigger Action Response Plan for unplanned movement

7.7 Emergency Response

In the event of an emergency, Hanson's Emergency Response Plan for the site will be triggered, the details of which are held currently by Hanson.

8 LIMITATIONS AND CLOSURE

This document has been prepared for use by Hanson Construction Materials in relation to works at the Westernport Road site, Yannathan, in accordance with generally accepted consulting practice. No other warranty, expressed or implied, is made as to the professional advice included in this document. Use of this report by parties other than Hanson Construction Materials is at their risk as it may not contain sufficient information for any other purposes.

WA127 YANNATHAN SLIMES MANAGEMENT PLAN

Client: Hanson Construction Materials

Ricardo ref. 30765 Issue:4 13/12/2023

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CONTENTS

1. INTRODUCTION 1
2. BACKGROUND 2
2.1 LOCATION 2
2.2 SURROUNDING LAND USE 2
2.2.1 Potential Receptors 3
2.2.2 Drainage 3
2.3 CLIMATE 3
2.4 GEOLOGY 4
2.5 HYDROGEOLOGY 4
3. SLIMES CHARACTERISATION AND MANAGEMENT 5
3.1 SLIMES AND FILTER CAKE PRODUCTION 5
3.2 SLIMES MANAGEMENT 8
3.2.1 Chemical Additives 8
3.2.2 EPA requirements 9
3.3 DAM CONSTRUCTION 9
4. RISK EVALUATION 14
4.1 HAZARD IDENTIFICATION 14
5. COMMUNITY ENGAGEMENT 15
6. REFERENCES 16

Figures

Figure 2-1 Site Location 2
Figure 2-2 Site and Surrounds 3
Figure 2-3 Monthly evaporation and precipitation 4
Figure 3-1 Current and Proposed Tailings Dams 6
Figure 3-2 Cross Sections 11

Tables

Table 2-1 Surrounding land use 2
Table 3-1 Estimates of Material Volumes 6
Table 3-2 Materials Mass Balance Estimate 7
Table 3-3 Filter Cake / Oversize Material Estimates 7
Table 3-4 Estimated Future Storage Capacities of Cells 8
Table 3-5 Dam Wall Construction 9
Table 4-1 Hazard Identification 14

Glossary

TERM	DEFINITION
AHD	Australian Height Datum
ANCOLD	Australian National Committee on Large Dams
ASS	Acid Sulfate Soil
BLCAC	Bunurong Land Council Aboriginal Corporation
CASS	Coastal Acid Sulfate Soil
CEP	Community Engagement Plan
CHMP	Cultural Heritage Management Plan
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEECA	Department of Energy Environment and Climate Action
DJPR	Department of Jobs, Precincts and Regions
ERR	Earth Resources Regulation
GME	Groundwater Monitoring Event
NHMRC	National Health and Medical Research Council
Poly DADMAC	2-Propen-1-aminium, N,N-dimethyl-N-2-propenyl-, chloride
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
WA	Work Authority

1. INTRODUCTION

Hanson Construction Materials (Hanson) operates the Yannathan extraction and processing operations at 870 and 910 Westernport Road, Yannathan, VIC 3981 (the Site). The site is operated under the existing Work Authority (WA127), and extraction of material at the site commenced in July 2004.

Ricardo Energy Environment and Planning (Ricardo) has been commissioned by Hanson to prepare Work Plan Variation documentation for submission to the Earth Resources Regulation (ERR) branch of Department of Energy Environment and Climate Action (DEECA) formerly the Department of Jobs, Precincts and Regions (DJPR) for Site. The Work Plan Variation proposes to increase the excavation area and depth within WA127.

In this document the following terminology is used:

- **Slimes**. A slurry product from the process plant with particle sizes generally less than sand.
- **Filter cake**. Slimes that have been dewatered by a belt press, having approximately 50% water content. This is a spadeable product that is able to be handled on a belt conveyor.
- **Oversize material**. Material mechanically screened, e.g. cobbles, boulders from feed material prior to entering the process plant. Oversize material will be deposited into cells with filter cake.

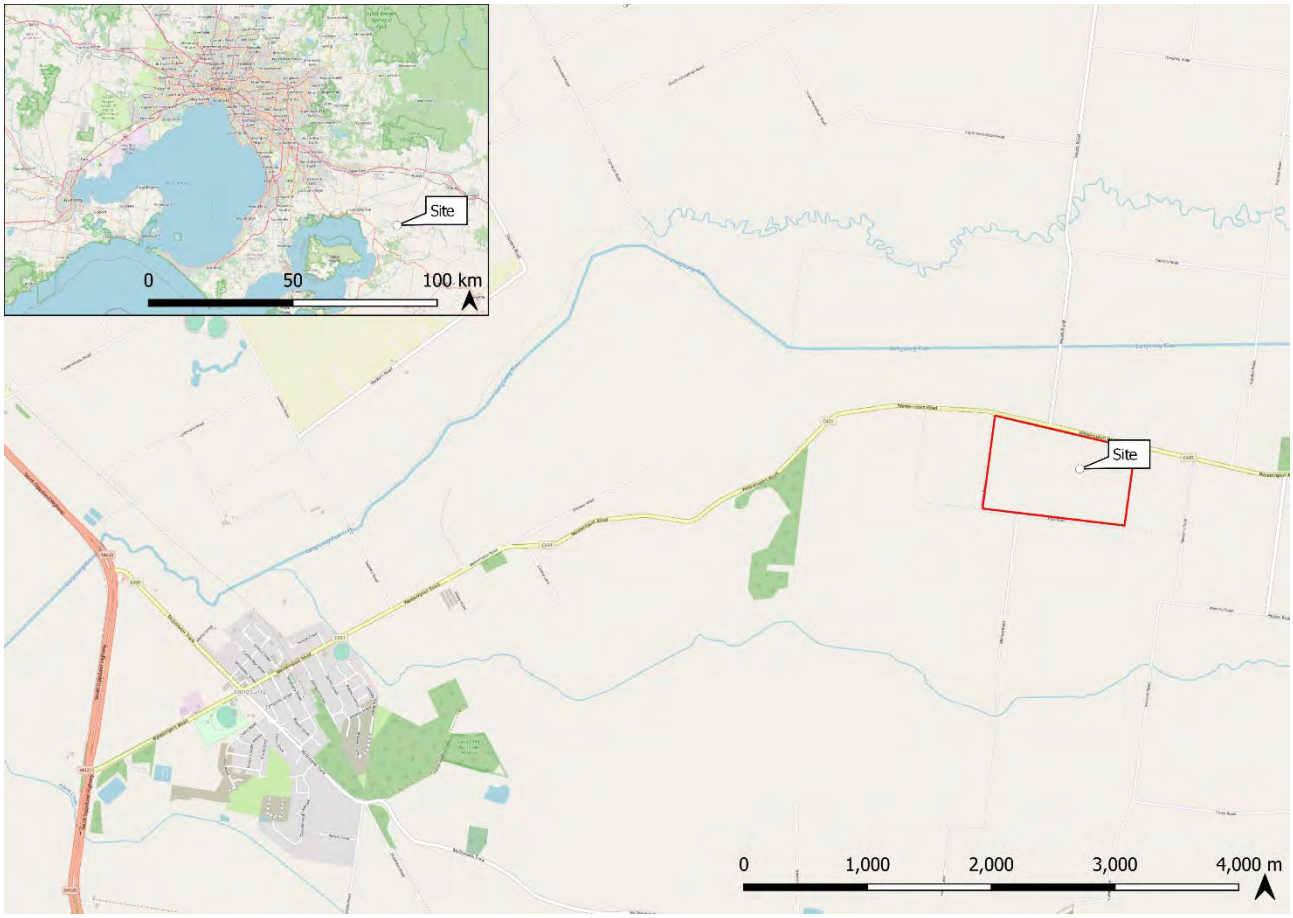
To support the Work Plan Variation, this Slimes Management Plan has been prepared to address management of filter cake and oversize material from additional extraction areas / depths. For completeness, this plan has been prepared with reference to ERR Technical Guideline "*Design and Management of Tailings Storage Facilities*" 2017, noting this is not required under this guideline for disposal of tailings into open pits.

2. BACKGROUND

2.1 LOCATION

The site is located at 870 and 910 Westernport Road, Yannathan as shown in **Figure 2-1**. The site has good access to the Bass Highway to supply the Melbourne market. The site is in a rural area, the township of Lang Lang is located approximately 6km west of the site. Yannathan is a hamlet approximately 2.5 km north of the site comprising a hall and sporting facilities and approximately five houses.

Figure 2-1 Site Location



2.2 SURROUNDING LAND USE

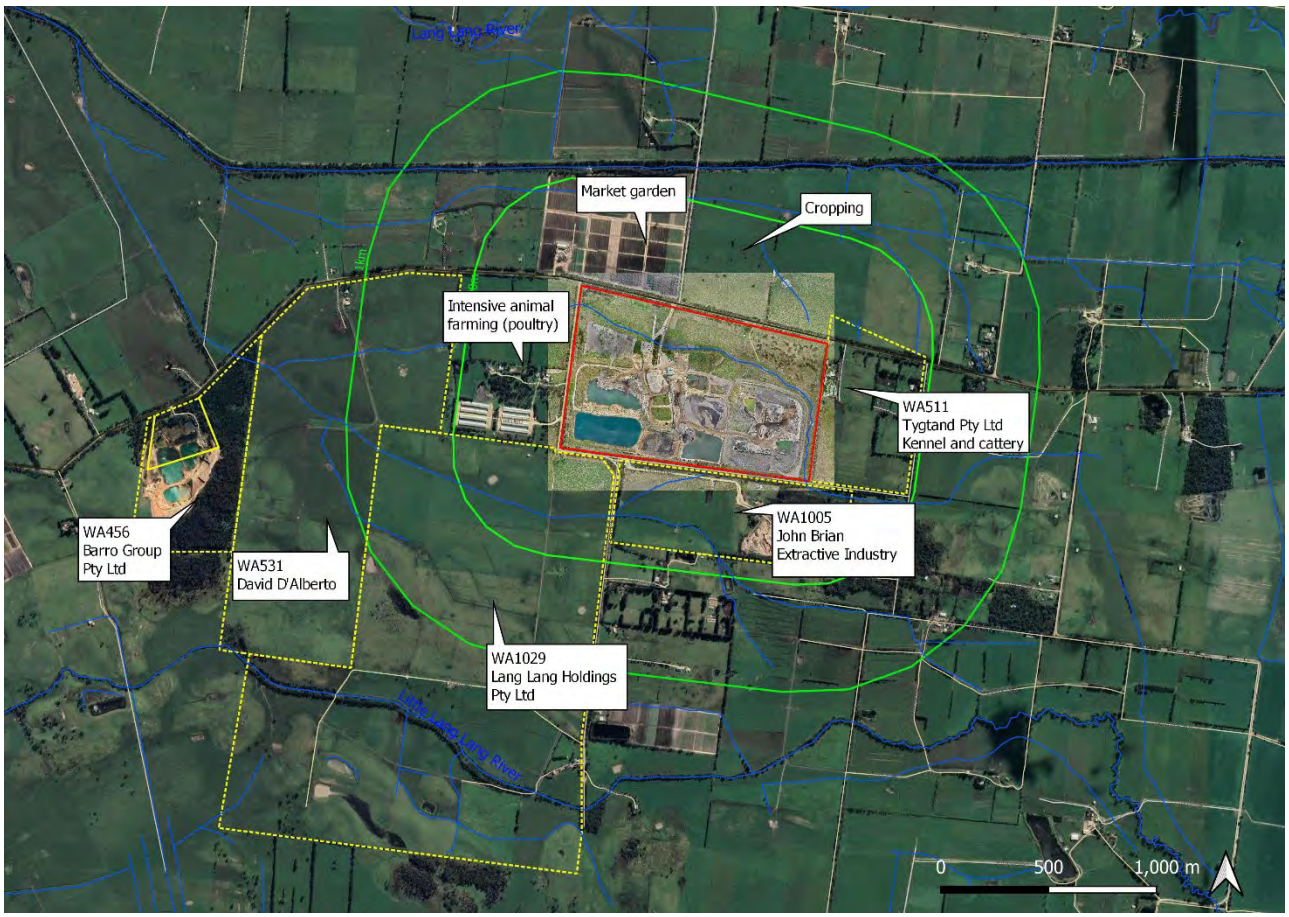
The following land uses surround the site:

Table 2-1 Surrounding land use

Direction	Comment
0	Agricultural uses. A residential farmhouse is located approximately 740 m from the north-western corner of the site. A former residential building to the north of the site is used as an office for the market garden, not a residence. However, it is understood that a caretaker stays overnight from time to time.
East	Land immediately east of the site is currently a kennel boarding and cattery facility and a farm with on-site residence. There is also a current work authority (WA511) over the property.

Direction	Comment
South	Current work authorities (WA1005 and WA1029) exist over the properties immediately south of the Site.
West	An intensive poultry farming facility with on-site residence exists immediately west of the site.

Figure 2-2 Site and Surrounds



2.2.1 Potential Receptors

Slimes, filter cake and oversize material are stored in previously excavated pits which are below natural surface levels. Any loss of containment from storage cells will only impact the surrounding pits. No material will migrate from the site.

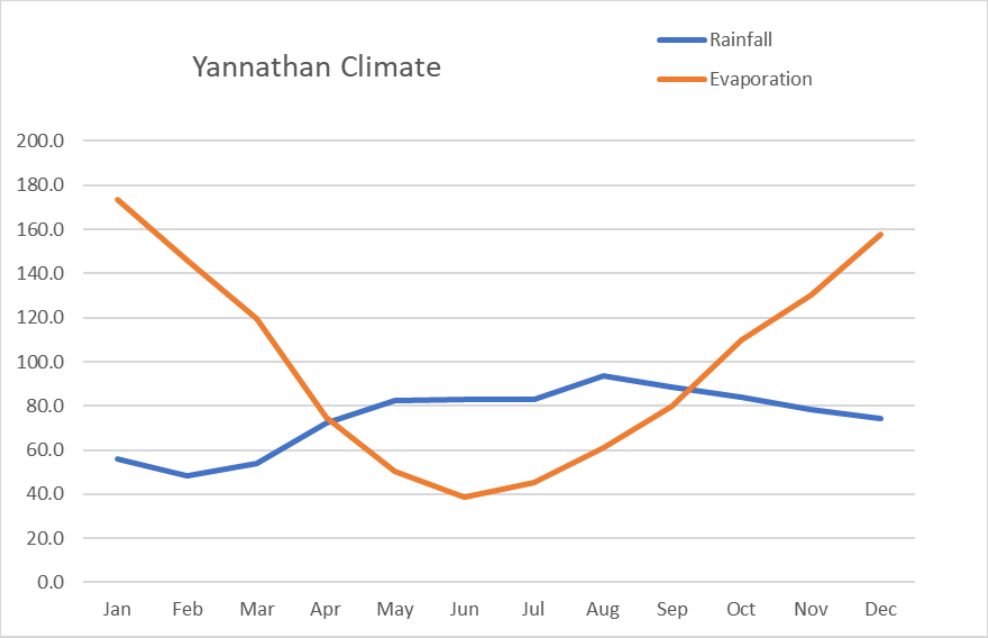
2.2.2 Drainage

A watercourse currently runs through the site and part of this watercourse will be relocated to the north of the site as part of this Work Plan variation. The watercourse in the eastern part of the site was previously relocated to allow development of the current East Pit. The watercourse is remote from cells used to store slimes, filter cake and oversize material.

2.3 CLIMATE

Average monthly rainfall varies from 48.3 mm in February to 93.7 mm in August. Evaporation is highest in January (173.7 mm) as shown in **Figure 2-3**.

Figure 2-3 Monthly evaporation and precipitation



Source: SILO | LongPaddock | Queensland Government

2.4 GEOLOGY

Drilling onsite indicates a relatively uniform geological profile across the site comprising:

- Uppermost dunal and swampy sediments comprising silts and clays to a depth on average of around 3m inferred to be of Quaternary age
- Interbedded sands, silts and gravels approximately 10m thick, inferred to be of Tertiary age.
- Dense gey-black silts, clays and lignite of varying thicknesses (sometimes absent)
- Sands

Drilling has revealed the sand deposit is thickest in the southern part of the site, thinning to the north where clay occurs at depths exceeding 8 metres. The base of the sand has a relatively constant elevation.

The drill samples show the sands are two sized with a coarse grading fining with depth. The two-size sand contains up to 20% coarse fraction and 30% of very fine sand. Testing reveals the coarse sand can be blended with the fine sand to be used in concrete manufacture.

The probability of occurrence of acid sulfate soils (ASS) is low to extremely low (Atlas of Australian Acid Sulfate soils, CSIRO). The site is not in an area of coastal acid sulphate soils (CASS_map3.pdf (agriculture.vic.gov.au), Victoria Resources Online).

2.5 HYDROGEOLOGY

The site surface ranges from approximately 29 mAHD in the south east, to 25 mAHD in the north west. Prior to site development, groundwater levels ranged from approximately 27 mAHD in the south east, to 20 m AHD in the north west, i.e. 2 – 5 metres below ground level. Groundwater is expected to return to predevelopment levels after site rehabilitation, including slimes, filter cake and oversize material storage areas.

Further information on site hydrogeology is detailed in the hydrogeological study appended to the **Part 1 Summary Report.**

3. SLIMES CHARACTERISATION AND MANAGEMENT

3.1 SLIMES AND FILTER CAKE PRODUCTION

Currently sand is quarried by dry quarry means. Dump trucks deliver the extracted material from the East Pit and West Pit to the plant and place this either into one of two raw material feed bins or stockpiles for processing at a later stage. A conveyor then feeds the quarried material through screens which remove primary oversize material. Water is then added to the material in an attrition cell to break up and clean the sand particles.

In the future it is proposed to include dredging for extraction at which time material will be delivered as a slurry to the production plant from dredging operations. Slurry will also be screened to remove secondary oversize material. The slurry is then discharged into a settling tank for transfer to a classifier to separate the coarse and fine sand fractions as required.

The coarse sand slurry travels through the bottom of the classifier onto a dewatering screen and then discharged onto a conveyor. The overflow slurry from the classifier containing the fines fraction is pumped through a series of cyclones. The semi dried material then passes through a second drying screen and transferred to a holding bin where the fine sand is blended at a controlled rate onto the coarse sand conveyor for delivery to the product storage stockpiles.

The silt and clay effluent produced by the wash process (slimes) is transferred to a separate treatment plant for dewatering. Organic coagulant and flocculant are added to the slurry in a tank and the resultant thickened slurry is dewatered via a belt press. The dewatered filter cake is mixed with the oversize material from the primary screens and placed back into completed areas of the excavated pit via a waste conveyor as part of progressive rehabilitation. The water removed from the effluent along with water from the dewatering screens is recycled back into the processing plant for reuse in the washing process.

The filter cake from the above process is currently deposited in a disused cell to the south of the production plant. The cell will be continually dewatered to manage water levels. When filling of this cell is complete, it is proposed to construct a new storage cell in the current east pit, and deposit filter cake / oversize material in the empty cell, with on-going removal of any water ingress until filling is complete.

Current Work Authority Condition 25.1 requires all reasonable measures to minimise the generation of slimes. This is addressed with the belt presses, and slimes are only generated when the belt presses are unavailable. Consequently, only one cell (the “Slimes Dam”) has been required over the life of the quarry.

The location of the proposed storage cells are shown in **Figure 3-1,** cross sections are presented in **Section 3.3.**

Figure 3-1 Current and Proposed Tailings Dams

The volumes of filter cake and oversize material generated are estimated based on current production rates per 100 tonnes of material processed of approximately 5.5 tonnes of filter cake (wet weight) and 15.9 tonnes of oversize material (Quarry Manager, Pers. Comm.).

The filter cake has a moisture content of approximately 50%, Compared to 10-15% for the raw feed.

The following mass balance is therefore assumed per 100 tonnes feed:

- Input, 100 tonnes at 10-15% moisture content
- Filter cake, 5.5 tonnes at 50% moisture
- Oversize, 15.9 tonnes at negligible water content (cobbles, boulders etc)
- Product 78.6 tonnes at approximately 3% - 7% moisture content

The expected saleable product volumes are 400,000 tonnes per year. The total volumes of all materials generated over the life of the quarry are summarised in **Table 3-1**.

Table 3-1 Estimates of Material Volumes

Material Description	Volume to be Generated (m^3)	Comments
All Material	6,165,000	Includes material from proposed extension area and currently unextracted material from currently approved Work Plan area
Overburden	1,405,331	To be used for construction of batters, dams and capping
Dune Sand	370,573	To be used for rehabilitation
Material Processed:	4,389,096	

Material Description	Volume to be Generated (m^3)	Comments
- Saleable product	3,451,425	Based on current production rates, 3% moisture content
- Filter cake	239,405	Based on current production rates from belt press, spadeable, 50% moisture content
- Oversize material	698,265	Based on current production rates, cobbles / boulders etc removed during screening

Clay overburden and some oversize material will be used in the construction of: rehabilitation batters; a 60m wide area to allow diversion of the current watercourse to the north of the property; additional dams; and capping of cells containing filter cake / oversize materials or the Slimes Dam. A mass balance of the volume of overburden and oversize materials required is shown in **Table 3-2**.

Table 3-2 Materials Mass Balance Estimate

Material Description	Volume (m^3)	Comments
Material required for Construction:		
- Batters and waterway diversion	1,142,080	Allows engineered construction for waterway diversion (60m width) and rehabilitation batters to 1 vertical : 3 horizontal
- New dams across East Pit	457,470	Allows 1 additional cell for storage of filter cake / oversize material and 1 additional water storage dam
- Capping of slimes / filter cake / oversize material cells	203,325	Allows 1.5m cap as used in previously rehabilitated cells
	1,802,875	**Total construction material required**
Material available:		
- Overburden	1,405,331	From stripping to be completed
- Stockpiled Overburden	192,000	Currently stockpiled in base of East Pit
- Oversize	205,544	Required from production
	1,802,875	**Material to be used in construction**
	492,721	Remaining oversize to be placed in cells with filter cake

If the remaining oversize materials are placed into cells with filter cake, rather than crushed and sold, the estimated volumes and resulting moisture content are shown in **Table 3-3**.

Table 3-3 Filter Cake / Oversize Material Estimates

Material Description	Volume (m^3)	Tonnes[1]	Comments
Filter Cake	239,405	478,810	At 50% moisture content by weight
-Filter cake solids		239,405	
-Filter cake moisture		239,405	
Oversize Material	492,721	985,443	Cobbles, boulders etc, minimal water content
Total	732,127	1,464,253	Includes 239,405t water = 16.3% moisture

1. Assumes 2 tonnes per m^3 for (recompacted) solids

The above figures demonstrate that the overall moisture content of filter cake and oversize material can be managed to be less than 20%, as suggested by ERR.

The available storage for filter cake / oversize materials are estimated in **Table 3-4**. Estimated water storage capacities have also been noted for completeness.

Table 3-4 Estimated Future Storage Capacities of Cells

Description	Volume (m^3)	Comments
Filter Cake / Oversize Storage		
Available Storage		
- Existing cell	59,438	Assumes 50% of original capacity remaining
- Future cell in East Pit	620,000	
- Total	679,438	
Required Storage	732,127	Excess material allows for mounding of filter cake / oversize material prior to capping to allow future surface drainage, as for previously capped cells
Other Storage		
Existing Water Storage	284,640	To south west of site
Existing Water Storage	N/A	To east of production plant. Area to be excavated
Additional Water Storage	312,500	To be constructed in East Pit
Slimes Dam	14,700	Cell near capacity. Disposal of slimes to be discontinued

Overall, it is estimated that the construction of an additional cell in the East Pit will allow sufficient storage for filter cake and oversize material forecast to be generated during quarry activity at the site. Additional water storage will also be provided in the East Pit to allow for future water management.

3.2 SLIMES MANAGEMENT

Historically, filter cake has been deposited into disused cells at the site. The material was of sufficient quality to settle and effectively fill a number of dams. This notwithstanding, future cells will be dewatered prior to filling with filter cake, and pumping maintained to remove any groundwater ingress / rain water. When complete, the cells will be capped with a nominal 1.5m layer of clay and topsoil prior to revegetation.

Slimes in the Slimes Dam will be allowed to settle, and when sufficiently consolidated the cell will be capped with nominally a 1.5m layer of clay and topsoil prior to revegetation.

All proposed cells have perimeter bunds that diverts surface water away from the pits.

The CSIRO Atlas of Acid Sulphate Soils (ASS) indicates that the site has a low to extremely low probability of occurrence of ASS. The site is not in an area of coastal acid sulphate soils. As such, the risk of slimes or filter cake forming acid sulphate soils is considered low.

3.2.1 Chemical Additives

The feed materials are naturally occurring sands and clays, and the only additives are coagulants and flocculants added to aid the dewatering process.

The following coagulants and flocculants are used on site in the processing plant:

- Flocculant “Magnafloc® 5250”, (polyacrylamide).
- Coagulant “Magnafloc® 1425”, 2-Propen-1-aminium, N,N-dimethyl-N-2-propenyl-, chloride, homopolymer (“poly DADMAC”).

Polyacrylamide and polyDADMAC are widely used as coagulants / flocculants for effluent treatment, in paper manufacture and water purification. Both chemicals are endorsed by the National Health and Medical Research Council (NHMRC) for use in drinking water treatment (NHMRC, 2011). Polyacrylamide may also be

used as a soil conditioner in agriculture, and as a surfactant in herbicides (Reber et al, 2007). At the Yannathan site they are used as coagulants / flocculants to assist in the removal of undersized material ("fines") to produce a filter cake. The filter cake is currently used to fill extracted pits in addition to oversize material. Currently, the filter cake (including residual coagulant / flocculant) is disposed by conveyor to the pond south of the processing plant.

In 2021, the following quantities were used at the site:

- Polyacrylamide 59,201kg
- PolyDADMAC 173,880L (10%-50% w/w solution)

A groundwater monitoring event (GME) in October 2022 (Ricardo 2022) included analysis of potential degradation products in groundwater wells, and water accumulating in the cell to which filter cake was being deposited. This included:

- Total Organic Carbon (TOC).
- Total Kjeldahl Nitrogen (TKN).
- Nitrogen containing non-organic compounds (nitrate, nitrite, ammonia).
- Acrylamide
- Chloride

The report concluded that that coagulants and flocculants used in processing were not resulting in unacceptable impacts to water within the cell that filter cake was disposed in, or groundwater.

3.2.2 EPA requirements

Waste disposal is regulated under the Environment Protection Act 2017. Requirements are specified depending on the waste classification. EPA waste code N190 is for *Filter cake contaminated with residues of hazardous substances*.

3.3 THIS CATEGORY IS VERY BROAD AND INCLUDES FILTER CAKE FROM A WIDE RANGE OF INDUSTRIES. ALTERNATIVE WASTE CODES SUCH AS T130 -NH WHICH IS A PRIORITY WASTE MAY ALSO BE APPLICABLE. THIS CAN BE DISPOSED TO LAND UNDER A PERMIT, SUBJECT TO A DETERMINATION OF THE WASTE CLASSIFICATION BY EPA IN ACCORDANCE WITH EPA PUBLICATION 1827.2.DAM CONSTRUCTION

The construction of free standing walls was established by reviewing historical photographs / surveys (where available) and discussions with the Quarry Manager. The construction details are summarised in **Table 3-5**.

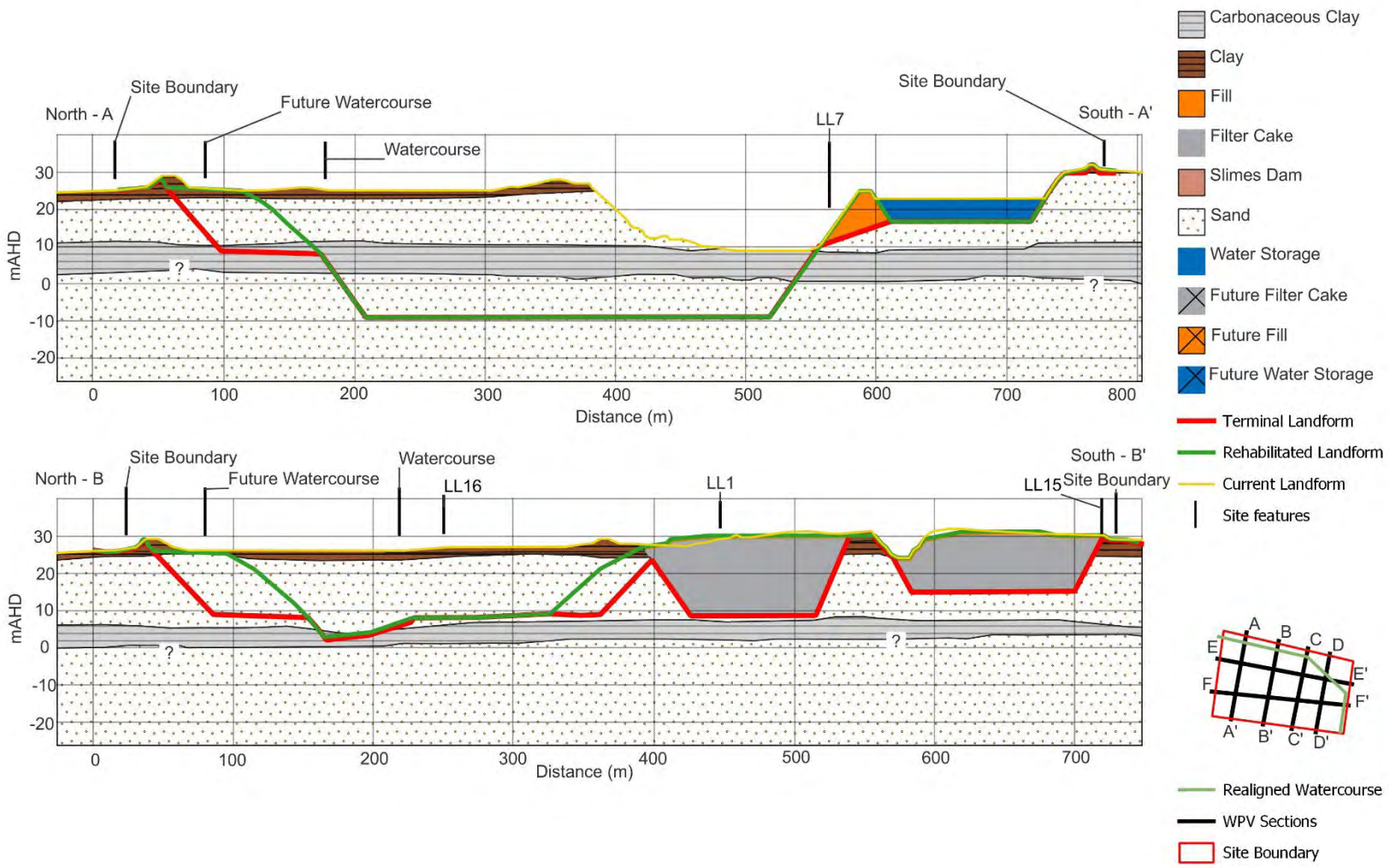
Table 3-5 Dam Wall Construction

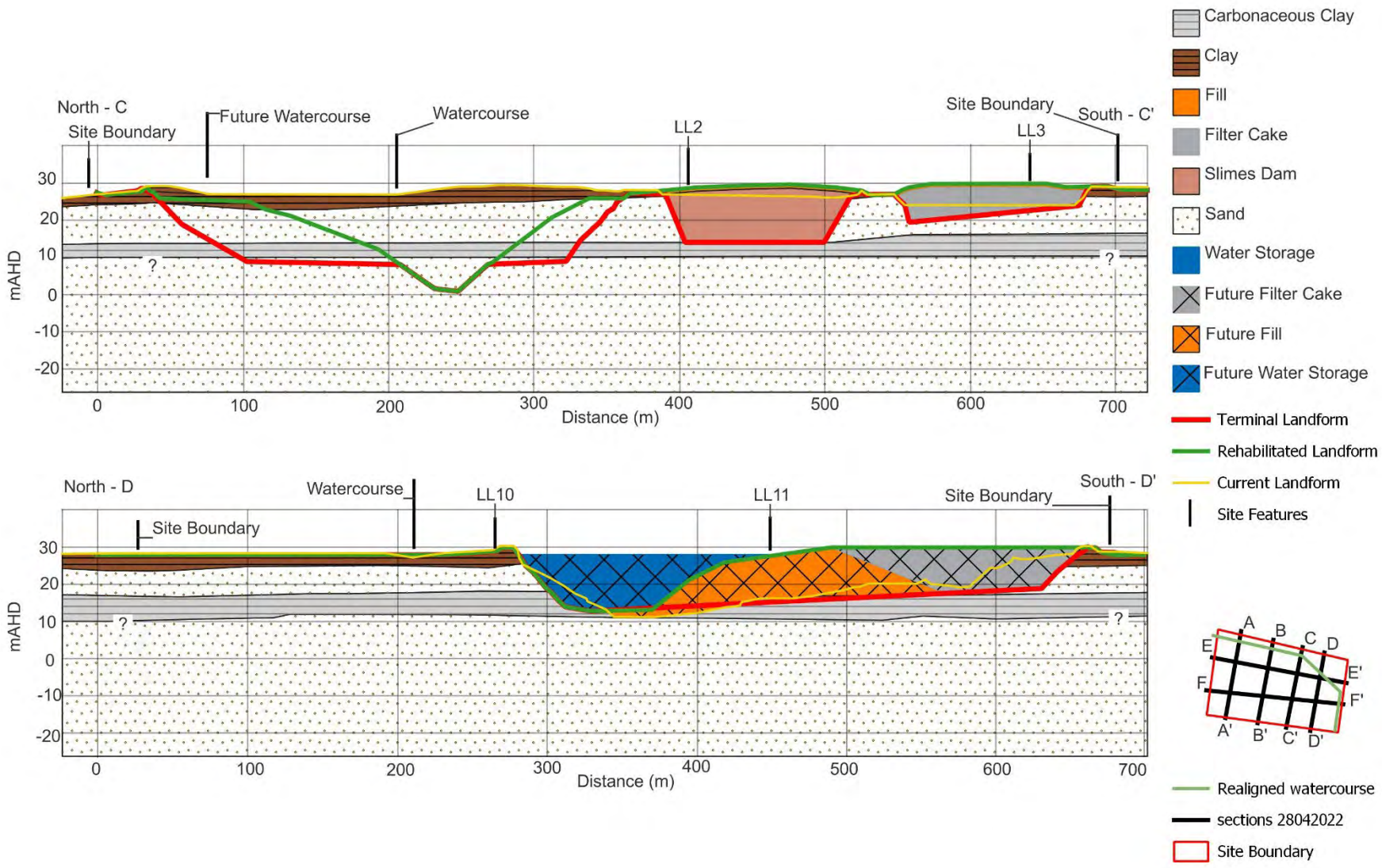
Cell	Dam Wall Construction	Comments
Current Filter Cake Cell	East wall: originally excavated to a maximum of 1V:1H on either side. Battered to 1V:2H with clay overburden.	South: not excavated (site boundary). West: former cell backfilled with filter cake / oversize material. North: current Slimes Dam.
Current Water Storage Dam in south-west corner of the site	North wall: fully excavated in several phases and reformed to 1V:2H on either side with clay overburden. Formed with lifts of 2-3m. No compaction testing, but subsequent use as haul road would have provided additional compaction.	East: former cell backfilled with filter cake / oversize material. South and west: not excavated (site boundary).

Cell	Dam Wall Construction	Comments
Current Slimes Dam	East wall: originally excavated to a maximum of 1V:1H on either side. Battered to 1V:2H with clay overburden Proposed North Wall. Currently 1V:1H on south side. Battered to 1V:2H with clay overburden. Currently not excavated immediately to north, but future excavations will allow a minimum 15m buffer prior to excavating at 1V:2.5H and battering with clay to 1V:3H	South: current filter cake / oversize cell. West: former cell backfilled with filter cake / oversize material.
Proposed Filter Cake Cell, current East Pit	North wall: an engineered wall with be constructed across the pit from overburden material. South of this wall will have a 1V:2.5H batter (to be filled), north of this wall will have a 1V:3H batter (rehabilitation profile).	East and south: not excavated. West: current filter cake / oversize cell and Slimes Dam.
Proposed Water Storage Dam, current East Pit	North west wall: an engineered wall with be constructed across the pit from overburden material. This wall will have a 1V:3H batter (rehabilitation profile).	North east and east: not excavated. South: wall to be constructed for new filter cake / oversize cell (see above). West: current Slimes Dam.

All dams are constructed in disused quarry cells below the surrounding ground levels and current / proposed waterway alignments (**Figure 3-2**). Therefore, in the unlikely event of a loss of containment from a dam, any materials will only flow into adjacent quarry pits and not off-site via waterways or overland flow. Further ANCOLD assessments of dam failure consequences are discussed in the geotechnical assessment appended to the summary report. The geotechnical assessment notes that on 22 September 2021 there was a magnitude 5.9 earthquake at Mansfield that resulted in approximately 70% of the acceleration of a 1:500 year earthquake at Yannathan. This event resulted in no significant ground deformation at the site.

Figure 3-2 Cross Sections

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Distance (m)
Carbonaceous Clay
Clay
Fill
Filter Cake
Slimes Dam
Sand
Water Storage
Future Filter Cake
Future Fill
Future Water Storage
Terminal Landform
Rehabilitated Landform
Current Landform
Site Features
A
B
C
D
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F'
A'
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C'
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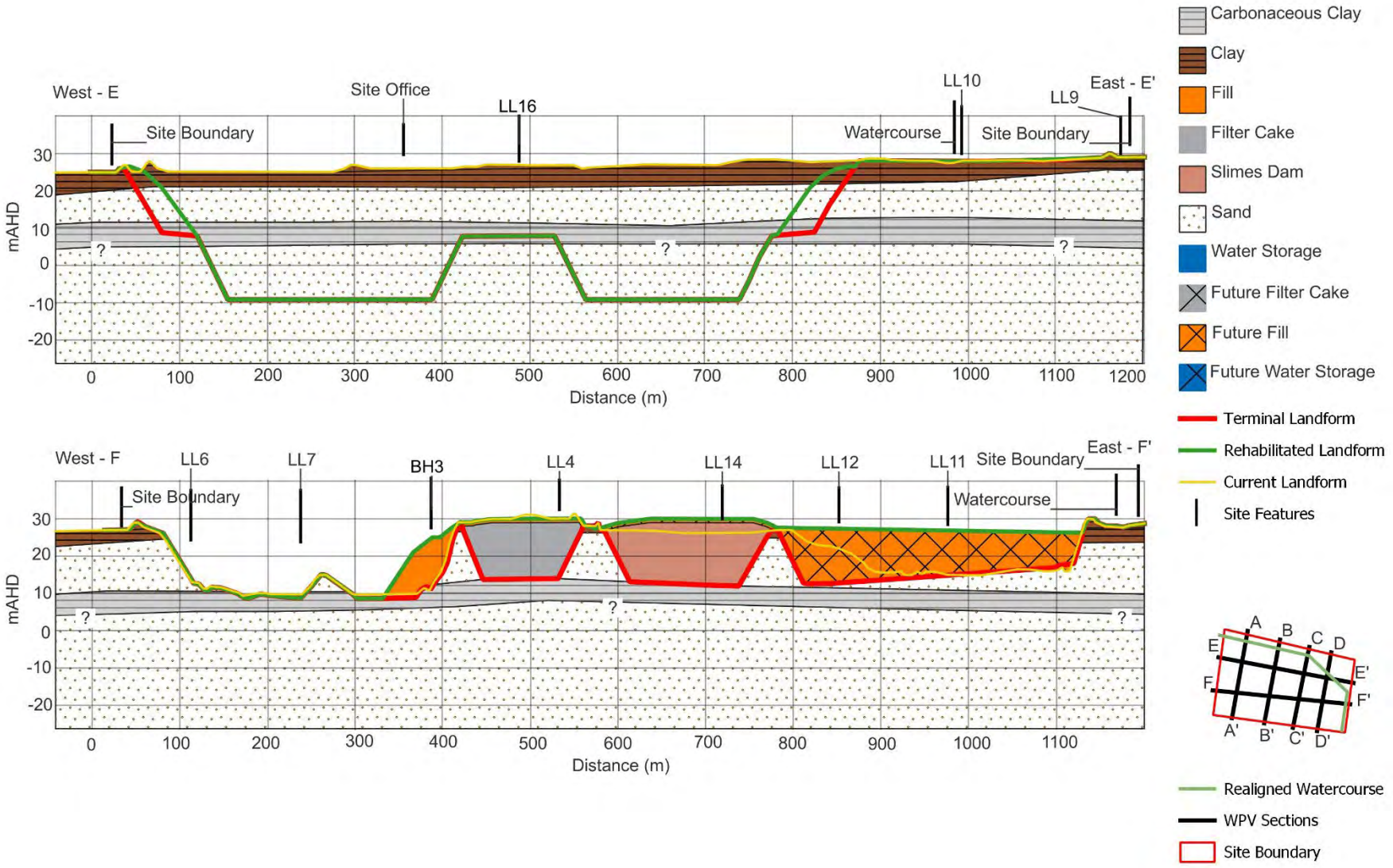
Realigned watercourse
sections 28042022
Site Boundary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Carbonaceous Clay
Clay
Fill
Filter Cake
Slimes Dam
Sand
Water Storage
Future Filter Cake
Future Fill
Future Water Storage
Terminal Landform
Rehabilitated Landform
Current Landform
Site Features
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C'
D'
Realigned Watercourse
WPV Sections
Site Boundary

4. RISK EVALUATION

4.1 HAZARD IDENTIFICATION

Hazards associated with management of slimes and filter cake / oversize material are summarised in **Table 4-1.**

Table 4-1 Hazard Identification

Hazard	Comment
Generation of slimes under abnormal conditions (failure of belt presses).	Discussed below.
Generation of dust during handling or drying of slimes / filter cake.	Addressed in the Dust Management Plan appended to the Summary Report.
Impacts to groundwater from coagulants and flocculants used in the process and subsequently contained in filter cake.	Addressed in the Hydrogeological Assessment appended to the Summary Report.
Stability of northern wall of Slimes Dam prior to placement of buttress.	Addressed in the Geotechnical Assessment appended to the Summary Report.
Stability of all dams retaining slimes or filter cake / oversize material.	Addressed in the Geotechnical Assessment appended to the Summary Report.
Erosion of batters (dam walls) prior to filling with slimes, or water on rehabilitation.	Addressed in the Geotechnical Assessment appended to the Summary Report.

Minor amounts of slimes generated in the event of filter press failure will be deposited in the existing Slimes Dam until full, or thereafter co-deposited with filter cake. The only difference between slimes and filter cake is that slimes have additional moisture. As such there are considered to be no material additional risks.

Additionally, the geotechnical assessment notes that on 22 September 2021 there was a magnitude 5.9 earthquake at Mansfield that resulted in approximately 70% of the acceleration of a 1:500 year earthquake at Yannathan. This event resulted in no significant ground definition at the site.

In summary, the material risks associated with management of slimes and filter cake, and associated risk management and monitoring, are addressed in:

- The Dust Management Plan appended to the Summary Report;
- The Hydrogeological Assessment appended to the Summary Report; and,
- The Geotechnical Assessment appended to the Summary Report.

5. COMMUNITY ENGAGEMENT

A Community Engagement Plan (CEP) is attached to the Work Plan Variation package.

A Cultural Heritage Management Plan (CHMP) has been prepared for this application, with meetings with Bunurong Land Council Aboriginal Corporation staff as required by this process at the following project milestones:

- Project initiation
- Completion of Desktop Review
- Completion of the Standard Assessment
- Completion of the Complex Assessment
- Agreement of management conditions

The CHMP has been approved by BLCAC.

6. REFERENCES

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Appendix J Air Quality (Dust)

AIR QUALITY IMPACT ASSESSMENT

Air Dispersion Modelling,

Hanson Sand Quarry

Hanson Construction Materials

870-910 Westernport Road, Yannathan, Vic

April 2023

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Project	20200075
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Role	Name/Title	Signature	Date
Written	Enzo De Fazio Director – Environment & OHS		8 April 2023
Reviewed	Peter Southern Director Strategy & Capability		8 April 2023
Approved	Peter Southern Director Strategy & Capability		8 April 2023

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20220075-R-01 AQ MOD_v3	Final	Edge Group Pty Ltd	8 April 2023

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Executive Summary

Edge Group Pty Ltd (Edge) has been engaged by Ricardo Energy Environment & Planning Pty Ltd (Ricardo) on behalf of Hanson Construction Materials Pty Ltd (Hanson) to undertake an Air Quality Impact Assessment of the extension to the existing sand quarry located at 870-910 Westernport Road, Yannathan, Victoria, 3981.

This report comprises dispersion modelling results and discussion for the extension of the Yannathan sand quarry, with the extension planned to take place at the northern section of this property ("the Site").

This report has been prepared to provide Earth Resources Regulation (ERR) with further information, being an assessment of air quality impacts:

- from expanded extractive industries *[Section 3 of the Protocol For Environmental Management (PEM): Mining And Extractive Industries, EPA Victoria, 2007*][1] and *Guideline for Assessing; and*
- in accordance with *Minimising Air Pollution in Victoria (for air pollution managers and specialists), EPA Victoria, Publication 1961, February 2022 (EPA Publication 1961)*.

This report provides the results of modelling using the Environment Protection Authority Victoria's (EPA) approved regulatory dispersion model, AERMOD and provides discussion on the predicted results. The objective of the report was to:

- Assess for air quality impacts (for parameters where there are known criteria – i.e., from EPA Victoria's Environment Reference Standard (ERS) and the PEM for a guide to deposition) from the proposed sand quarrying operations via a predictive desktop assessment for:
    - o concentrations of combustion gases such as carbon monoxide (CO) and nitrogen dioxide (NO_2);
    - o concentrations of Particulate Matter ($PM_{2.5}$[2]) and Particulate Matter (PM_{10}[3]); and
    - o deposition of general nuisance dust also called Total Suspended Particles (TSP).

As per EPA Guidelines[4], AERMOD meteorological data were prepared for the most recent available five years (2016-2020) relevant for the Site. The modelling was run for the full five years of data for the quarrying operations.

The pollutants above were modelled under generally representative to worst-case/conservative conditions. The modelling identified that respective ERS or PEM criteria

[1] The PEM is an incorporated document of the State Environment Protection Policy (Air Quality Management) 2001 (SEPP AQM), which is no longer in force in Victoria. However, according to EPA Victoria, the PEM "may contribute to the state of knowledge to inform, as appropriate" and so therefore is still used in this assessment for reference purposes only.
[2] Particulate matter 2.5 micrometers or less in diameter.
[3] Particulate matter 10 micrometers or less in diameter.
[4] Guidance Notes for Using the Regulatory Air Pollution Model AERMOD in Victoria, EPA Publication 1551, October 2013.

adopted in this assessment were not exceeded at the nearest sensitive (residential) receptors modelled for the following parameters:

- Concentrations of combustion gases
    - o CO
    - o NO_2
- Concentrations of particulate matter
    - o PM_{10}
- Deposition of general nuisance dust or TSP.

The dispersion modelling undertaken in this report was based on a representative to worst-case operating scenario. There were only excursions at the four sensitive receptors modelled in this investigation for one parameter being $PM_{2.5}$ (including background air quality) and for only one of the two averaging periods modelled. Accordingly, a dust risk assessment was employed in this investigation using EPA methodology. Given this risk assessment and that there have been no known external dust-related complaints due to the existing operations, it is unlikely that there will be any potential human health (or amenity) impact surrounding the site during the proposed operations, which would be operating in normal steady-state conditions almost all of the time.

Contents

1 Introduction 2
1.1 Proposed Site and Process Description 3
1.2 Topography 5
1.3 Climate over the region 5

2 Conceptual Site Model 6
2.1 Background 6
2.2 Proposed Site Activities 6
2.3 Dust Sources 7
2.4 Pathways 8
2.5 Receptors 11
2.6 Factors Influencing Dust Generation 13

3 AERMOD Model and Inputs 15
3.1 Averaging Periods 15
3.2 Modelling Sources and Inputs 15
3.2.1 Exhaust Emissions 16
3.2.2 Quarry Operation: Particulate Emissions 17
3.2.3 Quarry Operation: Wind Erosion Emission - Dust 18

4 Air Quality Assessment Criteria 19
4.1 Protocol For Environmental Management (PEM): Mining and Extractive Industries, EPA Victoria, 2007 19
4.2 Environment Reference Standard, EPA Victoria 19
4.3 Guideline for Assessing and Minimising Air Pollution in Victoria (for air pollution managers and specialists), EPA Victoria, Publication 1961, February 2022 20
4.4 Deposition Design Criteria (DC) 20
4.5 Buffer Distance 21

5 Air Quality Methodology 23
5.1 Characteristics of Emission Sources 24
5.2 Terrain 25
5.3 Computational Grid 25
5.4 Site Boundary Receptors 25
5.5 Sensitive/Discrete Receptors 26
5.6 Representative Meteorological Year 27
5.7 Background Concentrations 27
5.8 Background Deposition 28

6 Modelling Results 29
6.1 Concentrations 29
6.1.1 PM_{10} 29
6.1.2 $PM_{2.5}$ 30
6.1.3 NO_2 33
6.1.4 CO 35
6.2 Deposition 37

7 Risk Assessment 39
7.1 $PM_{2.5}$ 39

8 Discussion & Conclusions 41

8.1 Concentrations (NOx, CO, PM_{10}, $PM_{2.5}$) 41
8.2 Deposition (TSP) 41
8.3 Recommendation 42
9 References 43

Appendices

Appendix A – AERMOD Meteorological Data Files Report

1 Introduction

Edge Group Pty Ltd (Edge) was engaged by Ricardo Energy Environment & Planning Pty Ltd (Ricardo) on behalf of the sand quarry proponent, Hanson Construction Materials Pty Ltd (Hanson) to undertake the Air Quality Impact Assessment of the extension to the existing sand quarry located at 870-910 Westernport Road, Yannathan, Victoria, 3981 (the Site).

The operations at the Site will comprise dry sand quarrying moving to dredging of the deeper layers with the resulting material being processed on-site for offsite commercial applications.

This report provides the results of modelling using the Environment Protection Authority Victoria's (EPA) regulatory recommended dispersion model, AERMOD and provides discussion on the predicted results. The objective of the assessment is to:

- Assess for air quality impacts [for parameters where there are known criteria documented in the *Protocol For Environmental Management (PEM): Mining And Extractive Industries, EPA Victoria, Publication 1191, 2007* and EPA Victoria's Environment Reference Standard (ERS)[5]] from the proposed sand quarrying operations via a predictive desktop assessment for:
    - o concentrations of combustion gases such as carbon monoxide (CO) and nitrogen dioxide (NO_2);
    - o concentrations of Particulate Matter ($PM_{2.5}$[6]) and Particulate Matter (PM_{10}[7]); and
    - o deposition of general nuisance dust or also called Total Suspended Particles (TSP).

The PEM is an incorporated document of the State Environment Protection Policy (Air Quality Management) 2001 (SEPP AQM), which is no longer in force in Victoria. However, *Section 3 ("Assessment of air quality impacts from new or expanded mining and extractive industries")* of the PEM remains still relevant to the assessment. According to *EPA Publication 1994 (Using SEPPs and WMPs in the new environment protection framework)*, this PEM is still relevant as it "may contribute to the state of knowledge to inform, as appropriate:

- EPA regulatory activities and actions under the EP Act consistent with the EP Act, the ERS, Regulations and guidance.
- The standard of conduct expected of a person conducting an activity to meet their duties.
- Permissions applications.
- Other statutory schemes and organisations (for example, planning and local government) that currently incorporate or refer to SEPPs and WMPs as part of their activities."

Edge notes that the ERS has replaced SEPP (AAQ) and SEPP (AQM) as of 1 July 2021.

Where a SEPP or WMP provision is identified as a useful source of knowledge (as is the case with the PEM above), its suitability for such use must be:

[5],No. S245 Victoria Government Gazette 26 May 2021, as amended by Environment Reference Standard No. S 158 29 March 2022
[6] Particulate matter 2.5 micrometers or less in diameter.
[7] Particulate matter 10 micrometers or less in diameter.

- read in the context of the new legislative framework, and
- adjusted for any reference to legislation, requirement or process that no longer applies.

As *EPA Publication 1994* represents 'point in time' guidance at the time of commencement of the EP Act, users must be aware that new guidance published by EPA or other reputable source on matters covered by a SEPP or WMP clause will be regarded as superseding the equivalent position in a SEPP or WMP. This is because the newer material will represent the current state of knowledge on risks of harm (to the environment and human health) and ways of minimising those risks.

1.1 Proposed Site and Process Description

The Site is located within a Green Wedge Zone approximately 89 kilometres southeast from Melbourne's central business district (see *Figure 1*). The closest sensitive receptors are also shown in *Figure 1*, their distances (from the extraction area) shown in *Table 11* and they feature in the contours provided in this report.

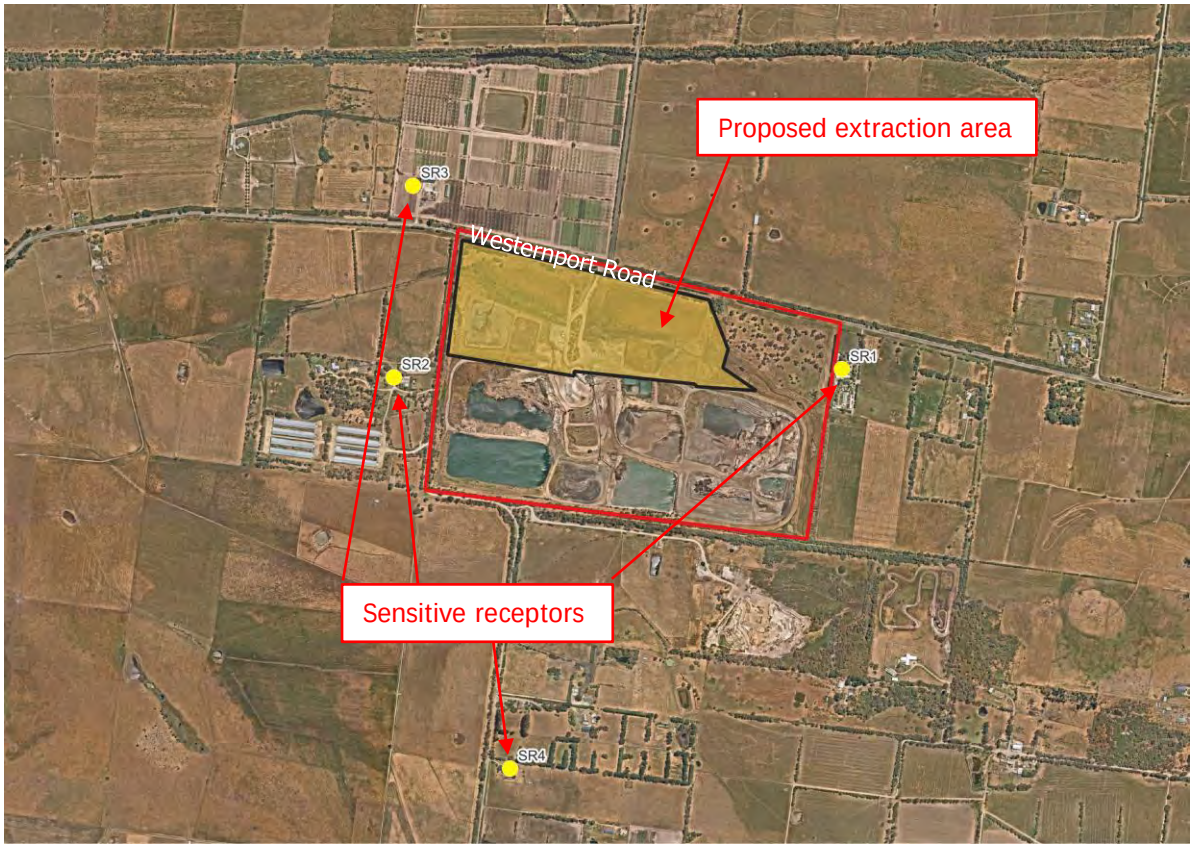


Figure 1: Red polygon is the boundary of the subject Site

The activities associated with the sand quarrying at 870-910 Westernport Road, Yannathan are predicted to be as follows:

- Removal/stripping of (approximately 0.3 metres of) surface vegetation;
- Pushing by dozer such vegetation and topsoil around the extension area to create mounds or edge bunds, which will be vegetated;
- Quarrying of sand using an excavator for shallower materials;

- Dredging will be used from approximately 9 metres Australian Height Datum (AHD), which is below groundwater level (that is approximately between 1 to 5 metres below ground level across the Site)
- Sand being transferred by dump trucks to the processing plant (approximately in the centre of the Site) until dredging commences, when sand will be predominantly pumped from a dredge via a floating pipeline to the processing plant for the deeper layers; and
- Additional equipment comprises front-end wheel loaders used primarily to load sales product and as back-up and control of raw feed material at the plant.

There will be no new sand stockpile on the Site –the existing stockpile to the west of the current processing plant will continue to be used. Haul roads will be on-site around each extraction area[8] within the total extraction area as per *Figure 1* above. All heavy vehicles and extraction equipment will access the Site via the existing quarry. The main source of dust generation during the quarrying process is the excavator and dozer.

Table 1 – Dust Source Characterisation

Dust Production Mechanism		Comment
		ON-SITE
Mechanical soil and sand extraction and/or disturbance/movement		• The lower the risk of dust emissions as mobile plant increasingly continues to work below ground level • Dust generated during quarrying activities • Dust generated by the placement of (moist) clay against the batters
Wind/atmospheric conditions		• Dust generated from un-sealed surfaces during windy conditions • Dust generated from un-vegetated areas such as stockpile west of processing plant and from surrounding mounds prior to them being vegetated • Potentially from some haul trucks transporting sand to the processing plant although less reliance on such vehicles as the extraction method to dredging for the deeper layers will occur
		OFF-SITE
Mechanical soil and/or product extraction and/or disturbance/movement (e.g. for rehabilitation	Associated with the Site	None known/anticipated as no known or recorded complaints with regards to the Site's air emissions
	Not associated	A smaller quarry (about a third of the proposed extraction area of the subject Hanson Site) exists to the south.

[8] Each extraction area not shown in this report as one overall extraction area only has been conservatively assumed (and modelled) as shown in *Figure 1*.

Dust Production Mechanism		Comment
processes by land filling)	with the Site	Mechanical soil workings (i.e. ploughing) associated with the market garden, north and northwest of the Site.
Wind/atmospheric conditions	Not associated with the Site	• Dust generated from un-sealed surfaces during windy conditions • Wind erosion on unsealed/unconsolidated surfaces

1.2 Topography

Topography (courtesy of Vicmap Topographic Maps Online) showed contours of 30 metres AHD over the Site and its immediate vicinity. Therefore, the topographic variation from the site to the surrounding area is not significant and is not expected to play a role in the pollution dispersion from the proposed plant. Hence, for modelling purposes, the topography over the region was assumed to be relatively flat.

1.3 Climate over the region

There are no known weather stations in the radius of 10 kilometres from the Site. Therefore data was simulated for the location in question running TAPM (Air pollution Model by CSIRO) as per guidelines by EPA Victoria.

The input meteorological data files have been compiled following EPA Victoria's draft guideline: "Construction of input meteorological data files for EPA Victoria's regulatory air pollution model (AERMOD), Publication No.1550, October 2013".

The Nilma North (Warragul) weather station (085313)[9], which was appropriate to use according to EPA Victoria, was used to access climate data below including the wind roses in *Section 2* (further below). The mean maximum temperature over the area from August 2021 until 20 September 2022 accessing the Nilma North (Warragul) weather station ranges from 12.6°C to 27.6°C, the minimum mean temperature is ranging from 3.4°C to 15.8°C. Using this same weather station, the average number of days per month where there was no rain from August 2021 until August 2022 inclusive was fourteen (14). Hence, it can rain slightly more than 50 percent of the days in a month when averaged over a year.

[9] Nilma North weather station (Latitude 38.13° Longitude 145.99°E; commenced 2014) located approximately 33 kilometres northeast of the Site.

2 Conceptual Site Model

2.1 Background

The purposes of the Conceptual Site Model (CSM) are to define potential sources of dust, potential exposure pathways and potential receptors to assist in determining the most appropriate dust monitoring to be consistent with the EPA PEM (used as a "State of Knowledge" only).

The particulates (or dust) that may be generated during extraction are typically categorised as:

- Total suspended particles (TSP);
- Inspirable particulates (PM_{10}); and
- Respirable Particulates ($PM_{2.5}$).

TSP ('nuisance dust' as referred to in the EPA PEM) generally causes nose, eye and throat irritations. It doesn't typically enter the respiratory system and is also responsible for visible dust deposition due to heavier particles present (such as on vehicle surfaces, etc). It is more conventional to consider dust deposition rates rather than TSP concentrations when dealing with 'nuisance dust,' as is adopted in this report and also consistent with the EPA PEM.

Inspirable particulates usually get captured and then cleared by the upper respiratory system, while respirable particulates are small enough to penetrate deep into the lungs and can cause irreversible lung damage.[10]

2.2 Proposed Site Activities

At the time of writing this report (from September 2022 to April 2023), the Site proposed to be quarried was largely vacant, undeveloped and was largely grassed (compared to the balance/south of the Site). As the water table will be reached, sand will be pumped to the processing plant (approximately in the centre of the Site) from a dredge in the pit where quarrying is occurring. Based on planning data sighted by Edge during the preparation of this report, dry material will be extracted to approximately 9 metres AHD (currently approved extraction depth). Dredging will occur from approximately 9 metres AHD to minus (-) 9mAHD. Note that water is expected to be encountered at approximately 19-24 metres AHD. As sand is excavated, batters are formed from (moist) clay overburden which reduces groundwater ingress sufficiently to allow dry excavation to 9 metres AHD.

The clearing of vegetation (with a dozer) needs to occur to access the sand. Such materials will be pushed in mounds (which will be vegetated) to be located around the proposed extraction area shown in *Figure 1*.

[10] www.safeworkaustralia.gov.au

2.3 Dust Sources

The activities associated with the sand quarrying at 870-910 Westernport Road, Yannathan are predicted to be as follows:

- Removal/stripping of (approximately 0.3 metres of) surface vegetation (assumed to occur during the first two months only);
- Pushing by dozer such vegetation around the Site to create mounds (of approximately 2-3 metres in height), which will be re-vegetated
- Quarrying of sand using an excavator;
- Placement of (moist) clay against pit batters;
- Transport of sand via haul truck to the processing plant on-site (although this will be minimised as dredging will occur to access the deeper layers of sand); and
- Loading existing stockpile approximately to the west of the processing plant.

No additional sand stockpiles (other than the bunds of topsoil) to the main existing stockpile of sand, slightly west of the processing plant will be required. Temporary haul roads will be on-site for haul trucks to access when transporting any quarried material before dredging occurs.

As part of the Site's General Environmental Duty (GED as defined by EPA Victoria), a more comprehensive focus on the existing and proposed controls for any dust emission sources at the Site are provided in the Site Environmental Management Plan (SEMP) focussing on dust, which has been prepared for Ricardo (for Hanson).[11] Edge recommends reading or referring to this SEMP in conjunction with this modelling report.

Other off-site sources, which can be potential sources of dust, in the general area (either abutting the subject Site or in the immediate vicinity) are the following:

- any unsealed section of roads abutting the Site to the west and south (i.e. Milners and Burt Roads, respectively);
- agricultural with some extractive industry to the south southeast (approximately 350 metres from the Site); and
- market garden (i.e. ploughing) across Westernport Road (of the Site) and west of Heads Road.

[11] Base report reference number 20220075-R-01-SEMP_Dust.

2.4 Pathways

The dust movement pathway relevant to amenities is air-deposition. This pathway is dependent on weather conditions – i.e. strong winds and high temperature (heat) can produce more dust. Due to the influence of weather conditions on dust dispersion, annual records were reviewed as taken by the Bureau of Meteorology (BOM) at the Nilma North (Warragul) weather station at 9 am and 3 pm intervals, shown in *Figures 2* and *3*, below. In correspondence with EPA, the Nilma North (Warragul) weather station was selected as it is the closest known active station to the Site (as also confirmed by EPA via email correspondence with Edge in June 2022). The Nilma North weather station data showed that the maximum recorded wind speeds at greater than 40 kilometres per hour at a frequency of at least 28% (of the time) from the east and 24% (of the time) from the west at 9am and more than 40 kilometres per hour up to approximately 35% (of the time) from the west at 3pm. In summary, it appears that the predominant wind direction between both recorded times is from the west. The sources of these data are shown in wind roses provided below:

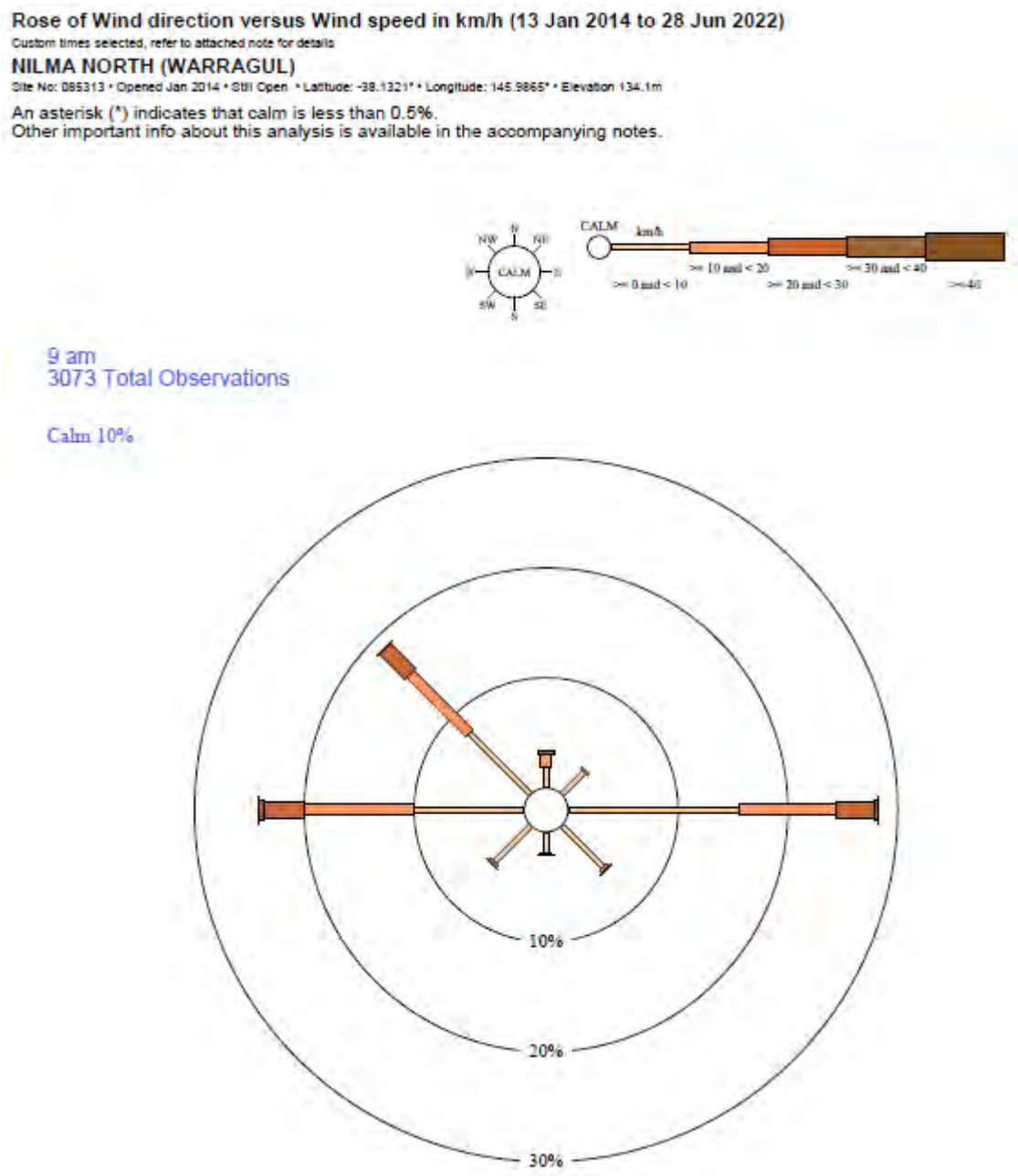


Figure 2 – Wind Rose showing 9am annual average wind speed and directions[12]

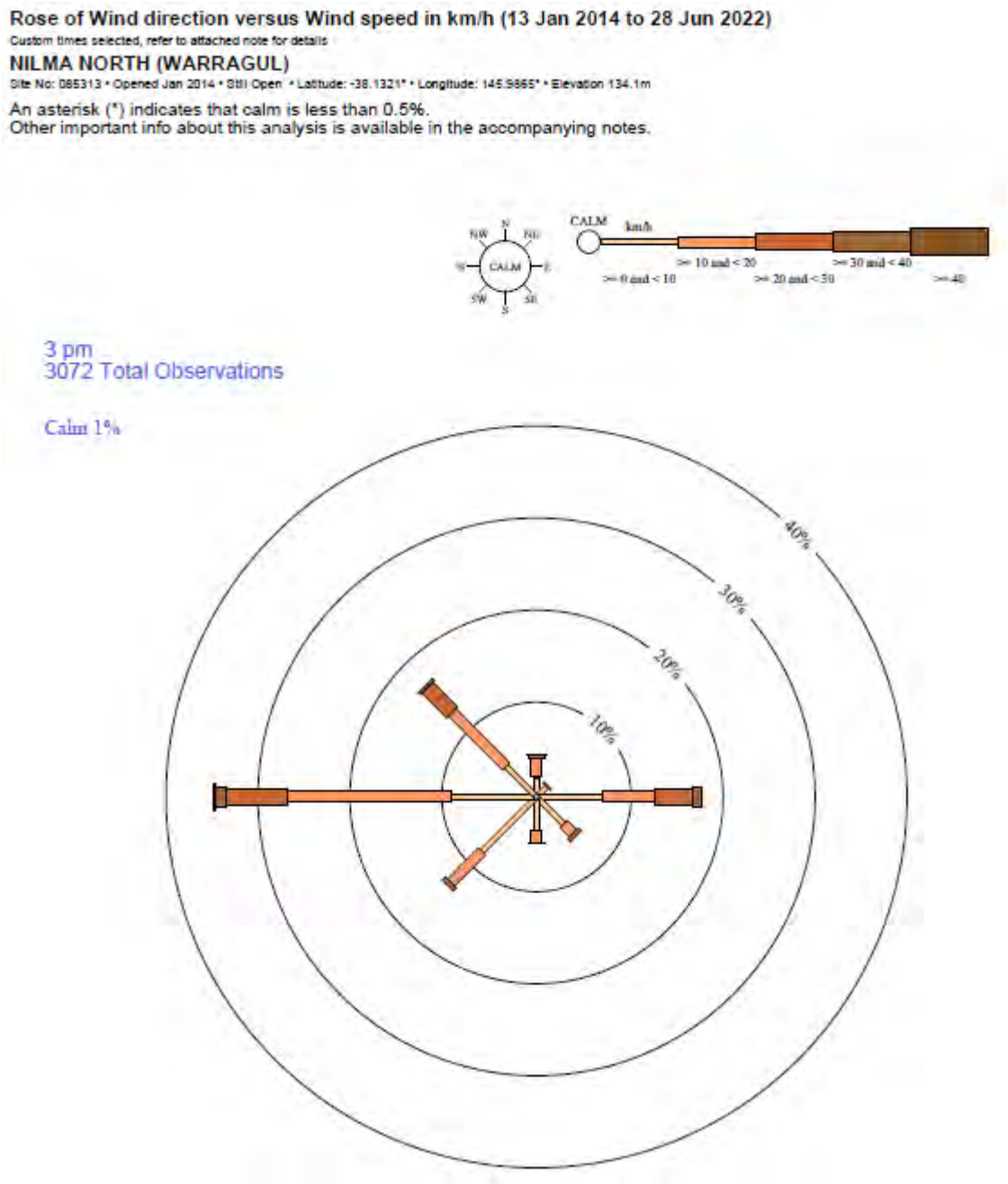


Figure 3 – Wind Rose showing 3pm annual average wind speed and directions[13]

As the pathway for dust dispersion is primarily atmospheric, nuisance dust emissions from site can settle rapidly and can have effect on the immediate surroundings of the site (both human and environmental).

As a general guide, particle sizes of 50 microns (µm) or more tend not to become airborne[14]. The hazard information provided in the Hanson "Aggregates, Road Base, Sand and fill" Safety Data Sheet (2020) applies to the dusts with silica sand and particularly inhalable dust particles

[14] https://www.der.wa.gov.au/images/documents/your-environment/air/publications/Guideline_for_managing_impacts_of_dust.pdf. Appendix 2.

with a diameter less than 75 microns. This does not appear to mean that all particulate matter are less than 75 microns at the Site. Based on Particle Size Distribution (Technical Services Clarinda) NATA laboratory results (April and June 2022) for Yannathan, respirable crystalline silica is not required to be monitored (as part of ongoing Site management) based on at least 98% of the sampled material being equal or greater than 75 microns. This is also consistent with the "Product Grading" (in *Table 1*) data in the Yannathan Sand Quarry, Assessment of Potential Dust Impacts, May 2013 (GHD for Hanson Construction Materials) where zero (0) to three (3) percent of particles passed through a pan size of 0.075 millimetres (75 microns). Given the above, it is presumed that sand will not be at a particle size of 4 microns, which was the size (or lower) that was reported to be responsible for silicosis according to the occupational hygiene department in WorkSafe Victoria as per the Silicosis Summit on 27 February 2020.

Therefore, the Particle Size Distribution results show that almost all of the particles tested were greater than 50 microns. This is consistent with a literature search that sand particles range in diameter from 63 µm to 2 millimetres (mm).

2.5 Receptors

The neighbours to the subject site are:

- North and northwest: Agricultural (market garden) uses property with an office that has a room where the caretaker occasionally sleeps and therefore considered a residence.
- East: Yannathan Park – Boarding Kennels and Cattery which is an accommodation facility for cats and dogs (owner resides on-site)
- South: Agricultural with some extractive industry
- West: Egg layer or broiler farm west of the quarry (farm manager residence on site).

Specific off-site locations are described below, where the receptors are workers, residents and visitors to the site or off-site that could potentially be impacted by any airborne nuisance dust. Specifically, sensitive receptors to nuisance dust can include vulnerable persons, flora and fauna or sensitive industrial processes where dust particle introduction can cause equipment failure. For the purposes of this report, sensitive receptors include off-site persons (residential), grazing animals (presumed), natural site flora, cars and drivers (e.g. Westernport, Milners and Burt Roads).

Table 2 – Receptors surrounding the Site

Direction	Location	Receptor	Approx. distance to receptor from closest Site boundary and extraction zone (m)
North, Northeast	Office and room (for occasional sleeping – i.e. caretaker residence)	• Workers • Visitors	• 215 m (boundary) and 235 m (extraction zone)

Direction	Location	Receptor	Approx. distance to receptor from closest Site boundary and extraction zone (m)
or Northwest	Westernport Road	• Drivers • Aesthetic impacts on vehicles	• 10 m (boundary) and 30 m (from extraction zone)
	Vacant land (north and northeast)	• Grazing animals (unknown) • Natural site flora	• 15 m (boundary) and 35 m (from extraction zone)
East	Residence abutting the eastern edge of the non-extraction area	• Residents • Visitors	• 0 m Boarding Kennels and Cattery abuts the Site (and 250 m from extraction zone)
	Vacant land	• Grazing animals (unknown) • Natural site flora	• 0 m abuts the Site and 250 m from extraction zone
South, Southeast or Southwest	Residence	• Residents	• 805 m (boundary) • 1.2 km (extraction zone)
	Agricultural with some extractive industry	• Workers	• 350 m (boundary) • 580 m (extraction zone)
	Burt Road (unmade road; doesn't take regular traffic)	• Drivers • Aesthetic impacts on vehicles	• 10 m (boundary) and 410 m (from extraction zone)
	Vacant Land (south, southeast and southwest)	• Grazing animals (unknown) • Natural site flora	• 10 m (boundary) and 420 m (from extraction zone)
West	Egg layer or broiler farm west abuts the overall Site but is southwest of the extraction area. Farm manager residence of broiler farm is set back from the extraction area.	• Residents • Workers	• 125 m Broiler Farm residence (boundary) and 160 m (extraction zone) • 140 m Broiler Farm workers from Site boundary and 290 m from extraction zone
	Milners Road	• Drivers	• 10 m (boundary) and 30 m (from extraction zone)

Direction	Location	Receptor	Approx. distance to receptor from closest Site boundary and extraction zone (m)
		• Aesthetic impacts on vehicles	
	Vacant Land	• Grazing animals (unknown) • Natural site flora	• 10 m (boundary) and 30 m (from extraction zone)

Note: 0 m indicates the 'receptor' shares a boundary with the Site.

2.6 Factors Influencing Dust Generation

The major factors that influence dust emissions are:

- The percentage of fine particles in the material on the surface *(note this is less of an issue for the proposed sand quarry given that almost all sand particles would be greater than 50 µm as discussed in Section 2.4 above)*;
- Wind speed across exposed surfaces; the critical wind speed for pickup of dust from surfaces is 5 m/s and the dust pickup increase rapidly above 10 m/s *(as most of the sand is above 50 microns, these wind speeds are likely to over-estimate the quantity of dust pickup)*;
- Moisture content of the material on the surface (i.e. the lower the moisture content, the more chance of dust being wind-blown). *As discussed in Section 1.3 above, it can rain slightly more than 50% of the time in the local area over an average month;*
- The area of exposed surface (i.e. the greater the area of exposed surface, the more chance of dust being wind-blown);
- Disturbances such as traffic, excavation, loading and unloading of materials (i.e. the greater the number/frequency of these operations, the more chance of dust being wind-blown);
- The elevation of the source above the surrounding ground level. That is, sand (at height) is tipped into the hopper at the processing plant. However, this will be generally moist sand so not expected to result in an ongoing airborne dust emission;
- The smaller the particle size of the material on the surface of a road or an exposed surface, the more easily the particles are able to be picked up and entrained in the wind. *This is less of an issue for the Site as the product is a coarse sand for concrete manufacture and that almost all sand particles would be greater than 50 µm as discussed in Section 2.4 above.* Further; Westernport Road*;* the main road in the area, is a sealed road so dust issues are not expected from this road and nor were any significant or ongoing dust emissions observed during Edge's Site visit in March 2022;
- Moisture content of the exposed surfaces, moisture binds particles together minimising them from being disturbed by wind or vehicle movements. *As discussed in Section 1.3*

above, it can rain slightly more than 50% of the time in the local area over an average month;

- The larger the area of exposed material, the more potential there will be for dust emissions (however, there will be no additional stockpiles of sand generated as part of the operation);
- Vehicles travelling over exposed surfaces tend to pulverise any surface particles; the particles are lifted and dropped from the rolling wheels and the road surface is exposed to strong air currents due to turbulence between the wheels and the surface. However, this will typically not be the case as the number of mobile plant with wheels will be minimal given the dredging process after the material will be dry excavated to approximately 9 metres AHD. Therefore, the common plant on-site would be the excavator and dozer, which are both moved by rolling track and therefore minimising dust emissions compared to haul trucks; and
- Dust can also be entrained into the turbulent wake created behind moving vehicles (although this will unlikely be the case given the relatively low speeds that will be travelled on-site compared to other mobile plant like trucks, which are planned not to be commonly present on-site).

3 AERMOD Model and Inputs

This section provides an overview of the model inputs and any assumptions made by Edge.

In general, the modelling was undertaken for a 12-month period under a representative to worst-case scenario in accordance with the PEM. Worst-case conditions are those for the periods when the maximum emissions are predicted to occur under normal operating conditions (for example when maximum earth moving activities are occurring or large areas of exposed land are expected on site) and/or where an expansion or development has maximum impact on sensitive receptors. The modelling was undertaken for a number of scenarios including and combining:

- Activities undertaken (i.e. topsoil stripping) during the development of the site; and
- Operational phase of the quarry.

3.1 Averaging Periods

The outputs from AERMOD are 1, 8 and 24-hour average concentration predictions that are determined using lateral dispersion values. For the purposes of this modelling and consistent with the EPA PEM, combustion gases such as NO_2 and CO were expressed as 1-hour and 8-hour averages, respectively; and particulate matter ($PM_{2.5}$ and PM_{10}) were expressed as 24-hour averages.

3.2 Modelling Sources and Inputs

Based on the interpretation of the *Guideline for Assessing and Minimising Air Pollution in Victoria (for air pollution managers and specialists), EPA Victoria, Publication 1961, February 2022 (EPA Publication 1961); the PEM* and the Site location; a *Level 2* assessment is required. That is, consistent with a *Level 2* assessment, the subject proposed operation will be a "Medium quarry" with no more than 500,000 tonnes/year extraction (of sand), which is the upper limit for a Level 2 assessment. Similarly, consistent with a Level 2 assessment, the Site is in a rural area close to residences (less than 500 metres) from the extraction area.

Given that no direct data for the parameters modelled in this assessment could be obtained from EPA Victoria or ERR, Edge Group conducted a literature review for the search of input data that could be used for this assessment. The following report was identified in which relevant data was used for the proposed quarry Site to be operated by Hanson: *Air Quality Assessment – Lots 1 And 2 Dp732708 Old Telegraph Road, Maroota Proposed Sand Quarry, Job ID. 08915, Pacific Air Environment for PF Formation (04 September 2014).* This report will be referred to as the *"Maroota Report."*

This *Maroota Report* contains a quarry rate of 100,000 tonnes/year and for the purposes of the subject site and consistent with Level 2 (EPA) assessment, this rate has been factored up to 500,000 tonnes/year.

The dust emissions (extrapolated from the *Maroota Report*) during operation of the proposed Hanson quarry have been estimated based on activities and equipment operating as follows:

- Dozer clearing vegetation/topsoil; and
- Wind erosion from active extraction area.

The maximum daily production scenario (worst case) was modelled in the *Maroota Report* based on maximum product transport of 660 tonnes per day. Even though there will be a combination of hauling (shallow material) and pumping (to the processing plant, located approximately in the centre of the Site), Edge scaled up this *Maroota Report* value up to a conservative 1800 tonnes/day (i.e. a factor of 2.73).[15]

Like in the *Maroota Report*, the maximum daily emissions were applied for each day of the modelled year(s) so that a range of meteorological conditions could be tested. This does not represent a realistic estimate of annual dust emissions, although they could potentially reach these emissions levels on a daily basis based on a worst-case scenario.

The subject Site's activities are assumed to occur between 6am and 10pm Monday to Saturday (there are no quarrying operations conducted on Sundays, Good Friday, Christmas Day and Boxing Day). There are no quarrying operations and off-site truck movements after 6pm (i.e. the processing plant will be in operation until 10pm).

The Power, Emission Factor and Load Factor values in *Table 3 and 4* were obtained from *National Pollutant Inventory, Emission Estimation Technique Manual for Combustion Engines, Version 3.0, Australian Government, Department of the Environment, Water, Heritage and the Arts, June 2008*. The average (293 kW) power rating was conservative[16] and it was based on the average of the Volvo A35FFS articulated hauler (SAE J1995 Gross)[17] and the Komatsu PC450 excavator, which are typical/average equipment that could be used on-site.[18]

3.2.1 Exhaust Emissions

Table 3 – Estimated bulldozer exhaust emissions

Substance	Power (kW)	Operating hrs (h/y)	Emission Factor (kg/kWh) [from *Appendix B, Table 26]*	Load Factor *[from Table 5]*	Emissions (t/y)
CO	293	3,255 (over 310 days/yr)	0.0029	0.55	1.5
NOx	293	3,255 (over 310 days/yr)	0.01	0.55	5.2
PM_{10}	293	3,255 (over 310 days/yr)	0.00093	0.55	0.5
$PM_{2.5}$	293	3,255 (over 310 days/yr)	0.00085	0.55	0.4

[15] This was based on the quarry operating up to 310 days (Monday to Saturday) per year accounting for no quarry operation on Sundays, Christmas Day, Boxing Day and Good Friday (i.e. 365 days minus 52 x 3 x Public Holidays). Operation by mobile plant on each working day has been assumed at 10.5 hours accounting for start-up, breaks and shutdown (thus 3,255 hours).

[16] Conservative in that the kW ratings for other plant modelled on other Hanson similar sites (e.g. Langwarrin) had a lower reported power rating.

[17] https://www.volvoce.com/-/media/volvoce/global/products/articulated-haulers/brochures/brochure_a35ffs_a40ffs_t4i_en_21_20026508_c.pdf?v=jnxHPw

[18] https://www.komatsu.jp/en/worldwide/PDF/PC450_450LC-8.pdf

Table 4 – Estimated excavator exhaust emissions

Substance	Power (kW)*	Operating hrs (h/y)	Emission Factor (kg/kWh) [from *Appendix B, Table 32]*	Load Factor *[from Table 5]*	Emissions (t/y)
CO	293	3,255 (over 310 days/yr)	0.003	0.5	1.4
NOx	293	3,255 (over 310 days/yr)	0.012	0.5	5.7
PM_{10}	293	3,255 (over 310 days/yr)	0.00088	0.5	0.4
$PM_{2.5}$	293	3,255 (over 310 days/yr)	0.00081	0.5	0.4

3.2.2 Quarry Operation: Particulate Emissions

Table 5 - Particle emissions from the bulldozer during the quarry's operation for the topsoil stripping operation and then during quarrying activity

Substance	Emission Factor *[Table 7.2, Maroota Report]*	Scaling factor	Emission (kg/yr)	Operation hours
PM_{10}	507	2.73	1,400	Mon-Sat: 06:00-18:00 (quarrying) Mon-Sat: 18:00-22:00 (processing only)
$PM_{2.5}$	196		540	
TSP	1,869		5,100	

Table 6 - Particle Emissions from the excavator during the quarry's operation

Substance	Emission Factor *[Table 7.2, Maroota Report]**	Scaling factor	Emission (kg/yr)	Operation hours
PM_{10}	45	2.73	123	Mon-Sat: 06:00-18:00 (quarrying) Mon-Sat: 18:00-22:00 (processing only)
$PM_{2.5}$	7		19	
TSP	95		260	

** Maroota: Excavator/front end loader loading sand to trucks for haulage to processing site*
Hanson: using Maroota's data, we have assumed this to cover the excavator operations on-Site

3.2.3 Quarry Operation: Wind Erosion Emission - Dust

Table 7 – Estimated annual dust emissions based on maximum daily production scenario (worst case)

Substance	Wind Erosion Emission Factor *[Table 7.2, Maroota Report]*	Scaling factor	Total Emission (kg/yr)	Tonnes/Yr	Total quarrying area (m^2)	Emission Flux ($t/m^2/yr$)
PM_{10}	876	2.73	2,400	2.4	193,518	0.0000340
$PM_{2.5}$	131		360	0.36		0.0000051
TSP	1752		4,800	4.8		0.0000680

Wind erosion is assumed to occur 24 hours per day. TSP, PM_{10} and $PM_{2.5}$ emission rates were calculated using emissions factors derived from US EPA (1995).

The subject facility has been modelled to extract up to 500,000 tonnes per annum, which is the maximum that can be extracted based on the criteria of a Level 2 assessment under EPA Publication 1961 *(and the PEM)*.

4 Air Quality Assessment Criteria

This section describes the compliance obligations that relate to the proposed subject operation. It includes general terminology and definitions relevant to the project and a summary of the statutory and policy framework for the area including EPA Publication 1961 and the ERS. That is, the SEPPs have been removed as subordinate instruments and ceased to have a formal legal status in Victoria's new environment protection framework when the *Environment Protection Act 2017 (EP Act)* commenced on 1 July 2021.

The EP Act's environment protection framework includes the ERS. This identifies environmental values, air indicators and objectives that set the benchmark for the quality of the air environment needed to protect the environmental values. The ERS is a reference standard, not a 'compliance standard' for businesses. However, some government decision-makers must take the ERS into account when making certain decisions. ERS objectives for air are health-based and as such, some are incorporated into this Standard, with the aim of informing how to assess and control risks from air emissions.

The ERS replaces *State Environment Protection Policy (Air Quality Management) 2001* (SEPP AQM) and generally adopts the objectives in the National Environment Protection Measure (Ambient Air Quality) (NEPM AAQ) with some modifications. The ERS also contains other environmental values, indicators and/or objectives that are not in the NEPM AAQ.

4.1 Protocol For Environmental Management (PEM): Mining and Extractive Industries, EPA Victoria, 2007

This PEM is an incorporated document of the SEPP AQM, which has now been replaced by the ERS. It supports the interpretation of the former SEPP AQM and sets out the statutory requirements for the management of emissions to the air environment arising from activities undertaken in the operation of mining and extractive sites.

Best Practice is the main guiding principle in controlling air emissions and meeting the requirements of this PEM. For particular hazardous air pollutants (Class 3 indicators in the former SEPP AQM), are now replaced by *Regulation 4* and *Schedule 4* of the *Regulations*.

The PEM was developed in consultation with Government agencies and key stakeholders. It is important that this PEM be read in conjunction with the SEPP AQM (where still relevant – i.e. as "State of Knowledge" only) and the ERS. EPA Publication 1994 says that the PEM may contribute to the state of knowledge for clause 40 (*Management of Large Line and Area-Based Sources of Emissions* – the latter being relevant to this assessment) in the SEPP (AQM). In addition, it should be noted that the Department of Jobs, Precincts and Regions (DJPR) regulates the mining and extractive industries under the *Mineral Resources (Sustainable Development) Act 1990*. Edge understands that the PEM will still be used by DJPR as a guide in the management of air quality impacts by mines and quarries.

4.2 Environment Reference Standard, EPA Victoria

Under the EPA Victoria's Environment Reference Standard, objectives (*Table 8*) are applied in the assessment of a proposal or activity to ensure that there will be no adverse impacts to the ambient air environment.

Table 8: Adopted Air Pollution Assessment Criteria (APAC) in this investigation

Indicator	Objectives (maximum concentrations)	Averaging Period
CO	9.0 ppm	8 hours
NO_2	0.08 ppm	1 hour
	0.015 ppm	1 year
PM_{10}	50 µg/m^3	1 day
	20 µg/m^3	1 year
$PM_{2.5}$	25 µg/m^3	1 day
	8 µg/m^3	1 year

ppm = parts per million
µg/m^3 = micrograms per cubic metre

4.3 Guideline for Assessing and Minimising Air Pollution in Victoria (for air pollution managers and specialists), EPA Victoria, Publication 1961, February 2022

The Guideline for Assessing and Minimising Air Pollution in Victoria provides a framework to assess and control risks associated with air pollution. It is a technical guideline for air quality practitioners and specialists with a role managing pollution discharges to air.

Under the EP Act, all risks to human health and environment from pollution and waste must be minimised so far as reasonably practicable. The contents of this guideline constitute guidance under the EP Act. This guideline provides duty holders with an approach to minimising risks in a proportionate way.

This guideline provides a tiered approach to the assessment of risks from air pollution, with three levels of assessment in order of increasing complexity.

- Level 1 assessments are qualitative or semiquantitative. They are used to assess risks from activities that either have intrinsically low risks, or have common, well-understood risks that can be controlled without extensive assessment.

- Level 2 assessments are the most common type of risk assessment. They usually involve the use of dispersion modelling or monitoring. Predicted or measured pollutant concentrations are benchmarked against pre-defined air pollution assessment criteria (APACs) to understand risks. *This is the level adopted in this assessment.*

- Level 3 assessments are detailed risk assessments. These are only used when a simple comparison of a pollutant's concentration to an APAC cannot adequately assess risks.

4.4 Deposition Design Criteria (DC)

As per the PEM, monitoring is conducted with dust deposition gauges that should be located both upwind and downwind of the site to reflect the impact of the quarry operations during the most predominant wind directions [see Edge Group's Site Environmental Management Plan (Dust) in regard to dust monitoring]. Results of monitoring should not exceed 4g/m^2/month (no more than 2g/m^2/month above background) as a monthly average. More recent advice from EPA Victoria is that these criteria are less commonly used and they are not criteria to "pollute up to" (see also the final paragraph in this section).

The above two criteria have been adopted in this modelling assessment for TSP. However, PM_{10} and $PM_{2.5}$ must be modelled as though they behave as a gas, which has been the case in this assessment (i.e. modelled as concentrations). Therefore, depositions for these latter size fractions were not included in the deposition modelling as they were not required by the PEM.

According to EPA Publication 1961, dispersion modelling and monitoring (for example dust deposition gauges which are present on the subject Site) can be useful and more affordable for smaller operators. Such information can help:

- characterise temporal or spatial trends.
- identify key problematic sources, or groups of sources on larger more complex sites.
- identify where dust sensitivities may occur.
- test the effectiveness of dust minimisation, control and management measures.

However, caution needs to be applied in using dust dispersion modelling and depositional monitoring results because they present some significant challenges due to uncertainty in emission source estimations, and the difficulties in setting acceptable threshold levels for nuisance dust risks.

Historically and as discussed above, threshold figures of 4 g/m^2/month (no more than 2 g/m^2/month above background), as a monthly average, taken at the boundary of an industrial premises, have been used. These figures can be continued to be used as a *rule of thumb* level for requiring further investigation and addressing dust issues, but not as a level up to which industry is allowed to pollute up to. This monitoring only partially contributes to meeting the GED, because the focus and emphasis needs to be on reviewing operation controls and management practices to prevent and minimise dust nuisance as far as reasonably practicable.

4.5 Buffer Distance

Buffer distances are a means of separating industrial, residential and other sensitive land uses thereby minimising any potential adverse air emissions impacts.

It is important to recognise that buffer distances are only relevant where amenity impacts, rather than health impacts, are involved and where there are compliance obligations to prescribe these. In particular, the buffer distance is usually implemented to protect the immediate area from ongoing emissions and accidental emissions that may occur due to equipment failure, accidents and abnormal weather conditions.

There appears to be no directly related recommended separation distance (for the Site) outlined in the *Recommended Separation Distances for Industrial Residual Air Emissions, Publication 1518, March 2013* for the type of activities at the subject Site. The recommended separation distance for *"Quarrying, crushing and screening, stockpiling and conveying of rock"* is 250 metres (with no blasting). Such "Industry activity/definition" does not match what is occurring on-site.

Based on the location of the proposed extraction zone area, residential buildings will be setback at least 250 metres east and west of this quarrying activity. Given the modelling results (and risk assessment) included in this report and the dust management controls (both inherent to the operations and those to be put in place by Hanson) outlined in the *Site Environmental Management Plan (Dust) prepared by Edge Group for Ricardo (for Hanson) for the proposed*

quarrying operation, the quarrying operations are not expected to have an air quality amenity impact on the nearest residents (east and west) and the market garden residence to the northwest (approximately 215 metres and 220 metres from the Site boundary and extraction area, respectively).

5 Air Quality Methodology

Gaussian plume dispersion models, such as AERMOD, assumes that the meteorological conditions are uniform spatially over the entire modelling domain for any given hour. While this may be valid for some applications, in complex topographical situations the meteorological conditions may be more accurately simulated using a 3D wind field model and puff modelling approach should be followed.

Over this project area, the topography is not considered to be complex no – i.e. mountains or valleys that trap and stagnate pollutants. We do not expect long range transport and all sources are ground based (no significantly high stacks that are incompatible with the surrounds).

The site is situated amongst generally flat topography, without significant localised meteorological effects from coastal or estuarine conditions, and as such it is considered appropriate that the modelling be undertaken through the use of AERMOD, EPA Victoria's approved regulatory air model.

AERMOD is an approved atmospheric dispersion model for use in Victoria. It is a steady-state plume model that incorporates air dispersions based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain, with the modelling system comprising three components:

- AERMOD (dispersion model) – *used in this assessment;*
- AERMET (meteorological pre-processor) – *the use of two meteorological files, a 'surface' data file and a 'profile' data file, have been used in this assessment as per EPA Victoria requirements;*
- AERMAP (terrain pre-processor) – *not featured as part of this assessment as the subject site and its surrounds included in the modelling were observed to be generally flat.*

As such, ground level concentrations and deposition of parameters in this assessment have been calculated using the current EPA Victoria (recommended) regulatory air pollution model, AERMOD, Version 18081 (version 7) as needed in the current form of this report. The following sections provide summaries of the input data and any assumptions used to predict ground level concentrations and deposition and therefore impacts associated with the processes within the operation.

It has been identified that three volume sources; in the form of a dozer, loader and an excavator, in the AERMOD model will exist on the Site. An area source was also modelled, which was the entirety of the proposed quarry extraction area.

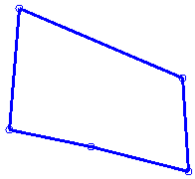
For cases involving a high degree of spatial variability of the flow within the boundary layer, such as upslope or downslope flows or flows along a winding river valley, the straight-line, steady-state assumption may not be valid beyond even a few kilometres, and a puff model may be more appropriate. Another consideration in deciding whether a puff or plume model is more appropriate for a particular application is whether the full spatial and temporal distribution of pollutant impacts is important, such as when using the model results for a risk assessment, or whether the results are to be used for a criteria pollutant analysis where only the high end of the concentration distribution is important, regardless of time or space. Again,

this is not the case on this assessment.[19] Further, based on pDs Consultancy (involved in the modelling in this assessment), significantly more topographic variation that what is the case across the Site and immediate surrounds would need to be the case before Calpuff was to be used.

5.1 Characteristics of Emission Sources

Volume and area sources were modelled in this assessment as per the following table:

Table 9 – Dimensions of the sources modelled

Source Type	Source Modelled	Height	Vertical Spread	Horizontal Spread
Volume	Excavator and Loader*	1.59	0.79	0.86
	Bulldozer**	1.61	0.81	1.28
Area	Active mine area	0 *(terrain not incorporated in the modelling as flat terrain was conservatively assumed)*	3m *[used for the SigmaZ (vertical dispersion/dilution) in AERMOD modelling and not related to topography]*	
	Windblown dust predicted Wind Speed> 5m/s			

** Average excavator dimensions used on other Hanson sites*
https://www.cat.com/en_AU/products/new/equipment/excavators/large-excavators/227227255575189.html

- *Shipping Height - Top of Cab 3,170 mm*
- *Transport Width 3,440 mm*

*** Average dozer dimensions used on other Hanson sites*
https://s7d2.scene7.com/is/content/Caterpillar/CM20181217-51568-10948

- *Width across end bits 5,100 mm*
- *Machine Height 3.222 m*

In summary, the following sources were modelled:

- three (3) volume sources (excavator, loader and bulldozer) centred at the eastern edge, which would be at its closest to the Boarding Kennels and Cattery owner's residence as compared to the other three sensitive receptors had these volume sources been modelled at the western centre edge; and
- one (1) area source (whole proposed extraction area) for windblown dust.

The following sources were discounted from the modelling due to the following listed controls (in *italic*) being in place by Hanson on-site:

- trucks carrying the excavated sand to the processing plant:
  - *the extracted sand will generally be moist;*
  - *the weather conditions are such that on average, rain falls on slightly more than 50 percent of the days in a month when averaged over a year[20]; and*

[19] http://www.src.com/calpuff/FAQ-answers.htm
[20] Based on Nilma North BOM weather data from Aug 2021 to Aug 2022 inclusive.

- *new diverted haul roads to/from the proposed extraction area shall be sprayed regularly with water to reduce airborne dust, with a water cart on standby (that was seen to be in operation by Edge during the existing Site operations in March 2022)*

- Processing plant:
  - *Material received is largely moist due to the shallow water table;*
  - *Loaders to hopper through various screens to remove the oversize material and then the sand is placed through a wet scrubber (attrition cell);*
  - *Material is wet after the attrition cell; and*
  - *Water spraying of stockpile slightly west of the processing plant to keep it such that no continual visible dust emissions occur.*
- Sales trucks:
  - *As above on any internal roads being sprayed by water where and when needed;*
  - *All loads will be tarped prior to leaving the quarry;*
  - *All trucks will use the wheel washer when exiting the quarry; and*
  - *Use of street sweeper, if required on sealed roads (primarily Westernport Road).*[21]

In general, any particulates greater than 30 microns in diameter, which is typically the case for the subject Site, are sufficiently large to settle in a comparatively short distance(s) from their source (s) and may cause amenity impacts, such as dust deposition on window sills.[22] This could be the case on-site rather than off-site as based on Particle Size Distribution data referred to in the SEMP_Dust, the sand particles quarried from the Site are generally greater than this size.

Based on the subject operation and the sources that were modelled, the 'Building Wake' effect (as part of AERMOD) was not needed to be incorporated in the modelling.

5.2 Terrain

Terrain variation is not considered to be significant across the modelling domain and therefore it was assumed to be flat.

5.3 Computational Grid

The grid was designed with a 50 metre (grid) resolution with a size extending to 5 kilometres by 5 kilometres to capture other sensitive land use in the surrounding area of the Site as per requirements outlined in *EPA Guidance Notes, Publication No. 1551*. This is also consistent with other air dispersion modelling projects that Edge has worked on, which have resulted in submission to (and approval by) EPA.

5.4 Site Boundary Receptors

Table 10 shows the coordinates of the Site boundary receptors included in the dispersion modelling in this assessment. See also *Figure 4*.

[21] As advised by Site management (20 Sept 2022), there have been no material on external road or any resulting dust emission issues to date.
[22] https://www.hanson.com.au/media/3445/calga-air-quality-management-plant-2017.pdf

Table 10: Site Boundary Receptor Locations

Site Boundary Receptor ID (*Refer to Figure 4*)	Boundary Location	X Coordinate	Y Coordinate
SB1	Boundary (NW corner)	380288	5765938
SB2	Boundary (mid-northern)	380906.2	5765794
SB3	Boundary (NE corner)	381418.6	5765689
SB4	Boundary (mid-eastern)	381382.5	5765333
SB5	Boundary (SE corner)	381334.6	5765015
SB6	Boundary (mid-southern)	380800.4	5765070
SB7	Boundary (SW corner)	380186.9	5765158
SB8	Boundary (mid-western)	380233.3	5765578

5.5 Sensitive/Discrete Receptors

Table 11 shows the coordinates of the discrete receptors included in the dispersion modelling in this assessment and shows their distances from the extraction area. The discrete receptors, SR1 to SR4, are residential dwellings. See also *Figure 4*.

Table 11: Discrete Receptors

Sensitive Receptors	Discrete Receptor ID	X Coordinate	Y Coordinate	Approximate distance (m) and orientation from extraction area*
Residential	SR1	381439.8	5765521	250 m E
	SR2	380093.4	5765496	160 m W
	SR3	380150.8	5766071	235 m NW
	SR4	380442.9	5764322	300 m S

**Nearest point of extraction area*

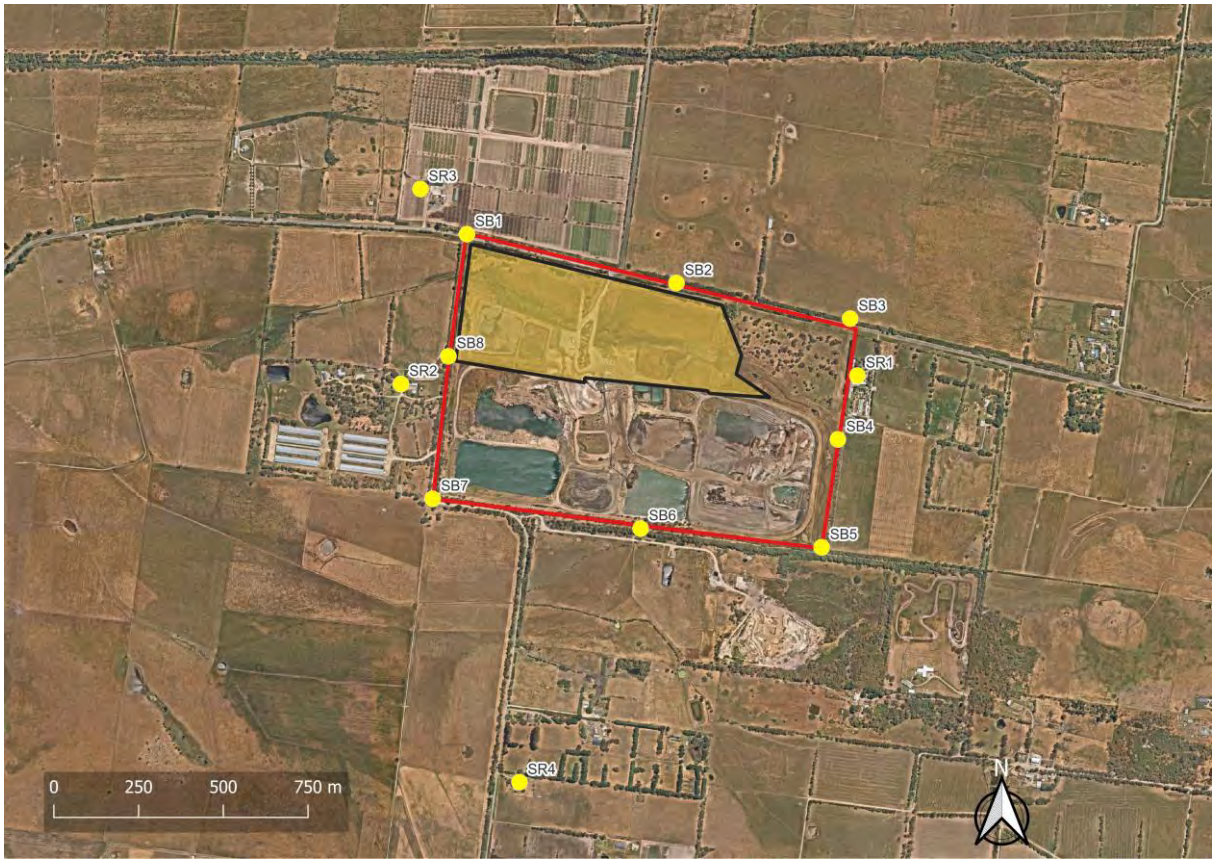


Figure 4: Location of sensitive (including 4 x residential) receptors: SR01-SR04 and boundary receptors: SB1-SB8 and Site boundary (red outline)

5.6 Representative Meteorological Year

A representative meteorological year which governs the dispersion of the pollutants emitted from the sources modelled was determined running AERMOD with the meteorological data for the recent five (5) years (2016 to 2020). The year 2016 was found to be representative (see results in *Table 12* and other coordinate modelled data not presented in this report) considering that no significant events that could have significantly affected the background air quality was known in this period [e.g. bushfires in eastern Victoria (2019-20)[23] and COVID (2020)].

5.7 Background Concentrations

Maximum background concentrations of PM_{10} and $PM_{2.5}$ were obtained from EPA Victoria air monitoring stations for the regions of Traralgon and Moe, respectively for the year 2016, to be consistent with a representative meteorological year identified from the modelling. Model scenarios for PM_{10}, and $PM_{2.5}$ were run with Time Varying Background (TVB) as directed by the PEM and in discussion with EPA during this assessment. The air monitoring stations were

[23] In the 2019-20 fire season (November 2019 until February 2020), Victoria endured extreme fire conditions with over 1.5 million hectares burnt, immeasurable impact on unique environments, 420 houses lost, and five fatalities. Communities in East Gippsland were isolated for weeks as thousands of kilometres of roads and critical infrastructure were rendered unserviceable. In addition, the bushfires have had a significant impact on wildlife and biodiversity. *Source:* *https://www.ffm.vic.gov.au/history-and-incidents/past-bushfires*

permitted to be used as a contingency (or an alternative to) real-time background monitoring for PM_{10} and $PM_{2.5}$ given that the Site was still exploring opportunities, respectively, at the time of writing this report (liaising with suppliers, obtaining quotes, understanding the lead-times involved of many months in accessing such equipment, etc).

In summary, this above background considerations were known to EPA Victoria at the time of preparation of this report.

Background concentration data for NO_2 and CO were not required for the purposes of this modelling in accordance with the PEM or any other known EPA compliance obligation (and not advised by the EPA at the time of reporting).

5.8 Background Deposition

In accordance with the PEM, maximum background deposition data was needed to be obtained to ensure that the modelling results for TSP did not exceed the background by more than 2 grams/square metre/month. Given that there was none in the immediate local area, Edge obtained TSP measured (via dust deposition gauges) data from Hanson's similar operations in the township of Lang Lang, approximately five kilometres south from the Site. For the purposes of this assessment, such data was assumed to be the background in the Yannathan area in the locality of the subject Site.

6 Modelling Results

6.1 Concentrations

6.1.1 PM_{10}

PM_{10} emission scenario (base scenario) was run with five years of meteorology (2016-2020) in order to demonstrate five-year compliance. Therefore, results demonstrate five-year compliance for PM_{10} in general (for all years modelled) against the respective adopted criterion (50 µg/m^3 for a 24-hour averaging period) even though technically such data needs to be compared against when respective background data is considered (i.e. as shown in *Table 13,* which compliance is still achieved at the sensitive receptors modelled).

Table 12: Predicted impacts by year for PM_{10} over five years

Pollutant	PM_{10} µg/m^3 (without background)											
Year/ Receptor	SR1	SR2	SR3	SR4 ^	SB1	SB2	SB3	SB4	SB5	SB6	SB7	SB8
2016	1.2	0.3	0.4	<0.3	0.5	4.1	1.8	1.8	0.7	0.6	0.3	0.6
2017	1.3	0.4	0.3	<0.3	0.6	4.2	1.5	1.3	0.5	0.5	0.3	1.1
2018	2.0	0.9	0.4	<0.4	0.9	3.7	1.4	1.4	0.9	0.5	0.3	2.1
2019	1.4	0.4	0.5	<0.4	0.7	3.6	2.0	1.6	0.9	0.6	0.3	0.8
2020	1.6	0.5	0.4	<0.4	0.7	4.9	2.1	1.6	0.8	0.6	0.4	1.1

**24 hour averaging time*

^ Receptor inserted post modelling

Given the base scenario in this section, Scenario 1 was modelled using PM_{10} emissions being run with a Time Varying Background (TVB) as directed by the PEM. *Table 13* shows the predicted values at Sensitive Receptors modelled.

Table 13: PM_{10} prediction at sensitive receptors

Pollutant	PM10 µg/m^3 (with TVB)		APAC µg/m^3	Compliance
Averaging Time/ Receptor ID	1 day	1 year	1 day/1 year	
SR1	49.4	14.3	50/20	Yes
SR2	49.2	14.1		
SR3	49.2	14.1		
SR4	49.2^	14.1^		
SB1	49.2	14.1		
SB2	49.7	14.6		
SB3	49.4	14.3		
SB4	49.5	14.3		
SB5	49.3	14.2		
SB6	49.3	14.2		
SB7	49.2	14.1		
SB8	49.2	14.1		

^ Conservative values as receptor added post modelling

Due to compliance being achieved for the PM_{10} adopted APAC for this investigation, no time series plot was prepared for the most affected sensitive receptor showing the background data for PM_{10} modelled and the contribution from the extractive operation alone and the combined predicted concentrations over an entire year.

The contour plot for PM_{10} is provided below in *Figure 5* showing the geographic extent of maximum concentrations arising from the extractive industry plus background. No excursions above the criterion were identified at the boundary and sensitive receptors modelled.

Within the Site, the percentage statistics for non-compliances noted for a minority of coordinates across both averaging periods for PM_{10} are as follow and can be seen in the contouring as per *Figure 5* below:

- 1 year averaging: 0.02% (2 coordinates out of total 10,213 coordinates modelled); and
- 1 day averaging: 0.46 % (47 coordinates out of total 10,213 coordinates modelled)

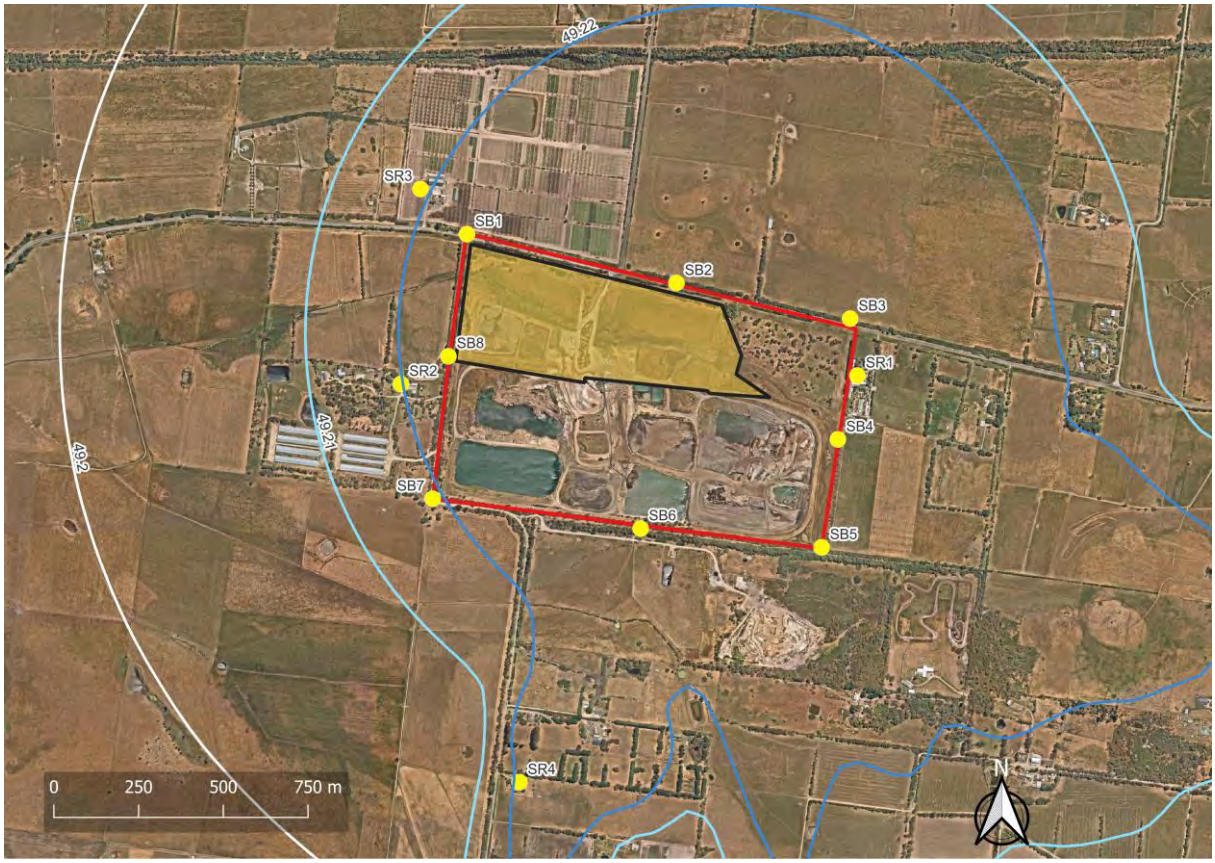


Figure 5: Contour plot of PM_{10} (24 hr average) with background showing compliance with the boundary and residential receptors

6.1.2 $PM_{2.5}$

Given the base scenario in this section, Scenario 2 was modelled using $PM_{2.5}$ emissions being run with a Time Varying Background (TVB) as directed by the PEM. *Table 14* shows the predicted values at the sensitive receptors modelled.

Table 14: $PM_{2.5}$ prediction at sensitive receptors

Pollutant	PM2.5 µg/m³ (with TVB)		APAC µg/m³	Compliance
Averaging Time/ Receptor ID	1 day	1 year	1 day/1 year	
SR1	31.2	7	25/8	No (1 day) Yes (1 year)
SR2	31.2	7		
SR3	31.2	7		
SR4	31.2^	7^		
SB1	31.2	7		
SB2	31.3	7		
SB3	31.2	7		
SB4	31.2	7		
SB5	31.2	7		
SB6	31.3	7		
SB7	31.3	7		
SB8	31.3	7		

^ Conservative values as receptor added post modelling

Time series plots in *Figures 6 and 7* for $PM_{2.5}$ for the discrete receptor SR2 was prepared to demonstrate that the highest predicted value is due to the background of $PM_{2.5}$ in the representative 2016 year modelled. This plot shows the combined background data for $PM_{2.5}$ modelled and the contribution from the extractive operation predicted concentrations over an entire year. This is designed to indicate the frequency of predicted concentrations and any exceedances of the assessment criteria (which occurred in February and April of 2016). Based on the data, this demonstrates that $PM_{2.5}$ excursions should not occur for a majority of a given year.

Within the Site, the percentage statistics for non-compliances noted for a minority of coordinates across both averaging periods for $PM_{2.5}$ are as follow and can be seen in the contouring as per *Figure 8* below:

- 1 year averaging: 0.02% (2 coordinates out of total 10,213 coordinates modelled); and
- 1 day averaging: 100 % (10,213 coordinates out of total 10,213 coordinates modelled).

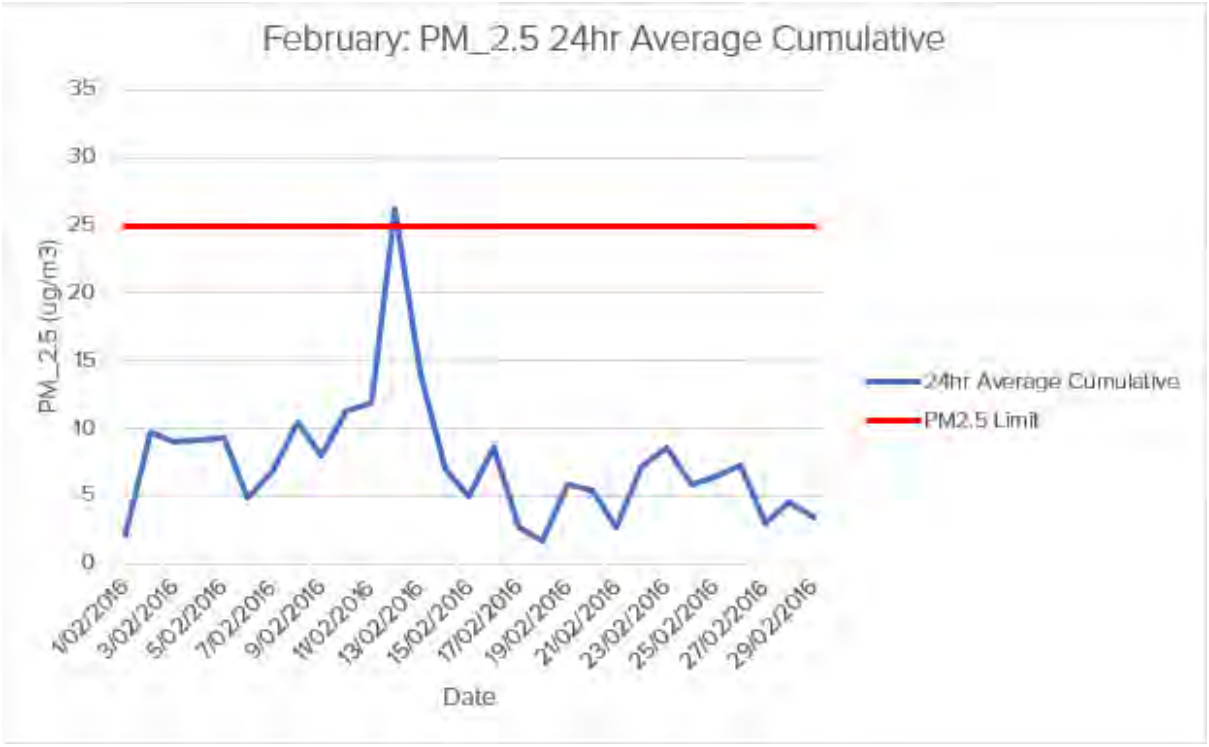


Figure 6: Time series plot for $PM_{2.5}$ (based on February 2016)

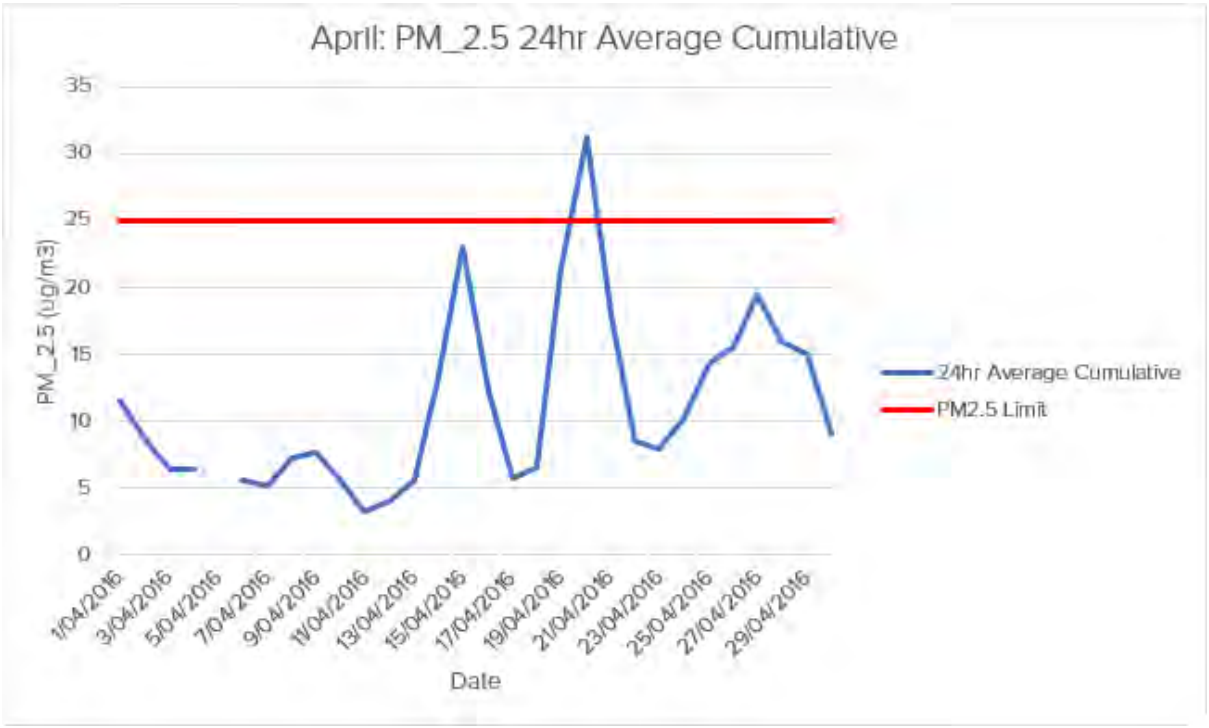


Figure 7: Time series plot for PM2.5 (based on April 2016)[24]

The contour plot in *Figure 8* shows that the predicted levels of $PM_{2.5}$ at the nearest residential receptors modelled arising from the extractive industry plus background concentrations obtained exceeded the APAC adopted in this investigation. In summary, the

[24] Gap in data on the plot is where no data was recorded.

background concentrations played a significant part in the predicted $PM_{2.5}$ cumulative concentrations.

Figure 8: Contour plot of $PM_{2.5}$ (24 hr average) with background; unable to show contouring that demonstrates the APAC being exceeded at the nearest residential receptors

6.1.3 NO_2

Scenario 3 comprised the NO_2 emission run without background as per the PEM. *Table 15* shows the predicted values at the sensitive receptors modelled.

Table 15: NO_2 prediction at sensitive receptors

Pollutant	NO_2 µg/m³		APAC µg/m³	Compliance
Averaging Time/ Receptor ID	1 hour	1 year	1 hour/1 year	
SR1	21.1	0.7	151/28	Yes
SR2	7.3	0.1		
SR3	4.3	0.1		
SR4	< 4.3^	< 0.1^		
SB1	4.8	0.1		
SB2	43.9	1.8		
SB3	17.5	0.8		
SB4	15.0	0.7		

Pollutant	NO_2 µg/m^3		APAC µg/m^3	Compliance
Averaging Time/ Receptor ID	1 hour	1 year	1 hour/1 year	
SB5	6.7	0.3		
SB6	9.4	0.2		
SB7	5.4	0.1		
SB8	9.2	0.2		

^ Conservative values as receptor added post modelling

The contour plot in *Figure 9* shows that there are no unacceptable levels of NO_2 at the nearest residential receptors. As per the PEM, modelling of this combustion gas did not require this assessment to consider respective background concentrations.

Within the Site, the percentage statistics for non-compliances noted for a minority of coordinates across both averaging periods for NO_2 are as follow and can be seen in the contouring as per *Figure 9* below:

- 1 year averaging: 0.06% (6 coordinates out of total 10,213 coordinates modelled); and
- 1 hour averaging: 0.13 % (13 coordinates out of total 10,213 coordinates modelled).

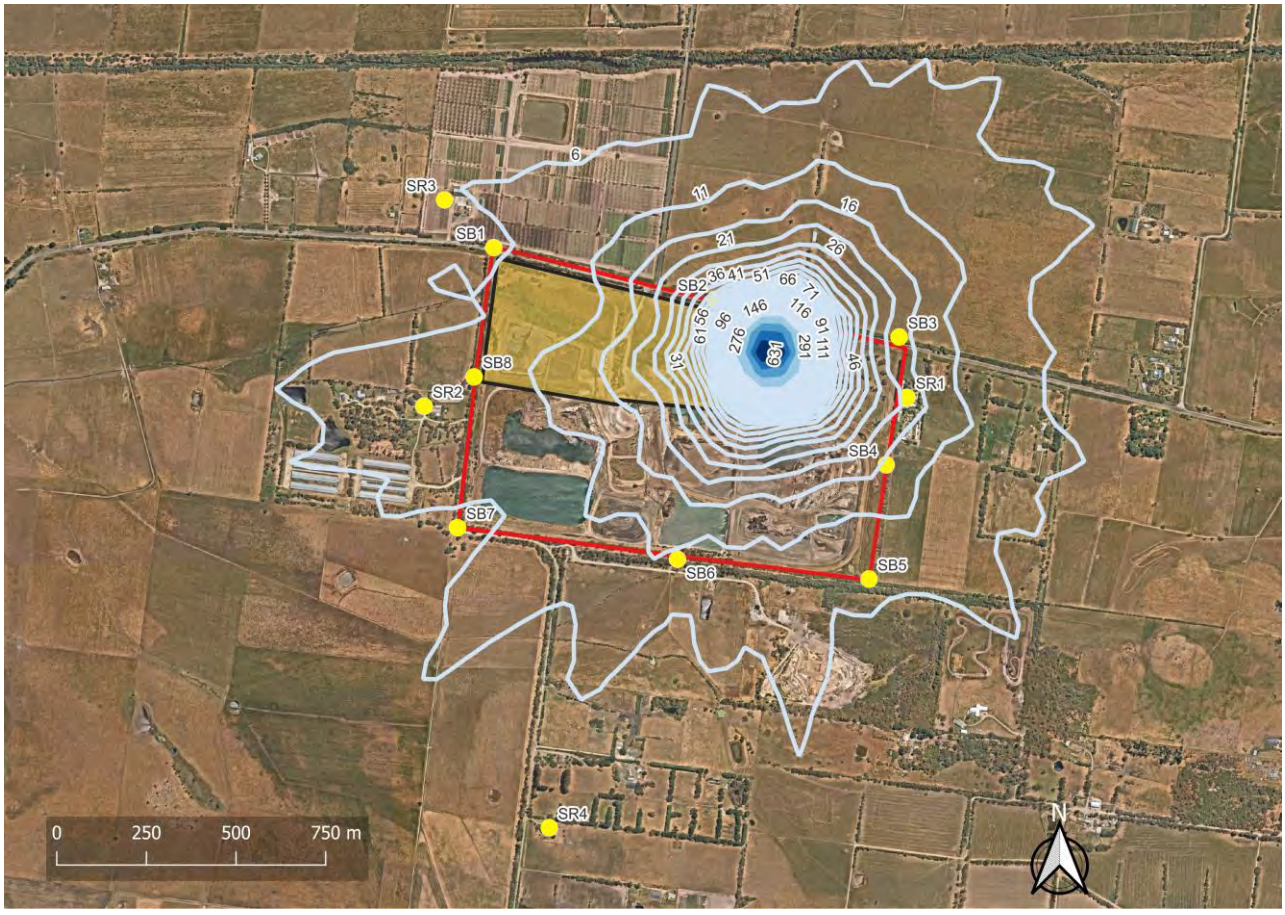


Figure 9: Contour plot of NO_2 (1 hr average) showing compliance with the residential receptors

Compliance with the adopted NO_2 criteria for the two average time durations are likely to still be achieved at the broiler farm residence (SR2) and the market garden residence (SR3) had the mobile plant sources been modelled to the centre western edge of the extraction area.

6.1.4 CO

Scenario 4 comprised the CO emission run without background as per the PEM. *Table 16* shows the predicted values at the sensitive receptors modelled.

Table 16: CO prediction at sensitive receptors

Pollutant	CO µg/m^3	APAC µg/m^3	Compliance
Averaging Time/ Receptor ID	8 hours	8 hours	
SR1	3.0	10,310	Yes
SR2	0.6		
SR3	0.9		
SR4	<0.6^		
SB1	0.6		
SB2	7.3		
SB3	2.6		
SB4	3.2		
SB5	1.2		
SB6	1.2		
SB7	0.7		
SB8	0.8		

^ Conservative value as receptor added post modelling

The contour plot in *Figure 10* shows that there are no unacceptable levels of CO at the nearest residential receptors and at any other coordinates modelled in the grid. This resulted in not having to show the criterion contour of 10,310 µg/m^3. As per the PEM, modelling of this combustion gas did not require this assessment to consider respective background concentrations.

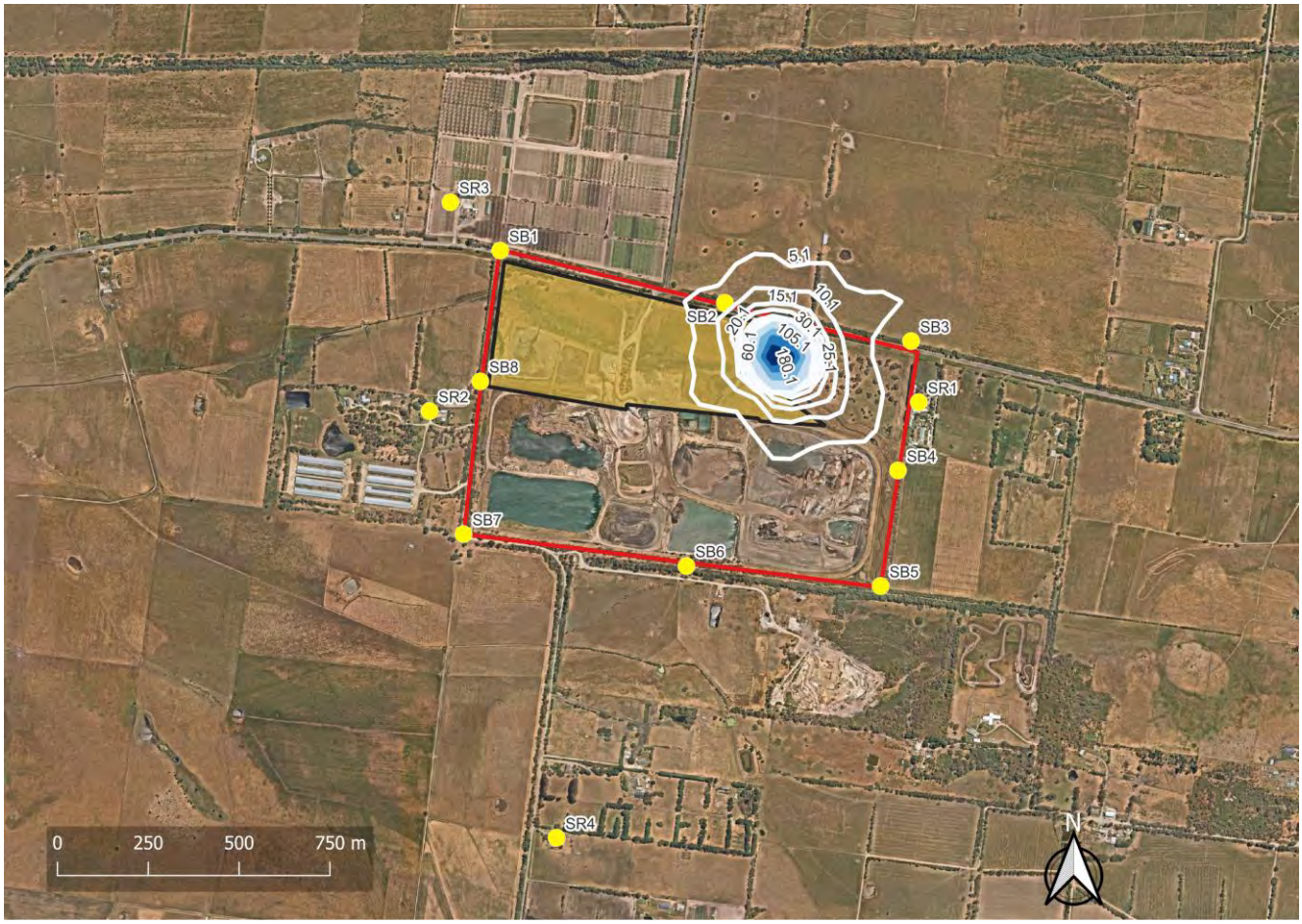


Figure 10: Contour plot of CO (1 hr average) showing compliance with all coordinates modelled in the grid

6.2 Deposition

Scenario 5 comprised the TSP emission run without background as per the PEM. *Table 17* shows the predicted values at the sensitive receptors modelled.

Table 17: TSP prediction at sensitive receptors

Pollutant	TSP µg/m^2/month	APAC µg/m^2/month	Compliance
Averaging Time/ Receptor ID	1 hour	1 hour	
SR1	21.4	2,000 (above background) or 4,000 (no background)	Yes
SR2	2.9		
SR3	3.2		
SR4	<2.1^		
SB1	7.1		
SB2	46		
SB3	21.3		
SB4	30.6		
SB5	15.4		
SB6	6.3		
SB7	2.1		
SB8	8.4		

^ Conservative value as receptor added post modelling

The contour plot in *Figure 11* shows that there are no unacceptable levels of nuisance dust /or TSP at the nearest residential receptors.

However, assuming there are background levels of TSP as detailed in the SEMP_Dust prepared by Edge (for Ricardo for Hanson), the APAC becomes 2,000 µg/m^2/month (rather than the 4,000 µg/m^2/month with no background in the area). It was predicted that two (2) out of 10,213 values (0.02 percent of the coordinates), identified to be within the Site, exceeded 2,000 µg/m^2/month.

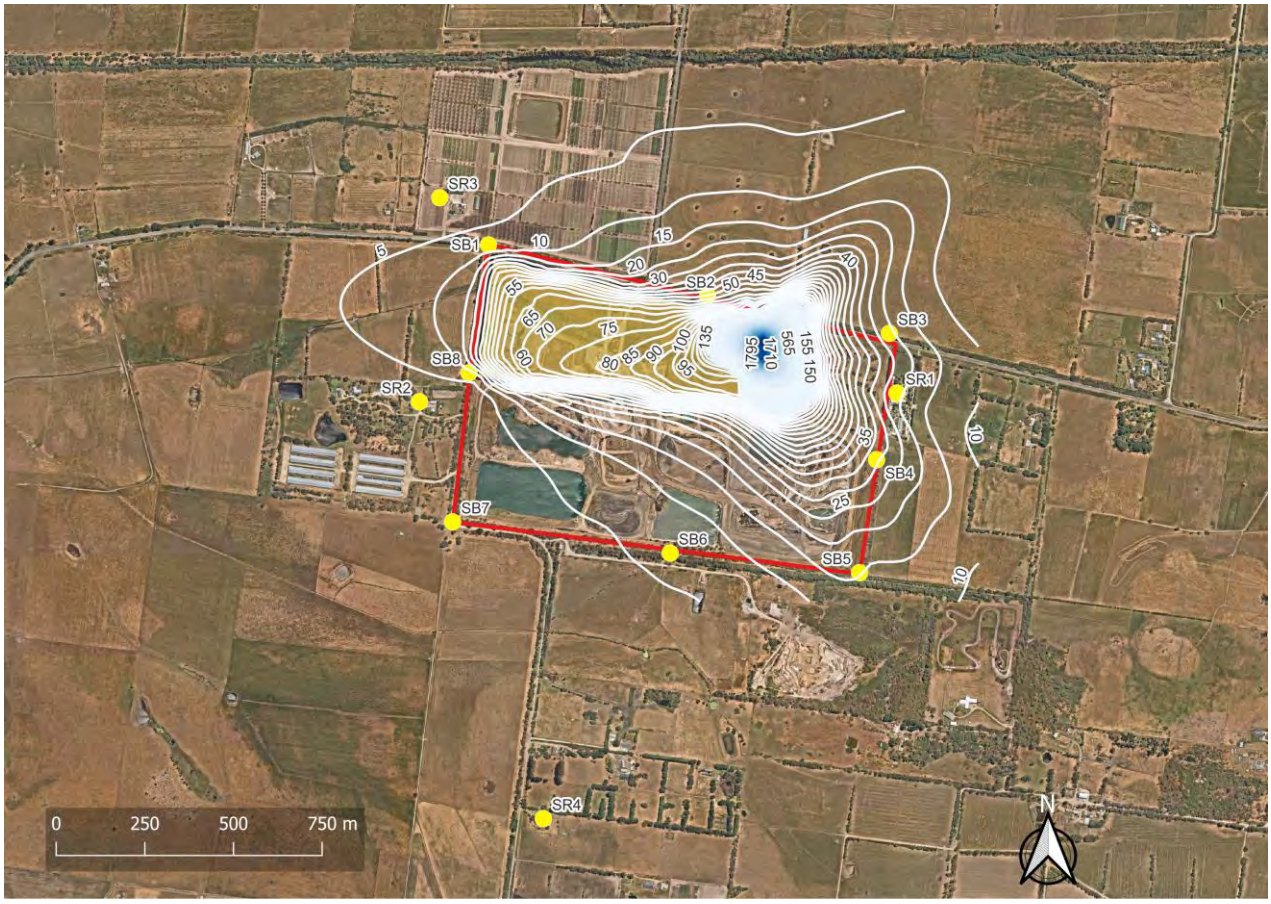


Figure 11: Deposition contour plot of TSP (µg/m^2/month) showing compliance with the 2,000 µg/m^2/month criterion at every coordinate except for two coordinates (inside the Site) modelled in the grid

7 Risk Assessment

7.1 $PM_{2.5}$

This section has been added to this report to deal with any excursions above the adopted APAC especially to the nearest sensitive (residences) receptors. In this assessment, we have determined this to be $PM_{2.5}$.

As per the *Guidance for assessing nuisance dust, EPA Victoria, June 2022, Publication 1943,* the risk assessment consists of four steps (*Figure 12*):

- Step 1: Determine the hazard potential of the source.
- Step 2: Determine the effectiveness of the exposure pathway between the source and receiving environment.
- Step 3: Determine the sensitivity of the receiving environment at the receptor.
- Step 4: Determine the overall risk of nuisance dust impact occurring based on the risk of the exposure and the sensitivity of the receiving environment.

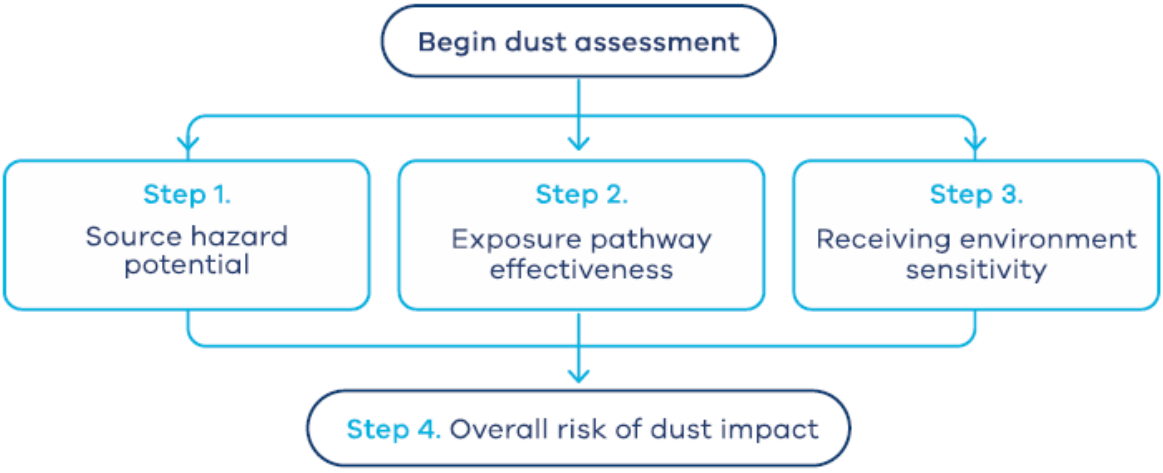


Figure 12: Nuisance dust – risk assessment process (Source: EPA Publication 1943)

The overall risk of dust impacts likely to occur is then determined by adding up the scores for each category of Steps 1 to 3 above and then assessed as per *Table 18* (which is *Table 4* from EPA Publication 1943) To reduce risk as you move up the scale, the level of control and intervention required increases.

Subsequently, the addition of scores in Steps 1 to 3 added to twenty (20),[25] which identified as Moderate Risk. Please refer to the definition in this section below.

[25] Each of the ten hazard categories from Steps 1, 2 and 3 received a score of two (2).

Table 18: Overall risk of dust impact (Source: EPA Publication 1943)

Score	Descriptor	Comment
32-36	very high	Dust impacts almost certain
27-31	high	Dust impacts highly likely to occur
22-26	medium	Dust impacts likely
17-21	moderate	Dust impacts only likely to occur on rare occasions
12-16	Low	Dust impacts are not likely

Very high risk	indicates that nuisance dust will occur. Any interventions to reduce risk in either the source, pathway or receiving environment are unlikely to be practical so effective mitigation is doubtful.
High risk	indicates that you can expect significant nuisance dust to occur, and impacts are highly likely. There may be some interventions that can be applied to reduce the risk, but it is likely that significant re-engineering or redesign will be required.
Medium risk	indicates that you can expect some nuisance dust to occur and without careful and considered application of mitigation measures it is likely to cause impacts. The focus should be what can be done to break the source-pathway-receiving environment chain.
Moderate risk	although there may be some residual risk of nuisance dust, but it is possible it can be practically and effectively managed.
Low risk	indicates the risk of nuisance dust is likely to be minimal

The overall risk rating seems to be consistent (or reinforce) the fact that there have been no known external dust-related complaints for the existing quarrying, which is believed to not take place at the time of works in the newly extended Site area. That is, it is planned that any (residual) existing sand would have been quarried by the time the 'new' Site works would have commenced.

8 Discussion & Conclusions

8.1 Concentrations (NOx, CO, PM_{10}, $PM_{2.5}$)

The pollutants above were modelled under generally representative to worst-case/conservative conditions. The modelling identified that the adopted EPA criteria were not exceeded at the nominated residential locations for CO, NO_2 and PM_{10} compared against the criteria employed in this investigation.

Compliance at these sensitive receptor locations was also achieved even when respective background concentrations were included (i.e. for PM_{10}).

There were only excursions at the four sensitive receptors modelled in this investigation for one parameter only being $PM_{2.5}$ (including background air quality as needed to be considered) for only one of the two averaging periods modelled. Accordingly, a dust risk assessment was employed in this investigation using EPA methodology. Given this risk assessment and that no known external dust-related complaints have been known to have been received as a result of the Site's operations, it is unlikely that there will be any potential human health (or amenity) impact surrounding the site during the proposed operations, which would be operating in normal steady-state conditions almost all of the time.

Although not significant, some points worth noting based on the modelling results where adopted respective criteria were exceeded for on-site nominated coordinates for the following parameters are:

- PM_{10}
  - 1 year averaging: 0.02% (2 coordinates out of total 10,213 coordinates modelled); and
  - 1 day averaging: 0.46 % (47 coordinates out of total 10,213 coordinates modelled)
- NO_2
  - 1 year averaging: 0.06% (6 coordinates out of total 10,213 coordinates modelled); and
  - 1 hour averaging: 0.13 % (13 coordinates out of total 10,213 coordinates modelled).
- $PM_{2.5}$ – similar scenario to PM_{10} (above) but we have not focussed on $PM_{2.5}$ here as predicted concentrations exceeded 1 day averaging criteria at the residential receptors modelled.

The above concentrations would typically only be an issue if the worker (or visitor) on-site would be at the particular nominated coordinate modelled for the averaging period related to the pollutant modelled (e.g. 1 hour for NO_2 or 1 day for PM_{10}). Further, the meteorological conditions would also have to match to those that were modelled. Given this, it is unlikely that human health (or amenity) issues would result in the minor excursions above)

8.2 Deposition (TSP)

Total Suspended Particles were modelled under generally representative to worst-case/conservative conditions. The modelling identified that the adopted EPA (PEM) criterion in this assessment was not exceeded at the residential locations surrounding the Site. No

equivalent criterion could be found in the new EPA legislation that came into effect from 1 July 2021. Despite this, the deposition results were at least two orders of magnitude below the adopted criterion outside the Site in this assessment. However, it was predicted that two (2) out of 10,213 values (0.02 percent of the coordinates), identified to be within the Site, exceeded 2,000 µg/m^2/month. Similar to the explanation for the gaseous concentrations in *Section 8.1* above, a person would have to be in the locations of these coordinates at the corresponding wind direction and averaging time for compliance not to be achieved

The dispersion modelling (both concentrations and deposition) undertaken in this report was based on a representative to worst-case operating scenario. There were no excursions at the four sensitive receptors modelled in this investigation apart from $PM_{2.5}$ for one averaging period only (i.e. 1 day not 1 year), which we subsequently risk-assessed (identifying a 'moderate' risk level[26]) and we understand that there have been no legitimate Site-related complaints from external sources. Given this, we suggest it is unlikely that there will be any ongoing potential human health (or amenity) impact surrounding the Site during the proposed operations, which would be operating in normal steady-state conditions almost all of the time.

8.3 Recommendation

No specific recommendations are warranted in this report assuming that site operations will be undertaken as considered in this report apart from Hanson following the control measures, as part of the Site's GED as outlined in the SEMP_Dust (prepared by Edge for this project).

[26] Dust impacts only likely to occur on rare occasions.

9 References

1. Air Quality Assessment – Lots 1 And 2 Dp732708 Old Telegraph Road, Maroota Proposed Sand Quarry, Job ID. 08915, Pacific Air Environment for PF Formation (04 September 2014).
2. Environment Reference Standard, Victoria Government Gazette, No. S 158 Tuesday 29 March 2022
3. Guidance Notes for Using the Regulatory Air Pollution Model AERMOD in Victoria, EPA Publication 1551, October 2013
4. Protocol For Environmental Management (PEM): Mining And Extractive Industries, EPA Victoria, 2007 – used as *State of Knowledge only*
5. US EPA (1995), Compilation of Air Pollutant Emission Factors, AP-42, Fourth Edition United States Environmental Protection Agency, Office of Air and Radiation Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina 27711
6. Guideline for Assessing and Minimising Air Pollution in Victoria (for air pollution managers and specialists), EPA Victoria, Publication 1961, February 2022 (EPA Publication 1961)
7. Guidance for assessing nuisance dust, EPA Victoria, June 2022, Publication 1943
8. Site Environmental Management Plan (SEMP)_Dust; Edge Group for Ricardo (for Hanson), 20220075-R-01-SEMP_Dust, 2022

Appendix A

AERMOD Meteorological Data Files Report

AERMOD ready Meteorological data files

Yannathan- VIC

This file was exclusively compiled for **EDGE Group** By pDs Consultancy.

pDs Consultancy
@1999-2022

INTRODUCTION

New generation regulatory model AERMOD requires hourly averaged meteorological data from a single site that is preferably within the model domain ('on-site' or site-specific data). However, data from the nearest 'off-site' meteorological station can be used when on-site data are not available, and the off-site data are representative of the area of concern (i.e. the meteorological parameters as well as surface characteristics characterise the transport and dispersion conditions of the location in question).

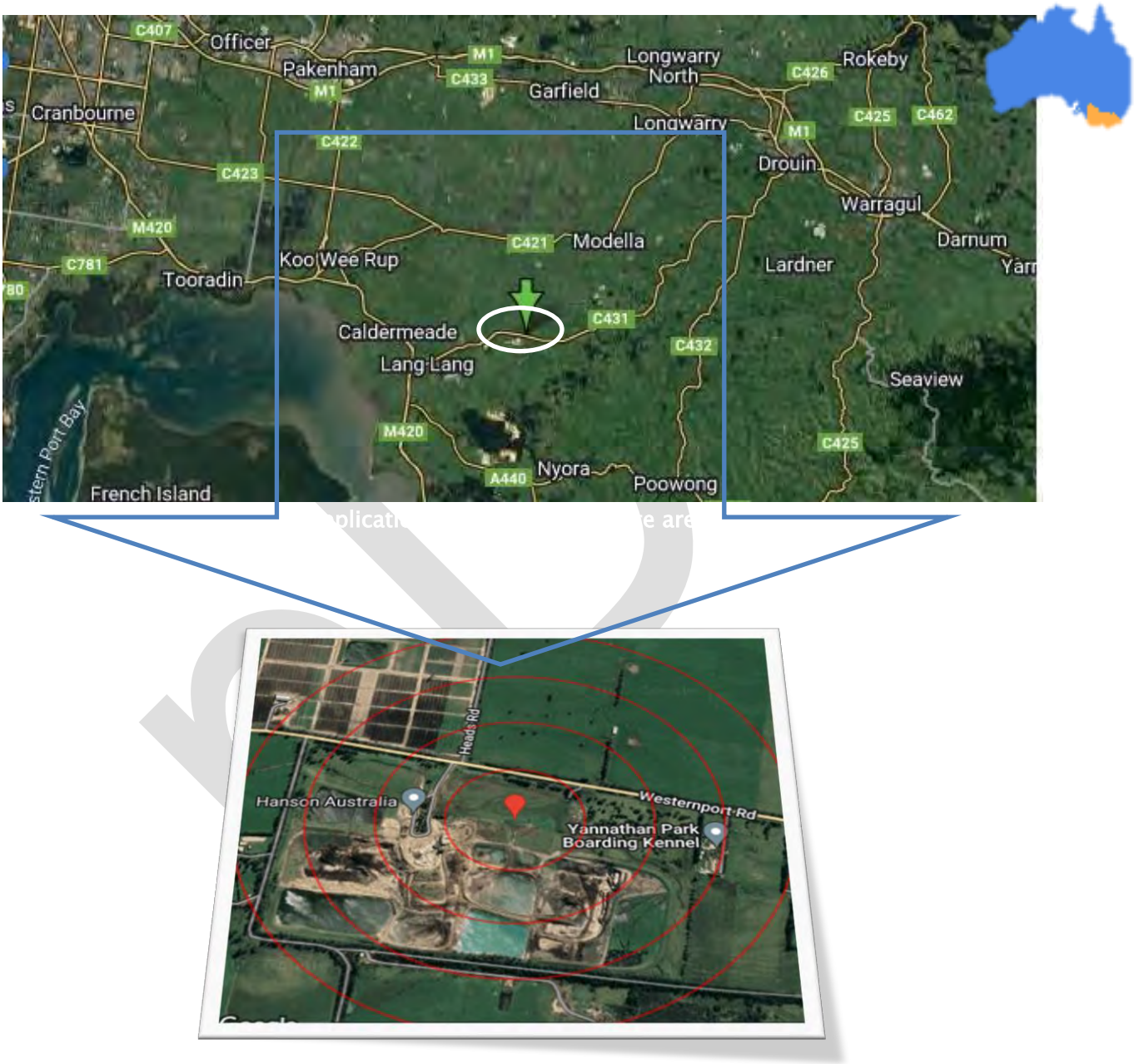
It is also preferable that:

- The compilation of the input meteorological data file is done in accordance with 'best practice', with procedures and algorithms recommended or set by environment regulators/US & VIC EPA.

pDs Consultancy has been engaged by **EDGE Group** to compile an 'AERMOD-ready' meteorological files for an application site at Westernport Road, Yannathan, Victoria. There are no weather stations in the radius of 10 KM. Therefore data was simulated for the location in question running TAPM (Air pollution Model by CSIRO) as per guidelines by EPA, Victoria.

This input meteorological data files have been compiled basically following the EPA, Victoria's draft guidelines: "Construction of input meteorological data files for EPA Victoria's regulatory air pollution model (AERMOD) (Publication No.1550)". The calculations for Stable Boundary layer was done following the latest formulations published by US, EPA.

LOCATION OF THE APPLICATION SITE–WESTERNPORT ROAD, YANNATHAN



Data Processing

Input Information

Data Used for the compilation

Meteorological Data

1. **Mandatory Data (TAPM)**
    i. 10m Wind Direction and Speed
    ii. Ambient Temperature (Screen Level)

2. **Supplementary data (TAPM)**

I. Surface Pressure set to 1013 hPa
II. Net Radiation simulated by TAPM
III. Relative Humidity
IV. Rainfall Rate

3. **Upper air Data (TAPM)**
I. TAPM simulated convective mixing heights were used.

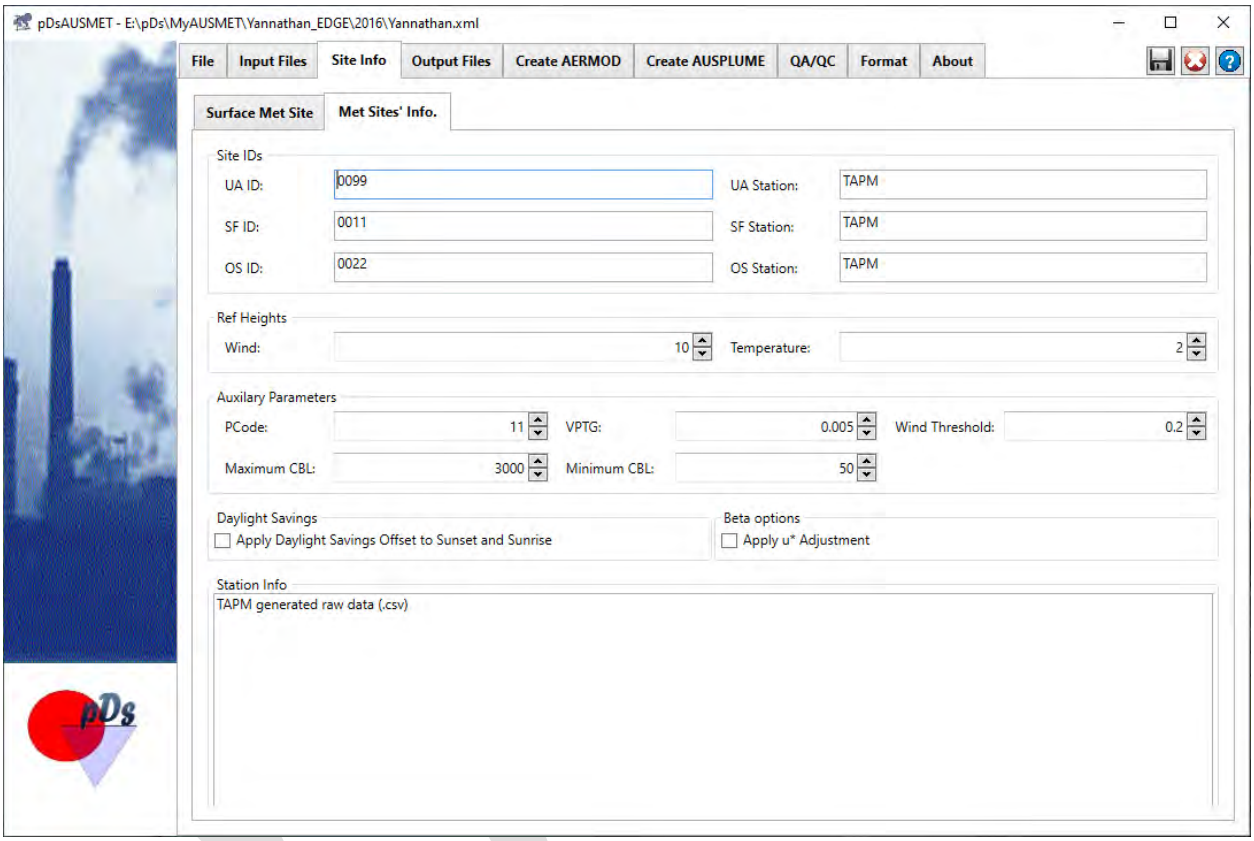
DATA SOURCE

- Data Source: **CSIRO**
- Period :1 Jan 2016 to 31 Dec 2020

QA/QC ON RAW DATA

I. Parameters QA/QCed based on extreme values

METSITE INFORMATION



DATA COVERAGE:

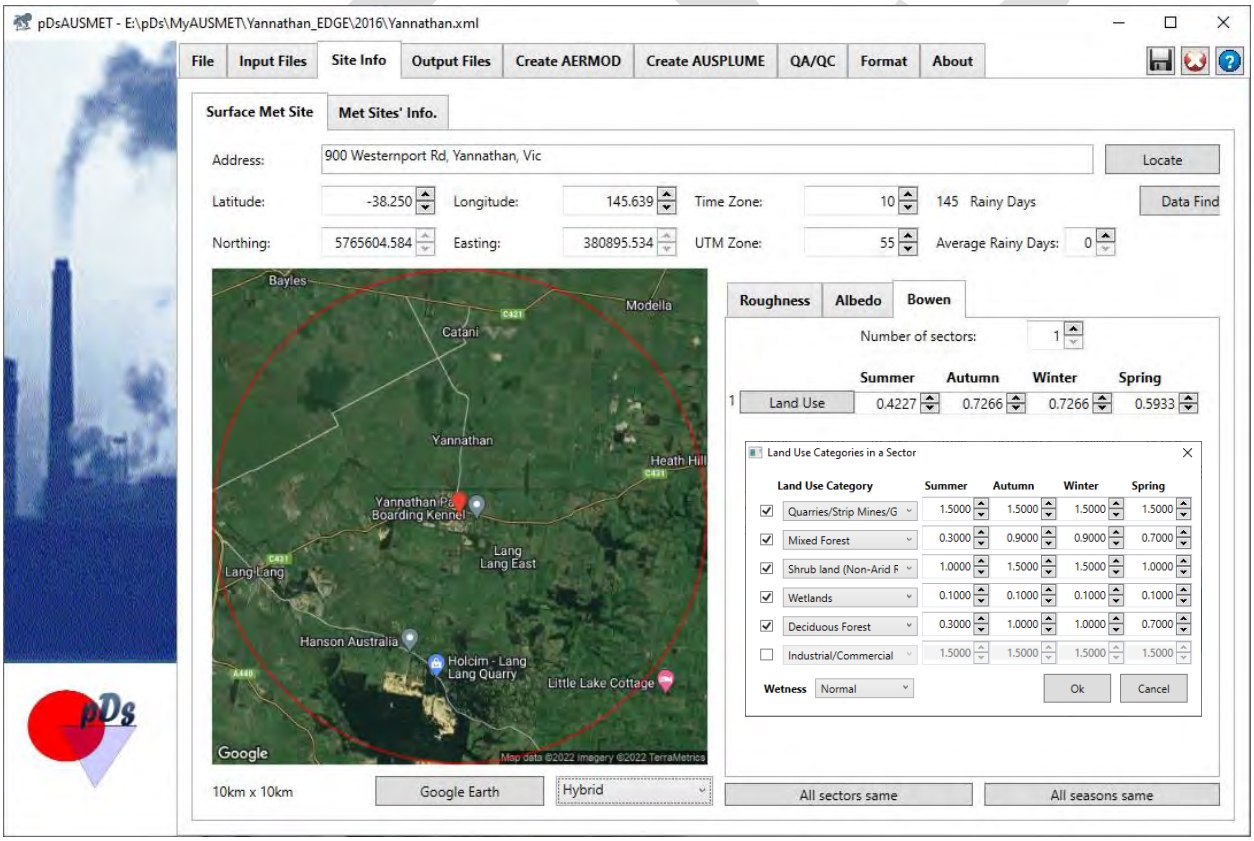
Season	Data Coverage %				
Year	2016	2017	2018	2019	2020
Summer	100	100	100	100	100
Autumn	100	100	100	100	100
Winter	100	100	100	100	100
Spring	100	100	100	100	100
Annual	100	100	100	100	100

Annual and Seasonal data coverage are meeting regulatory requirement (90% or better).

DETERMINATION OF SURFACE CHARACTERISTICS

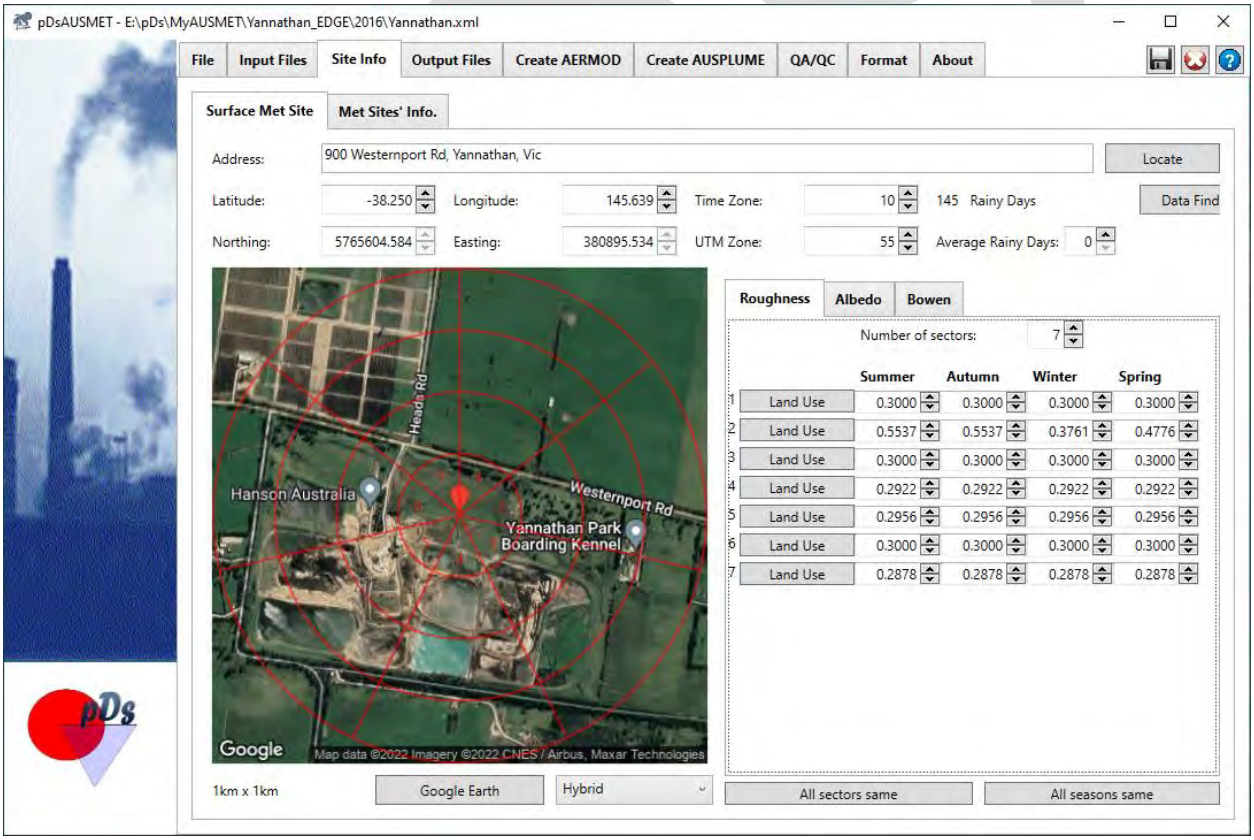
All available surface maps including google maps examined to determine correct land use categories within 10 Km by 10 KM area centring the application site.

Albedo and **Bowen ratio** were determined using land use categories shown



SURFACE ROUGHNESS

Sector dependent surface roughness was determined considering 7 sectors. The Roughness of each sector was assigned carefully examining land use distribution in 4 segments (250 m) of each sector.



The following parameters were determined/computed following EPA, VIC and US EPA guidelines.

Sensible Heat flux –Calculated based on cloud observations

I. Friction Velocity (U*)
II. Monin-Obukhov Length (L)
III. Height of the Stable Boundary Layer (SBL)
IV. Vertical Velocity Scale (W*)
V. Height of the Convective Boundary Layer (CBL)

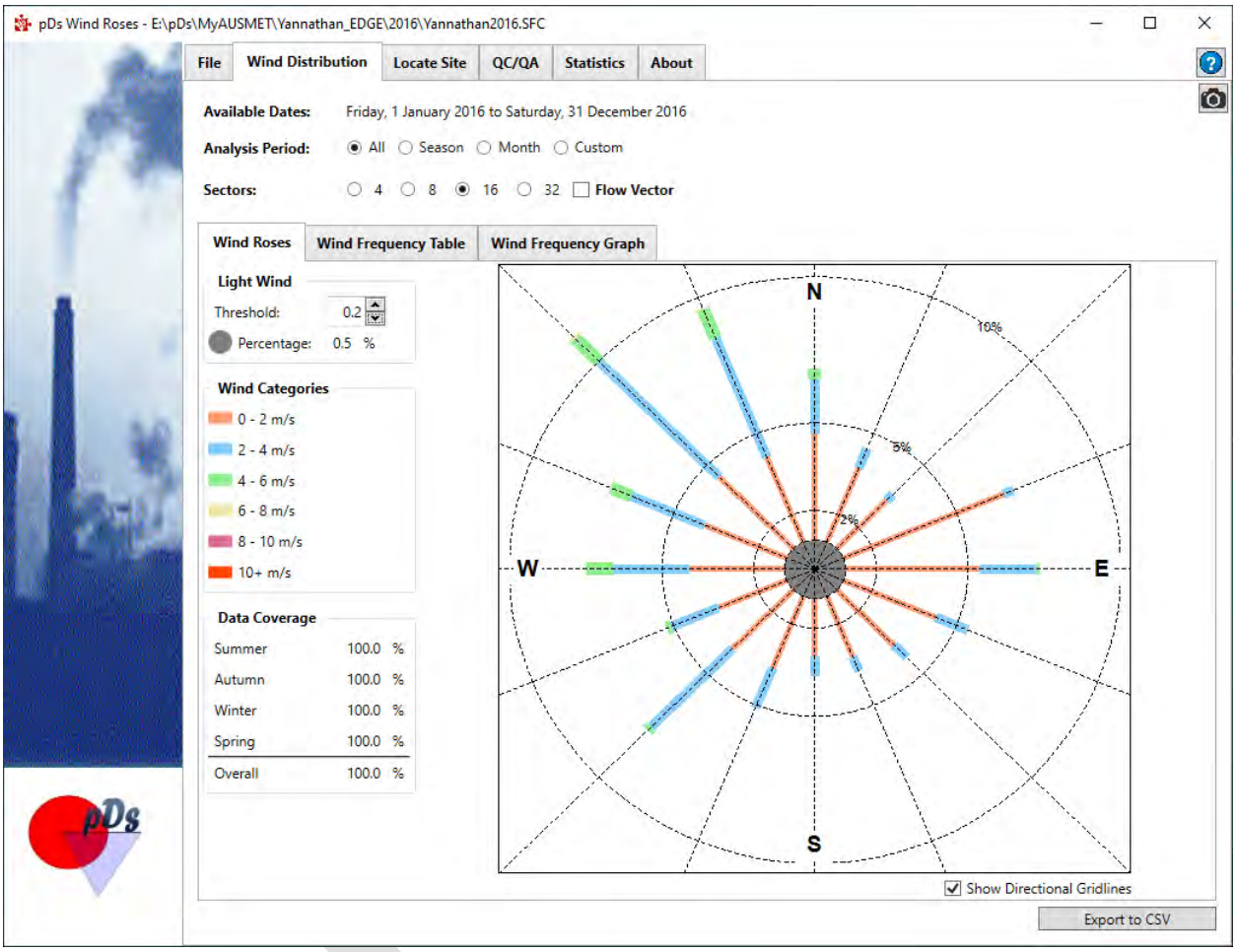
Mixing height (Convective)-CBL

DEFINITION:

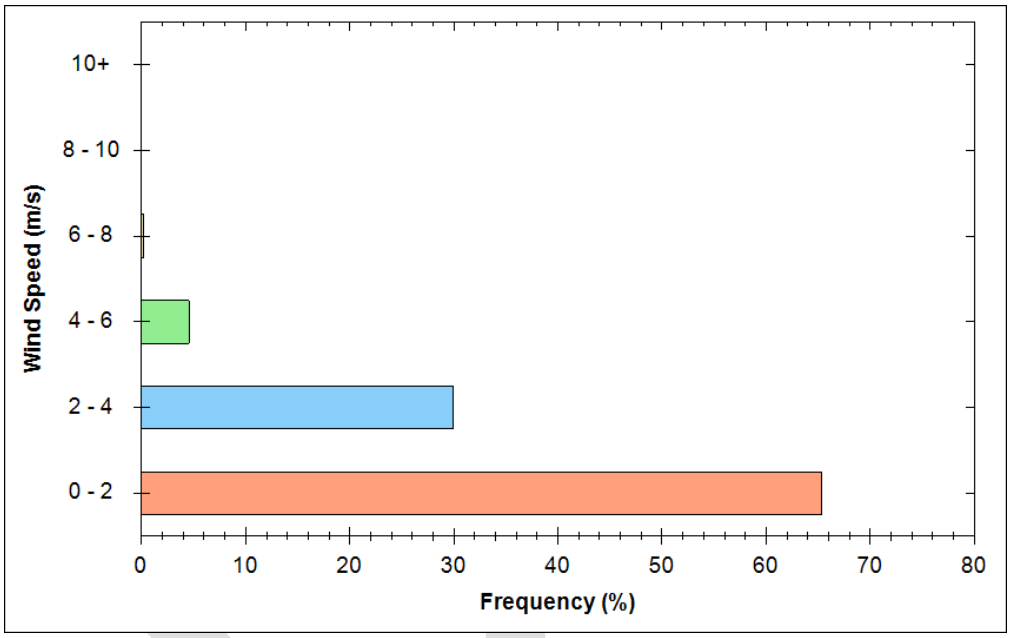
The convective mixing height, the depth of the surface mixed layer is the height of the atmosphere above the ground, which is well mixed due either to mechanical turbulence or convective turbulence. This height was simulated running TAPM.

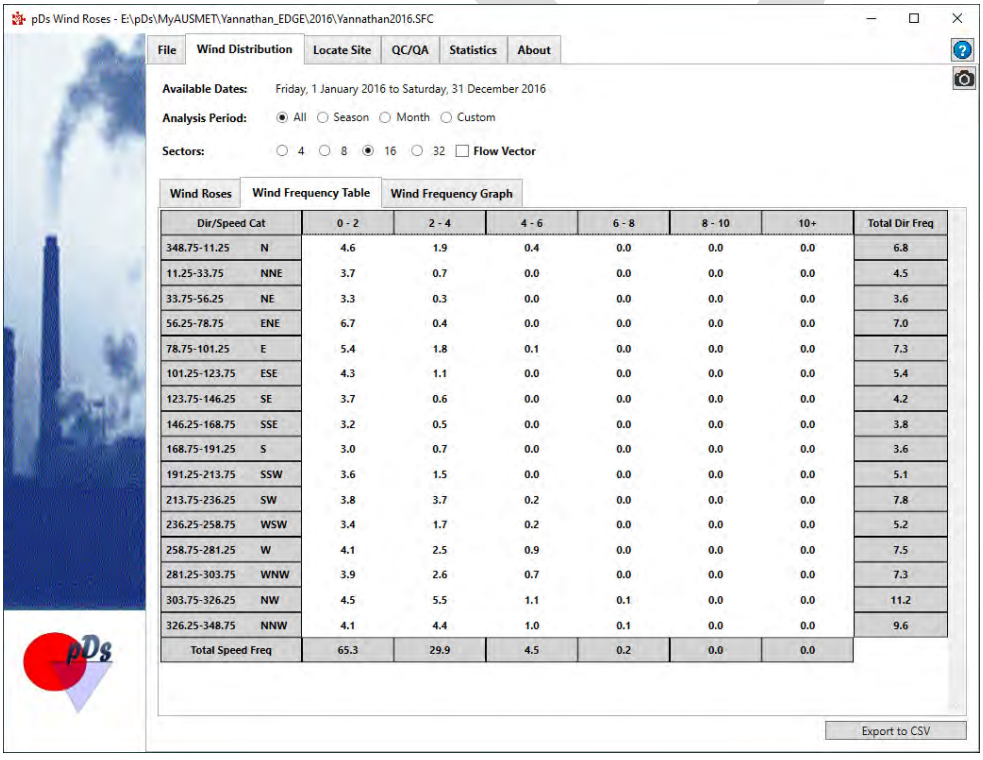
DATA ANALYSIS

ANNUAL WINDROSES FOR YANNATHAN-2016



FREQUENCY OF WIND SPEED

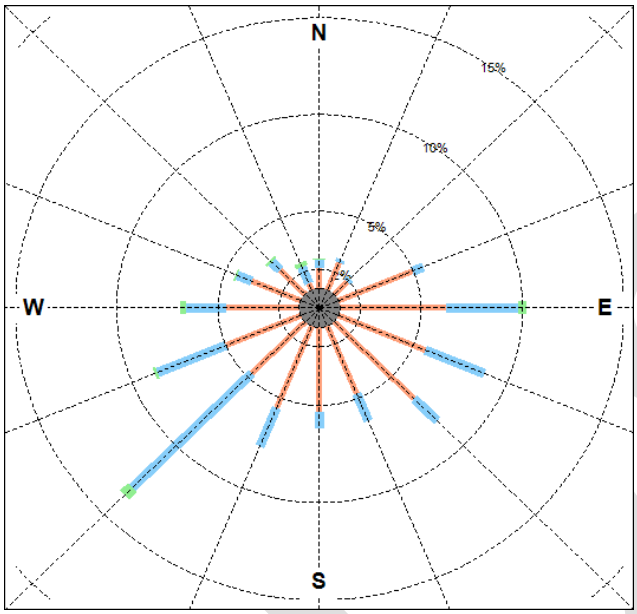


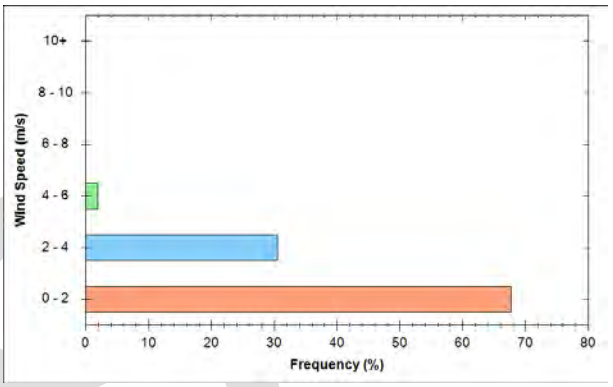


Dir/Speed Cat		0 - 2	2 - 4	4 - 6	6 - 8	8 - 10	10+	Total Dir Freq
348.75-11.25	N	4.6	1.9	0.4	0.0	0.0	0.0	6.8
11.25-33.75	NNE	3.7	0.7	0.0	0.0	0.0	0.0	4.5
33.75-56.25	NE	3.3	0.3	0.0	0.0	0.0	0.0	3.6
56.25-78.75	ENE	6.7	0.4	0.0	0.0	0.0	0.0	7.0
78.75-101.25	E	5.4	1.8	0.1	0.0	0.0	0.0	7.3
101.25-123.75	ESE	4.3	1.1	0.0	0.0	0.0	0.0	5.4
123.75-146.25	SE	3.7	0.6	0.0	0.0	0.0	0.0	4.2
146.25-168.75	SSE	3.2	0.5	0.0	0.0	0.0	0.0	3.8
168.75-191.25	S	3.0	0.7	0.0	0.0	0.0	0.0	3.6
191.25-213.75	SSW	3.6	1.5	0.0	0.0	0.0	0.0	5.1
213.75-236.25	SW	3.8	3.7	0.2	0.0	0.0	0.0	7.8
236.25-258.75	WSW	3.4	1.7	0.2	0.0	0.0	0.0	5.2
258.75-281.25	W	4.1	2.5	0.9	0.0	0.0	0.0	7.5
281.25-303.75	WNW	3.9	2.6	0.7	0.0	0.0	0.0	7.3
303.75-326.25	NW	4.5	5.5	1.1	0.1	0.0	0.0	11.2
326.25-348.75	NNW	4.1	4.4	1.0	0.1	0.0	0.0	9.6
Total Speed Freq		65.3	29.9	4.5	0.2	0.0	0.0	

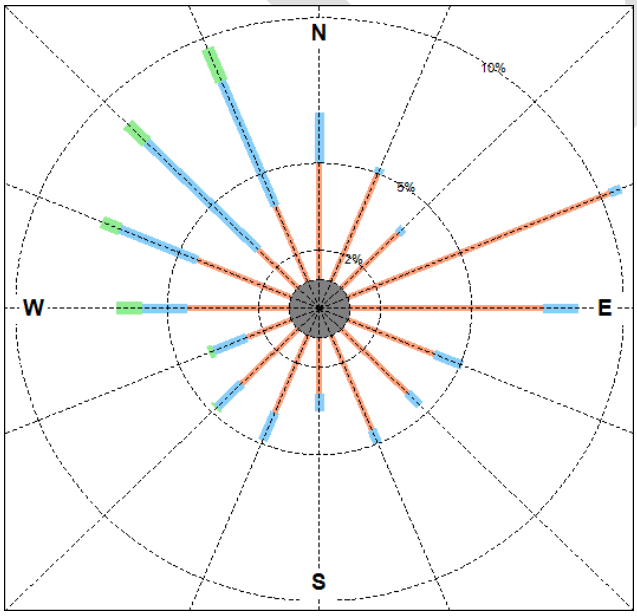
SEASONAL WINDROSES

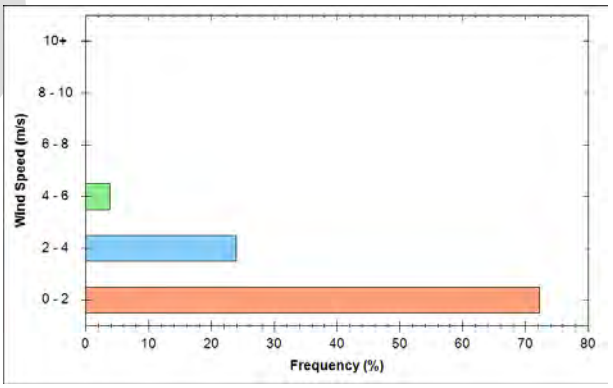
Summer



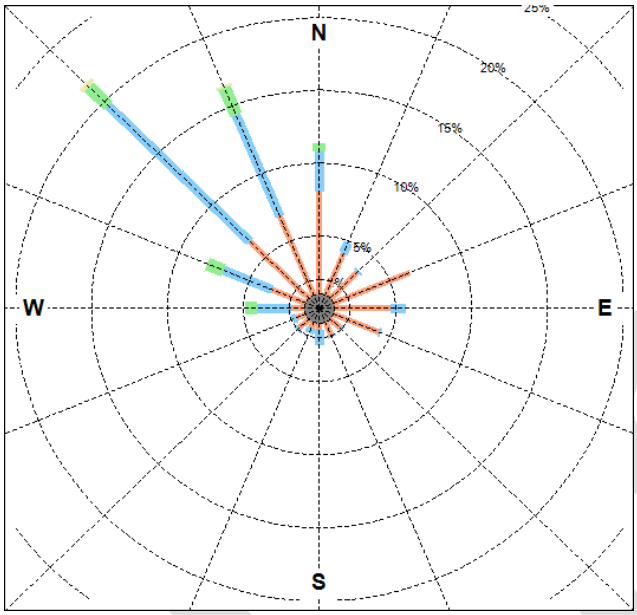


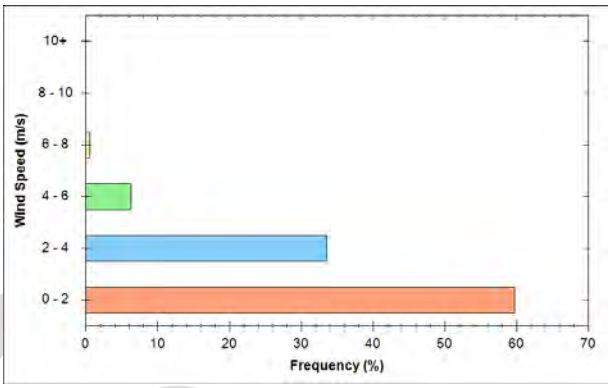
Autumn



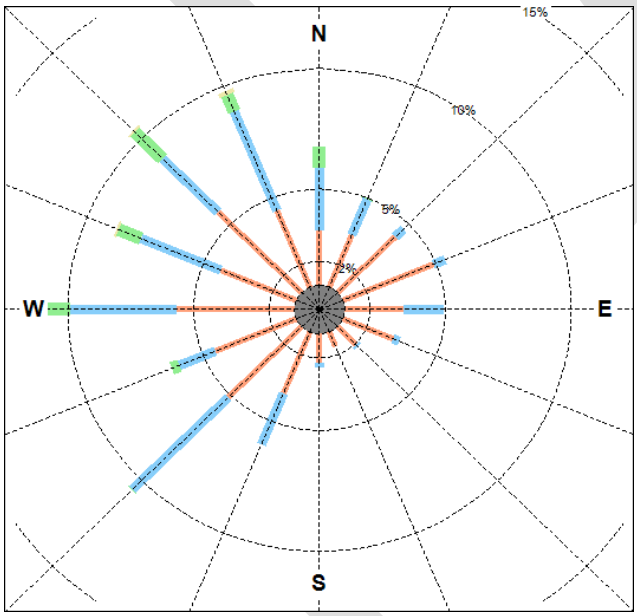


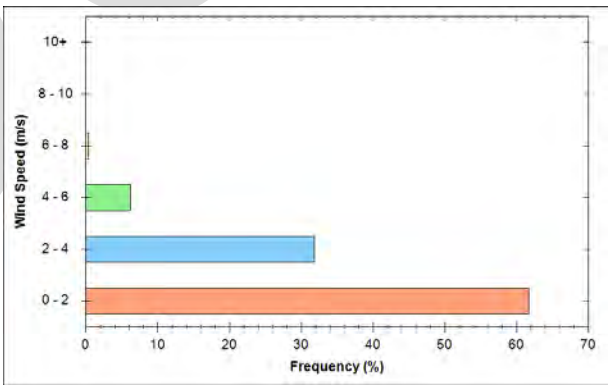
Winter





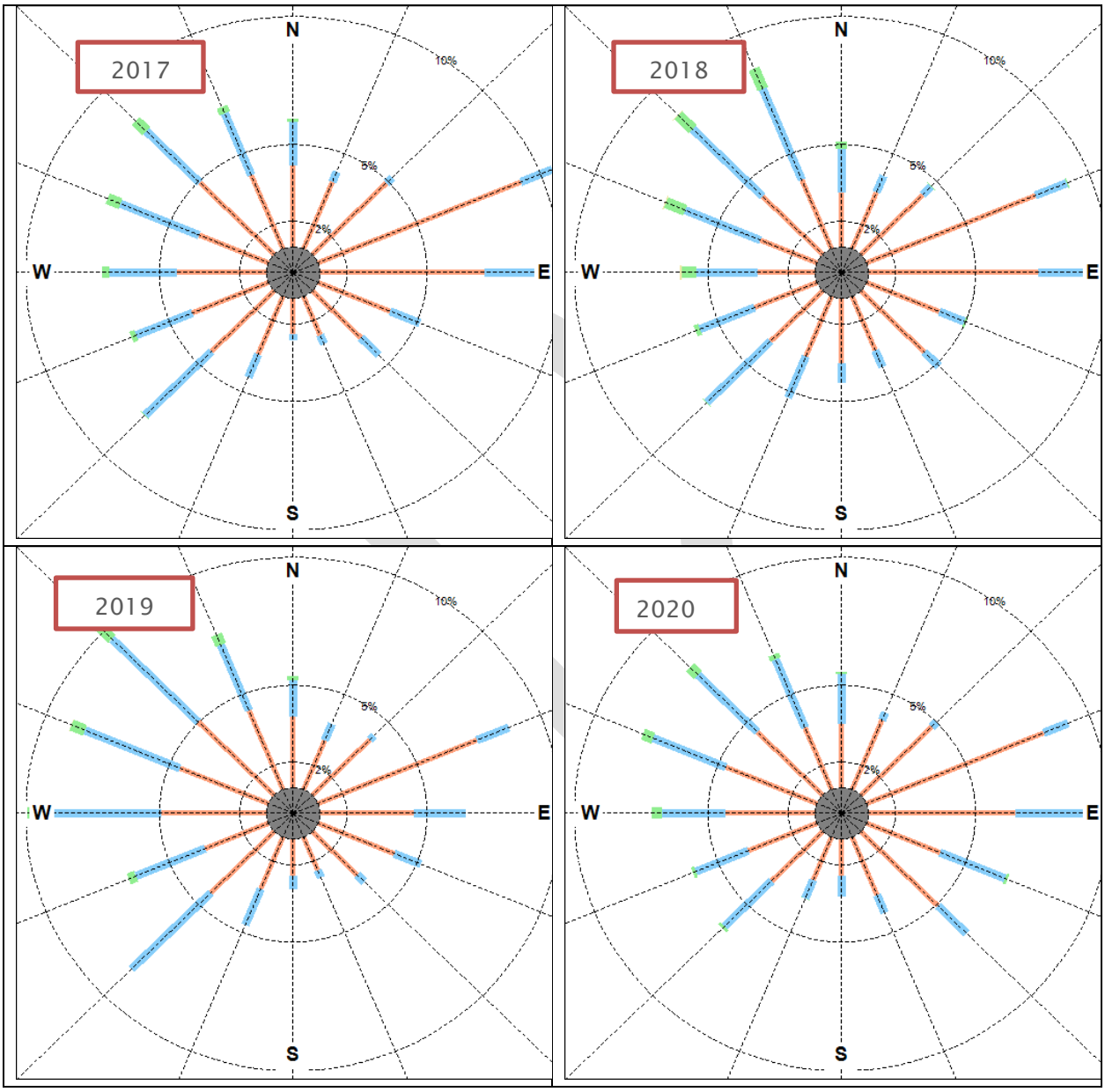
Spring





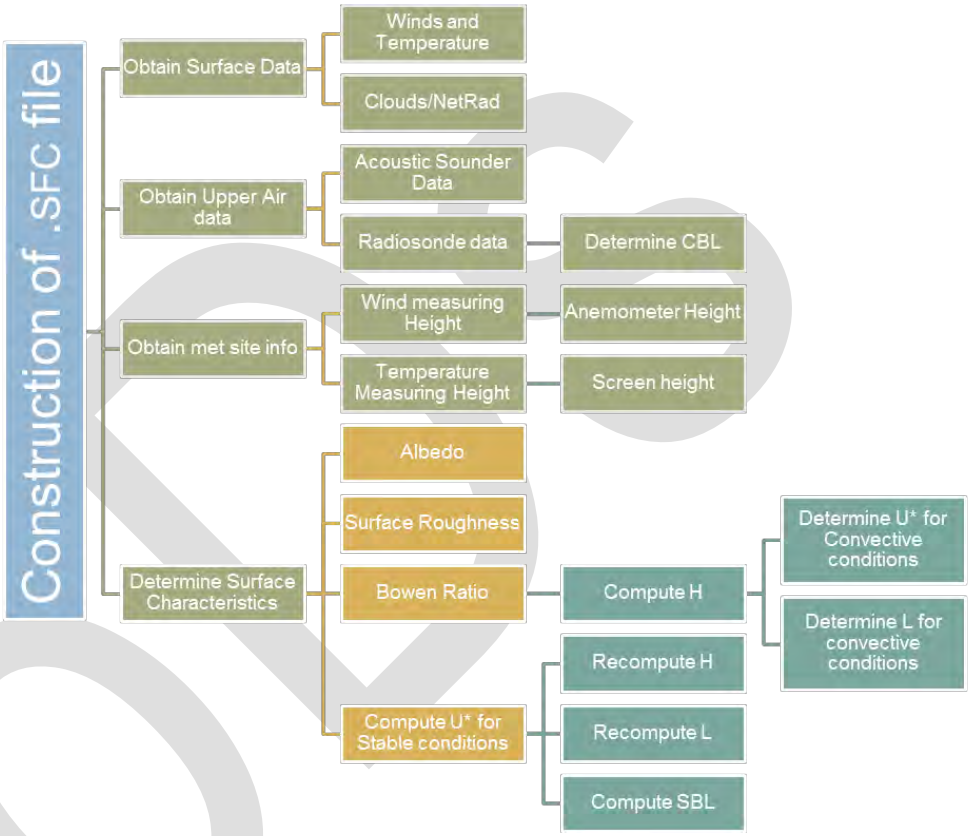
Seasonal variations are clearly depicted.

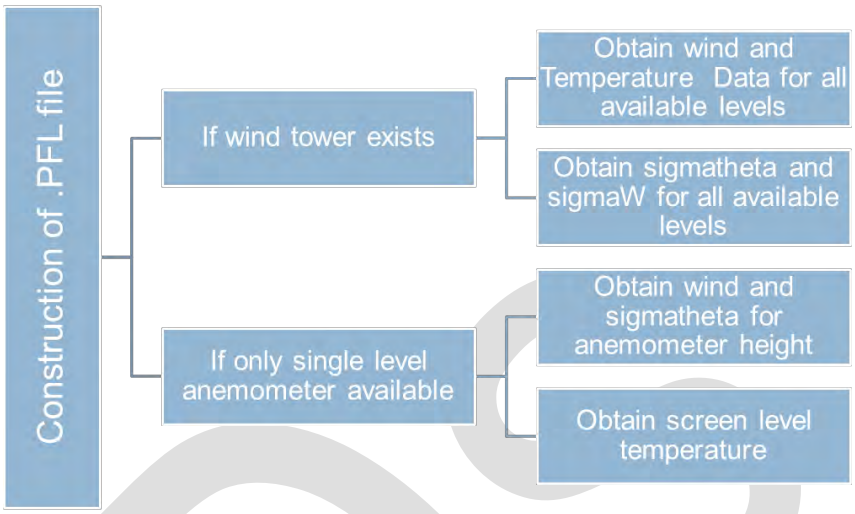
ANNUAL WINDROSES FOR THE REST OF THE YEARS



Appendix

FLOW CHARTS - CONSTRUCTION PROCEDURE




Construction of .PFL file
If wind tower exists
Obtain wind and Temperature Data for all available levels
Obtain sigmatheta and sigmaW for all available levels
If only single level anemometer available
Obtain wind and sigmatheta for anemometer height
Obtain screen level temperature

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USEPA, Office of Air Quality Planning and Standards, AERSURFACE User's Guide, Research Triangle Park, North Carolina, EPA 454/B-08-001

USEPA, Office of Air Quality Planning and Standards, User's Guide for the AERMOD Meteorological Processor (AERMET) and Addendum, Research Triangle Park, North Carolina, EPA 454/B-03-002.

DISCLAIMER

Compilation of input meteorological data files for AERMOD was done under the supervision of qualified and experienced meteorologists. Although all due care has been taken, we cannot give any warranty, nor accept any liability (except that required by law) in relation to the information given, its completeness or its applicability to a particular problem. These data and other material are supplied on the condition that you agree to indemnify us and hold us harmless from and against all liability, losses, claims, proceedings, damages, costs and expenses, directly or indirectly relating to, or arising from the use of or reliance on the data and material which we have supplied.

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Site Environmental Management Plan (Dust)

Hanson Sand Quarry

Hanson Construction Materials

870-910 Westernport Road, Yannathan, Vic

April 2023

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Client	**Hanson Construction Materials Pty Ltd**
Project	20220075
Document Title	Site Environmental Management Plan (Dust)
Document ID	20220075-R-01 SEMP_Dust_v4
Distribution	Electronic PDF

Role	Name/Title	Signature	Date
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Reviewed	Enzo De Fazio Director – Environment & Safety		8 April 2023
Approved	Enzo De Fazio Director – Environment & Safety		8 April 2023

Document Revision Table

Document ID	Changes	By	Date
20220075-R-01 SEMP_Dust_Draft	Draft	Edge Group Pty Ltd	9 May 2022
20220075-R-01 SEMP_Dust	Final	Edge Group Pty Ltd	03 July 2022
20220075-R-01 SEMP_Dust_v1	Final (internal only)	Edge Group Pty Ltd	18 July 2022
20220075-R-01 SEMP_Dust_v2	Final	Edge Group Pty Ltd	12 September 2022
20220075-R-01 SEMP_Dust_v3	Final	Edge Group Pty Ltd	30 September 2022
20220075-R-01 SEMP_Dust_v4	Final	Edge Group Pty Ltd	8 April 2023

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Table of Contents

1 Document Control 1
2 Introduction 2
2.1 Purpose 2
2.2 Objective 2
2.3 Responsible Party 2
2.4 Scope of Work 3
2.5 Background 3
2.6 Complaints received by Council and EPA 3
3 Site Description 4
3.1 Site Description and Features 4
3.1.1 Proposed Future Site Use 4
3.2 Site Inspection 5
4 Wind Roses 6
5 Roles and Responsibilities 9
6 Dust Emission Control 10
6.1 Existing Dust Suppression Controls 10
6.2 Strategies or Controls for Dust Suppression (planned or if required) 11
6.3 Emergency Actions 13
7 Dust Monitoring Plan 14
7.1 Overview 14
7.2 Assessment Criteria 14
7.3 Weather Monitoring 15
7.4 Frequency and Duration of Dust Monitoring 16
8 Triggers and Contingencies 22
9 Monitoring Data Management and Reporting 24
9.1 Monitoring Data 24
10 Conclusions 25
10.1 Controls and Mitigation Strategies 25
11 SEMP (Dust) Review 26
12 Disclaimer 27
13 References 28

Appendices

Appendix A	Proposed Extraction Area and Existing Dust Monitoring Locations
Appendix B	Existing Site Dust Deposition Gauges Naming Protocol
Appendix C	Safety Data Sheet
Appendix D	AS/NZS 3580.10.1:2016
Appendix E	Key considerations/details from AS/NZS 3580.14:2014
Appendix F	Weather Parameters & Units
Appendix G	Dust Deposition Exceedance Graphs

1 Document Control

This Site Environmental Management Plan focussing on dust [SEMP (Dust)] is subject to a document control procedure, to ensure that all SEMP (Dust) holders have only up to date document versions.

The initial version of the document is designated as Version 0. As the SEMP is updated or supplemented as required, it must be designated as Versions 1, 2, 3, etc. Previous versions must be removed from used and stored – the latter up to seven years or in accordance with the recipient's document control management system (where applicable).

A record of the up-to-date version of document must be maintained using the format below. The Site owner or at minimum, the Site Supervisor/Manager, is responsible for ensuring that the SEMP (Dust) is kept up to date and must sign the record to confirm that replacement and new versions have been incorporated into the SEMP (Dust).

SEMP (Report) ID	Version	Date of Issue	Recipient	Signature
20220075-R-01 SEMP_Dust_Draft	0	9/05/2022		
20220075-R-01 SEMP_Dust	0	04/07/2022		
20220075-R-01 SEMP_Dust_v1	1	18/07/2022	Internal only	Internal only
20220075-R-01 SEMP_Dust_v2	2	12/09/2022		
20220075-R-01 SEMP_Dust_v3	3	30/09/2022		
20220075-R-01 SEMP_Dust_v4	4	8/04/2023		

2 Introduction

Edge Group Pty Ltd (Edge) has been engaged by Hanson Construction Materials Pty Ltd (Hanson) to develop a Site Environmental Management Plan focusing on the monitoring of dust [SEMP (Dust)] in relation to the proposed extension of the existing sand quarry at 870-910 Westernport Road, Yannathan, Victoria (the Site). The subject area (of the extension) is currently grassed and is an undeveloped (northern) section of the overall Site. The locations of the proposed extension quarry area and current dust deposition monitoring locations are shown in *Appendix A*.

The Site already engages in boundary dust monitoring via the placement of four directional deposition dust gauges (DDDGs) set up at its boundaries.

2.1 Purpose

This management plan has been developed to assist Hanson with the monitoring of particles or dust as required in the Environmental Protection (EP) Act (2017) and its associated general environmental duty (GED) that came into effect 1 July 2021. The GED requires all Victorians to understand and minimise their risks of harm to human health and the environment from pollution and waste. The Environmental Reference Standard (ERS) under section 93 of the EP Act 2017 sets out the environmental values of ambient air, sound, land and water environments that are sought to be achieved or maintained in Victoria. The ERS is not a compliance standard. Its primary function is to provide an environmental assessment and reporting benchmark. The *Guideline for Assessing and Minimising Air Pollution*, *EPA Victoria Publication 1961, February 2022* provides a framework to assess and control risks associated with air pollution. Hereafter, this is referred to as the *EPA GAMAP.*

2.2 Objective

The objective of this plan is to design a program that can suitably monitor for dust generated by sand quarrying activities in accordance with the *EPA GAMAP* as required by Earth Resources Regulation (ERR), Victoria.

2.3 Responsible Party

Hanson is responsible for the implementation of this SEMP (Dust) including:

- Ensuring that monitoring is conducted at the frequency specified and associated reporting;

- Engagement of and responsibility for a suitably qualified environmental consultant to undertake monitoring and reporting as specified in this plan (where applicable); and
- Provision of reporting to stakeholders as needed.

2.4 Scope of Work

The scope of work undertaken by Edge is as follows:

- Site visit to assess the Site and surrounds;
- Identify likely areas of dust sources/generation;
- Recommend effective dust mitigation strategies for the proposed facility; and
- Prepare a dust monitoring program for the new quarry expansion area (and/or enhance the existing program).

2.5 Background

Edge understands the current landowner, Hanson, is proposing to extend its sand quarrying operation to the north of the Site. As part of that process, Hanson needs to prepare a particle or dust monitoring program or plan in accordance with the *EPA GAMAP* in order to capture the new quarry area.

2.6 Complaints received by Council and EPA

As part of the preparation of this SEMP, a Freedom of Information (FOI) was requested from the Cardinia Shire Council (Council) and EPA Victoria (EPA) of any dust related complaints received from surrounding properties within the last twelve months. At the time of writing, Council advised Edge that no dust related complaints had been received within this time frame (i.e. back to approximately mid-2021). Furthermore, EPA also did not receive any complaints within the same period.

ERR has noted a complaint was lodged in 2015. According to Site management, the complaint came from approximately a kilometre south of the Site on the other side of another quarry. After further investigation (by the Site and ERR), ERR decided the complaint was vexatious, however technically still recorded as a complaint.

3 Site Description

3.1 Site Description and Features

A summary of the site details is provided in *Table 1*.

Table 1 – Summary of Site Details

Site Details	Description
Site Address	870-910 Westernport Rd, Yannathan, Victoria
Municipality	Shire of Cardinia
Planning Zoning	Green Wedge Zone (GWZ) Green Wedge Zone – Schedule 1 (GWZ1)
Planning Overlays	Significant Landscape Overlay Significant Landscape Overlay – Schedule 3 (SLO3)
Other Overlays	Aboriginal Cultural Heritage Designated Bushfire Prone Area
Abutting/nearest Land Uses	North and northwest: Agricultural (market garden) uses property with an office that has a room where the caretaker occasionally sleeps and therefore considered a residence. East: Yannathan Park – Boarding Kennels and Cattery which is an accommodation facility for cats and dogs (owner resides on site) South: Agricultural with some extractive industry West: Egg layer or broiler farm west of the quarry (includes a caretaker residence on site).

3.1.1 Proposed Future Site Use

Edge understands the Site will be used for an expansion of sand quarrying/extraction purposes.

Extraction will occur at least 250 metres away from the nearest sensitive receptor to the east of the Site (i.e. approximately 225 metres to the eastern Site boundary and then approximately 25 metres to the residential property, which is part of the Boarding Kennel and Cattery).

Once quarrying activities have ceased, the site will have one large dam with a central area of land, which will be revegetated.

3.2 Site Inspection

Edge attended Site (escorted by Hanson) on 28 March 2022 and observed the expansion Site area covered with grass. Dust emissions were observed below ground level (whilst extraction was taking place) and on haul roads closer to ground level. Dust was not observed to have escaped the Site to impact sensitive receptors. According to Hanson, there will be no additional haul roads or stockpiles associated with the quarry expansion. Hanson notes that existing haul roads may need to be diverted during extraction works.

4 Wind Roses

The dust movement pathway relevant to amenity is air-deposition. This pathway is dependent on weather conditions – i.e. windy conditions and elevated temperatures (heat) can produce more dust. Due to weather conditions, which influence dust dispersion; annual records were reviewed as taken by the Bureau of Meteorology (BOM) at the Nilma North (Warragul) weather station at 9 am and 3 pm intervals, shown in *Figures 1* and *2*, below. In correspondence with EPA, the Nilma North (Warragul) weather station was selected as it was the known closest active station to the Site (as also confirmed by EPA via email correspondence with Edge in June 2022). The Nilma North weather station data showed that the maximum recorded wind speeds at greater than 40 kilometres per hour at a frequency of at least 28% (of the time) from the east and 24% (of the time) from the west at 9am and more than 40 kilometres per hour up to approximately 35% (of the time) from the west at 3pm. In summary, it appears that the predominant wind direction between both recorded times is from the west. The sources of these data are shown in wind roses provided below:

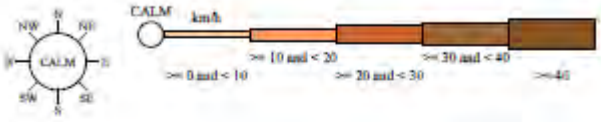
Rose of Wind direction versus Wind speed in km/h (13 Jan 2014 to 28 Jun 2022)

Custom times selected, refer to attached note for details

NILMA NORTH (WARRAGUL)

Site No: 085313 • Opened Jan 2014 • Still Open • Latitude: -38.1321° • Longitude: 145.9865° • Elevation 134.1m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



9 am
3073 Total Observations

Calm 10%

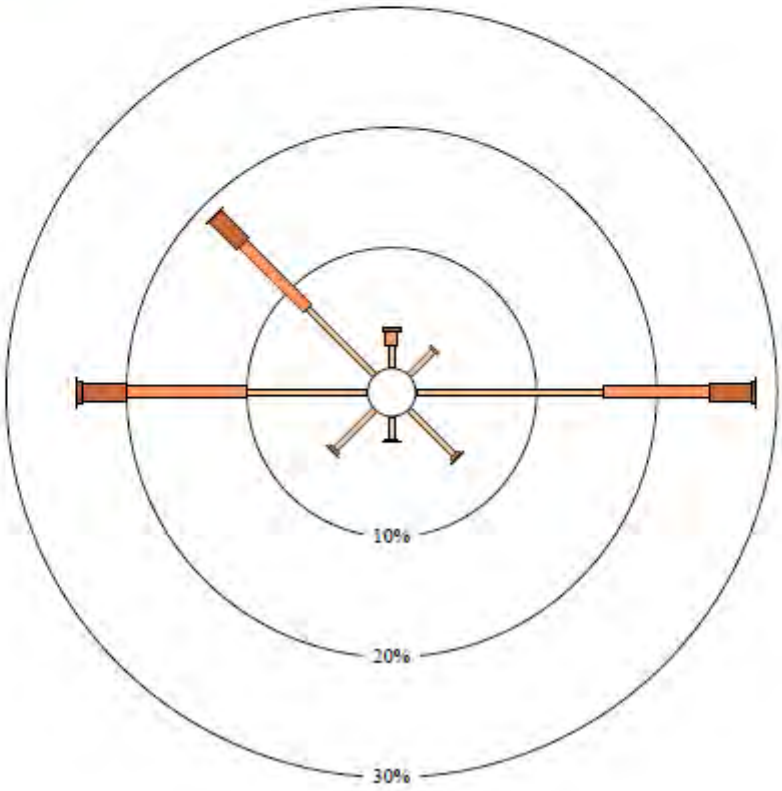


Figure 1 – Wind Rose showing 9am annual average wind speed and directions

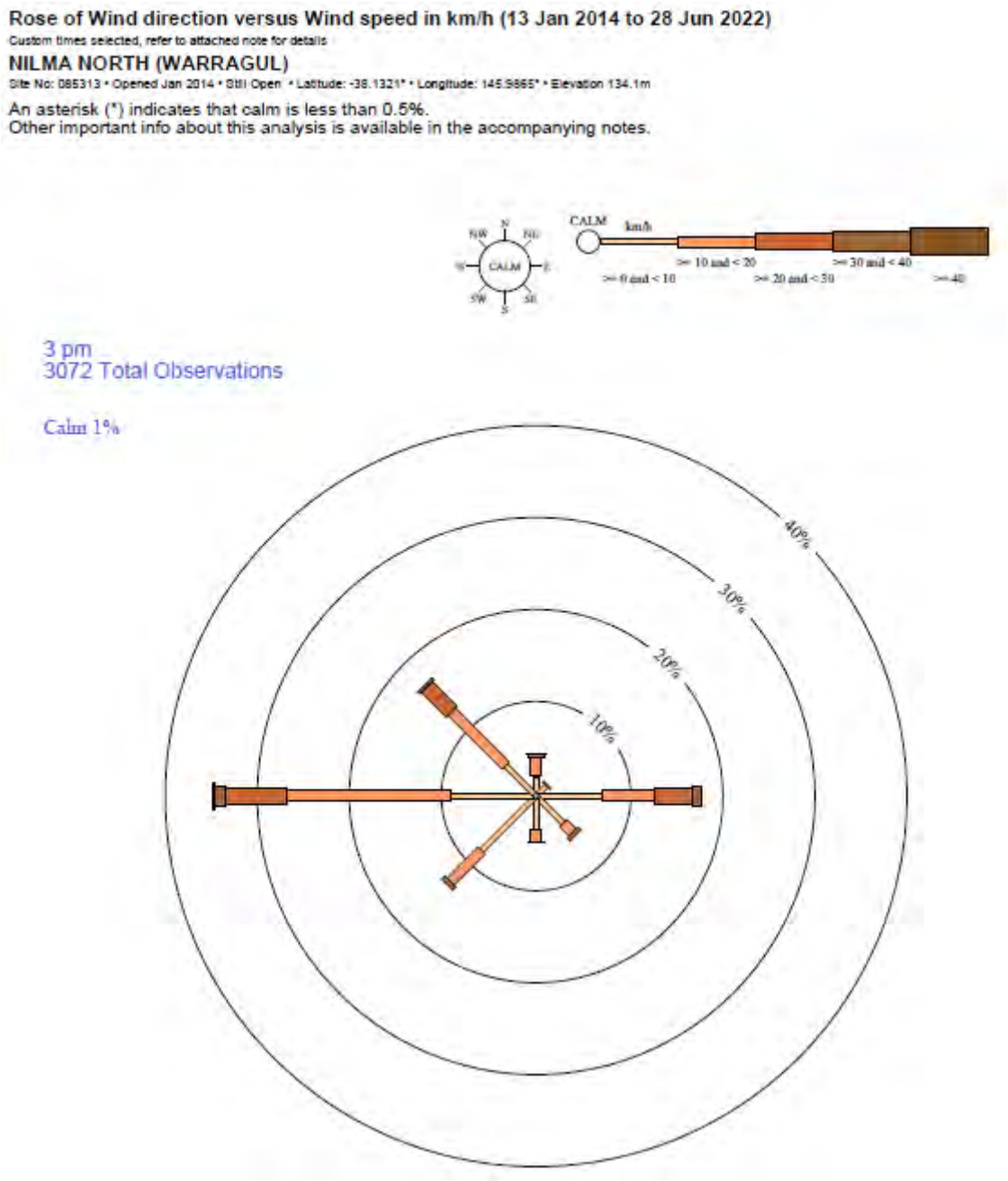


Figure 2 – Wind Rose showing 3pm annual average wind speed and directions

5 Roles and Responsibilities

Table 2: Roles and Responsibilities

Role	Responsibilities
Managers	• Monitor overall environmental performance; • Assure compliance with applicable legal and other requirements to which the organisation subscribes; and • Promote continual improvement.
Project Managers	• Management of all operations, workers and subcontractors (typically focussing on projects); • Ensure compliance with all environmental requirements outlined in the SEMP; • Ensuring that all relevant environmental protection equipment is provided and maintained; and • Review environmental reports and inspections and initiate actions to rectify as appropriate.
Site HSEQ Advisor	• Undertake site inspections; • Carry out monitoring activities; • Implement this SEMP; • Provide on-site advice in relation to the management of environmental issues; • Assist in developing training programs regarding environmental requirements and deliver where required, including delivery of the environmental components of any toolbox talks; • Conduct environmental incident investigations; and • Prepare environmental monitoring reports as required for the Site.
Workers (including Sub-Contractors)	• Comply with the relevant requirements of the SEMP, or other environmental management guidance as instructed by a member of Site management; • Participate in any Project/Site induction program(s) as required; • Report any environmental incidents to the Site Manager immediately or as soon as practicable if reasonable steps can be adopted to control the incident; • Undertake remedial action as required to ensure environmental controls are maintained in good working order; and • Stop activities where there is an actual or immediate risk of harm to the environment or human health and advise the Project Manager or Site Manager.

6 Dust Emission Control

The following list existing controls and strategies (or actions) currently in place and those to be implemented against (any) adverse dust emissions and emergency processes to be put in place in the event that they need to be implemented.

6.1 Existing Dust Suppression Controls

- There are mature trees on-site to the north-western, northern and north-eastern boundaries of the extraction area. Such vegetation assists in preventing any adverse dust emissions escaping the site. These trees are expected to continually grow (with the exception of felling a small number of trees on the northern boundary) thus minimising the chance of off-site nuisance dust emissions from the proposed quarry emissions:
- Haul roads are regularly sprayed with water to reduce airborne dust in the current extraction area;
- Dust resulting from all operations including extraction, loading, transportation, and stockpiling are controlled by the use of water sprays, dust extraction or dust proof enclosures;
- Trucks that are transporting product (i.e. sales) are fitted with canopies/tarps;
- Trucks use the on-site wheel washer when exiting the quarry;
- Continuously observe Site conditions and off-site migration of dust;
- Spray and extraction systems are maintained in an operable condition;
- Water spraying of stockpile slightly west of the processing plant to keep it such that no continual visible dust emissions occur.
- Mounds of (soil) stockpiles from two to three metres high were built on the east of the Site, which are covered in grass, to protect the off-site sensitive (kennel and cattery) receptor being impacted by noise;

- Based on Hanson (Yannathan) data, the material being extracted (i.e. sand) is typically greater that 50 µm in particle size, thus not of the typical size to be wind-blown;[1] and
- Provision of field personnel with information (e.g. through tool boxes) and training on the measures used to prevent dust generation and emissions at the site.

6.2 Strategies or Controls for Dust Suppression (planned or if required)

Hanson has changed its extraction method to dredging for the deeper (sand) layers - this is believed to reduce dust by removing the need for haul trucks to the processing plant (located approximately in the centre of the Site). The following controls will be in place for the processing plant:

- Material received is largely moist due to the shallow water table;
- Loaders to hopper through various screens to remove the oversize material and then the sand is placed through a wet scrubber (attrition cell); and
- Material is wet after the attrition cell.

In terms of other dust suppression strategies, Hanson shall select a combination of the following controls when required (i.e. if continuous dust plumes are generated or a significant number of complaints are received by Hanson):

- Avoid stripping topsoil during periods of high winds (>20 m/s);
- Watering with dust suppressant additive when topsoil or sand source is exposed and causing adverse emissions outside the Site;
- Implement corrective actions to eliminate the causal factors (see also *Section 8, Table 7*);
- The new diverted haul roads to the proposed extraction area shall be sprayed regularly with water to reduce airborne dust, with a water cart on standby;

[1] https://www.der.wa.gov.au/images/documents/your-environment/air/publications/Guideline_for_managing_impacts_of_dust.pdf. **Appendix 2**.

- Ensure the entry/exit road on-Site and the adjacent (off-site) Westernport Road are not covered in sediment. Especially for Westernport Road, any sediment will be removed as soon as possible with a street sweeper/cleaner;[2]
- Rumble grid at the Site exit point if needed;
- Avoid dry sand quarrying works during windy days i.e. >20 m/s (but would have to be confirmed on-site during such activities in terms of what would be the trigger for adverse windspeeds); and
- Although not an example of a dust suppression control to prevent an off-site dust nuisance, it is expected that the operators of mobile plant (i.e. front end loaders, excavator and articulated dump trucks) will be protected from any dust inside air-conditioned sealed cabins. *The operators are also expected to clean their cabins by an appropriate industrial-type vacuum cleaner;*
- Installation and monitoring of an additional closed-circuit television (CCTV) camera along each of the sensitive receptor boundaries, which could be integrated into existing CCTV network and enable monitoring potential dust emissions;
- Vehicle speed restrictions to reduce airborne dust on haul roads;
- Application of magnesium chloride-based sealant to haul roads in late spring in preparation for summer. This provides a harder wearing and longer-lasting crust to the roadways through the dryer months (it is soluble and will disperse during the rainy season);
- Use of dust suppressants (environmentally friendly) on any stockpiles to minimise the production of dust (the main one being slightly off-centre of the Site to the west of the processing plant);
- Water to be sprayed on work faces when the risks of dust are elevated;
- Long term storages of any fill and overburden materials in stockpiles to be stabilised (i.e. covered);

[2] *To date (30 September 2022), Site management advised Edge that no issues have resulted from quarry material having spilt on Westernport Road or any resulting dust emissions.*

- Availability on-site of at least 2,000 litres of water per hectare of disturbed land for dust control; and
- Physically mark out the boundaries of the work area to identify permitted / prohibited areas of soil disturbance, vegetation clearing, etc.

6.3 Emergency Actions

In case of an emergency (especially related to human health), contact emergency services on 000 and notify Site Manager. The Hanson 24 hour emergency contact phone number is also 1800 882 478. Should the emergency involve dust, consult the appropriate Safety Data Sheet *(Appendix C)* and enact the following:

- If in eyes, hold eyelids apart and flush continuously with running water for at least 15 minutes; and
- If inhaled remove self from dusty area.

7 Dust Monitoring Plan

7.1 Overview

For the purposes of this plan, the following aspects drives the design of data collection:

- Dust deposition rates at the boundaries of the extraction site generated from on-site sources, with particular attention to boundaries adjacent to (any) sensitive receptors.

Collected data may be split into the following assessment requirements:

- Deposited dust – for assessment against amenity-based (dust nuisance) criteria;
- Weather (e.g. wind speed and direction) – to assist with identifying possible particle sources; and
- Sampling methodology must be undertaken in accordance with *AS/NZS 3580.10.1:2016 Methods for sampling and analysis of ambient air Guide to siting air monitoring equipment* – please refer to *Appendix D*.

Required dust monitoring types are shown in *Table 3.*

Table 3 – General Monitoring Types

Monitoring Type	Details
Visual observations	• Regular (e.g. daily) inspections of haul roads and entry / exit points are required • Responding to any potential dust issues/complaints from nearby residents
Gravimetric sampling	• Ambient (deposition) sampling of total suspended particles (TSP)
Real time sampling	• Real-time (concentration) sampling of particular matter such as PM_{10} and $PM_{2.5}$

7.2 Assessment Criteria

Applicable assessment criteria for the site are the EPA ERS shown in *Table 4*.

Table 4 – Assessment Criteria Summary

Pollutant	Air Quality Criterion	Allowable Exceedances	Source	Monitoring
PM_{10}	165 µg/m^3 (10-min average)	0	Guideline for Assessing and Minimising Air Pollution in Victoria (for air pollution managers and specialists). EPA Publication 1961 February 2022.	Continuous monitoring equipment being explored by Hanson
	150 µg/m^3 (15-min average)	0		
	120 µg/m^3 (30-min average)	0		
	80 µg/m^3 (1-hour average)	0		
	50 µg/m^3 (1-day average)	0	Environment Reference Standard (ERS), No. S245 Wednesday 26 May 2021	
	20 µg/m^3 (1-year average)	0		
$PM_{2.5}$	25 µg/m^3 (1-day average)	0		
	8 µg/m^3 (1-year average)	0		

7.3 Weather Monitoring

Weather is a component of a dust monitoring program. Site-specific knowledge of wind speed and direction can be essential in validating dust monitoring locations (which are shown in *Appendix A*). The Nilma North (Warragul) Weather Observation Station (as managed by the *Australian Government, Bureau of Meteorology*) is located approximately 32 kilometres east north-east of the subject site at its closest boundary. Given that the GAMAP does not specify the requirement of a weather station, weather observations for the site (particularly wind data where needed) will rely on this data source, unless otherwise notified.

In the event that a weather station needed to be set up on-site, it would need to be positioned in accordance with *AS/NZS 3580.14:2014 Methods for sampling and analysis of ambient air Part 14: Meteorological monitoring for ambient air quality monitoring applications* as is practicable. Reporting and logging would also need to be consistent with this standard. Please refer to *Appendix E* on this standard for some key considerations/ details when deploying a weather station.

7.4 Frequency and Duration of Dust Monitoring

Table 4 of the *EPA ERS* specifies that the following be monitored for rural locations with residences in close proximity (which is the case of the subject site due to distances to nearest sensitive receptors):

- PM_{10}, $PM_{2.5}$ and nuisance dust (dust deposition)[3]; and
- 12 months of 24-hour representative data to be available.

For operational practices:

- Real-time continuous monitoring of PM_{10} and $PM_{2.5}$ at nearest sensitive locations linked to a reactive management strategy.[4]

A dust monitoring plan is provided in *Table 5*. The following frequency and duration of sampling is proposed to meet this plan's objectives:

- To proactively demonstrate compliance with the *EPA GAMAP*:
    - Nuisance dust (dust deposition) on twelve (monthly) consecutive occasions in the first year (minimum 30-day sample period) and after one year, this requirement should be assessed (i.e. based on the results being compared against the deposition criterion) – *this is already occurring on-site*:
    - Monitoring locations are designed (along with wind data) to differentiate between Hanson and other neighbours that could be potentially generating dust emissions, and which could impact sensitive receptors in the local area (e.g. ploughing on the market garden site immediately north of Westernport Road, across the road from the subject Site). One directional dust deposition

[3] The hazard information provided in the Hanson "Aggregates, Road Base, Sand and fill" Safety Data Sheet (2020) applies to the dusts within silica sand and particularly inhalable dust particles with a diameter less than 75 microns. This does not appear to mean that all particulate matter are less than 75 microns at the Site. Based on Particle Size Distribution (Technical Services Clarinda) NATA laboratory results (April and June 2022) for Yannathan, respirable crystalline silica is not required to be monitored based on at least 98% of the sampled material being equal or greater than 75 microns. This is also consistent with the "Product Grading" (in *Table 1*) data in the *Yannathan Sand Quarry, Assessment of Potential Dust Impacts, May 2013* (GHD for Hanson Construction Materials) where zero (0) to three (3) percent of particles passed through a pan size of 0.075 millimetres (75 microns). Given the above, it is presumed that sand will not be at a particle size of 4 microns, which was the size (or lower) that was reported to be responsible for silicosis according to the occupational hygiene department in WorkSafe Victoria as per the Silicosis Summit on 27 February 2020 (that Edge personnel attended).

[4] Most sensitive receptors are considered off-site immediate to the site boundary.

gauge is currently placed on the subject Site to assist with this dust source investigation/identification process:

- Hanson proposes to install a real-time dust monitor (for PM_{10}. $PM_{2.5}$ and Total PM) to be located at each of the two common boundaries between the two closest eastern and western residences and the subject Site; and
- Hanson proposes to install a real-time dust monitor (for PM_{10}. $PM_{2.5}$ and Total PM) to be located at the northern Site boundary. This could act as a comparative measurement source between quarrying operations not occurring in the northern portion of the site compared to when the proposed quarry extension was to occur.

Table 5 – Dust Monitoring Plan (Existing and Proposed)

Location	Main Receptors Targeted	Parameter	Frequency	Duration	Comments
Existing: Northern Boundary (Westernport Road)	Visitors and market garden across Westernport Road (no resident in this area – i.e. office located to the northwest of Site across the road)	Dust Deposition [4g/m^2/month]*	12 x times/year (i.e. monthly)	30 days minimum	Refer to *Table 6* for results
Existing: Southern Boundary (Burts Road)	Any off-site sensitive receptors to the south	Dust Deposition [4g/m^2/month]*	12 x times/year (i.e. monthly)	30 days minimum	
Existing: Western Boundary (West Milners Road)	Residential receptor to the west (part of an industrial facility)	Dust Deposition [4g/m^2/month]*	12 x times/year (i.e. monthly)	30 days minimum	
Existing: Eastern Boundary (Pine Trees)	Cattery and Kennel resident	Dust Deposition [4g/m^2/month]*	12 x times/year (i.e. monthly)	30 days minimum	
Proposed: Northern Boundary	To detect any change between existing Site and proposed extension in quarrying operations to the north. Any ploughing emission to the north across from the Site could also potentially be detected.	PM_{10} [50 µg/m^3] & $PM_{2.5}$ [25 µg/m^3]; 24 hr average; PM_{10} [20 µg/m^3] & $PM_{2.5}$ [8 µg/m^3]; 1 year average Environmental Reference Standards, ERS; No. S 245 Wednesday 26 May 2021 PM_{10} monitoring is frequently used as an indicator of nuisance dust, with trigger	Continuous for 12 months	365 days minimum	Various options being explored by Hanson for real-time equipment.** Weather Monitoring in place.

Location	Main Receptors Targeted	Parameter	Frequency	Duration	Comments
Proposed: Western Boundary (West Milners Road)	Residential receptor to the west (part of an industrial facility)	levels set at 80 µg/m^3 (1-hour average), 120 µg/m^3 (30-minute average), 150 µg/m^3 (15-minute average) or 165 µg/m^3 (10-minute average). *Guideline for Assessing and Minimising Air Pollution in Victoria (for air pollution managers and specialists). EPA Publication 1961 February 2022.*	Continuous for 12 months	365 days minimum	Various options being explored by Hanson for real-time equipment.** Weather Monitoring in place.
Proposed: Eastern Boundary (Pine Trees)	Cattery and Kennel resident		Continuous for 12 months	365 days minimum	Various options being explored by Hanson for real-time equipment.** Weather Monitoring in place.

Notes:

** Historically, threshold figures of 4 g/m2 /month (no more than 2 g/m2 /month above background), as a monthly average, taken at the boundary of an industrial premises (such as the subject Site), have been and are currently used. These figures can be continued to be used as a 'rule of thumb' level for requiring further investigation and addressing dust issues, but not as a level up to which industry is allowed to pollute up to. According to the EPA, this monitoring only partially contributes to meeting the GED, because the focus and emphasis needs to be on reviewing operation controls and management practices to prevent and minimise dust nuisance as far as reasonably practicable.*

*** Although to be used for background measurement purposes for the EPA, this proposed monitoring (that is currently being explored by Yannathan) can be linked to a reactive management strategy that would allow changes to the operations on the Site to be made if particle concentrations are reaching adopted criteria over a short timeframe (e.g. 1 hour) that may impact on the achievability of the 24-hour health-based values.*

Table 6 – Dust Monitoring (Existing) Results

Location	Results
Northern Boundary (Westernport Road)	Directional dust deposition gauge The (top) bottle of this gauge recorded the most samples (i.e. 92 out of 170 samples or 54% of samples from 2007-2022), compared to the sample containers in the NESW directions, that exceeded 4 g/m^2/mth. In two instances (Sample 324987 24/01/2012 and Sample 328024 21/02/2012), all five samples exceeded 4 g/m^2/mth. The most common reason given (for only the main gauge) for criterion excursions is "due to high winds." The average for the (main) bottle recorded between 2007 and 2022 is 8.9 g/m^2/mth. The averages for the NESW samples recorded between 2007 and 2022 are between 1.8 and 2.5 g/m^2/mth.
Southern Boundary (Burts Road)	Directional dust deposition gauge The (top) bottle of this gauge recorded 72 out of 169 samples (or 43%) from 2007-2022 to have exceeded 4 g/m^2/mth. In ten instances (between 2007 and 2022), all five samples exceeded 4 g/m^2/mth. The most common (i.e. 20 out of 40) reason given (for any of the sample containers) for criterion excursions was due to northerly winds. The average for the main gauge recorded between 2007 and 2022 is 5.4 g/m^2/mth. The averages for the NESW samples recorded between 2007 and 2022 are between 2.4 and 8.0 g/m^2/mth (only the northern sample had exceeded the criterion).
Western Boundary (West Milners Road)	Directional dust deposition gauge The (top) bottle of this gauge recorded the most samples (i.e. 119 out of 159 samples or 75% of samples from 2007-2022), compared to the sample containers in the NESW directions, that exceeded 4 g/m^2/mth. In eleven instances (between 2007-2022) did all five samples exceed 4 g/m^2/mth. The most common reason (i.e. 36 out of 38) given for criterion excursions is "due to high winds." The average for the (main) bottle recorded between 2007 and 2022 is 7.0 g/m^2/mth. The averages for the NESW samples recorded between 2007 and 2022 are between 2.6 and 3.8 g/m^2/mth.
Eastern Boundary (Pine Trees)	Directional dust deposition gauge The (top) bottle of this gauge recorded 88 out of 145 samples (or 61%) from 2007-2022 to have exceeded 4 g/m^2/mth.

Location	Results
	In five instances (between 2007 and 2022), all five samples exceeded 4 g/m^2/mth. The most common (i.e. 38 out of 48) reason given (for any of the sample containers) for criterion excursions was due to high winds with a mixture of wind directions given mainly from the southern and western directions. The average for the (main) bottle recorded between 2007 and 2022 is 9.8 g/m^2/mth. The averages for the NESW samples recorded between 2007 and 2022 are between 2.3 and 14.7 g/m^2/mth (only the western sample had exceeded the criterion).

8 Triggers and Contingencies

Table 7 identifies triggers and contingency actions relating to the dust monitoring program.

Table 7 – Triggers and Contingencies

Trigger	Contingency/Action
Dust complaint made to Hanson, Council or EPA	All complaints (or concerns) made to Hanson shall be investigated for verification and validated within 24 hours of the initial complaint being made and recorded in Hanson's incident/complaint register (or as appropriate). The following must be recorded for all verification investigations for follow-up on a complaint: • Time, date and location of incident; • General description of incident and person making the report (if not anonymous); • Weather conditions at the time of the incident (including wind direction); • What did the dust look like to the interested party including colour if possible?; • Record the intensity of the dust (strong or weak emissions)?; • Where was the dust thought to be coming from (i.e. what direction?); • How long the dust emission lasted for that day?; • How often has the dust emission occurred if it has happened before?; • The impact that the dust has had on the interested party; • Time and date of follow-up investigation; • Weather conditions at the time of the follow-up investigation (face to face follow-up is preferred here); • Name of person undertaking the investigation; • If determined to be an on-site source, assess need to alter on-site activities or further mitigate dust (e.g. implement water truck use, dust binder, etc); • Summary of investigation findings; • Specification of whether further action is required (e.g. continue existing monitoring in area, if any; or change and/or implement new monitoring); • Where applicable, let the interested party know of the findings and any actions to be put in place [(Hanson may also need to follow up with them with results/outcomes of changes processes/procedures (e.g. monitoring, work practices, etc)]; • Completion and closing out of any required actions in the action register;

Trigger	Contingency/Action
Dust levels reported above adopted criteria	• Undertake further monitoring at the affected location over the following week, including weather conditions at the time of the follow-up investigation; • If results remain elevated, review weather conditions and daily inspection reports to identify the likely source; • Enter incident into a (site) reporting register, log, etc with detail of the determined source of the dust; • If determined to be an on-site source, assess need to alter on-site activities or further mitigate dust (e.g. implement water truck use, dust binder, etc); • Undertake additional monitoring following alteration of activities, including weather conditions at the time of the follow-up investigation; and • Closure for rectification of issue/s.

In the event of an incident or an emergency, the following 24 hour emergency contact number shall be called:

24 hour Emergency Contact: 1800 882 478

9 Monitoring Data Management and Reporting

9.1 Monitoring Data

An electronic database of all recorded monitoring data will continue to be maintained by Hanson (as it has been up to now for the results from the dust deposition gauge monitoring currently employed on-site). Hanson shall continue to add new data to the database after each collection event and include the complete set of data for all historical and recent events.

In addition to analytical monitoring, daily dust inspection records, any dust release events and weather station data should also be stored electronically.

Hanson should maintain such a database with the potential that it could be audited at any time by regulatory authorities such as ERR, EPA, WorkSafe, etc.

10 Conclusions

Depending on the phase of works and meteorological conditions, Edge has developed controls and mitigation strategies to manage the risk to human and ecological health. The controls and mitigation strategies include:

10.1 Controls and Mitigation Strategies

- Prior to all work continuing, all personnel must read and understand this plan;
- Ensure this plan and appropriate SDS are accessible by all site workers and visitors (the latter where applicable if not escorted);
- Have controls at the ready (if needed) such as water hoses and/or water carts;
- Monitor wind and weather forecasts (Bureau of Meteorology), if Hanson does not have access to an on-site weather monitor;
- Cease work activities temporarily or re-organise quarrying activities based on any adverse weather conditions (e.g. relocate active works away from sensitive locations or cease works for a short period of time, such as a 'few' hours, until more favourable meteorological conditions are experienced); and
- Check all boundaries when monitoring dust conditions.

11 SEMP (Dust) Review

It is the responsibility of the Site Manager/Supervisor to review the SEMP (dust) periodically and ensure that it is:

- Up-to-date with potential dust sources and their controls; and
- Current with any organisational changes, such as changes to site management.

Amendments to the SEMP (dust) must be carried out in accordance with the document control procedure discussed in *Section 1*.

The Site Manager/Supervisor or its nominated consultants may periodically audit the SEMP (dust) in relation to the site operations that are being undertaken. Such a review may result in a requirement for the SEMP (dust) to be updated.

12 Disclaimer

This plan was prepared in accordance with industry accepted environmental sustainability consulting practice concerned with the operation on sites similar to the subject site. The service provided is conducted in a manner consistent with that of the same care and skill ordinarily exercised by members of the same profession currently practicing under the same conditions.

No other warranty, expressed or implied, is made as to the professional advice indicated in this plan. Note that it may not contain sufficient information for the purposes of other parties or for other uses. It should be recognised that this plan is not intended to be a definitive investigation of the environmental management at the subject property. The assessment did not include a review of compliance with any Building requirements, any applicable environmental legislation other than the dust-related criteria included within.

The information contained in this plan is accurate to the best of the consultant's knowledge based on the data (plans, etc) given during the preparation of the document in May 2022. Environmental criteria can change in a limited time, which may be important if the plan is used after a protracted delay, without reviews in place, etc.

The initiatives/measures of this plan are based upon phone conversations with the proponent, perusal of external data from regulatory agencies and industry bodies – which was conducted by Edge personnel. While normal assessments of data reliability have been made, Edge assumes no responsibility or liability for errors in any data obtained from the regulatory agencies, statements from sources outside of Edge, or developments resulting from situations outside the scope of this project.

Opinions and recommendations presented herein apply to the existing and reasonably foreseeable site conditions at the time of this plan preparation. They cannot apply to site changes of which Edge is unaware and has not had the opportunity to review. Changes in applicable standards may also occur because of legislation or the broadening of knowledge in the subject industry/sector. Accordingly, the initiatives/measures put forward in this plan may be invalidated, wholly or in part, by changes beyond our control.

This plan does not, and not purports to give legal advice on the actual construction/set-up or operation of the development or matters relating to it. Qualified legal practitioners can only give this advice.

13 References

1. A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities. *Department of Environment and Conservation,* March 2011.
2. Bureau of Meteorology – Nilma North (Warragul) Wind Roses, Prepared and purchased, 28 June 2022
3. Civil Construction, building and demolition guide, *EPA Victoria Publication 1834*, November 2020
4. Environment Protection Act 2017 – EPA Victoria
5. Environmental Reference Standard 2021 – EPA Victoria
6. Managing truck and other vehicle movements Guidance sheet*, EPA Victoria Publication 1896*, September 2020
7. The Guideline for Assessing and Minimising Air Pollution, *EPA Victoria Publication 1961*, *February 2022*
8. Victoria planning report, viewed June 2022

Appendix A

Proposed Extraction Area and Existing Dust Monitoring Locations

Figure 1: Proposed extraction area (red polygon is the boundary of the subject Site)

Figure 2: Existing Dust Gauge Locations *(Source: Assessment of Potential Dust Impacts, GHD for Hanson Construction Materials, May 2013)*

Figure 3: Dust Gauge (Burt Road)

Figure 4: Dust Gauge (Western Port Road)

Figure 5: Dust Gauge (West Milners Road)

Figure 6: Dust Gauge (Pine Trees)

Appendix B

Existing Site Dust Deposition Gauges Naming Protocol

Table 1: Sample descriptions for dust deposition samples

Site Location	DDG Samples	DDDG Samples
Northern Boundary	Western Port	North (1)
		East (1)
		South (1)
		West (1)
Southern Boundary	Burts Road	North (2)
		East (2)
		South (2)
		West (2)
Western Boundary	West Milners Road	North (3)
		East (3)
		South (3)
		West (3)
Eastern Boundary	Pine Trees	North (4)
		East (4)
		South (4)
		West (4)

Appendix C

Safety Data Sheet

Hanson
HEIDELBERGCEMENT Group

Quarry Products

Safety Data Sheet

SECTION 1: IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Company Details:	Hanson Construction Materials Pty Ltd ABN 90 009 679 734
Address	Level 10, 35 Clarence street Sydney 2000
Tel/Fax	Tel: +61 2 9323 4000 Fax: +61 2 9323 4500
Emergency Contact No	1800 882 478

Product:	AGGREGATES, ROAD BASE, SAND AND FILL
Other Names/Synonyms	Gravel, Fill, Road Base, Blue metal, Ridge gravel, Quartz sands, Scoria
Use	Quarry products are used in building construction and other civil Engineering activities such as road building.
Other Information	NA

SECTION 2: HAZARDS IDENTIFICATION

HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA
NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

Classification of the substance or mixture
GHS classifications Specific Target Organ Systemic Toxicity (Repeated Exposure): Category 2

Label elements
Signal word WARNING Pictograms

Hazard Statement(s)
H373 May cause damage to organs (lungs) through prolonged or repeated exposure (inhalation).
Prevention Statement(s)
P260 Do not breathe dust.
P272 – Contaminated work clothing should not be allowed out of the workplace.
Response Statement(s)
P314 Get medical advice/attention if you feel unwell.
P363 – Wash contaminated clothing before reuse.
Storage Statement(s)
Disposal Statement(s)
P501 Dispose of contents/container in accordance with relevant regulations.

Other Hazards

The hazard information provided in this Safety Data Sheet applies to the dusts within Silica Sand and particularly inhalable dust particles with a diameter less than 75 microns.

Silica Sand are supplied from naturally occurring materials excavated and processed at sand pits, gravel pits and hard rock quarries. Depending upon the source materials, the quarry product may contain varying amounts of quartz (crystalline silica).

SECTION 3: COMPOSITION / INFORMATION ON INGREDIENTS

All significant constituents are listed below:

Major Ingredients

Name	CAS	Proportion
SAND (INCLUDING CRYSTALLINE SILICA)	14808-60-7	0-100 %
Crushed Stone, Gravel	Not required	0-100 %

Note: These are naturally occurring materials excavated and processed at sand pits, gravel pits and hard rock quarries. Depending on the source materials/deposit the Crystalline Silica (quartz) content of any particular quarry product can range from 0 to 100%

Other ingredients may be added:

- ☐ Some quarry products such as road base, stabilized and pre-coated aggregates are made by blending materials from one or more quarries/sources in order to meet the required physical properties or customer specification. Aggregates used for road works are often mixed or coated with the below prior to delivery

Portland cement	65997-15-1	0 - 4 %
Blast Furnace Slag or Fly Ash		0 - 4 %
Pozzolans		0 - 4 %
Precoat (Diesel and bitumen)		0 - 1 %
Lime		0 - 4 %

- ☐ Some materials sold as quarry products are made by recycling by products from building demolition, and wash out waste from concrete operations
- ☐ Depending on the source materials the Crystalline Silica (quartz) of any particular quarry product can range from 0 to 100%

SECTION 4: FIRST AID MEASURES

Swallowed	Rinse mouth and lips with water. Do not induce vomiting. If symptoms persist, seek medical attention
Eye	Flush thoroughly with flowing water, while holding eyelids open, for 15 minutes to remove all traces. If symptoms such as irritation or redness persist, seek medical attention
Skin	Remove heavily contaminated clothing. Wash off skin thoroughly with water. Use a mild soap if available. Shower if necessary. Seek medical attention for persistent redness, irritation or burning of the skin
Inhaled	Remove the source of contamination or move the victim to fresh air. Ensure airways are clear and have a qualified person give oxygen through a face mask if breathing is difficult. If irritation persists seek medical attention
First Aid Facilities	Eye wash and normal washroom facilities

Advice to Doctor: Treat symptomatically or consult a Poisons Information Centre

SECTION 5: FIRE FIGHTING MEASURES

Flammability:	Not flammable or combustible
Hazards from combustion products:	None
Suitable extinguishing media:	Not applicable
Special protective precautions ands equipment for fire fighters:	None
Hazchem code:	None allocated

SECTION 6: ACCIDENTAL RELEASE MEASURES

Spills:

- Dust is best cleaned up by vacuum device to avoid making dust airborne. Wetting down before sweeping up dust may be a useful control measure
- Recommendations on Exposure Controls / Personal Protection (see Section 8 below) should be followed during spill clean-up if conditions are dusty

SECTION 7: HANDLING AND STORAGE

Storage Precautions	No special storage requirements
Transport	Not classified as a Dangerous Goods, according to the Australian Code for the Transport of Dangerous Goods by Road and Rail (6th Edition)
Proper Shipping Name	None Allocated

SECTION 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

The following applies to dust from this product:

Exposure Limits:
Workplace Exposure Standards for Airborne Contaminants, Safe Work Australia.

- Exposure to dust should be kept as low as practicable, and below the following NES.
- Crystalline silica (quartz): 0.05 mg/m^3 TWA (time –weighted average- 8 Hour) as respirable dust
- Total dust (of any type, or particle size): 10 mg/m^3 TWA

All occupational exposures to atmospheric contaminants should be kept to as low as reasonably practicable and in all cases to below the Workplace Exposure Standard (WES).
TWA (Time Weighted Average): the time-weighted average airborne concentration over an eight-hour working day, for a five-day working week over an entire working life. According to current knowledge this concentration should neither impair the health of, nor cause undue discomfort to, nearly all workers.

Engineering Controls:

- All work should be carried out in such a way as to minimise dust generation, and exposure to dust.
- Mechanical ventilation: Dust extraction and collection may be used, if necessary, to control airborne dust levels
- Work areas should be cleaned regularly

Personal Protection:

Skin:	Ensure a high level of personal hygiene is maintained when using this product. That is; always wash hands before eating, drinking, smoking or using the toilet Remove all contaminated clothing. Wash gently and thoroughly with tepid water and non-abrasive soap. If irritation develops and persists seek medical attention
Eyes	Safety glasses with side shields or safety goggles (AS/NZ 1336) or a face shield should be worn
Respiratory:	Where engineering and handling controls are not enough to minimise exposure to total dust and to respirable crystalline silica, personal respiratory protection may be required. The type of respiratory protection required depends primarily on the concentration of the respirable crystalline silica dust in the air, and the frequency and length of exposure time. Amount of exertion required during the work, and personal comfort are other considerations in choice of respirator. A suitable P1 or P2 particulate respirator chosen and used in accordance with AS/NZS 1715 and AS/NZS 1716 may be sufficient for many situations, but where high levels of dust are encountered, more efficient cartridge-type or powered respirators or supplied-air helmets or suits may be necessary. Use only respirators that bear the Australian Standards mark and are fitted and maintained correctly. For dust levels approaching or exceeding the NES (see above) a more effective particulate respirator providing a greater protection factor should be worn. Procedures for effective use of respirators should be applied and supervised. Do not contaminate the home environment with dusty work clothes and shoes. Do not shake out work clothes before laundering

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Appearance	May range from fine white grains (sand) to large dark rock (aggregate/road base).
Odour	None
Ph	3.0 –10.0
Vapour Pressure	Not determined
Vapour Density	Not determined
Boiling Point/range	Not determined
Freezing/melting point	Not determined
Solubility	Not soluble.
Specific gravity	2.2- 2.7 (water=1)
Flash Point	Not applicable
Upper and lower flammability Limits	Not applicable
Ignition Temp	Not applicable
Particle Size	A *proportion* of the dust may be respirable (below 10 microns) and if it becomes airborne constitutes an exposure if inhaled.

SECTION 10: STABILITY AND REACTIVITY

Chemical Stability:	Chemically Stable
Condition to avoid:	Dust generation.
Incompatible materials:	None
Hazardous Decomposition: Products	None
Hazardous Reactions:	None

Crystalline silica is stable, compatible with other materials, does not polymerise, and will not decompose into hazardous by-products**.**

SECTION 11: TOXICOLOGICAL INFORMATION

Health Effects

Acute (short term)-

Swallowed	Unlikely under normal industrial use. Mildly abrasive to mouth and throat if swallowed
Eye	Dust is irritating to the eyes. Exposure to dust may aggravate pre-existing eye conditions
Skin	Dust may be mildly irritating and drying to the skin due to its physical characteristics
Inhaled	Dust is mildly irritating to the nose, throat and respiratory tract and may cause coughing and sneezing. Pre-existing upper respiratory and lung diseases including asthma and bronchitis may be aggravated

Chronic (long term) -

Eyes	Dust may cause irritation and inflammation of the eyes and aggravate pre-existing eye conditions
Skin	Repeated heavy contact with the dust may cause drying of the skin and can result in skin rash (dermatitis) typically affecting the hands. Over time this may become chronic and can also become infected

Inhaled	Repeated exposure to the dust may result in increased nasal and respiratory secretions and coughing. Inflammation of lining tissue of the respiratory system may follow repeated exposure to high levels of dust with increased risk of bronchitis and pneumonia. Long term occupational over-exposure or prolonged breathing-in (or inhalation) of crystalline silica dust at levels above the NES carries the risk of causing serious and irreversible lung disease, including bronchitis, and silicosis (scarring of the lung), including acute and/or accelerated silicosis. It may also increase the risk of other irreversible and serious disorders including scleroderma (a disease affecting the skin, joints, blood vessels and internal organs) and other auto-immune disorders. Inhalation of dust, including crystalline silica dust, is considered by medical authorities to increase the risk of lung disease due to tobacco smoking The product contains a proportion of respirable free crystalline silica in the quartz component. Crystalline silica (inhaled in the form of quartz or cristobalite from occupational sources) has been classified by The International Agency for Research on Cancer (IARC) as carcinogenic to humans (Group 1). Safe work Australia - workplace exposure standards for airborne contaminants classifies RCS as Category 1A (Carc. 1A) -Known to have carcinogenic potential for humans.
Other Information	Inhalation of airborne particles from other sources in the work environment, including those from cigarette smoke, may increase the risk of respiratory diseases. It is recommended that all storage and work areas should be smoke-free zones and that other airborne contaminants should be kept to a minimum

SECTION 12: ECOLOGICAL INFORMATION

Aggregates, Road Base, Sand and Fill

Ecotoxity	Quarry Products pose no ecology risk. They are non-toxic to aquatic and terrestrial organisms and are not biodegradable
Persistence and Degradability	Product is persistent and is non-degradable
Mobility	Low mobility would be expected in a landfill situation
Dust	Crystalline silica is non-toxic to aquatic and terrestrial organisms; is not biodegradable; is insoluble and is expected to have low mobility in landfill

SECTION 13: DISPOSAL CONSIDERATIONS

- Crystalline silica itself in all common forms can be treated as a common waste for disposal or dumped into a landfill site in accordance with local authority guidelines.
- Measures should be taken to prevent dust generation during disposal and exposure and personal precautions should be observed (see above).
- Wear sufficient respiratory protection. Dampen spilled material with water to avoid airborne dust, then transfer material to a suitable container for reuse.
- May be disposed in local landfill.

SECTION 14: TRANSPORT INFORMATION

UN Number None Allocated

UN proper Shipping name	None Allocated
Class and subsidiary risk	None Allocated
Packing Group	None Allocated
Hazchem Code	None Allocated
Special precautions for user	See Above
DG class	None Allocated

SECTION 15: REGULATORY INFORMATION

- Crystalline silica is classified as non-Dangerous Goods according to the Australian Code for the Transport of Dangerous Goods by Road and Rail
- Crystalline silica in the form of respirable dust is classified as Hazardous according to the Safe work Australia (formerly ASCC/NOHSC) Approved Criteria For Classifying Hazardous Substances [NOHSC:1008] 3rd Edition
- Exposures by inhalation to high levels of dust may be regulated under the Hazardous Substances Regulations (State and Territory) as they are applicable to Respirable Crystalline Silica, requiring exposure assessment, and control of inhalation exposure below the NES
- Persons who have potential for exposure above the NES may be required by Regulations to have periodic health surveillance including Chest X-ray (see relevant State Government Regulations and SWA (ASCC/NOHSC documentation)

SECTION 16: OTHER INFORMATION

Emergency Contact No (All hours)
1800 882 478

Emergency Contact No (Office Hours)
Contact For further information contact the Risk Manager at your nearest Hanson office;

New South Wales & ACT
Level 18, 2-12 Macquarie St
Parramatta, NSW, 2150
Ph: (02) 9354 2600
Fax: (02) 9354 2699

Tasmania
114 Gormandston Road
Moonah, TAS, 7009
Ph: (03) 6272 6796
Fax: (03) 6272 1714

South Australia
55 Galway Avenue
Marleston, SA, 5033
Ph: (08) 8292 5950
Fax: (08) 8292 5995

Northern Territory
Winnellie Road Level 1
Winnellie, NT, 5789
Ph: (08) 8984 4266
Fax: (08) 8984 3717

Victoria
601 Doncaster rd
Doncaster, VIC, 3108
Ph: (03) 9274 3700
Fax: (03) 9274 3794

Queensland
10 The Boulevard
Brisbane Airport 4008
Toowong, Qld, 4066
Ph: (07) 3246 5500
Fax: (07) 3246 5533

Western Australia
level 1 35 Great Eastern Highway
Rivervale, WA, 6103
Ph: (08) 9311 8811
Fax: (08) 9470 2793

Authorised by: Paul Johnston
Date of issue information 1/7/2020 (*Replace version dated 1-7-15*)

Notice: We believe the information contained in this Safety Data Sheet is accurate and is given in good faith, but no warranty expressed or implied is made. The suggested procedures are based on experience as of the date of publication. They are not necessarily all-inclusive nor fully adequate in every circumstance. Users are advised to make their own independent determination of suitability and completeness of information at their own risk, in relation to the particular purposes and specific circumstances.
Since the information contained in this document may be applied under conditions beyond our control, no responsibility can be accepted by us for any loss or damage cause by any person acting or refraining from action as a result of any information contained in this Safety Data Sheet. Where the information provided herein disclosed a potential hazard or hazardous ingredient, adequate warning should be provided to employees and users and appropriate precautions taken

END OF SDS

Appendix D

AS/NZS 3580.10.1:2016

Australian/New Zealand Standard™

Methods for sampling and analysis of ambient air

Method 10.1: Determination of particulate matter—Deposited matter—Gravimetric method

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EV-007, Methods for Examination of Air, to supersede AS/NZS 3580.10.1:2003.

The objective of this Standard is to provide regulatory and testing bodies with a Standard method for determining deposited matter that rapidly settles from the air. The objective of this revision is to add Appendix A which sets out a procedure for determining the mass deposition rate of metals present in the deposited matter.

The term 'normative' has been used in this Standard to define the application of the appendix to which it applies. A 'normative' appendix is an integral part of a Standard.

FOREWORD

Particulate matter sampled by this method is predominantly dust particles which, because of their size, rapidly settle from the air. This dust can be a nuisance by soiling property in the vicinity of its point of emission. Some common sources of such particles are minerals processing, bulk materials handling, surface mining operations, industrial processes, unsealed roads, incineration and natural causes such as wind-blown dust.

This method is used primarily to establish long-term trends and to investigate localized dustfall.

This procedure has been widely used in Australia for over 40 years and, during this time, extensive data has been collected. Data collected using this method is not directly comparable with data obtained by other deposit gauge methods.

Depending on the situation, the metal content of the deposited matter can be of interest. Metals occur naturally in soil and rocks and can be released into the air as particulate matter through weathering, mining activities and wind-blown dust. Anthropogenic sources of particulate metals include minerals processing, incineration and combustion of fuels containing metals. Some metals, upon inhalation or ingestion, can lead to a range of health effects such as cancer, neurotoxicity and reproductive toxicity.

STANDARDS Australia STANDARDS NEW ZEALAND

METHOD

1 SCOPE

This Standard sets out a method for the sampling of particulate matter that is deposited from the atmosphere, and procedures for the gravimetric determination of the mass deposition rate of insoluble solids, ash, combustible matter, soluble solids and total solids from ambient air.

The method provides an estimate of the mean surface concentration of deposited matter settling from the air over a sampling period, typically one month. Particulate matter deposition rates of 0.1 g/m^2 month and above may be determined using a monthly sampling period.

The sample obtained by the sampling procedure specified may be subjected to physical or chemical analysis. A method to determine deposition rates for metals present in deposited matter is provided in Appendix A of this Standard.

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS	
1152	Specification for test sieves
2162	Verification and use of volumetric apparatus
2162.1	Part 1: General—Volumetric glassware
2164	Laboratory glassware—One-mark volumetric flasks
2166	Laboratory glassware—One-mark pipettes
AS/NZS	
3580	Methods for sampling and analysis of ambient air
3580.1.1	Part 1.1 Guide to siting air monitoring equipment
3580.9.15	Method 9.15 Determination of suspended particulate matter—Particulate metals high or low volume sampler gravimetric collection—Inductively coupled plasma (ICP) spectrometric method

3 DEFINITIONS

For the purpose of this Standard, the definitions below apply.

3.1 Ash

The mass of that portion of the insoluble matter remaining after combustion.

3.2 Combustible matter

The mass of that portion of the insoluble matter lost during combustion.

3.3 Constant mass

Within ±1 mg of the previous mass.

3.4 Deposited matter

Particles which are collected in a deposit gauge (see Clause 6.1) and which pass through a 1 mm mesh sieve complying with AS 1152.

3.5 Insoluble matter

The mass of the insoluble portion of the deposited matter.

3.6 Soluble matter

The mass of the soluble portion of the deposited matter.

3.7 Total solids

The mass of the particulate matter deposited in a deposit gauge.

3.8 U_{95}

A measurement of uncertainty at a confidence interval of 95% according to ISO GUM.

4 PRINCIPLE

Over a given sampling period, particles that settle from the ambient air are collected in a vessel and retained together with any rainwater. The sample is passed through a sieve to remove any extraneous matter (e.g. leaves, insects) and the sieved sample containing the deposited matter is transferred to a filtration apparatus. The insoluble and soluble materials are separated by filtration and the mass of the dried insoluble solids is gravimetrically determined.

The ash and combustible matter content are determined by loss on ignition of the insoluble solids. Soluble solids are determined from the filtrate. The total solids are obtained by the addition of the insoluble solids and the soluble solids. The mass deposition rate of deposited matter is then calculated from the mass of solids obtained, the funnel cross-sectional area and the exposure period.

5 REAGENTS

5.1 General requirements

Only reagents of recognized analytical grade and distilled water or water of an equivalent purity shall be used.

5.2 Copper sulfate solution

Dissolve 7.8 g of copper sulfate pentahydrate ($CuSO_4.5H_2O$) in water and dilute to 1 L in a volumetric flask.

6 APPARATUS

6.1 Deposit gauge

A deposit gauge (see Figure 1) consists of a 150 ±10 mm diameter glass funnel (nominal angle of cone sides 60°) and a glass collection bottle. The internal diameter of the funnel stem shall be sufficient to permit passage of particulate matter during washing. The funnel is supported firmly in the neck of a wide-mouth, glass bottle of a suitable size, preferably of a minimum volume of 4 L, by means of a rubber or plastic stopper with a groove or outlet pipe to allow water overflow under excessive rainfall conditions. The funnel diameter shall be known to the nearest millimetre when used in the calculation of results.

NOTES:

1 The size of the bottle should be selected after consideration of the expected rainfall over the sampling period.

2 The funnel diameter is determined by taking the mean of two measurements (at right angles to each other) of the internal diameter of the funnel.

3 Stoppers should preferably be constructed from a non-reactive, non-friable substance and should be replaced when ageing is evident.

4 Plastic funnels or bottles should not be used.

6.2 Lid

A tight-fitting lid for sealing the deposit gauge collection bottle shall be used during transport. It shall be made of an impermeable material that does not react with the expected constituents of the collected deposited matter.

6.3 Stand

The stand supports the deposit gauge such that the horizontal plane of the funnel is 2.0 ±0.2 m above ground level. The stand shall be sufficiently sturdy to prevent any noticeable sway and ensure the funnel aperture plane is maintained in a horizontal position. A typical stand is illustrated in Figure 2. The stand generally incorporates a container or beaker to protect the bottle contents from sunlight which has the potential to accelerate algal growth. This container or beaker should be provided with a drainage hole at the base to prevent rainwater build-up.

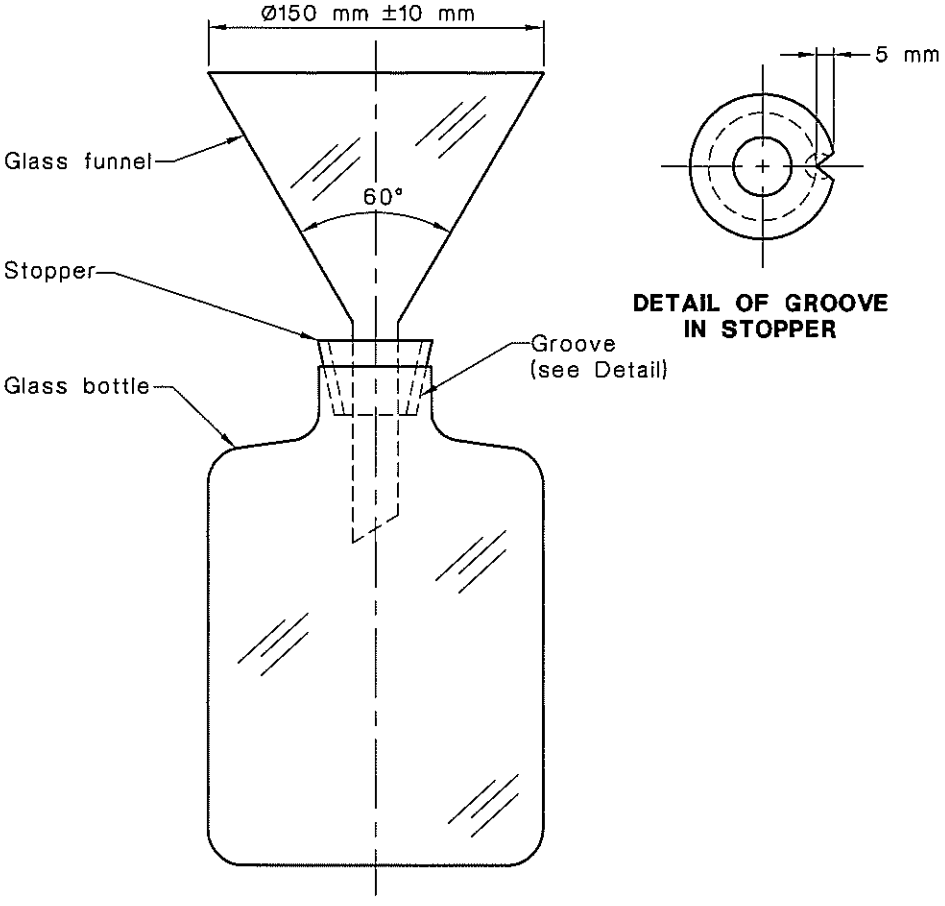


FIGURE 1 TYPICAL STANDARD DEPOSIT GAUGE

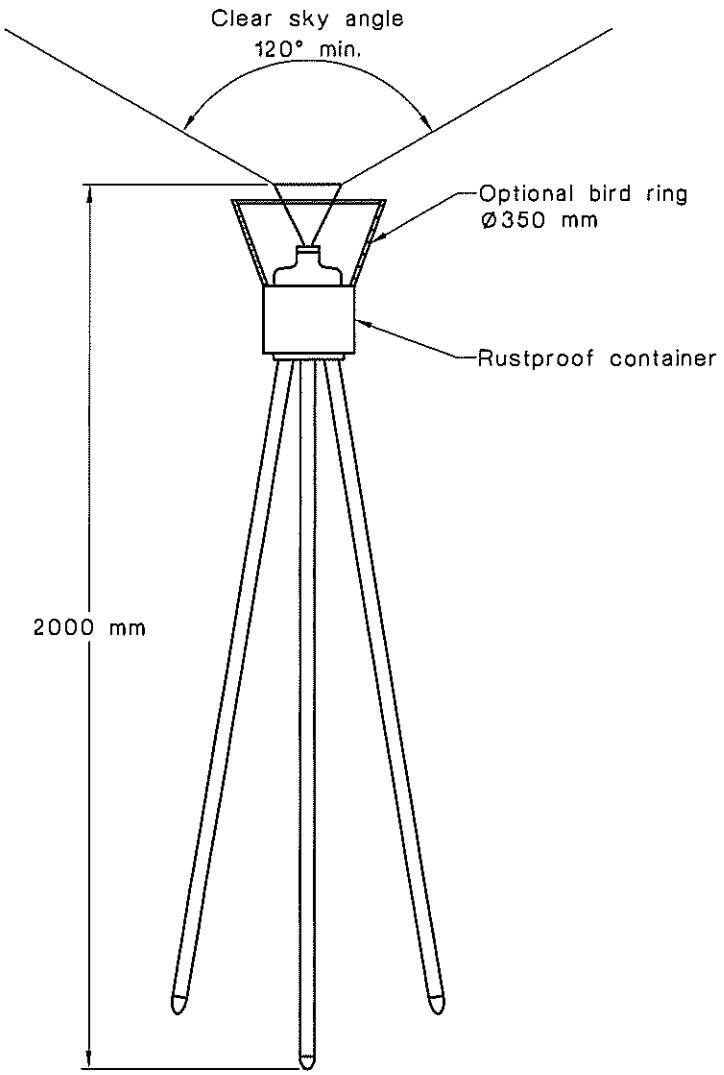


FIGURE 2 TYPICAL STAND WITH DEPOSIT GAUGE

6.4 Bird ring (optional)

The bird ring (see Figure 2) shall be of inert and corrosion-resistant metal wire (having a diameter of 4 mm to 6 mm) and of suitable design to prevent birds perching on the funnel.

6.5 Glassware

Grade A volumetric glassware shall be used throughout. Volumetric flasks shall comply with AS 2164, and pipettes shall comply with AS 2166. Use of volumetric glassware shall comply with AS 2162.1.

All beakers, flasks, evaporating dishes and crucibles (including filters) shall be uniquely numbered to ensure traceability of each sample as it proceeds through the analysis process.

6.6 Filtration apparatus

Silica crucibles with porous filter bases (porosity 3) or Gooch crucibles of porcelain, silica or alundum with filter pads of equivalent retention are acceptable for separation of the insoluble fraction from the soluble fraction. Alternatively, Buchner funnels with an appropriate filter pad of glass, quartz or ashless filter paper and membrane filters may be used.

NOTE: Consideration should be given to the hygroscopic nature of the filter.

The choice of filter apparatus is based on the difficulty of filtering the deposited material and any further analysis of collected material required.

6.7 Test sieve

The test sieve shall have a 1 mm aperture and comply with AS 1152.

6.8 Filter cutter

If required, a means of cutting filter pads without contamination shall be used. Suitable cutters include ceramic knives or scissors.

7 SAMPLING

7.1 Location

The sampling site should be selected in accordance with the guidelines given in AS/NZS 3580.1.1.

7.2 Positioning of the gauge

The height of the funnel aperture above the surface of the immediate surrounding area shall be 2 ±0.2 m. It is important that the funnel aperture plane is horizontal.

7.3 Period of exposure

For routine monitoring programs, the period of exposure is typically 30 ±2 days.

7.4 Procedure

7.4.1 *Preparation of deposit gauge*

Washing agents that do not attack the inside surface of the deposit gauge and lid shall be used to clean the deposit gauge bottle. After cleaning, the deposit gauge bottle shall be rinsed with water in order to remove any remaining extraneous matter and residual washing agent. Pipette 10.0 mL of copper sulfate solution (see Clause 5.2) into the deposit gauge bottle so as to prevent algal growth in the deposit gauge. Tightly seal the bottle. The gauge and prepared assembly should be packed for transport to the sampling site.

7.4.2 *Gauge exchange*

Deposit gauges should be changed on the first day of each month or as near as possible to the first day of each month. Where a gauge has overflowed soluble matter cannot be determined. The volume of liquid in the gauge should be recorded as it gives an indication of the rainfall for the exposure period.

At the end of the exposure period, the gauge exchange procedure shall be as follows:

(a) Wash any deposited matter adhering to the inside of the funnel into the deposit gauge bottle using a minimum volume of distilled water from a wash bottle.

NOTE: A brush or rubber policeman may be used to dislodge any foreign/particulate matter adhering to the internal surface of the funnel.

(b) Remove the funnel and attached stopper and seal the bottle with a lid. Identify the bottle with a label detailing the site location, period of exposure and funnel diameter to the nearest millimetre. Return the bottle to the laboratory for analysis.

(c) Insert the clean funnel with attached stopper into a fresh bottle containing algicide and leave exposed for the next sampling period.

(d) Ensure that the funnel is firmly held in the neck of the bottle and that the funnel aperture plane is horizontal.

7.4.3 *Storage*

During storage, deposit gauges shall be tightly sealed and kept in a cool, dark environment to prevent the growth of algae, fungi and other micro-organisms. Analysis of the deposited matter should be performed at the earliest opportunity and completed within 30 days of collection.

8 PROCEDURE FOR SAMPLE ANALYSIS

8.1 Determination of total solids

8.1.1 *General*

Total solids shall be determined by either of the procedures in this Clause (8.1).

8.1.2 *Procedure 1*

The procedure shall be as follows:

(a) Pass the contents of the deposit gauge bottle into a beaker or flask through a 1 mm test sieve (see Clause 6.7), ensuring that all particulate matter is washed out.

(b) Transfer the remaining particles adhering to the internal surface of the deposit gauge into the beaker or flask, with the aid of a rubber policeman, and small quantities of water. Evaporate the contents of the vessel on a hotplate to a volume of approximately 30 mL and then transfer the contents to an evaporating dish which has been dried at 105°C for 1 h, cooled in a desiccator and weighed (m_1).

NOTES:

1 It may be necessary to carry out the evaporation in several stages if the total volume of rainwater and washings are large.

2 For rapidity, provided that no material is lost, vacuum distillation, a vacuum oven or a sand bath may be used as alternatives to the hotplate.

(c) Evaporate the contents of the evaporating dish on a steam bath or hotplate to near dryness and transfer to a drying oven. Dry at 105 ±5°C for 1 h, cool in a desiccator and weigh. Repeat the drying, cooling and weighing process until the dish and its contents are at a constant mass and record the mass (m_2).

(d) Place the evaporating dish on a hotplate, add approximately 50 mL of water and heat gently for 30 min to redissolve soluble solids, then proceed to Clause 8.2.2(d) or Clause 8.2.3(d), as applicable for the determination of insoluble solids.

8.1.3 *Procedure 2*

Determine the insoluble solids according to Clause 8.2 and soluble solids according to Clause 8.4. The sum of these two fractions comprises the total solids.

8.2 Determination of insoluble solids

8.2.1 *General*

If the deposit gauge bottle contains a large volume of water (rainfall plus washings from Clause 7.4.2(a)), filter the contents of the bottle through the filtration apparatus (see Clause 6.6) until approximately 400 mL remains, taking care not to disturb the deposit.

Determine insoluble solids by either of the procedures in this Clause (8.2).

If soluble solids are to be determined then ashless filters shall be used.

NOTES:

1 The filter details, i.e. type, porosity and grade, should be recorded.

2 This filtrate is required for the determination of soluble solids (as described in Clause 8.4.3(b)) and should be retained if determination of soluble solids is required.

8.2.2 *Using Gooch crucibles with filter pads or silica crucibles with porous bases*

The procedure shall be as follows:

(a) Assemble the Gooch crucible apparatus.

(b) Pass the contents of the deposit gauge bottle into a beaker or flask through a 1 mm test sieve. Use a rubber policeman to ensure that all particulate matter in the gauge is transferred.

(c) Place the beaker or flask containing the sample on a steam bath or hotplate and evaporate to approximately 30 mL (see Clause 8.1.2(b), Note 2).

(d) Heat a crucible to 850°C in a furnace and maintain for 30 min, allow to cool in a desiccator and weigh. Repeat the heating, cooling and weighing process to constant mass and record the mass (m_3).

(e) Pass the sample through the prepared crucible (Step (d)).

NOTE: The filtrate from this procedure should be added to the filtrate collected at Clause 8.2.1 if soluble solids are to be determined using the procedure in Clause 8.4.

(f) Dry the filter crucible in a drying oven for a minimum of 1 h at 105 ±5°C, cool in a desiccator and weigh. Repeat the heating, cooling and weighing process to constant mass and record the mass (m_4).

8.2.3 *Using Buchner funnel and filter pad*

The procedure shall be as follows:

(a) Assemble the Buchner funnel and filter, apply a vacuum and pass 500 mL of distilled water through the filter. Discard the filtrate.

(b) Dry the filter in an oven held at 105 ±5°C for 1 h, cool in a desiccator and weigh. Repeat the heating, cooling and weighing process to constant mass and record the mass (m_3).

NOTE: The procedure described in Steps (a) and (b) is not required for membrane filters.

(c) Pass the contents of the deposit gauge bottle into a beaker or conical flask through a 1 mm test sieve. Use a rubber policeman to ensure that all particulate matter in the gauge is transferred.

(d) Filter the sample through the Buchner funnel and previously prepared filter.

NOTE: The filtrate from this procedure should be added to the filtrate collected at Clause 8.2.1 if soluble solids are to be determined using the procedure in Clause 8.4.3.

(e) Remove the filter and dry in an oven held at 105 ±5°C for a minimum of 4 h. Cool in a desiccator and weigh. Repeat the heating, cooling and weighing process to constant mass and record the mass (m_4).

8.3 Determination of ash and combustible matter

8.3.1 *General*

Determine combustible matter by calculation according to Clause 9.1(d). Determine ash by either of the procedures in this Clause (8.3):

8.3.2 *Using Gooch crucibles with filter pads or silica crucibles with porous bases*

The procedure shall be as follows:

(a) Heat the crucible from Clause 8.2.2 Step (f) to 850°C for 30 min to ignite the sample.

(b) Allow the crucible to cool in a desiccator and weigh. Repeat the heating, cooling and weighing process to constant mass. Record the mass (m_5).

8.3.3 *Using Buchner funnel and filter pad*

The procedure shall be as follows:

(a) Heat a crucible to 850°C for 30 min.

(b) Allow the crucible to cool in a desiccator and weigh. Repeat the heating, cooling and weighing process to constant mass. Record the mass (m_3).

(c) Fold and place the dried filter paper, or portion of filter paper if metals analysis is also being undertaken, containing the insoluble solids (see Clause 8.2.3(e)) into the crucible.

(d) Heat the crucible at 850°C for 30 min to ignite the sample. Allow to cool in a desiccator and weigh. Repeat the heating, cooling and weighing process to constant mass (m_5).

NOTE: The temperature of the furnace should be raised gradually to 850°C to minimize loss of sample. The crucible may be placed in a furnace at 200°C and the temperature increased gradually to 500°C over a 30 min period and then increased to 850°C over a further 30 min period. The total ashing time will therefore be 90 min.

8.4 Determination of soluble solids

8.4.1 *General*

Soluble solids are calculated from the difference between the total solids and the insoluble solids or by evaporation of the filtrate from the insoluble solids determination.

Determine by either method in this Clause (8.4).

8.4.2 *Using direct calculation*

Soluble solids are calculated from the difference between the total solids and the insoluble solids (see Clause 9.1(e)(i)).

8.4.3 *Using filtrate collected during the insoluble solids procedure*

The soluble solids are determined from the filtrate of the insoluble solids determination (see Clause 8.2). The procedure shall be as follows:

(a) Transfer the filtrate from Clause 8.2 to a large beaker and evaporate on a hot plate to approximately 30 mL.

(b) Transfer the filtrate to a pre-weighed evaporating dish (m_6) that has been dried at 105 ±5°C for 1 h.

(c) Evaporate the contents of the evaporating dish on a steam bath or hotplate to near dryness and transfer to a drying oven. Dry at 105 ±5°C for 1 h, cool in a desiccator and weigh. Repeat the drying cooling and weighing process until the dish and its contents are at a constant mass and record the mass (m_7).

NOTE: For large volumes of filtrate (greater than 1 L) it is permissible to determine the soluble solids from an aliquot of the total filtrate. Record the total volume of filtrate then take a known volume and proceed as in Step (a). The aliquot volume should be sufficient to obtain a measurable mass.

9 CALCULATION AND EXPRESSION OF RESULTS

9.1 Calculation

The results shall be calculated as follows:

(a) *Mass deposition rate of total solids*

Total solids are calculated by either of the following methods:

(i) If total solids are determined according to Clause 8.1.2—

$$S_t = \frac{\left[(m_2 - m_1) - 0.055\right] \times 10^6 \times 4 \times F}{\pi \times D^2 \times t} \quad \ldots 9.1(1)$$

where

S_t = mass deposition rate of total solids, in grams per square metre per month

m_2 = mass of the evaporating dish and the total solids in the sample, in grams

m_1 = mass of the evaporating dish, in grams

F = factor to express results to a 30-day month

= 30

D = diameter of the funnel, in millimetres

t = sampling period, in days

NOTE: The subtraction of 0.055 g in Equation 9.1(1) is a correction for the mass of algicide added to the gauge in Clause 7.4.1.

(ii) If total solids are determined according to Clause 8.1.3—

$$\text{Total solids } (g/m^2.\text{month}) = S_i + S_s \quad \ldots 9.1(2)$$

where

S_i = mass deposition rate of insoluble solids, in grams per square metre per month, determined according to Clause 8.2

S_s = mass deposition rate of soluble solids, in grams per square metre per month, determined according to Clause 8.4

(b) *Mass deposition rate of insoluble solids*

$$S_i = \frac{(m_4 - m_3) \times 10^6 \times 4 \times F}{\pi \times D^2 \times t} \quad \ldots 9.1(3)$$

where

S_i = mass deposition rate of insoluble solids, in grams per square metre per month

m_4 = mass of the filter, or crucible if used, and the insoluble solids in the sample, in grams

m_3 = mass of the pre-dried filter, or crucible if used, in grams

F, D and t are as previously defined in Item (a)(i).

(c) *Mass deposition rate of ash*

$$S_a = \frac{(m_5 - m_3) \times 10^6 \times 4 \times F}{\pi \times D^2 \times t} \times \frac{m_4}{(m_4 - m_8)} \quad \ldots 9.1(4)$$

where

S_a = mass deposition rate of ash, in grams per square metre per month

m_5 = mass of the crucible and the ash in the sample, in grams

m_3 = mass of the crucible, in grams

m_4 = mass of the filter, and the insoluble solids in the sample, as determined in Clause 8.2.3(e), in grams

m_8 = mass of the portion of the filter, and the insoluble solids in the portion, used for insoluble metals analysis, as determined in Clause A2.2(b), in grams

F, D and t are as previously defined in Item (a)(i).

Where the entire filter is ashed, Equation 9.1(4) can be simplified by reducing the $\frac{m_4}{(m_4 - m_8)}$ term to one.

(d) *Mass deposition rate of combustible matter*

$$\text{Combustible matter (g/m}^2\text{.month)} = S_i - S_a \quad \ldots 9.1(5)$$

where

S_i = mass deposition rate of insoluble solids in grams per square metre per month, determined according to Clause 8.2

S_a = mass deposition rate of ash, in grams per square metre per month, determined according to Clause 8.3

(e) *Mass deposition rate of soluble solids*

Soluble solids shall be calculated by either of the following methods:

(i) If soluble solids are determined according to Clause 8.4.2—

$$\text{Soluble solids (g/m}^2\text{.month)} = S_t - S_i \quad \ldots 9.1(6)$$

where

S_t = mass deposition rate of total solids, in grams per square metre per month, determined according to Clause 8.1.2

S_i = mass deposition rate of insoluble solids, in grams per square metre per month, determined according to Clause 8.2

(ii) If soluble solids are determined according to Clause 8.4.3—

$$S_s = \frac{\left[(m_7 - m_6) - 0.055\right] \times 10^6 \times 4 \times F}{\pi \times D^2 \times t} \times \frac{V_{tot}}{V_{part}} \quad \ldots 9.1(7)$$

where

S_s = mass deposition rate of soluble solids, in grams per square metre per month

m_7 = mass of the evaporating dish and soluble solids, in grams

m_6 = mass of the evaporating dish, in grams

V_{tot} = total volume of filtrate, in mL

V_{part} = volume of filtrate used for soluble solids determination, in mL

F, D and t are as previously defined in Item (a)(i).

NOTE: The subtraction of 0.055 g in Equation 9.1(7) is a correction for the mass of algicide added to the gauge in Clause 7.4.1. This assumes the loss of four of the five water molecules.

Where the total filtrate volume is evaporated to dryness, Equation 9.1(7) can be simplified by reducing the $\frac{V_{tot}}{V_{part}}$ term to one.

9.2 Expression of results

Results may be reported in either grams per square metre per month or milligrams per square metre per day. To convert g/m^2.month to mg/m^2.day, multiply by 33.3.

10 MEASUREMENT UNCERTAINTY

The measurement uncertainty shall be determined based on individual laboratory sampling and weighing procedures.

11 TEST REPORT

The test report shall contain the following information:

(a) Reference to this Standard, i.e. AS/NZS 3580.10.1.

(b) Reporting organization.

(c) Deposition rate of solids from air in grams per square metre per month or milligrams per square metre per day.

(d) Location of the deposit gauge: all relevant details, for example, including a coordinate reference to within 100 m, height above ground level, classification of area (e.g. industrial, residential, agricultural or urban).

(e) Any non-conformance with AS/NZS 3580.1.1 or this Standard.

(f) The dates and times of sampling.

(g) Any other relevant data, for example, meteorological conditions, proximity of bushfires, farm ploughing activities, traffic on unsealed roads.

(h) The uncertainty associated with the measurement along with the confidence interval and coverage factor according to ISO GUM.

NOTE: The reporting of data depends somewhat on future use. Additional relevant information which could be reported includes the following:

(a) Mean values (quarterly or annually).

(b) Maximum values (monthly or annually).

APPENDIX A

DETERMINATION OF DEPOSITION RATES OF METALS PRESENT IN DEPOSITED MATTER

(Normative)

A1 SCOPE

This Appendix sets out a procedure for determining the metals content of deposited matter collected in accordance with this Standard using inductively coupled plasma-atomic emission spectroscopy (ICP-AES) or inductively coupled plasma mass spectrometry (ICP-MS).

This method is applicable to the determination of hydrochloric/nitric acid-soluble metals present in the deposited matter. This method is suitable for the determination of the following metals:

(a) Aluminium.

(b) Arsenic.

(c) Antimony.

(d) Barium.

(e) Beryllium.

(f) Cadmium.

(g) Chromium.

(h) Cobalt.

(i) Iron.

(j) Lead.

(k) Magnesium.

(l) Manganese.

(m) Molybdenum.

(n) Nickel.

(o) Selenium.

(p) Thallium.

(q) Tin.

(r) Titanium.

(s) Vanadium.

(t) Zinc.

NOTE: Other elements may be determined by this method if adequate performance is demonstrated.

This method is not suitable for the determination of deposited copper unless a metal-free algicide is used in place of the copper sulfate solution specified in Clause 7.4.1.

The procedure described in this Appendix for extracting metals from the insoluble solids will dissolve metals that are environmentally available.

Typically, metal deposition rates of 0.02 mg per square metre per month and above may be determined for samples collected over a 30-day period, with subsequent analysis by ICP-MS. The minimum reporting limit will vary for different metals.

A2 PROCEDURE FOR METALS DEPOSITION ANALYSIS

A2.1 General

If metals deposition analysis is required, the Buchner funnel and filter pad procedure (see Clause 8.2.3) with ashless filter paper shall be used for the determination of insoluble solids and evaporation of the insoluble solids filtrate (see Clause 8.4.3) shall be used for the determination of soluble solids.

Filters with low and consistent metal content shall be used.

The procedure described in AS/NZS 3580.9.15 for extraction of metals from high and low volume air sampler filters shall be used to extract metals from the insoluble solids collected on the filter paper. Analysis of the metals extraction solution shall be carried out by ICP-AES or ICP-MS as described in AS/NZS 3580.9.15.

Determination of soluble metals shall be performed by redissolving the dry solids from the soluble solids determination in 2% nitric acid solution (i.e. the working diluent solution described in Clause 6.5.3 of AS/NZS 3580.9.15), followed by analysis by ICP-AES or ICP-MS (as described in AS/NZS 3580.9.15).

A2.2 Determination of insoluble metals

After the completion of the insoluble solids determination (see Clause 8.2.3), the procedure for determining insoluble metals shall be as follows:

(a) Cut the dried filter paper into two approximately equal pieces using a filter cutter (see Clause 6.8). To avoid contamination and damage, handle the filter with non-metallic and non-serrated forceps.

(b) Weigh the portion of the filter paper being used for insoluble metals analysis. Record the mass (m_8).

(c) Transfer the filter paper portion to a beaker, or digestion vessel compatible with a dry block heater.

(d) Follow the procedure described in Clause 9.1.3 of AS/NZS 3580.9.15 to extract any metals present on the filter paper in to the solution.

(e) Determine the mass of metals present on the filter paper by ICP analysis of the extracted solution using the procedure described in Clause 9.3 of AS/NZS 3580.9.15.

(f) Prepare and analyse, as described in Clause 9.2.2 of AS/NZS 3580.9.15, a minimum of one laboratory blank filter solution from each batch of filter papers analysed.

NOTES:

1 As an alternative to weighing the filter paper portion as described in Step (b) above, the proportion of the total filter paper used for insoluble metals analysis can also be calculated based on the area of the filter paper portion relative to the area of the original filter paper.

2 The remaining filter paper portion can be used for the determination of ash and combustible matter (see Clause 8.3.3). If determination of ash and combustible matter is not required, the entire filter can be used for metals determination.

A2.3 Determination of soluble metals

The procedure for determining soluble metals shall be as follows:

(a) Following completion of the soluble solids determination (see Clause 8.4.3), place the evaporating dish on a hotplate, add approximately 50 mL of 2% nitric acid solution (prepared as described in Clause 6.5.3 of AS/NZS 3580.9.15) and heat gently to redissolve the soluble solids.

(b) Remove the evaporating dish from the hotplate and allow to cool to room temperature.

(c) Decant the solution into a 100 mL volumetric flask.

(d) Rinse the evaporating dish with approximately 10 mL of 2% nitric acid solution and add to the volumetric flask. Make up to the mark with 2% nitric acid solution and mix thoroughly.

(e) Determine the mass of soluble metals by ICP analysis of the solution using the procedure described in Clause 9.3 of AS/NZS 3580.9.15.

A3 CALCULATION AND EXPRESSION OF RESULTS

A3.1 Calculation

A3.1.1 *General*

Metals results determined using ICP-AES instruments are commonly reported in mass units of micrograms (μg). Metals results determined using ICP-MS instruments are typically reported in units of nanograms (ng) and shall be converted to mass units of μg for the purpose of the following calculations.

A3.1.2 *Calculation of the mass of metals in the insoluble solids fraction*

The mass of metal x present on the filter shall be calculated from Equation A3.1.2:

$$m_{xf} = c_x \times v_x \times d_f \times \frac{m_4}{m_8} \quad \ldots \text{A3.1.2}$$

where

m_{xf} = mass of metal x present on the filter, in μg

c_x = concentration of metal x in the test sample solution, in μg/mL

v_x = volume of test solution, in mL

d_f = dilution factor ($d_f = 1$ when there is no dilution of the sample solution)

m_4 = mass of the filter, and the insoluble solids in the sample, as determined in Clause 8.2.3(e), in grams

m_8 = mass of the portion of the filter, and the insoluble solids in the portion, used for insoluble metals analysis, in grams

The mass of metal x present on each laboratory blank filter (m_{xl}) shall be calculated in the same way.

A3.1.3 *Calculation of the average mass of metals on the laboratory blank filter*

The mass of metal x present on the laboratory blank filter shall be calculated as the mean value of all laboratory blank filter analyses conducted for the particular batch of sample filters:

$$\overline{m_{xl}} = \frac{\sum_{j=1}^{n} m_{xl,j}}{n} \quad \ldots \text{A3.1.3}$$

where

$\overline{m_{xl}}$ = average mass of metal x present in a laboratory blank filter, in µg

$m_{xl,j}$ = mass of metal x present in laboratory blank filter j, in µg

n = number of laboratory blank filters analysed

A3.1.4 *Calculation of the mass of metals in the soluble solids fraction*

The mass of soluble metal x present shall be calculated from Equation A3.1.4:

$$m_{xs} = c_x \times v_x \times d_f \times \frac{V_{tot}}{V_{part}} \quad \ldots \text{A3.1.4}$$

where

m_{xs} = mass of metal x present in solution, in µg

c_x = concentration of metal x in the test sample solution, in µg/mL

v_x = volume of test solution, in mL

d_f = dilution factor ($d_f = 1$ when there is no dilution of the sample solution)

V_{tot} = total volume of filtrate, in mL

V_{part} = volume of filtrate used in soluble metals determination, in mL

Where the total filtrate volume has been used in the soluble metals mass determination, Equation A3.1.4 can be simplified by reducing the $\frac{V_{tot}}{V_{part}}$ term to one.

A3.1.5 *Calculation of the total deposition rate of metals from ambient air*

The total deposition rate of metal x from ambient air shall be calculated from Equation A3.1.5:

$$S_{mx} = \frac{\left[\left(m_{xf} - \overline{m_{xl}}\right) + m_{xs}\right] \times 10^3 \times 4 \times F}{\pi \times D^2 \times t} \quad \ldots \text{A3.1.5}$$

where

S_{mx} = total mass deposition rate of metal x, in milligrams per square metre per month

m_{xf} = mass of metal x present on the filter, in µg

$\overline{m_{xl}}$ = average mass of metal x present on laboratory blank filters, in µg

m_{xs} = mass of metal x present in solution, in µg

F, D and t are as previously defined in Clause 9.1(a)(i).

A3.2 Expression of results

Results are typically reported in either milligrams per square metre per month or micrograms per square metre per day. To convert from mg/m^2 month to µg/m^2.day, multiply by 33.3.

A4 MEASUREMENT UNCERTAINTY

The measurement uncertainty shall be determined based on individual laboratory sampling, weighing and analysis procedures.

A5 TEST REPORT

The test report shall contain the following information:

(a) Reference to this Standard, i.e. AS/NZS 3580.10.1.

(b) Reporting organization.

(c) Deposition rate of each metal from air in milligrams per square metre per month or micrograms per square metre per day. If the measured concentration is less than the method detection limit, the result shall be reported as 'less than the method detection limit'.

(d) The method detection limit for each metal.

(e) The dates, times (expressed as local or standard time) and period of sampling.

(f) Sampling location—all relevant details, including a coordinate reference to within 100 m, height above ground level and classification of area (peak station, neighbourhood station or background station; refer to AS/NZS 3580.1.1).

(g) Any non-conformance with this Standard.

(h) Any non-conformance with AS/NZS 3580.1.1.

(i) The uncertainty associated with the measurement along with the confidence interval and coverage factor.

(j) Laboratory blank filter results.

(k) Any recovery rates outside of the acceptable range.

(l) Any other relevant data.

NOTES

NOTES

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Australian Aluminium Council
Australian Industry Group
Clean Air Society of Australia and New Zealand
CSIRO Division of Marine and Atmospheric Research
Department of Environment Regulation, WA
Department of Science, Information Technology and Innovation, Qld
Environment Canterbury, New Zealand
Environment Protection Authority, Vic.
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Appendix E

AS/NZS 3580.14:2014

(Key considerations/details)

AS/NZS 3580.14: 2014 sets out methods for the collection of meteorological data for use in ambient air quality monitoring and modelling applications. Requirements and guidance are provided for the in-situ monitoring of primary meteorological variables being: wind speed, wind direction, temperature, humidity, atmospheric pressure, precipitation and solar radiation.

This Standard specifies the following:

- Stable location
- A requirement for the siting of wind sensors at a height of 10 metres above ground level is preferable; however the Installation of wind sensors at a height of at least 2 metres above surrounding ground level is acceptable taking into account other siting factors below.
- Temperature and relative humidity:
    - Mounted over a plot of open level ground at least 9 metres in diameter free of obstructions, and freely exposed to sunshine and wind
    - To be clear of obstructions, this means a distance of at least four times the obstruction height
    - Located at least 30 metres from large, paved areas and not close to hollows or ridges or other changes in terrain (so far as is reasonably practicable)
    - Area should ideally be unwatered short grass, or natural earth (not concrete)
    - Should not be located close to artificial or natural sources of moisture
    - Measurements at 2 metres or higher above ground
- Solar radiation and black globe temperature:
    - An upward-looking solar radiation sensor should be free from any obstructions above the sensor
    - No shadows should be cast on the sensor
    - Should be located away from light-coloured walls or other objects likely to reflect sunlight.

It is sometimes not practical to meet these standards at a particular location. In these instances, the station should ideally be located:

- On a flat cleared area (e.g. a grassy surface)

- Clear from obstructions such as buildings and trees (a rule of thumb would be to locate the weather station ten times the height of the obstruction away).

The station should not be:

- In a gully or other depression
- On a geological formation such as a rock outcrop
- On or near steep slopes, cliffs, or ridges
- On a veranda or under an awning.

If there is a solar panel, this should face north

The data from a weather monitoring station should also be reported and logged in accordance with *AS3580.14-2014.*

The report will include:

- Reference to the Australian standard (*AS3580.14: 2014*).
- Reporting organisation (e.g., Hanson).
- A recorded value for each parameter:
  - The type of instrument used to obtain the recorded value, including starting thresholds for wind direction and wind speed sensors.
  - The calibrated measurement range in the corresponding reporting units.
  - The measurement height above ground level (in meters).
- Date, time and period of sampling.
- Sampling location, including:
  - Coordinate reference.
  - Height above ground level (mAHD).
  - Classification of area with a description of the sampling location.
- Any non-conformance with the standard.
- Uncertainty associated with the measurement along with the confidence interval and coverage factor.
- Any other relevant data, for example:
  - Mean values (e.g. hourly, daily, monthly or annual).
  - Minimum/Maximum values (e.g. hourly, daily, monthly or annual).
  - Time/day, month or year certain values exceeded.

Appendix F

Weather Parameters & Units

Table 1: Reporting Weather Parameters & Units

Parameter Units	Units
Wind Speed	Meters/second (m/s)
Wind Direction	Degrees from true North (°)
Ambient Temperature	Degrees Celsius (°C)
Relative Humidity	Percent (%)
Barometric Pressure	Hectopascals (hPa)
Precipitation	Millimetres (mm)

Appendix G

Dust Deposition Exceedance Graphs

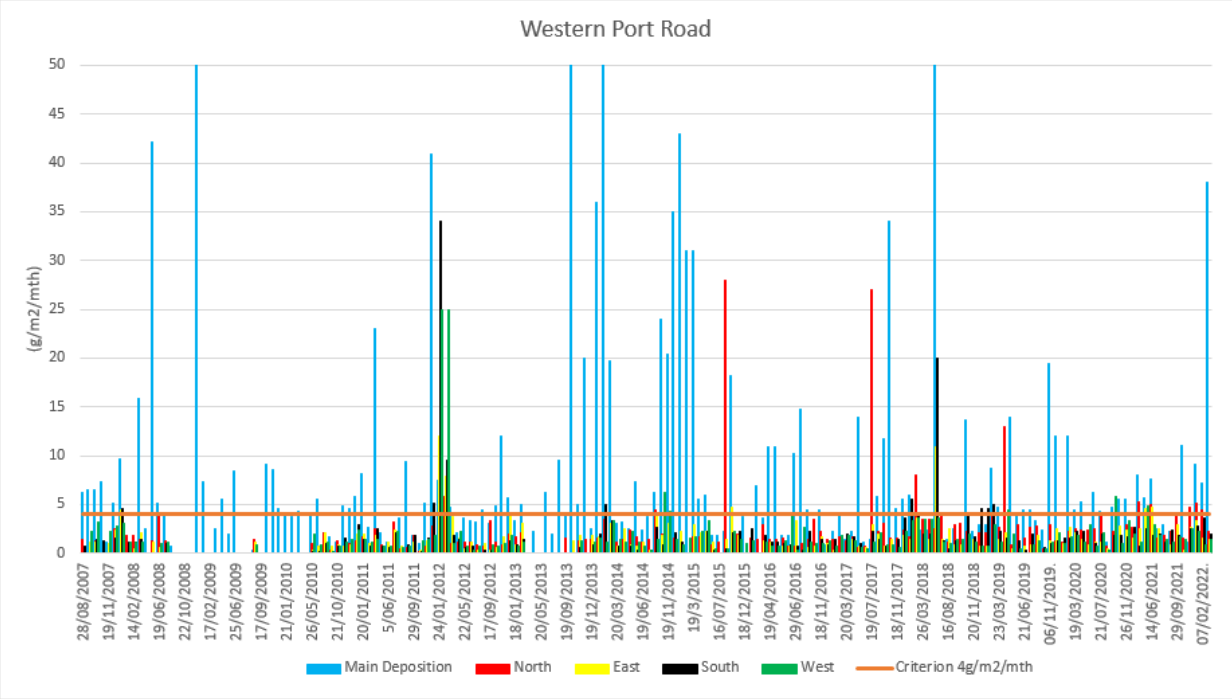

Figure 1: Dust deposition data (over 4g/m^2/mth) between 2007-2022 from Western Port Road dust gauge

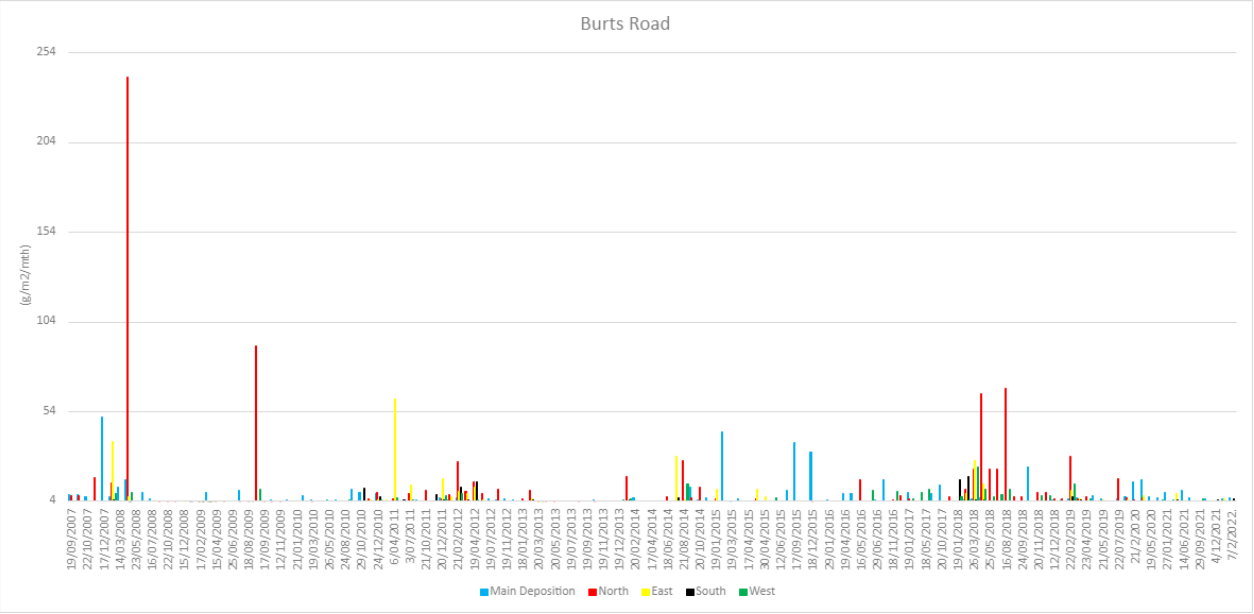

Figure 2: Dust deposition data (over 4g/m^2/mth) between 2007-2022 from Burts Road dust gauge

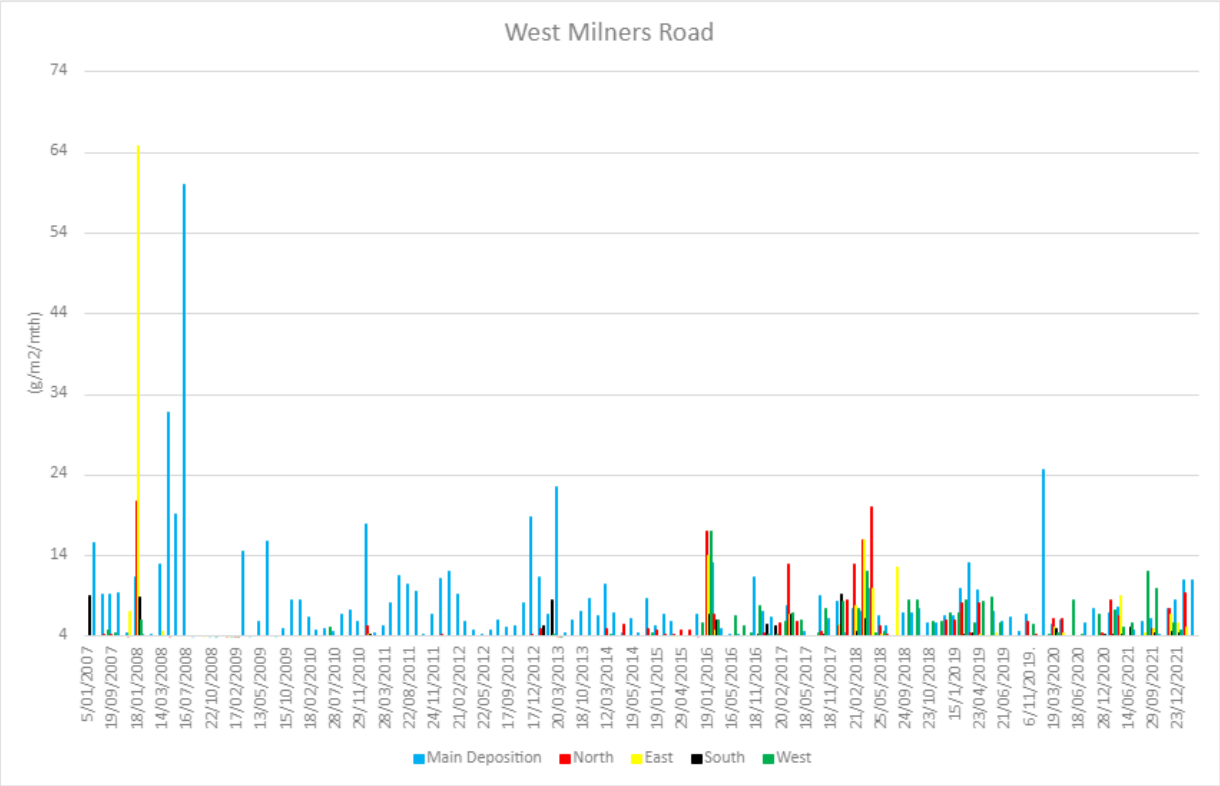

Figure 3: Dust deposition data (over 4g/m^2/mth) between 2007-2022 from West Milners Road dust gauge

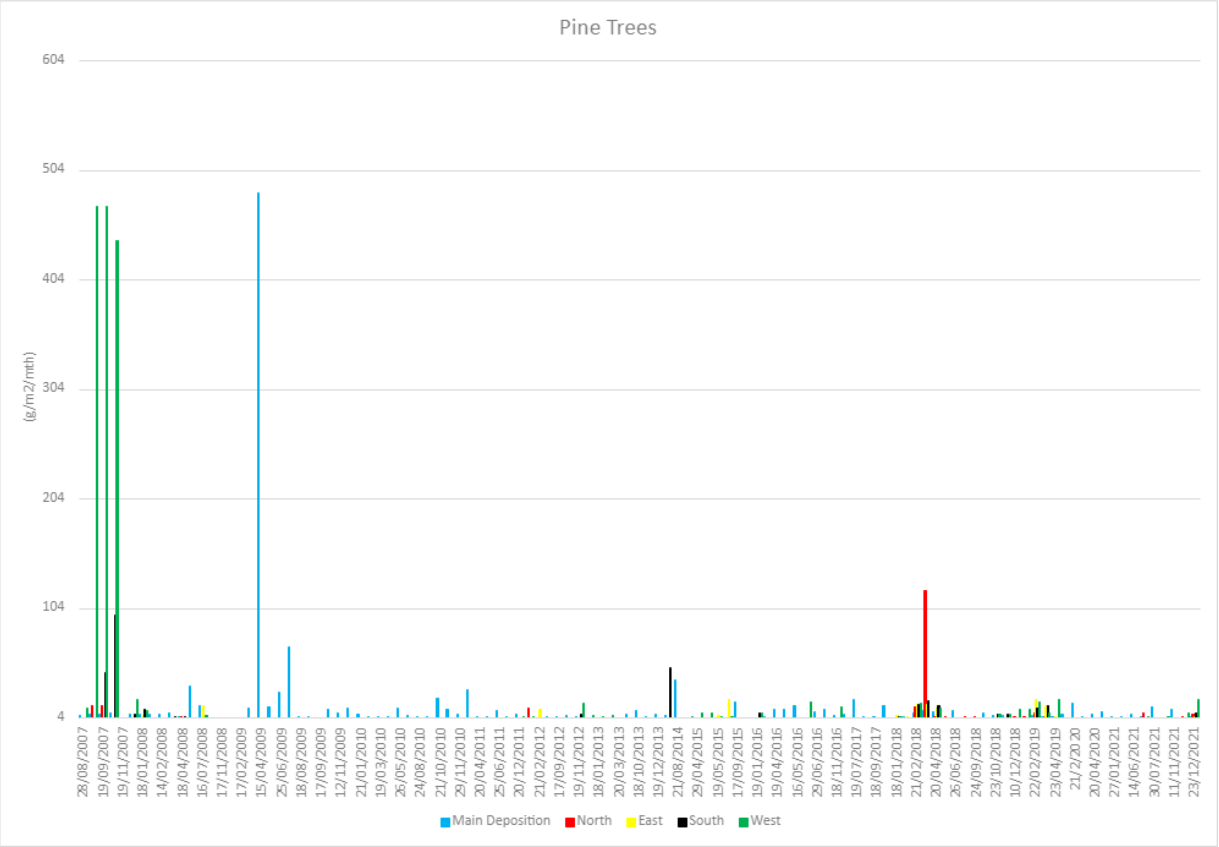

Figure 4: Dust deposition data (over 4g/m^2/mth) between 2007-2022 from Pine Trees dust gauge

Appendix K Noise

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YANNATHAN QUARRY

870-910 WESTERNPORT ROAD YANNATHAN

PROPOSED EXTENSION OF EXTRACTION AREA

Noise Emission Assessment

A report
prepared on behalf of:

Hanson Construction Materials Pty Ltd
601 Doncaster Road,
Doncaster, VIC 3108

Ref: 12919-3ng.docx
28 February 2023

EXECUTIVE SUMMARY

This report sets out the findings of a noise emission assessment of the proposal to extend the presently approved extraction area of the Yannathan Sand Quarry, 870-910 Westernport Road Yannathan, operated by Hanson Construction Materials Pty Ltd.

The purpose of the assessment has been to identify potential constraints associated with off-site noise emission from the quarry on the proposed extension of the extraction area and depth and develop appropriate noise mitigation strategies as required.

The noise assessment has been conducted in terms of the Environment Protection Act 2017 (the Act) and subordinate legislation.

This report covers the following aspects:

- Determination of noise limits in accordance with the Noise Protocol EPA Publication 1826.4
- Modelling of noise levels at potentially affected residential locations resulting from the quarry including the proposed extraction area extension, using a three-dimensional noise modelling software package.
- Consideration of modelled noise levels in terms of noise limits and other guidance under the Act.
- Determination of required noise control measures, if necessary, to achieve compliance with relevant noise criteria at noise sensitive locations.

It has been concluded that implementation of appropriate strategies and noise controls will allow operation of the quarry with the proposed new extraction area to proceed in compliance with the Noise Protocol noise limits.

Consideration has also been given to additional measures that could reduce noise emission so far as reasonably practicable, consistent with the General Environmental Duty under the Act.

At the time when the previous version of this noise emission assessment report, WMG Ref 12919-1.1ng, was prepared in September 2022, it was understood that the existing building located on 815 Westernport Rd was being used as an office for the market garden at the site, no longer being used for residential purposes.

It has since been learned that the building at 815 Westernport Rd is occupied by a caretaker at times, so the noise emission assessment has been updated to include this location.

The noise emission assessment has also been updated to include a second house at 35 Milners Rd.

Table of Contents

Executive Summary 2
1 Introduction 4
2 Subject Site and Surrounding Environment 4
3 Project History in Relation to Noise Emission 6
4 Noise Assessment Terminology 7
5 Noise Emission Assessment Criteria 7
5.1 Environment Protection Regulations And Noise Protocol 8
5.1.1 General Methodologies 8
5.1.2 Derivation of Noise Protocol Noise Limits 9
5.1.3 Noise Protocol Assessment Adjustments 10
5.2 Environment Reference Standard 11
5.3 EPA Noise Guideline – Assessing Low Frequency Noise 12
6 Operational Parameters Relevant to Consideration of Noise Emission 13
7 Relevant Noise Sources 13
8 Modelled Noise Levels due to Noise Emissions from Operations At The Quarry Site 14
8.1 Noise Modelling Methodology 14
8.2 Noise Prediction Results and Noise Control Considerations 15
8.3 Low Frequency Noise 16
9 Summary of Noise Control Measures to Achieve Compliance with Noise Protocol Noise Limits 17
9.1 Extraction Between 0600 and 0700 Hrs 17
9.2 Noise Bunds 17
9.3 Reversing Beepers 17
10 Consideration of Options for Reducing Low Frequency Noise Emission 18
11 Additional Noise Control Measures to Minimise Noise Emission so far as Reasonably Practicable 18
12 Conclusions 19
Appendix One: Aerial Photo of Site and Surrounds including Location of Noise Sensitive Areas 20
Appendix Two: Planning Scheme Zoning Map 21

1 INTRODUCTION

This report sets out the findings of a noise emission assessment of the proposal to extend the presently approved extraction area and depth of the Yannathan Sand Quarry, 870-910 Westernport Road Yannathan, operated by Hanson Construction Materials Pty Ltd.

The purpose of the assessment has been to identify potential constraints associated with off-site noise emission from the quarry on the proposed extension of the extraction area and develop appropriate noise mitigation strategies as required.

The noise assessment has been conducted in terms of the Environment Protection Act 2017 (the Act) and subordinate legislation.

This report covers the following aspects:

- Determination of noise limits in accordance with the Noise Protocol EPA Publication 1826.4
- Modelling of noise levels at potentially affected residential locations resulting from the quarry including the proposed extraction area extension, using a three-dimensional noise modelling software package.
- Consideration of modelled noise levels in terms of noise limits and other guidance under the Act.
- Determination of required noise control measures, if necessary, to achieve compliance with relevant noise criteria at noise sensitive locations.

2 SUBJECT SITE AND SURROUNDING ENVIRONMENT

The subject site is located at 870-910 Westernport Road Yannathan.

An aerial photo of the quarry site appears in Appendix One. The annotated aerial photo includes the locations of relevant off-site independently owned residential receiver locations for the noise emission assessment.

The two noise sensitive areas located closest to the quarry site are 35 Milners Rd to the west and 950 Westernport Rd to the east.

At the time when the previous version of this noise emission assessment report, WMG Ref 12919-1.1ng, was prepared in September 2022, it was understood that a building formerly used as a dwelling at 815 Westernport Rd was being used as an office for the market garden at the site, no longer being used for residential purposes.

It has since been learned that the building at 815 Westernport Rd is occupied by a caretaker for residential purposes at times, so the noise emission assessment has been updated to include this location.

The noise emission assessment has also been updated to include a second house at 35 Milners Rd.

The illustration below shows the subject site in more detail, including the proposed extension area outlined in black.

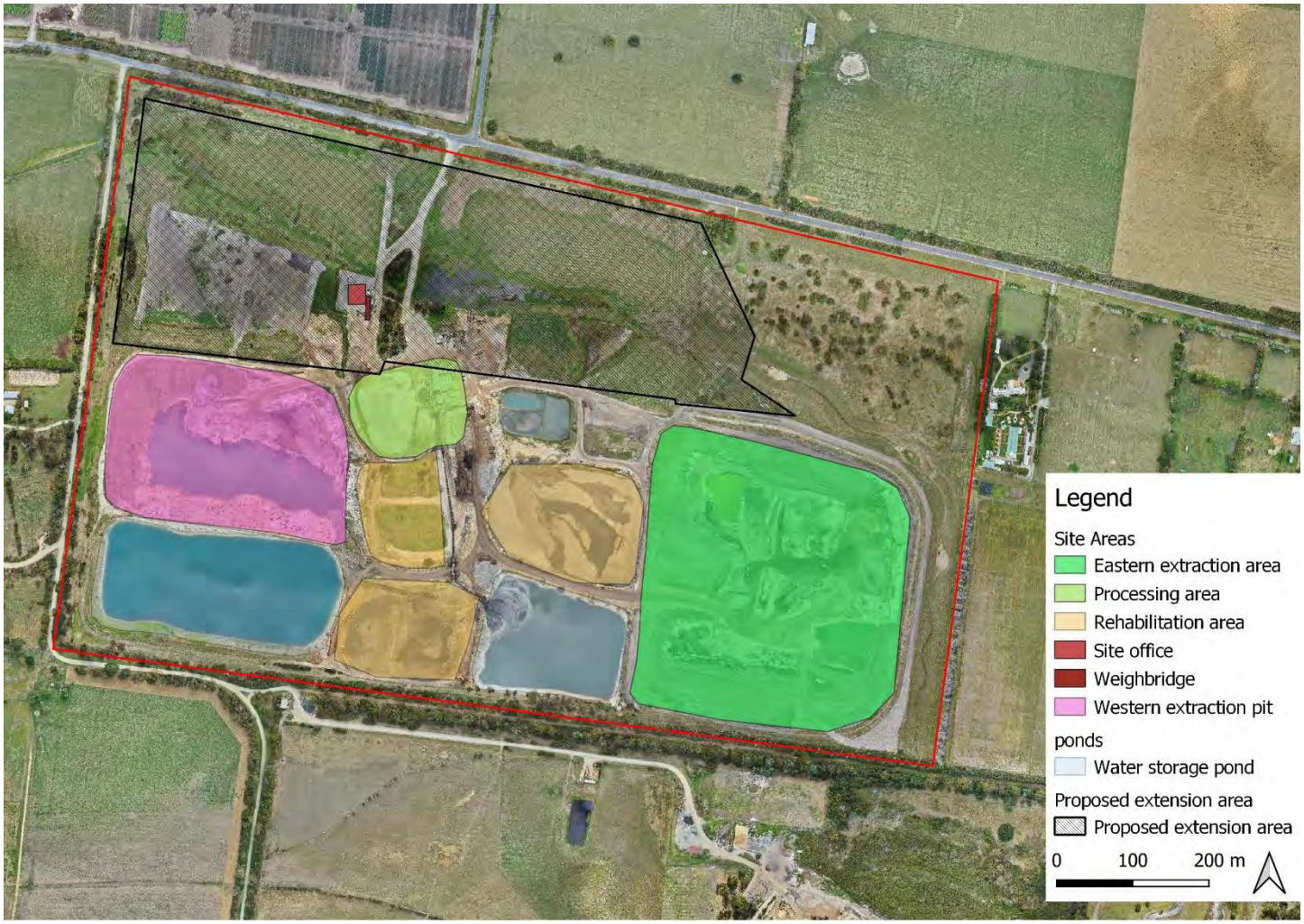


Figure 1: Subject site indicating proposed extension area

As can be seen from Figure 1 viewed in conjunction with Appendix One, the proposed new extraction area is further from the noise sensitive areas than the extraction areas that have been successfully worked under the pre-existing approvals.

A Planning Scheme zoning map is included in Appendix Two. The Planning Scheme zonings are relevant to the determination of the noise constraints. The subject site and all relevant noise receiver locations are zoned GWZ1.

3 PROJECT HISTORY IN RELATION TO NOISE EMISSION

The currently approved extraction area that is reaching the end of its life was the subject of a noise emission assessment as part of the approvals process in 2013.

The 2013 noise emission assessment was conducted in accordance with the then-applicable *NOISE FROM INDUSTRY IN REGIONAL VICTORIA Recommended Maximum Noise Levels from Commerce, Industry and Trade Premises in Regional Victoria* (NIRV).

The extraction area for which approval is being sought now is located further from noise sensitive areas than the previously approved and successfully extracted resource area, and the other components of the quarry being the processing, stockpiling and sales areas are not changing as part of the current approvals that are being sought.

Overall, the quarry extraction area noise contribution has the prospect of reducing at most existing noise sensitive areas compared with the pre-existing extraction areas.

The quarry extraction area will move closer to the building at 815 Westernport Rd that is occupied by a caretaker for residential purposes at times, which was not included in the previous noise assessment report in September 2022.

Changes in noise assessment introduced as part of the Environment Protection Act 2017 that came into operation on 1 July 2021 will place additional constraints on noise emission, even though the quarry extraction area noise contribution at most of the existing noise sensitive areas will, if anything, reduce as extraction moves to the proposed new areas.

The 2013 noise assessment concluded that noise emission with the recommended noise controls would meet the NIRV Recommended Maximum Noise Levels during the day period, but not during the evening and night periods at times. This had been found to be the case with the previously approved extraction area, but without causing concern to nearby residents.

On the basis of the prior experience in operation of the quarry and the modelling findings that resultant noise levels at residential premises would not increase as part of the new extraction areas proposed in 2013, the proposed extension was approved and has operated successfully since then.

The proposed extraction area that is the subject of the current noise assessment is being considered in terms of the noise assessment procedures under the now-applicable Environment Protection Act 2017.

4 NOISE ASSESSMENT TERMINOLOGY

Noise assessment terminology used as part of the assessment within the report is described below in Table 1.

Table 1: Description of noise terminology

Reference	Description
dB(A)	Decibels recorded on a sound level meter, which has had its frequency response modified electronically to an international standard, to quantify the average human loudness response to sounds of different character.
L_{eq}	The equivalent continuous level that would have the same total acoustic energy over the measurement period as the actual varying noise level under consideration. It is the noise measure defined by the EPA as the measure of the noise to use in assessing compliance with noise limits.
L_{90}	The level exceeded for 90% of the measurement period, which is representative of the typical lower levels in a varying noise environment. It is the noise measure defined by the EPA as the measure of the background noise level to use in determining noise limits.
Sound power level	The amount of energy in the form of sound emitted by a source, which is an inherent characteristic of a machine independent of the surroundings. This is the quantity input into the noise model as the starting point for calculating resultant noise levels at off-site locations.

5 NOISE EMISSION ASSESSMENT CRITERIA

Noise emissions within the State of Victoria are governed by the legislative framework contained within the Environment Protection Act 2017 (the Act), which commenced on 1 July 2021.

The approach within the Act focuses on prevention of pollution impacts rather than managing the impacts after they have occurred and is based on a person or entity's *General Environmental Duty* (GED) for the protection of human health and the environment from pollution and waste.

The GED is explained within Part 3.2 of the Act and stipulates that 'a person who is engaging in an activity that may give rise to risks of harm to human health or the environment from pollution or waste must minimise those risks, so far as reasonably practicable'.

Determining what is deemed 'reasonably practicable' is explained within EPA Publication 1856 and relates to the implementation of controls that are proportionate to the potential risk. It relates to the potential for harm to occur, the potential impacts on the environment, and considers what controls are available to reduce the risk, and their associated costs.

Under the Act it is the responsibility of the operator to understand and assess the risks which their operations may pose on human health or the environment, and once understood, implement proportionate controls to mitigate or minimise the risk of harm.

The definition of harm within the Act introduces the concept of what is deemed 'unreasonable' generally, and in particular 'unreasonable noise'. The Regulations under the Act essentially define unreasonable noise as noise that exceeds the noise limit that applies under the Noise Protocol (EPA Publication 1826.4) at the time the noise is emitted.

Methodologies, specific criteria, and guidance regarding unreasonable noise emissions are included within the following Regulations and guideline documentation referred to within the Act and provided by the Environment Protection Authority (EPA):

- Environment Protection Regulations 2021 (The Regulations).
- EPA Publication 1826.4 '*Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*' (Noise Protocol).
- Environmental Reference Standard (ERS).
- EPA Publication 1996 *Noise Guideline – assessing low frequency noise*.
- EPA Publication 1856 *Reasonably practicable*.

With the above considered, whilst evaluating risks and implementing reasonably practicable measures are considered as a necessity to comply with the GED, the basis for any noise emission assessment will be ensuring that noise emissions are not deemed 'unreasonable', discussed further below.

5.1 Environment Protection Regulations And Noise Protocol

Implementation of the general concepts within the Act rely on the Regulations. The objectives of the Regulations are to further the purposes of and give effect to the Act by imposing obligations in relation to environmental protection through providing a basis for addressing potential emissions.

The Regulations further define the concepts of 'unreasonable' and 'aggravated' noise and introduce the Noise Protocol as a tool for quantitatively addressing noise emissions from commercial premises within 'noise sensitive areas' including residential and accommodation type premises as well as childcare, kindergarten, primary school and secondary school facilities.

Within the Regulations, a person who conducts a prediction, measurement, assessment, or analysis of noise within a noise sensitive area for the purpose of the Act or the Regulations must conduct the relevant works in accordance with the Noise Protocol.

The main focus of the noise assessment has therefore been consideration of noise emission in terms of noise limits determined in accordance with the Noise Protocol.

5.1.1 General Methodologies

The subject site land and the sensitive receptors surrounding the subject site are not located within a 'major urban area' and will therefore be defined as a 'rural area'.

In accordance with the Noise Protocol, noise limits for site operations are determined as set out in Part I, A:2.7 of the Noise Protocol document 'noise limits in rural areas for earth resources'. Using the rural area method, relevant 'earth resources levels' for noise emission from the subject site are determined based on the noise sensitive area zonings and the methodologies described in Clauses 33-36 of the Noise Protocol 'noise limits in rural areas for earth resources'.

The earth resources levels vary depending on the time of the day, evening, or night with the highest during the day period and the lowest during the night periods.

The relevant day, evening, and night assessment periods are shown in Table 2 below.

Table 2: Details of EPA Assessment Periods

EPA Assessment Period	Relevant Days	Relevant Time Periods
Day	Monday to Saturday	7:00am to 6:00pm
Evening	Monday to Saturday	6:00pm to 10:00pm
	Sunday, Public Holidays	7:00am to 10:00pm
Night	All Days	10:00pm to 7:00am

Where the site is located within a background relevant area, typically near a major highway or the coast where there are non-typical sources of background noise, further derivation of noise limits applicable for commercial, industrial and trade noise emissions are based on measurement of the existing ambient background noise level at nearby relevant sensitive receptors in accordance with Clauses 21-23 of the Noise Protocol.

If the background noise level plus 8 during the day or 5 during the evening or night exceeds the zone level, then noise limits for site operations are based on the following:

- The day background noise level plus 8dB.
- The evening background noise level plus 5dB
- The night background noise level plus 5dB.

For the night period, the noise criterion is limited to 55 dB(A) as a maximum applicable value.

The subject site and surrounds are not in a background relevant area.

5.1.2 Derivation of Noise Protocol Noise Limits

The Planning Scheme zoning map indicates that the subject site and all relevant receivers are zoned GWZ1.

For this noise sensitive area zoning, the Noise Protocol earth resources levels are 46, 41 and 36 dB(A) for the day, evening and night periods respectively.

The operating hours of the quarry are within the defined night period (the hour from 0600 to 0700), the day period (0700-1800), plus the evening period (1800-2200) for processing only.

The noise sensitive areas relevant to consideration of noise emission from the subject site are not located in a background relevant area, therefore the zoning-based earth resources levels apply as the Noise Protocol noise limits.

Table 3: Noise Protocol noise limits

EPA Assessment Period	Relevant Days	Relevant Time Periods	Noise Protocol Noise Limit, dB(A) L_{eq}
Day	Monday to Saturday	7:00am to 6:00pm	46
Evening	Monday to Saturday	6:00pm to 10:00pm	41
	Sunday, Public Holidays	7:00am to 10:00pm	
Night	All Days	10:00pm to 7:00am	36

The noise limits are to be met within a 'noise sensitive area', which for this site will be within the boundary of any of the nearby houses, and within 10 metres of the outside of the external walls of the dwelling.

5.1.3 Noise Protocol Assessment Adjustments

When considering noise impacts on residential receptors, the Noise Protocol methodology includes relevant adjustment factors which account for the potential for the noise source to impact on the acoustic amenity of the noise sensitive receptor. The relevant adjustments include:

- Tonal Adjustment
- Impulsive adjustment.
- Intermittency adjustment.
- Reflection Adjustment.
- Duration Adjustment.

Clarification regarding each of the adjustments is shown below in Table 4.

Table 4: Noise Protocol Assessment Adjustments

Relevant Adjustment	Description
Tonal Adjustment	When the noise is tonal in character then an adjustment shall be made as follows: ▪ When the tonal character of the noise is just detectable then + 2 dB(A). ▪ When the tonal character of the noise is prominent then + 5 dB(A).
Impulsive Adjustment	When the noise is impulsive in character then an adjustment shall be made as follows: ▪ When the impulsive character of the noise is just detectable then + 2 dB(A). ▪ When the impulsive character of the noise is prominent then + 5 dB(A).

Relevant Adjustment	Description
Intermittency Adjustment	An intermittency adjustment applies when the noise increases in level rapidly by at least 5 dB, on at least two occasions during a 30-minute period and maintains the higher level for at least one minute duration. The relevant intermittency adjustments applicable include: ▪ When the level increase is >10 dB during the day period, then apply an adjustment of +3 dB(A). ▪ When the level increase is 5-10 dB during the night period, then apply an adjustment of +3 dB(A). ▪ When the level increase is >10 dB during the night period, then apply an adjustment of +5 dB(A).
Reflection Adjustment	When the measurement point is located outdoors and the microphone is located from 1 to 2 metres from an acoustically reflecting surface, an adjustment of -2.5 dB shall be made.
Duration Adjustment	If noise emissions from the commercial, industrial or trade premises investigated do not occur over the whole continuous 30-minute period, the duration adjustment applies. This adjustment is negative, reducing the effective level compared with the 'raw' measured level.

The above adjustments are applied to the measured/predicted values at residential receptors to determine the 'effective' noise level impacting on the residential receptor.

Observations at quarries indicate that the offsite noise emissions are typically dominated by the processing plant, diesel engine noise associated with mobile plant, and conventional tonal reversing beepers if they are in use at the site.

One of the recommendations is to continue the practice of using broadband reverse alarms at the site, to avoid the tonal adjustment that would apply to the use of tonal reversing beepers.

5.2 Environment Reference Standard

The ERS provides environmental values which have been developed to reflect the ambient soundscape associated with different land use settings, from highly urbanised areas to natural environments.

Through consideration of land zoning types, and varying assessment periods for the day and night, it is understood that the ERS intends to provide consideration of noise levels which may impact on:

- Sleep during the night.
- Domestic and recreational activities.
- Normal conversation.
- Child learning and development.
- Human tranquillity and enjoyment outdoors in natural areas.
- Musical entertainment.

Whilst being included within the Act, the ERS is not a compliance standard and clearly states that 'the objectives for each land use category are typical ambient sound level values and are neither noise limits nor noise design criteria'.

It's understood that the primary function of the ERS is to provide an environmental assessment benchmark to assist 'decision makers' with evaluating noise emissions within areas not captured within The Regulations and Noise Protocol.

The assessment has considered noise emissions from the site at existing residential receptors as well as within currently vacant farm zone land which may be developed for residential use at a later stage.

Given the proximity of the noise sensitive residential receptors to the site, and the fact that the focus of the noise emission assessment is based on the Noise Protocol, it is understood that consideration of the ERS will not impact on the findings of the assessment and has therefore not been considered further.

5.3 EPA Noise Guideline – Assessing Low Frequency Noise

As defined within the Act, a person must not, from a place or premises that are not residential premises emit an unreasonable noise or permit an unreasonable noise to be emitted.

Within the Regulations, consideration of unreasonable noise is based on exceedances determined in accordance with the Noise Protocol, however, the Regulations also include consideration of the sound frequency spectrum associated with a noise emission.

To provide some basis for addressing low frequency noise emissions and determining whether the noise emission is deemed 'unreasonable', the EPA released Publication 1996 *Noise Guideline – assessing low frequency noise*.

The guideline document provides 'threshold levels for assessing low frequency noise' which are not set limits, but levels that indicate a potential risk of problematic low frequency noise. The threshold levels for indoor and outdoor measurements are included within Table 5 below.

Table 5: Indoor and outdoor measurement one-third octave band noise level thresholds

Measurement Location	One-third octave band noise levels Hz												
	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
Indoor noise dB L_{eq}	92	87	83	74	64	56	49	43	42	40	38	36	34
Outdoor noise dB L_{eq}	92	89	86	77	69	61	54	50	50	48	48	46	44

EPA Publication 1996 *Noise Guideline – assessing low frequency noise* notes the following:
Predicting expected noise levels at noise sensitive receivers may be compared against the

relevant low frequency threshold levels (Table 2 for indoor or Table 3 for outdoor measurements).

However, noise level calculations in the low frequency range can be problematic and of limited accuracy.

The use of noise calculations should be restricted to indicative estimations only. Due to this, calculations should only be used as a screening tool to assess the risk of low frequency noise from the proposed development and/or extension of existing commercial, industrial and trade premises.

Therefore, modelling results can be used with some caution in considering low frequency noise levels.

6 OPERATIONAL PARAMETERS RELEVANT TO CONSIDERATION OF NOISE EMISSION

Extraction of raw material and removal of overburden occurs from 0600 to 1800 hrs Monday to Saturday.

The processing plant operates from 0600 to 2200 hrs and sales occur between 0600 and 1800 hrs. Sales involves typically 6 to 8 trucks per hour entering the site, being loaded by a loader and exiting the site.

During the day period haul trucks are loaded by an excavator operating at the quarry working face and deliver raw material directly to the feed hopper for the processing plant. The haul trucks also build up a stockpile of raw material that is then fed into the processing plant hopper by a loader during the evening period, 1800-2200 hrs.

It has been indicated that a small diesel-powered cutter suction dredge may be added to the equipment list at the Yannathan quarry. The cutter suction dredge would be used to extract sand in locations where the sand is immersed in water.

This would occur at the bottom of the pit once the water table has been intersected. The combination of a source noise level typically lower than conventional earthmoving equipment and operation at the base of the pit means that this source does not require detailed consideration. Using a dredge also means that haul trucks are not required, further reducing noise generation at the site.

7 RELEVANT NOISE SOURCES

The noise level that is to be assessed in terms of the noise limits at off-site residential premises is the L_{eq} over a 30-minute period, adjusted as discussed in section 4.1 above.

Therefore, the objective of noise modelling to predict resultant off-site noise levels is to capture the mix of noise sources operating during a 30-minute period.

Source noise measurements were conducted at the quarry and drawn from WMG file records to obtain the data to input into the noise modelling to allow calculation of resultant effective levels at the residential receivers.

The sound power levels derived from these noise measurements and used in the noise modelling have been tabulated below.

Sound power levels in one-third octave frequency bands have been modelled, but octave band figures are tabulated below for convenience.

Table 6: Source Noise Sound Power Levels

Noise Source	Sound Power Level (dB Re. 1pW) In Octave Frequency Bands (Hz)								
	31.5	63	125	250	500	1000	2000	4000	dB(A)
Processing plant	132	122	111	103	101	102	100	96	107
Excavator Komatsu PC450L	108	106	112	105	99	100	96	90	105
Excavator Hitachi ZX490	107	113	109	100	101	97	96	91	104
Loader Volvo L180H	121	117	108	102	99	101	100	92	107
Loader Komatsu WA470/WA480	104	112	107	98	97	101	101	96	106
Volvo A35/A30/A25 haul truck	110	108	106	106	108	105	103	97	110
Typical Road Truck	107	113	107	102	100	99	98	91	104

8 MODELLED NOISE LEVELS DUE TO NOISE EMISSIONS FROM OPERATIONS AT THE QUARRY SITE

8.1 NOISE MODELLING METHODOLOGY

Modeling of operational noise emissions has been conducted using the CadnaA software package, implementing the ISO 9613-2 sound propagation algorithms. The ISO 9613-2 method aims to determine the average sound level under meteorological conditions favourable to propagation, that is, moderately downwind propagation, or propagation under a well-developed, but moderate, ground-based temperature inversion, such as can occur at night.

Environment Protection Authority assessment methodology indicates that residual noise levels at noise sensitive receivers should be considered when weather conditions assist propagation of noise emissions in the direction of the receivers. This condition is implemented by the noise modelling software.

The noise modelling has allowed for the effects of light breezes from the noise sources to the residential locations enhancing sound propagation. For much of the time, the resultant noise levels would be lower than predicted on this basis.

Apart from the reduction of sound due to distance, ground attenuation and atmospheric effects, noise attenuation results from acoustic shielding.

Topographical files were obtained for the quarry site from the project team based on an aerial survey conducted in April 2022. These files include all the bunding presently on the site.

Topographical data for the surrounding area was obtained from *Elvis - Elevation and Depth - Foundation Spatial Data* (https://elevation.fsdf.org.au/).

Noise modelling has been used iteratively in conjunction with discussions with the quarry operations personnel to develop modifications to the site operations to reduce noise emission.

8.2 Noise Prediction Results and Noise Control Considerations

Modelling scenarios have been run in relation to eight extraction locations representing easterly, midline and westerly locations in the northern and southern parts of the proposed new extraction area as indicated below.

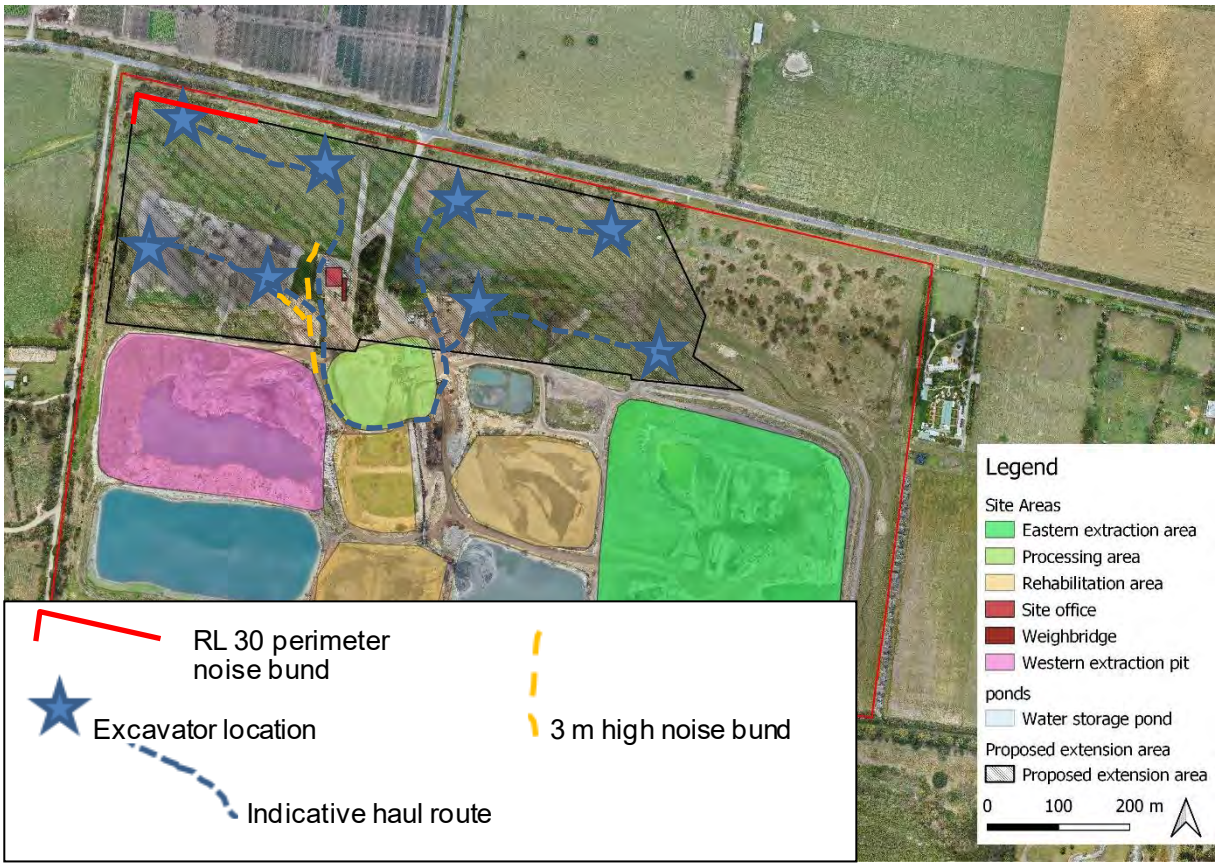


Figure 2: Noise modelling scenarios

The modelling reflects the operational parameters described in section 6 above.

The modelling results were found to meet the Noise Protocol noise limits for the day and evening periods at all noise sensitive areas, including for initial site works when operations are occurring at the natural surface level.

Initial modelling established that operation of an excavator loading haul trucks at the natural surface level would not be consistent with meeting the noise limit from 0600 to 0700 hrs.

Modelling was replicated for the locations shown above with progressively lower operation of an excavator loading haul trucks, and it has been established that the excavator will need to operate at a level nominally 6 m below the natural surface between 0600 and 0700 hrs to remain below the noise limit during that period, in conjunction with the other operating noise sources.

With haul trucks operating at the natural surface level, the noise modelling has established that a 3 m high noise bund will be required on the western side of the haul route as indicated in Figure 2, to achieve compliance with the 0600 to 0700 noise limit at 35 Milners Rd. The bund extent is from the point of access to the now depleted southwestern pit and stopping short of the ephemeral watercourse that crosses the site through the proposed new extraction area.

The bund can be progressively shortened as extraction proceeds and a pit established in the southwestern section of the proposed new extraction area.

Introducing a noise assessment location at 815 Westernport Rd has led to introduction of a perimeter noise bund to RL 30 at the north west corner of the site to reduce modelled noise levels to reduce the modelled noise level at that location to no more than 36 dB(A) between 0600 and 0700.

8.3 Low Frequency Noise

Resultant low frequency modelled noise levels at the nearest houses were found to be above the low frequency threshold levels by up to 4 dB in the 31.5 and 50 Hz one-third octave frequency bands respectively, due to noise emission from the wet screens at the processing plant under light breeze conditions assisting sound propagation from the source to noise sensitive areas.

Light breeze conditions are the most relevant to consideration of noise emission as even though stronger winds also assist sound propagation, they also generate elevated noise levels due to interactions with vegetation and other obstructions, elevating the masking background levels.

The processing plant is not changing, so these resultant levels will also not be changing and will have been a part of the quarry operation for many years.

The EPA Publication 1996 low frequency threshold levels are not set limits. Rather, they are levels that indicate a potential risk of problematic low frequency noise. The disturbance from low frequency noise depends on the noise level; characteristics that can increase annoyance with the noise, for example, tonality, frequency modulation; and the baseline noise levels in the absence of the low frequency noise.

The existing operation of this source for many years indicates that it has not caused disturbance in the context of the quarry locality and the operating hours, despite the finding of noise levels above the low frequency threshold in two one-third octave frequency bands.

The magnitude of these margins above the threshold, 4 dB, is not large and would be characterised as a 'just noticeable difference', which is a possible explanation for the long-term operation of the processing plant without adverse effects on the surrounding environment.

Consideration of noise mitigation at such low frequencies is hampered by a lack of sound transmission data and computational limitations.

Discussion regarding options for reducing low frequency noise emission appears in section 10 of this report.

9 SUMMARY OF NOISE CONTROL MEASURES TO ACHIEVE COMPLIANCE WITH NOISE PROTOCOL NOISE LIMITS

9.1 EXTRACTION BETWEEN 0600 AND 0700 HRS

It is recommended that extraction in the proposed new area between 0600 and 0700 hrs only occur when the pit has reached a stage where the excavator can operate at a level nominally 6 m below the natural surface level, or 3 m below the natural surface level in conjunction with bunds 3 m high relative to the natural surface between the excavator location and the houses to the east and west of the site.

9.2 NOISE BUNDS

A perimeter noise bund to nominally RL 30 is recommended extending along the western boundary from north of the ephemeral watercourse to the north western corner of the site, then extending along the northern boundary for nominally 200 m, as shown in Figure 2.

A noise bund nominally 3 m high is recommended along the western side of the haul route to the western extraction areas, extending from the entry point of the existing and now depleted southwestern pit to just south of the ephemeral watercourse that crosses the site through the proposed new extraction area.

This extent is indicated in Figure 2, and can be reduced as the pit develops and haul trucks are operating within the pit.

9.3 REVERSING BEEPERS

Conventional reversing beepers have the potential to cause annoyance to residents and contribute to exceedance of noise limits at the residential locations around the site by addition of a tonal adjustment, due to the highly distinctive tonal noise character and on-off nature of the noise.

All mobile equipment operating at the site should be fitted with broadband reverse alarms, which vary their noise output according to the ambient noise level. These reversing alarms should be selected for the lowest noise level consistent with safe operation.

Product stockpiles and travel routes within the site should be configured to minimise any need for sales trucks to reverse.

This is already the case and should be maintained.

10 CONSIDERATION OF OPTIONS FOR REDUCING LOW FREQUENCY NOISE EMISSION

EPA Publication 1996 recommends a hierarchy of controls for reduction of low frequency noise.

The first of these is elimination of the noise emission such as through plant design and siting. The processing plant is located approximately centrally on the site, which maximises distances to off-site receiver locations. The motion of the screens that is responsible for the low frequency noise generation is also the motion that is required for the screens to achieve the purpose of dewatering the sand.

Elimination is not an option as the screens are an essential part of processing plant.

The second in the hierarchy of control is substitution, which involves replacing a process or equipment that generates low frequency noise with a lower noise alternative. It may be possible to investigate an alternative dewatering technology, but as noted above, the motion of the screens that generates the low frequency noise is an inherent part of the processing plant achieving its function.

The third control strategy is engineering controls, and in this respect the characteristics of low frequency noise present challenges in achieving noise reduction. Simply bolting rigid panels to the framework of the processing plant would not be effective, as the panels themselves would become radiating sound sources.

If the current circumstances change, consideration could be given to options such as limp sound attenuation materials or a free-standing noise barrier, but sound attenuation properties of materials are not available at such low sound frequencies as acoustic test facilities are not large enough to conduct sound transmission testing with the large wavelengths of low frequency sound.

The final control in the hierarchy is administrative controls, such as avoiding operating of machinery in the most noise sensitive periods. The processing plant does not operate through the night period, with the exception of 0600-0700. It is likely that the existing processing plant has not been found to cause disturbance during this time period because the rural nature of the area is likely associated with significant other activity from 0600 as general activity increases for the day.

In view of the foregoing considerations, it would appear to be reasonable for the processing plant to continue as it has been operating, with the possibility of giving consideration to engineering and administrative controls should disturbance associated with low frequency noise arise in future.

11 ADDITIONAL NOISE CONTROL MEASURES TO MINIMISE NOISE EMISSION SO FAR AS REASONABLY PRACTICABLE

There are bunds located at the western and eastern boundaries of the subject site, but the updated topography files that have been generated to provide a basis for the noise emission modelling have indicated that the bunds are typically only in the range 2-3 m high.

Increasing these to 4 m would provide an additional noise reduction and could be deemed to be reasonably practicable, subject to other considerations such as visual impact, cost and the availability of horizontal space to increase the height of the bunds.

12 CONCLUSIONS

A noise assessment has been conducted to quantify noise emission from the sand quarry at 870 Westernport Road Yannathan and identify noise control requirements to extend the currently approved quarry extraction area while remaining in compliance with relevant noise constraints.

The noise assessment has been undertaken in accordance with the new Environment Act and subordinate legislation that have been in force since 1 July 2021.

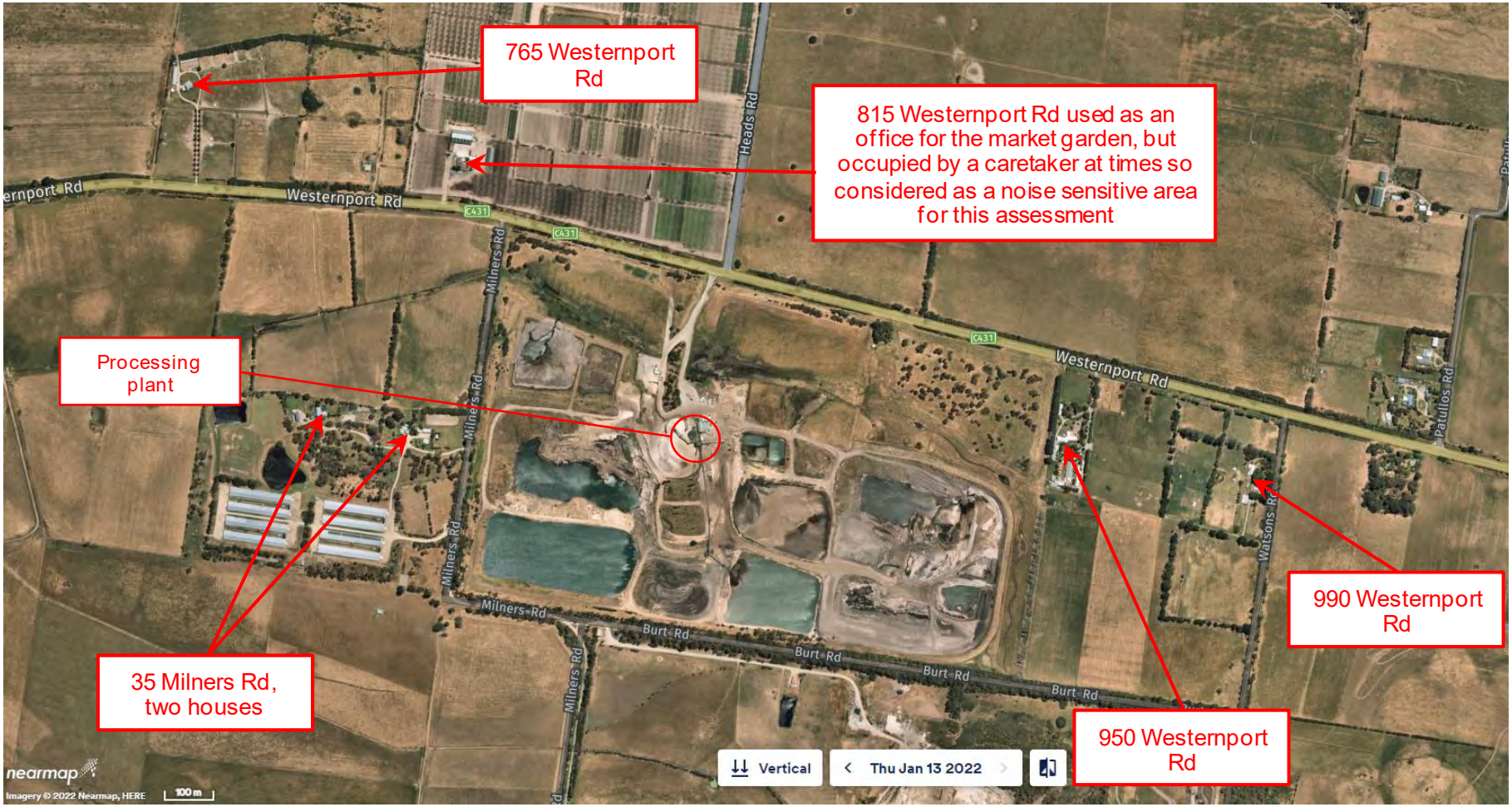
It has been concluded that implementation of the strategies and noise controls set out in Section 9 can allow operation of the quarry with the proposed extended extraction area to proceed in compliance with the Noise Protocol noise limits.

Consideration has also been given to additional measures that could reduce noise emission so far as reasonably practicable, consistent with the General Environmental Duty under the Act.

Neville Goddard

NEVILLE GODDARD
WATSON MOSS GROWCOTT
acoustics pty ltd

APPENDIX ONE: AERIAL PHOTO OF SITE AND SURROUNDS INCLUDING LOCATION OF NOISE SENSITIVE AREAS



APPENDIX TWO: PLANNING SCHEME ZONING MAP

Appendix L Greenhouse Gas and Climate Change

GREENHOUSE AND CLIMATE CHANGE ASSESSMENT

Yannathan Quarry

Client: Hanson

Ricardo ref. 30765 Issue: 2 26/08/2022

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Ricardo is certified to ISO9001, ISO14001, ISO27001 and ISO45001.

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CONTENTS

1. INTRODUCTION 1
1.1 LOCATION 1
1.2 TENURE 1
1.3 RELEVANT LEGISLATION AND GUIDANCE 2
1.3.1 Mineral Resources (Sustainable Development) Act 1990 2
1.3.2 Environment Protection Act 2
2. GREENHOUSE GAS ASSESSMENT 4
2.1 DATA SOURCES 4
2.1.1 Mobile Plant 4
2.1.2 Electricity Usage 4
2.1.3 Site Processing Capacity 4
2.2 ASSUMPTIONS 4
2.3 EMISSIONS ASSESSMENT 5
2.3.1 GHG from mobile plant 5
2.3.2 GHG Due to Electricity Use 5
2.3.3 Overall GHG Assessment 5
3. CLIMATE CHANGE ADAPTATION 7
3.1 POTENTIAL IMPACTS 7
3.1.1 Longer Fire Seasons 8
3.1.2 More intense downpours 8
3.1.3 Increased evapotranspiration 9
3.2 SUMMARY 9
4. REFERENCES 10

Figures

Figure 1-1 Site Location 1
Figure 1-2 Titles 2
Figure 2-1 Emissions forecast 6
Figure 2-2 Mobile Plant Scenarios 5
Figure 3-1 Climate Change Impacts 7
Figure 3-2 Climate Change Risk Assessment Methodology 8

Tables

Table 3-1 Local Catchment Climate Change Impacts 8

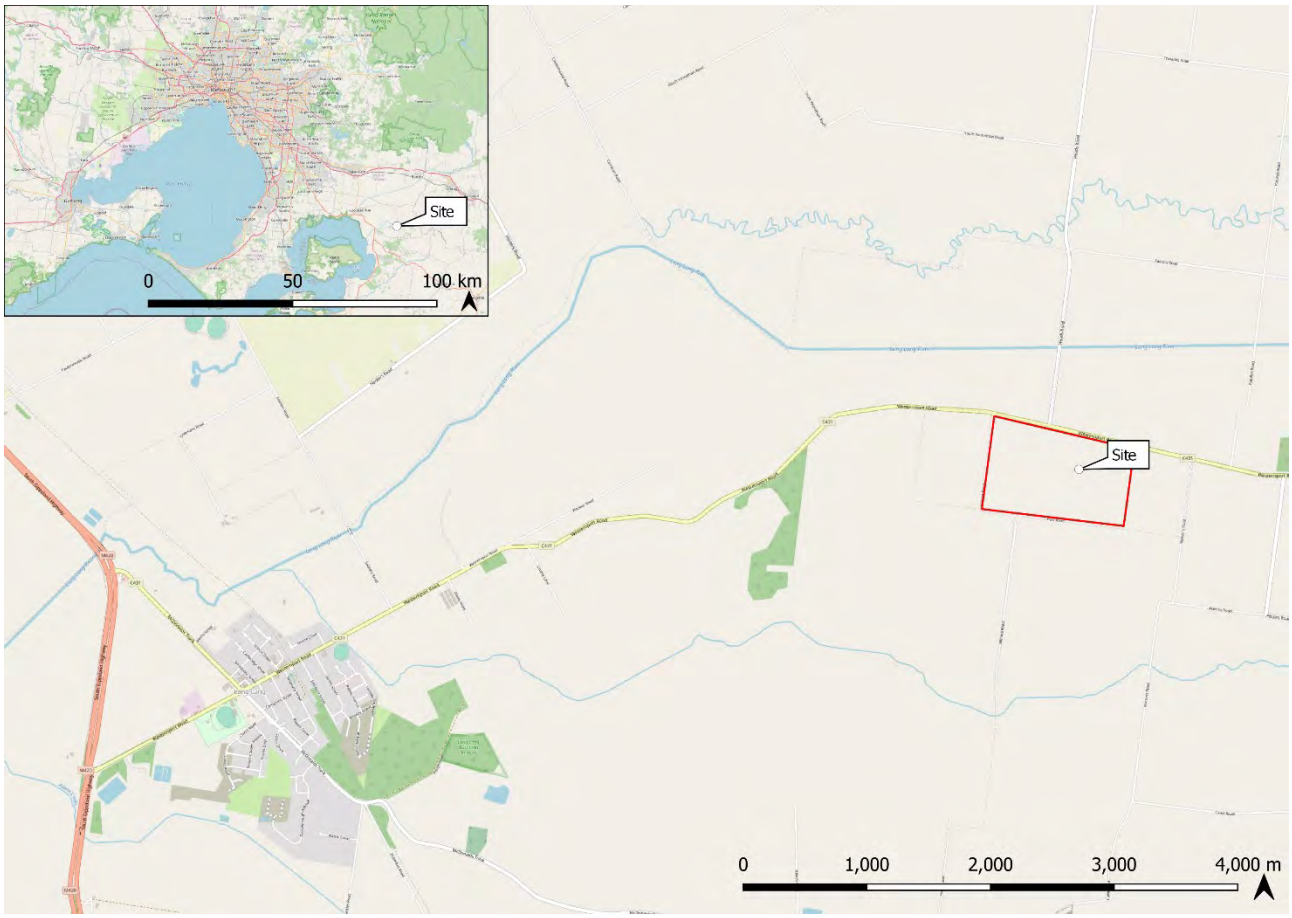
1. INTRODUCTION

Ricardo Energy Environment and Planning (Ricardo) has been engaged by Hanson to prepare a Work Plan Variation application for an extension to the existing Yannathan Quarry on Westernport Rd in Yannathan, south east of Melbourne. This variation proposes to extend the area of extraction to the northern portion of the site and to increase the depth of extraction to -9 mAHD. This report outlines the climate change impacts of the proposed variation and how the landfill will respond to a changing climate in the future.

1.1 LOCATION

The site is located at 870 and 910 Westernport Road, Yannathan as shown in **Figure 1-1**. The site has good access to the Bass Highway to supply the Melbourne market. The site is in a rural area, the township of Lang Lang is located approximately 6km west of the site. Yannathan is a hamlet approximately 2.5 km north of the site comprising a hall and sporting facilities and approximately five houses.

Figure 1-1 Site Location



1.2 TENURE

The site is wholly owned by Hanson. There are two titles over the site as shown in **Figure 1-2**. The proposed extraction area is to the north of the existing areas, on the same titles.

Figure 1-2 Titles

1.3 RELEVANT LEGISLATION AND GUIDANCE

1.3.1 Mineral Resources (Sustainable Development) Act 1990

The site is subject to approvals under the *Mineral Resources (Sustainable Development) Act 1990* (Victorian Government, 1990). This act includes principles of sustainable development, which are to be considered when administering the Act, including approvals under the Act and its subordinate legislation.

The principles of sustainable development relevant to climate change include:

(b) there should be equity within and between generations;

(c) biological diversity should be protected and ecological integrity maintained;

(f) both long and short term economic, environmental, social and equity considerations should be effectively integrated into decision-making;

(g) if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation and decision making should be guided by—

(i) a careful evaluation to avoid serious or irreversible damage to the environment wherever practicable; and

(ii) an assessment of the risk-weighted consequences of various options;

1.3.2 Environment Protection Act

The *Environment Protection Act* (Victorian Government, 2017) introduces a General Environmental Duty (GED) which also applies to extractive industry. The GED requires any person who is engaging in an activity that may give rise to risks of harm to human health or the environment from pollution or waste must minimise

those risks so far as reasonably practicable. This includes the emission of greenhouse gases which are considered to be a waste, and to pose a risk of harm to both human health and the environment.

In addition, the Act empowers EPA to regulate greenhouse gas emissions.

1.3.2.1 Environment Reference Standard

The *Environment Reference Standard* (Victorian Government, 2022) gives effect to EPA's regulation of greenhouse gases by specifying the air emissions environmental value:

> *Climate systems that are consistent with human development, the life, health and well-being of humans, and the protection of ecosystems and biodiversity*

2. GREENHOUSE GAS ASSESSMENT

Ricardo undertook greenhouse gas emissions modelling to understand the emissions profile for the Yannathan Quarry. The assessment was based on information provided by Hanson and included an assessment of mobile plant and electricity usage required to operate the facility.

2.1 DATA SOURCES

The following sections outline the data and associated assumptions related to the sources of emissions.

2.1.1 Mobile Plant

Existing mobile plant usage at the site has been obtained from Hanson for the 2021 calendar year. The mobile plant onsite include:

- 3 Excavators
- 3 Front End Loaders
- 4 Articulated Dumpers
- Bulldozer
- Water cart

These used a total of 490,180L of diesel in 2021.

Two of the excavators and one of the front end loaders may be replaced by a dredge to enable the deeper sections of the quarry to be excavated without excessive water management costs.

Dredges at reference sites used between 9,532L and 13,738L per month. The higher figure has been adopted in this assessment.

2.1.2 Electricity Usage

Electricity usage onsite was provided for the 2021 calendar year. The power usage on site included the following items:

- Processing plant and workshop
- Office
- Weighbridge
- Lunch Room/Amenities
- General lighting

These sources used a total of 1,227,665 kWh in 2021. It is assumed that the majority of the onsite demand is for the processing plant.

A forecast of grid decarbonisation has been built into the electricity emissions, with a scenario that the electricity grid is 80% decarbonised by 2050 (Roam Consulting, 2011), assuming that the majority of coal fired power stations will have reached end of life and will be replaced by renewable energy.

2.1.3 Site Processing Capacity

In 2021 the site sold approximately 500,000tpa of material. However the annual ongoing production is estimated at 400,000tpa. As the figures were based on a higher production rate than forecast in future years and there is no data provided for how accurately these numbers scale up or down with production, no adjustment has been made on the basis of volume. This estimate should therefore be considered conservative.

2.2 ASSUMPTIONS

The following key assumptions have been adopted:

- Mobile plant will continue to use diesel as a fuel for the life of the facility (no electrification)
- The dredge will replace two excavators, three articulated dumpers and one front end loader

  - One excavator and one articulated dumper are still required to manage site stability (e.g. clay placement on batters, managing site roads)
  - Two front end loaders are required to handle processed product
- Decarbonisation of the grid will happen according to a high emissions reduction scenario (80% by 2050)
- Emissions due to transport of material from the site were considered out of scope

2.3 EMISSIONS ASSESSMENT

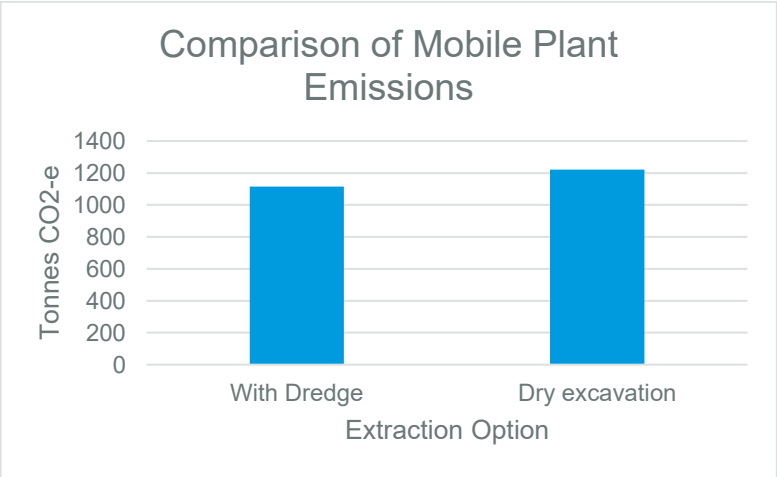
The emissions sources outlined above have been assessed. Diesel and electricity usage figures obtained from the site were converted to emissions using the *National Greenhouse Accounts Factors* (Department of the Environment and Energy, 2021), specifically Table 4 (Diesel Oil) and Table 46 (latest estimate Full Cycle Emission Factor for electricity in Victoria).

The two main sources of GHG emissions were diesel usage in mobile plant, and electricity consumption primarily for processing plant operation but including ancillary uses such as office facilities.

2.3.1 GHG from mobile plant

The use of a dredge to extract material from the pit decreases emissions slightly compared to the current dry excavation method. A comparison of emissions from mobile plant in different scenarios is presented in **Figure 2-1** below.

Figure 2-1 Mobile Plant Scenarios



The dredge excavation option will be the primary method at the site in future due to the depth of excavation required and has been assumed in this assessment. Overall, GHG emissions from mobile plant are forecast to remain consistent during the site's lifespan at about 1,114t CO_2-e per annum.

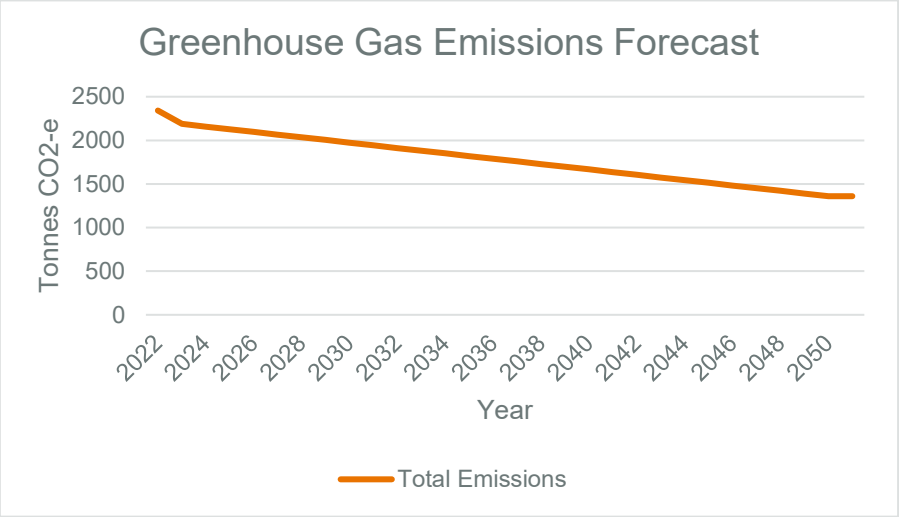
2.3.2 GHG Due to Electricity Use

Electricity use is assumed to remain constant at the 2021 rate of 1,227,665 kWh per annum. However, greenhouse gas emissions per kWh are forecast to fall due to decarbonisation of the electricity grid. Therefore, in 2022, electricity was forecast to generate approximately 1,225t CO_2-e while in 2052, emissions from electricity usage drop to only 245t CO_2-e.

2.3.3 Overall GHG Assessment

The emissions (from mobile plant and electricity usage) are presented in **Figure 2-2** below. The forecast shows the effect of decarbonisation of the electricity grid, while mobile plant usage is forecast to remain consistent, with an assumed production of 400,000tpa of material until 2052. Overall, greenhouse gas production is forecast to fall from 2,341t CO_2-e in 2022 to 1,359t CO_2-e in 2052.

Figure 2-2 Emissions forecast



3. CLIMATE CHANGE ADAPTATION

Climate change is impacting Victoria in a range of ways including changes to temperature and rainfall patterns. Some of these changes will require proactive mitigation from parties involved in managing activities while others will have no impact or a benefit to operations.

3.1 POTENTIAL IMPACTS

A summary of the potential (worst case) climate change impacts by 2050, sourced from Victoria's Climate Science Report (DELWP, 2019), is shown in **Figure 3-1** below.

Figure 3-1 Climate Change Impacts

Source: Victoria's Climate Science Report 2019

The *Guidelines for Assessing the Impact of Climate Change on Water Availability in Victoria* (DELWP, Nov 2020) provide detailed local predictions for the years 2040 and 2065 for temperature, potential evapotranspiration, rainfall, runoff and groundwater recharge, for each river basin in Victoria.

This data is provided for two Representative Concentration Pathways (RCPs) incorporating different scenarios of greenhouse gas emissions and concentrations over time. This report has assumed the mid-point projection of the highest climate change scenario (RCP8.5) to provide a conservative estimate of impacts. Expected changes, relative to a 1995 baseline in the relevant catchment (Bunyip River basin), are presented in **Table 3-1** below.

Table 3-1 Local Catchment Climate Change Impacts

Aspect	Change	
	2040	2065
Average Annual Temperature	+1.2ºC	+2.1ºC
Potential evapotranspiration	+4.3%	+7.3%
Annual Streamflow	-13.7%	-19.1%

Annual total rainfall is not an appropriate measure of water management challenges at a local scale, and the changes in seasonality of rainfall predicted in the guidelines are less relevant than the runoff assessment presented in **Section 3.1.2** below.

Groundwater recharge is also not a suitable metric for this assessment as groundwater is being actively managed and extracted at this site, changing the local conditions such that general aquifer recharge rates are not relevant.

The key changes induced by climate change that will impact the operation of Yannathan Quarry are:

- Longer fire seasons – 60% more high fire danger days
- More intense downpours
- Increased evapotranspiration

3.1.1 Longer Fire Seasons

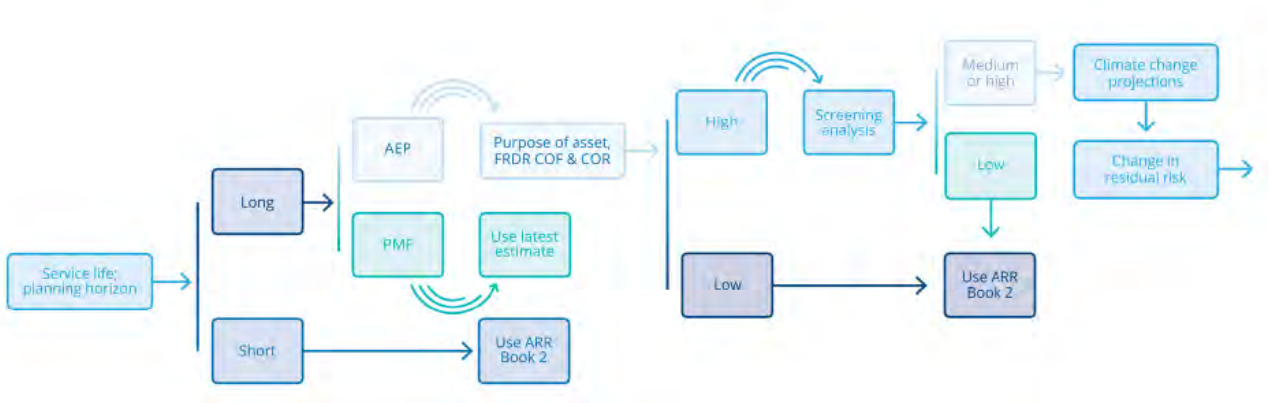
The potential increased number of high fire danger days will pose an increased risk of fires affecting the site's operations and of grass fires on the site's buffer, rehabilitated and undeveloped areas. Fires in the area may cause interruptions to the site's operations and fire damage to plant and equipment, which would be expected to occur at a higher frequency under a future climate scenario. This change does not change the actions required to address the risk as these remain similar regardless of the frequency.

3.1.2 More intense downpours

An assessment of the impacts of climate change on the volume and intensity of runoff was undertaken using the methodology in Chapter 6 of Australian Rainfall and Runoff: A guide to Flood Estimation (Ball J, 2019) (known as the ARR). The methodology is outlined in **Figure 3-2** below.

Figure 3-2 Climate Change Risk Assessment Methodology

Source: Figure 1.6.2, Chapter 6, Australian Rainfall and Runoff: A guide to Flood Estimation



A service life assumption for the facility of 30 years was adopted based on the expected reserves available at the site and the proposed rate of extraction. This is defined as a long horizon in the ARR, finishing in 2052.

The applicable design standard is assumed to be the Annual Exceedance Probability (AEP), as the site is not flood prone (being outside the Land Subject to Inundation Overlay which is to the north of the site) and the key design issue is management of runoff into the pit rather than flooding risk.

Therefore the facility was assessed for its Consequence of Failure (COF). The COF is assessed according to the following descriptions.

- *Low consequence* - some probability that asset performance will be impacted but the delivery of services will be only partially or temporarily compromised, or alternative sources of services (e.g. availability of different power sources) are readily available.
- *Medium consequence* - moderate to large probability that performance of important but non-critical assets and delivery of services will be impacted or fail for a short period of time.
- *High consequence* - moderate to large probability that performance will be impacted or fail, leading to disruption to delivery of essential services (where alternative sources of services are not readily available). This category generally relates to high value assets, or assets of significant economic or welfare importance.

It is assessed that the COF is Low. The system is capable of managing the water generated by single rainfall events through storage located in the pit and asset performance is unlikely to be more than partially or temporarily compromised by the presence of additional surface water. It is therefore suggested that no allowance for climate change-related rainfall increases is required, and an assessment of the Cost of Retrofitting (COR) is not relevant.

3.1.3 Increased evapotranspiration

The increase in evapotranspiration will assist the site's water balance by improving the rainfall / evapotranspiration balance and reducing the need to manage and discharge water to surface water receptors.

3.2 SUMMARY

Yannathan Quarry will be impacted by climate change in three key areas:

1. Increased fire danger
    - It is suggested that fire management measures continue to be adopted at the site
2. Increased intensity of rainfall events
    - No additional management measures are suggested due to the low consequence of failure and built in buffering in the system.
3. Increased evapotranspiration
    - This change will assist in managing the water balance at the site, minimising the requirement to discharge water to surface water bodies.

4. REFERENCES

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Appendix M Correspondence with Regulators

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PO Box 11219, Frankston VIC 3199
336-340 Nepean Hwy, Frankston VIC 3199
Ph: (03) 9770 1273
www.bunuronglc.org

30 January 2023

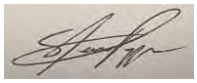
To whom it may concern,

Approval Notice for Cultural Heritage Management Plan 17359 – Proposed Expansion at Yannathan Quarry, Yannathan. Cover date: 30 December 2022.

We refer to your application to the Bunurong Land Council Aboriginal Corporation requesting approval of the above cultural heritage management plan (CHMP).

With reference to section 63(1)(a)(i) of the *Aboriginal Heritage Act 2006* (Act), the Bunurong Land Council Aboriginal Corporation as the Registered Aboriginal Party (RAP), have evaluated and approved this CHMP. The conditions set out in this CHMP are now compliance requirements.

Kind regards,



Steven Pepper
Cultural Heritage Manager
steven.pepper@bunuronglc.org.au

*This notice of approval must be inserted after the title page and bound with the body of the CHMP

STATEMENT OF ACKNOWLEDGEMENT

Our community culturally and spiritually acknowledge our ancestors who have provided our community today with the opportunity to continue to practice our culture and be a representative voice for our land, waters and community. We value and acknowledge the relationships we have with all practitioners on Bunurong country to facilitate and nurture the protection and preservation of our shared culture, Bunurong culture.

MacInnes, Kathy

Subject: FW: 20220075 Hanson Sand Quarry Extension, Yannathan: Air Qual Real-time Monitoring (provided a former Langwarrin reporting as an example for Yannathan to be still modelled)_EPA response

From: Natalie Shade <Natalie.Shade@epa.vic.gov.au>
Sent: Sunday, 14 August 2022 11:25 PM
To: Enzo De Fazio <enzod@edgegroup.net.au>
Cc: Jason Choi <Jason.Choi@epa.vic.gov.au>; Zaro Kasi <zaro.kasi@edgegroup.net.au>; ERR Referrals <err.referrals@epa.vic.gov.au>
Subject: RE: 20220075 Hanson Sand Quarry Extension, Yannathan: Air Qual Real-time Monitoring (provided a former Langwarrin reporting as an example for Yannathan to be still modelled)_EPA response

OFFICIAL

Thanks for your notes below Enzo.

Can you let us know how this variation procedures as it assists us to be aware of when they may be referred to us.

Thanks
Cheers
Natalie

Natalie Shade
Senior Project Advisor
Development Advisory

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From: Enzo De Fazio <enzod@edgegroup.net.au>
Sent: Friday, 12 August 2022 4:39 PM
To: Natalie Shade <Natalie.Shade@epa.vic.gov.au>
Cc: Jason Choi <Jason.Choi@epa.vic.gov.au>; Zaro Kasi <zaro.kasi@edgegroup.net.au>; ERR Referrals <err.referrals@epa.vic.gov.au>
Subject: RE: 20220075 Hanson Sand Quarry Extension, Yannathan: Air Qual Real-time Monitoring (provided a former Langwarrin reporting as an example for Yannathan to be still modelled)_EPA response

OFFICIAL

Thanks Natalie

See my comments next to yours in red.

Regards

Enzo

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From: Natalie Shade <Natalie.Shade@epa.vic.gov.au>
Sent: Thursday, 11 August 2022 4:57 PM
To: Enzo De Fazio <enzod@edgegroup.net.au>
Cc: Jason Choi <Jason.Choi@epa.vic.gov.au>; Zaro Kasi <zaro.kasi@edgegroup.net.au>; ERR Referrals <err.referrals@epa.vic.gov.au>
Subject: 20220075 Hanson Sand Quarry Extension, Yannathan: Air Qual Real-time Monitoring (provided a former Langwarrin reporting as an example for Yannathan to be still modelled)_EPA response

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

OFFICIAL

Hi Enzo

Due to the nature of particle sampling, you generally need to have a PM10 inlet (Figure 1) for PM10 monitoring, to measure PM2.5, you then need a PM2.5 cyclone (Figure 2) in the sampling line. So for monitoring like EPA does at our ambient stations, it's not possible to do both via a single inlet. The physical separation of the particles before going into

the instrument gives us the greatest confidence that what we are measuring is PM10 and PM2.5. That's fine – sounds like two instruments (one for PM10 and one for PM2.5) – we've had a provider come and see us already.

If you prefer to use a non standard instrument to derive the background, you're going to have to then demonstrate that the data is comparable with something like the instruments we discussed (10/08/2022). This may be difficult to achieve with the compressed timelines that your client has indicated, which is why we might consider using other data over five years as an alternative to one year of local monitoring. Ok – acknowledged.

In terms of your second question, what you are trying to achieve with the background monitoring is establishing a background concentration. You may want to look at the wind data and select a site which is generally up wind (i.e., not impacted by the activities of the site). This way when the background is added to the modelled outputs, there is less double counting. Acknowledged (and we have good data/wind roses from Nilma North to assist us) – I'll have to let my client know that this is all around background monitoring – they may have thought that this was all around monitoring the impact of their site but rather it's the impacts from others around them

Also, as per our discussion, once you've got the right controls that minimise the risk enough, i.e., haul roads sealed where possible, stockpiles with some cover, adequate wind breaks around stored materials.... then we can say that the proposed design is best practice and would likely meet the GED, then the emphasis on modelling the residual risk is easier and using background data from further away is less of an issue. Ok - acknowledged

Figure 1 - PM10 inlet

Figure 2 - PM2.5 cyclone

Cheers
Natalie

Natalie Shade
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Sent: Wednesday, 10 August 2022 8:08 PM
To: Natalie Shade <Natalie.Shade@epa.vic.gov.au>
Cc: Jason Choi <Jason.Choi@epa.vic.gov.au>; ERR Referrals <err.referrals@epa.vic.gov.au>; Zaro Kasi <zaro.kasi@edgegroup.net.au>
Subject: RE: 20220075 Hanson Sand Quarry Extension, Yannathan: Air Qual Real-time Monitoring (provided a former Langwarrin reporting as an example for Yannathan to be still modelled)_EPA response

OFFICIAL

Hi Natalie

Thanks for today's meeting.

Jason spoke about the following pieces of air monitoring equipment:

- Partisol (I'm assuming it's the 2025i Sequential Air Sampler?, which monitors both PM2.5, PM10)
- TEOM – for PM10 (but I know it can be used for PM2.5)
- 5014i (Beta Continuous Ambient Particulate Monitor, which monitors both PM2.5, PM10)
- BAM 1022 (looks like this may only measure PM2.5??)

These appear to be all different pieces of equipment. What is the piece (a one-stop shop?) that other mines and/or quarries use that you know of? I'm confident that my client would want one type that can measure both PM2.5 and PM10 (at hourly intervals at a minimum).

Further, do other sites just go for one monitoring location? In our case, there is a cattery/kennel (and associated caretaker house) and broiler farm to the east and west of our client's site, respectively as per the image below. Therefore, would that constitute/trigger two items of equipment? If any site you know are using one piece of equipment, are they moving it around the site – say six months at a time to get data from multiple parts of their site?

Regards

Enzo

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From: Natalie Shade <Natalie.Shade@epa.vic.gov.au>
Sent: Tuesday, 9 August 2022 5:16 PM
To: Enzo De Fazio <enzod@edgegroup.net.au>
Cc: Jason Choi <Jason.Choi@epa.vic.gov.au>; ERR Referrals <err.referrals@epa.vic.gov.au>; Zaro Kasi <zaro.kasi@edgegroup.net.au>
Subject: RE: 20220075 Hanson Sand Quarry Extension, Yannathan: Air Qual Real-time Monitoring (provided a former Langwarrin reporting as an example for Yannathan to be still modelled)_EPA response

OFFICIAL

Thanks Enzo, noted

Natalie Shade
Senior Project Advisor
Development Advisory

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From: Enzo De Fazio <enzod@edgegroup.net.au>
Sent: Tuesday, 9 August 2022 4:30 PM
To: Natalie Shade <Natalie.Shade@epa.vic.gov.au>
Cc: Jason Choi <Jason.Choi@epa.vic.gov.au>; ERR Referrals <err.referrals@epa.vic.gov.au>; Zaro Kasi <zaro.kasi@edgegroup.net.au>
Subject: RE: 20220075 Hanson Sand Quarry Extension, Yannathan: Air Qual Real-time Monitoring (provided a former Langwarrin reporting as an example for Yannathan to be still modelled)_EPA response

OFFICIAL

Hi Natalie

Thanks for below. Yes, the meeting would work tomorrow. I'll send an invite out. I'm going to invite Piya Dewundege (pDs; ex EPA) as he's been assisting us with modelling and my colleague Zaro.

Regards

Enzo

Enzo De Fazio
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From: Natalie Shade <Natalie.Shade@epa.vic.gov.au>
Sent: Tuesday, 9 August 2022 3:27 PM
To: Enzo De Fazio <enzod@edgegroup.net.au>
Cc: Jason Choi <Jason.Choi@epa.vic.gov.au>; ERR Referrals <err.referrals@epa.vic.gov.au>
Subject: RE: 20220075 Hanson Sand Quarry Extension, Yannathan: Air Qual Real-time Monitoring (provided a former Langwarrin reporting as an example for Yannathan to be still modelled)_EPA response

OFFICIAL

Hi Enzo

EPA has reviewed the below information you provided. I suggest we have a brief meeting to discuss further, Jason and I are available Wed 10 August 12-1230pm.

Based on EPAs review we have the following comments:

- The assessment should be carried out against the criteria in EPA publication 1961 - Guideline for Assessing and Minimising Air Pollution (GAMAPV) rather than the PEM as we will be making our assessment against the ERS and EPA Publication 1961. EPA Publication 1961 is the key guidance document for your reference.
- The assessment will be looking at the GED and minimising emissions as far as reasonably practicable and not assuming that levels below those in the ERS/EPA Publication 1961 are acceptable.

- All activities that can generate emissions should be included in the modelling and should be outlined in the report, at first glance it seems that there should be other sources beyond the dozer and the wind erosion from the active site.
- The five years of met data is the expectation and there should be hourly background data used as per our discussions. For sites which have collected their own data, EPA has accepted a single year of monitoring data as background. The preference would be to have monitoring carried out nearby to establish background. EPA has looked at what stations are nearby and suggest Moe for PM2.5 and Traralgon for PM10 could be used as a plan B if the project does not do their own monitoring. There is suitable data from 2016 to 2020 which could be used. The Moe PM2.5 data is lower than that at Alphington and Traralgon and should be ok. There's not a lot of difference in the pattern for PM10 between Alphington and Traralgon, but Traralgon is closer.

Thanks
Cheers
Natalie

Natalie Shade
Senior Project Advisor
Development Advisory

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From: Enzo De Fazio <enzod@edgegroup.net.au>
Sent: Thursday, 4 August 2022 7:44 AM
To: Natalie Shade <Natalie.Shade@epa.vic.gov.au>
Cc: Jason Choi <Jason.Choi@epa.vic.gov.au>; ERR Referrals <err.referrals@epa.vic.gov.au>
Subject: RE: 20220075 Hanson Sand Quarry Extension, Yannathan: Air Qual Real-time Monitoring (provided a former Langwarrin reporting as an example for Yannathan to be still modelled)

OFFICIAL

Hi Natalie (for Jason and whoever else)

The attached report (20200032-R-01 AQ MOD_v2) was identified in which relevant data was used for the proposed (Langwarrin) quarry Site to be operated by Hanson: *Air Quality Assessment – Lots 1 And 2 Dp732708 Old Telegraph Road, Maroota Proposed Sand Quarry, Job ID.08915, Pacific Air Environment for PF Formation (04 September 2014).*
This report will be referred to as the "*Maroota Report.*"
This *Maroota Report* contains a quarry rate of 100,000 tonnes/year and for the purposes of the subject site and consistent with Level 2 (EPA) assessment, this rate will be factored to the appropriate quarry rate for the Yannathan quarry expansion.

The dust emissions (extrapolated from the *Maroota Report*) during operation of the proposed (expanded) Hanson quarry will be estimated based on activities and equipment operating as follows:
• Dozer clearing vegetation/topsoil to operate up to a nominated period of time; and
• Wind erosion from active extraction area for a nominated period of time.

The Power, Emission Factor and Load Factor values will be obtained from *National Pollutant Inventory, Emission Estimation Technique Manual for Combustion Engines, Version 3.0, Australian Government, Department of the Environment, Water, Heritage and the Arts, June 2008 (or whatever is the most current version at the time).*

We will use background data – we just have not confirmed where we will get this from in this area as I recall Alphington ended up not being appropriate for Langwarrin. Having conducted a site inspection of the Yannathan area, the background is expected to be low (and likely to be set at that accordingly based on what is occurring on the Yannathan Site at the moment and the expected expansion). Happy if EPA was to give any sources of data that other consultants have used in this area. There are no known sources of air quality parameters that will be modelled in this assessment (PM10, PM2.5 and combustion gases) that we consider to be significant.

We are providing you the base report (even though it is out-dated now compared against the new legislation) as a sample only. What is more relevant is the addendum provided and we would prepare our modelling assessment consistent with this. As you can see, we have included Total Varying Background (TVB) in the Langwarrin assessment and we expect to do the same for Yannathan using the attached Maroota data to be used as source data.

I've also attached the 5yrs worth of Met Data, which will be used in our modelling assessment.

In a separate submission (as part of the EMP focussing on dust, we have accessed the Nilma North database for wind direction data)

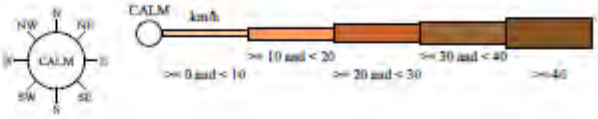
Rose of Wind direction versus Wind speed in km/h (13 Jan 2014 to 28 Jun 2022)

Custom times selected, refer to attached note for details

NILMA NORTH (WARRAGUL)

Site No: 085313 • Opened Jan 2014 • Still Open • Latitude: -38.1321° • Longitude: 145.9865° • Elevation 134.1m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



9 am
3073 Total Observations

Calm 10%

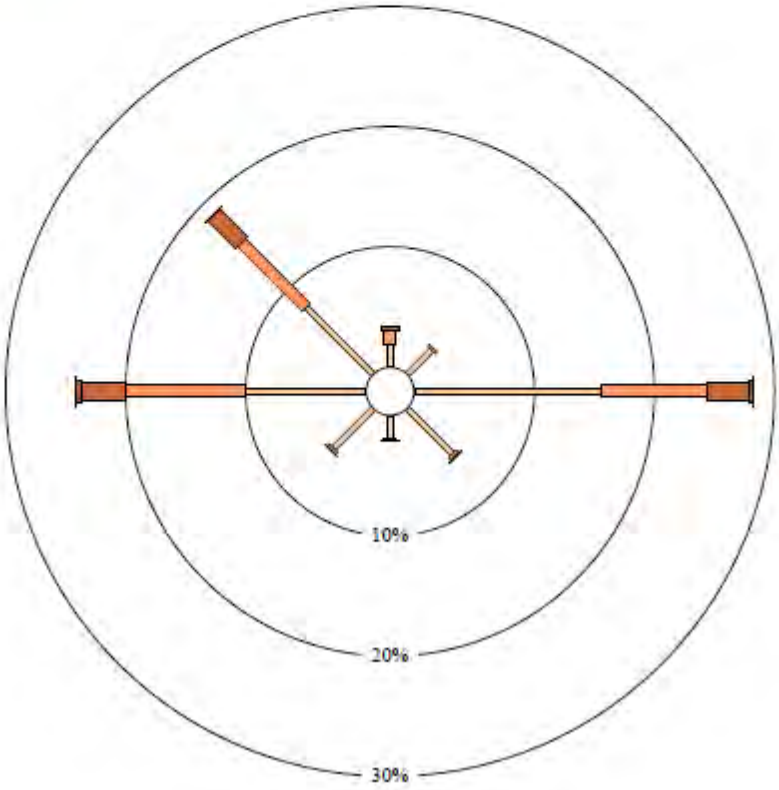


Figure 1 – Wind Rose showing 9am annual average wind speed and directions

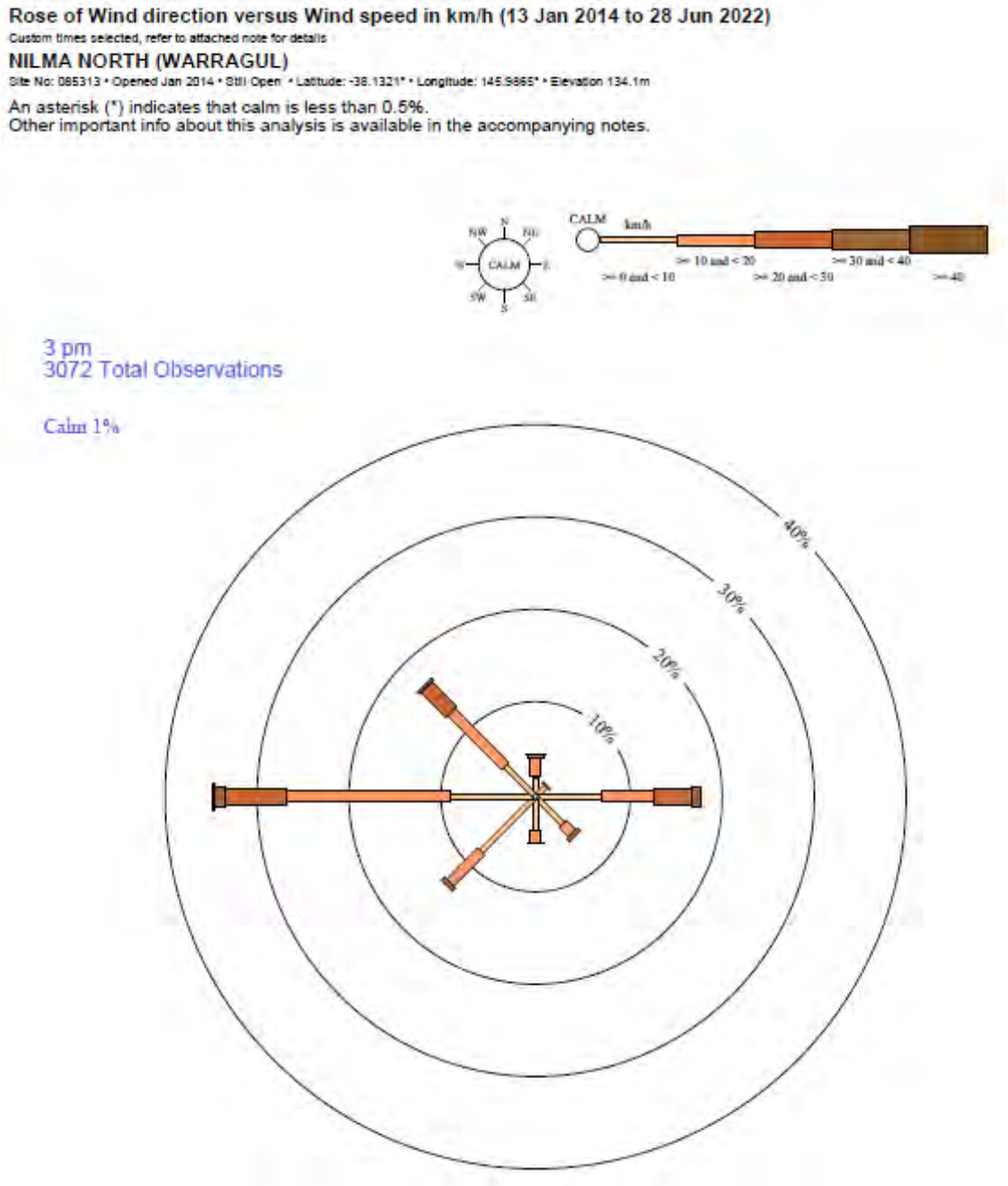


Figure 2 – Wind Rose showing 3pm annual average wind speed and directions

Appreciate any advice you may have (although I realise you cannot consult) to make the (ERR) application pathway smooth for our client.

Regards

Enzo

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From: Enzo De Fazio
Sent: Wednesday, 3 August 2022 12:44 PM
To: Natalie Shade <Natalie.Shade@epa.vic.gov.au>
Cc: Jason Choi <Jason.Choi@epa.vic.gov.au>; ERR Referrals <err.referrals@epa.vic.gov.au>
Subject: RE: 20220075 Hanson Sand Quarry Extension, Yannathan: Air Qual Real-time Monitoring

Hi Natalie

Thanks for your time yesterday (and Jason's). We plan on sending you the data set this week (ASAP) for EPA review.

I will pass your email below to my client.

Regards

Enzo

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From: Natalie Shade <Natalie.Shade@epa.vic.gov.au>
Sent: Wednesday, 3 August 2022 11:38 AM
To: Enzo De Fazio <enzod@edgegroup.net.au>; ERR Referrals <err.referrals@epa.vic.gov.au>
Cc: Jason Choi <Jason.Choi@epa.vic.gov.au>
Subject: RE: 20220075 Hanson Sand Quarry Extension, Yannathan: Air Qual Real-time Monitoring

OFFICIAL

Hi Enzo

Following on from the discussion yesterday regarding Yannathan extension we note an action from the discussion was that EPA will receive a data set to review. When provided to EPA for review please note we will require at least two weeks given our work pipeline and priorities.

I hope Hanson and Ricardo have clarity on EPA expectations regarding air pollution. We highly recommend the review and consideration of EPA publication 1961 Guideline for Assessing and Minimising Air Pollution in Victoria. Please share with them. It is also important to note that the *Environment Protection Act 2017* is a concurrent requirement to other legislation relevant to the extractive industry with specific reference to the general environmental duty.

Thanks
Cheers
Natalie

Natalie Shade
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Development Advisory

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From: Enzo De Fazio <enzod@edgegroup.net.au>
Sent: Tuesday, 2 August 2022 8:30 AM
To: Natalie Shade <Natalie.Shade@epa.vic.gov.au>

Cc: Zaro Kasi <zaro.kasi@edgegroup.net.au>; gunther.benedek@hanson.com.au; Jason Choi <Jason.Choi@epa.vic.gov.au>; andrew.ritchie@hanson.com.au; MacInnes, Kathy <Kathy.MacInnes@ricardo.com>; dave.adams@ricardo.com
Subject: RE: 20220075 Hanson Sand Quarry Extension, Yannathan: Air Qual Real-time Monitoring

OFFICIAL

Thanks Natalie

We understand.

Could we aim for 3.30pm today as the first preference as we would be able to all make it?

Failing that, we would take the 3pm (or even 3.15pm?) slot (but Dave Adams from Ricardo would not be able to make it until 3.30pm).

Regards

Enzo

P.S. Please find attached an aerial of the site.

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From: Natalie Shade <Natalie.Shade@epa.vic.gov.au>
Sent: Tuesday, 2 August 2022 8:14 AM
To: Enzo De Fazio <enzod@edgegroup.net.au>; gunther.benedek@hanson.com.au; Jason Choi <Jason.Choi@epa.vic.gov.au>; andrew.ritchie@hanson.com.au; MacInnes, Kathy <Kathy.MacInnes@ricardo.com>; dave.adams@ricardo.com

Cc: Zaro Kasi <zaro.kasi@edgegroup.net.au>
Subject: RE: 20220075 Hanson Sand Quarry Extension, Yannathan: Air Qual Real-time Monitoring

OFFICIAL

Hi Enzo

Late notice but can we change the meeting time to 3pm today – I need to accommodate for Jason's availability, and we are all managing COVID and what that means individually for us.

If it cant be 3pm today we would need to defer the meeting as we need technical input.

Thanks
Cheers
Natalie

Natalie Shade
Senior Project Advisor
Development Advisory

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-----Original Appointment-----
From: Enzo De Fazio <enzod@edgegroup.net.au>
Sent: Friday, 29 July 2022 7:52 AM
To: Enzo De Fazio; gunther.benedek@hanson.com.au; Natalie Shade; Jason Choi; andrew.ritchie@hanson.com.au; MacInnes, Kathy; dave.adams@ricardo.com
Cc: Zaro Kasi
Subject: 20220075 Hanson Sand Quarry Extension, Yannathan: Air Qual Real-time Monitoring
When: Tuesday, 2 August 2022 1:00 PM-1:45 PM (UTC+10:00) Canberra, Melbourne, Sydney.
Where: Microsoft Teams Meeting

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27 July 2022

Julian Giannetti
Engeny Water Management
Tenancy 5, Level 34, 360 Elizabeth Street
Melbourne VIC 3000

Dear Julian,

Proposal: Review of Stormwater Management Strategy
Site location: 870 Westernport Road, Yannathan

Melbourne Water reference: MWA-1188291
Date referred: 09/10/2020

Plan reference: Reference 1100501, Coronet Bay Estate Stages 4 - 12, Coronet Bay Stormwater Management Strategy, prepared by Beveridge Williams, dated 24 October 2019

Thank you for your submission of the above referenced document.

Melbourne Water has reviewed the submitted information/plans and provides the following advice and requirements:

Hydraulic assessment

The following comments are provided from the floodplain management and waterway hydraulic function
perspective:

- The SWMP references a report by ATC Williams as being the design report for the waterway remodelling along the eastern and north-eastern sides of the quarry, however this report was only for the concept design. The final design of the remodelling works was undertaken by GHD on behalf of Hanson under a Works Offer Agreement with Melbourne Water.

The final design increased the width of the waterway to around 40m with a meandering pilot channel with pools and riffles to satisfy Melbourne Water requirements. See attached plans.

- The proposed staging of works for the quarry does not adequately outline how the waterway, including the floodplain, is being managed for each stage. Floodwater from the catchment are not supposed to enter an excavation hole. The last stage of rehabilitation once extraction is completed does not provide any indication of what the rehabilitated land form may be.
- The backfilling of a quarry and construction of a waterway on the backfilled land has not previously been approved. If it is to be considered, we will need guarantee

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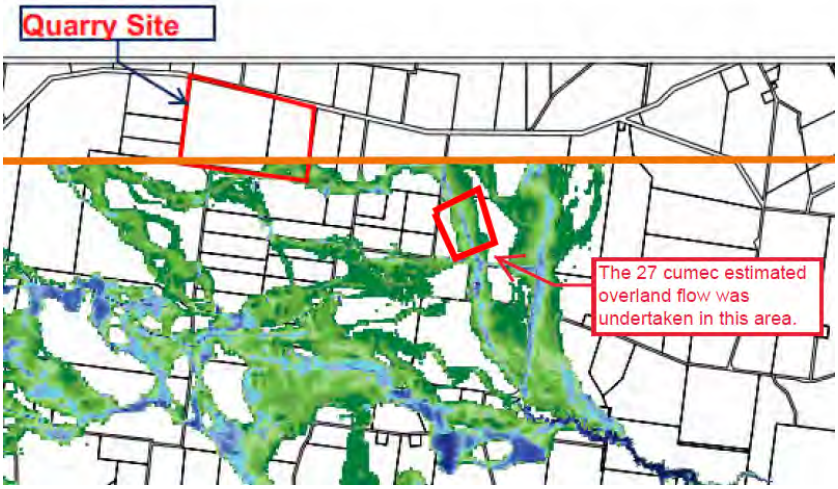
from geotechnical consultants that the backfilled land is as good as or better than undisturbed land for the long term stability of the waterway (including floodplain). (This could covered as part of works offers.

- The assessment of the local catchment (Scenario 1) has determined a different catchment area to what was previously determined by this office. We do not agree with the reduced catchment area. The local catchment definition is only an issue for work / assessments using the flow from the local catchment. As the dominant design flow for the waterway is the break-away flow from the Little Lang Lang River, their adoption of the 1% AEP Q=27.8 m3/s is accepted for the 1% AEP design flow for the proposed realignment.
- For the Little Lang Lang River catchment flooding, it is agreed that the straight horizontal line
  represents the boundary of the Cardno Sobek model. The overland break-away flow heading to
  the quarry property was estimated from the area marked in the below portion of the Cardno
  results plot. The Cardno Sobek model used 20m x 20m grid size.



- The HEC-RAS steady state modelling does not evaluate loss of floodplain storage. Additional modelling and/or a change of modelling technique will need to be undertaken.
- The Little Lang Lang River is not one of the waterways that Melbourne Water provide advice to the Bureau of Meteorology for the issuing of flood warnings. Therefore it cannot be assumed that any warning of rising floodwaters will be available.
- The comparison of velocities in Table 5.2 shows Existing and Design but there is no statement specifying whether it is from Scenario 1 or Scenario 2. The table also only compares the velocities upstream and downstream of the reach being remodelled. The requirement is that the remodelling was not to increase the velocity within the reach being remodelled.
- The Concept design only looks to be based on hydraulic objectives. Waterway form objectives should also be included in the concept design. Continuing the previously remodelled waterway (Reach A) would be an expected design.
- Appendix G & H, HEC-RAS section plots are not usable without knowing which section is which.Additional results tables including channel and overbank for V, Q & Shear would also be useful.

Waterway health and environmental assessment

1. The Stormwater Management Strategy shows the design of the realigned channel as having a much enlarged channel size than the Section A which is upstream. Review of the concept design for Section B generates the following comments:

- The waterway form of Section B is not consistent with Section A even though on p28 of the Strategy it is stated that "*The proposal is to build a similar style of constructed waterway to what now exists in Reach A. On this basis it would be*

expected that the waterway diversion would improve the overall condition of reaches B and C of the waterway once the diversion construction is completed." From a geomorphic & waterway health perspective this would be a preferred scenario. Utilising a meandering low flow channel within a wider floodplain corridor in a similar proposal to Reach A and designing this to mimic the Swampy riparian woodland small, low gradient waterways of the local area would be a geomorphically more appropriate waterway in the landscape context and would transition into upstream & downstream reaches.

2. Melbourne Water has concerns regarding construction of a waterway within backfill conditions, and our preference would be that the proposed waterway alignment corridor remain under natural conditions – ie not be excavated for improved stability & long term viability.

3. Melbourne Water requires that works be conducted during low flow conditions, i.e. in summer and that the realigned waterway be constructed and stabilised prior to carrying any flow. This will help to minimise transportation of sediment downstream.

4. Provision of adequate maintenance access to waterway

5. A landscape concept plan is to be included with the realignment design showing revegetation of the waterway & corridor to mimic Swampy Riparian woodland EVC and consideration of the movement of water through the site & waterway corridor.

6. Provision of a waterway corridor similar in width or greater to Reach A which can supply the floodplain function & transfer flows above the low flow capacity of the channel.

7. Provide further information of the consideration of the realigned waterway design in the context of long term rehabilitation of the site.

8. Provide Fencing to exclude livestock from waterway & corridor – Note: this was also a condition of realignment of Reach A but photos suggest livestock have had access to waterway which will have impacted vegetation establishment success & potentially waterway stability.

Melbourne Water has previously received Technical advice from Streamology on 26 July 2022, in which the following recommendation is to be noted (page. 4):

'To assist with negotiating an appropriate offset which will minimise the risks of piping failure, additional investigation should be undertaken, particularly relating to geotechincal stability of substrate (floodplain and bund)

Advice

It is advised that the above requirements are to be addressed in an amended strategy and/or accompanying documents prior to progressing for a works offer application for the re-alignment of the waterway.

For general development enquiries contact our Customer Service Centre on 131722.

Regards,

Segujja Kakembo
Development Planning Services

Southern Rural Water
Managing Water. Serving Communities.

7 October 2020

Kathy Mac Innes
Associate Director
Ricardo Energy, Environment & Planning
Level 4, 3 Bowen Crescent,
Melbourne, Victoria 3004

Sent by email to kathy.macinnes@ricardo.com

Dear Kathy

Yannathan Quarry (Lang Lang) – SRW feedback in relation to proposed quarry expansion (Work Plan Variation WA127)

Thank you for the copy of your updated groundwater assessment of the proposed quarry expansion (draft version 3.0 emailed 30th Sept 2022), and for the subsequent discussion on 4th October regarding this proposal.

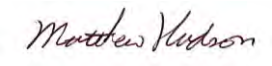
Our feedback is as follows:

- We note that the expansion proposal is now for dredging and you have indicated that the volumes of product removed, and the associated groundwater, will remain within the existing licence volume of 19.8ML/year. Based on this information no increase in groundwater licence is necessary. In order to evidence this, please can you confirm in writing the current and projected annual product volumes, and the calculation of water taken. Please can you also confirm any other proposed consumptive uses of groundwater, e.g. dust suppression, vehicle washing or irrigation, and if these are proposed, whether they fit within the licence limit.
- I note from your report and the discussion on the 4th October that there are no farm dams on the property that will be impacted and that the existing drainage line will be diverted around the quarry extension. Based on this information there are no surface water licensing implications from a SRW perspective.
- SRW recommends that the existing groundwater monitoring network is reviewed and expanded to ensure that the upper shallow aquifer and the lower shallow aquifer are both monitored around the perimeter of the proposed quarry property. This is particularly important given the number of stock and domestic and licensed bores in the vicinity. Groundwater level data should be collated annually and reports made available to the relevant authorities.

- SRW recommends that the proponent undertakes a risk assessment of the proposed quarrying activities in respect of potential water quality changes that may occur, including but not limited to chemicals on site, chemicals used in the processing of aggregates, and the disturbance caused by the dredging activity.
- The groundwater quality data in the report indicates that the groundwater ph at the western end of the site (ph 4 – 5). is lower than the background (ph 6 – 7). SRW suggests that the cause of the low ph is identified and this issue is included in the risk assessment. Is there any risk of quarrying increasing the groundwater acidity and will this impact offsite ?
- A suitable water quality monitoring plan, with triggers and actions should be developed to ensure no unacceptable offsite impacts. Groundwater quality data should be collated annually and reports made available to the relevant authorities

Regards

Yours sincerely,



Principal Hydrogeologist

Email Matthewh@srw.com.au