Attachment 8

Additional Information

Attachment 8A

Environmental Noise Assessment

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Environmental Noise Assessment - Wedgefield Tyre Recycling Facility

[redacted]

Reference: 23017813-01_Rev1

Prepared for:
Rowe Group Pty Ltd

Reference: 23017813-01_Rev1

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Date	Rev	Description	Author	Verified
13-Feb-23	0	Issued for Information	[redacted]	[redacted]
23-Feb-23	1	Updated Lot Boundary Analysis	[redacted]	[redacted]

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EXECUTIVE SUMMARY

Noise emissions from the proposed specialist tyre recycling facility at [redacted] (#20) [redacted] has been assessed for compliance against the *Environmental Protection (Noise) Regulations 1997* limits at adjacent industrial Lots. Fixed limits of L_{A10} 65dB, L_{A1} 80dB and L_{AMAX} 90dB apply at Industrial Lease boundary locations at all times of the day.

For day-to-day building services (L_{A10}) operation scenarios using assumed plant noise levels and locations, predicted noise levels are considered compliant when operated during daytime hours, 7.00am to 5.00pm Mondays to Fridays. This includes an assumed array of 6x high Sound Power Level industrial fans located on the warehouse roof. If operations occur outside of these hours, compliance is also achieved.

In all cases, building services-type noise emissions are considered manageable within the context of any forthcoming mechanical design, provided the location of the services at roof level maximises natural screening from the office building roof height(s) to the Lease boundary receivers. It is recommended that the mechanical services designs be reviewed during Detailed Design to ensure compliance with *the Regulations* – this includes any plant not yet identified or assumed in the Schematic Design noise model.

Regards specialist tyre recycling machinery, operating indoor tyre recycling plant as per plant layout requires noise mitigation to comply at the southern and northern Lot boundary(s):

- Where all roller doors are required to be open for operations/airflow reasons, alternative mitigation strategy is to apply internal acoustic absorption using 75mm thick perforated foil faced Anticon™ lining to roof and walls in combination with the screen walls;

- Regards use of internal acoustic absorption using 75mm thick perforated foil faced Anticon™ lining to 100% area of roof and walls:
  - Lining the walls and roof for noise emissions compliance may attract a significant cost given the m^2 area of internal roof and walls for coverage.
  - However, there are multiple benefits to reducing the internal reverberant sound levels from L_{pRev} 83.4dB(A) to L_{pRev} 76.5dB(A) with the treatment installed:
    - Lower internal noise levels imply the office building fabric walls, glazing and roof/ceiling build-ups will require a lower specification to achieve suitable conditions for office work;
    - Anticipating building energy and thermal performance requirements, the internal acoustic lining could be coordinated with thermal requirements where by application of 75mm thick perforated foil faced Anticon™ achieves thermal and acoustic requirements, in a single product.

Note – the calculated Reverberant Sound Pressure Level $L_{P,Rev}$ of 76.5dB(A) with internal linings to 100% roof and wall area is averaged across the entire 2,400m^2 space – operational noise levels will be above 85dB(A) in close proximity to the tyre recycling plant hence OH&S signage and use of ear defenders will be an operational requirement.

- Where internally lining the warehouse space is not preferred, alternative mitigation strategies for compliance will require either:
  - All sliding doors being closed during tyre cutting operations;
  - South (x1) and west (x3) façade sliding doors being closed during operations tyre cutting operations and 100% of the roof areas being lined with 75mm thick perforated foil faced Anticon™;
  - All sliding doors open requires construction of 5.0m solid screen walls to the north and south boundary(s) and 100% of the roof areas being lined with 75mm thick perforated foil faced Anticon™;

To minimise audible noise from day-to-day operations at nearby receiving premises, the following 'best practice' measures are suggested:

- Truck drivers are to be instructed to use good driving techniques and minimise excessive vehicle noise (no air brakes, excessive revving etc);
- Where reversing must occur, alternatives to tonal 'beeper' reversing alarms are to be implemented, whilst still maintaining a safe workplace such as:
  - Trucks and forklifts to be fitted with broadband style alarms; or
  - Reversing alarms are to be turned off and spotters used to ensure a safe environment.
- Delivery activities are to be undertaken in as careful and quiet a manner as practicable and this is to be advised to staff and delivery personnel;
- Areas where known impact noise will occur are to have suitable rubber impact matting installed;
- Service road area is to be smooth and free of gaps that may cause banging when driven over with vehicles, pallet jacks or the like. Control joints are to be filled with non-hardening mastic to provide a flat finish;
- Metal grates shall be secured with rubber gaskets or plastic grates used;
- Waste collection shall not occur outside of Monday to Saturday, 7am to 7pm and Sundays and public holidays, 9am to 7pm. Shows compliance etc.

NB – predicted compliance assumes Sound Power Level (SWL) data interpreted from Manufacturer (Salvadori) of *"~80dB(A) at workstations"*. This data is compared and correlated with Lloyd George Acoustics' previous assessments of tyre recycling facility(s) using on-site measurement methods based upon internal reverberant sound pressure level measurements of ~85dB(A):

As such, a "headroom" of 3dB(A) for compliance is applied to this model. It is recommended the manufacturer supply more detailed noise measurement results which may be used to calibrate and confirm the noise modelling predictions in this report during Detailed Design stage, to ensure compliance with *the Regulations* once the facility is constructed.

1. INTRODUCTION

Lloyd George Acoustics was engaged by Rowe Group Pty Ltd to undertake an environmental noise assessment for a proposed Tyre Recycling Facility to be located at [redacted]. The two Lots are proposed to be amalgamated and form part of an existing industrial estate to the south of [redacted] – aerial imagery identifies the site in *Figure 1-1*.

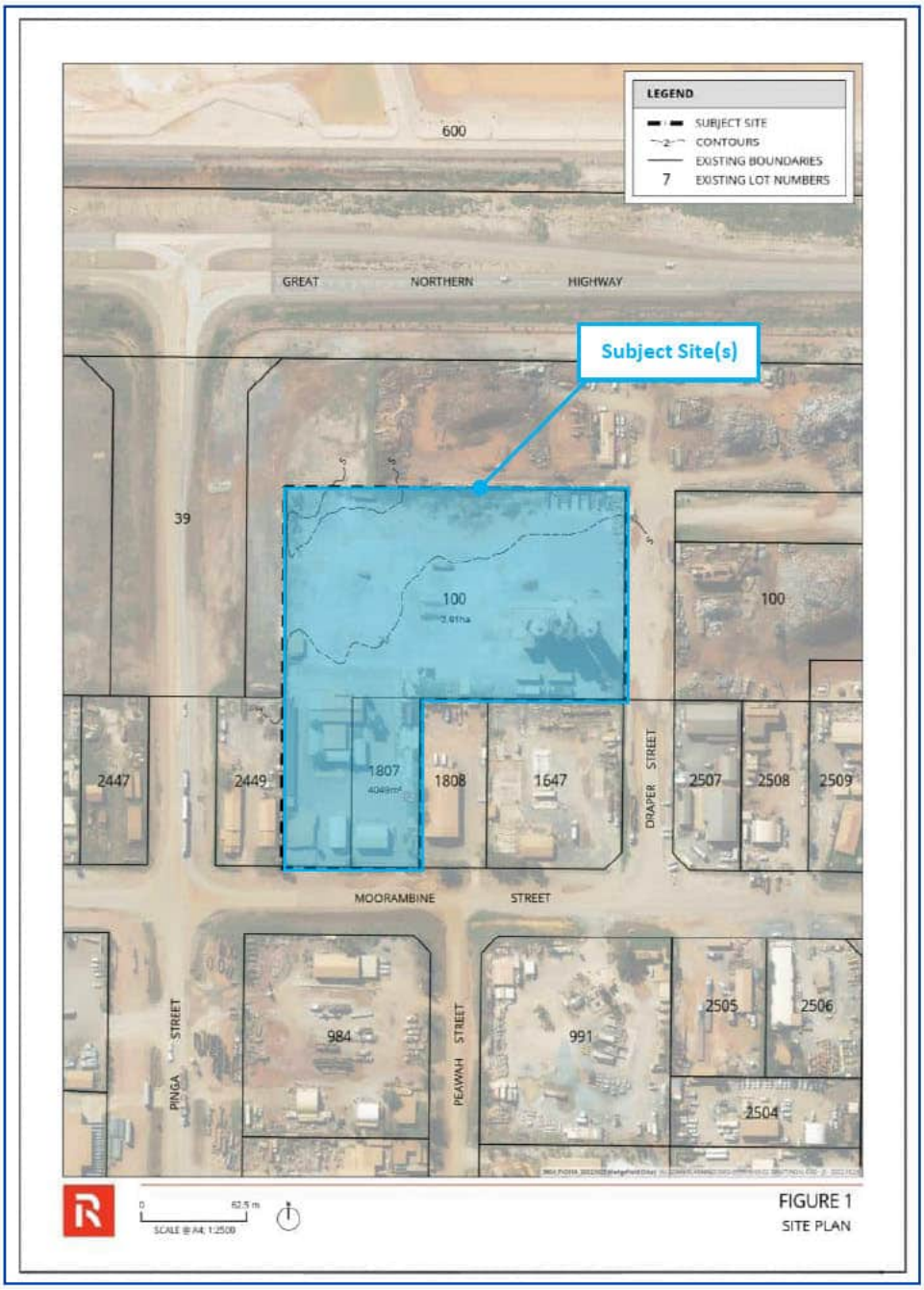


Figure 1-1: Subject Site Location (Source: Rowe Group)

The facility is a new purpose built 2,400m^2 warehouse with internal processing plant specific to recycling large mining spec tyres. *Appendix B* includes specialist equipment suited to recycling large tyres.

Figure 1-2 shows the proposed site plan showing the Subject Lot(s) 100 and 1807, and the proposed lease boundary for use as tyre recycling operations.

Figure 1-2: Subject Site Location (Source: Rowe Group)

The warehouse will have internal industrial fans and internal office building w/AC. Tyres will be in external storage areas. The facility is proposed to operate during nominated business hours of 7.00am to 5.00pm Monday to Friday with all roller doors open. A commercial activity level of up to 72x large tyre drop offs via heavy vehicle truck deliveries per day is anticipated. *Appendix A* contains scheme drawings used in the assessment.

With regard to noise emissions, consideration is given to noise from the primary tyre recycling plant equipment, delivery trucks, tyre unloading incl. forklifts and building mechanical services at the neighbouring industrial Lot boundary, against the prescribed standards of the *Environmental Protection (Noise) Regulations 1997*. *Appendix C* contains a description of some of the terminology used throughout this report.

2. CRITERIA

Environmental noise in Western Australia is governed by the *Environmental Protection Act 1986*, through the *Environmental Protection (Noise) Regulations 1997* (the Regulations).

2.1. Regulations 7, 8 & 9

This group of regulations provide the prescribed standard for noise as follows:

"7. Prescribed standard for noise emissions

(1) Noise emitted from any premises or public place when received at other premises –

(a) must not cause, or significantly contribute to, a level of noise which exceeds the assigned level in respect of noise received at premises of that kind; and

(b) must be free of –

(i) tonality; and

(ii) impulsiveness; and

(iii) modulation,

when assessed under regulation 9.

(2) For the purposes of subregulation (1)(a), a noise emission is taken to significantly contribute to a level of noise if the noise emission … exceeds a value which is 5 dB below the assigned level at the point of reception."

Tonality, impulsiveness and modulation are defined in regulation 9 (refer *Appendix C*). Under regulation 9(3), *"Noise is taken to be free of the characteristics of tonality, impulsiveness and modulation if -*

(a) the characteristics cannot be reasonably and practicably removed by techniques other than attenuating the overall level of noise emission; and

(b) the noise emission complies with the standard prescribed under regulation 7(1)(a) after the adjustments in the table are made to the noise emission as measured at the point of reception."

Table 2-1 Adjustments Where Characteristics Cannot Be Removed

Where Noise Emission is Not Music*			Where Noise Emission is Music	
Tonality	Modulation	Impulsiveness	No Impulsiveness	Impulsiveness
+ 5 dB	+ 5 dB	+ 10 dB	+ 10 dB	+ 15 dB

* These adjustments are cumulative to a maximum of 15 dB.

The assigned levels (prescribed standards) for all premises are specified in regulation 8(3) and are shown in *Table 2-2.* The L_{A10} assigned level is applicable to noises present for more than 10% of a representative assessment period, generally applicable to "steady-state" noise sources. The L_{A1} is for short-term noise sources present for less than 10% and more than 1% of the time. The L_{Amax} assigned level is applicable for incidental noise sources, present for less than 1% of the time.

Table 2-2 Baseline Assigned Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area[1]	0700 to 1900 hours Monday to Saturday (Day)	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays (Sunday)	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days (Evening)	40 + influencing factor	50 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	35 + influencing factor	45 + influencing factor	55 + influencing factor
Noise sensitive premises: any area other than highly sensitive area	All hours	60	75	80
Commercial Premises	All hours	60	75	80
Industrial and Utility Premises	All hours	65	80	90

1. ***highly sensitive area*** means that area (if any) of noise sensitive premises comprising —
   (a) a building, or a part of a building, on the premises that is used for a noise sensitive purpose; and
   (b) any other part of the premises within 15 metres of that building or that part of the building.

In this project, the nearest premises are all *Industrial and Utility Premises* hence fixed limits apply at all times of the day, evening and night-time. It is understood 22 Moorambine Street has a caretaker residence on site – under *the Regulations* this residence is to be treated as Industrial Use. *Table 2-3* presents the limits applicable at neighbouring site boundary(s).

Table 2-3 Assigned Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Commercial Premises	All hours	60	75	80
Industrial and Utility Premises	All hours	65	80	90

It must be noted the assigned levels above apply outside the receiving premises and at a point at least 3 metres away from any substantial reflecting surfaces. Where this was not possible to be achieved due to the close proximity of existing buildings and/or fences, the noise emissions were assessed at a point within 1 metre from building facades and a -2 dB adjustment was made to the predicted noise levels to account for reflected noise.

The assigned levels are statistical levels and therefore the period over which they are determined is important. The Regulations define the Representative Assessment Period (RAP) as "*a period of time of not less than 15 minutes, and not exceeding 4 hours*, *determined by* an *inspector* or *authorised person to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission"*.

An inspector or authorised person is a person appointed under Sections 87 & 88 of the *Environmental Protection Act 1986* and include Local Government Environmental Health Officers and Officers from the Department of Water Environmental Regulation. Acoustic consultants or other environmental consultants are not appointed as an inspector or authorised person. Therefore, whilst this assessment is based on a 4-hour RAP, which is assumed to be appropriate given the nature of the operations, this is to be used for guidance only.

2.2. Regulation 3

*"**3. Regulations do not apply to certain noise emissions***

(1) Nothing in these regulations applies to the following noise emissions –

(a) Noise emissions from the propulsion and braking systems of motor vehicles operating on a road;"

The car park is considered a road and therefore vehicle noise (propulsion and braking) is not assessed. Noise from vehicle car doors however are assessed, since these are not part of the propulsion or braking system.

2.3. Regulation 14A

*"**14A. Waste Collection and Other Works***

(2) Regulation 7 does not apply to noise emitted in the course of carrying out class 1 works if –

(a) The works are carried out in the quietest reasonable and practicable manner; and

(b) The equipment used to carry out the works is the quietest reasonably available;

class 1 works means specified works carried out between -

(a) 0700 hours and 1900 hours on any day that is not a Sunday or a public holiday; or

(b) 0900 hours and 1900 hours on a Sunday or public holiday.

specified works means -

(a) The collection of waste; or

(b) The cleaning of a road or the drains for a road; or

(c) The cleaning of public places, including footpaths, cycle paths, car parks and beaches;"

In the case where specified works are to be carried out outside of class 1, a noise management plan is to be prepared and approved by the CEO.

3. METHODOLOGY

3.1. Noise Modelling

Computer modelling has been used to predict the noise emissions from the development to all nearby receivers. The software used was *SoundPLAN 8.2* with the CONCAWE (ISO 171534-3 improved method) algorithms selected, as they include the influence of meteorological conditions. Input data required in the model are listed below and discussed in *Section 3.1.1* to *Section 3.1.4*:

- Meteorological Information;
- Topographical data;
- Ground Absorption; and
- Source sound power levels.

3.1.1. Meteorological Conditions

Meteorological information utilised is provided in *Table 3-1* and is considered to represent worst-case conditions for noise propagation. At wind speeds greater than those shown, sound propagation may be further enhanced, however background noise from the wind itself and from local vegetation is likely to be elevated and dominate the ambient noise levels.

Table 3-1: Modelling Meteorological Conditions

Parameter	Day (7.00am to 7.00pm)[2]	Night (7.00pm to 7.00am)[2]
Temperature (°C)	20	15
Humidity (%)	50	50
Wind Speed (m/s)	4	3
Wind Direction[1]	All	All
Pasquil Stability Factor	E	F

Notes:

1. The modelling package allows for all wind directions to be modelled simultaneously.
2. The conditions above are as defined in *Guideline: Assessment of Environmental Noise Emissions*; May 2021

Alternatives to the above default conditions can be used where one year of weather data is available and the analysis considers the worst 2% of the day and night for the month of the year in which the worst-case weather conditions prevail (source: *Draft Guideline on Environmental Noise for Prescribed Premises*, May 2016). In most cases, the default conditions occur for more than 2% of the time and therefore must be satisfied.

3.1.2. Topographical Data

Topographical data was adapted from publicly available information (e.g. *Google*) in the form of spot heights and combined with the site plan. Surrounding existing buildings were also incorporated in the noise model, as these can provide noise shielding as well as reflection paths. Industrial Warehouse buildings are typically 4.0 - 8.0 metres in height with receivers 1.4 metres above ground.

The area is an established industrial area south of Great Northern Highway. *Figure 3-1* shows a 3D overview of the noise model with proposed new roads, existing industrial buildings and relevant aspects of the model identified:

- Red Sphere – Noise Prediction points at lease boundary
- Yellow – Existing Industrial Buildings
- Blue Sphere – Outdoor Noise Sources
- Red Building – Sound Radiating Building Façade and Roof
- White – Sound Radiating Building Openings

NB – Adjacent Lot boundary lines are shown for reference:

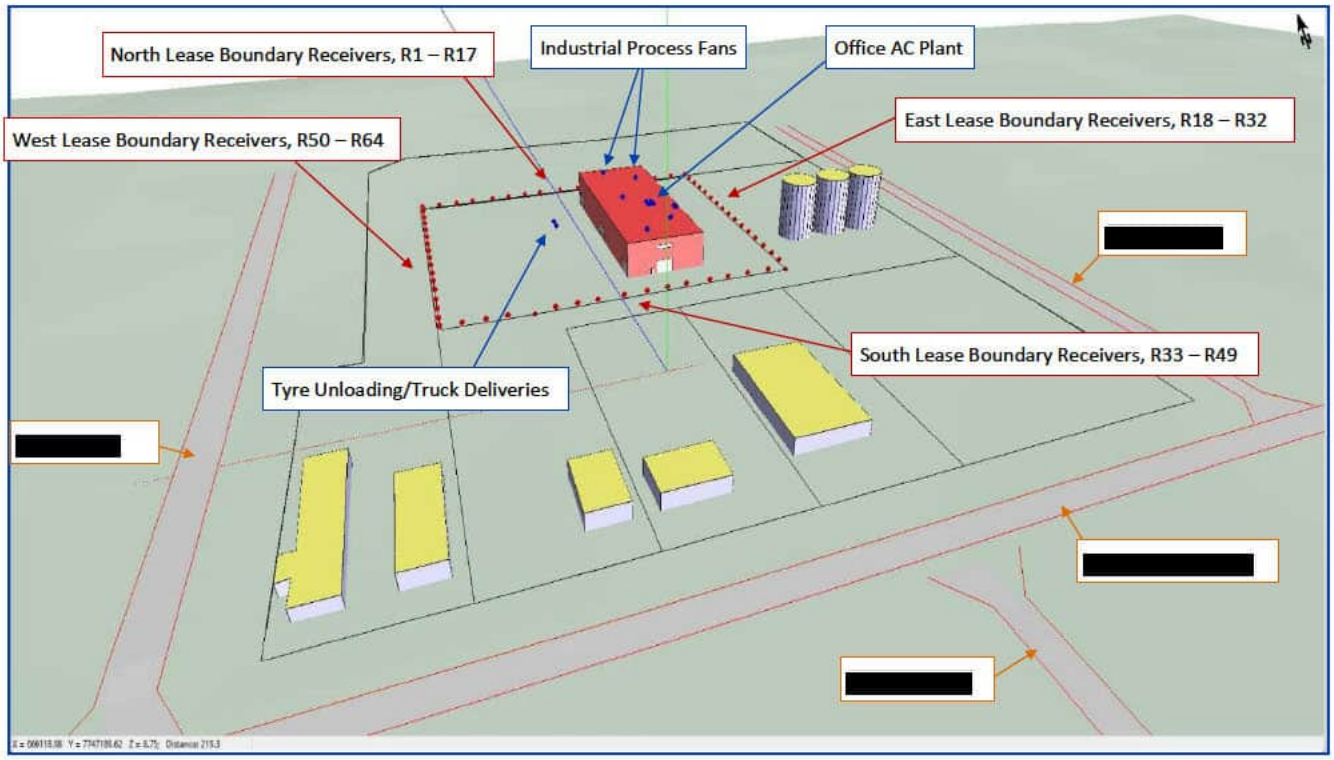


Figure 3-1: Overview of Noise Model (Inset Close-up of Lot 104/105)

3.1.3. Ground Absorption

The ground absorption has been assumed to be 0.0 (0%) for the roads and 0.4 (40%) elsewhere, noting that 0.0 represents hard reflective surfaces such as water and 1.0 represents absorptive surfaces such as grass.

3.1.4. Plant Layout

Figure 3-2 shows the plant layout assessed in this study – specialist large tyre recycling plant is proposed by Salvadori, included in *Appendix B*:

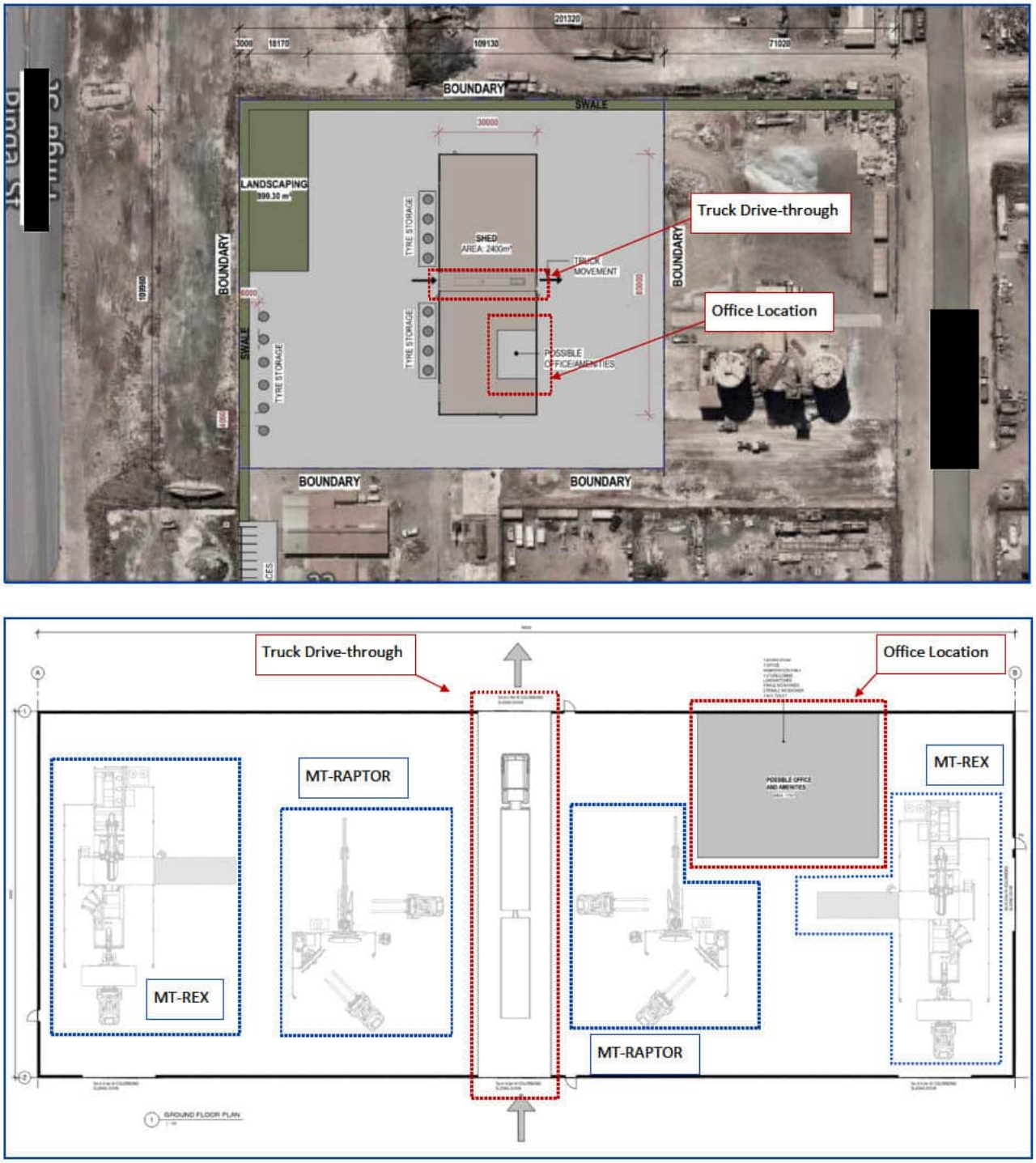


Figure 3-2: Proposed Tyre Recycling Plant Layout

3.1.5. Source Sound Levels

The source sound power levels used in the modelling are provided in *Table 3-2*.

Table 3-2: Source Sound Power Levels, dB

Description	Octave Band Centre Frequency (Hz)								Overall dB(A)
	63	125	250	500	1k	2k	4k	8k	
Industrial Processing Sources									
Primary Tyre Processing MT-REX*	93	96	99	93	91	88	94	86	**103**
Secondary Tyre Processing MT-RAPTOR*	79	90	98	95	92	88	85	80	**94**
Process Cooling/Ventilation Fans	90	98	99	93	88	88	85	84	**103**
Isuzu 12 Tonne Truck, High Idle	96	101	96	97	101	99	95	92	**104**
Logistics									
Slow Moving Delivery Truck (L_{A1})	97	88	84	85	80	78	76	72	**87**
Unloading (Incl. Forklifts) (L_{AMAX})	94	99	88	82	82	95	88	81	**97**
Building Services									
Assumed Office Condenser Units (x6 CUs)	81	81	74	73	67	61	57	54	**74**
Assumed Office Exhaust Fans (x4 TEFs)	56	49	56	56	57	54	47	39	**61**

* - Noise data Interpreted from Manufacturer (Salvadori) provided noise data of ~80dB(A) at workstations. This data is compared and correlated with Lloyd George Acoustics' previous assessments of tyre recycling facility(s) using on-site measurement methods based upon internal reverberant sound pressure level measurements of ~85dB(A):

The following is noted in relation to *Table 3-2*:

- Tyre Recycling plant is arranged with 2 x MT-REX machines and 2 x MT-RAPTOR machines located inside the warehouse as per proposed plant layout, refer *Figure 3-2*;
- Unless otherwise noted, model assumes all roller doors to be open, and double-skin steel (PA doors) closed;
- 6 x Industrial process ventilation fans are assumed located at roof level;
- Building Services Abbreviations – CU: Condenser Unit, TEF: Toilet Exhaust Fan;
- Noise data for building services plant has been obtained from previous projects, however are indicative only and will be subject to change once mechanical contractor has designed and selected plant;
- Unless otherwise noted, mechanical ventilation plant is generally located on the roof, ranging 0.5 to 1.0 metres above assumed roof level;
- Plant located centrally on roof to maximise screening effect to Ground level receivers.
- All plant assumed to be installed on anti-vibration mounts between plant and skid, appropriately suited to plant dynamic load under full 100% duty to mitigate structural vibration;
- All steady-state noise sources are assessed against L_{A10} assigned level, deemed appropriate for fixed industrial constant noise emission sources;

- Delivery truck is assessed against L_{A1} assigned level, deemed appropriate for temporary arrival/departure of heavy vehicles, approx. 7 per hour, during daytime office hours per usual business hours Monday to Friday;
- Tyre unloading noise incl. forklifts is assessed against L_{AMAX} assigned level, deemed appropriate for short-term instantaneous noise;

3.2. Sound Attenuation Performance of Building Materials

3.2.1. Building Envelope Material Sound Insulation Properties

Sound insulation of the main building envelope (roof and walls) is a key consideration. High levels of internal noise from the tyre recycling plant will radiate more or less sound through the roof and walls as noise emissions in a direct relationship to the acoustic performance of the wall/roof material.

This characteristic is referred as Sound Transmission Loss, expressed as a single figure value "R_w" – however, each material build-up is frequency specific, hence a profile across the frequency range 63Hz – 8kHz is required to ensure adequacy of design relative to processing noise. Example constructions and their performances are listed in *Table 3-3*.

Table 3-3: Building Envelope Materials - Sound Transmission Loss Data, R_w

Construction Build-up	R_w	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Steel Roller Door	**15**	9	14	15	14	15	17	17	16
1mm bmt profile steel sheet to one side of steel frame	**21**	8	11	15	19	23	20	21	31
1mm bmt profile steel sheet to one side of steel frame, lined internally w/75mm thick perf foil face Anticon™ fibrous insulation	**28**	12	15	19	25	30	28	30	31
90mm depth steel frame clad externally w/1mm bmt profile steel sheet, an internally with perforated FC sheet lined with 90mm thick fibrous insulation in formed cavity	**45**	18	22	33	51	54	54	56	58
180mm thick Concrete w/90mm thick fibrous insulation in formed cavity	**54**	36	42	41	50	57	60	65	70

3.2.2. Acoustic Absorption Profile Properties

Internal sound levels within the building can be reduced by the application of acoustic absorption at room boundary surfaces, causing conversion of sound energy into heat via friction between fibres in the applied absorbing materials. The extent to which a sound is absorbed at each reflection is expressed an acoustic absorption coefficient, referred as Alpha, "α", and is frequency-specific hence is expressed in octave bands.

A coefficient of 0.1 is considered mostly reflective, absorbing only 10% of incident sound energy, whereas a rating of 0.9 absorbs 90% of incident sound energy. By reducing internal sound levels, there is a directly

proportional reduction in corresponding noise emissions. Given the intended environment and application, a perforated sheet lining with fibrous insulation in the formed cavity is used in internal noise modelling.

Table 3-4 lists the acoustic absorption coefficients used in modelling

Table 3-4: Internal Acoustic Absorption Coefficient Data, "α"

Acoustic Absorbing Surface	α	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
1mm bmt profile steel sheet	**0.1**	0.3	0.25	0.15	0.1	0.08	0.05	0.06	0.05
Concrete	**0.05**	0.02	0.03	0.04	0.05	0.05	0.05	0.08	0.08
Perforated foil face Bradford Anticon™ 75mm thick	**0.9**	0.15	0.3	0.7	0.9	0.95	0.95	0.95	0.9
Large Opening	**1.0**	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

4. RESULTS

Noise modelling has been undertaken against the following scenarios, assuming the Tyre Recycling facility observes standard business hours, operating 7:00am – 5.00pm on weekdays and Saturdays.

- **Scenario 1** – Standard operations of building services only, Office AC CUs, TEFs and warehouse roof fans:
  - Monday to Saturday between hours 7.00am and 5.00pm;

- **Scenario 2A** – Standard operations for tyre recycling Monday to Saturday between 7.00am and 5.00pm;
  - All indoor and outdoor tyre recycling plant operating simultaneously, 12 Tonne truck idling inside warehouse:
  - All roller doors open;

- **Scenario 2B** – Standard operations for tyre recycling operations w/mitigation, Monday to Saturday 7.00am to 5.00pm:
  - Internal surfaces (roof and walls) lined with 75mm thick perforated foil faced Anticon™
  - All roller doors open;

- **Scenario 3** – Delivery Truck movements (L_{A1}) and Unloading (incl. forklifts) (L_{Amax}) – considered in isolation to other noise sources at the above times.

Results and assessment of these scenarios are presented in *Section 4.1* to *Section 4.4.*

4.1. Scenario 1 - Building Services AC and Exhaust Plant

Figure 4-1 presents the noise modelling scenario for emissions from assumed building services plant sources assessed in Scenario 1

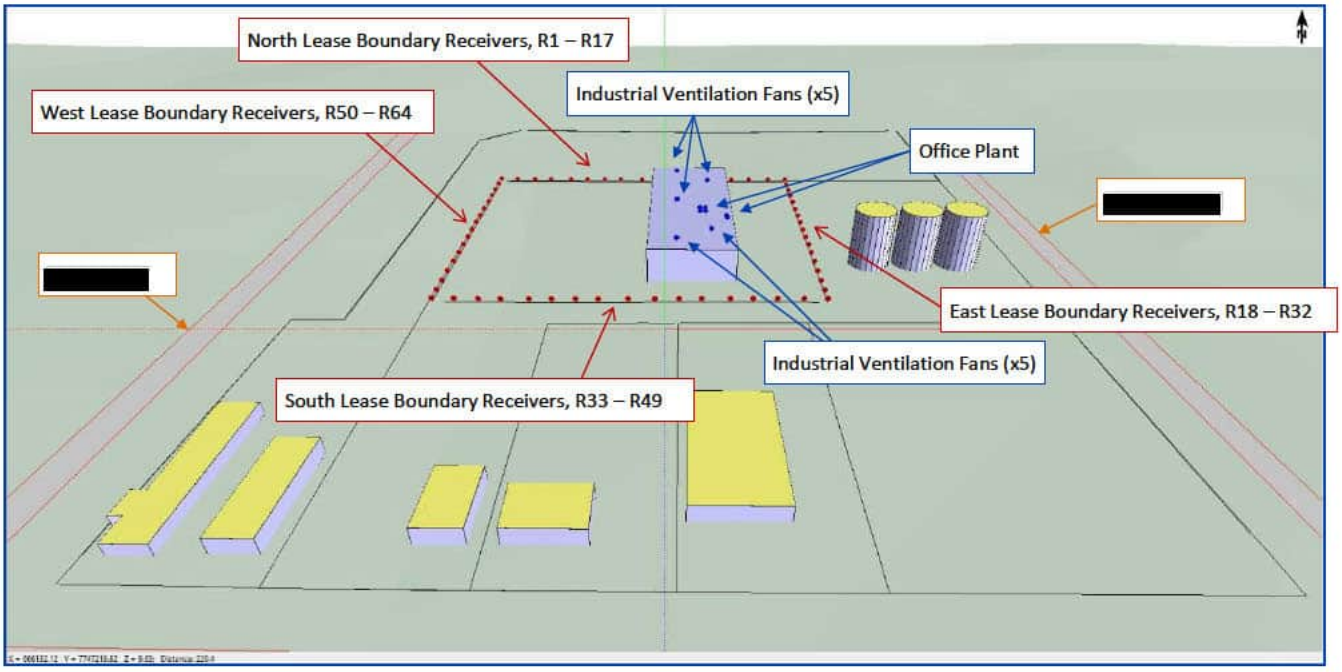


Figure 4-1: Overview of Building Services Noise Model – Sources and Receivers

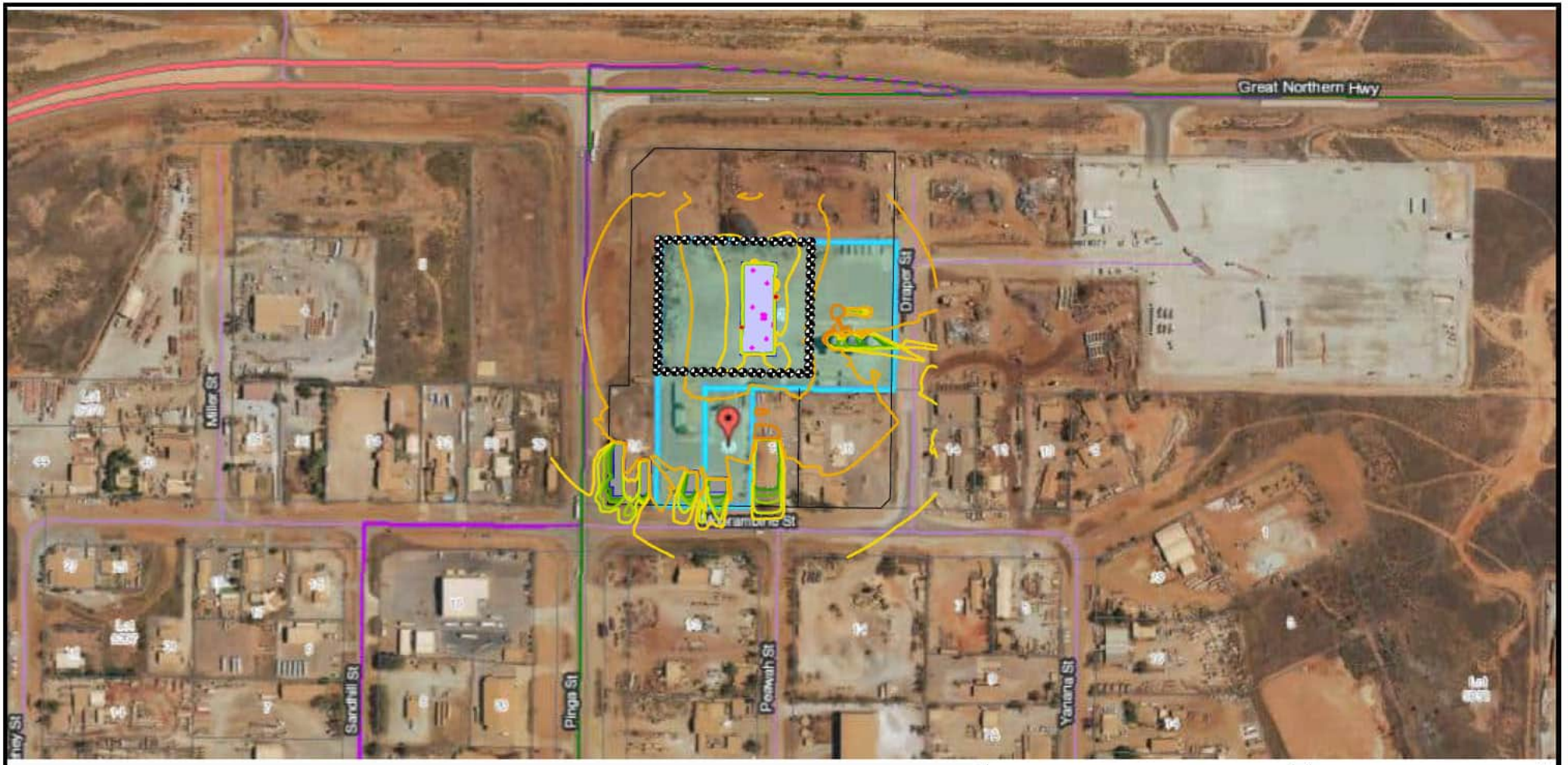
The results for the assumed building services operations are provided in *Table 4-1*. A *Tonal* penalty of +5 dB is applied to plant noise to account for potential tonal characteristics associated with AC CUs, EF and industrial process ventilation fan systems.

Table 4-1: Scenario 1 Building Services Noise: Predicted Levels, dB(A)

Receiver	Predicted Noise Level	+5 dB *Tonal* Penalty	Daytime Limit L_{A10}	Daytime Assessment
Lot Boundary (i.e. Industrial) Receivers				
R1 North Lease Boundary, NW Extent to **R17** North Lease Boundary NE Extent	46 – 51	51 – 56	**65**	*COMPLIES*
R17 East Lease Boundary, NE to **R32** East Lease Boundary SE	48 – 51	53 – 56	**65**	*COMPLIES*
R33 South Lease Boundary, SE Extent to **R49** South Lease Boundary, SW Extent	47 – 52	52 – 57	**65**	*COMPLIES*
R50 West Lease Boundary, SW to **R76** West Lease Boundary NW	52 – 53	57 – 58	**65**	*COMPLIES*

Table 4-1 shows that based on the assumed equipment located on the office building roof in proximity to the main warehouse wall, noise levels are calculated to comply at all receivers at all times with no additional mitigation applied to building services plant. A noise contour plot is also provided in *Figure 4-2* showing noise levels at ground floor.

Note, predicted noise emissions from building services are based upon assumed equipment selections and located to maximise screening to Ground Level Lot boundary receivers. It is expected that any mechanical services equipment selections will be reviewed during detailed design of mechanical services, once more and better particulars become known.



23017813 Wedgefield Tyre Recycling Facility
Noise Level Contours @ 1.4m Above Ground Level

Scenario 1 - L_{A10} Scenario 1 Building Services Noise

SoundPLAN v8.2
CONCAWE Algorithms

13 February 2023

Lloyd George Acoustics
[redacted]

Length Scale 1:5000
0 25 50 100 150 200 m

Figure 4-2

Signs and symbols
- Noise Source
- Point receiver
- Proposed Building

Noise levels
L_{A10} - dB
= 35
= 38
= 41
= 44
= 47
= 50
= 53
= 56
= 59
= 62
= 65

N

4.2. Scenario 2A - Standard Operations, No Mitigation

Figure 4-3 presents the noise modelling scenario for emissions from the tyre recycling plant with:

- All indoor tyre recycling plant operating at 100%;
- 1 x 12 Tonne truck idling inside warehouse;
- All roller doors open; And
- Bare Steel walls (i.e. internal acoustic absorption treatment) to walls and roof.

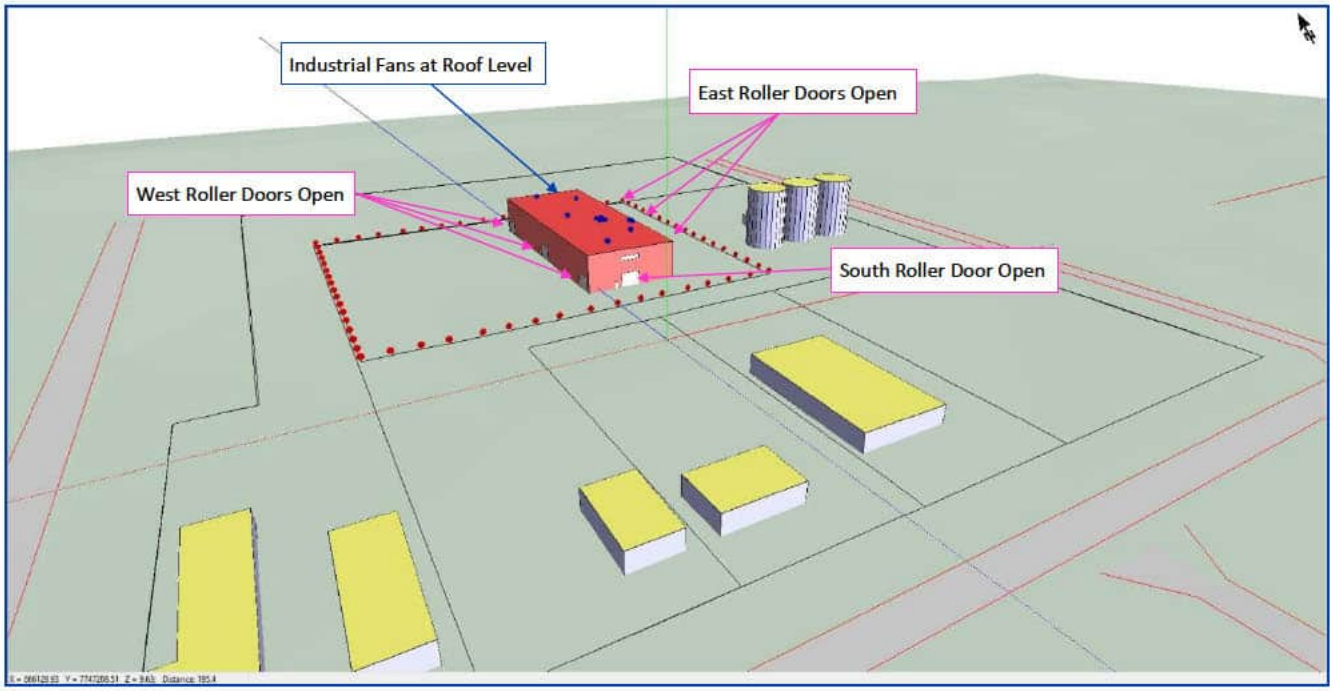


Figure 4-3: Overview of Tyre Recycling Noise Model w/ No Mitigation – Sources and Receivers

The results for Scenario 2A are provided in *Table 4-2*. A *Tonal* penalty of +5 dB is applied to tyre recycling plant noise to account for potential tonal characteristics associated with fan driven systems. A noise contour plot is also provided in *Figure 4-4* showing noise levels at ground floor.

Table 4-2: Scenario 2A Standard Tyre Recycling Operations, No Mitigation: Predicted Levels, dB(A)

Receiver	Predicted Noise Level	+5dB *Tonal* Penalty	Night-time Limit L_{A10}	Assessment
Lot Boundary (i.e. Industrial) Receivers				
R1 North Lease Boundary, NW Extent to **R17** North Lease Boundary NE Extent	55 – 61	60 – 66	**65**	*EXCEEDS (up to +1dB)*
R17 East Lease Boundary, NE to **R32** East Lease Boundary SE	56 – 60	61 – 65	**65**	*COMPLIES*
R33 South Lease Boundary, SE Extent to **R49** South Lease Boundary, SW Extent	54 – 64	59 – 69	**65**	*EXCEEDS (up to +4dB)*
R50 West Lease Boundary, SW to **R64** West Lease Boundary NW	55 – 56	60 – 61	**65**	*COMPLIES*

4.2.1. Comment on Scenario 2A Results

Table 4-2 shows that under standard operations, with no internal acoustic treatment and all roller doors open, noise levels are predicted to exceed the assigned limits (inclusive of +5 dB *Tonal* penalty) on the north Lease boundary by +1dB(A), facing the untreated ventilation louver grilles; And at the south Lease boundary by +4dB(A), facing the open south roller door and untreated ventilation louvers. Exceedences will require mitigation to comply with *the Regulations*.

Analysis of the noise source contributions at the highest exceedence points on the south Lease boundary (R38, +4dB(A)), and north Lease boundary (R9, +1dB(A)) are shown in *Table 4-3*. In order to simplify the analysis, the highest 10 dB(A) noise source contributions at this location are assessed, with remaining sources deemed not contributing to overall level. Dark orange indicates exceedences outright; light orange indicates contribution to cumulative exceedence at each receiver.

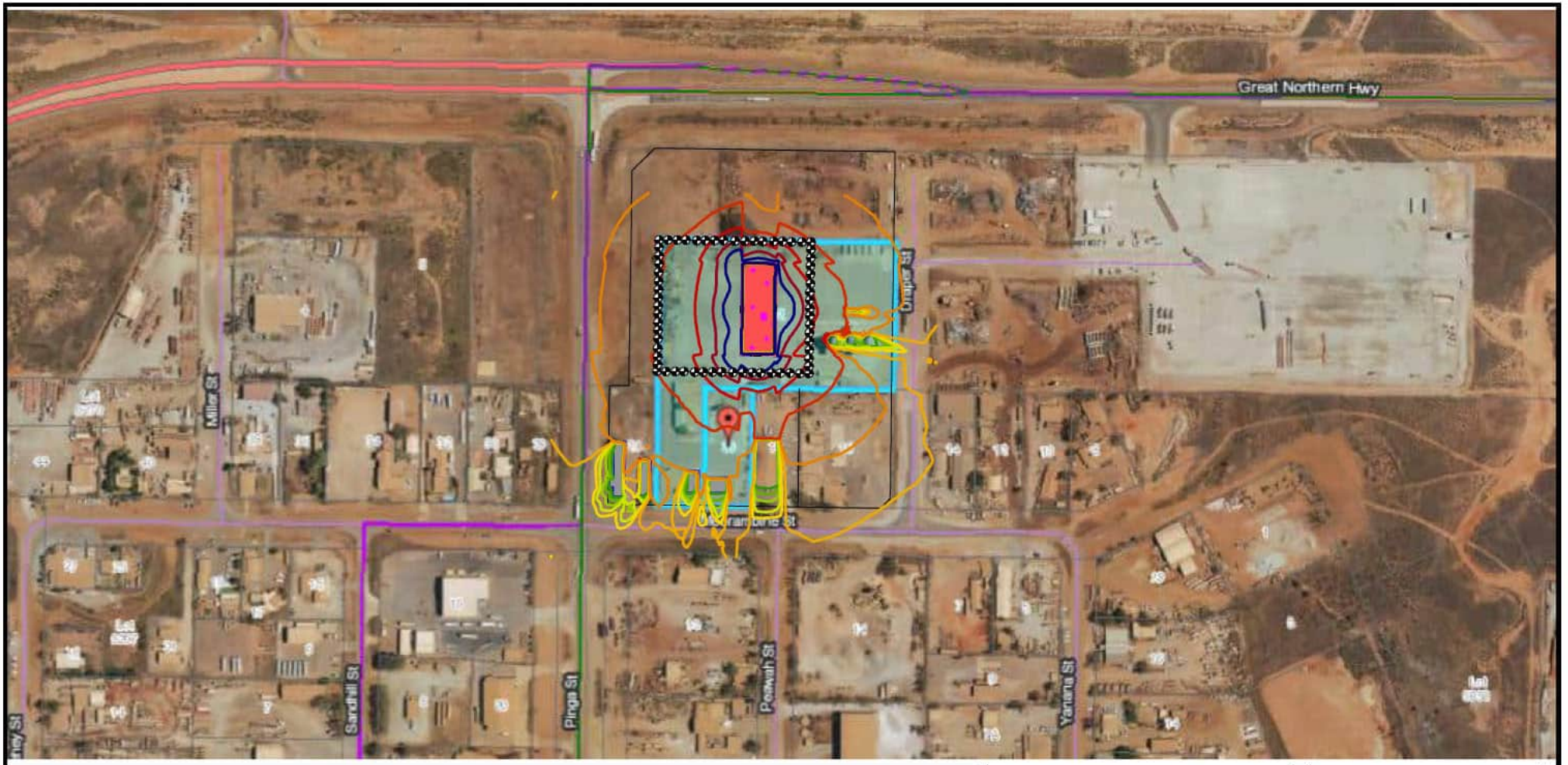
Table 4-3: Scenario 2A –L_{A10} Source Group Contribution Analysis at Exceedences, Receivers R38, R9

Receiver	Source Group	Contribution Level L_{A10} dB	Incl. +5dB *Tonality*	Predicted Level, dB(A)	ANL	L_{A10} Source Group Rank
R38 South Lease Boundary, between SE Corner and Centre	South Facade 5m x 6m Sliding Doors	63	68	69	**65**	**1**
	South Facade 6m x 1.2m Louver	56	61			**2**
	Main Bldg Envelope - South Façade	51	56			**3**
R9 North Lease Boundary, Centre	West Facade Gridline B 5m x 6m Sliding Door	59	64	66	**65**	**1**
	West Facade Central 5m x 6m Sliding Door	51	56			**2**
	North Facade Louver 1	50	55			**3**

Results show exceedences due to noise egress through open roller doors at both north and south boundaries. Internal noise levels within the warehouse space are averaged at 83.4dB(A)* across the entire warehouse floor area – by reducing internal noise levels by use of acoustic absorption, corresponding noise reductions can be expected at the Lot boundaries. There are also benefits to reducing internal workshop noise by potentially reducing the office/amenities building fabric in terms of providing suitable noise conditions for office work.

Scenario 2B therefore examines the initial model exceedences, applying internal acoustic absorption in the form of 75mm thick perforated foil faced Bradford Anticon™ to all roof and wall internal area increasing building envelope fabric build-up acoustic performance (Rw), refer *Table 3-3* and reducing internal reverberant sound pressure level by increasing absorption (α), refer *Table 3-4*.

** Note, noise levels will be above 85dB(A) in proximity to the tyre recycling plant hence OH&S signage and use of ear defenders will be an operational requirement.*



23017813 Wedgefield Tyre Recycling Facility
Noise Level Contours @ 1.4m Above Ground Level

Scenario 2A - L_{A10} Standard Operations, All Sliding Doors Open, No Mitigation

SoundPLAN v8.2
CONCAWE Algorithms

13 February 2023

Lloyd George Acoustics

Length Scale 1:5000

0 25 50 100 150 200 m

Figure 4-4

Signs and symbols

- Noise Source
- Point receiver
- Industrial building/Room
- Roof as source
- Facade as source
- Transmissive area

Noise levels
L_{A10} - dB

= 35
= 38
= 41
= 44
= 47
= 50
= 53
= 56
= 59
= 62
= 65

N

4.3. Scenario 2B - Standard Operations w/Internal Absorption

Scenario 2B examines the noise emissions from the tyre recycling facility with:

- All indoor and outdoor tyre recycling plant operating simultaneously;
- 1 x 12 Tonne truck idling inside warehouse;
- All roller doors open; And
- Internal acoustic absorption treatment applied to warehouse internal walls and roof.

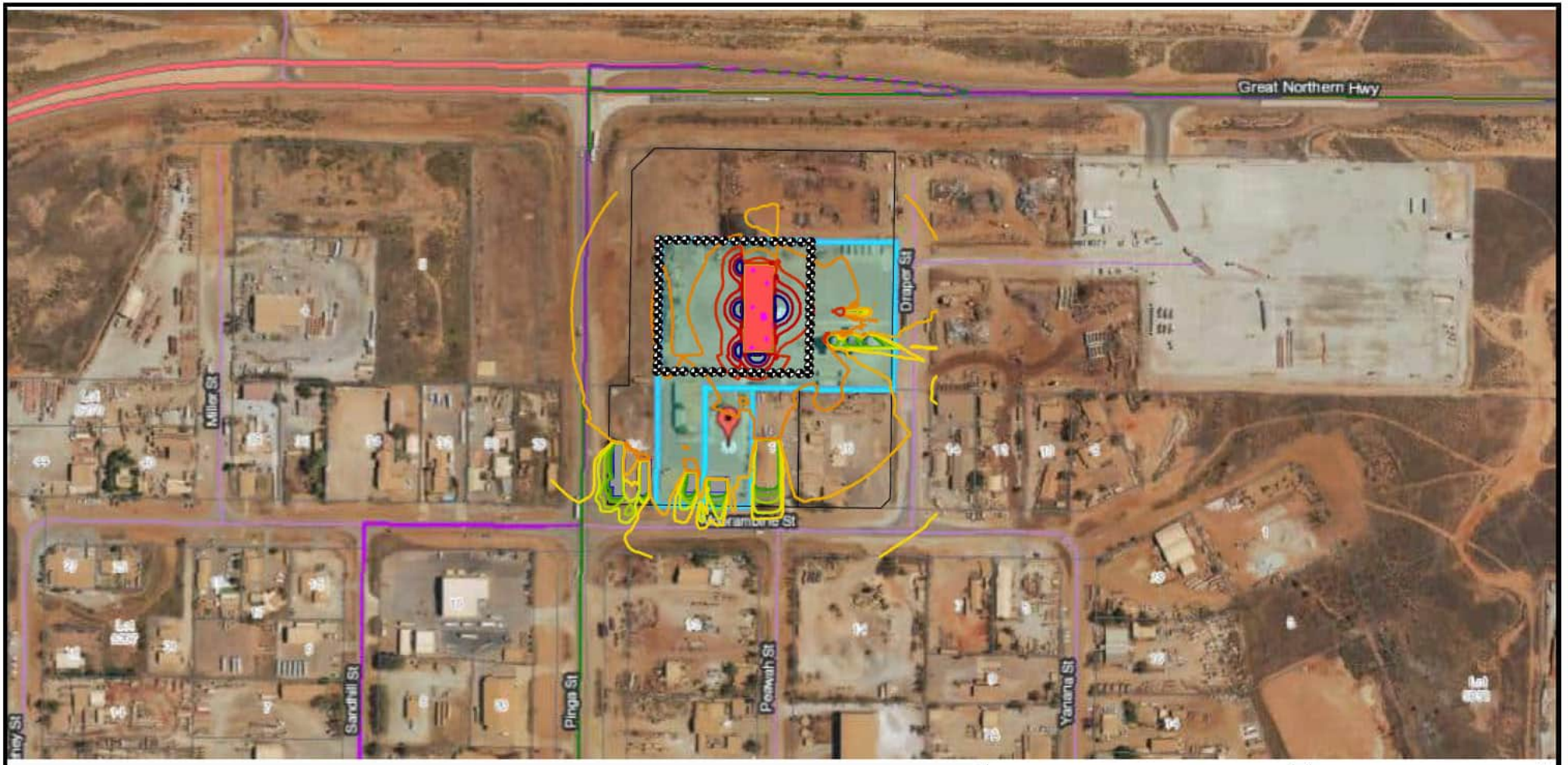
The results for Scenario 2B are provided in *Table 4-4*. A noise contour plot is also provided in *Figure 4-5* showing noise levels at ground floor. A *Tonal* penalty of +5 dB is applied to tyre recycling plant noise to account for potential tonal characteristics associated with fan driven systems.

Table 4-4: Scenario 2B Standard Tyre Recycling Operations w/Internal Absorption: Predicted Levels, dB(A)

Receiver	Predicted Noise Level	+5dB *Tonal* Penalty	Night-time Limit L_{A10}	Assessment
Lot Boundary (i.e. Industrial) Receivers				
R1 North Lease Boundary, NW Extent to **R17** North Lease Boundary NE Extent	50 – 54	55 – 59	**65**	*COMPLIES*
R17 East Lease Boundary, NE to **R32** East Lease Boundary SE	52 – 57	57 – 62	**65**	*COMPLIES*
R33 South Lease Boundary, SE Extent to **R49** South Lease Boundary, SW Extent	53 – 58	58 – 63	**65**	*COMPLIES*
R50 West Lease Boundary, SW to **R64** West Lease Boundary NW	53	58	**65**	*COMPLIES*

4.3.1. Comment on Scenario 2B Results

Lining the inside of the main warehouse space (walls and u/side of roof) results in a reduced internal Reverberant Sound Pressure Level ($L_{P,Rev}$) of 76.5dB(A). Corresponding results in *Table 4-4* show noise reductions of between 3 - 6dB(A) predicted across all receivers at all boundaries due to reduced internal sound levels emanating from open roller doors, and louver grilles, which now fully complies with *the Regulations'* assigned limit, inclusive of +5dB *Tonality* penalty).



23017813 Wedgefield Tyre Recycling Facility
Noise Level Contours @ 1.4m Above Ground Level

Scenario 2B - L_{A10} Standard Operations, All Sliding Doors Open,
100% u/Side of Roof and Walls Area Internally Lined w/75mm thick perf foil faced Anticon

SoundPLAN v8.2
CONCAWE Algorithms

13 February 2023

Lloyd George Acoustics

Length Scale 1:5000
0 25 50 100 150 200 m

Figure 4-5

Signs and symbols
- Noise Source
- Point receiver
- Industrial building/Room
- Roof as source
- Facade as source
- Transmissive area

Noise levels
L_{A10} - dB
= 35
= 38
= 41
= 44
= 47
= 50
= 53
= 56
= 59
= 62
= 65

N

4.4. Scenario 3 – Delivery Truck (L_{A1}) and Tyre Unloading (L_{AMAX}) Noise

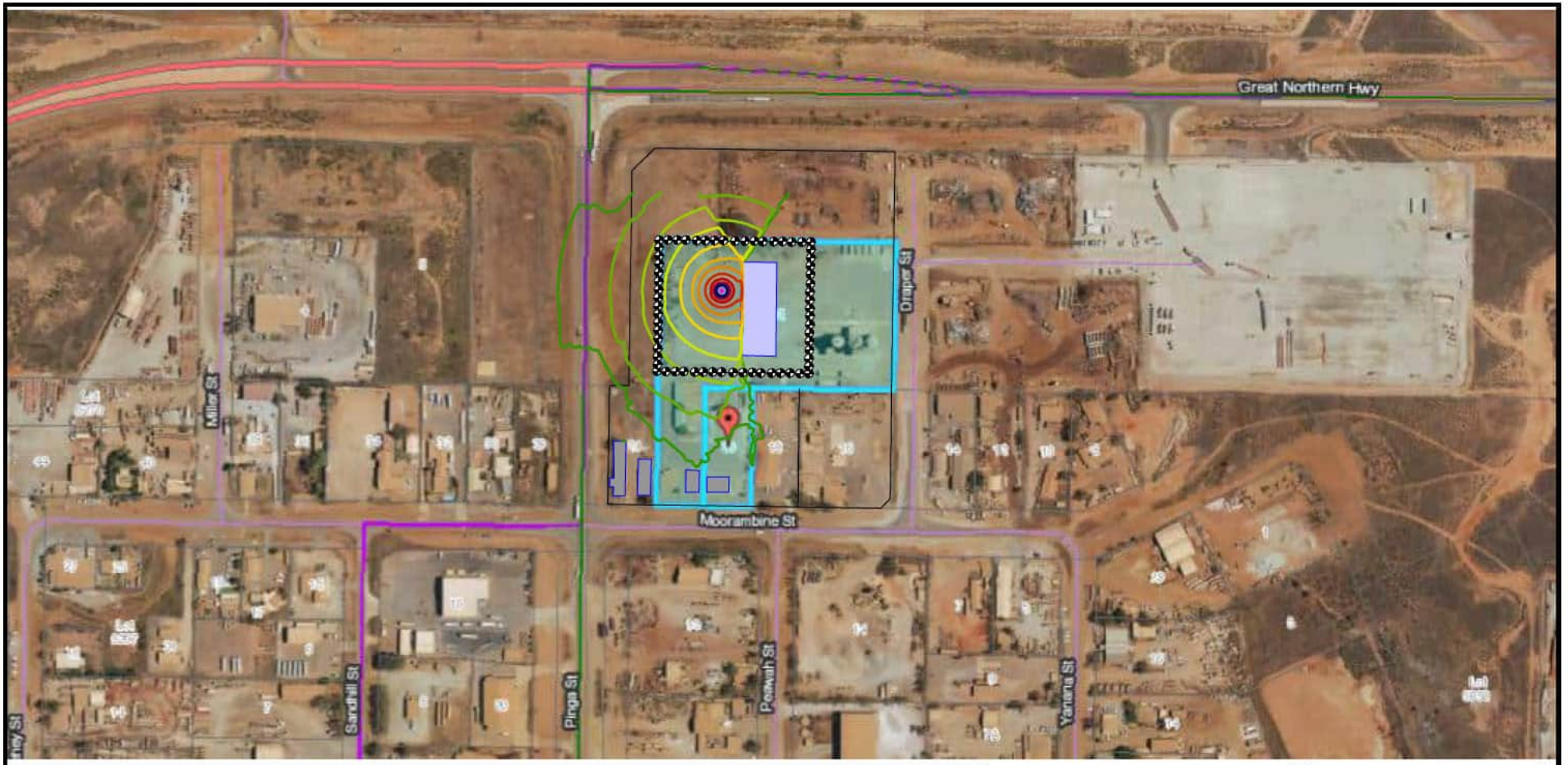
Scenario 3 examines the noise emissions from delivery truck movements (outside of main warehouse) using the applicable L_{A1} criteria for up to 72 truck movements per day; And, and tyre unloading noise using the applicable L_{AMAX} criteria as appropriate to assess short term "transient" noise sources associated with unloading tyres.

The results for delivery truck movements (L_{A1}) noise emissions are provided in *Table 4-5*. No additional penalties are assessed for delivery truck noise.

Table 4-5: Scenario 3 Delivery Truck (L_{A1}) Noise: Predicted Levels, dB(A)

Receiver	Predicted Noise Level	Daytime Limit L_{A1}	Assessment
Lot Boundary (i.e. Industrial) Receivers			
R1 North Lease Boundary, NW Extent to **R17** North Lease Boundary NE Extent	13 – 46	**80**	*COMPLIES*
R17 East Lease Boundary, NE to **R32** East Lease Boundary SE	12 – 14	**80**	*COMPLIES*
R33 South Lease Boundary, SE Extent to **R49** South Lease Boundary, SW Extent	12 – 42	**80**	*COMPLIES*
R50 West Lease Boundary, SW to **R64** West Lease Boundary NW	40 – 43	**80**	*COMPLIES*

Table 4-5 shows that delivery truck noise is calculated to comply at all receivers at all times, with no mitigation required. A noise contour plot is also provided in *Figure 4-6* showing noise levels at ground floor.



23017813 Wedgefield Tyre Recycling Facility
Noise Level Contours @ 1.4m Above Ground Level

Scenario 3 - L_{A1} Delivery Truck Movements

SoundPLAN v8.2
CONCAWE Algorithms

13 February 2023

Lloyd George Acoustics

[redacted]

Length Scale 1:5000

0 25 50 100 150 200 m

Figure 4-6

Signs and symbols

- Noise Source
- Point receiver
- Proposed Building

Noise levels
L_{A1} - dB

= 35
= 38
= 41
= 44
= 47
= 50
= 53
= 56
= 59
= 62
= 65

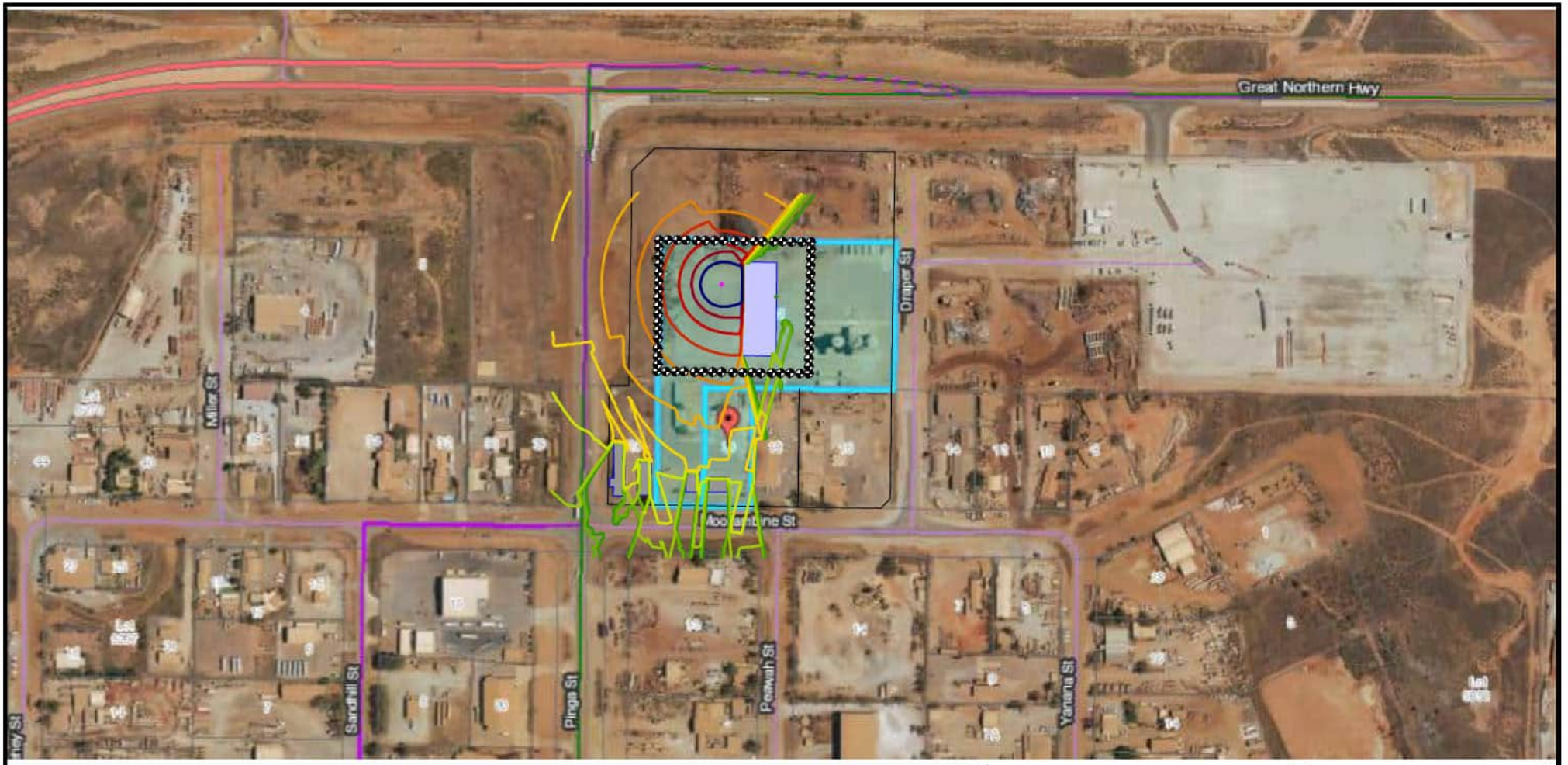
N

The results for unloading tyre (L_{AMAX}) noise emissions are provided in *Table 4-6*. Unloading tyres noise (incl. forklifts) is likely to be considered *Impulsive* under *the Regulations* intrusive noise characteristics criteria, hence a +10 dB penalty is applied.

Table 4-6: Scenario 3 Unloading Tyre (L_{AMAX}) Noise: Predicted Levels, dB(A)

Receiver	Predicted Noise Level	+10 dB *Impulsiveness* Penalty	Day-time Limit L_{AMAX}	Assessment
Noise Sensitive (i.e. Residential) Receivers				
R1 North Lease Boundary, NW Extent to **R17** North Lease Boundary NE Extent	26 – 60	36 – 70	**90**	*COMPLIES*
R17 East Lease Boundary, NE to **R32** East Lot Boundary SE	22 – 24	32 – 34	**90**	*COMPLIES*
R33 South Lease Boundary, SE Extent to **R49** South Lease Boundary, SW Extent	22 – 52	32 – 62	**90**	*COMPLIES*
R50 West Lease Boundary, SW to **R64** West Lease Boundary, NW	50 – 53	60 – 63	**90**	*COMPLIES*

Table 4-6 shows that unloading tyre noise including forklifts (incl. +10 dB *Impulsive* penalty) are calculated to comply at all receivers at all times, with no mitigation required. A noise contour plot is also provided in *Figure 4-7* showing noise levels at ground floor.



23017813 Wedgefield Tyre Recycling Facility
Noise Level Contours @ 1.4m Above Ground Level

Scenario 3 - L_{AMAX} Tyre Unloading (Incl. Forklifts)

SoundPLAN v8.2
CONCAWE Algorithms

13 February 2023

Lloyd George Acoustics

Length Scale 1:5000

0 25 50 100 150 200 m

Figure 4-7

Signs and symbols
- Noise Source
- Point receiver
- Proposed Building

Noise levels
L_{AMAX} - dB
- = 35
- = 38
- = 41
- = 44
- = 47
- = 50
- = 53
- = 56
- = 59
- = 62
- = 65

N

5. RECOMMENDATIONS

For day-to-day building services (L_{A10}) operation scenarios using assumed plant noise levels and locations, predicted noise levels are considered compliant when operated during daytime hours, 7.00am to 5.00pm Mondays to Fridays. This includes an assumed array of 6x high Sound Power Level industrial fans located on the warehouse roof. If operations occur outside of these hours, compliance is also achieved.

In all cases, building services-type noise emissions are considered manageable within the context of any forthcoming mechanical design, provided the location of the services at roof level maximises natural screening from the office building roof height(s) to the Lot boundary receivers. It is recommended that the mechanical services designs be reviewed during Detailed Design to ensure compliance with *the Regulations* – this includes any plant not yet identified or assumed in the Schematic Design noise model.

Regards tyre recycling machinery, operating indoor tyre recycling plant as per plant layout requires noise mitigation to comply at the southern and northern Lease boundary(s):

- Where all roller doors are required to be open for operations/airflow reasons, alternative mitigation strategy is to apply internal acoustic absorption using 75mm thick perforated foil faced Anticon^{TM} lining to roof and walls in combination with the screen walls;

- Regards use of internal acoustic absorption using 75mm thick perforated foil faced Anticon^{TM} lining to 100% area of roof and walls:
  - Lining the walls and roof for noise emissions compliance may attract a significant cost given the m^2 area of internal roof and walls for coverage.
  - However, there are multiple benefits to reducing the internal reverberant sound levels from L_{pRev} 83.4dB(A) to L_{pRev} 76.5dB(A) with the treatment installed:
    - Lower internal noise levels imply the office building fabric walls, glazing and roof/ceiling build-ups will require a lower specification to achieve suitable conditions for office work;
    - Anticipating building energy and thermal performance requirements, the internal acoustic lining could be coordinated with thermal requirements where by application of 75mm thick perforated foil faced Anticon^{TM} achieves thermal and acoustic requirements, in a single product.

Note – the calculated Reverberant Sound Pressure Level $L_{P,Rev}$ of 76.5dB(A) with internal linings to 100% roof and wall area is averaged across the entire 2,400m^2 space – operational noise levels will be above 85dB(A) in close proximity to the tyre recycling plant hence OH&S signage and use of ear defenders will be an operational requirement.

- Where internally lining the warehouse space is not preferred, alternative mitigation strategies for compliance will require either:
  - All sliding doors being closed during tyre cutting operations;
  - South (x1) and west (x3) sliding doors being closed during operations tyre cutting operations and 100% of the roof areas being lined with 75mm thick perforated foil faced Anticon^{TM};
  - Construction of 5.0m solid screen walls to the north and south boundary(s) and 100% of the roof areas being lined with 75mm thick perforated foil faced Anticon^{TM};

NB – predicted compliance assumes Sound Power Level (SWL) data interpreted from Manufacturer (Salvadori) of *"~80dB(A) at workstations"*. This data is compared and correlated with Lloyd George Acoustics' previous assessments of tyre recycling facility(s) using on-site measurement methods based upon internal reverberant sound pressure level measurements of ~85dB(A):

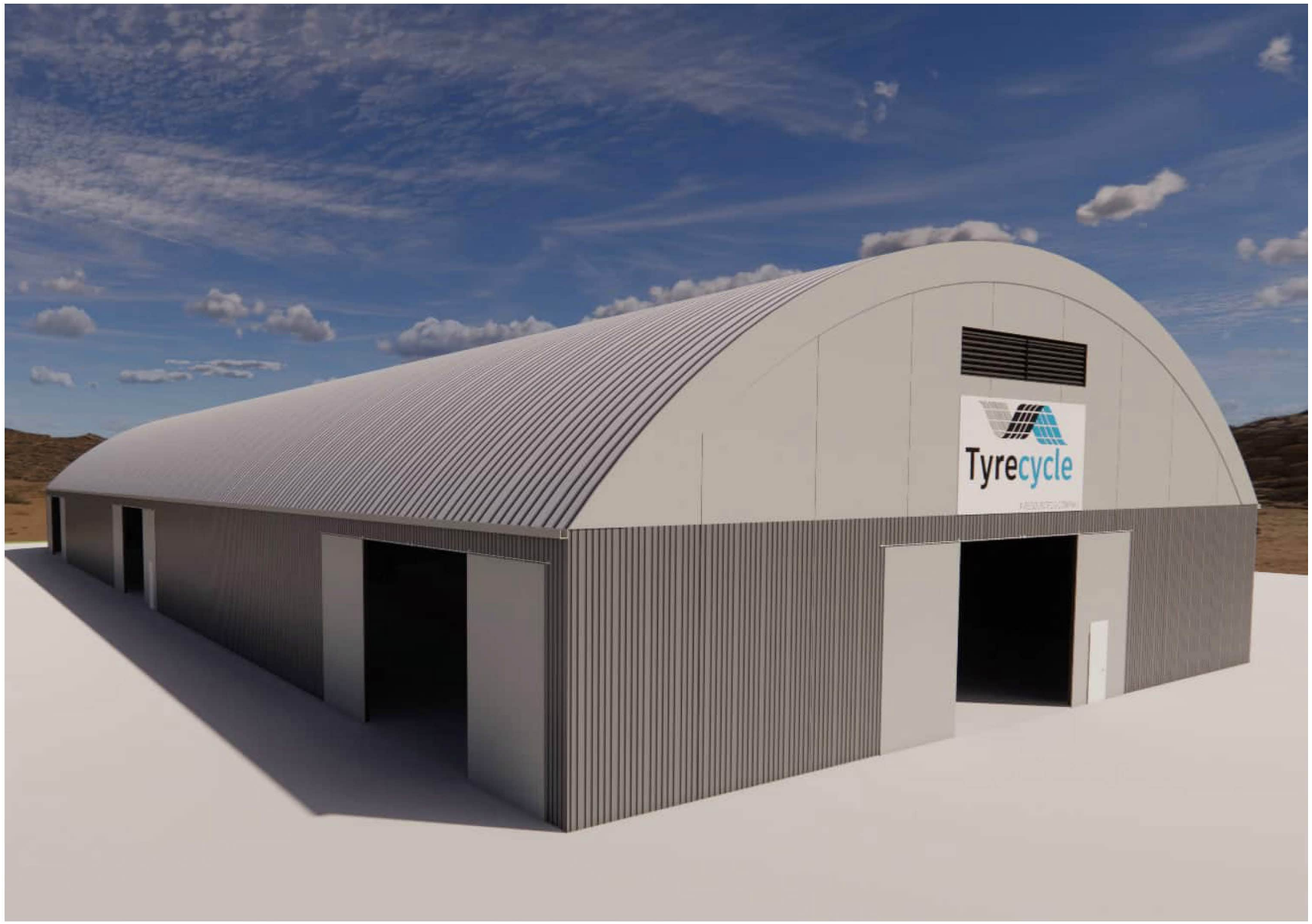
As such, a "headroom" of 3dB(A) for compliance is applied to this model. It is recommended the manufacturer supply more detailed noise measurement results which may be used to calibrate and confirm the noise modelling predictions in this report during Detailed Design stage, to ensure compliance with *the Regulations* once the facility is constructed.

To minimise audible noise from day-to-day operations at nearby receiving premises, the following 'best practice' measures are suggested:

- Truck drivers are to be instructed to use good driving techniques and minimise excessive vehicle noise (no air brakes, excessive revving etc);
- Where reversing must occur, alternatives to tonal 'beeper' reversing alarms are to be implemented, whilst still maintaining a safe workplace such as:
  - Trucks and forklifts to be fitted with broadband style alarms; or
  - Reversing alarms are to be turned off and spotters used to ensure a safe environment.
- Delivery activities are to be undertaken in as careful and quiet a manner as practicable and this is to be advised to staff and delivery personnel;
- Areas where known impact noise will occur are to have suitable rubber impact matting installed;
- Service road area is to be smooth and free of gaps that may cause banging when driven over with vehicles, pallet jacks or the like. Control joints are to be filled with non-hardening mastic to provide a flat finish;
- Metal grates shall be secured with rubber gaskets or plastic grates used;
- Waste collection shall not occur outside of Monday to Saturday, 7am to 7pm and Sundays and public holidays, 9am to 7pm. Shows compliance etc.

Appendix A – Development Plans

Tyrecycle
A RESOURCECO COMPANY



-Drawing List

SHEET NO.	SHEET NAME
SK0001	COVER SHEET
SK1101	SITE PLAN
SK2201	FLOOR PLAN
SK3101	OVERALL ELEVATIONS

SK0001 REV S2 08.12.2022 BAP220106 TYRECYCLE SHED COVER SHEET Scale@A1

0m 1m 2m 3m 4m 5m

PRELIMINARY

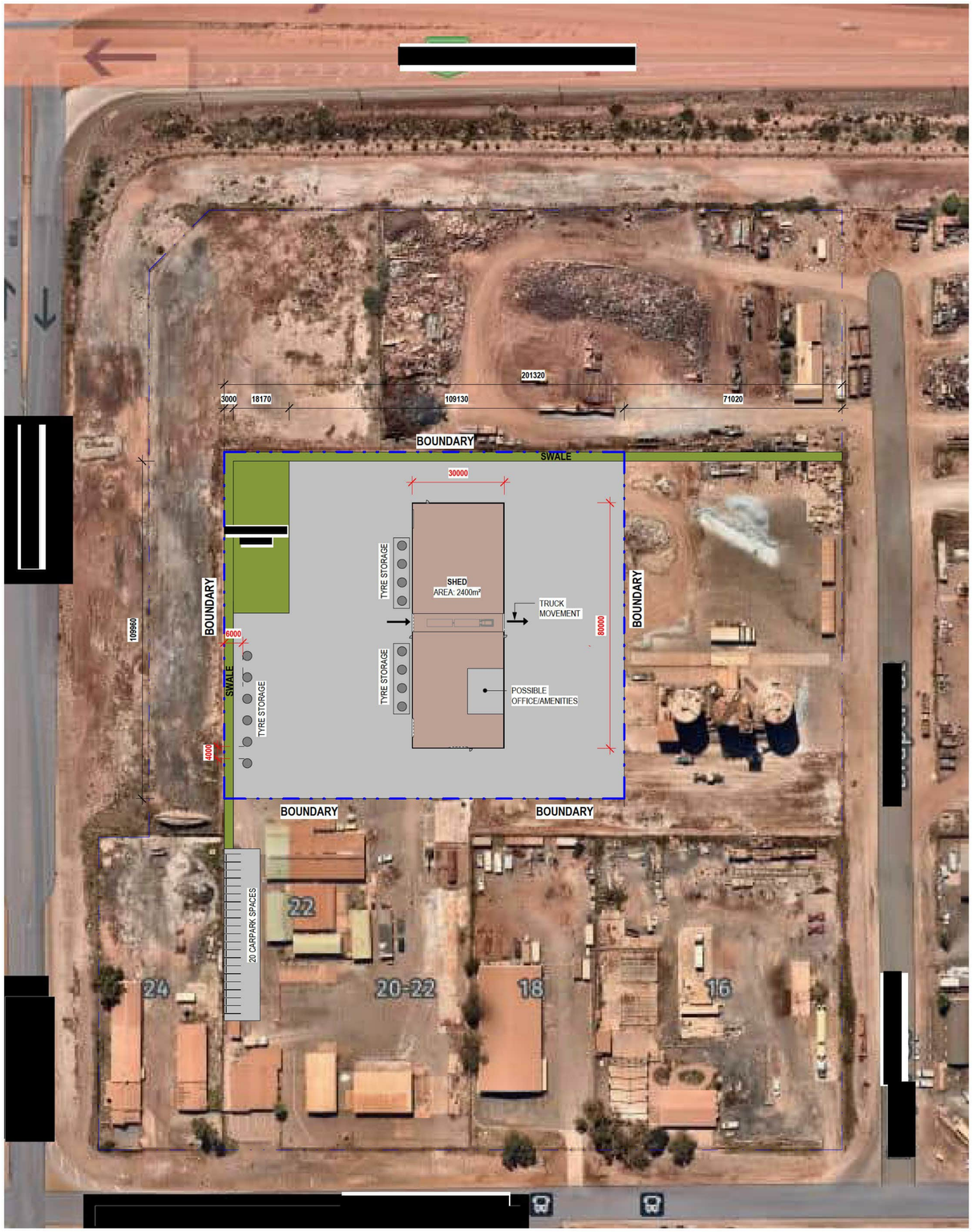
BELL

BELL Architecture Pty Ltd ABN 26 169 081 734 Level 1, 80 Pirie Street, Adelaide, 5000 PO Box 3029 Rundle Mall 5000 M +61 419 996 978 P +61 8 8373 3870

Tyrecycle

A RESOURCECO COMPANY

[redacted]



2 SITE PLAN
1 : 800

SK1101 REV S6 08.12.2022 BAP220106 TYRECYCLE SHED SITE PLAN Scale@A1 As indicated

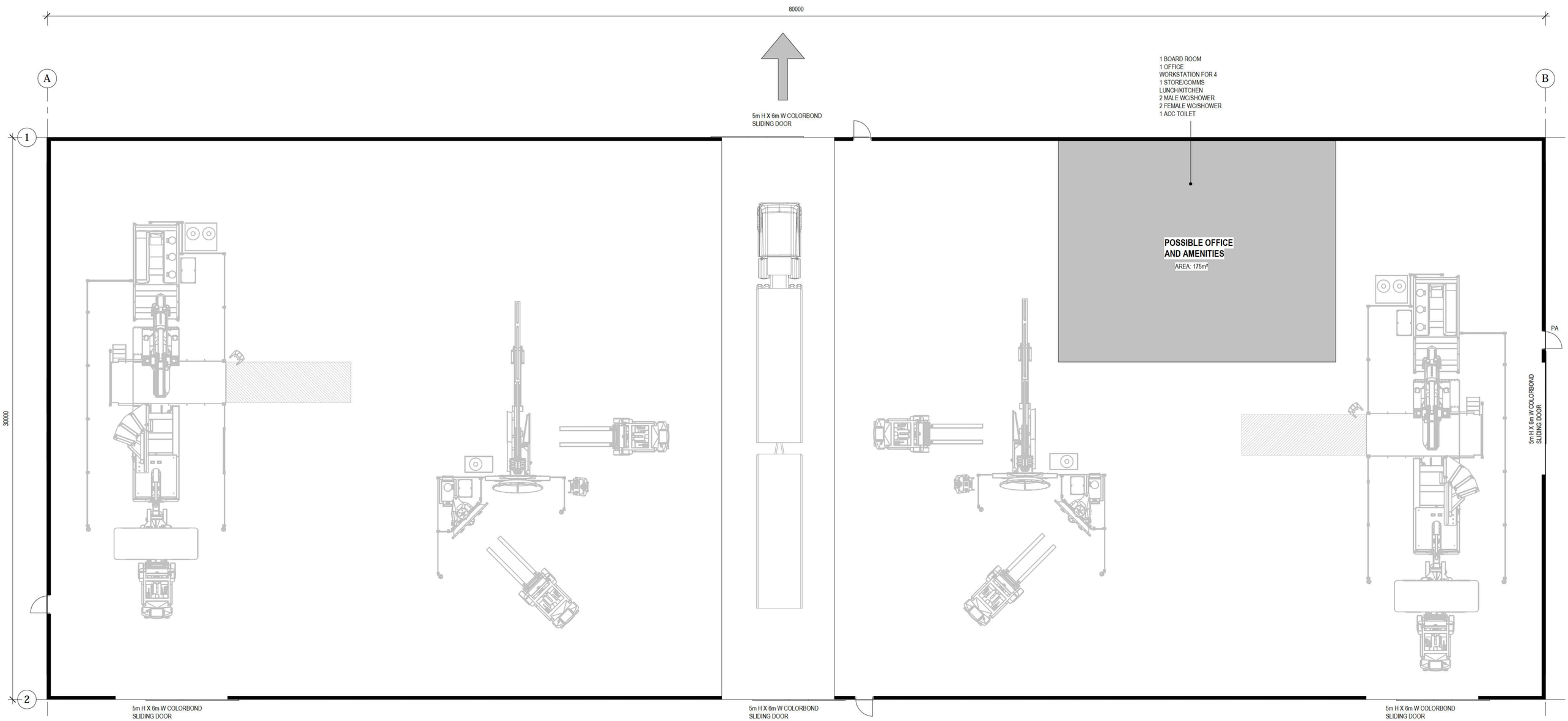
0m 1m 2m 3m 4m 5m

PRELIMINARY

BELL Architecture Pty Ltd ABN 26 169 081 734 Level 1, 80 Pirie Street, Adelaide, 5000 PO Box 3029 Rundle Mall 5000 M +61 419 996 978 P +61 8 8373 3870

BELL

Tyrecycle
A RESOURCECO COMPANY



1 GROUND FLOOR PLAN
1 : 100

AREA SCHEDULE	
NAME	AREA
SHED	2400m²
POSSIBLE OFFICE /AMENITIES	175m²
LANDSCAPING	1620m²
HARDSTAND/TYRE STORAGE	1070m²
BITUMEN	655m²
CARPARK SPACES	20

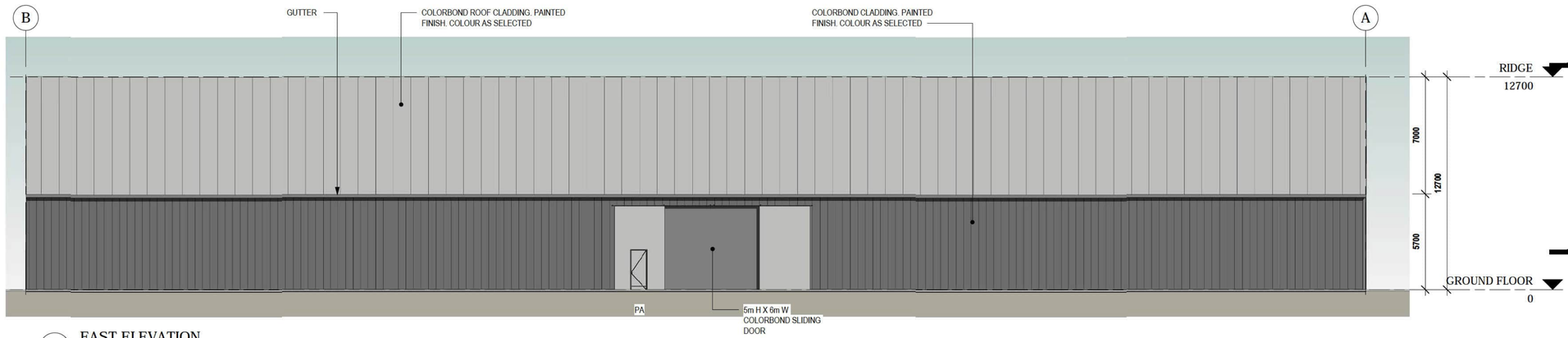
SK2201 REV S4 08.12.2022 BAP220106 TYRECYCLE SHED FLOOR PLAN Scale@A1 As indicated

0m 1m 2m 3m 4m 5m

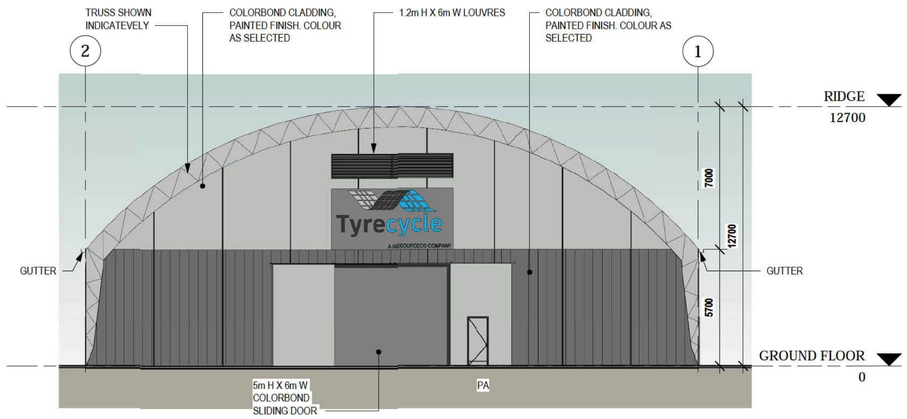
PRELIMINARY

BELL

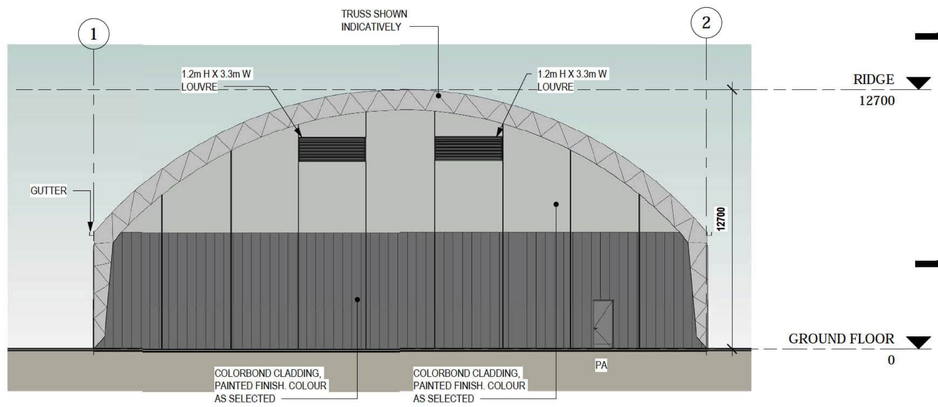
BELL Architecture Pty Ltd ABN 26 169 081 734 Level 1, 80 Pirie Street, Adelaide, 5000 PO Box 3029 Rundle Mall 5000 M +61 419 996 978 P +61 8 8373 3870



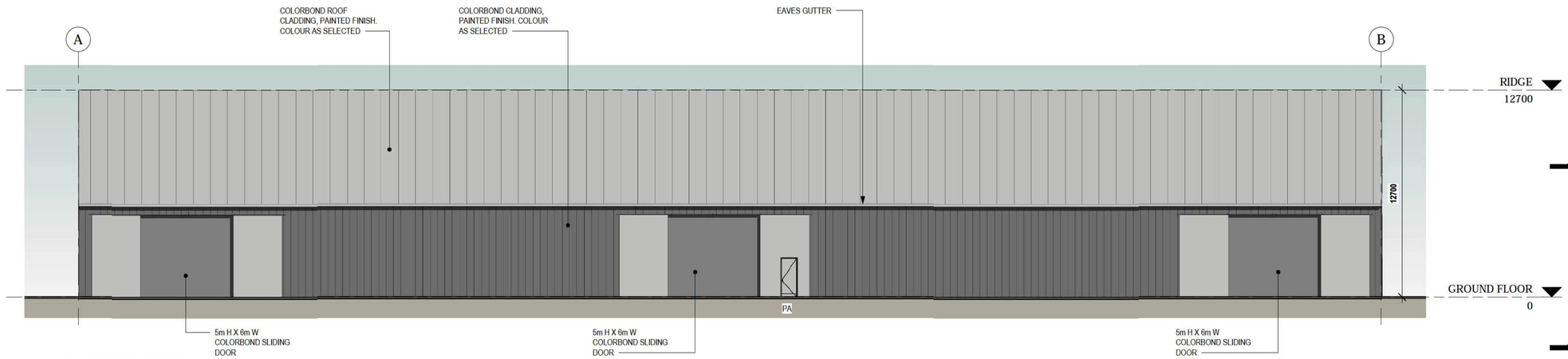
1 EAST ELEVATION
1 : 150



3 SOUTH ELEVATION
1 : 150



2 NORTH ELEVATION
1 : 150



4 WEST ELEVATION
1 : 150

SK3101 REV S4 08.12.2022 | BAP220106 | TYRECYCLE SHED | OVERALL ELEVATIONS | Scale@A1 1 : 150

0m 1m 2m 3m 4m 5m

PRELIMINARY

BELL

Appendix B – Proposed Tyre Recycling Machinery

MT-REX™

Otr & Mining Shear

PATENT PENDING

SALVADORI®

MT-Rex system is designed to handle large earthmoving vehicle tyres, the ones that are used primarily in open pit mines. These tyres are not currently included in the disposal cycle for re-use, with rare exceptions.

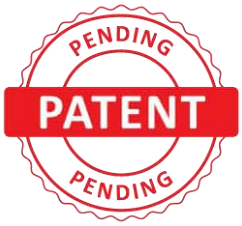
These tyres are normally stacked and buried in disused areas of mines, generating pollution and environmental damage.

This is because the cost of transporting them to recycling plants is too high, which is due to the size of the tyres. If, for example, we look at the situation regarding the larger tyres, a properly equipped truck can transport no more than 2 tyres.

Thus, it is necessary to find alternative solutions, also to adapt to global regulations requiring certification of disposal of worn tyres for each new tyre placed on the market.

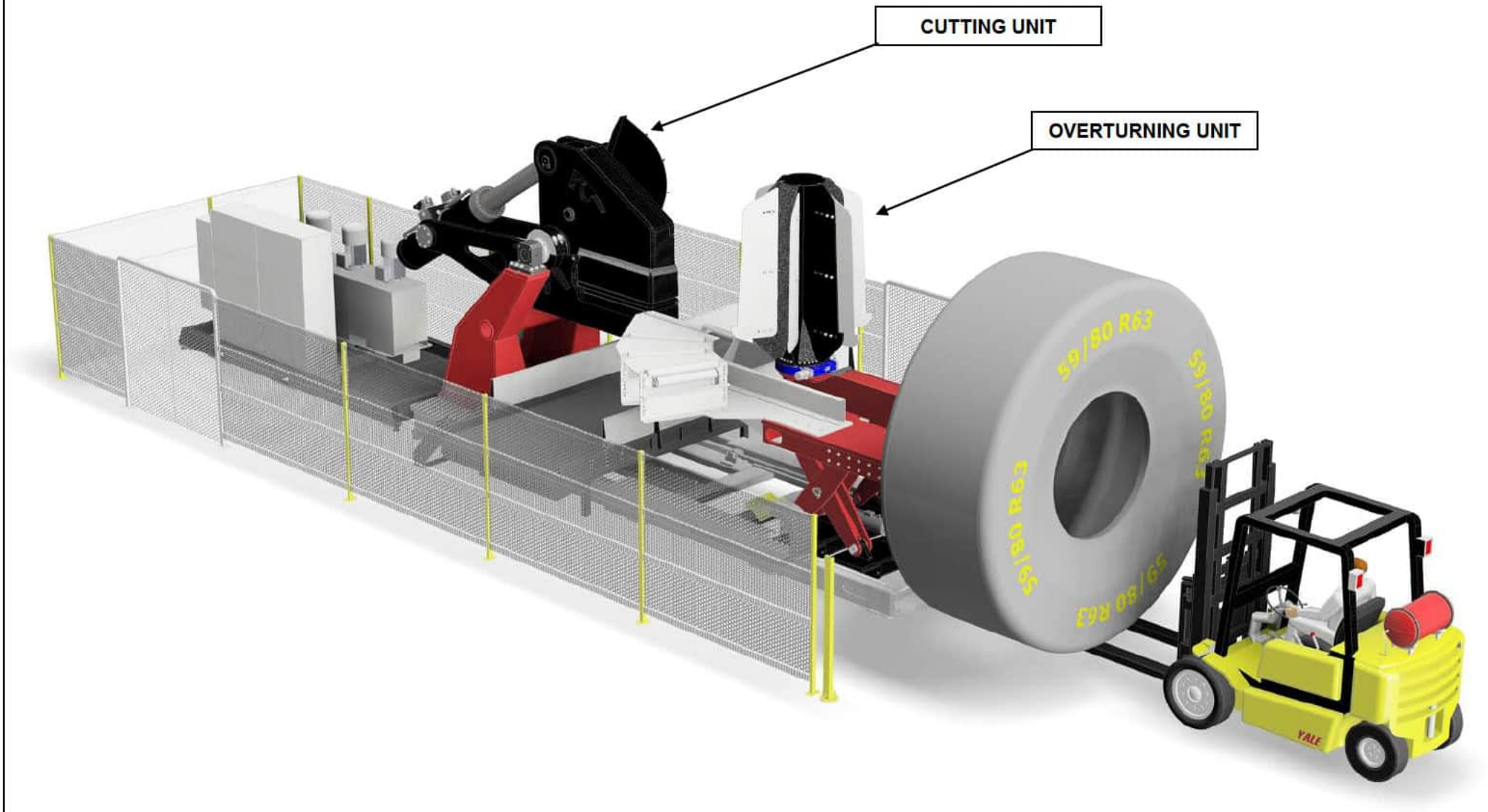
Purpose

- The MT-Rex machine purpose is the demolition of earthmoving OTR tyres by reducing their volume.
- The parts of tyres generated are of a size that can be processed by waste disposal and granulation facilities using passenger car and truck tyre processing plants from major suppliers.
- MT-Rex aims to facilitate the disposal of these tyres with a high environmental impact by reducing transportation costs, thus making it more economical to send them to recycling plants.
- Trucks can be fully loaded with sheared tyres and therefore, again in relation to larger tyres, they can take approximately four times the previous weight, increasing it from 10 to 40 tonnes per load, proportionately reducing the transport cost ratio.



Description of the machine:

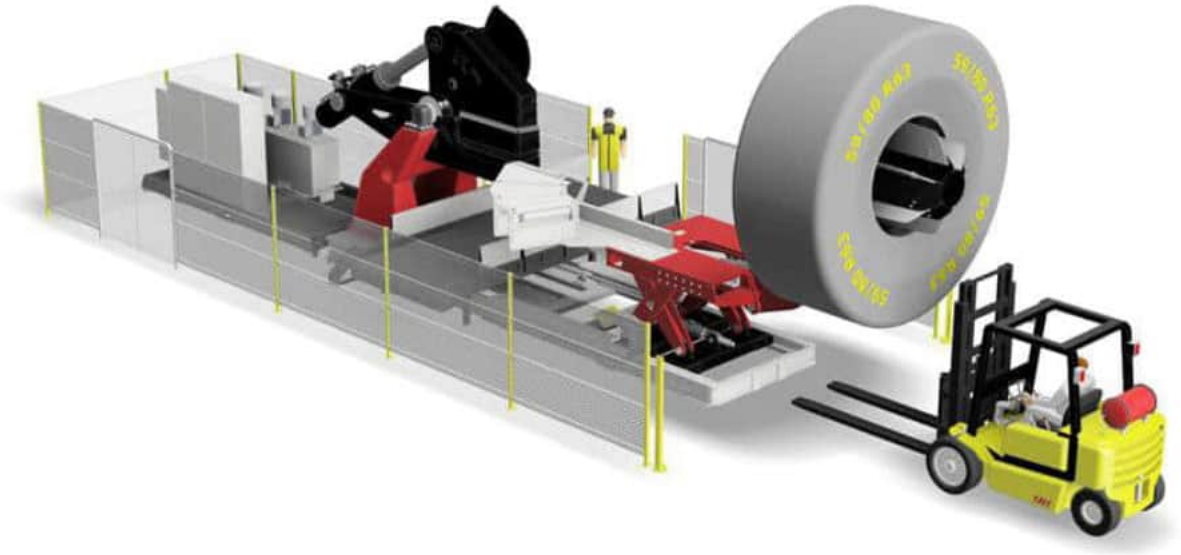
- MT-Rex can be operated by a single operator by means of a forklift (overall crane is not necessary)
- Whole OTR tyres are processed.
- The machine is structurally divided into two main units:
  The "**overturning**" unit
  The "**cutting**" unit;
  A spindle for keying from 45” to 63" tyres.
  Cut rubber parts unloading conveyor.
- The cutting and overturning groups are hydraulically operated, while the unloading conveyor is electrically operated.
- MT-Rex also has a PLC + MMI management system which can process tyres in manual or automatic cycle mode depending on customer needs.
- Possibility of storing a sufficient amount of programs (recipes) for the processing of different types of tyres, used as required.
- The controls can be managed either by using the control panel or by wireless remote control, while the programming has to be carried out using the control panel.
- Power to the machine is supplied by 400V-50Hz-3 phases + neutral + grounding.
- *Safety*: there are fixed guards that completely surround the cutting area with 2 side gates for maintenance work. These gates have suitable electric locks that inhibit access while the system is being used. Emergency stop buttons can be positioned on the perimeter. The loading area is guarded by safety laser barriers.
- *Accessories*: remote internet and webcam connection.

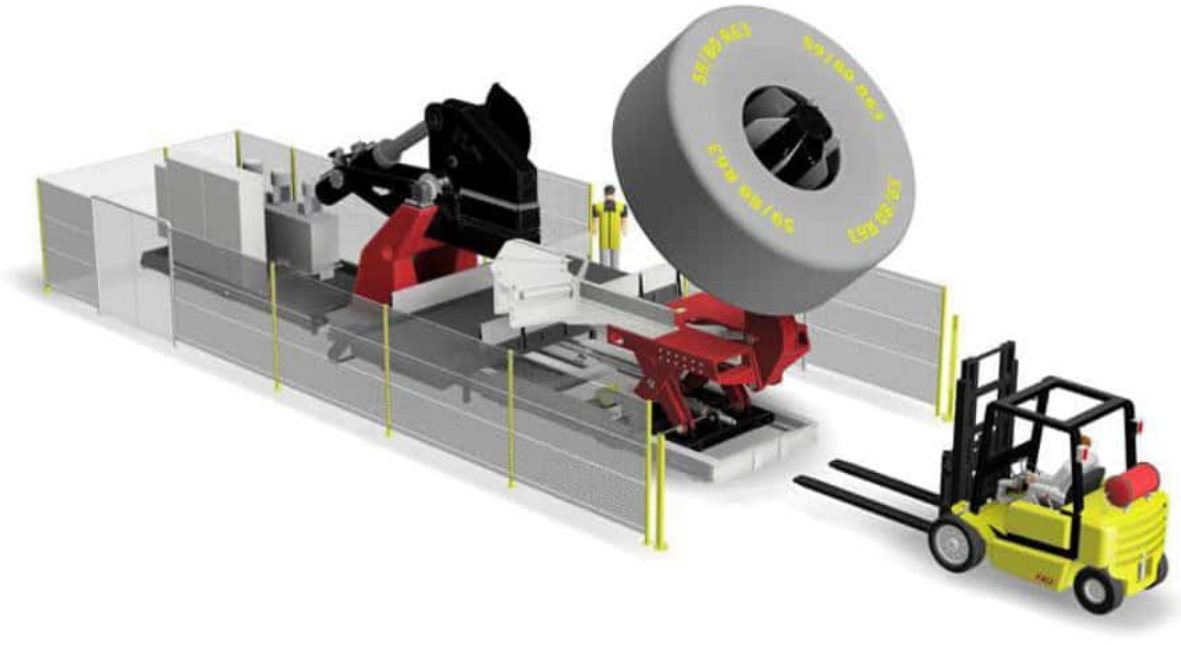

CUTTING UNIT
OVERTURNING UNIT
59/80 R63
YALE

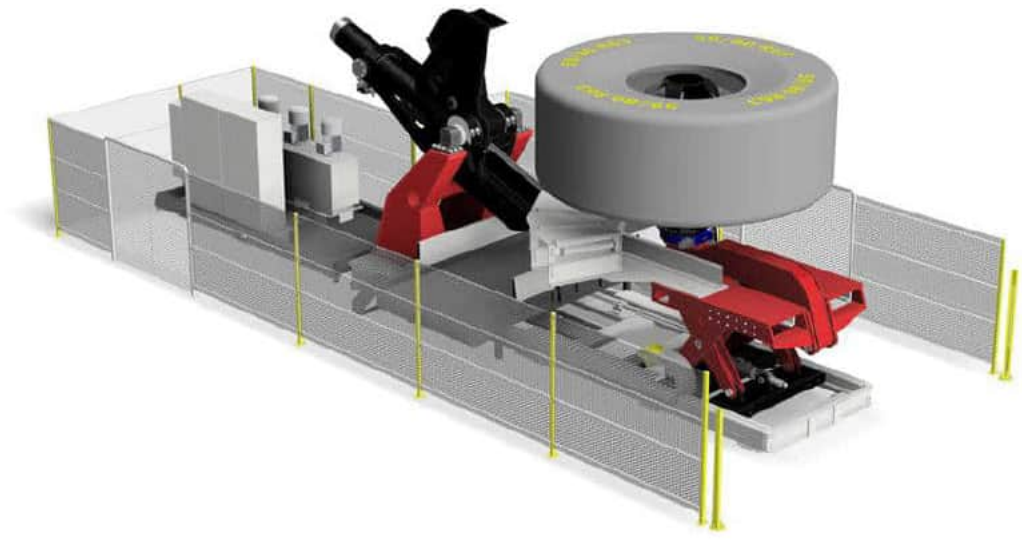
SALVADORI
FROM WASTE TO VALUE

MT-REX™

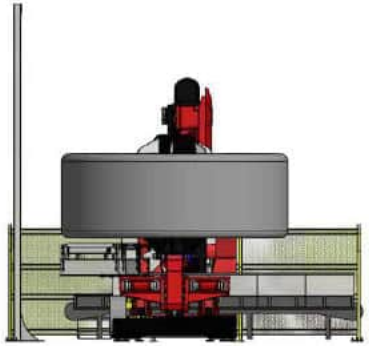
OTR & Mining Shear

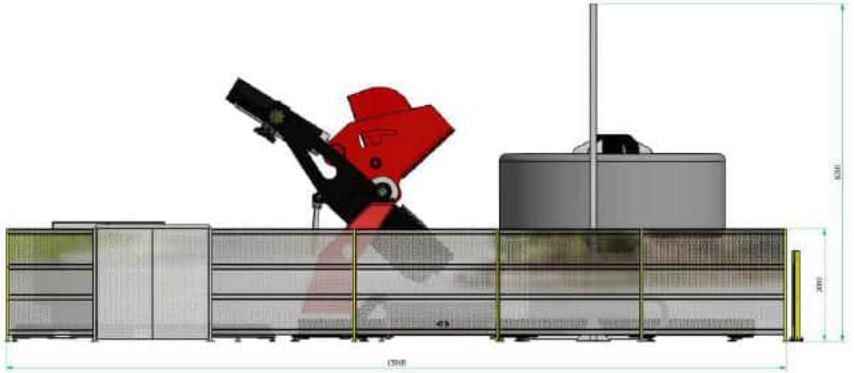


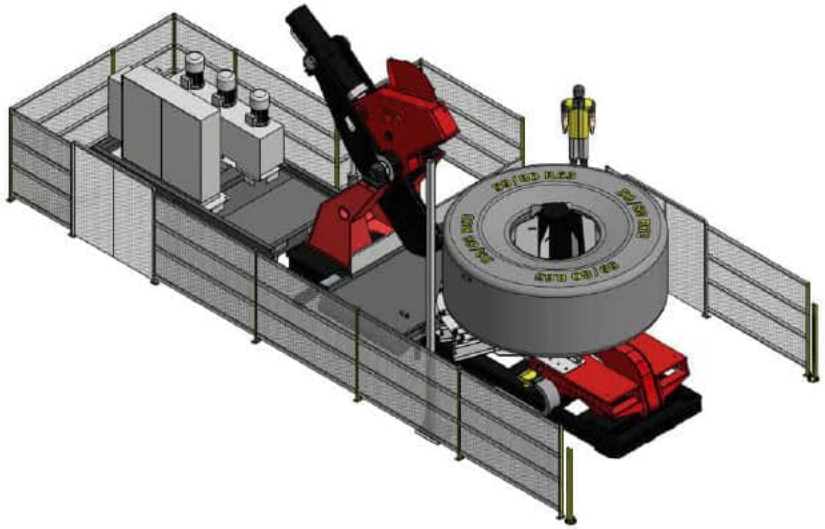


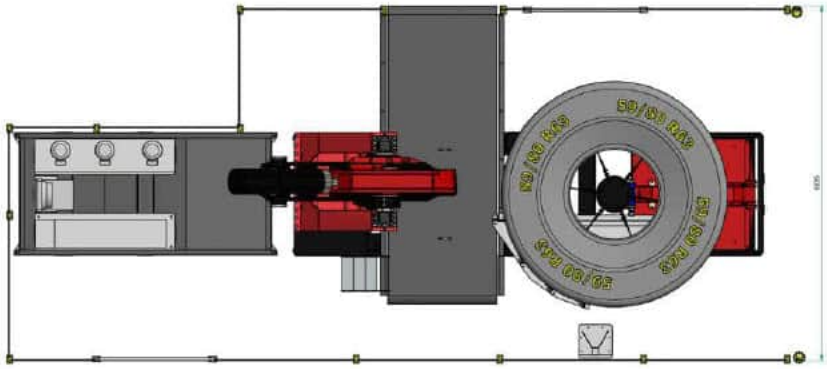


'adori.com









Technical specifications:

Tyres that can be processed: Textile or radial earthmoving OTR vehicle tyres.
Measure range: from 45 to 63 inches (33 to 63 inches by adding an optional spindle)

Main power supply:	400V – 50 Hz – 3 phases + neutral + grounding.
Protection ratio:	IP 55 for electrical panel
Electrical power:	~70 Kw (consumption approx. 50kWh)
Weight:	~37 ton
Plan dimensions:	as per attached layout

Productivity rate:

- 59/80 R 63 tyres — 1 tyre in 45 minutes
- Average weight — 4 tonnes/hour

Usage conditions:

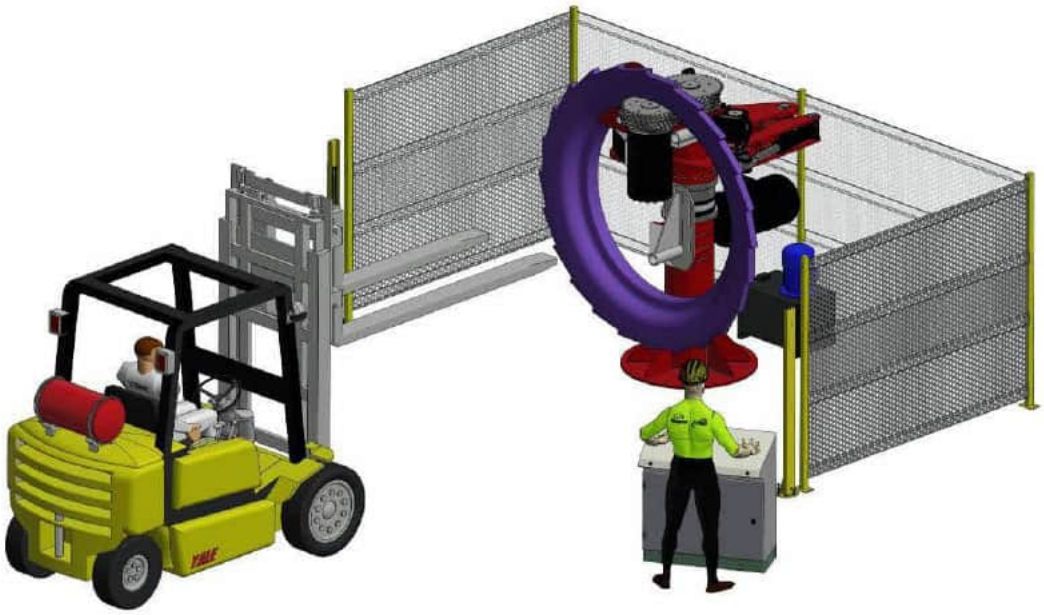
- Temperature for using the device — Minimum -10°C maximum 40°C Extended temperature version available on request
- Work environment — indoor operation keep away from atmospheric agents, resistant to dusty environments.

Installation type: Modular composition easily relocatable. Can be moved to alternative site in 2 days

Reference standard: Machine Directive 2006/42/EC.

MT-Raptor

At the end of MT-Rex working cycle, two rings containing the tyre beads are discharged with the forklift. Depending on the recycling process these can rings be directly processed downstream with systems like pyrolysis or might need to be prepared for shredding.
In the latter case MT-Raptor, an optional accessory of MT-Rex, can be used for separating the metal bead from the rubber ring containing it.



Technical specifications:

Rings that can be processed: Textile or radial earthmoving OTR.

Measure range: from 49 to 63 inches

Main power supply:	400V – 50 Hz – 3 phases + neutral + grounding
Protection ratio:	IP 55 for electrical panel
Electrical power:	~80 Kw (consumption approx. 40kWh)
Weight:	~7 ton
Plan dimensions:	as per attached layout
Productivity rate:	4 rings/hour

Usage conditions:

- Temperature for using the device — Minimum -10°C maximum 40°C Extended temperature version available on request
- Work environment — indoor operation keep away from atmospheric agents, resistant to dusty environments.

Reference standards: Machine Directive 2006/42/EC.

TERMS OF SUPPLY:

MT-Rex + MT-Raptor **Euro 1.350.000**

PRICES:	net in Euro excluding Italian VAT if applicable
DELIVERY TERMS:	EXW our factory in Rovereto (TN) – Italy as per Incoterms 2010
LEAD TIME:	within 5 months after contract signing, excluding August, save unforeseen events not due to Salvadori srl.
PACKING:	included
PAYMENT:	to be agreed
OFFER VALIDITY:	30 days
TRANSPORT:	excluded

INSTALLATION, TESTING
AND PERSONNEL TRAINING: Euro 19'000 including a preliminary two days site survey to evaluate site conditions and installation details.
Travel, board and lodging costs excluded.

WARRANTY: 12 months from testing at our works, excluding parts subject to wear.

Excluded from the terms of supply

- All building and civil engineering work needed.
- Compressed air system.
- Water system.
- Hydraulic oil.
- Customizations to the standard output conveyor belt.
- Installation and connection of electrical cables and relevant connections, pipework and cableways upstreams of the machine main switchboard.
- All machine and system lifting and positioning equipment.
- Any air/fume extractor ducts from the machine exit point to beyond the facility roof.
- Any and all air and effluent filter systems as required by local and/or national regulations.
- Any type of declaration as may be required by any competent local Fire Service or Health and Safety organisation.
- Any and all other items not clearly identified in the offer.

N.B.: SALVADORI Srl reserves the right to make with no warning any alteration to the system offered, without altering the production characteristics described.

SALVADORI S.r.l.

Appendix C – Terminology

The following is an explanation of the terminology used throughout this report:

- **Decibel (dB)**

The decibel is the unit that describes the sound pressure levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

- **A-Weighting**

An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A, dB.

- **Sound Power Level (L_w)**

Under normal conditions, a given sound source will radiate the same amount of energy, irrespective of its surroundings, being the sound power level. This is similar to a 1kW electric heater always radiating 1kW of heat. The sound power level of a noise source cannot be directly measured using a sound level meter but is calculated based on measured sound pressure level at known distances. Noise modelling incorporates source sound power levels as part of the input data.

- **Sound Pressure Level (L_p)**

The sound pressure level of a noise source is dependent upon its surroundings, being influenced by distance, ground absorption, topography, meteorological conditions etc. and is what the human ear actually hears. Using the electric heater analogy above, the heat will vary depending upon where the heater is located, just as the sound pressure level will vary depending on the surroundings. Noise modelling predicts the sound pressure level from the sound power levels taking into account ground absorption, barrier effects, distance etc.

- **L_{ASlow}**

This is the noise level in decibels, obtained using the A-frequency weighting and the S (slow) time weighting. Unless assessing modulation, all measurements use the slow time weighting characteristic.

- **L_{AFast}**

This is the noise level in decibels, obtained using the A-frequency weighting and the F (fast) time weighting. This is used when assessing the presence of modulation.

- **L_{APeak}**

This is the greatest absolute instantaneous sound pressure level in decibels using the A-frequency weighting.

- **L_{Amax}**

An L_{Amax} level is the maximum A-weighted noise level during a particular measurement.

- **L_{A1}**

The L_{A1} level is the A-weighted noise level exceeded for 1 percent of the measurement period and is considered to represent the average of the maximum noise levels measured.

- **L_{A10}**

The L_{A10} level is the A-weighted noise level exceeded for 10 percent of the measurement period and is considered to represent the "intrusive" noise level.

- **L_{A90}**

The L_{A90} level is the A-weighted noise level exceeded for 90 percent of the measurement period and is considered to represent the "background" noise level.

- **L_{Aeq}**

The equivalent steady state A-weighted sound level ("equal energy") in decibels which, in a specified time period, contains the same acoustic energy as the time-varying level during the same period. It is considered to represent the "average" noise level.

- **One-Third-Octave Band**

Means a band of frequencies spanning one-third of an octave and having a centre frequency between 25 Hz and 20000 Hz inclusive.

- **Representative Assessment Period**

Means a period of time not less than 15 minutes, and not exceeding four hours, determined by an inspector or authorised person to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission.

- **L_{Amax} assigned level**

Means an assigned level, which, measured as a L_{ASlow} value, is not to be exceeded at any time.

- **L_{A1} assigned level**

Means an assigned level, which, measured as a L_{ASlow} value, is not to be exceeded for more than 1 percent of the representative assessment period.

- **L_{A10} assigned level**

Means an assigned level, which, measured as a L_{ASlow} value, is not to be exceeded for more than 10 percent of the representative assessment period.

- **Tonal Noise**

A tonal noise source can be described as a source that has a distinctive noise emission in one or more frequencies. An example would be whining or droning. The quantitative definition of tonality is:

– the presence in the noise emission of tonal characteristics where the difference between -

(a) the A-weighted sound pressure level in any one-third octave band; and

(b) the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

is greater than 3 dB when the sound pressure levels are determined as $L_{Aeq,T}$ levels where the time period T is greater than 10% of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as $L_{A\ Slow}$ levels.

This is relatively common in most noise sources.

- **Modulating Noise**

A modulating source is regular, cyclic and audible and is present for at least 10% of the measurement period. The quantitative definition of modulation is:

– a variation in the emission of noise that —

(a) is more than 3 dB $L_{A\ Fast}$ or is more than 3 dB $L_{A\ Fast}$ in any one-third octave band; and

(b) is present for at least 10% of the representative assessment period; and

(c) is regular, cyclic and audible.

- **Impulsive Noise**

An impulsive noise source has a short-term banging, clunking or explosive sound. The quantitative definition of impulsiveness means:

– a variation in the emission of a noise where the difference between L_{Apeak} and L_{Amax} is more than 15 dB when determined for a single representative event.

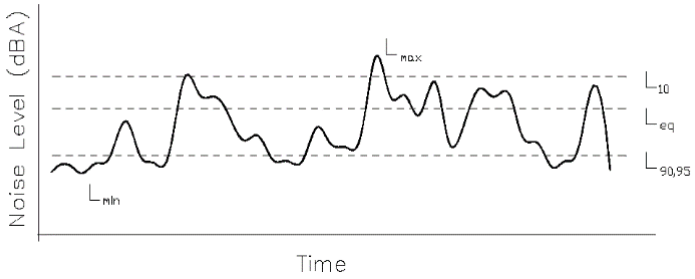
- **Major Road**

Is a road with an estimated average daily traffic count of more than 15,000 vehicles.

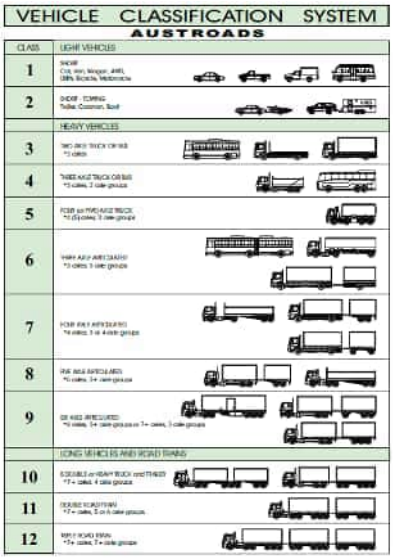
- **Secondary / Minor Road**

Is a road with an estimated average daily traffic count of between 6,000 and 15,000 vehicles.

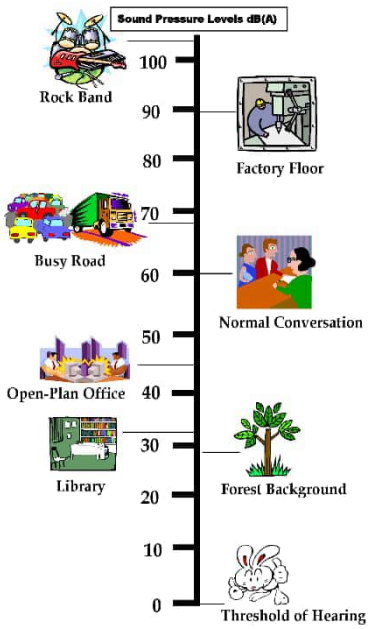
- **Chart of Noise Level Descriptors**



- **Austroads Vehicle Class**



- **Typical Noise Levels**



Attachment 8B

Fire Safety Risk Assessment

LUCID
CONSULTING AUSTRALIA

TYRECYCLE – WEDGEFIELD

[redacted]

Fire Safety Risk Assessment

Revision Number: 3.0

Date: 08/06/2023

Document Number: 23755-005

DOCUMENT CONTROL

DOCUMENT DETAILS	
Title	TYRECYCLE WEDGEFIELD
Lucid Document Ref.	LCE23755-005

ISSUE REGISTER				
Revision	**Description**	**Date**	**Author**	**Reviewer**
0.1	Draft for client review	14/02/2023	[redacted]	[redacted]
1.0	Final issue	14/04/2023	[redacted]	[redacted]
2.0	Updated to suit client comments	07/06/2023	[redacted]	[redacted]
3.0	Formatting update	08/06/2023	[redacted]	[redacted]

APPROVED FOR ISSUE	
Approver	[redacted] [redacted] [redacted] MIEAust, CPEng, NER

EXECUTIVE SUMMARY

This report pertains to the proposed tyre recycling facility to be located at [redacted]. The proposed site shall process whole tyres into cut sections of tyres. These sections shall be shipped to additional facilities for further processing.

The site features a dome structure where tyres are processed with the majority of tyres stored external to the building.

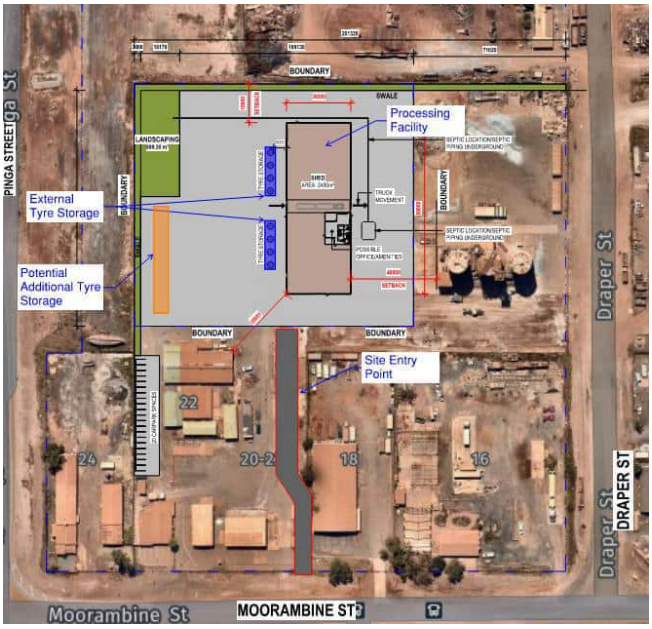


Figure 2-1 Building Layout

The new tyre recycling facility seeks to store tyres in excess of 2m^3. Under the Environmental Protection Regulations, a license issued by The Department of Water and Environmental Regulation is required to permit storage of used tyres. In addition to seek a building permit compliance with the National Construction Code 2019 Amendment 1 is required (NCC).

The report pertains to the Fire Safety Study required to support the client's application for licensing with the Department of Water and Environmental Regulation along with demonstrating the building meets the performance requirements of the NCC, with relation to fire safety.

The assessments undertaken reviewed four key hazards identified through the hazard assessment. These four potential hazards where:

- Insufficient water for fire suppression
- Fire brigade access limited
- Ignition of internal tyre fire
- Ignition of external tyre fire

A fire risk assessment was undertaken on these hazards to develop control measures to address these risks. The key control measures identified were:

- Storage of tyres to follow DFES guideline GN 2, except that tyres may be within 18m of the combustible elements of the dome structure.
- Fire hydrant system capable of providing a minimum 30l/s of hydrant water to be provided, and designed by a suitably qualified fire protection engineer/contractor.
- Civil engineering design to be undertaken to store water run of on site, with storage to be a minimum 432,000l. System to be designed by a suitably qualified fire protection engineer/contractor.

- Management in use procedures to be developed to ensure staff are trained and can assist during a fire event.
- Natural smoke venting to be provided from the dome structure.
- Building systems to be maintained to minimise the risk of ignition.

An assessment of the building against the National Construction Code, 2019 Amendment 1 found that the building achieved compliance with the NCC's Deemed-to-Satisfy design solution.

1.1 ABBREVIATIONS/TERMS

Table 2-1: Abbreviations used in this Report.

Abbreviation	Term
AFAC	National Council for Fire & Emergency Services (formerly the Australasian Fire and Emergency Service Authorities Council)
ASET	Available Safe Egress Time (time available for an occupant to reach a point of safety)
BCA	Building Code of Australia
BWM	Building Works Manual
DFES	Department of Fire and Emergency Services
DWER	Department of Water and Environmental Regulation
DtS	Deemed-to-Satisfy
FBIM	Fire Brigade Intervention Model
FHR	Fire hose reel
FRL	Fire Resistance Level
FRNSW	Fire & Rescue New South Wales
FRV	Fire & Rescue Victoria
MFPE	Manual for Fire Protection Engineering
NCC	National Construction Code
PR	Performance Requirement
RSET	Required Safe Egress Time (time for occupant to reach a point of safety)
Term	**Definition**
Stack	A pile of tyres of similar size located atop another with the bottom tyre located on on the ground.
Group of Tyres	Multiple stacks of tyres located 6.0m or less from each other.
Untenable	Area can not support human life for an extended period.

TABLE OF CONTENTS

2 INTRODUCTION

2.1 THE SCOPE OF REPORT

This report pertains to the proposed tyre recycling facility to be located at Lots 100 and 1807 Moorambine Street Wedgefield. The facility is to be located on a portion of the site with the existing landowner occupying the remaining area, as indicated in Figure 2-1.

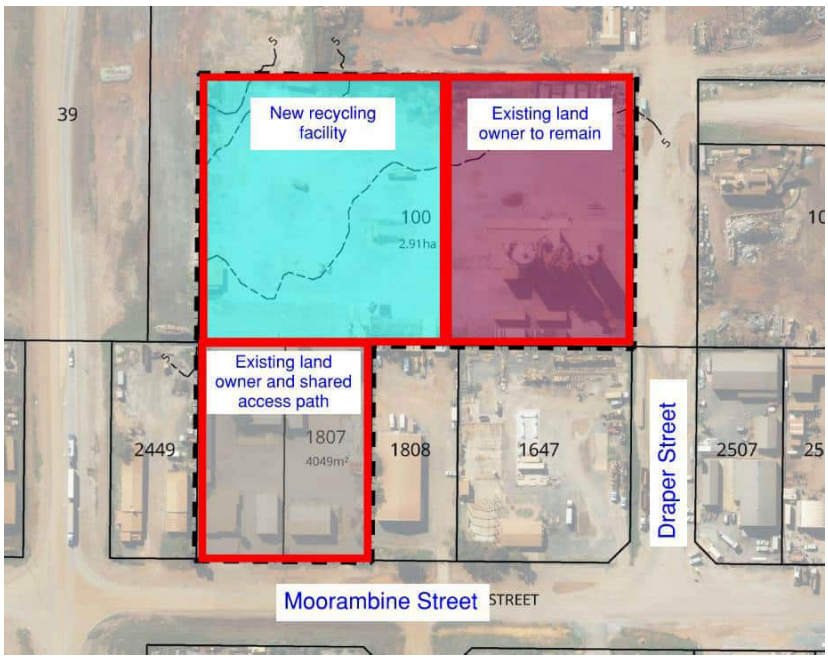


Figure 2-1 Site Plan Summary
(Dashed black line represents site boundary)

The new tyre recycling facility seeks to store tyres in excess of 2m³. Under the Environmental Protection Regulations, a license issued by The Department of Water and Environmental Regulation is required to permit storage of used tyres. In addition to seek, a building permit compliance with the National Construction Code 2019 Amendment 1 is required (NCC).

The report pertains to the Fire Safety Study required to support the client's application for licensing with the Department of Water and Environmental Regulation along with demonstrating the building meets the performance requirements of the NCC, with relation to fire safety.

2.1.1 Process

The fire safety risk assessment has been undertaken in accordance with the following guidelines:

- Australian Fire Engineering Guidelines (ABCB, 2021)
- NSW Government Planning, Hazardous Industry Planning and Advisory Paper No 2 – Fire Safety Study Guideline (Government, 2011)
- Department of Water and Environmental Regulation WA – Risk Assessments Guideline (Australia, 2020)

In addition to the above the following key guidelines have been used in assessing the risks and possible risk mitigation measures associated with the storage of tyres:

- DFES Guidance Note: GN02 – Bulk Storage of Rubber Tyres Including Shredded and Crumbed Tyres (Services, 2002)
- Fire & Rescue NSW – Guidelines for Bulk Storage of Rubber Tyres (Government, 2014)
- Tyre Stewardship – Best Practise Guidelines for Tyre Storage and Fire and Emergency Preparedness (Equilibrium, 2022)

2.2 ASSUMPTIONS AND LIMITATIONS

The following assumptions have necessarily been made in formulating this Report:

- Any modifications to the design that result in the assumptions becoming invalid may alter the analysis presented.
- All requirements related to management and maintenance of system are fully in place in accordance with report and relevant standards.
- All Items are not addressed in this report satisfy the performance requirements of the NCC Deemed to Satisfy provisions.

The following limitations apply to this Report:

- This report has been prepared based upon the information made reasonably available to Lucid Consulting Australia as listed in Table 2-2. Any additional and amended information can in turn affect the outcomes of this report.
- This report designs, analysis, and assessments apply to the proposed building works only and must not be applied to any other building and projects.
- The intent of the fire risk assessment is to reduce the level of risk associated with the site to so far as is reasonably practical. The assessment does not seek to achieve an absolute (100%) level of fire safety as it is not possible to eliminate risks of fire ignition or growth, or harm or damage resulting thereof.
- The report is primarily intended for reference by stakeholders involved in the design and approval authorities. Following development of the building design additional assessments may be required to verify the risk reporting undertaken.
- The fire safety strategy and fire engineering assessment presented in this report considers the building in the complete and operational form. It does not include consideration of ongoing construction works or alterations. Additional fire safety measures may be required whilst construction works are ongoing. These must be determined in consultation with the relevant authorities and/or specialist advisors (e.g. a fire safety engineer) as appropriate.
- Any change of use, alterations /additions in building, change in occupant, volumes of goods stored internal or external, or fuel conditions outside of those considered by this report occur in the future, a reassessment will be needed to verify consistency with the analysis contained within this report.

2.3 RELEVANT STAKEHOLDERS

Stakeholders in the fire safety engineering process are listed in Table 2-1. It is necessary that the relevant stakeholders are consulted and actively engaged in development of the fire safety strategy and preparation of this Report.

A record of stakeholder consultation for this Report is included in Appendix A.

Table 2-1: Relevant stakeholders involved in the preparation of this report.

Role	Organisation	Representative(s)
Client Strategic Projects Manager	Tyrecycle	Ryan Hodgson
Client Site Operations Manager	Tyrecycle	Ashley Battilana
Fire Safety Engineer	Lucid Consulting Australia	Jacob Drury
Fire Brigade	Department of Fire and Emergency Services (DFES)	Ryan Murtagh Alexandra Viale Jeff Davis Buang Hisham
Town Planner	Rowe Group	Nathan Stewart
Environmental Consultancy	SLR Consulting	Katherine Fox

2.4 REFERENCED DOCUMENTATION

This Report has been developed with reference to the project documentation listed in Table 2-2. Any modification to these documents may affect the outcomes of the fire engineering analysis and the associated level of fire safety achieved.

Table 2-2: Project documentation referenced in preparation of this report.

Document	Doc. No.	Document Name	Author	Date	Rev.
Drawing	SK0001	Cover Sheet	Bell Architect	08.12.2022	S2
Drawing	SK1101	Site Plan	Bell Architect	08.12.2022	S6
Drawing	SK2201	Floor Plan	Bell Architect	08.12.2022	S4
Drawing	SK3101	Overall Elevations	Bell Architect	08.12.2022	S4
Report	9666	Development Application	Rowe Group	19.12.2022	1

3 KEY DESIGN CHARACTERISTICS

3.1 PRINCIPAL BUILDING CHARACTERISTIC

The new facility is to be built and operated by Tyrecycle who own and operate multiple tyre recycling facilities across Australia. The facility shall take large scale mining tyres (i.e tyres typically exceeding 1.0m in diameter) and break these down to smaller segments (approximately 60kg). These smaller segments will be shipped to other facilities typically owned and operated by Tyrecycle to be processed further. The mining tyres are broken down using machines known as Raptor (2 off proposed), and T-Rex (2 off proposed). Figure 3-1 demonstrates the operation of the larger T-Rex machine.

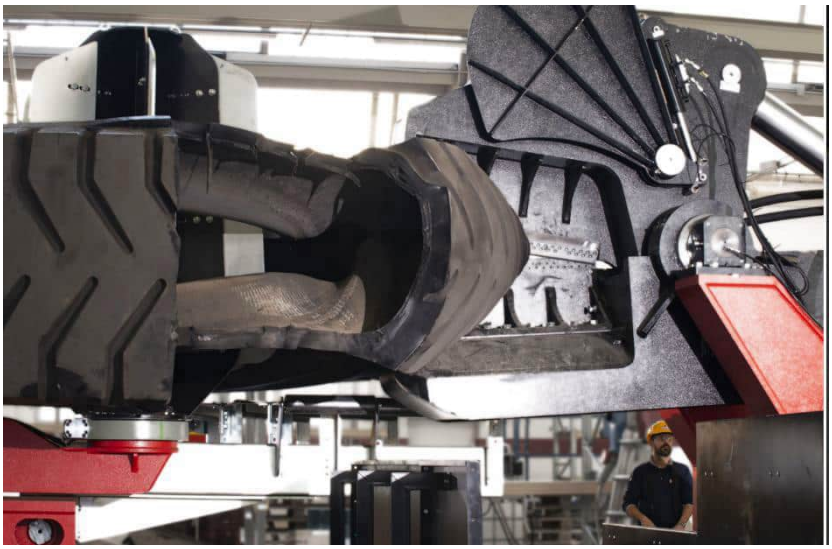


Figure 3-1 Example Machine

The tyres shall be processed inside a 30m (wide) and 80m (long) steel dome structure cladded in Colorbond sheeting. The roof of the structure is to be a combusible armourtex fabric sheet. Net building volume is approximately 26,000m^3 with no fire resistant structure proposed. Early concepts of the building are indicated in Figure 3-2.

Figure 3-2 Proposed Building Structure

The peak ridge height of the building is 12.7m with the lowest point of the roof 5.7m high.

Tyres are stored external to the building located in stacks up to three tyres high (but less than 3.7m in overall height), until the tyres are ready for processing. The volumes of tyres stored external to the

building is limited to 3 groups of tyres, made up of multiple stacks. Each group of tyres contains a maximum 50 tonnes of tyres each. In accordance with DFES guidance note GN02 the facility is considered as a Large facility with each group of tyres less than that permitted for a small facility. Tyres are moved as described in Figure 3-3 and Figure 3-4.

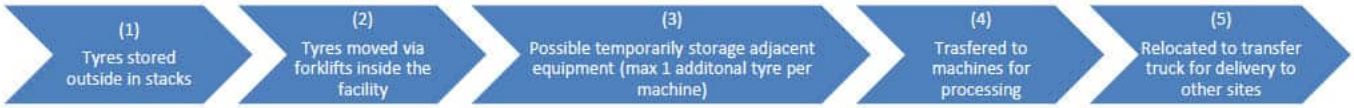


Figure 3-3 Site Processing Flow Chart

Figure 3-4 Site Processing Diagram

Storage inside the facility is limited to a maximum of 8 whole tyres should all four machines be in use (4 tyres undergoing processing, plus 1 additional tyre being temporarily stored adjacent each machine). The largest volume of storage is expected to be located within the transport truck when filled with cut martial. Trucks used for the collection of cut material are semi-trailer (19m long) with an estimated 5 deliveries per day forecasted.

An office/amenities area is proposed to be located within the dome structure. The office area is approximately 175m², less than 10% of the net floor area. The building is considered a Class 8 building.

Table 3-1 provides a brief description of key design characteristics of the building described above.

Table 3-1: Building characteristics

Characteristic	Description
Building Classification(s)*	Class 8: Factory/Processing Facility
Rise in storeys*	1
Number of storeys contained	1
Effective height*	0 m
Peak Building Height	12.7m
Net Floor Area Enclosed**	2,400m^2
Net Volume Enclosed**	26,000m^3

*as defined in the NCC

**Approximate only, rounded up to the nearest 100 m^2/m^3

3.2 SITE ACCESS

. Access to the site is provided from [redacted] with a shared access road provided through the existing site. The building is provided with an 18m set back to all site boundaries with truck access roads to the site is greater than 3.5m in width to allow for truck entry. Truck access is provided around the entire building with the narrowest point being 15m in width as indicated in Figure 3-5.

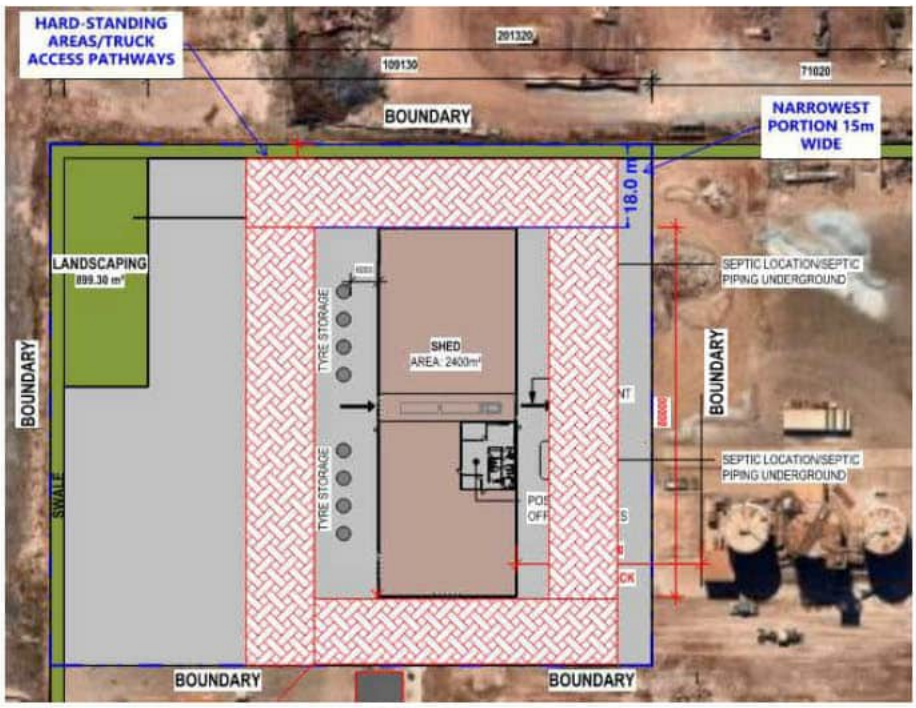


Figure 3-5 Site Access

3.3 SURROUNDING LAND USE

As detailed in Section 2.1 the facility shall be located on a shared site with the existing landowner Buckeridge Group of Companies (BGC) who use the site to produce asphalt and cement. BGC shall occupy the Eastern and Southern Portions of the existing site. To the north of the site is a metal recycling centre,. To the West of the site is vacant land and [redacted] (a public road). The South Eastern boundary of the site adjoins a property containing a Pirtek (hydraulic hoses) supply centre, as identified in Figure 3-6.

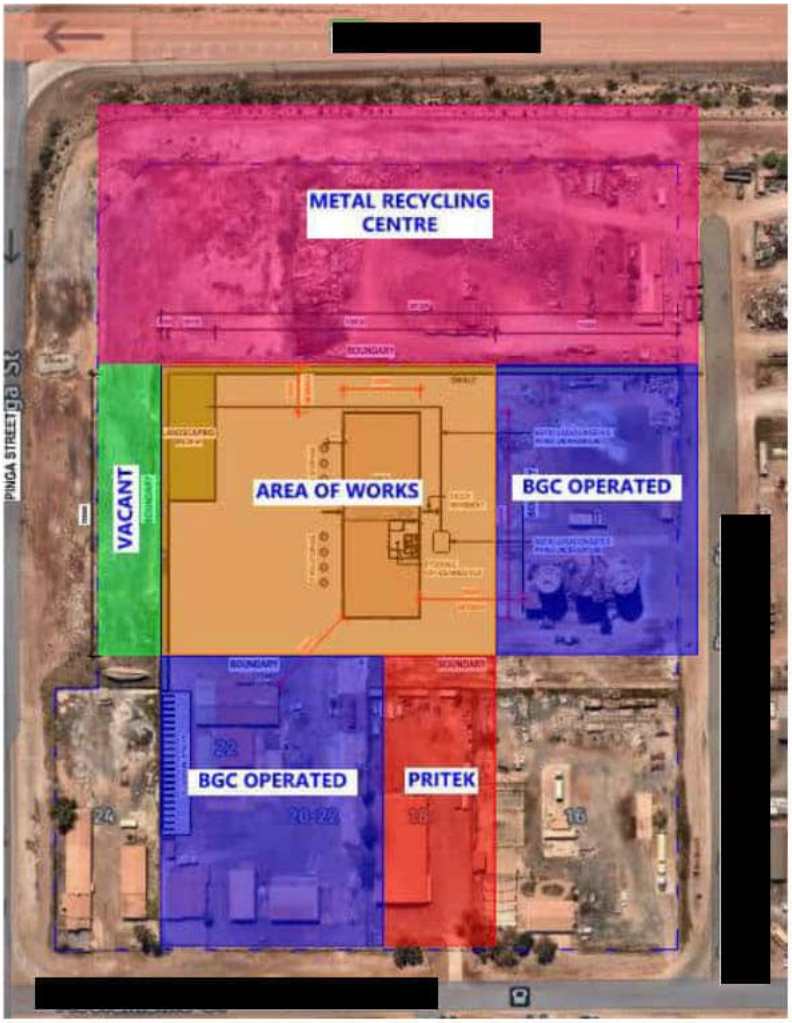


Figure 3-6 Adjacent Land Use

3.4 OCCUPANT CHARACTERISTICS

The facility is operated in shifts, with two shifts undertaken per day. Each shift comprises of 8 staff. The site is expected to be occupied during trading hours which typically comprise of Monday – Friday 7:00am – 5:00pm, however weekend work may occur at times. During this time the number of occupants is expected be as low as 8, but never greater than 30 when accounting for shift change over (16 staff) and a number of visitors/delivery drivers.

Outside of operating hours, no occupants are expected to be lawfully located on site.

Dominant occupant characteristics expected to significantly influence fire safety outcomes are identified in Table 3-2.

Table 3-2: Dominant occupant characteristics within the building

Characteristic	Description
Staff	
State and activity	Considering that this is their place of employment, staff are not likely to be asleep or under the influence of alcohol and/or drugs. Staff are expected to be awake, alert and aware of their surroundings.
Physical and cognitive attributes	Due to the nature of the works staff, outside of office areas, are expected to be able to evacuate without assistance. It is possible that some staff would have trouble hearing alarms or verbal commands due to the use of ear protection devices. Once a direction has been issued (by other staff or the brigade) it is expected that most staff will act as directed.
Emergency training	At least one staff member per shift shall be required to be trained in the operation of portable fire extinguishers and fire hose reels. In addition, at least one staff member per shift shall be accredited in operating a forklift and may be relied upon during an emergency to assist in moving material.
Familiarity	Considering this is a place of their employment, staff are expected to be familiar with the building and the location of exit routes and exits.
Visitors	
State and activity	Visitors are not likely to be asleep or under the influence of alcohol and/or drugs. Visitors are expected to be awake, alert and aware of their surroundings.
Physical and cognitive attributes	Some visitors/patrons may not be fully mobile and may need additional assistance during an evacuation. It is assumed that some visitors would have follow directions issued by staff during an emergency.
Emergency training	No fire training is expected to be provided to the visitors. As a result, there is no expectation that visitors would be trained in the operation of fire hose reels of fire extinguishers.
Familiarity	There is no expectation that visitors are familiar with the building and the location of exit routes and exits. Visitors are expected to be supervised by staff when on site. Staff are expected to provide advice during an emergency.

3.5 FIRE BRIGADE CHARACTERISTICS

The nearest fire brigade station is the South Hedland Fire and Rescue Service, located at [redacted] This station is approximately 7km from the project site, as indicated in Figure 3-7, and operates as a volunteer fire service.

Figure 3-7 Closest Fire Station

The site shall be provided with a fire hydrant system designed in accordance with AS2419.1-2005 and DFES guidance note GN02. In addition, portable fire extinguishers and a fire hose reel system shall be provided in accordance with AS2444-2001 and AS2441-2005 respectively. The dome structure is provided with natural ventilation openings to assist in maintaining operating conditions for the facility. These vents shall also assist in clearing of smoke within the building.

4 FIRE SAFETY OBJECTIVES

4.1 DEPARTMENT OF WATER AND ENVIRONMENTAL REGULATION OBJECTIVES

The objectives of the Department of Water and Environmental Regulation, with relation to the licensing of Tyre Recycling facilities, is to prevent public health and/or the environment from being subject to an unacceptable level of risk.

The objective of the fire safety design is therefore to:

- Minimize the potential for a large-scale fire event from occurring; and
- Reduce the consequences incurred by the environment and/or public health should a fire eventuate.

4.2 NCC BUILDING COMPLIANCE OBJECTIVES

The objectives of the NCC are to enable and maintain acceptable standards of structural sufficiency, safety (including safety from fire), health and amenity for the benefit of the community both now and in the future. These goals are applied so that the NCC extends no further than is necessary in the public interest, is cost effective, easily understood, and is not needlessly onerous in its application.

The fire safety objectives defined within the building regulations are as identified in the explanatory information within the NCC:

- Safeguard occupants from illness, injury or fatality due to fire in a building; and
- Safeguard occupants from illness, injury or fatality whilst evacuating a building during a fire; and
- Facilitate the activities of the fire brigade and other emergency services personnel; and
- Avoid the spread of fire between buildings; and
- Protect other buildings/property from damage as a consequence of structural failure during a fire.

5 FIRE HAZARDS

A "fire hazard" is considered to be any aspect of the building layout, usage or occupant behaviour that may contribute to ignition or growth of a fire and/or compromise the fire safety objectives (Section 4).

All facilities inherently incorporate fire hazards. Fire hazards for the subject facility are identified through two independent studies and presented herein:

- Review of selected literature containing fire-related statistics for similar building types and occupancies.
- Review of documentation to identify fire hazards specific to this building.

5.1 STATISTICAL FIRE HAZARDS

A literature review of the fire hazards associated with tyre recycling and tyre storage facilities was undertaken with the following documents included in the literature review:

- DFES Guidance Note: GN02 – Bulk Storage of Rubber Tyres Including Shredded and Crumbed Tyres (Services, 2002)
- Fire & Rescue NSW – Guidelines for Bulk Storage of Rubber Tyres (Government, 2014)
- Tyre Stewardship – Best Practise Guidelines for Tyre Storage and Fire and Emergency Preparedness (Equilibrium, 2022)
- U.S. Fire Administration/Technical Report Series – Special Report Scrap and Shredded Tire Fires (Stanley & Poole, 1998)
- Fire Test with a Front Wheel Loader Rubber Tyre (Ingason & Hammarstrom, 2010)
- Emissions from Tyre Fires (Lonnermark & Blomqvist, 2005)
- The Flame Characteristics of a Tyre Fire on a Mining Vehicle (Hansen, 2022)

The following key findings where apparent from the literature review undertaken:

- Whole and cut tyres are difficult to ignite, as the tyre when used for its original purpose is designed to absorb a high amount of energy without igniting (i.e when used on a road). Self-ignition of tyre crumb (shredded tyres) had been recorded where the pile is more than 3.0m deep.
- Typical ignition sources for tyre piles included:
  - Arson from malicious acts.
  - Lightning strikes.
  - Hot works/smoking material in proximity of the tyre storage.
  - Faulty machinery equipment.
- Should a fire event occur, the consequences to the environment is high as:
  - Ignited tyres will produce a toxic oil. When mixed with water (used to extinguish the fire) the volumes of oil/water entering the environment and soil can be high.
  - Tyre fires produce a thick and toxic smoke in high volumes which can affect neighbouring properties and communities.
- Once ignited a tyre fire is difficult to extinguish. This is largely due to the tyres aquaphobic nature (i.e repels water to be suitable for wet road conditions). In addition, should tyres be stored in large disorderly piles, water penetrating to the core of the fire can be difficult as the fire is shielded by the rubber tyres.
- Large tyre fires have occurred across the globe, with some cases including piles in excess of 1Million tyres. The time required to fully extinguish these large-scale fire events can be significant with the longest recorded tyre fire lasting 15years in Wales. These large-scale events however had tyre

storage greatly exceeding the proposed facilities operational limitations (i.e tyres measured in millions)

- Extinguishing methods for putting out the fire generally ranged from the application of water/foam during the fires early stages, free burn allowing the fire to complete its combustion process, and excavating/burying the burnt material.
- The key method of protection against fire events occurring was pre-planning by providing clear separation between tyre piles. This ensured the potential fire size was limited.

The key parameters, identified in Table 5-1, were identified during the literature review undertaken.

Table 5-1: Tyre Fire Properties

Parameter	Value	Source
Heat of Combustion	27 MJ/kg-40MJ/Kg	(Ingason & Hammarstrom, 2010) (Services, 2002)
Heat Release of Tyres (Piled or Single)	0.15MW/m^2-0.2MW/m^2 (exposed area)	(Ingason & Hammarstrom, 2010) (Hansen, 2022)
Typical peak Heat Release Rate For Single Tyre Fire (mining tyre size)	3MW-3.5MW	(Ingason & Hammarstrom, 2010) (Hansen, 2022)
Fire Growth Rate	Fast	(Ingason & Hammarstrom, 2010) (Hansen, 2022)
Critical Heat Flux	17.1 kW/m^2 (non piloted)	(Hansen, 2022)
Ignition Temperature	297-538°C	(Hansen, 2022) (Stanley & Poole, 1998)
Soot Yield	0.25 kg/kg	(Lonnermark & Blomqvist, 2005)
CO2 Yield	0.048 kg/kg	(Lonnermark & Blomqvist, 2005)
CO Yield	2.0 kg/kg	(Lonnermark & Blomqvist, 2005)

5.2 SPECIFIC FIRE HAZARDS

The fire hazard specific to the fire risk assessment is associated with the ignition of Whole and Cut tyres. As the facility specialises in the recycling of used tyres, the size and chemical makeup of each tyre would differ, but generally comprise of compounds such as Carbon, Oil, Benzene, Toluene, Rubber and Sulphur (Stanley & Poole, 1998).

The four key areas where tyres may be stored are:

1. Three external storage stacks, with one located on the Western boundary and two located adjacent the Western Façade of the Dome structure. Each contains no more than 50tonnes of tyres and features:
    a. A maximum storage height of 3.7m
    b. Each individual stack no closer than 2.5m.
    c. The Western tyre stack is located at least 18.0m from the Western chain link fence.
    d. The two tyre stacks located adjacent the dome structure are located less than 18.0m, but more than 6.0m from the façade. The building roof is a combustible sheet plastic cover.
2. On ground internal to the Dome Structure, awaiting loading onto the process machines (whole tyres).
3. While located on the process machinery (whole/cut pieces)

4. Loaded onto the delivery truck awaiting transfer (cut pieces).

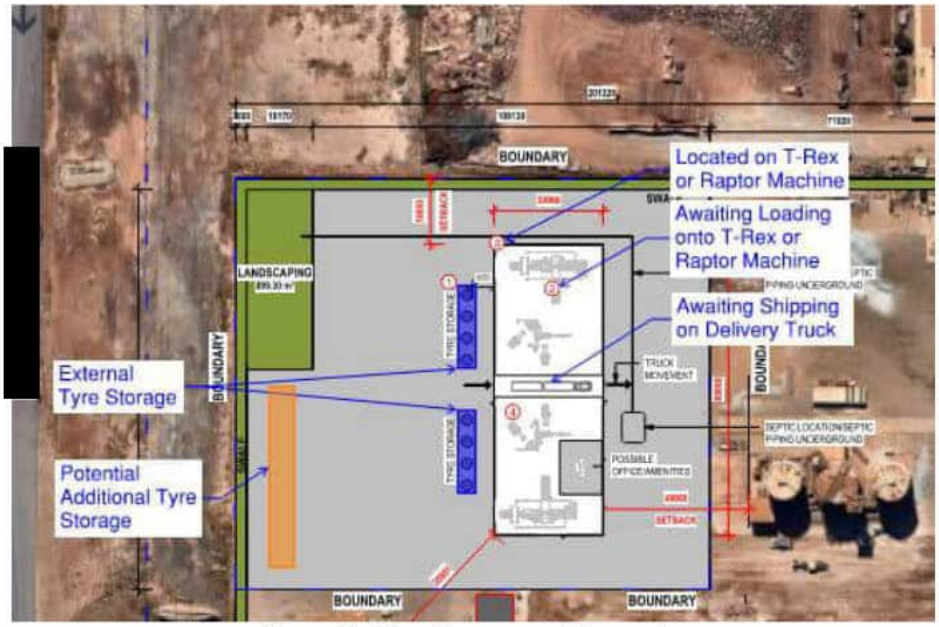


Figure 5-1 Tyre Storage and Processing

5.3 MITIGATION OF FIRE HAZARDS

It would be impractical to eliminate all fire hazards in a functional facility. Fire hazards identified are instead to be mitigated via implementation of fire safety systems within the building design as described in Section 6 of this report.

Table 5-2: Potential preventative and protective measures to address the potential fire hazards identified.

Fire Hazard	Cause/Comments	Possible Results/Consequences	Prevention/Detection/Protection Required	Associated Analysis and Hazard Assessment
Insufficient water for fire suppression	▪ Unique fire risk not considered in hydrant system design	▪ Fire hydrant System incorrectly sized ▪ Brigade are unable to supress the fire.	▪ Fire hydrant system to be designed in accordance with AS2419.1, DFES Guideline GN-2, and Fire and Rescue NSW Guidelines	Hazard Assessment 1
Fire brigade access limited	▪ Clear pathways not established or maintained. ▪ Clear access around tyres not provided.	▪ Brigade are unable to access fire ▪ Brigade reach a dead-end preventing escape in an emergency situation	▪ Fire tuck access to be provided in accordance with DFES guideline GL-11 : DFES Site planning and fire appliance specification	Hazard Assessment 2
Ignition of internal tyre fire	▪ Hot works/smoking igniting the stacks ▪ Processed machinery ignites tyres under processing (faulty machinery including electrical faults) ▪ Ignition of cut tyres stores within delivery truck by heat build-up from truck. ▪ Arson attack ▪ Ignition from LPG cylinders used for forklifts	▪ Internal tyre fire resulting in: o Occupants exposed to untenable conditions o Failure of building structure ▪ Water runoff from tyres spreading to the environment	▪ Tyres to be removed from hot works areas ▪ Natural relief vents to assist in clearing of smoke ▪ Evacuation management plan to be enforced ▪ Limit access to facility to staff or supervised personnel ▪ At least one staff member per shift shall be trained in the use of extinguishing fires using portable fire extinguishers and fire hose reels ▪ Staff and equipment to be provided to move un-burnt tyres in a fire event ▪ Spare LPG cylinders to be stored outside.	Hazard Assessment 3

Ignition of external tyre fire	▪ Hot works/smoking igniting the stacks ▪ Arson from malicious intent ▪ Lightning strike ▪ Neighbouring bushfire ▪ Fire originating from neighbouring properties	▪ Fire/smoke spread from stacks to: o Neighbouring properties o Dome building o Additional tyre stacks ▪ Water runoff from tyres spreading to the environment ▪ Ignition of adjacent flora resulting in a bush fire	▪ Hot works clear area around external tyre stacks to be provided ▪ Staff and equipment to be provided to move stacks in a fire event ▪ Tyre storage to be in accordance with DFES Guideline GN-2, and Fire and Rescue NSW Guidelines ▪ Site security to limit access from the public ▪ Water runoff catchment system to be established ▪ Goods to be stored outside of bushfire zones	Hazard Assessment 4

6 FIRE HAZARD ASSESMENT

6.1 FRAMEWORK

The fire hazards and proposed protection systems outlined in Table 5-2 are to be assessed to determine the residual risk rating associated with the hazard, with fire engineering analysis undertaken to determine the likely consequences of each hazard. The hazard shall first be assessed without the provisions of any preventative or protection measures (untreated risk) and repeated when considering the preventative and protective measures provided.

The risk rating associated with each hazard shall be determined in accordance with the Department of Water and Environmental Regulations Guidelines to Risk Assessments (Australia, 2020). The risk criteria for each hazard shall be selected in accordance with Figure 6-1.

Table 1: Risk criteria

Consequence

The department will use the following criteria to assess the consequences of a risk event occurring:

	Environment	Public health* and amenity (such as air and water quality, noise and odour)
Severe	• Onsite impacts: **catastrophic** • Offsite impacts local scale: **high level or above** • Offsite impacts wider scale: **mid level or above** • **Mid to long-term or permanent impact to an area of high conservation value or special significance^** • **Specific Consequence Criteria (for environment) are significantly exceeded**	• **Loss of life** • Adverse health effects: **high level or ongoing medical treatment** • **Specific Consequence Criteria (for public health) are significantly exceeded** • Local scale impacts: **permanent loss of amenity**
Major	• Onsite impacts: **high level** • Offsite impacts local scale: **mid level** • Offsite impacts wider scale: **low level** • **Short-term impact to an area of high conservation value or special significance^** • **Specific Consequence Criteria (for environment) are exceeded**	• Adverse health effects: **mid level or frequent medical treatment** • **Specific Consequence Criteria (for public health) are exceeded** • Local scale impacts: **high level impact to amenity**
Moderate	• Onsite impacts: **mid level** • Offsite impacts local scale: **low level** • Offsite impacts wider scale: **minimal** • **Specific Consequence Criteria (for environment) are at risk of not being met**	• Adverse health effects: **low level or occasional medical treatment** • **Specific Consequence Criteria (for public health) are at risk of not being met** • Local scale impacts: **mid level impact to amenity**
Minor	• Onsite impacts: **low level** • Offsite impacts local scale: **minimal** • Offsite impacts wider scale: **not detectable** • **Specific Consequence Criteria (for environment) likely to be met**	• **Specific Consequence Criteria (for public health) are likely to be met** • Local scale impacts: **low level impact to amenity**
Slight	• Onsite impact: **minimal** • **Specific Consequence Criteria (for environment) met**	• Local scale: **minimal impacts to amenity** • **Specific Consequence Criteria (for public health) criteria met**

Likelihood

The department will use the following criteria to assess the likelihood of a risk event occurring.

Almost certain	**The risk event is expected to occur in most circumstances**
Likely	**The risk event will probably occur in most circumstances**
Possible	**The risk event could occur at some time**
Unlikely	**The risk event will probably not occur in most circumstances**
Rare	**The risk event may only occur in exceptional circumstances**

^ For areas of high conservation value or special significance, we will use the *Guideline: Environmental siting* to inform our decision

* In applying public health criteria, we may use the Department of Health's *Health risk assessment (scoping) guidelines*

'Onsite' means within the prescribed premises boundary

Figure 6-1 Risk Criteria (Australia, 2020)

Based on the consequence rating and likihood the associated risk rating shall be determined in accordance with Figure 6-2

Table 2: Risk rating matrix

Likelihood	Consequence				
	Slight	Minor	Moderate	Major	Severe
Almost certain	Medium	High	High	Extreme	Extreme
Likely	Medium	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	Extreme
Unlikely	Low	Medium	Medium	Medium	High
Rare	Low	Low	Medium	Medium	High

Figure 6-2 Associated Risk Level (Australia, 2020)

The acceptable level of risk shall be determined in accordance with the Risk Assessment guideline produced by the Department of Water and Environmental Regulation (Australia, 2020), as presented in Figure 6-3. This table has been extracted from the Department of Water and Environmental Regulations Guidelines to Risk Assessments (Australia, 2020). The term WE relates to DWER's stance/acceptability.

Table 3 – Risk treatment

Rating of risk event	Acceptability	Treatment
Extreme	Unacceptable	Risk event will not be tolerated. We may refuse the application.
High	May be acceptable subject to multiple regulatory controls	Risk event may be tolerated. We may apply multiple regulatory controls, including both outcome-based and management conditions.
Medium	Acceptable, generally subject to regulatory controls	Risk event is tolerable. We may apply some regulatory controls, including outcome-based conditions where practical and appropriate.
Rating of risk event	Acceptability	Treatment
Low	Acceptable, generally not controlled	Risk event is acceptable. Generally we will not apply regulatory controls.

Figure 6-3 Risk Acceptability (Australia, 2020) Extracted from DWRS Guideline

6.3 HAZARD ASSEMENT 1 –WATER FOR FIRE SUPRESSION

6.3.1 Description of Hazard

Under the NCC all buildings exceeding 500m² in floor area are required to be provided with a fire hydrant system designed in accordance with AS2419.1-2005, with no direct reference to alternate standards/specifications with relation to fire hydrant systems. AS2419.1-2005 is intended to be used on a range of different buildings/facilities and in instances is insufficient to address unique fire risks.

6.3.2 Risk Rating Without Treatment

Where the hydrant system is not designed for the unique fire hazards associated with the storage of used tyres, the system may not be sufficient to supress or extinguish a fire. Without supressing the fire the volume of pollutants entering the atmosphere would be maximised with a medium impact to the local area expected as the area is industrial. The consequence incurred by the environment and Public is deemed a **Major Consequence**.

The likelihood of the system to be designed incorrectly if solely designed in accordance with AS2419.1-2005 is **Likely.**

Without treatment the risk rating for this hazard is **High.**

6.3.3 Control Systems

The fire hydrant design is to be undertaken in accordance with AS2419.1-2005, DFES guideline GN2 (Services, 2002) and NSW Fire and Rescue Guidelines (Government, 2014). The guidelines produced by DFES and NSW Fire and Rescue are specifically designed to establish the parameters required to suit a tyre fire. The systems will therefore be capable of suppressing or controlling a tyre fire within the expectations of DFES's operational requirements.

6.3.4 Control System Parameters

DFES Guideline GN2 (Services, 2002) requires the hydrant system to be designed in accordance with AS2419.1, except that the fire hydrant water supply must be increased to suit the values presented in Figure 6-4.

Number of Fire Hydrants Outlets to Discharge Simultaneously @ 10 litres per second. According to Size and Type of Tyre Storage Facility.

Internal Storage	Fire Compartment Floor Area	Number of Outlets
Non-Sprinklered internal	<5000 m²	3
Non-Sprinklered Internal	≥5000 m²	4 Plus one additional outlet for each additional 5,000m² or part thereof
Sprinklered Internal	<5000 m²	2
Sprinklered Internal	≥5000 m²	3
External Storage	**Area Used for Storage**	**Number of Outlets**
Open Yard	<5000 m²	3
Open Yard	≥5000 m²	4 Plus one additional outlet for each additional 5,000m² or part thereof
Fixed Monitor Protection	Area protected As per design	Flow rate Refer installer

Note: Except where modified by this GN, the fire hydrant system is to be otherwise designed, installed, and commissioned in accordance with AS 2419.1 Fire Hydrants Installations.

Figure 6-4 Fire Hydrant Demand Extract DFES Guideline GN2

The NSW Fire and Rescue guideline (Government, 2014) does not provide any additional requirements to the hydrant system design.

The peak storage area for the facility comprises of the internal dome building and adjacent external yard storage. When combined the net floor area falls below 5,000m², as demonstrated in Figure 6-5.

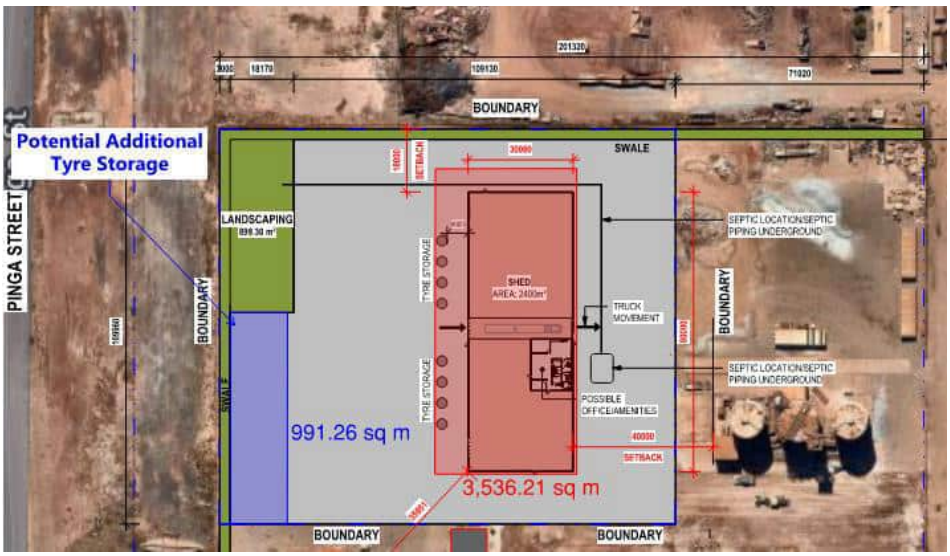


Figure 6-5 Storage Areas

In accordance with DFES's guideline the hydrant system is required to accommodate a peak flow rate of 3 hydrant outlets operating at 10l/s. Net flow rate required by the hydrant system is 30l/s to operate for a minimum 4 hour period. The total volume of water required for the fire hydrant system is a minimum:

$$30\ (l/s)\ \times 60\ (s/min)\ \times 60\ (min/hr)\ \times 4\ (hr) = 432{,}000l$$

The locations of hydrants, and the infrastructure to support the required flow shall be designed by a suitably qualified fire protection engineer. Street mains flow and pressure testing (Appendix C) has demonstrated that the towns main is insufficient to support a feed hydrant system. To provide sufficient flow and pressure onsite fire hydrant pumps with associated water storage tanks are required. An indicative system design is provided in Appendix B with a detailed design to be undertaken by a suitably qualified fire protection engineer.

6.3.5 Management Controls

To ensure the control system remains functional during buildings operational life, the building operator must maintain the fire hydrant system to meet the required fire hydrant demand of 30l/s. Maintenance should be undertaken by a suitably qualified fire protection contractor with the hydrant system maintained in accordance with AS1851-2012 or associated best practise standard in the event AS1851-2012 is superseded in the future.

6.3.6 Risk Rating With Treatment

Where the hydrant system is designed for the unique fire hazards the system would be assumed sized appropriate to extinguish and/or assist in controlling a tyre fire, meeting DFES operational requirements. The volume of pollutants entering the atmosphere would be minimised with a low level impact expected to the local area. The consequence incurred by the environment and Public is deemed a **Moderate Consequence** as pollutants are still expected should a fire event occur. With the system capable or reducing the duration of the fire only.

The likelihood that the system is designed in accordance with DFES's Guidelines and maintained in full working order, does not provide sufficient water to control the fire is **Unlikely.**

With treatment the risk rating for this hazard is **Medium.**

6.4 HAZARD ASSEMENT 2 – BRIGADE ACCESS

6.4.1 Description of Hazard

When undertaking firefighting efforts, the brigade would be required to manoeuvre fire trucks and equipment to the correct areas to allow effective firefighting efforts to occur. Where sufficient truck access is not provided the brigades response and effectiveness can be delayed allowing the fire to continue to grow producing toxic material, endangering the brigade, the environment, and the community.

In addition, should the access provided by the brigade lead to a dead end the attending crew would be limited in their ability to escape the fire.

6.4.2 Risk Rating Without Treatment

Where the brigade are unable to undertake effective firefighting efforts the fire may continue to grow and spread to adjoining areas. Should the brigade reach a dead end travel the risk to life would be high as the brigade could become trapped. Should this occur the consequence incurred by the environment and Public is deemed a **Severe Consequence** as a loss of life may occur by one or more of the fire brigade members.

The likelihood of this hazard being realised if truck access pathways are not considered is **Likely.**

Without treatment the risk rating for this hazard is **Extreme.**

6.4.3 Control Systems

Clear fire truck access around the storage yards and buildings are to be provided in accordance with DFES guideline GL-11 DFES Site planning and fire appliance specification (Services, 2017) and DFES Guideline GN2 (Services, 2002). DFES guideline GL-11 defines truck access for the brigade for all buildings, including large isolated building. DFES Guidelines GN2 defines additional provisions for Tyre Storage Areas to maintain access around exposed tyre stacks.

By ensuring the access pathways meet DFES's operational requirements access to essential fire systems is provided while maintaining brigade safety.

6.4.4 Control System Parameters

GL-11 DFES Site planning and fire appliance specification (Services, 2017) outlines the following key parameters associated with the proposed facility:

- Material used for truck access to be designed suitable for a 30 Tonne appliance.
- Site entry and accessways to be a minimum 3.5m wide.
- A clear area of 18m wide around the large isolated buildings, which are not sprinkler protected, is to be provided and kept clear of storage.
- A 6.0m wide access path for fire truck manicuring is required with the internal side of the pathway a minimum 10m from the building.
- Turning facilities, if required, are to be provided in accordance with Figure 6-6.

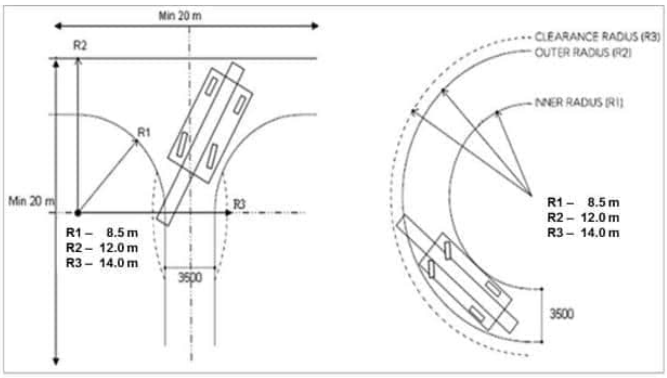


Figure 6-6 Truck Turning Provisions

DFES Guideline GN2 (Services, 2002) outlines the following key parameters associated with the proposed facility:

- External tyre stacks to be no closer than 6m from the allotment boundaries.
- External tyre stacks to be no closer than 6m to buildings constructed from non-combustible material.
- A minimum of two site entries are to be provided.

Truck access around the facility shall comply with the requirements mentioned above as indicated in , with the following exceptions:

1. Site access is limited to a single entry point.
2. Tyre stacks may be located within 6.0m of the combusible dome building elements.

6.4.4.1 Single Entry Point

The site is provided (temporarily) with a single entry with a secondary entry point is planned to be provided. In lieu of two entry and exit points truck turning circles are located around the site. The turning circles shall prevent dead end travel on the site ensuring access to the single entry and entry point is maintained. Refer Figure 6-7 for turning circles should the fire trucks manoeuvre around the site in either direction.

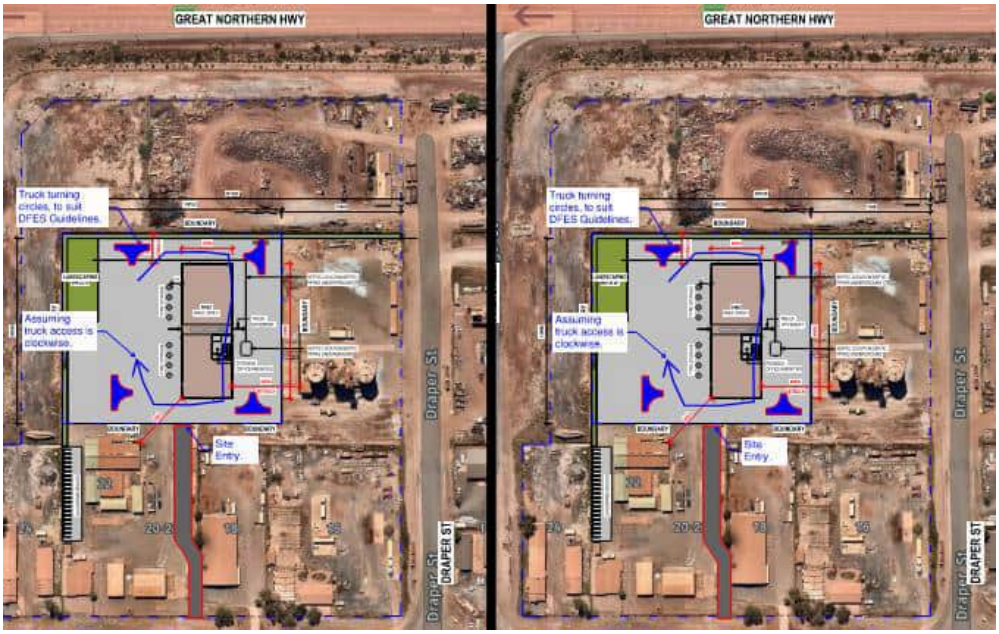


Figure 6-7 Fire Truck Turning Circles

While two access points are not provided, the design meets the operational intent of the aforementioned DFES guidelines as dead end travel is prevented. A meeting with DFES was undertaken with no objections raised with the single access point, refer to Appendix A for full meeting details.

6.4.4.2 Separation to combustible building elements

The separation to a combustible building element is only 6.0m, in lieu of the brigades requested 18.0m. This reduced separation is provided on one side of the stacks only with 18.0m provided around the remaining 3 sides. Truck access around the stack is provided to ensure fire trucks may undertake firefighting efforts from any side of the stacks. As such the brigade's ability to undertake firefighting efforts is not effected by the reduced separation.

While the combustible elements of the building are located within 6.0m of the stacks, should ignite,acks ignite the losses would be commercial only with the dome structure lost to the fire effects. The risk to the environment and occupant safety is not increased through the reduced separation. This is demonstrated in Section 6.5 which demonstrates that, for internal fires, occupants can evacuate prior to untenable conditions being met. As the external fire scenario would take longer to effect occupants inside the building reach a point of safety before the building is considered untenable. While failure of the structure does result in a consequential loss, the effect on the environment is no greater than that of any other building and is not increased due to the presence of tyres external to the building.

6.4.5 Management Controls

To ensure the control system remains functional during buildings operational life, the building operator must maintain the clear access routes indicated in Figure 6-7. Where access routes are to be temporarily obstructed, the site operator shall inform the local fire brigade of the obstruction and seek agreement on any temporary measures that may be deemed suitable.

6.4.6 Risk Rating With Treatment

Where fire truck access provisions have been provided in accordance with DFES's guidelines, accessibility to fire safety systems and protection to the brigade personnel shall meet DFES's operational requirements. The risk to public safety would be low with the fire effects minimised to a low level impact at a local scale. The consequence of this fire event is deemed a **Moderate Consequence,** as accessing fire systems will only decrease the potential for an uncontrolled fire occurring. However, pollutants and fire risks would remain.

The likelihood of DFES's access around the site to be obstructed, limiting their ability to undertake firefighting efforts is **Rare.**

With treatment the risk rating for this hazard is **Medium.**

6.5 HAZARD ASSEMENT 3 – INTERNAL TYRE FIRE

6.5.1 Description of Hazard

Should a tyre within the facility be ignited, smoke and heat may accumulate within the dome structure. The occupants most at risk from the fire effects in these instances are the staff working in the facility. Exposure to toxic gases and heat can create an atmosphere inside the building which is considered "untenable" posing a risk to occupant safety. As the brigade require time to arrive to the site, occupants within the building, when the fire occurs, would need to undertake evacuation efforts and early firefighting efforts without the assistance of the local brigade for a period of time.

6.5.2 Risk Rating Without Treatment

Where an internal tyre fire can occur without due consideration on the effects on building occupants, the consequence of a fire event occurring can be a **Severe Consequence** as a loss of life may occur.

The likelihood of this hazard being realised is **Unlikely** as fire events are rare.

Without treatment the risk rating for this hazard is **High.**

6.5.3 Control Systems

To reduce the likelihood of a tyre fire occurring inside the facility, the following measures shall be taken:

- Visitors shall be always supervised during operation hours, with the facility securely closed to prevent entry when not in use. This shall limit the potential for arson attacks on the tyres stored internal to the building.
- Where hot works (welding, grinding, oxygen cutting etc) are required to occur within the facility, these shall not occur within 18.0m of tyres. 18m has been selected in accordance with the separation distances recommended by DFES for external tyre storage to combustible structures/materials.
- Electrical equipment shall be installed in accordance with AS3000, including AS61439. Limiting the potential for an electrical fire.
- Electrical equipment tested and tagged in accordance with AS/NZS 3760:2010, with switchboards undergoing thermal graphic imagery scanning at least once a year to minimise the risk of faults and electrical fires.
- Natural smoke vents shall be provided at heigh level of the building to assist in clearing smoke from the dome structure.
- Spare LPG cylinders used for forklift trucks to be stored outside.

To reduce the consequence of tyre fire occurring, the following operational requirements shall be undertaken:

- Personnel on discovering a fire shall dial "000" immediately to reduce brigade call out times.
- At least one member of staff per shift shall be trained in the use of the Fire Hose Reel and Portable Fire Extinguishers to limit the potential fire size.
- Storage inside the facility shall be at most 8 whole tyres (4 on undergoing processing and a maximum 4 waiting)
- Cut tyres shall be stored only within the trailers of the delivery trucks. The trailers shall be located in the centre of the facility which is free of ignition risks (excluding machinery used to load and unload the tyres)

6.5.4 Tenability Assessment

To determine the likely consequence of an internal fire an RSET vs ASET assessment has been undertaken, where by the RSET time determines the time required for occupants to reach a point of safety (time to escape) and the ASET time is the time available for occupants to escape, this being the time after fire ignition that the space become unsafe (untenable) to occupy.

6.5.4.1 RSET Time

The RSET is calculated as:

$RSET = t_d + t_a + t_o + t_e,$

where:

- t_d is the time from fire ignition to fire detection;
- t_a is the time from fire detection to fire alarm;
- t_o is the time from notification until occupants decide to take action;
- t_e is the time from start of evacuation until it is completed (i.e. the "travel time").

As no automatic detection and alarm systems are provided, detection of the fire is required by observation by the building occupants only. This is achieved through various ques, including visually seeing the smoke, smelling a fire, or feeling the heat generated by the fire. To estimate the time required for occupants to acknowledge the fires presence the following equation as presented in the New Zealand Verification Method (Ministry of Business, 2014) has been used.

$$t_d = 10 + w + 1.7L$$

Where by:

W= Width of the enclosure = 30m

L = Length of enclosure = 80m

$$t_d = 10 + 30 + 1.7 \times 80 = 121.7s$$

The alarm time is equal to zero, as occupants through discovering the fire without an alarm system are automatically alerted of the fires presence through the method used for detection (i.e seeing the fire, seeing smoke, feeling the heat etc).

The time required by occupants to take action once detecting a fire (t_o) shall be determined again using the values presented in the New Zealand Verification Method (Ministry of Business, 2014). For occupants remote from the fire but familiar with the building a time of 60s is proposed.

The time required to reach an exit once starting the evacuation efforts (t_e) shall be determined by the following equation.

$$t_e = \frac{Distsance\ Travelled}{Occupant\ Travel\ Speed}$$

The peak travel distance within the building is 40m to reach an exit.

Due to the nature of building occupants, it is not expected that building occupants would require assistance with evacuating the building. SPFE (SFPE, 2016) notes a travel speed of 1.0m/s for occupants with no impairments. However, to provide a level of conservatism to the assessment considerations shall be made for partial mobility impairment.

SPFE notes that for occupants provided with significant locomotor disability (walking frame) a mean travel speed of 0.57m/s is acceptable. On this basis, it is considered that a conservative travel speed of 0.8m/s will be utilised to calculate evacuation time as outlined within the SFPE Handbook to accommodate a range of occupants (SFPE, 2016).

Therefore the time required for occupants to travel to the closest exit is:

$$t_e = \frac{40}{0.8} = 50s$$

The total RSET time is therefore calculated as:

$$RSET = t_d + t_a + t_o + t_e,$$

$$RSET = 121.7 + 0 + 60 + 50 = 231.7$$

To allow for a factor of safety in the assessment, a 50% increase in the time to escape shall be considered. The RSET time considered as part of the analysis is therefore:

$$RSET = 231.7 \times 1.5 = 347.5s$$

6.5.4.2 ASET Time

A smoke model has been undertaken to verify that occupant safety is maintained. The model has been undertaken using NIST fire dynamic simulator (FDS). The model included the following input parameters.

- Peak fire size = 6.0MW. While a peak fire size of 3MW was recorded through the literature review as the data was limited. Therefore, a safety factor of 2 has been applied.
- Remaining fire properties were selected in accordance with Table 5-1 including:
  - Fast Growth rate fire
  - Soot yield = 0.2 kg/kg
  - CO2 yield = 0.048 kg/kg
  - CO Yield = 2.0kg/kg
- Natural venting through low level roller doors was not considered, with venting of the space provide through high level louvres only. These louvres comprise of a single 1.2m(h) x 6.0m(w) louvre provided to the southern elevation and two off 1.2m(h) x 3.3m (w) louvres provided to the Northern Elevation.
- FDS does not allow for the modelling of curved structures. The volume of the space was simplified with the roof to be a flat structure at the average roof height.
- A mesh size of 0.2m was selected. This corresponded to a mesh coarseness of medium when undertaking D* calculations. Given the safety factor applied to the fire size, and RSET times it was concluded that a medium mesh size provided a sufficient level of accuracy.

While the roof structure of the dome features a combustible plastic covering the smoke model assumes that the roof structure remains in place for the entire simulation time. This shall provide a level of conservatism to the assessment as the roof burning away would act as an additional means to ventilate smoke and reduce the building up of heat within the building.

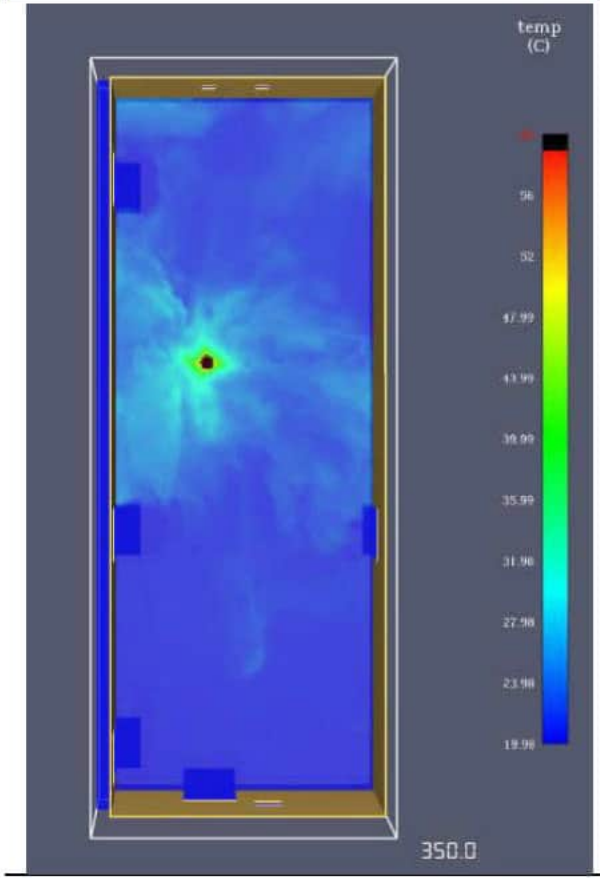
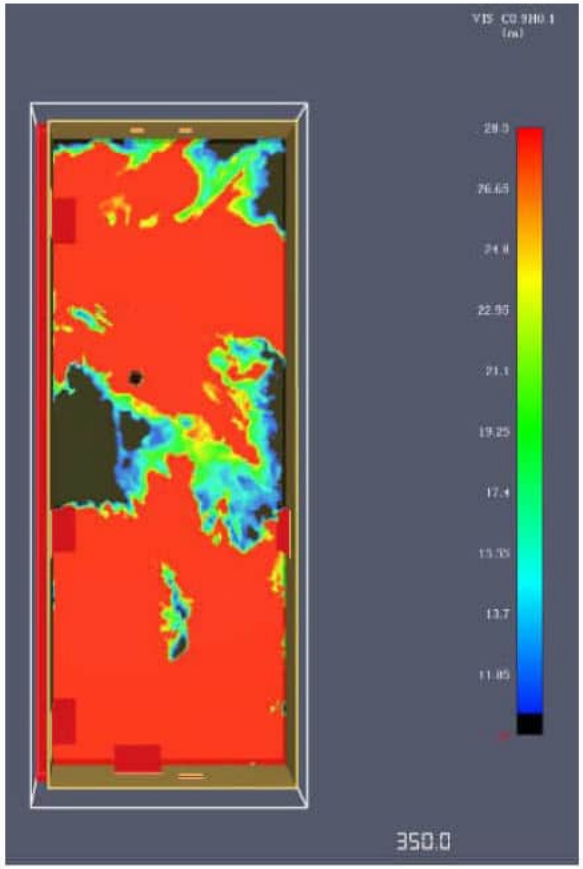
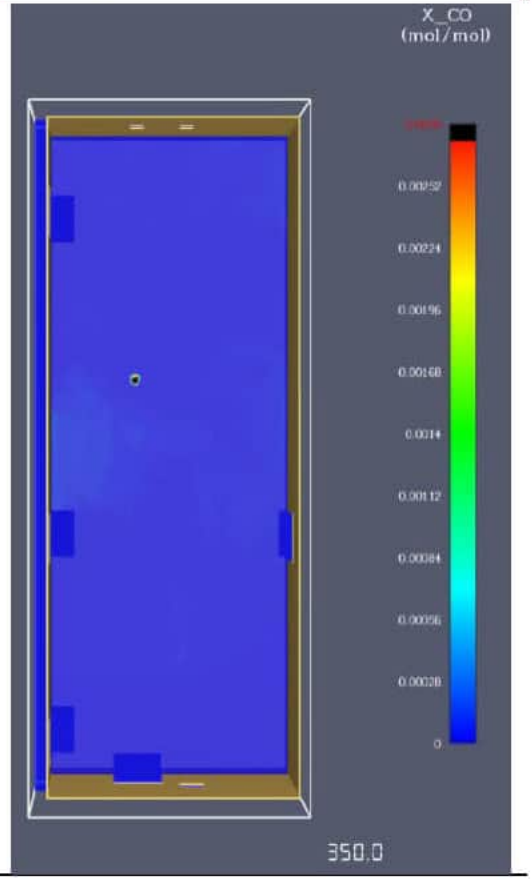
The ASET time is be determined as the time that tenability is lost within/along the evacuation pathway(s). Table 6-1 summarises the tenability criteria of the occupants.

Table 6-1: Occupant Tenability Limitations

Criteria	Limitation	Reference
Convective Heat Infinite Time	60ºC	(Poh, 2011)
Convective Heat 10-minute Exposure Time	100ºC	(Poh, 2011)
Visibility For Occupants Away From Exits	10 m @ 2.0m above FFL	(Poh, 2011)
CO Concentration	2,800 PPM	(Poh, 2011)

Table 6-2 demonstrates the output slices of each of the tenability criteria. Each slice has been taken at a height of 2.0m above the FFL at 350s, with the black zones representing areas within the building where tenable conditions are not met. As demonstrated in Table 6-2 tenable conditions are provided for at least 350s throughout the building with the exception being visibility where pockets of the floor falls below the 10.0m visibility distance. These black areas however are not more than 10.0m from the walls of the building, as a result occupants within this space may still see the bounding walls to identify a path of escape from the building.

Table 6-2 Tenability Output Slices

Temperature (Black = >60°C)	Visibility (Black = <10m)	Visibility (Black = <2800PPM)
		

As demonstrated in section 6.5.4.1, the RSET time, when applying a factor of safety of 1.5 is 347.5s. Section 6.5.4.2 was able to demonstrate that the ASET time exceeded this value. On this basis the analysis has demonstrated that should an internal tyre fire event occur, it is unlikely that occupants, who take assertive action to escape, will not be exposed to unsafe conditions.

6.5.5 Management Controls

To limit the potential for a fire to occur, and to reduce the consequences should an event occur, the building operator shall enact the following management controls and emergency response procedures:

- Site induction to staff and supervision of visitors.
- Hot works to be undertaken in a planned manner with tyres moved to be no closer than 18m during hot works events.
- Electrical equipment and switchboards are to be maintained as a minimum in accordance with AS300, AS61439, and AS/NZS 3760:2010.
- Training shall direct occupants to dial "000" immediately should a fire event occur.
- As a minimum, one person per shift shall be trained in the use of the FHR and portable fire extinguisher systems. To assist in early suppression prior to brigade arrival should a fire event occur.
- Storage of tyres within the facility shall be limited to 8 whole tyres.
- Delivery trucks shall not sit idle within the building and shall be shutdown when not moving.

6.5.6 Risk Rating With Treatment

As demonstrated in 6.5.4 should a fire event occur, the building occupants are provided with sufficient time to escape prior to untenable conditions being incurred within the building. Occupants may still suffer some minor smoke inhalation while egressing resulting in a low level medical treatment being required. The consequence incurred by the environment and Public is deemed a **Moderate Consequence** as some level of medical treatment due to smoke inhalation may still be required.

The likelihood of an internal fire event occurring is reduced through the management in use systems proposed. The likihood of the fire event occurring is therefore **Rare.**

With treatment the risk rating for this hazard is **Medium.**

6.6 HAZARD ASSEMENT 4 – EXTERNAL TYRE FIRE

6.6.1 Description of Hazard

The storage of tyres at the facility is largely associated with external tyre storage. Whereby the tyres ahead of processing are stacked on top of one another, in stacks up to 3.7m in height. While a fire event is unlikely, should the event occur without adequate control measures, significant volumes of smoke, oil run off, and heat may be produced posing a risk to the environment and public health.

6.6.2 Risk Rating Without Treatment

Where an external tyre fire can occur without due consideration on the effects on the environment and public the consequence of a fire event occurring can be a **Severe Consequence** as a loss of life may occur.

The likelihood of this hazard being realised is **Unlikely** as fire events are rare.

Without treatment the risk rating for this hazard is **High.**

6.6.3 Control Systems

To reduce the likelihood of a tyre fire occurring inside the facility the following measures shall be taken:

- Visitors shall be always supervised during operation hours, with the facility securely closed to prevent entry when not in use. This shall limit the potential for arson attacks on the tyres stored internal to the building.
- Where hot works (welding, grinding, oxygen cutting etc) are required to occur, these shall not occur within 18m of tyres located within the facility. 18m has been selected in accordance with the separation distances recommended by DFES for external tyre storage to combustible structures/materials.
- Storage outside the facility shall be in accordance with the DFES Guideline GM-2 and NSW Fire and Rescue guidelines. Except that tyres may be located within 6.0m of the combustible building elements to reduce the likelihood of a neighbouring fire igniting an external tyre stack.

To reduce the consequence of tyre fire occurring the following requirements shall be undertaken:

- Personnel on discovering a fire shall dial “000” immediately to reduce brigade call out times.
- At least one member of staff per shift shall be trained in the use of the Fire Hose Reel and Portable Fire Extinguishers to limit the potential fire size. External fire hose reels shall be provided to provide coverage to the tyre stacks.
- At least one member of staff per shift shall be capable of operating a forklift. It would be excepted that tyres in proximity of the fire source, but not ignited, and moved to prevent the spread and volume of fuel involved in the fire event.
- Storage outside the facility shall be in accordance with the DFES Guideline GM-2 and NSW Fire and Rescue guidelines. Except that tyres may be located within 6.0m of the combustible building elements.
- Water runoff from a fire shall be collected to prevent runoff entering the environment.
- Tyres shall be stored in locations that are not expected to receive radiant heat exceeding the 17.1 kW/m^2 estimated to cause ignition of the tyre stacks.
- Tyres shall not impose a radiant heat back to the environment, neighbouring properties, or the dome structure that may pose a risk of igniting the environment, neighbouring properties, or the dome structure.

6.6.4 Radiant Heat Assessment

To demonstrate that the proposed arrangement provides a limited potential to cause fire spread from a tyre fire to the environment, a radiant heat assessment is proposed. The assessment shall calculate the radiant heat transmitted from the tyre fire.

Radiant heat calculations shall be calculated using the program "Firewind" (Shestopal, 2003) which uses these empirical formulae to determine radiant heat distribution. The analysis shall assume a single tyre stack occurs with staff removing unburnt tyres adjacent to the ignited stack prior to ignition.

The size of the fire shall be limited to a single tyre stack of 3.7m high and width of 4.0m (very large tyre). The temperature of the fire is estimated to be between 1000-1300°C based on the following sources.

Table 6-3: Tyre Fire Temperature

Temperature	Dataset	Reference
1100°C	Expected internal temperature of a stake during the "equilibrium" and Pyrolysis stage	(Stanley & Poole, 1998)
1000°C-1300°C	Peak temperatures recorded during testing of 4 different tyre stacks.	(Lonnermark & Blomqvist, 2005)
1000°C	Peak temperature recorded during testing of a full mining vehicle with thermal couples applied to the wheel.	(Hansen, 2022)

A value of 1300°C shall be applied as this was the peak value recorded from the studies assessed.

The height of the flame shall be calculated using the following equation presented in the International Fire Engineering Guidelines (IFEG, 2005).

$$L_c = C_1 Q^{2/5}$$

Where:

Lc= Length of the Flame in meters

C1 = Is a constant = 0.2 m/kW$^{2/5}$

Q = The total heat release rate in kw.

The fire size shall be assumed to be 6000kW as presented in Section 6.5.4.2. the flame length is therefore estimated as:

$$L_c = 0.2 \times 6000^{2/5} = 6.49m$$

The separation distance to the closest combustible element, excluding the dome structure, is 18.0m with non-combustible elements permitted 18m but no closer than 6m from the stacks.

The radiant heat flux required to ignite combustible elements outside of the 18.0m zone (i.e the neighbouring properties, the environment, and goods stored outside of the 18.0m clearance zone) shall be considered as 12.6kW/m^2. this value has been selected as

- AS1530.4 stipulates an ignition heat flux of 13kw/m^2 for wood and fabric materials.
- DFES guideline GL-15 "Fire Engineered Performance Solutions" outlines a maximum heat flux of 12.6kW/m^2 is required to demonstrate fire spread won't occur.

When applying the values presented to Firewind, the following radiant profiles are produced:

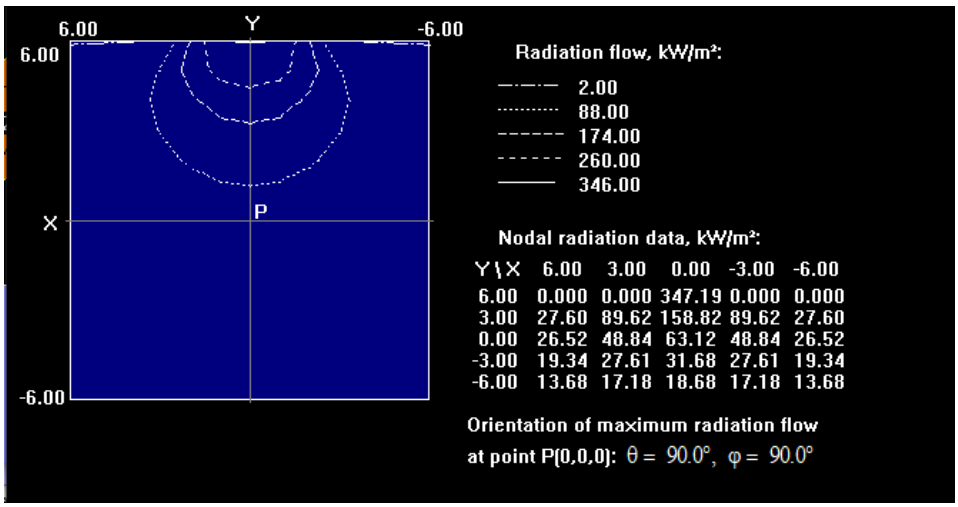


Figure 6-8 Radiant Heat Flux 6m

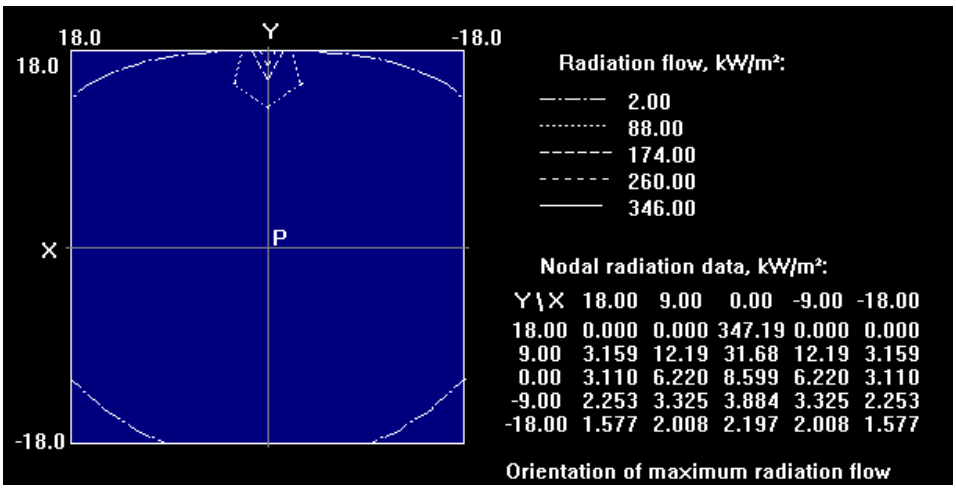


Figure 6-9 Radiant Heat Flux at 18m

As demonstrated in Figure 6-8 and Figure 6-9 the radiant heat flux imposed is 63.12 kW/m² and 8.6 kW/m² at distances 6.0m and 18.0m from the tyre fire respectively. As demonstrated, the heat flux greatly exceeds the 12.6kW/m² required for ignition of combustible materials at the 6.0m mark, with the radiant heat still exceeding 12.6kW/m² at a distance of 12m. However, at a distance of 18m the peak radiant heat is less than the prescribed 12.6kW/m², demonstrating that combustible material stored in excess of 18m from the stack would not pose a significant risk of ignition.

To prevent fire spread to adjoining properties, the environment and adjacent tyre stacks each stack shall be located no closer than 18m from the site boundaries and adjacent tyre stacks. While the dome structure is deemed combustible and located between 18.0m and 6.0m of the tyre stacks the loss of the structure does not pose an environmental risk greater than a standard building fire, and does not pose a risk to occupant safety as demonstrated in Section 6.5. Therefore the consequence of loss due to a stack fire effecting the dome structure is commercial only with the building operator required to replace the structure on failure at their cost.

Should combustible elements be located within 18m of the stacks in the future a non-combustible structure 6.5m high shall be required to separate the stacks from the combustible elements.

6.6.5 Water Run Off

During a fire event the external fire hydrant system shall be used to extinguish the fire. The water used by the hydrant system would mix with the bi-products produced by the tyre fire creating a toxic water run off from the fire. This water is to be collected and stored onsite to prevent run off effecting the environment. Once collected the client would engage a private contractor to take and safely dispose of the wastewater.

The volumes of water used by the hydrant system have been calculated to be 432,000l (refer Section 6.3.6). A catchment system suitable to collect and store this volume of contaminated water on site will be provided and designed by a suitably qualified civil engineer.

6.6.6 Control System Parameters

Tyres should not be located in a bushfire area where the expected radiant heat of exposure exceeds 17.1kW/m^2. The DFES bushfire prone map places the entire site outside of a bushfire prone area, as demonstrated in Figure 6-10. On this basis storage can not be located within a zone exceeding 17.1kW/m^2.

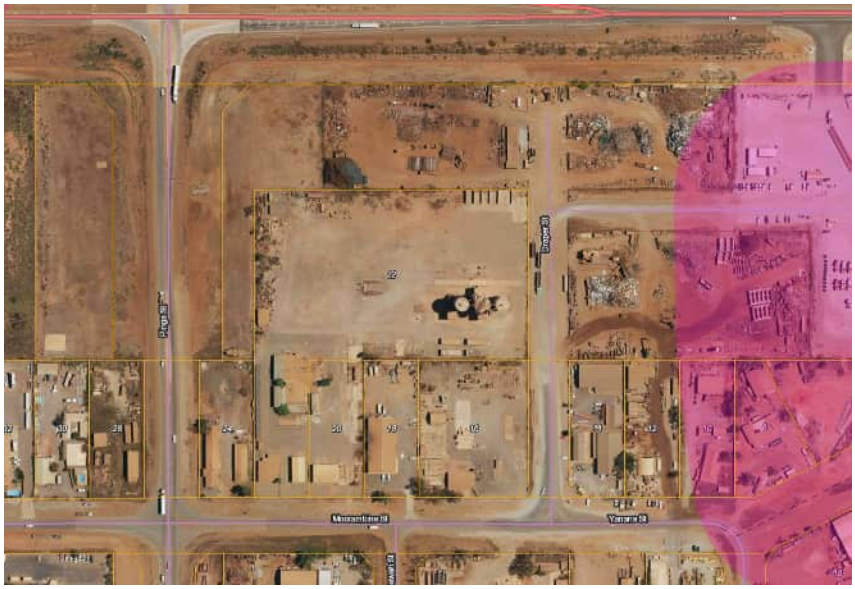


Figure 6-10 Bush Fire Prone Area Designated in Pink

- To maintain compliance with DFES Guideline GM-2 and NSW Fire and Rescue guidelines, and the radiant heat analysis undertaken, tyre stacks shall be provided as follows:
  - Tyre stacks are to be no more than 3.7m high with a maximum 12.5 tonne of tyres stored in any single stack.
  - Stacks may be grouped together provided a separation distance between each stack of 2.5m is achieved, and the total tonne of the group of tyres does not exceed 50 tonne.
  - A minimum of 6.0m clear around each group of stacks shall be provided.
  - Combustible material and site boundaries should not be located within 18m of the tyre stacks, unless shielded by a non-combustible structure (i.e steel fence), except for the dome structure which may be located between 18-6m of the stacks.
  - Each stack shall be no closer than 6.0m from any object.
- A water catchment system capable of storing 432,000l of water is to be provided to capture water run of from the fire hydrant system.

6.6.7 Management Controls

To limit the potential for a fire to occur, and to reduce the consequences should an event occur, the building operator shall enact the following management controls and emergency response procedures:

- Site induction to staff and supervision of visitors.
- Hot works to be undertaken in a planned manner with tyres moved to be no closer than 18m during hot works events.
- Training shall direct occupants to dial “000” immediately should a fire event occur.

- As a minimum, one person per shift shall be trained in the use of the FHR and portable fire extinguisher systems. To assist in early suppression prior to brigade arrival should a fire event occur.
- As a minimum, one person per shift shall be available to move unburnt tyre stacks. With the associated equipment available.
- Storage of the tyres shall be as outlined in section 6.6.6.

6.6.8 Risk Rating With Treatment

As the extent of fuel is controlled through separation the volumes of fuel and potential fire spread is limited. The consequence incurred by the environment and Public is deemed a **Moderate Consequence** as some level of medical treatment may still be required with local effects to the environment expected due to the gases produced..

The likelihood of an external fire event occurring is reduced through the management in use systems proposed. The likihood of the fire event occurring is therefore **Rare.**

With treatment the risk rating for this hazard is **Medium.**

7 NCC COMPLIANCE ASSESMENT

A review of the buildings compliance with the NCC 2016 Amendment 1 has been undertaken with relation to fire and life safety. The building has been considered as a non-sprinkler protected large isolated building of Type C Construction. Compliance with the NCC's DtS provisions has been met with the proposed design, as summarised in Table 7-1.

Table 7-1 NCC Compliance Assessment

BUILDING CHARACTERISTICS, COMPARTMENTATION & SEPARATION (SECTIONS A & C)			
Building Designation	Tyre Storage Facility		
Classification(s): BCA Clause A 3.2	Class 8: Factory/Processing Facility		
Rise in storeys: BCA Clause C1.2	1		
Type of construction: BCA Clause C1.1	Type C		
Effective height: BCA Definition A1	0		
Approximate Floor area(s): BCA Table C2.2	Level / Compartment	Area (m^2)	
	Ground	2,400m^2	
Maximum area of fire compartment: BCA Clause C2.2		D-t-S Permissible	Proposed
	Ground	18,000m^2	2,400m^2
Maximum volume of fire compartment: BCA Clause C2.2		D-t-S Permissible	Proposed
	Ground	108,000m^3	26,000m^3
Large isolate building: BCA Clause C2.3	Yes		
Perimeter access: BCA Clause C2.4	Yes, with 18.0m clear area (excluding tyres) provided.		
Separation of buildings and boundary separation: BCA Clause C3.2, C3.3	18.0m		
EGRESS (SECTION D)			
Maximum permissible egress distance: BCA Clause D1.4		D-t-S Permissible	Proposed
	Distance to Point of Choice	20m	<20m
	Peak Travel Distance	40m	<40m
FIRE FIGHTING EQUIPMENT (SECTION E)			
Fire hydrant system: BCA Clause E1.3	REQUIRED: YES ☒ NO☐		
	REQUIRED AND PROVIDED		
Fire hose reels: BCA Clause E1.4	REQUIRED: YES ☒ NO☐		
	REQUIRED AND PROVIDED		

Automatic fire sprinkler system: BCA Clause C2.3, E1.5 , E2.2	REQUIRED: YES ☐ NO☒
	NOT REQUIRED AND NOT PROVIDED
Portable fire extinguishers and fire blankets: BCA Clause E1.6	REQUIRED: YES ☒ NO☐
	REQUIRED AND PROVIDED
Automatic fire detection and alarm system: BCA Clause E2.2	REQUIRED: YES ☐ NO☒
	NOT REQUIRED AND NOT PROVIDED
Sound System and Intercom System for Emergency Purposes (EWIS) BCA Clause E4.9	REQUIRED: YES ☐ NO☒
	NOT REQUIRED AND NOT PROVIDED
Smoke Management system: BCA Clause E2.2	REQUIRED: YES ☒ NO☐
	STAIR PRESSURISATION ☐ SMOKE EXHAUST ☐ SMOKE/HEAT VENTS ☐ NATURAL VENTING☒
	NATRUAL VENTING OF AT LEAST 1.5% OF FLOOR AREA PROVIDED

8 FIRE SAFETY STRATEGY & DESIGN REQUIREMENTS

The Fire Safety Strategy outlines the key aspects of the building design that, in combination, are expected to result in a building that meets each fire safety objectives. The combination of systems and strategies has been nominated with due consideration of the Fire Hazards present for the site as identified within the hazard assessment undertaken.

This section (Section 8) identifies the systems that are to be incorporated within the building design, including management in use and maintenance requirements.

8.1 EXTERNAL TYRE STORAGE

External tyre stacks shall be provided as follows for the life of the building:

- Tyre stacks are to be no more than 3.7m high with a maximum 12.5 tonne of tyres stored in any single stack.
- Stacks may be grouped together provided a separation distance between each stack of 2.5m is achieved, with each group not to exceed 50 tonne.
- A minimum of 6.0m clear around each group of stacks shall be provided.
- Combustible material and site boundaries should not be located within 18m of the tyre stacks, unless shielded by a non-combustible structure (i.e steel fence), except for the dome structure which may be located between 18-6m of the stacks.
- Each stack shall be no closer than 6.0m from any object.

8.2 INTERNAL TYRE STORAGE

Internal tyre storage shall be limited to:

- 8 whole tyres (4 on machines and 4 on floor awaiting loading)
- Cut tyres stored within the delivery truck awaiting dispatch from site.

8.3 FIRE HYDRANT SYSTEM

A fire hydrant system designed in compliance with AS2419.1-2005 and DFES guideline GN2 designed to operate 3 hydrants at 10l/s each (30l/s total) for a minimum of 4 hours.

8.4 EGRESS PATHWAYS

Egress pathways are to remain in compliance with the NCC, including:

- Peak travel to a point of choice, or a single exit = 20m
- Peak travel to an exit where a point of choice has been achieved = 40m

Roller doors shall not be considered an exit for the purpose of determining an evacuation distance.

8.5 WATER RUN OFF

Water run of from the fire hydrant system shall be stored on site with the drainage system designed by a qualified civil engineer. The system shall be designed to store a minimum of 432,000l.

8.6 NATRUAL SMOKE RELIEF

Natural smoke relief vents on the north and south façade are to be provided and are to have a free area equal to or greater than 1.5% of the floor area.

8.7 MANAGEMENT CONTROLS

The following management strategies shall be implemented at the site:

- Visitors shall be always supervised during operation hours, with the facility securely closed to prevent entry when not in use. This shall limit the potential for arson attacks on the tyres stored internal to the building.
- Where hot works (welding, grinding, oxygen cutting etc) are required to occur within the facility, these shall not occur within 18.0m of tyres. 18m has been selected in accordance with the separation distances recommended by DFES for external tyre storage to combustible structures/materials.
- Electrical equipment shall be installed in accordance with AS3000, including AS61439. Limiting the potential for an electrical fire.
- Electrical equipment tested and tagged in accordance with AS/NZS 3760:2010, with switchboards undergoing thermal graphic imagery scanning at least once a year to minimise the risk of faults and electrical fires.
- Hot works to be undertaken in a planned manner with tyres moved to be no closer than 18m during hot works events.
- Training shall direct occupants to dial "000" immediately should a fire event occur.
- As a minimum, one person per shift shall be trained in the use of the FHR and portable fire extinguisher systems. To assist in early suppression prior to brigade arrival should a fire event occur.
- As a minimum, one person per shift shall be available to move unburnt tyre stacks. With the associated equipment available.
- An 18m clearance around the building shall be maintained for fire truck access and to limit the potential for fire spread to neighbouring buildings.
- Fire systems shall be maintained in accordance with AS1851.

9 REFERENCES

9.1 REFERENCED LITERATURE

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APPENDIX A DFES MEETING MINUTES

PROJECT:	Tyrecycle – Western Australia Developments			PROJECT NO:	LCE 23755-004
BY:	CM	CC TO:	Refer Below	SHEET 1 OF 6	DATE: 12/01/2023

☑ Meeting ☐ Telephone Conversation ☐ Memo ☐ Calculation ☐ File Note ☐ Site Inspection

MINUTES OF MEETING HELD WITH THE DEPARTMENT OF FIRE AND EMERGENCY SERVICES WESTERN AUSTRALIA ON 12th of JANUARY 2023

Present:	
[redacted]	Department of Fire and Emergency Services (DFES)
[redacted]	Department of Fire and Emergency Services (DFES)
[redacted]	Department of Fire and Emergency Services (DFES)
[redacted]	Department of Fire and Emergency Services (DFES)
[redacted]	Lucid Consulting Engineers (LCE)
[redacted]	Lucid Consulting Engineers (LCE)
[redacted]	Rowe Group (RG)
[redacted]	SLR Consulting (SC)
[redacted]	Tyrecycle (TC)
[redacted]	Tyrecycle (TC)
[redacted]	Tyrecycle (TC)

DETAILS **ACTION**

1 General

1.1 The meeting was convened with DFES to outline the proposed Tyrecycle developments in East Rockingham and Wedgefield. Given the nature of the sites, the meeting aimed at briefing DFES of the inherent process and storage risks present and how these risks intend to be mitigated. It is hoped that agreement of the appropriate mitigation strategies can be achieved between DFES and remaining project stakeholders. Note

2 East Rockingham

LCE provided a brief overview of the proposed [redacted] site. The site is a brownfield development located on [redacted]. Tyrecycle intent to occupy the facility and repurpose the existing site to enable them to recycle vehicle tyres. Note

The site comprises of a 6,000 m^2 open warehouse facility with complete perimeter access and external storage/set down areas adjacent within the site.

The site is provided with access from the West, East and from the North side of the Lot via [redacted] and [redacted] respectively.

[redacted]

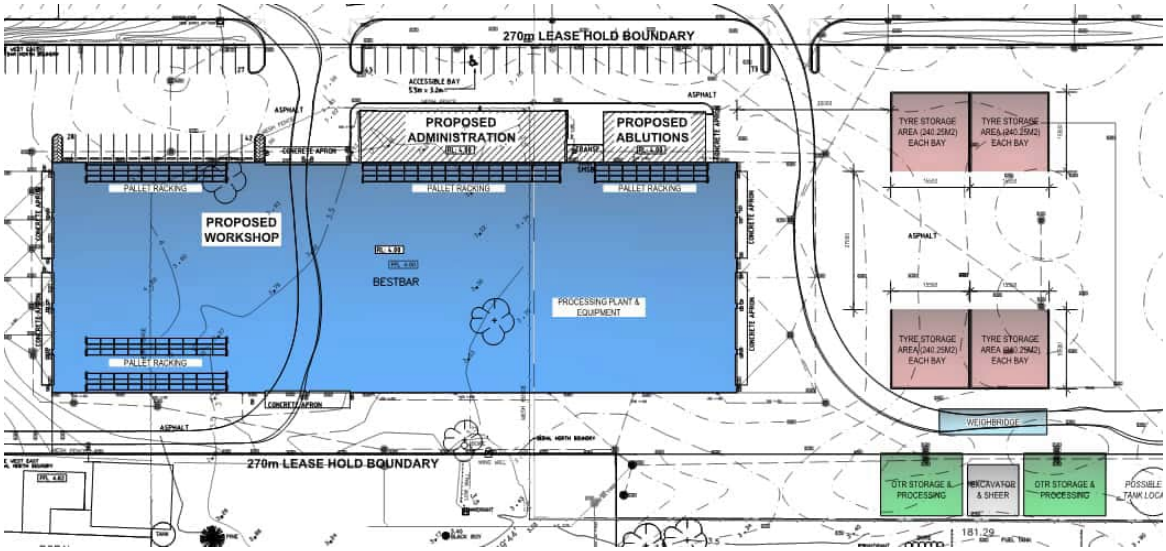
2.1 Storage Arrangements

2.1.1 TC provided an overview of the operational processes at the site, stating that the input of the process included standard car tyres as well as sectioned portions of Mining Vehicle tyres delivered from their Wedgefield facility. — Note

The product output of the process was stated to be 'crumbed' rubber. DFES queried the anticipated size of the 'crumbs,' with TC stating that it would likely vary and depend on their client requirements at a given time. — Note

LCE displayed some preliminary site plans which illustrated approximate storage locations for incoming rubber for processing (to be stored externally) as well as the crumbed rubber for distribution (to be stored internally). — Note

The external storage proposes concrete fire walls to separate 240m^2 piles of rubber tyres that are stacked up to a height of 2.7 m. This is an alternative arrangement to the physical displacement/separation recommended in the DFES guidelines. — Note



2.1.2 DFES queried the proposed height of the dividing walls. TC stated that they currently have them specified as being 4 m tall, however were exploring the possibility of reducing this height down to 3 m (300 mm above the storage height). DFES stated that 3.0 m would not be a sufficient height to prevent fire spread between the storage areas and suggested 4 m or higher. DFES also queried the thickness of the walls, stating that an FRL of 240 would need to be achieved to support Brigade operations. — Note

LCE stated that both the height and thickness of the walls would be subject to further Fire Engineering assessment, but did take DFES' recommendations on board. — LCE

2.1.3 DFES recommended that TC put measures in place to prevent external tyre/rubber storage exceeding 2.7 m, suggesting that the walls above 2.7 m be painted as an indicator for staff. — TC

2.1.4 LCE noted that the crumbed rubber product would be installed internal to the building in a racked arrangement. The rubber is to be stored in large bags and stored up to a height of 7.0 m. — Note

DFES questioned whether a definitive location for the internal storage had been identified. TC stated that it will likely be stored within the North-West portion of the building, however final layouts will determine the location(s). — Note

2.2 Proposed Fire Services Systems

2.2.1	LCE described the fire services systems proposed to serve the new depot: • Automatic High Hazard Fire Sprinkler system (in accordance with AS2118.1 and recommendations of Fire Risk Study). • Fire Hydrant system – existing to be amended to suit proposed site arrangement (in accordance with AS2419.1 and recommendations of Fire Risk Study). • Supplementary on-site Fire Water Storage and Fire Pumps (sizes pending investigation and recommendations of Fire Risk Study). • Occupant Warning System complete with Direct Brigade Alarm linked to the Sprinkler System (in accordance with AS1670). • Fire Hose Reels – existing to be amended to suit proposed site arrangement (in accordance with AS2441 and recommendations of Fire Risk Study). • Portable Fire Extinguishers (in accordance with AS2444 and recommendations of Fire Risk Study).	Note
2.2.2	DFES questioned whether in-rack sprinkler protection would be provided for the internal product storage. LCE stated that it would be preferrable to utilise ceiling/roof level sprinkler protection, however DFES noted that the height of the building and high fuel loads would make the ceiling/roof level sprinkler ineffective in the event of a fire. *Post meeting note: TC have stated that in-rack sprinkler protection will be required to satisfy their insurance requirements – hence shall be provided as part of the design.*	LCE Note
2.2.3	DFES queried the illustrated location of the Fire Water Storage tank within the South-East corner of the site and raised concerns of its proximity to the external tyre/rubber storage. TC and LCE stated that the intent is to in fact locate this tank to the North-West corner of the site adjacent to Mandurah Road.	LCE
2.2.4	The size of the tank(s) will be subject to further investigation and design development. DFES recommended that the Fire Hydrant and Fire Sprinkler systems both be supplemented by on-site pumps and water storage to provide a level of redundancy.	LCE
2.2.5	DFES stated that due to the nature of the site, as well as the neighbouring Toll fuel fleet being in proximity to the main building, they would require the use of a 'combined ladder platform' (CLP) and at least two (2) handlines simultaneously. It was noted that the CLP can use a water demand of up to 420 L/min. DFES also stated that Toll would need to be consulted on the proposed Fire Strategy for the site and be considered as a Stakeholder in its development.	Note LCE/TC

2.2.6	LCE discussed the proposed Ventilation strategy for the workshop. The existing building is provided with a ridge vent along the entire apex of the roof. It is also provided with up to fourteen (14) external roller doors, each up to 6 m in height. Given the volume of the space, LCE proposed that Mechanical Ventilation (e.g. smoke exhaust fans) would be ineffective in relieving the space of smoke in the event of a fire. Instead, natural ventilation through the ridge vent and roller doors would be preferred.	Note
	DFES stated that more venting would be required along the roof to supplement the single ridge vent that is currently present. It was noted however, that the 'plastic' skylights (32 in total) along the roof would likely melt in the event if a fire, providing an additional relief path for smoke.	Note
	DFES stated that the top 2 m of the roller doors would need to be perforated to be utilised for passive smoke relief, as fire override controls could not be relied upon to open the roller doors in the event of a fire outside of operational hours.	LCE
	DFES stated that a CFD model would need to be developed to determine tenability for the attending Fire Brigade. It was noted that multiple fire scenarios would need to be considered, each running for a minimum of 30 mins.	LCE
	LCE stated that it is not anticipated that there will be performance solutions required for extended travel distances or extended fire hydrant hose lengths.	Note
2.2.7	DFES raised concerns for the surrounding residential areas surrounding East Rockingham in the event of a fire at the facility. It was noted that due to the likely characteristics of a fire at the site and the prevailing winds from the coast, a smoke plume would initially rise vertically above the site (due to the heat of the fire(s)), before being swept inland (east) by the prevailing wind. This would cause the smoke to cool and descend onto the adjacent suburbs of Leda, Calista, Parmelia and Wellard. These areas contain schools, aged care facilities and significant number of Residential areas.	Note
	DFES stated that all available measures must be put in place to prevent this scenario for occurring. Further to this, DFES ensured that given the potential severity of a fire event, they would provide all available resources in the region to mitigate the fire and resultant smoke spread.	DFES
2.2.8	DFES emphasised the importance of TC's Emergency response procedures to prevent fire growth and to contain a potential blaze until the brigade arrives to the site. TC stated that they will have equipment on site (e.g., 'bobcats'), operated by trained personnel that could be used to move rubber and tyres in the event of a fire to prevent it from spreading.	TS
	TC will also be required to train their staff to use the installed Portable Fire Extinguishers and Fire Hose Reels to limit initial fire ignition/spread.	TS
2.2.9	DFES noted that perimeter access around the site would need to be considered. TC stated that overhead conveyors are no longer required to be installed above the perimeter access way, preventing a compliance issue with DFES' operational guidelines. LCE also highlighted that the site has multiple entry/exit points, providing DFES with flexibility with it's approach to the building/storage areas in the event of a fire.	Note
2.2.10	DFES stated that the likely demands of the Fire Hydrant system and the Automatic Fire Sprinkler system(s) would mean that a combined system would not be feasible. This would result in a dedicated pumpset and supplementary water storage for EACH system. LCE acknowledged this and stated that infrastructure details would be circulated to DFES once defined more clearly.	Note

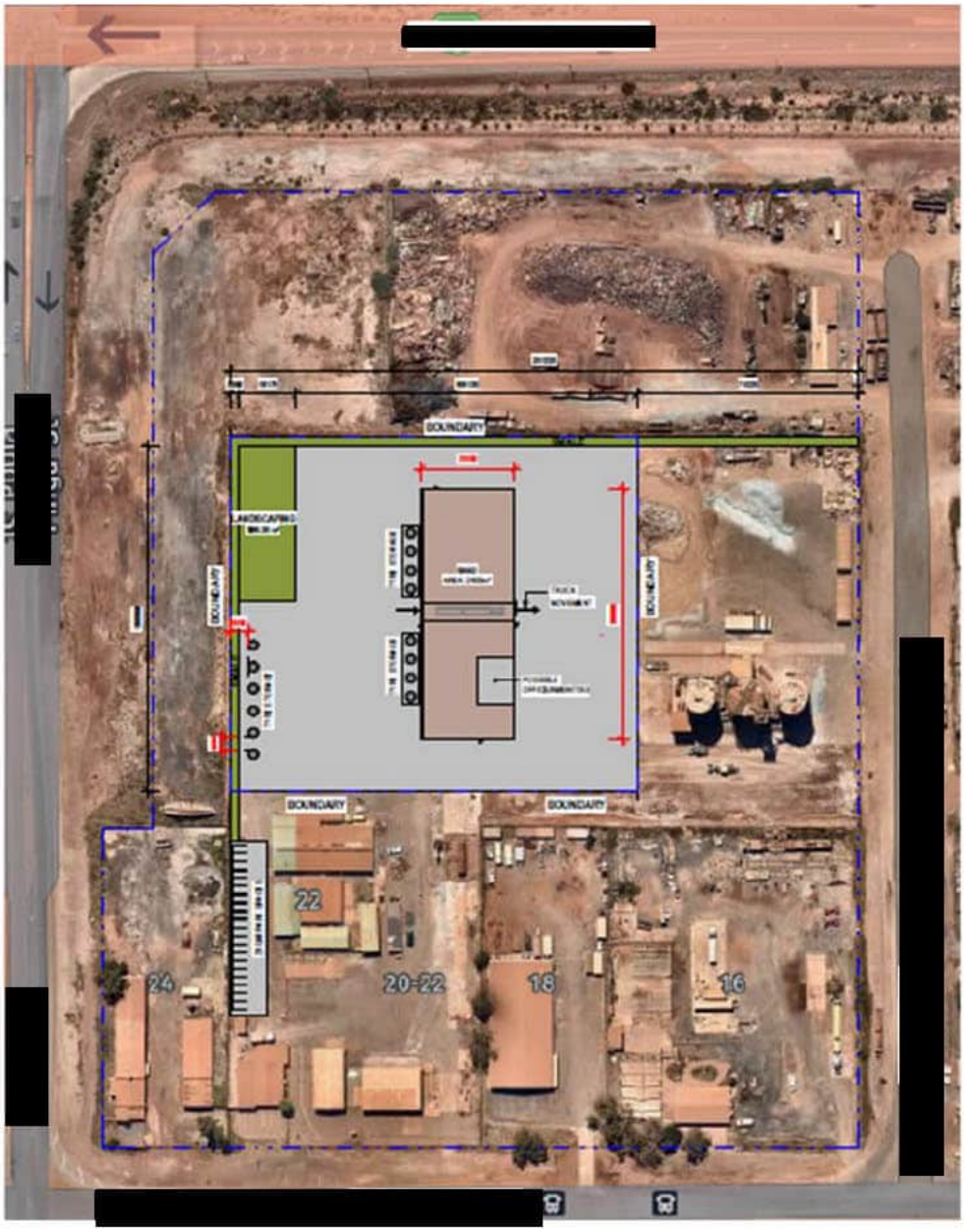
3.0 Wedgefield Site

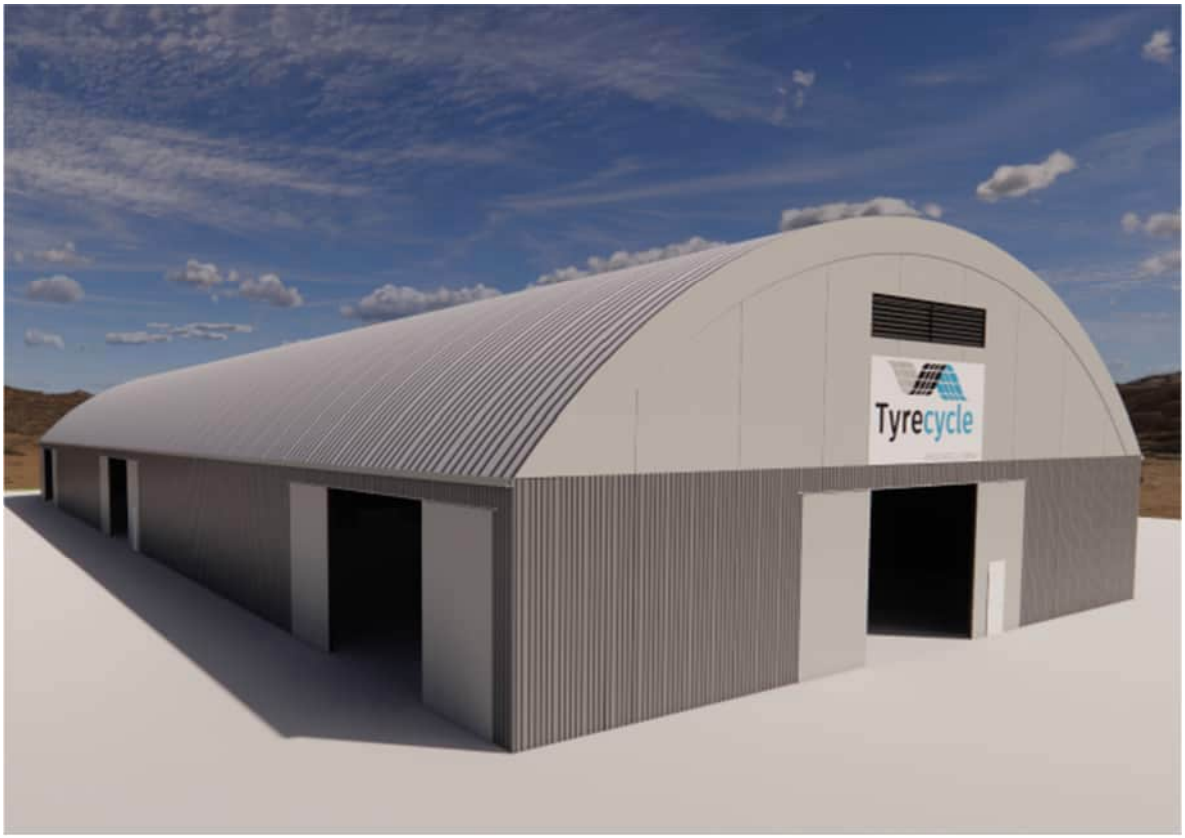
3.0.1 DFES mentioned that the proposed Wedgefield site is currently provided with a DFES reference number: *344393*. Note

3.0.2 LCE and TC provided a brief overview of the proposed Wedgefield site. The site is a greenfield development located on [redacted]. Tyrecycle intends to develop the site and construct a facility to separate large mining truck tyres into smaller ~60 kg portions. Note

3.0.3 LCE displayed some preliminary site plans which illustrated approximate storage locations for incoming mining tyres for processing (to be stored externally). TC stated that the external storage arrangement would consist of having mining tyres stacked on top of each other (up to 3 tyres high), each separated from each other and the main building. Note

The site will comprise of a ~3,000 m^2 open warehouse facility with complete perimeter access and external storage/set down areas adjacent within the site. The site is currently to be provided with access from [redacted], with the intent of applying to the local authorities to also permit vehicular access from [redacted] (East of the site). Note





3.0.4	TC went on to state that there would be no storage of rubber or product inside of the building and that it would be used for processing purposes only. Separated tyres will be loaded straight onto a flat bed truck to then be transported down to the East Rockingham site for further processing.	Note
	LCE stated that with internal storage being omitted, they would be relying only on Fire Hydrant system coverage for active fire protection and did not envisage that an automatic fire sprinkler system would be required. DFES acknowledged the proposed storage and processing arrangements and agreed that an Automatic Sprinkler system would not be required for the Wedgefield site.	Note
3.0.5	Due to the Wedgefield site's relative simplicity compared to the East Rockingham site, DFES were satisfied with the information given and the proposed Fire Services systems for the site.	Note

4.0 Any Other Business

4.0.1	LCE mentioned that minutes from the meeting would be compiled and circulated to all in attendance.	Note
	Given the volume of topics covered, LCE mentioned that it would be likely that further correspondence via email would likely be held with DFES to inform them of further information as it becomes available to inform them. A future meeting would likely be required to be held for the East Rockingham site once further design details have been developed.	Note

Distribution:

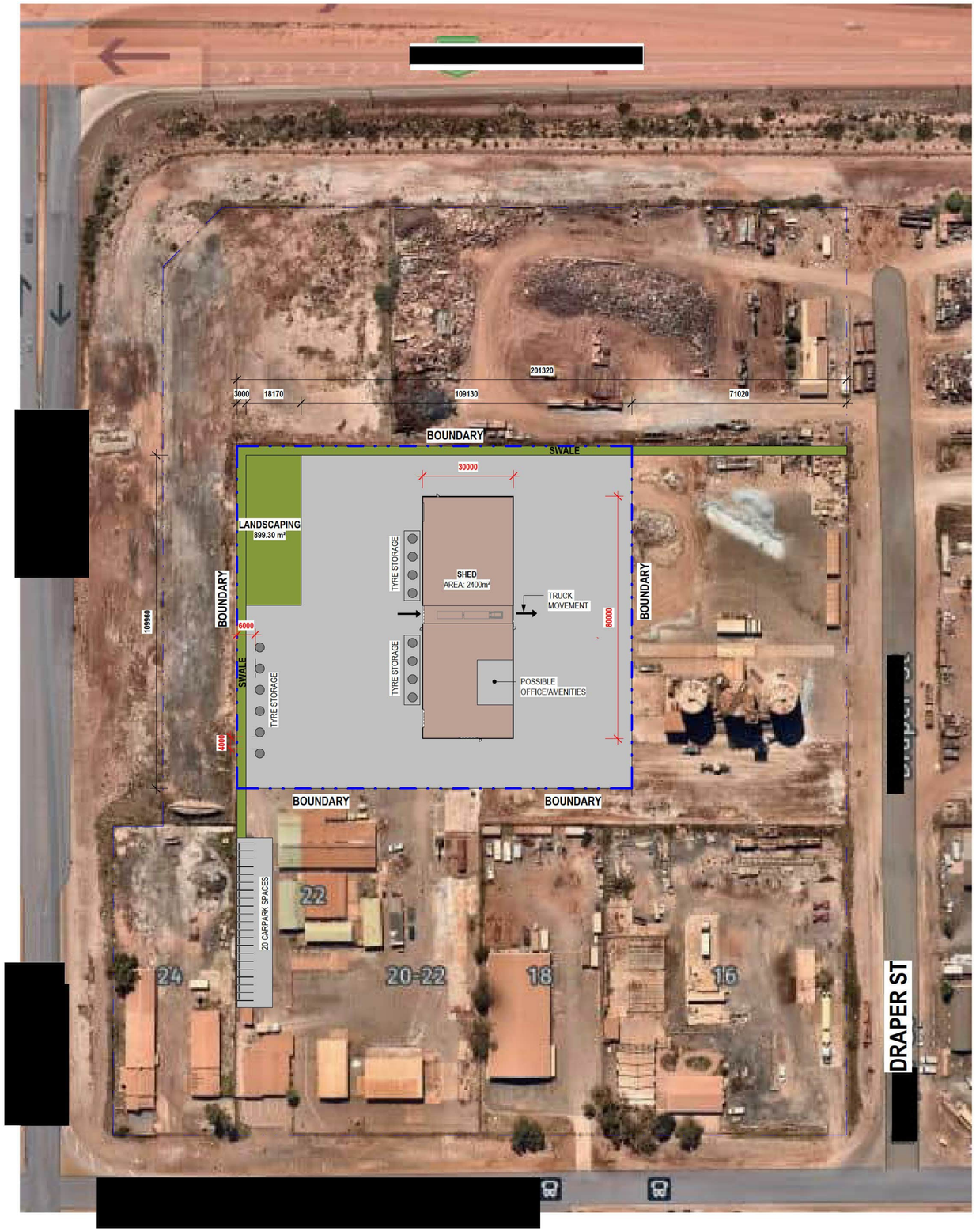
All present

APPENDIX B INDICATIVE FIRE HYDRANT SYSTEM DESIGN

Tyrecycle

A RESOURCECO COMPANY

AREA SCHEDULE	
NAME	**AREA**
SHED	2400m²
POSSIBLE OFFICE /AMENITIES	175m²
LANDSCAPING	1620m²
HARDSTAND/TYRE STORAGE	1070m²
BITUMEN	655m²
CARPARK SPACES	20



2 SITE PLAN
1 : 800

SK1101 REV S6 08.12.2022 BAP220106 TYRECYCLE SHED SITE PLAN Scale@A1 As indicated

0m 1m 2m 3m 4m 5m

PRELIMINARY

BELL Architecture Pty Ltd ABN 26 169 081 734 Level 1, 80 Pirie Street, Adelaide, 5000 PO Box 3029 Rundle Mall 5000 M +61 419 996 978 P +61 8 8373 3870

APPENDIX C STREET MAIN FLOW AND PRESSURE TEST

INSPECTION and TEST RECORD
WATER MAINS

FLOW AND PRESSURE TEST REPORT SHEET

NAME: Lucid Consulting Australia

PROJECT: Wedgefield

LOCATION: [redacted]

STATIC PRESSURE: 300kPa

Litres per Second	Litres per Minute	Pressure kPa	Comments
2.5	150	280	
5.0	300	250	
10	600	175	
12.5	750	140	
15	900	105	
20	1000	0	

COMMENTS: **The pressures displayed above are tests conducted on and are subject to infrastructure demands.**

REMARKS OF TEST:

Tester: Ben Neate

Date: 09.02.2023

Time:

INSPECTION and TEST RECORD
WATER MAINS

FLOW AND PRESSURE TEST REPORT SHEET

NAME: Lucid Consulting Australia

PROJECT: Wedgefield

LOCATION: [redacted]

STATIC PRESSURE: 325kPa

Litres per Second	Litres per Minute	Pressure kPa	Comments
2.5	150	290	
5.0	300	275	
10	600	225	
12.5	750	205	
15	900	160	
20	1000	100	

COMMENTS: **The pressures displayed above are tests conducted on and are subject to infrastructure demands.**

REMARKS OF TEST:

Tester: Ben Neate

Date: 09.02.2023

Time:

Attachment 8C

Traffic Impact Statement

transport planning
traffic engineering
modelling

Proposed Tyre Recycling Facility

[redacted]

Transport Impact Statement

PREPARED FOR:
TyreCycle

December 2022

Document history and status

Author	Revision	Approved by	Date Approved	Revision type
[redacted]	r01	[redacted]	18/11/22	Final
[redacted]	r01a	[redacted]	14/12/22	Revised Final
[redacted]	r01b	[redacted]	19/12/22	2nd Revised Final
[redacted]	r01c	[redacted]	19/12/22	3rd Revised Final

File name: t22.281.jd.r01c

Author: [redacted]

Project manager: Vladimir Baltic

Client: TyreCycle

Project: [redacted]

Document revision: r01c

Project number: t22.281

TABLE OF CONTENTS

REPORT FIGURES

1 Introduction

This Transport Impact Statement (TIS) has been prepared by Transcore on behalf of TyreCycle with regard to a proposed tyre recycling facility to be located at [redacted], in the City of Rockingham.

The subject site is located south of the [redacted] and is currently occupied by an existing industrial building. It is proposed to modify the existing building to a tyre recycling facility with associated car parks and outdoor storage areas. The subject site is bound by the existing industrial land uses to the south, [redacted] to the west, [redacted] to the east and Icon Way to the north, as shown in Figure 1.

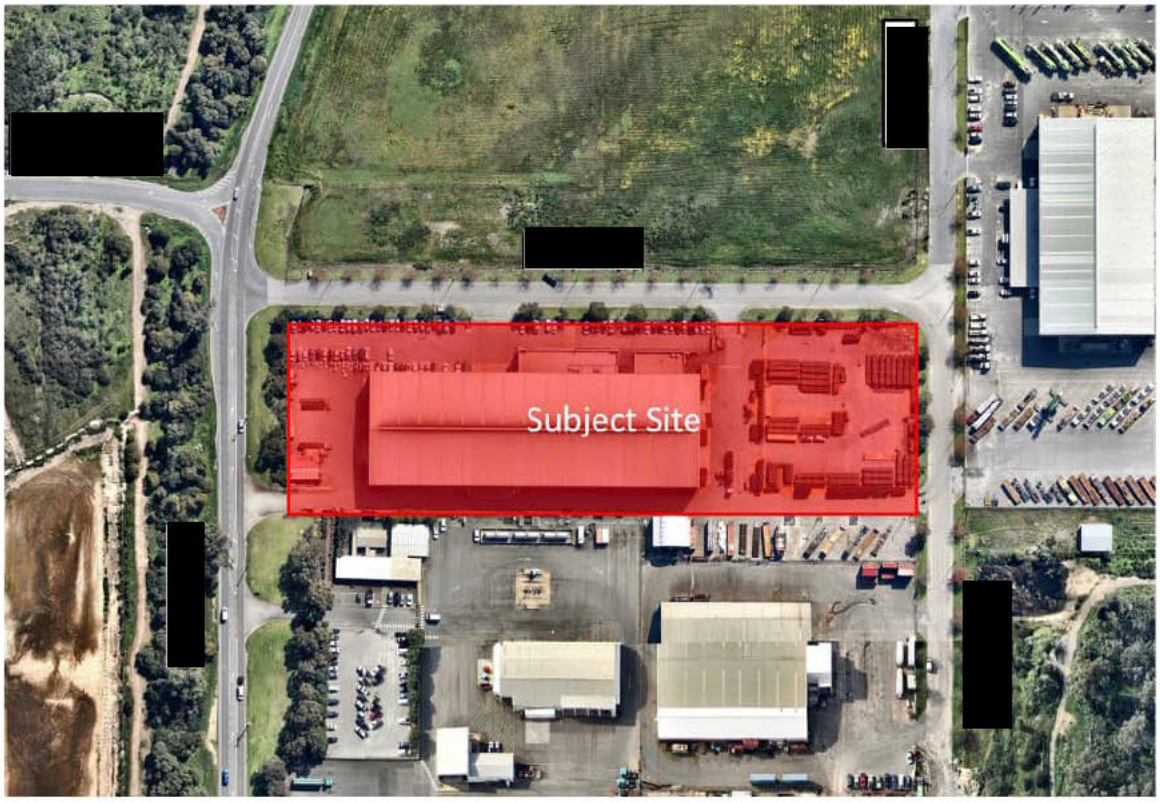


Figure 1: Location of the subject site

The location of the subject site within the Metropolitan Region Scheme (MRS) context is illustrated in Figure 2. The subject site is zoned as "Industrial" in the MRS. The MRS map identifies this section of Mandurah Road as local road under the care and control of the local authority. [redacted] and [redacted] are private roads.

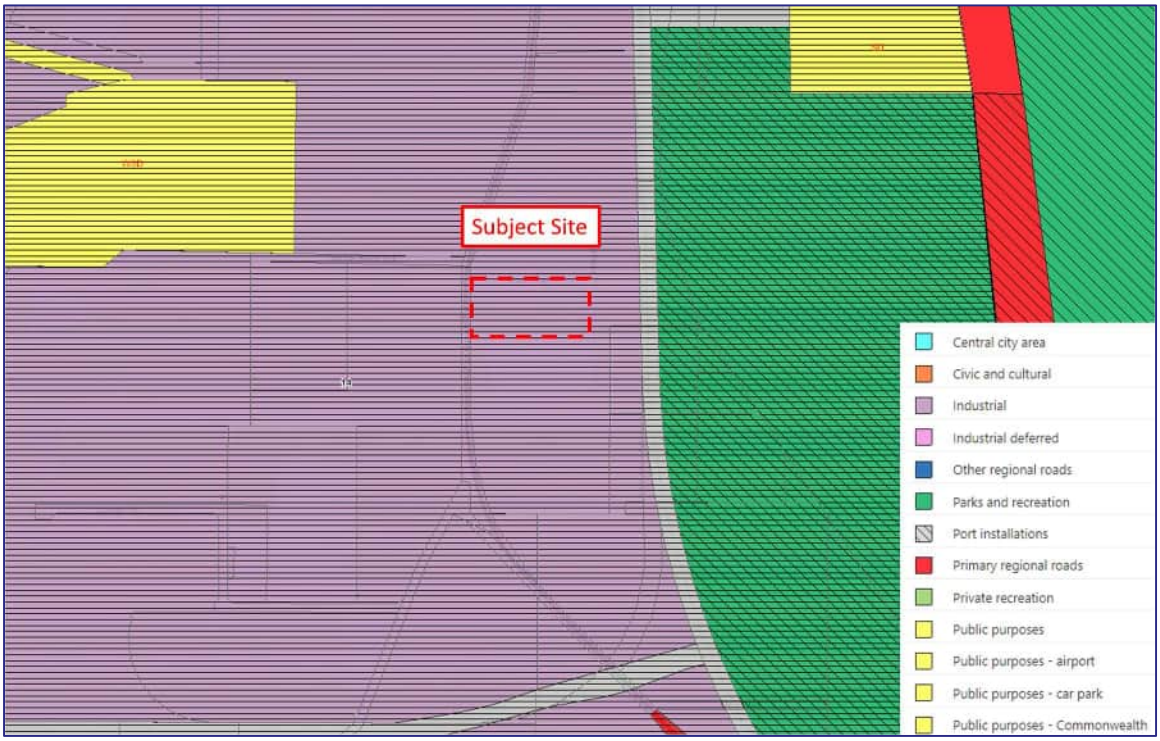


Figure 2. Location of the subject site in MRS

The Transport Impact Assessment Guidelines (WAPC, Vol 4 – Individual Developments, August 2016) states: *"A Transport Impact Statement is required for those developments that would be likely to generate moderate volumes of traffic*[1] *and therefore would have a moderate overall impact on the surrounding land uses and transport networks"*.

Section 6 of Transcore's report provides details of the estimated trip generation for the proposed development. Accordingly, as the net peak hour vehicular trips reflects anticipated reduction in traffic volumes generated by the site and the existing crossovers and adjacent road network are of a standard sufficient to accommodate the former workshop's traffic, a *Transport Impact Statement* is deemed appropriate for this development.

Key issues that will be addressed in this report include the traffic generation and distribution of the traffic associated with the proposed development, access and egress movement patterns and parking supply.

[1] *Between 10 and 100 vehicular trips per hour*

2 Proposed Development

The subject of this report is the proposed tyre recycling facility to service the mining industry. The facility will comprise the following elements:

- Workshop;
- Office; and,
- Tyre storage area.

The facility will receive large pieces of waste tyres and cut them into smaller pieces. A total of 33 staff will be required on-site to support the tyre recycling facility operations on a daily basis.

According to the development plan provided in **Appendix A**, a total of 72 on-site parking bays, including one ACROD bay, are proposed to address the parking demand of the proposed tyre recycling facility.

As part of the proposed development, vehicular access to the subject site is proposed to be facilitated via four existing full-movement crossovers on [redacted] and [redacted]. Two full-movement crossovers are located along Icon Way at the north of the site. One full-movement crossover each are located along Progress Way at the east of the site and [redacted] at the west of the site. These crossovers will be shared between employees (using light vehicles) and delivery trucks (heavy vehicles).

3 Vehicle Access and Parking

3.1 Access

Currently, four existing full-movement crossovers to the subject site on [redacted], [redacted] and [redacted] are serving the existing industrial building. As part of the development proposal, it is proposed to retain all crossovers but modify the full-movement crossover on [redacted] to exit-only crossover, as illustrated in Figure 3. Two existing full-movement crossovers on [redacted] at the north of the site, one existing full-movement crossover on [redacted] at the east of the site, and one proposed exit-only crossover on [redacted] at the west end of the site.

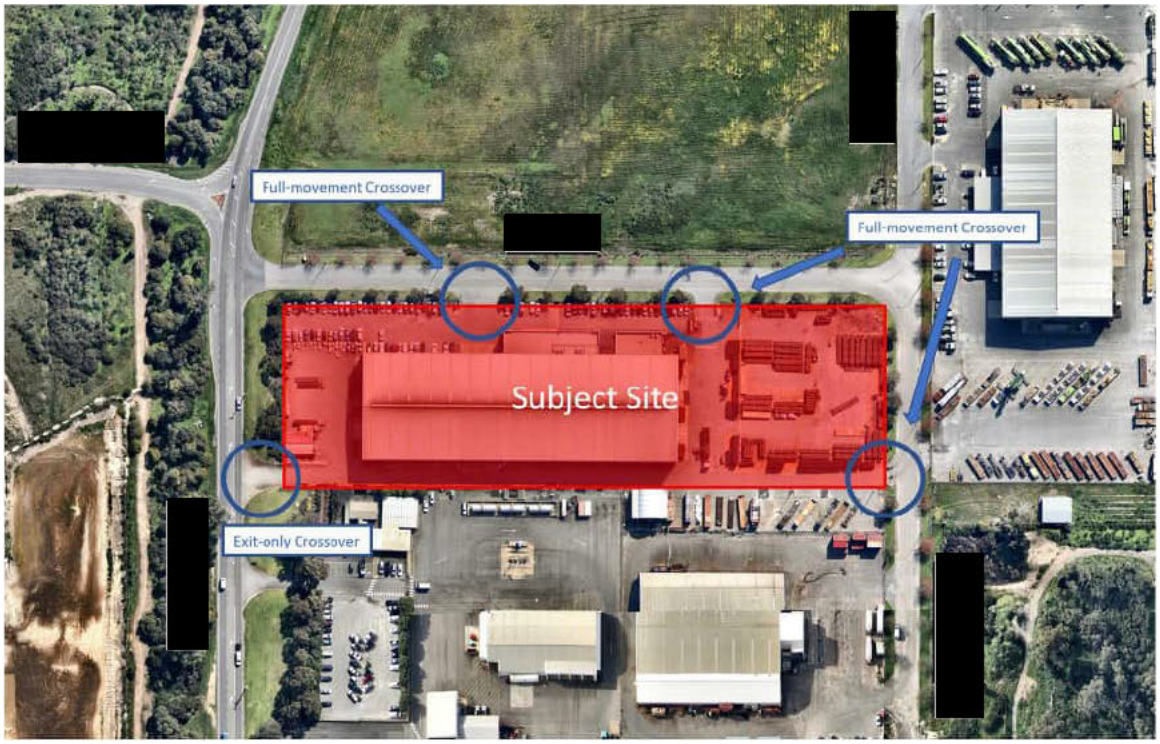


Figure 3: Development crossover

3.2 Parking Supply and Demand

The total on-site car parking provision for the proposed development is 72 bays inclusive of one ACROD bay. The on-site parking bays will generally be used by a limited number of staff (33 staff) and occasional visitors or service/maintenance contractors arriving by private vehicles. Therefore, the proposed car parking is sufficient to cater for the staff and occasional visitors.

4 Provision for Service Vehicles

A turn path assessment was undertaken for inbound and outbound movements of 19m semi-trailer, which are expected to be the largest size vehicles to access the site. The outcome of the assessment is attached in **Appendix B**.

As demonstrated in **Appendix B**, the turn paths confirm the adequacy of the existing crossover.

5 Hours of Operation

The proposed tyre recycling facility is proposed to operate 24 hours during weekdays, Monday to Friday.

6 Daily Traffic Volumes and Vehicle Types

6.1 Existing Site Traffic Generation

The subject site is presently occupied by an existing industrial building which is proposed to be modified into the proposed tyre recycling facility.

The traffic volumes likely to currently be generated by the existing development have been estimated based on the land uses in accordance with the *ITE Trip Generation Manual (11th Edition)*.

Accordingly, the trip rates which were used to estimate the existing development traffic generation are as follows:

Manufacturing (140) – 1000 Sq. Ft. GFA

- Weekday daily: 4.75 vpd per 1000 Sq.Ft. GFA/0.929 = 5.11vpd per 100 m^2 GFA:
- Weekday AM peak hour: 0.8vph per 100 Sq. F. GFA/0.929 = 0.86 vph per 100 m^2 GFA; and,
- Weekday PM peak hour: 0.8vph per 100 Sq. F. GFA/0.929 = 0.86 vph per 100 m^2 GFA.

Accordingly, it is estimated that the traffic generations for the existing industrial building are:

- Weekday daily: [5.11 x 6650/100(GFA)] = 340 vpd;
- Weekday AM peak hour: [0.86 x 6650/100(GFA)] = 57 vph; and,
- Weekday PM peak hour: [0.86 x 6650/100(GFA)] = 57 vph.

6.2 Proposed Development Trip Generation

The traffic volumes likely to be generated by the proposed development have been estimated based on advice provided by the future operator. The proposed development is of commercial character and will generate two distinct types of traffic: workforce/visitor traffic and commercial/heavy vehicle traffic. The workforce/visitor traffic is generally undertaken by passenger-type vehicles, while the heavy vehicle traffic will be undertaken generally using vehicles up to 19m semi-trailer in size.

The proposed facility will be operated by up to 33 staff who are expected to arrive and depart the site by private vehicles generating up to 66 (33 inbound / 33 outbound) weekday trips, as the proposed facility is intended to operate 24 hours Monday to Friday, and three shifts for up to six (6) yard staff, one shift for up to 14

collection staff, and one shift for office staff. It is possible that there will be ten (10) occasional visitor trips sometime between 7:00 AM and 5:00 PM.

Deliveries to/from the site are expected on a daily basis mostly by 19.0 m semi-trailers between 7:00 AM and 5:00 PM. Based on the advice provided to Transcore, the proposed tyre recycling facility will generate weekday freight traffic volumes in line with Table 1.

Table 1: Heavy vehicle traffic frequency

Truck size	Loads	Trips
12.5m Rigid truck	8 loads/day	16 trips/day
19 m Semi-trailers	9 loads/day	18 trips/day

Accordingly, on a typical weekday, the following trip generation is estimated for the proposed tyre recycling facility:

- AM peak hour: 18 trips generated (4 in / 14 out);
- PM peak hour: 6 trips generated (0 in / 6 out); and,
- Daily traffic generation: 110 trips generated (55 in / 55 out).

6.3 Traffic Impact Comparison

Based on the calculations s and assumptions outlined in the previous section, traffic analysis indicates that the net change in critical peak hour traffic generation of the subject site estimated as:

Weekday AM peak hour: 18 – 57 = -39 vph (decrease)
Weekday PM peak hour: 6 – 57 = -51 vph(decrease)
Weekday daily: 110 – 340 = -230 vpd (decrease)

As evident, the proposed tyre recycling facility would generate less traffic than the former operator. The existing site crossovers and the adjacent road network have been accommodating the former traffic and therefore is expected to comfortably accommodate the traffic generation of the proposed tyre recycling facility.

6.4 Traffic Flow

Based on the general spatial distribution of existing residential developments in the immediate area and the permeability of the local road network, the tyre recycling facility's traffic distribution adopted for this analysis is as follows:

Light vehicles (staff) trips:

- 30% from/to the north on [redacted]; and,
- 70% from/to the south on [redacted].

Heavy vehicles trips:

- 80% from/to the north on [redacted]; and.
- 20% from/to the south on [redacted].

Figure 4 illustrates trip generation and traffic distribution over the local road network for the proposed tyre recycling facility.

Figure 4: Estimated total daily traffic movements for the subject site

AM Peak Hour / PM Peak Hour / Daily

6.5 Impact on Surrounding Roads

The WAPC Transport Impact Assessment Guidelines (2016) provide guidance on the assessment of traffic impacts:

"As a general guide, an increase in traffic of less than 10 per cent of capacity would not normally be likely to have a material impact on any particular section of road, but increases over 10 per cent may. All sections of road with an increase greater than 10 per cent of capacity should therefore be included in the analysis. For ease of assessment, an increase of 100 vehicles per hour for any lane can be considered as equating to around 10 per cent of capacity. Therefore, any section of road where development traffic would increase flows by more than 100 vehicles per hour for any lane should be included in the analysis."

As detailed in **Section 6.4**, the proposed redevelopment result in a net decrease in traffic generation. Therefore, the impact of the development traffic will not result in any traffic increase to warrant further detailed analysis.

7 Traffic Management on the Frontage Streets

The Figure 5 illustrates the road hierarchy of the surrounding roads based on the Main Roads WA *Road Information Mapping System*. As evident, [redacted] is classified as a Regional Distributor and operates under a speed limit regime of 80 km/h, as shown in Figure 6.

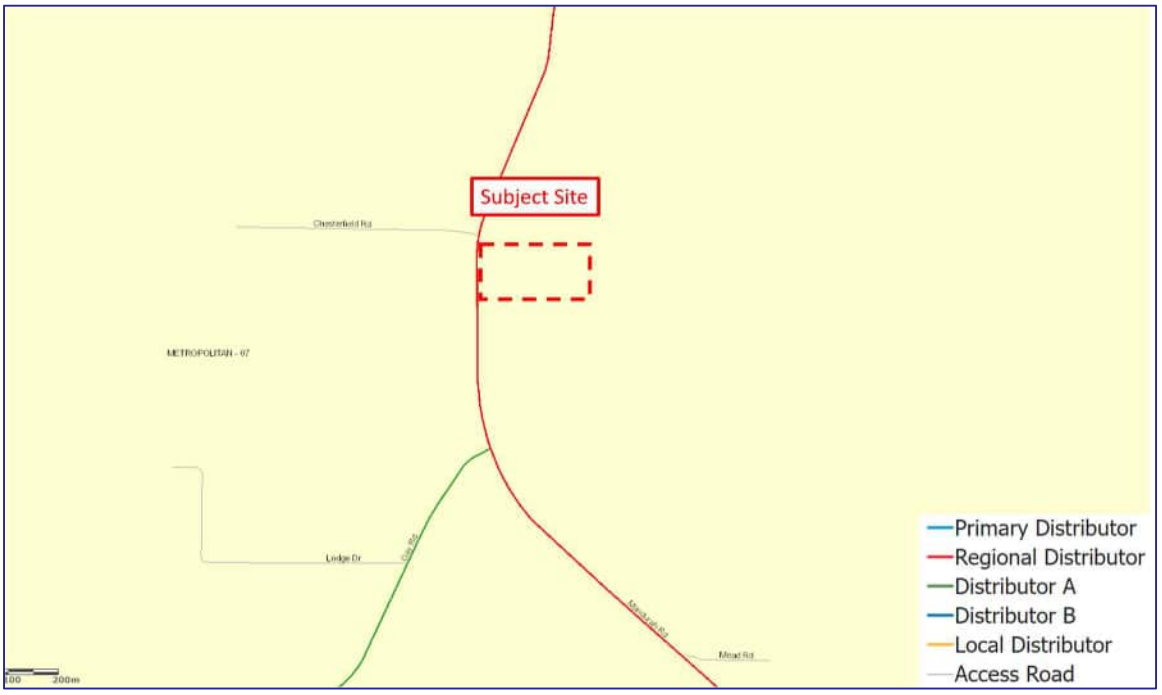


Figure 5. Main Roads WA Road Information Mapping System Road Hierarchy

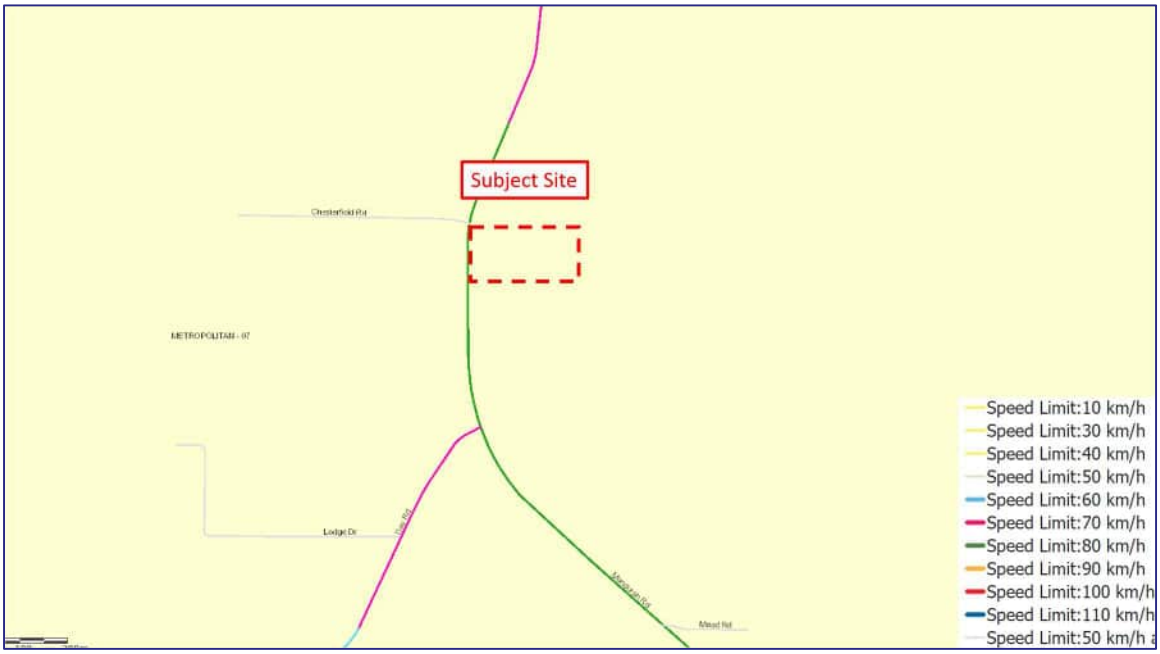


Figure 6. Main Roads WA Road Information Mapping System Speed Data

The existing traffic counts sourced from Main Roads WA *Trafficmap* on the surrounding roads in the vicinity are shown in **Figure 7**.

Figure 7. Existing traffic counts on surrounding roads

[redacted], north of the subject site, is constructed as a single carriageway, two-way undivided industrial road with approximately 10.2 m wide trafficable pavement, as shown in **Figure 8**. Icon Way forms a priority-controlled 'T' intersection with [redacted] to the west, and uncontrolled "T" intersection with Progress Way to the east. [redacted] is a private industrial road.

Figure 8. East-bound view along [redacted]

[redacted], west of the subject site, is constructed as a single carriageway, two-way undivided road with approximately 10.4 m wide trafficable pavement, as shown in **Figure 9**. [redacted] forms a priority-controlled 'T' intersection with [redacted] to the north.

Figure 9. North-bound view along Mandurah Road

Progress Way, east of the subject site, is constructed as a single carriageway, two-way undivided industrial road with approximately 10 m wide trafficable pavement. [redacted] forms an uncontrolled 'T' intersection with [redacted] Progress Way is a private industrial road.

8 Public Transport Access

As detailed in **Figure 10**, the subject site has no access to the existing bus services that operate in the vicinity of the site.

The closes available bus services are route 549, which operate along [redacted] with the nearest bus stop located approximately 1.8 km walking distance from the site. This bus route provides a direct link to [redacted].

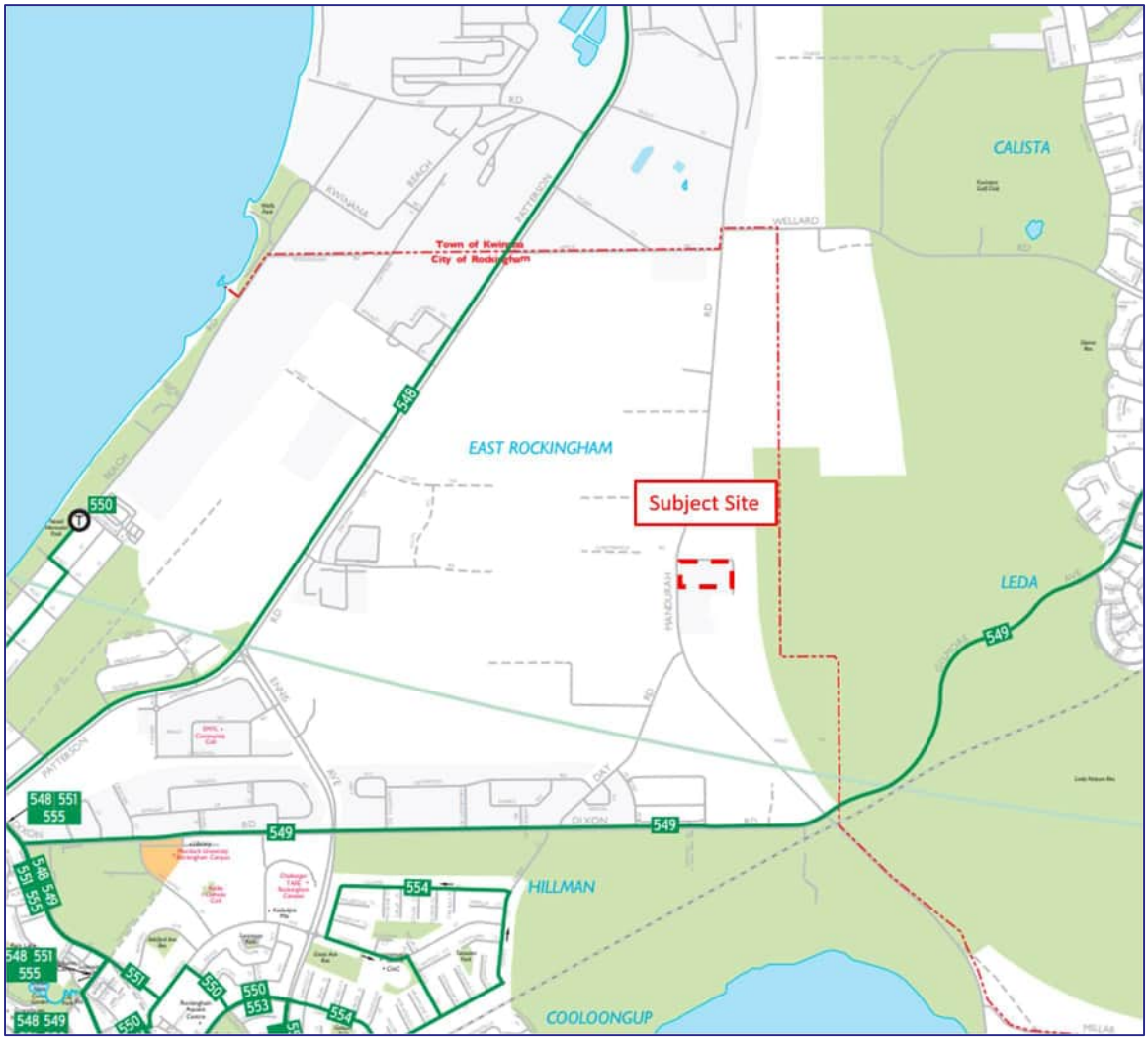


Figure 10. Public transport services (Transperth Maps)

9 Pedestrian Access

There is no pedestrian access available to the subject site at present; however, the proposed operation will not generate any pedestrian movements due to the nature of the proposed operation.

10 Cycle Access

There is no cycle access available to the subject site at present; however, the proposed operation will not generate any cycle traffic due to the nature of the proposed operation.

11 Site Specific Issues

No site-specific issues have been identified within the scope of this assessment for the proposed tyre recycling facility.

12 Safety Issues

No particular safety issues have been identified within the scope of this assessment for the proposed tyre recycling facility.

13 Conclusions

This Transport Impact Statement (TIS) has been prepared by Transcore on behalf of TyreCycle and provides information on the proposed tyre recycling facility to be located at [redacted], in the [redacted].

The proposed facility will be operated by up to 33 staff to operate 24 hours Monday to Friday, and three shifts for up to 6 yard staff, one shift for up to 14 collection staff, and one shift for office staff. Currently, four existing full-movement crossovers to the subject site on [redacted] are serving the existing industrial building. As part of the development proposal, it is proposed to retain all crossovers but modify the full-movement crossover on [redacted] to exit-only crossover. Two existing full-movement crossovers on Icon Way at the north of the site, one existing full-movement crossover on Progress Way at the east of the site, and one proposed exit-only crossover on [redacted] at the west end of the site.

The total on-site car parking provision for the proposed development is 72 bays inclusive of one ACROD bay. The on-site car parking can be directly accessed from the proposed crossover on the western crossover on Icon Way.

The traffic analysis undertaken in this report shows that the traffic generation of the proposed development is relatively low and, as such, would have a positive net impact on the surrounding road network due to the proposed change in land uses.

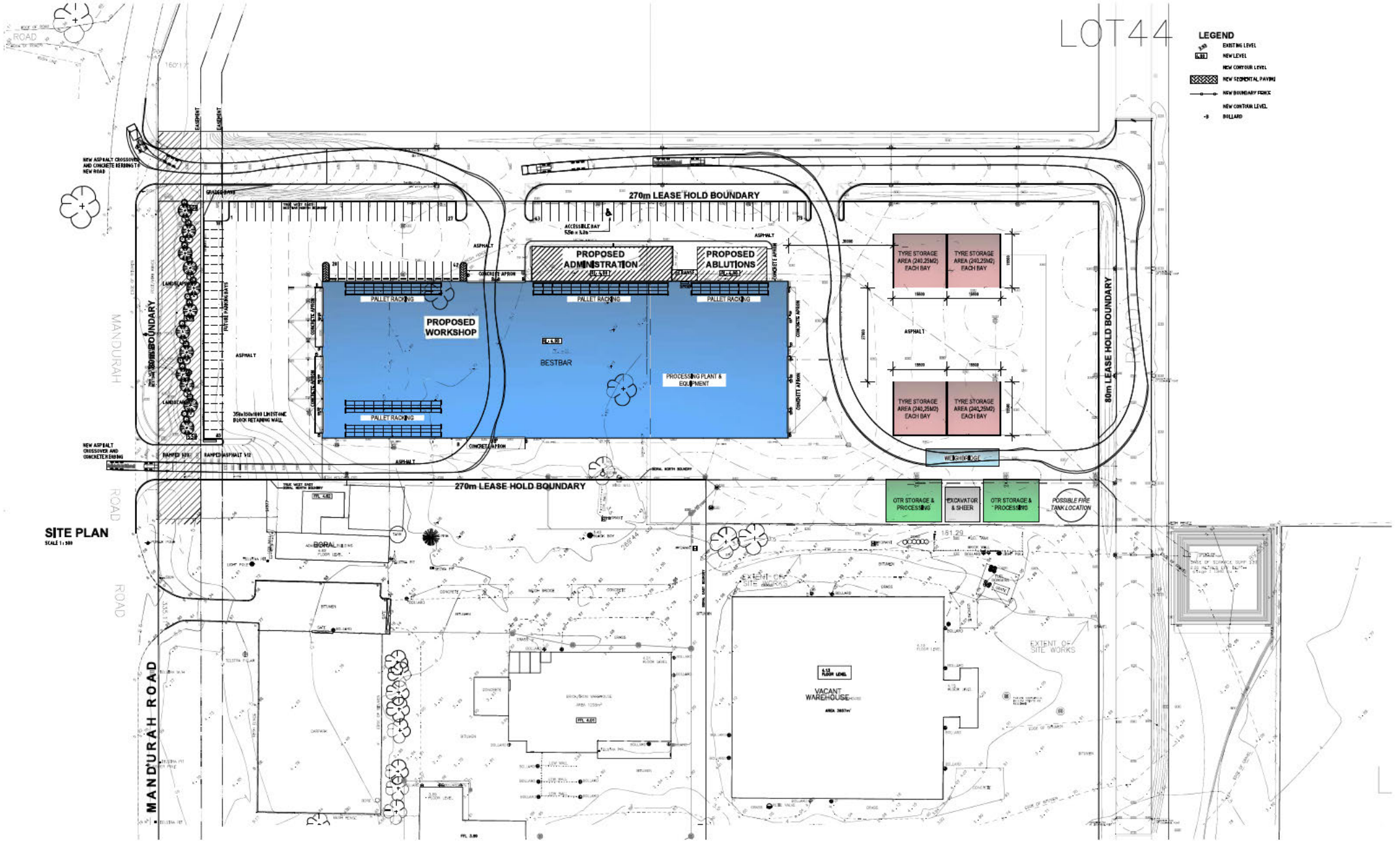
The development-generated traffic will comprise staff, visitor traffic and a portion of freight traffic. The staff and visitors would be using mostly passenger cars, while delivery/distribution traffic would generally be undertaken using heavy vehicles of up to 19 m Semi-trailer in size.

No particular transport or safety issues have been identified for the proposed tyre recycling facility.

It is concluded that the findings of this Transport Impact Statement are supportive of the proposed tyre recycling centre.

Appendix A

PROPOSED DEVELOPMENT PLAN



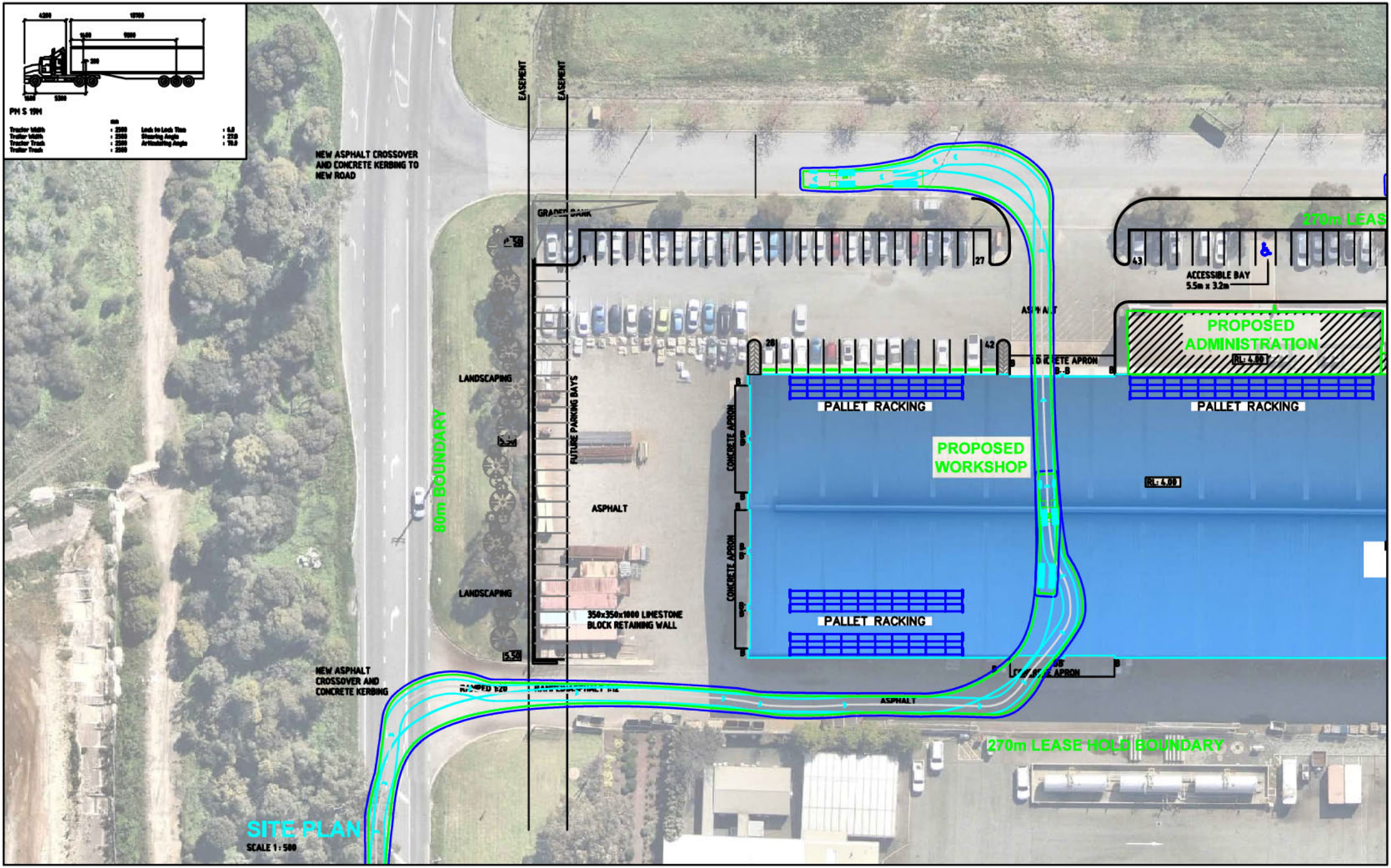
SITE PLAN

SCALE 1 : 500

TYRECYCLE ROCKINGHAM WA – SITE PLAN SCALE 1:500 @ A1

Appendix B

TURN PATH ANALYSIS



[redacted]

19 m Service Vehicle (Radius 12.5 m)

Service vehicle circulation

LEGEND

Vehicle Body

Wheel Path

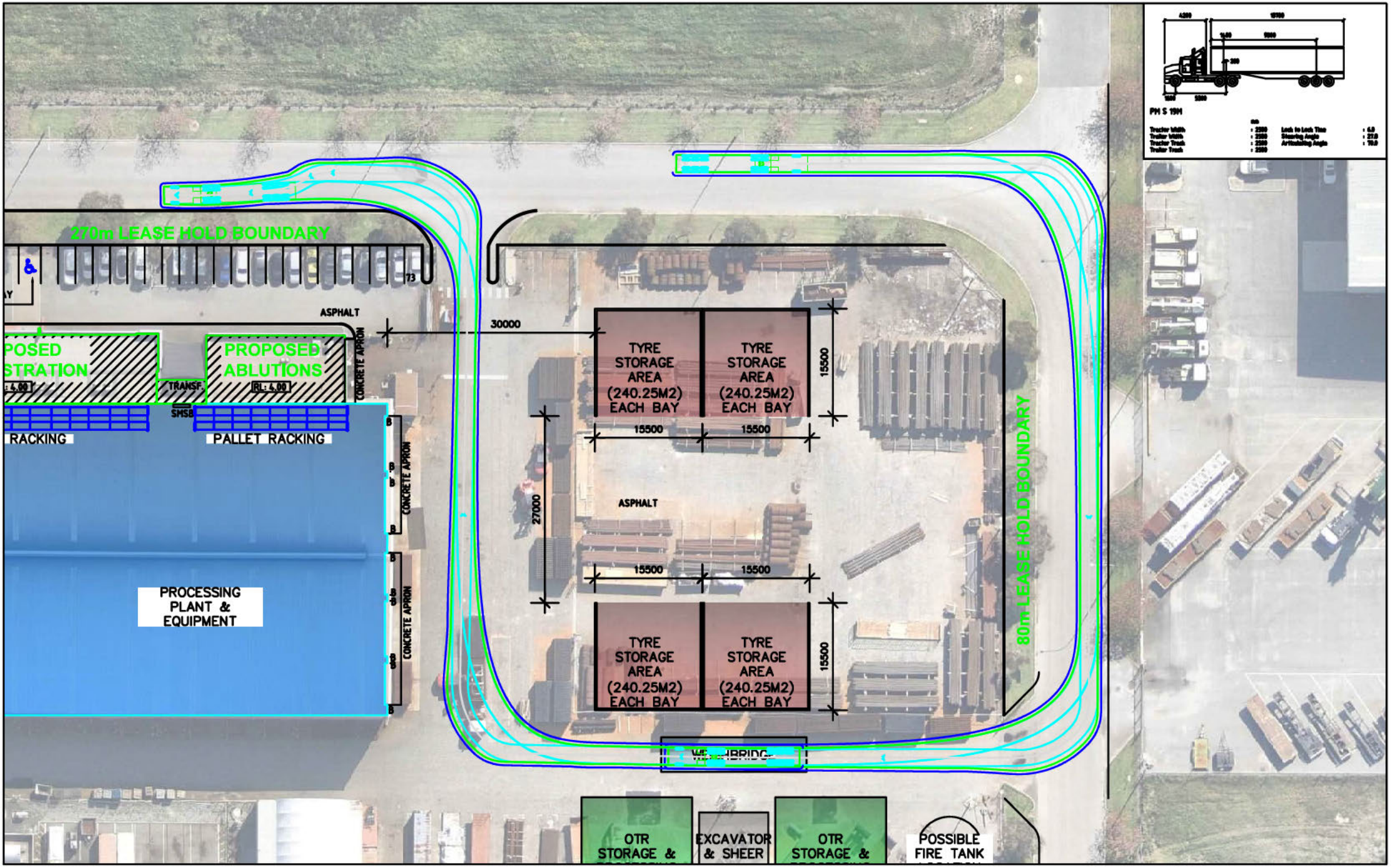
500mm Clearance

t22.281.sk01b

19/12/2022

Scale: 1:550 @ A3

transcore



[redacted]

19 m Service Vehicle (Radius 12.5 m)

Service vehicle circulation

LEGEND

Vehicle Body

Wheel Path

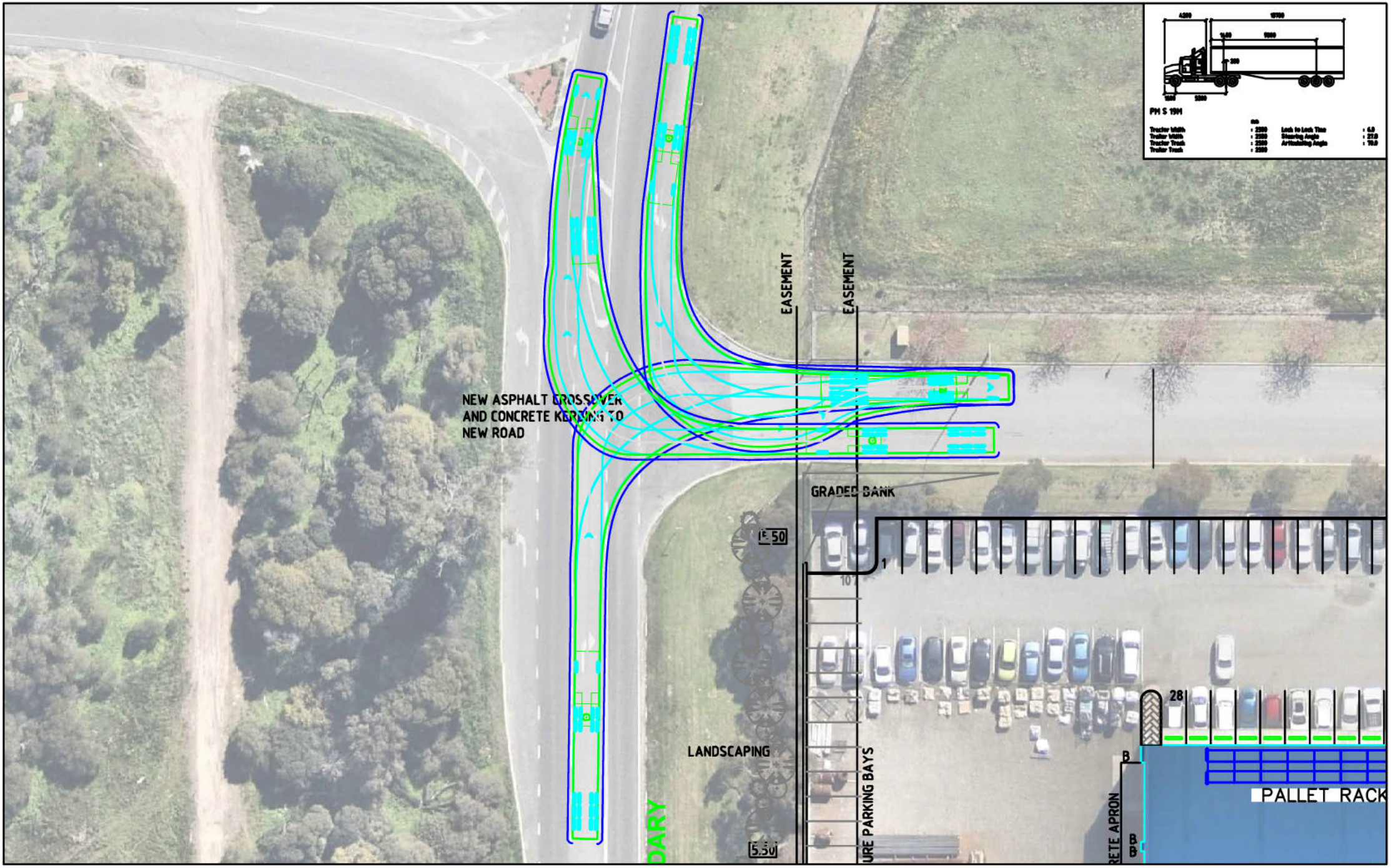
500mm Clearance

t22.281.sk02a

19/12/2022

Scale: 1:500 @ A3

transcore



19 m Service Vehicle (Radius 12.5 m)
Service vehicle entry/exit

LEGEND

Vehicle Body
Wheel Path
500mm Clearance

t22.281.sk03a
19/12/2022
Scale: 1:350 @ A3

transcore