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Elan Energy - Tyre Resource Recovery Facility

Public Environmental Review

Prepared for
Elan Energy Matrix Pty Ltd
by Strategen

February 2017

Elan Energy - Tyre Resource Recovery Facility

Public Environmental Review

Strategen is a trading name of
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February 2017

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Client: Elan Energy Matrix Pty Ltd

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
				Form	Date
Draft Report	A	Client review	A Welker; P Forster / L Taylor; D Walsh	Electronic	24-Nov-16
Final Draft Report	0	Draft for EPA	P Forster / L Taylor	Electronic	30-Nov-16
Revised Draft	1	Revised Draft for OEPA approval to release	P Forster / L Taylor	Electronic	07-Feb-17
Final Report	2	Public review	L Taylor	Hard copy and electronic	15-Feb-17

Filename: EEM16113 01 R006 Rev 2 - 15 February 2017

Invitation to Make a Submission

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal. The environmental impact assessment process is designed to be transparent and accountable, and includes specific points for public involvement, including opportunities for public review of environmental review documents. In releasing this document for public comment, the EPA advises that no decisions have been made to allow this proposal to be implemented.

Elan Energy Matrix Pty Ltd (Elan), the Proponent, proposes to develop a Tyre Resource Recovery Facility (TRRF, the Proposal) within Lot 60, 9 Fargo Way, Welshpool in the City of Canning. The Proposal involves processing of shredded end of life (EOL) tyres using an indirect fired Thermal Conversion Unit (TCU) to produce char, steel wire, oil and process gas. In accordance with the *Environmental Protection Act 1986*, a Public Environmental Review (PER) has been prepared that describes this proposal and its likely effects on the environment.

The PER is available for a public review period of approximately four weeks from 20 February 2017, closing on 21 March 2017.

Information on the proposal from the public may assist the EPA to prepare an assessment report in which it will make recommendations on the proposal to the Minister for Environment.

Why write a submission?

The EPA seeks information that will inform the EPA's consideration of the likely effect of the proposal, if implemented, on the environment. This may include relevant new information that is not in the PER document, such as alternative courses of action or approaches.

In preparing its assessment report for the Minister for Environment, the EPA will consider the information in submissions, the proponent's responses and other relevant information.

Submissions will be treated as public documents unless provided and received in confidence, subject to the requirements of the *Freedom of Information Act 1992*.

Why not join a group?

It may be worthwhile joining a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on information in the PER document.

When making comments on specific elements in the PER document:

- clearly state your point of view and give reasons for your conclusions
- reference the source of your information, where applicable
- suggest alternatives to improve the outcomes on the environment.

What to include in your submission

Include the following in your submission to make it easier for the EPA to consider your submission:

- your contact details – name and address
- date of your submission
- whether you want your contact details to be confidential
- summary of your submission, if your submission is long.
- list points so that issues raised are clear, preferably by environmental factor.
- refer each point to the page, section and if possible, paragraph of the ERD.
- attach any reference material, if applicable. Make sure your information is accurate.

The closing date for public submissions is: 21 March 2017.

The EPA prefers submissions to be made electronically via the EPA's Consultation Hub at https://consultation.epa.wa.gov.au.

Alternatively submissions can be:

- posted to: Chairman, Environmental Protection Authority, Locked Bag 10, EAST PERTH WA 6892

or

- delivered to: the Environmental Protection Authority, Level 8, The Atrium, 168 St Georges Terrace, Perth 6000.

If you have any questions on how to make a submission, please contact the Office of the Environmental Protection Authority on 6145 0800.

Executive Summary

Introduction

Elan Energy Matrix Pty Ltd (Elan), the Proponent, is proposing to develop a Tyre Resource Recovery Facility (TRRF, the Proposal) within Lot 60, 9 Fargo Way, Welshpool in the City of Canning (Figure ES1). The Proposal involves processing of shredded end of life (EOL) tyres using an indirect fired Thermal Conversion Unit (TCU) to produce char, steel wire, oil and process gas.

The Proposal was referred to the Environmental Protection Authority (EPA) on 7 July 2016 under s 38 of the EP Act, and the EPA determined that the Proposal required assessment at the level of Public Environmental Review (PER) with a four week public comment period.

The EPA prepared an Environmental Scoping Document (ESD) identifying the preliminary key environmental factors to be addressed in the PER and the work required to inform the assessment of the environmental impact of the Proposal. A draft ESD was issued to the Proponent on 4 October 2016 and the final ESD was issued on 9 November 2016.

Elan proposes to transfer its existing tyre storage and shredding facility (TSSF) from Lot 106, 101 Dowd St, Welshpool to the Proposal site. Elan has lodged an application for a works approval with the Department of Environment Regulation (DER) to transfer the TSSF to this Proposal site. The Proposal does not include the storage and shredding of EOL tyres.

Proposal overview

Elan is looking to expand its tyre management operations by incorporating a TRRF to recover valuable resources from EOL tyres. The Proposal involves processing of shredded EOL tyres using an indirect fired Thermal Conversion Unit (TCU) to produce char, steel wire and oil for sale to Australian and/or international markets.

The residual process gas stream that remains after recovery of the oil fraction contains predominately hydrogen, carbon monoxide and methane. That gas stream will be combusted in a thermal oxidiser - in effect a high efficiency flare. Heat recovery will be installed on the combustion gas exhaust duct from the TCU to preheat combustion incoming combustion air for the TCU operation. Exhaust gases from the thermal oxidiser and TCU combustion chamber will be discharged to atmosphere via a 15 m tall stack.

The Proposal utilises best practice technologies, which includes air pollution controls from use of low NOx burners, removal of pollutant precursors from the process gases with the oil recovery system, use of a high efficiency thermal oxidiser for control of residual process gas emissions and efficient dispersion of exhaust emissions via a 15 m high single stack.

Benefits of the Proposal

While some re-use and recycling options exist in Western Australia for EOL tyres, these options are not sufficient to manage the volume of EOL tyres generated per year. Any EOL tyres that are not being re-used or managed by existing tyre recyclers are currently either being stored in dedicated tyre storage facilities, disposed of in approved landfills or illegally dumped.

The key benefits of the Proposal include the diversion of EOL tyres from landfill and the recovery, reprocessing and re-use of valuable resources. It is anticipated that the Proposal would have significant environmental and economic benefits. The Proposal, providing for the recovery and reuse of valuable EOL tyre resources, is consistent with the objectives of the waste hierarchy.

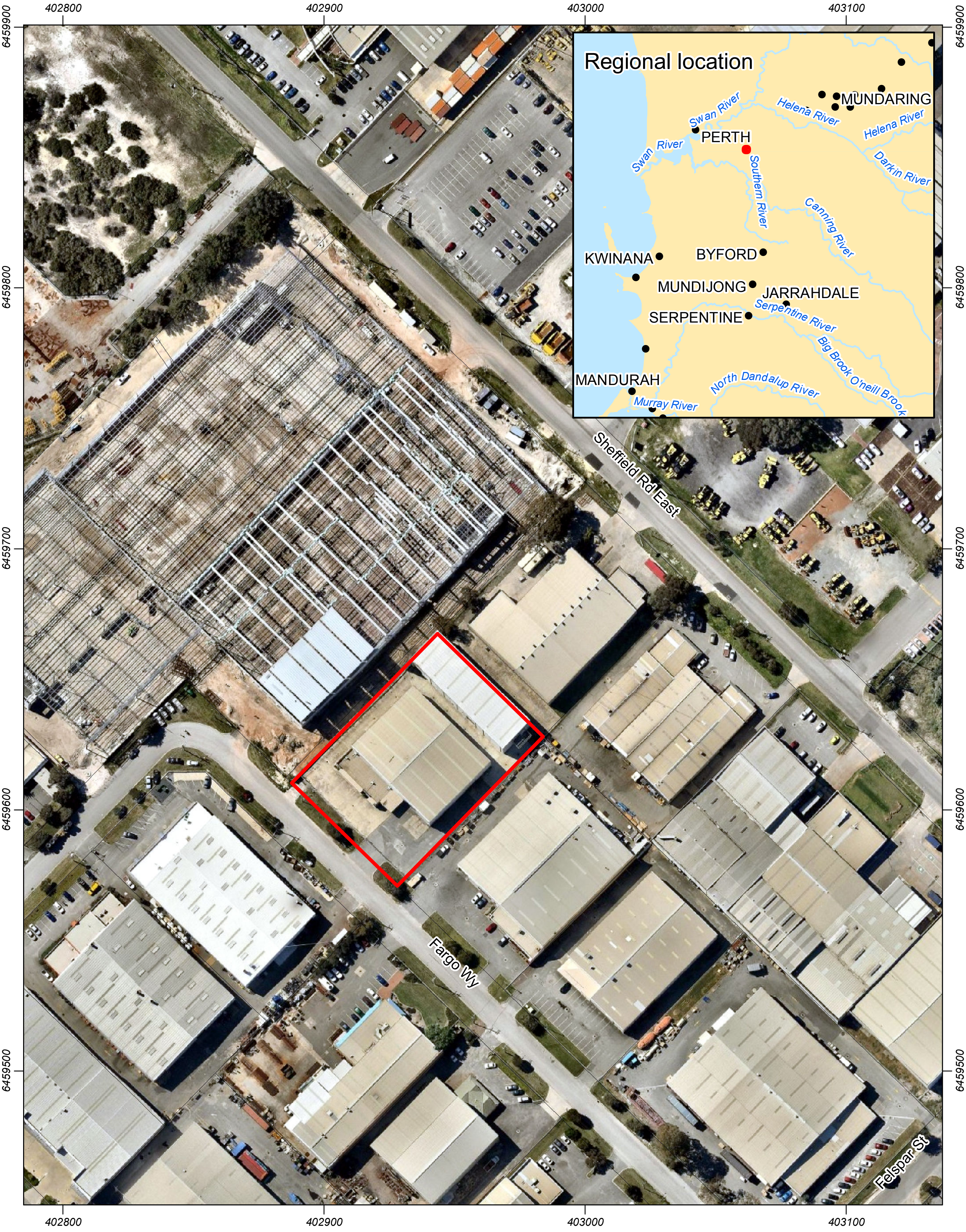

Figure ES1: Proposal site – Lot 60, 9 Fargo Way, Welshpool.

Scale 1:2,000 at A4

0 10 20 30 40 50 m

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 24/11/2016
Author: JCrute
Source: Aerial image: Nearmaps: October 2016. Existing cadastre: SLIP, Landgate 2016.

Legend

Lot 60 boundary

Existing cadastre

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Air Quality and atmospheric gases

The ESD recognised the potential for emissions generated from the Proposal to impact residential areas and neighbouring industrial premises. Emissions include nitrogen oxides, sulfur dioxide, carbon monoxide, particulates (PM_{10} and $PM_{2.5}$), acid gases, metals, dioxins, polycyclic aromatic hydrocarbons, volatile organic compounds.

To characterise the background pollutant levels**,** published data from DER's monitoring network across the metropolitan area were examined to identify conservative concentrations to use as backgrounds for the cumulative air emissions risk assessment (DER 2015). The reported concentrations for the respective time averages of regulatory interest from all stations from 2014 were pooled and the maximum values for NOx, SO_2 and CO were used as the background for the cumulative assessment. The 95^{th} percentile PM_{10} and $PM_{2.5}$ concentrations were used for the assessment of those parameters, since the maxima were a consequence of bushfire smoke emissions and are unlikely to be reflective of a background derived from vehicle emissions and other activities in the area.

Ambient air data for other parameters were obtained from various monitoring programs conducted by DER. Maximum concentrations of these parameters observed in those studies were used to provide appropriate level of conservatism in the cumulative assessment.

Three operating scenarios are relevant to the operation of the Proposal – normal, start-up and shutdown. The emissions impact assessment has considered emissions from normal operations only, since these represent the greatest potential environmental risk for the Proposal.

To understand and predict emissions from the Proposal, a comprehensive mass balance has been developed from consideration of reported compositional data for EOL tyre materials, the proposed feed rate of those materials, and key process design parameters that influence the formation and fate of air emissions within the process.

Demonstration scale tests of EOL tyre thermal processing were carried out at an established test plant, with samples of char, wire, oil and residual process gas obtained for analysis and characterisation. In addition, air emissions from a thermal oxidiser were tested for NOx, CO, SO_2, CO_2, O_2, particulates and acid gases. The test data were used to verify aspects of the mass balance.

The risk of actual emissions being greater than predicted was further evaluated through a sensitivity analysis of EOL tyre inputs. That analysis considered variability in feed rate to the TRRF and the homogeneity of the tyre shred. Overall, the sensitivity analysis demonstrated that variances in feed rate and feed composition have no significant impact on emissions from the Proposal.

Dispersion modelling of emissions from the single point source emissions stack was carried out using the AERMOD atmospheric dispersion model. The residential areas to east of the Proposal site was identified as sensitive receptors for the emissions impact assessment with industrial premises surrounding the remainder of the Proposal site.

The results from the dispersion modelling at the Proposal site boundary and at nearest sensitive receptors were compared with relevant environmental and health air emission standards.

Dispersion modelling predicted that emissions are well below the air quality criteria for the maximum predicted GLCs in all circumstances. Emissions from the Proposal combined with background concentrations were also well below respective air quality criteria for the majority of emissions parameters, with the exceptions being of hexane, PAHs, Arsenic and $PM_{2.5}$, at sensitive receptors and the Proposal site boundary. These exceedances were entirely by the background concentrations used for the assessment, with insignificant contributions from the Proposal.

The outcomes of the air emissions assessment will be validated by stack testing and campaign based monitoring during commissioning and operation of the Proposal. The Proposal will also be regulated under Part V of the EP Act (works approval and licence).

Other factors

The ESD identified Inland Waters Environmental Quality and Amenity as ‘other factors’ to be considered.

Inland Waters Environmental Quality

Wastewater in the form of cooling tower blow-down will be generated from the Proposal.

Liquid and solid wastes can be readily managed and regulated through other regulatory mechanisms.

The TRRF will operate in accordance with the *Dangerous Goods Safety Act 2004* and Regulations for the manufacture and storage of Dangerous Goods. The Proponent understands that a Dangerous Goods Licence will be required for the proposed storage of hydrocarbons (oil). Hydrocarbon and chemical storage is considered a minor environmental factor in relation to this application.

Amenity (Noise and Odour)

Noise will be generated by the shredder and TCU. The Proposal will be located within existing enclosed buildings which are expected to provide significant attenuation of noise emissions from plant and equipment.

A noise assessment was undertaken for the Proposal to determine the potential noise impacts to neighbouring industrial premises, as well as nearest sensitive receptors, in accordance with the *Environmental Protection (Noise) Regulations 1997* (Noise Regulations).

Predicted noise levels at the residential premises were found to be below the assigned levels during all modelled scenarios. Noise monitoring will be undertaken to validate the results of the modelling and compliance with the Noise Regulations once the TRRF is operational.

The primary source of odour from thermal treatment of tyres is the presence of sulfur species such as H_2S, thiols and organosulfides in process gases. These gases are not released to atmosphere and as such the Proposal is unlikely to give rise to odour emissions impacts at sensitive receptors.

Summary of environmental factors and management

Table ES1 provides a summary of the assessment, management and predicted outcome after the application of management measures. The predicted outcome is also assessed against the relevant EPA objective as identified in the ESD.

Table ES1: Summary of environmental impact assessment of key environmental factors

EPA objective	Existing environment	Potential impact	Environmental management	Predicted outcome	Compliance with EPA objective
Air quality and other atmospheric gases. To maintain air quality for the protection of the environment and human health and amenity, and to minimise the emissions of greenhouse and other atmospheric gases through the application of best practice	The Proposal site is located approximately 12 km of Perth CBD within the Welshpool industrial area. The Proposal site is zoned 'General Industry', under the City of Canning Town Planning Scheme 40. The Proposal site was previously utilised for a storage and wholesaling business and contains paved and hard panned lots. An existing warehouse occupies approximately half of the site. The nearest sensitive receptors are in the residential area 600 m to the east of the Proposal site. Emissions characteristics have been derived from a mass balance (i.e. accounting for material entering and leaving the process) and emissions testing from a trial plant. The emissions data obtained from the mass balance and test plant trials have been used in dispersion modelling to assess the potential impacts at sensitive receptors.	The key air emissions parameters from the Proposal in respect of significance of impacts are: • oxides of nitrogen (NOx) • sulfur dioxide (SO_2) • carbon monoxide (CO) • particulates. The assessment also considered a range of metals, hydrogen chloride (HCl) and hydrogen fluoride (HF), dioxins, polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs). Dispersion modelling of emissions from the single stack was carried out using the AERMOD atmospheric dispersion model. The residential area to the east of the Proposal site has been identified as containing sensitive receptors, with industrial premises surrounding the remainder of the Proposal site. Modelling has addressed direct impacts from the Proposal and cumulative impacts where background emissions from other sources are considered. The worst-case impacts are presented to ensure that the assessment of emissions is highly conservative. Ambient air quality guidelines and standards are derived from the Ambient Air Quality NEPM, DER (Toxikos), WHO and the Department of Health. These are the same standards as used for other projects recently assessed by EPA. Direct impacts of NOx at the Proposal site boundary are predicted to be 8% of the hourly average NEPM and 2.7% of the annual NEPM, SO_2 impacts are 13%, 7.9%, 13% and 6.7% of the 10-minute, 1-hour, 24-hour and annual standards, respectively; and CO impacts are 0.04% of the 8 hour standard. The cumulative impacts of air emissions from the Proposal are insignificant. For example, the predicted NOx GLC from the Proposal combined with background concentrations is 4% of the NEPM at the boundary, with the background accounting for 37% of NEPM. The cumulative hourly average SO_2 GLC is 36% of the NEPM with the background accounting for 28% of the NEPM. High backgrounds of hexane, As, PAHs and $PM_{2.5}$ lead to exceedances of air quality standards for the cumulative assessment, with the emissions from the Proposal minor contributors.	The TRRF will utilise 'state-of-art' technology, designed for processing EOL tyres to recover valuable materials. The proposed process is fully contained and the only emissions to the environment will be from a single stack of sufficient height to maximise dispersion and dilution, and minimise ground level concentrations. Dispersion model predictions show Ground Level Concentrations of air emissions are well below the air quality standards under worst-case meteorological conditions for both direct impacts and cumulative impacts where background concentrations are included. The following emissions management will be undertaken: • low NOx burners will be installed on the TCU combustion chamber and the thermal oxidiser • the process gas condenser will remove the majority of sulfides thereby reducing the SO_2 emissions from the thermal oxidiser • the thermal oxidiser design provides for a minimum two second residence time at high temperature to ensure highly efficient combustion efficiencies • a 15 m tall stack will be installed to ensure efficient dispersion of emissions • stack emissions will be discharged at high temperature, providing good plume buoyancy for efficient dispersion of emissions.	Taking into consideration: • dispersion modelling using the results of a mass balance emissions assessment and test plant trials • worst case dispersion modelling has indicated acceptable air emissions outcomes • application of pollution control and monitoring. The Proposal is not expected to represent a significant impact to the air quality of the area and meets the EPA objective for air quality. Furthermore, air emissions from the Proposal can be adequately regulated and managed under Part V of the EP Act. Relevant limits, targets, monitoring and management actions can be applied through conditions on a works approval and operating licence.	After the application of monitoring and management measures, the EPA objective for air quality and atmospheric gases is expected to be met.

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Acronyms and short titles

Acronyms and abbreviations used in PER

Acronym/abbreviation	Description
AH Act	*Aboriginal Heritage Act 1972*
AHD	Australian Height Datum
ARI	Average Recurrence Interval
BaP	Benzo[a]pyrene equivalents (PAHs)
BoM	Bureau of Meteorology
DAA	Department of Aboriginal Affairs
DER	Department of Environment Regulation
DoP	Department of Planning
DEE	Department of the Environment and Energy (Commonwealth)
EAG	Environmental Assessment Guidelines
EIA	Environmental Impact Assessment
EMS	Environmental Management System
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
ESD	Environmental Scoping Document
GoWA	Government of Western Australia
MNES	Matters of National Environmental Significance
MOU	Memorandum of Understanding
MRS	Metropolitan Region Scheme
NA	Not applicable
NEPM	National Environment Protection Measure
OEPA	Office of the Environmental Protection Authority
Parks and Wildlife	Department of Parks and Wildlife
PAH(s)	Polycyclic aromatic hydrocarbon(s)
PER	Public Environmental Review
PM_{10}	Particulate matter with effective aerodynamic diameter of 10 micrometres
$PM_{2.5}$	Particulate matter with effective aerodynamic diameter of 2.5 micrometres
Proposal	The construction and operation of a Tyre Resource Recovery Facility.
Proposal site	Lot 60, 9 Fargo Way, Welshpool
TEQ	Toxic equivalent quotient (for dioxins)
TRRF	Tyre Resource Recovery Facility
TSSF	Tyre Storage and Shredding Facility
VOC(s)	Volatile organic compound(s)
WAPC	Western Australian Planning Commission

1. Introduction

Elan Energy Matrix Pty Ltd (Elan), the Proponent, is proposing to develop a Tyre Resource Recovery Facility (TRRF, the Proposal) within Lot 60, 9 Fargo Way, Welshpool, in the City of Canning (Figure 1). The Proposal involves processing of shredded EOL tyres using an indirect fired Thermal Conversion Unit (TCU) to produce char, steel wire, oil and process gas.

Elan proposes to transfer its existing tyre storage and shredding facility (TSSF) from Lot 106, 101 Dowd St, Welshpool, to the Proposal site. Elan has lodged an application for a works approval with the Department of Environment Regulation (DER) to transfer the TSSF to this Proposal site. The Proposal does not include the storage and shredding of EOL tyres.

1.1 Background

The Proposal was referred to the Environmental Protection Authority (EPA) on 7 July 2016 under s 38 of the EP Act, and the EPA determined that the Proposal required assessment at the level of Public Environmental Review (PER) with a four week public comment period. The PER process is summarised in Figure 2.

Under the *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2012* (the Administrative Procedures; GoWA 2012), the EPA prepared an Environmental Scoping Document (ESD) identifying the preliminary key environmental factors to be addressed in the PER and the work required to inform the assessment of the environmental impact of the Proposal. A draft ESD was issued to Elan on 4 October 2016 and the final ESD was issued on 9 November 2016 (Appendix 2).

Following the release of the ESD for the Proposal and the preparation of the draft PER, the EPA released a new suite of environmental impact assessment policy and guidance documents which replace the previous policy and guidance documents. The PER was prepared in accordance with the ESD and the EPA policy and guidance applicable at that time; however, consideration has been given to the EPA's new policy and guidance through revisions of this document.

1.2 Purpose of this document

The purpose of this document is to present an environmental review of the Proposal, including a detailed description of the key components, environmental impacts and proposed environmental management measures for the relevant environmental factors identified by the ESD.

This PER describes the specific studies and investigations conducted by the Proponent in relation to the preliminary key environmental factors identified in the ESD, as well as those identified through consultation and screening processes. The objectives of the reviews and additional studies and investigations are to:

- ensure that the full environmental effects of the Proposal are properly understood
- inform mitigation and optimal management controls
- enable a reliable and knowledge-based environmental impact assessment to be conducted.

1.3 Proposal location

The TRRF will be located within Lot 60, 9 Fargo Way, Welshpool, approximately 12 km south east of Perth CBD (Proposal site). The Proposal site is zoned 'Industry' under the Metropolitan Region Scheme (MRS) and 'General Industry' zone within the City of Canning Local Planning Scheme No. 40. The location of the Proposal site is shown in Figure 1 and spatial data is provided in the attached CD.

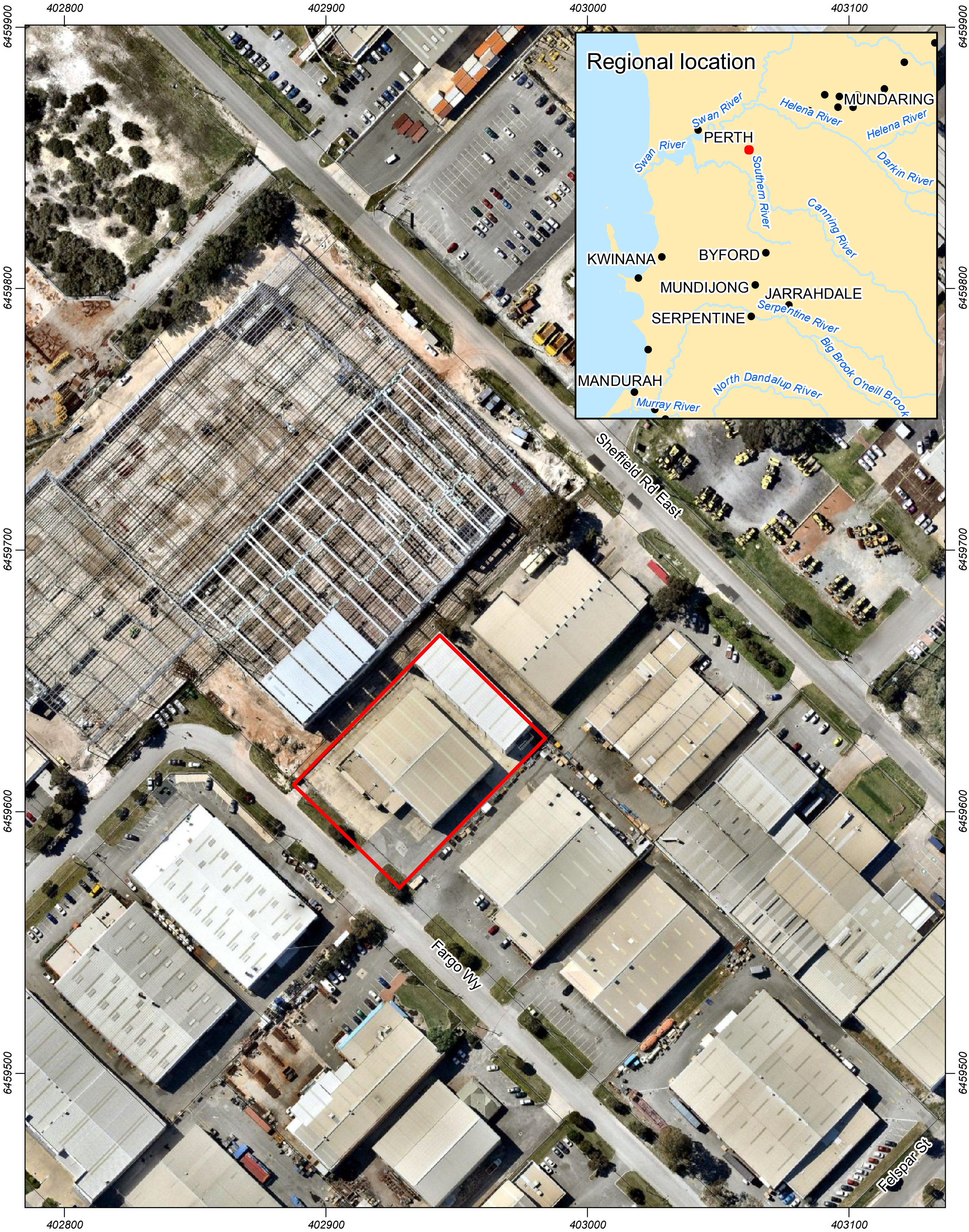

Figure 1: Proposal site – Lot 60, 9 Fargo Way, Welshpool.

Scale 1:2,000 at A4

0 10 20 30 40 50 m

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 24/11/2016
Author: JCrute
Source: Aerial image: Nearmaps: October 2016. Existing cadastre: SLIP, Landgate 2016.

Legend

- Lot 60 boundary
- Existing cadastre

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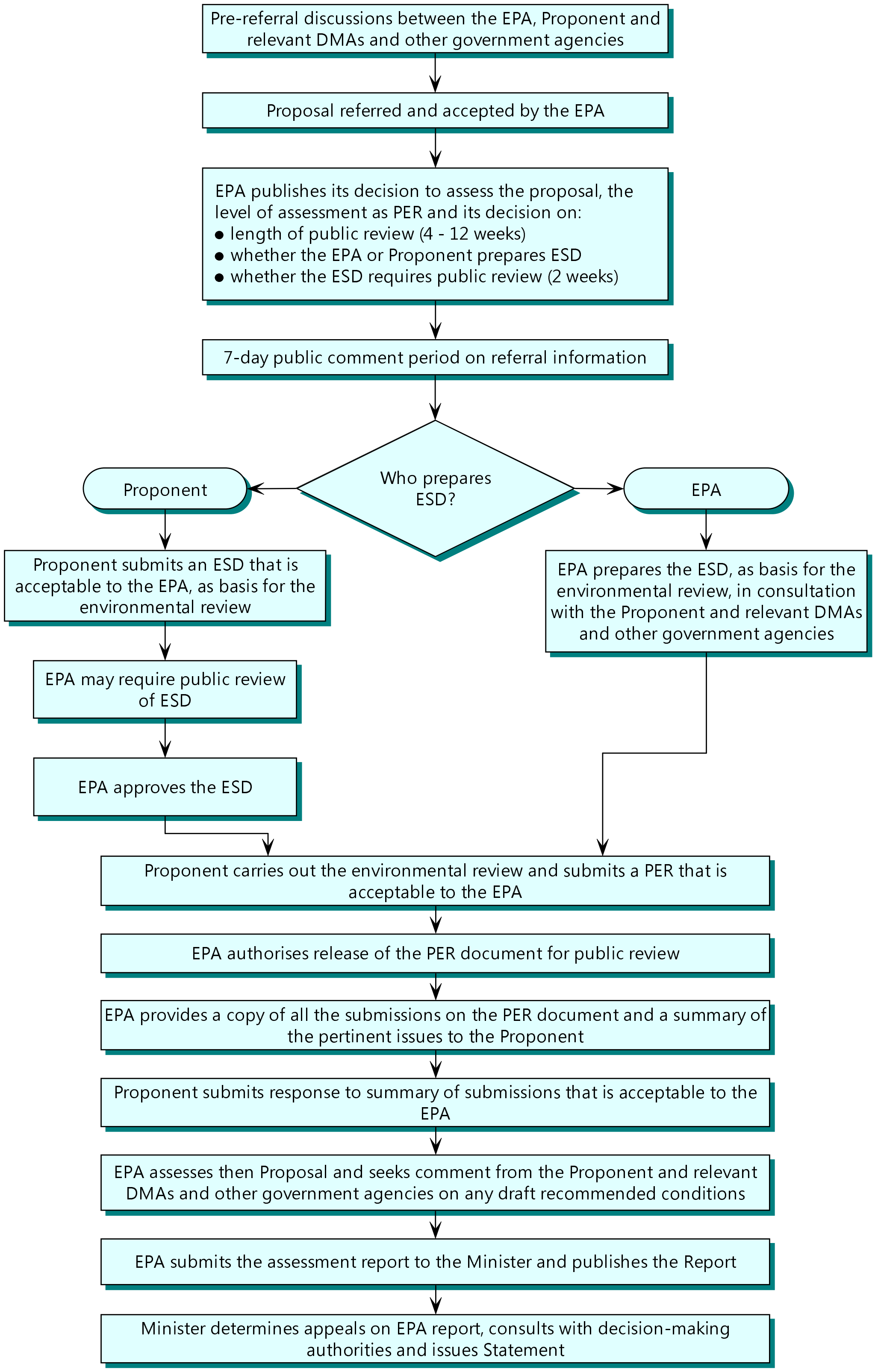

Figure 2: Public Environmental Review procedure

1.4 Document structure

In accordance with the requirements of the Administrative Procedures, this document contains the following information:

1. A description of the Proposal and alternatives considered, including alternative locations with a view to minimising environmental impacts (Section 2).
2. Details of stakeholder consultation (Section 3).
3. A description of the environmental studies and survey effort undertaken (Section 4).
4. A description of the receiving environment likely to be adversely affected by the Proposal, its conservation values, and key ecosystem processes as well as discussion of their significance in a regional setting (Section 5). Section 5 also presents the regional environmental and social setting.
5. Discussion and analysis of the direct and indirect impacts of the Proposal, in both a local and regional context. Section 6 provides an assessment of the impacts of the Proposal with respect to the key environmental factor. For other relevant factors refer to Section 7.
6. Identification of offsets (where appropriate) after all other steps in the mitigation sequence have been exhausted (Section 6.4).
7. Management measures to mitigate significant adverse impacts are presented in Sections 6 and summarised in Section 8.
8. Demonstration that the Proposal conforms to relevant environmental policies, guidelines, standards and procedures (Section 6 to Section 7).
9. A glossary of acronyms and short titles is presented following the table of contents, and a list of references is provided in Section 9.
10. Spatial datasets, information products and databases, provided as appendices.

1.5 Proponent details

Elan, the Proponent, is a Western Australian-owned and operated full-service end of life (EOL) tyre disposal company (ABN: 88 611 714 580, ACN: 611 714 580).

Tyre Recyclers WA is a division of Elan and it has been operating a EOL tyre shredding facility from its current site in Lot 106, 101 Dowd St, Welshpool since 2012 under *Environmental Protection Act 1986* (EP Act) Licence L8682/2012/1.

Information on the Proponent is detailed in Table 1.

Table 1: Details of the Proponent

Proponent information	
Name of the Proponent	**Elan Energy Matrix Pty Ltd**
Joint Venture parties (if applicable)	NA
Australian Company Number(s)	611 714 580
Postal Address	Elan Energy Management Pty Ltd PO Box 254 WELSHPOOL WA 6986
Key Proponent contact for the Proposal	**Ian Bellinge** Managing Director Ph:+61 8 6230 220 Ian.Bellinge@elanem.com.au
Consultant for the Proposal	**Strategen Environmental** Level 1, 50 Subiaco Square Road SUBIACO WA 6008 Ph: 9380 4608

1.6 Assessment approach

Implementation of the Proposal will require compliance with Australian legislation and regulations as listed in Section 1.6.1. Further to these statutory requirements, a range of other guidelines, standards and policies are also relevant to the Proposal. The generic standards, policies and guidelines are listed in Section 1.6.2.

1.6.1 Key environmental Western Australian legislation

Key Western Australian legislation relevant to the Proposal includes:

- *Environmental Protection Act 1968* (EP Act)
- Environmental Protection (Controlled Waste) Regulations 2004
- Environmental Protection (Noise) Regulations 1997
- Environmental Protection (Unauthorised Discharges) Regulations 2004
- *Health Act 1911.*

1.6.2 Federal and State environmental standards, guidelines and policies

Assessment of the environmental impacts of the Proposal is based on various Western Australian Position Statements and Guidance Statements. Standards, guidelines and policies related to specific environmental factors or individual aspects of the Proposal are listed and discussed in the individual sections relevant to the environmental factor being addressed.

Following the release of the ESD for the Proposal and the preparation of the draft PER, the EPA released a new suite of environmental impact assessment policy and guidance documents which replace the previous policy and guidance documents. The PER was prepared in accordance with the ESD and the following EPA policy and guidance applicable at that time:

Environmental Assessment guidelines:

- Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2012
- Environmental Assessment Guidelines No. 1 (EAG1): *Environmental Assessment Guideline for Defining the Key Characteristics of a proposal Environmental Protection Act 1986* (EPA 2012)
- Environmental Assessment Guidelines No. 6 (Revised, EAG6): *Timelines for Environmental Impact Assessment of Proposals* (EPA 2013a)
- Environmental Assessment Guidelines No. 8 (Revised, EAG8): *Environmental Assessment Guideline for Environmental principles, factors and objectives* (EPA 2015a)
- Environmental Assessment Guidelines No. 9 (revised EAG9): *Environmental Assessment Guideline for Application of a significance framework in the environmental impact assessment process* (EPA 2015b)
- Environmental Assessment Guideline No. 16: *Referral of a proposal under s38 of the Environmental Protection Act 1986* (EPA 2015b).

EPA guidelines and position statements:

- EPA PER guidelines - *Guidelines for Preparing a Public Environmental Review* (EPA 2015c)
- EPA Guidance Statement No. 55: Implementing Best Practice in proposals Submitted to the Environmental Impact Assessment Process, Perth, Western Australia (EPA 2003)
- State Guidance Statement No. 3 Separation Distances between Industrial and Sensitive Land Uses (EPA 2005b)
- Advice of the Environmental Protection Authority to the Minister for the Environment under Section 16(e) of the Environmental Protection Act 1986, Environmental and health performance of waste to energy technologies (Report 1468) (EPA 2013b).

Through subsequent revisions of the PER, consideration was given to the application of the updated EPA policy and guidance, specifically:

- Procedures Manual (and Instructions) (EPA 2016a)
- Statement of Environmental Principles, Factors and Objectives (EPA 2016b)
- Factor Guideline - Air Quality (EPA 2016c).

Other guidance:

- Civil Air Safety Authority guidelines
- Department of Environment (2006), Air Quality Modelling Guidance Notes, Perth, Western Australia
- National Environment Protection Measures (NEPM) standards and goals
- World Health Organisation (WHO) Air Quality and Health guidelines
- Department of Health (DoH) and Department of Environment Regulation (DER), Relevant policy and air quality guidelines.

1.6.3 Australian Government environmental impact assessment process

While the states and territories have responsibility for environmental matters at a state and local level, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) aims to focus the Australian Government interests on protecting Matters of National Environmental Significance (MNES). The EPBC Act requires an assessment as to whether a proposed action is likely to have a significant effect on a MNES.

The Proposal is located within an already cleared area and does not involve an action that would impact on MNES under the EPBC Act.

1.6.4 Other approvals

Environmental Protection Act 1986 (Part IV)

The TRRF is likely to be “prescribed” under Schedule 1 of the Environmental Protection Regulations 1987. The Proposal will require a prescribed premises works approval and licence under Part V of the EP Act. Part V of the EP Act is administered by Department of Environment Regulation (DER).

Planning

The Proposal site is zoned Industry under the Metropolitan Region Scheme and ‘General Industry’ zone within the City of Canning Local Planning Scheme No. 40 and no change to this current zoning is required. The Proponent will be required to submit a Development Application to the City of Canning for approval.

2. Description and key characteristics

2.1 Proposal overview

Elan is looking to expand its tyre management operations by incorporating a TRRF to recover valuable resources from EOL tyres. The Proposal involves processing of shredded EOL tyres using an indirect heated Thermal Conversion Unit (TCU) to produce char, steel wire and oil for sale to Australian and/or international markets. Shredded tyres will be sourced from the Proponent's existing Tyre Storage and Shredding operations, which will be relocated to the Proposal site (refer to Section 2.5).

The residual process gas stream remaining after recovery of oil, which contains predominately hydrogen, carbon monoxide and methane, will be combusted in a high efficiency thermal oxidiser. Heat recovery will be installed on the combustion gas exhaust duct from the TCU to preheat combustion incoming combustion air for the TCU operation. Exhaust gases from the process will be discharged to atmosphere via a 15 m tall stack.

The Proposal is anticipated to commence late 2017, following receipt of all necessary approvals and operate for a period of approximately 20-30 years.

2.2 Land tenure and ownership

Table 2 presents the legal description of the lot subject to the Proposal.

Table 2: Tyre Resource Recovery Facility land tenure

Lot number	Plan number	Registered Landowner
60	13025	Farway Holdings Pty

2.3 Existing facilities

The premises was previously utilised for furniture storage and wholesaling business and contains paved and hard panned lots. An existing warehouse occupies approximately 52% (0.23 ha) of the Proposal site.

2.4 Key Proposal characteristics

A summary of the key Proposal characteristics is provided in Table 3.

Table 3: Key Proposal characteristics

Summary of the Proposal		
Proposal Title	Tyre Resource Recovery Facility.	
Proponent name	Elan Energy Matrix Pty Ltd.	
Short description	The proposal is to construct and operate a Tyre Resource Recovery Facility at Lot 60, 9 Fargo Way Welshpool, approximately 12 kilometres southeast of Perth in the City of Canning. The proposal includes processing of shredded tyres using a thermal conversion unit to produce char, steel wire, oil and gas.	
Physical elements		
Element	**Location**	**Extent**
Tyre Resource Recovery Facility	Lot 60, 9 Fargo Way, Welshpool (Figure 1).	Construction on 0.45 hectares cleared land within existing buildings.
Operational elements		
Element	**Location**	**Extent**
EOL tyres processed	Lot 60, 9 Fargo Way, Welshpool (Figure 1).	Up to 60 tonnes per day[1].

[1] The shredder has a capacity of 900 tyres per hour as equivalent passenger units (EPUs) and will be operated about 8 hours per day. This equates to about 60 tonnes per day of shredded tyres that will be processed within the TRRF.

2.5 Exclusion

Elan proposes to transfer its existing tyre storage and shredding facility (TSSF) from Lot 106, 101 Dowd St, Welshpool to the Proposal site. Elan has been operating at 101 Dowd Street since 2012 under *Environmental Protection Act 1986* (EP Act) Licence L8682/2012/1. The TSSF is a “prescribed premises” under Schedule 1 of the Environmental Protection Regulations 1987 as:

- **Category 57** – used tyre storage (general): premises (other than premises within category 56 on which used tyres are stored)
- **Category 61A** – solid waste facility: premises (other than premises on which solid waste produced on other premises is stored, reprocessed, treated, or discharged onto land.

Elan’s current activities involve collection, temporary storage and shredding of used tyres. Shredded tyres are then stockpiled into sea containers ready for transport via trucks to port. The TSSF will be managed generally in accordance with the current operations. Elan has submitted an application for a works approval to transfer the TSSF at Lot 106, 101 Dowd St, Welshpool, to the new premises at Lot 60, 9 Fargo Way, Welshpool, under Part V of the EP Act.

The transfer of Elan’s existing TSSF from Lot 106, 101 Dowd St, Welshpool to Lot 60, 9 Fargo Way, Welshpool does not form part of the Proposal and is being assessed as part of a separate approvals process under Part V of the EP Act.

2.6 Benefits of the Proposal

While some re-use and recycling options exist in Western Australia for EOL tyres, these options are not sufficient to manage the volume of EOL tyres generated per year. Any EOL tyres that are not being re-used or managed by existing tyre recyclers are currently either being stored in dedicated tyre storage facilities, disposed of in approved landfills or illegally dumped.

Tyres are approximately 60% hydrocarbon, and have a higher calorific value than fuel sources such as wood, coke and brown coal. The need for alternative uses for EOL tyres has long been recognised along with the need to both preserve valuable resources and to prevent environmental damage due to improper disposal.

The key benefits of the Proposal include the diversion of EOL tyres from landfill and the recovery, reprocessing and re-use of valuable resources. It is anticipated that the Proposal would have significant environmental and economic benefits. The Proposal, providing for the recovery and reuse of valuable EOL tyre resources, is consistent with the objectives of the Western Australia Waste Authority waste hierarchy (Figure 3).[1]

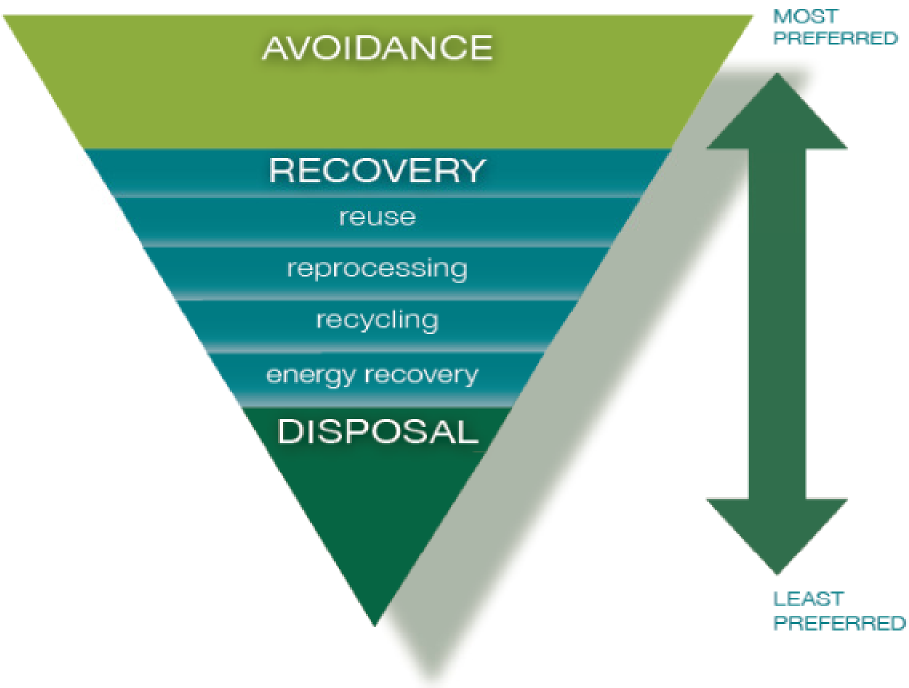

Figure 3: Waste Hierarchy

2.7 Schedule

It is anticipated the Proposal will commence operation in 2018 following completion of all environmental and planning approval requirements.

2.8 Consequences of not proceeding

Waste minimisation is a priority for both State and Australian Governments. The Proposal provides a superior alternative to and will assist in reducing the ongoing storage, disposal or illegal dumping of EOL tyres.

The resource recovery benefits outlined in Section 2.6 would also not be realised if the Proposal does not proceed.

2.9 Alternatives considered

Alternatives approaches for recovery of resources from EOL tyres which were considered in development of the Proposal are detailed in Table 4.

[1] See *http://www.wasteauthority.wa.gov.au/media/files/documents/Waste_Hierarchy_2013.pdf*.

Table 4: Alternative approaches for recovery of resources from EOL tyres

Alternatives	Details	Discussion
Recovery of tyre crumb	EOL tyre resources can be recovered as crumb for re-use in various applications.	Recovery of crumb requires specialised equipment which has high operating costs. Crumb is a relatively low value resource recovered, with limited applications and relatively low flexibility in the markets. Recovery of oil, wire and char from the Proposal provides three products for a much larger range of re-use applications, with greater commercial and environmental benefit.
Site location	A number of sites were considered, in the Hazelmere and Welshpool industrial areas.	A Hazelmere site was not favoured based on experience from EMRC Wood Waste to Energy Proposal. Two sites in Welshpool were considered appropriate from consideration of planning, zoning, environmental, transport, infrastructure and business factors.
Technology	Thermal treatment is required to recovery primary resources (oil, carbon and wire) from EOL tyres. Various commercially available thermal processing technologies were evaluated. Key features were operability, compliance with Australian engineering codes, environmental controls, timelines for supply of equipment, local support, environmental performance and cost.	US technologies were considered problematic due to blockages from wire, local representatives were not technically strong and local support would be problematic. An alternative Australian technology has been developed at demonstration plant scale but has failed to be commercialised, the provider company was not adequately capitalised and IP issues precluded use for the Proposal. The selected thermal processing technology is locally sourced, well proven at commercial scale for other applications and efficacy for EOL tyre resource recovery could be demonstrated at the technology provider's test plant facility. Also, the technology is currently being installed for the EMRC WWTE project at similar scale, providing confidence in the suitability for the Proposal.

Overall, the selected technology provides for recovery of resources with greater value in a range of markets, and the selected site is expected to satisfy environmental and regulatory requirements.

2.10 Description of Proposal

2.10.1 Proposal construction

The construction of the TRRF will include the following tasks:

- engineering design and process HAZOP
- acquisition of "off-the-shelf" components and equipment such as pumps, fans, burners, conveyors, cooler, control systems, char processing and bagging systems, etc.
- fabrication of the feed system, TCU, char handling system, oil recovery (condenser) system, thermal oxidiser, stack, etc.
- site civil works include installation of services as required
- transport of components, equipment and process modules to the Proposal site
- installation and assembly of infrastructure and equipment inside the existing building at the Proposal site
- connection of electrical and other utilities
- mechanical and electrical commissioning
- engineering and related inspections and permitting
- full plant commissioning and hand-over.

It is anticipated that those tasks would take 4-6 months to complete, depending on lead time for components sourced from overseas. The fabrication work is proposed to be carried out in Western Australia by a well-established engineering fabrication company that produces thermal processing equipment for the minerals processing and waste management sectors.

2.10.2 Inputs and outputs

A process flow chart for the TRRF is presented in Figure 4.

Inputs to the process include:

- shredded EOL tyres
- natural gas
- combustion air
- make-up water (for cooling tower).

Outputs (resource recovery) from the process will comprise:

- char
- wire
- oil.

Outputs (wastes/emissions) will comprise:

- exhaust gases to atmosphere from combustion of natural gas and residual process gas
- cooling tower blow-down (wastewater).

The flow chart shows the process for recovery and export of wire, oil and pelletised char from the processing of EOL tyres. The cooling water circuit is not shown in the flow chart.

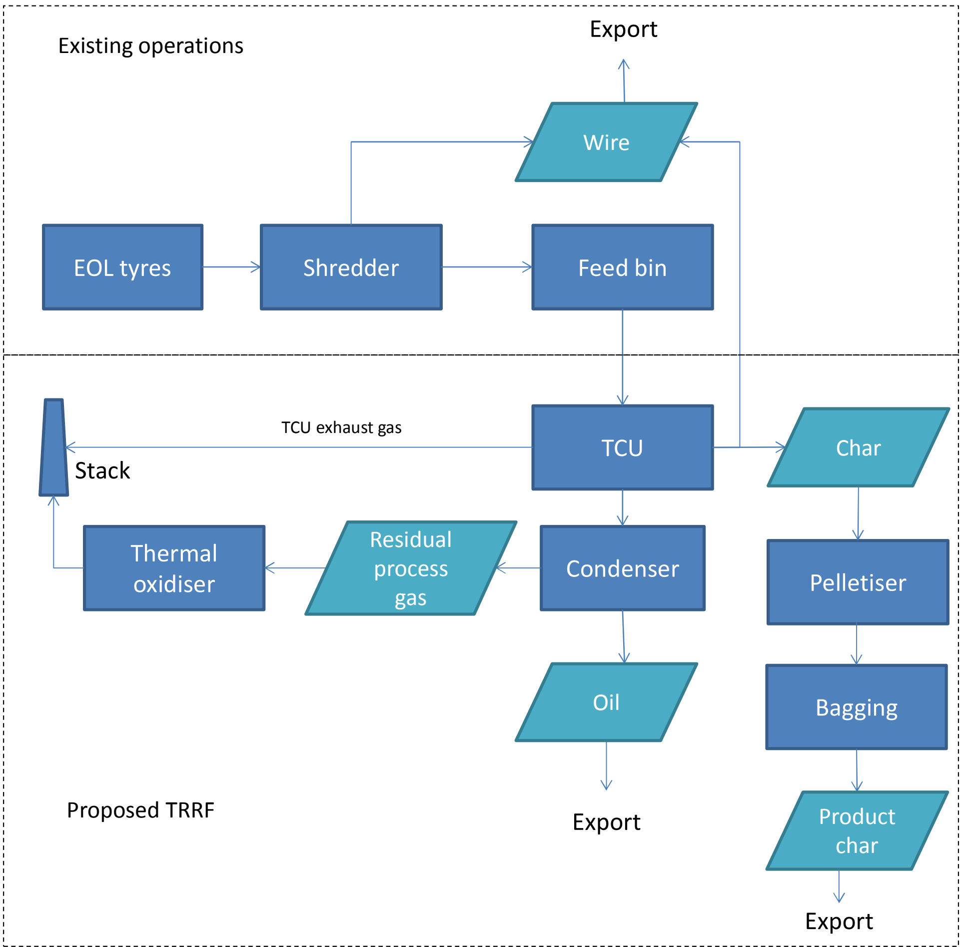

Figure 4: Process flow chart

2.10.3 Feed system

Shredded EOL tyre of nominal 70-80 mm size is conveyed from the shred feed bin to the TCU via a series of valves and a feed screw, to prevent ingress of air into the TCU. The feed rate is controlled by the screw rotation speed which is continually monitored and adjusted to accommodate variability in shed size. A target feed rate of 60 t/day is proposed for the TRRF.

The typical composition of EOL tyre material is shown in Table 5. This is based on combination of passenger car, trucks and OTR tyres ('off the road' – heavy machinery tyres) typically observed in an EOL tyre stream.

Table 5: Typical composition of shredded EOL tyre

Component	Composition
Rubber	46%
Fibre (polyester)	6%
Wire	17%
Carbon black	22%
Zinc oxide	2%
Total carbon	72%
Total sulfur	1%

2.10.4 Thermal Conversion Unit

The TCU comprises an indirect fired heat tube which is enclosed in a refractory lined combustion chamber with heat energy supplied from natural gas fired, low NOx burners. The shredded EOL tyre material within the heat tube undergoes thermal decomposition in the absence of oxygen at approximately 550 to 650˚C to generate process gas, char and wire. The process gas separates from the char and wire in the heat tube discharge chamber for downstream processing. Table 6 outlines the TCU specifications.

Table 6: TCU specifications

Aspect	Specification
Feed rate (normal operation)	Nominal 2500 kg/h (60 t/d)
Heat tube operating temperature range	550-750 ˚C
Maximum heat tube temperature	900 ˚C
Process gas production rate	Approximately 1320 kg/h
Char production rate	Approximately 810 kg/h
Wire recovery rate	Approximately 370 kg/h

The TCU will be operated to maximise recovery of oil and char, with minimal residual process gas generated after oil recovery.

2.10.5 Oil recovery

The process gas from the discharge chamber is passed into a condenser and cooled to recover liquid hydrocarbons as an oil fraction, leaving behind a residual process gas fraction comprised of predominately hydrogen, carbon monoxide, methane and other light hydrocarbons; which separate from the oil. The condenser will produce approximately 1110 kg/h of oil, leaving a residual gas stream of approximately 215 kg/h.

A 100 000 litre oil storage tank is to be installed in a bunded area to hold up to one week of oil production from the TRRF. It is anticipated that oil would be exported from the TRRF via road tanker every 1-2 days.

2.10.6 Char and wire recovery

The char and wire which exit the TCU at high temperature is discharged to a sealed cooling conveyor that transports and air-cools the solids prior to separation of the steel wire. The wire is recovered via a magnetic separator and combined with wire recovered from the shredding process for sale to scrap metal merchants. Water sprays may also be used to assist the cooling process. The char is conveyed to a pelletiser to increase the particle size to customer specifications, then packed into bags for export. Conveyors and char handling systems will be fully enclosed to minimise fugitive dust emissions within the building.

2.10.7 Thermal oxidiser

Residual process gas is directed to a thermal oxidiser for safe destruction of flammable gases. Staged air flow is used to encourage turbulence within the unit to maximise both mixing and temperature and essentially achieve complete combustion of the gases. Exhaust from the thermal oxidiser is delivered to the exhaust stack to combine with exhaust gases from the TCU combustion chamber. Thermal oxidiser specifications are outlined in Table 7.

Table 7: Thermal oxidiser specifications

Aspect	Specification
Fuel (pilot burner)	Natural gas
Residual process gas flow	215 kg/h
Maximum process gas flow	Nominal 1350 kg/h
Gas residence time	2 seconds
Combustion temperature	850˚C
Exhaust gas temperature from stack	400˚C

The maximum process gas flow specification shown in Table 7 is based on a loss of cooling efficiency in the condenser, which means all process gas formed in the TCU would report to the thermal oxidiser. Under those conditions, the tyre shred feed and the TCU burners would be shut down to stop the thermal conversion processes and production of process gas. The fault with the condenser would be rectified and before plant operations are restored. This provides a safe route for disposal (high efficiency flaring) of the process gas in the event of loss of cooling efficiency in the condenser.

2.10.8 Main stack

Exhaust gases from the TCU combustion chamber and thermal oxidiser will be combined and discharged to atmosphere through a 15 m tall stack. Details of the stack emissions are presented in Section 6.

2.10.9 Char export

The char produced from thermal decomposition of EOL tyres contains carbon black (from tyre manufacturing) and char from decomposition of rubber and fibres in the tyres. The markets identified for the char require a particle size of nominal 1-4 mm. Therefore, the char will be pelletised before bagging and shipment to markets.

2.10.10 Utilities and plant services

The plant will require:

- water (mains)
- natural gas (mains)
- electrical power (mains and backup generator)
- cooling water (from a cooling tower)
- plant air compressors.

Plant services equipment required include:

- building ventilation system
- fire water supply
- control room
- maintenance workshop
- office equipment and support facilities
- wastewater consolidation and export.

The TRRF plant will be located within a warehouse building at the rear of the Proposal site (Figure 1). The char handling equipment will be fully enclosed to manage risks of fugitive emissions. Exhaust air from the building ventilation systems will be filtered in a baghouse before discharge from the building to remove any fugitive dust that may be present.

2.10.11 Pollution control equipment

The pollution control equipment incorporated into the Proposal design is outlined below. Consideration of pollution control equipment has been informed by the outcomes of the air emissions assessment outlined in Section 6.

<u>Low NOx burners</u>

Low-NOx burners will be installed in the TCU combustion chamber and thermal oxidiser to minimise NOx emissions.

<u>Condenser</u>

Aside from recovery of oil, the condenser also removes the majority of organosulfides from the process gas, which reduces the level of sulfur reporting to the thermal oxidiser for combustion to generate SO_2.

<u>Thermal oxidiser</u>

Excess process gas will report to the thermal oxidiser for high efficiency combustion before discharge of combustion products to the atmosphere via the main stack.

<u>Stack</u>

Gaseous emissions from both TCU and thermal oxidiser will report to the single 15 m tall emission stack for discharge to atmosphere. The gas temperature will be in the order of 400 °C (depending on the extent of heat recovery) which will assist to ensure efficient dispersion of exhaust gases.

2.10.12 Technology providers

The plant will utilise proven technologies from well-established suppliers. The TCU, feed system, char handling and pelletising, oil recovery system and thermal oxidiser will be designed and fabrications by a Western Australian engineering firm with a demonstrated record of experience in provision of thermal processing equipment.

3. Stakeholder consultation

A comprehensive Stakeholder Engagement Strategy was developed to identify and inform stakeholders in relation to the Proposal. Targeted consultation was initiated in October 2015 to inform stakeholders on details of the Proposal and to enable stakeholder concerns and comments to be considered in the development of the Proposal. Consultation has engaged the local members of parliament, local government (on behalf of the local community), State Government and nearby industrial businesses. A summary of the consultation program for the Proposal is presented in Table 8 below.

Table 8: Consultation summary

Stakeholder/date of consultation	Consultation	Purpose / key discussion Response to issues
EPA/ Office of EPA (OEPA)	Meeting on 12 November 2015	Initial engagement to provide an overview of the Proposal and gain an understanding of the regulatory processes. Elan will need to: • provide process flow diagram • demonstrate 'proven' technology • identify waste products and emissions data • consider zoning and buffers in siting decision.
	Meeting on 8 June 2016	An overview of the Proposal including: location, process flow, environmental investigations and assessment. Key matters to be addressed/considered: • EPA Report 1468 on waste to energy • separation distance guidance • consultation with DER and other stakeholders.
Department of Environment Regulation (DER)	Meeting on 21 October 2015	Initial engagement to provide an overview of the Proposal and gain an understanding of the regulatory processes.
	Meeting on 14 June 2016	An overview of the Proposal including: location, process flow, environmental investigations and assessment.
Office of the Minister for Environment (Hon Albert Jacob MLA)	Meeting on 10 December 2015	Initial engagement to provide an overview of the Proposal.
	Meeting on 17 May 2016	Additional information and detail on the location of the Proposal process design and key environmental outcomes.
Member for Belmont Local government – City of Belmont	Meeting on 15 December 2015	Initial engagement to provide an overview of the Proposal.
	Meeting 1 June 2016	Follow-up meeting to update and provide further information on the Proposal.
Shadow Environment Minister	Meeting on 22 December 2015	Initial engagement to provide an overview of the Proposal.
	Meeting on 23 May 2016	An overview of the Proposal including: location, process flow, environmental investigations and assessment.
Department of Planning	Correspondence on 12 May 2016	Response received from DoP on 30 May 2016. Advised that matter will be dealt with by City of Canning.
Shadow Minister for Planning	Meeting on 21 January 2016	Initial engagement to provide an overview of the Proposal.
Member for East Metropolitan Region	Meeting on 18 March 2016	Initial engagement to provide an overview of the Proposal.
	Correspondence sent on 30 June 2016	Follow-up correspondence to update and provide further information on the Proposal.
Minister for Health / Department of Health	Correspondence sent on 12 May 2016	Initial engagement to provide an overview of the Proposal. DoH response received 20 May 2016. DoH assists DER in assessment of proposed technologies that may impact on public health.

Stakeholder/date of consultation	Consultation	Purpose / key discussion Response to issues
Civil Aviation Safety Authority (CASA)	Correspondence sent on 12 May 2016	Overview of the Proposal provided. No response received to date.
Perth Airport	Correspondence sent on 12 May 2016	Overview of the Proposal provided. No response received to date.
Kewdale Freight Terminal	Correspondence sent on 12 May 2016	Overview of the Proposal provided. No response received to date.
Councillors, City of Canning	Meeting on 13 June 2016	Overview of the Proposal provided. Positive feedback and response to initiative.
	Correspondence to all councillors July 2016	Overview of the Proposal provided.
City of Canning, Planning and Development Manager	Meeting on 14 June 2016	Overview of the Proposal provided. Identification of any local groups (e.g. ratepayer associations) that should be consulted.
EPA / OEPA	Meeting on 28 September 2016	Meeting to discuss outcome on level of assessment for the Proposal, indicative timing and process.
OEPA	Meeting on 12 October 2016	Discussion on the draft ESD prepared for the Proposal. Clarification on the work required relating to the air emissions assessment.
Alliance for a Clean Environment (ACE)	Correspondence dated 28 November 2016	Invitation to attend an overview and information session on the Proposal
	Meeting 20 December 2016	Presentation provided to ACE representatives. Key discussion points included: • test plant data and sampling parameters • dioxin monitoring - undertaken and proposed • baseline ambient air quality data (cumulative impact with existing emissions sources) • availability of monitoring data reports.

Elan will continue to consult with specific agencies and other stakeholders throughout the assessment and implementation of the Proposal.

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4. Environmental studies and investigations

Details of environmental studies and /or investigations undertaken and specifically relevant to the Proposal and this PER are provided in Table 9. Copies of reports from those studies are provided in Appendix 2.

Table 9: Summary of environmental studies and surveys

Factor	Consultant	Survey/investigations name	Study area, type and timing	Study standard/guidance
Air quality and Atmospheric Gases	Strategen	*Process Mass Balance*	The study area involved construction of a process mass balance to determine type and amount of air emissions from the Proposal. The inputs to the process are well described in the literature, in particular precursor chemicals to air emissions, and the chemical and physical processes within the TRRF technology are well understood. The mass balance also facilitates a sensitivity analysis to address impact of variability in inputs from processing of different types of EOL tyres.	Standard mass balance principles (conservation of mass and energy) were followed, with inputs and outputs described for all relevant parameters, and chemical and physical processes captured in the balance. The predicted emissions rates for some parameters were verified against test plant data. Strategen has conducted mass balances for other thermal processes which have underpinned air emissions studies supporting environmental approvals for other projects.
	SigmaTheta	*Air Quality Assessment*	A study area included the single point source emissions stack within the Proposal site. The study type involved dispersion modelling to predict ground level concentrations of pollutants from the emissions stack for comparison with air quality standards. Final report (V2) issued 28 November 2016.	Department of Environment (2006). Department of Environmental Protection (2015).
Amenity – generation of noise	Lloyd George Acoustics	*Environmental Noise Assessment*	The study area was the Proposal site. The study type involved modelling of noise emissions to predict noise levels at noise sensitive receptors and boundaries of the Proposal site. Final report issued 30 August 2016.	Environmental Protection (Noise) Regulations 1997.

5. Existing environment

5.1 Physical environment

5.1.1 Climate

The Welshpool locality experiences a Mediterranean climate characterised by mild, wet winters and warm to hot, dry summers. Highest temperatures occur between December and March, with average monthly maximums ranging from 30.4°C in December to 33.2°C in January (BoM 2016). Average annual rainfall recorded at Welshpool since 1961 is 820.3 mm (BoM 2016). Rainfall may occur at any time of year; however, most occurs in winter in association with cold fronts from the southwest. Lowest temperatures occur between June and September, with average monthly minimums ranging from 8.7°C in July to 10.2°C in September (BoM 2016). Prevailing winds are from the east during the mornings and from the west southwest during the afternoons and evenings.

5.1.2 Geology and soils

Soils are listed as Bassendean Sands; quartz sand (dunes) over Guildford Formation. There is no risk of acid sulphate soils occurring in the area (JDSi 2013).

5.1.3 Surface water

There are no surface water bodies within a 500 m radius of the Proposal site. A sumpland Multiple Use Wetland (UFI 9044) occurs 250 m east of the Proposal site and is not listed as Bush Forever or as containing species of conservation significance. These features will not be impacted by the TRRF.

Two Conservation Category Wetland (UFI 9042, 9046) occur approximately 500 m of the Proposal site. These surrounding wetlands will not be impacted by the operation of the TRRF.

5.1.4 Groundwater

Groundwater is expected to occur beneath the Proposal site at 5.5 metres below ground level (mBGL) with the base of the aquifer expected to occur at 20.5 mBGL.

Groundwater flow is inferred in a south-westerly to southerly direction from the premises. The Proposal site not lie or sit adjacent to a Public Drinking Water Source Area.

5.1.5 Biological

The Proposal site situated in a general industrial area which contains paved and hard panned lots. The Proposal site does not contain any vegetation and flora or fauna values.

The environment surrounding the premises is largely cleared with remnant patches of native vegetation and exotic grasses amongst the industrial development.

5.2 Social environment

5.2.1 Surrounding land use

The surrounding land uses in the area comprises of larger and smaller industrial warehouses, factories, workshops and offices. Among others, the area supports transport business and equipment storage facilities.

A review of surrounding industrial premises has shown existing facilities to be all low emissions generating activities. The majority of facilities are logistics, transport, manufacturing, scrap metal recycling and mining equipment businesses. Some fugitive dust emissions are generated from scrap metal and materials handling businesses. The Suez Medical Waste Solutions incinerator is located approximately 750 m from the Proposal site. The emissions from that facility are managed under a DER operating licence.

The Proposal site is located in close proximity to major transport routes such as Roe Highway, Welshpool Rd and Orrong Rd.

The issue of cumulative emissions impacts from combination of Proposal emissions and emissions from existing industrial emissions sources in proximity to the Proposal site has been considered in the air quality assessment.

5.2.2 Sensitive receptors

Residential premises are located approximately 600 m and 800 m to the south and east of the Proposal site within Wattle Grove and East Cannington, respectively.

Two Bush Forever Areas (BFA) occur within the vicinity of the Proposal site. The nearest, BFA 282: Tomah Road Bushland, Wattle Grove, is located 640 m to the east and the other, BFA 50: Welshpool Road Bushland, Wattle Grove, is located 800 m to the south west.

6. Air quality and atmospheric gases

6.1 Relevant environmental objective, legislation, policies and guidelines

The ESD outlines the work required for the environmental impact assessment of key environmental factors. Table 10 outlines the requirements for air quality and atmospheric gases and the relevant sections within the PER where the requirements are addressed.

Table 10: ESD requirements for air quality and atmospheric gases

EPA objective	To maintain air quality for the protection of the environment and human health and amenity, and to minimise the emissions of greenhouse and other atmospheric gases through the application of best practice	
Relevant aspects	Thermal processing of used tyres using an indirect fire Thermal Conversion Unit.	Relevant PER Section
Potential impacts and risks	The proposal may have the following effects: Emissions generated may impact residential areas and neighbouring industrial premises. Emissions include nitrogen oxides, sulphur dioxide, carbon monoxide, particulates (TSP, PM_{10} and $PM_{2.5}$), acid gases, metals, dioxins, volatile organic compounds.	6.3
Required work	1. Identify all atmospheric emissions from all potential points of discharge.	6.3
	2. Establish and predict the background pollutant levels to be used in cumulative modelling for particulates (PM_{10} and $PM_{2.5}$) oxides of nitrogen and sulphur dioxide, carbon monoxide, acid gases, volatile organic compounds, metals, zinc oxide, dioxins and furans at residential areas and neighbouring industrial premises, including the impacts of existing and proposed facilities. Where reliance is placed on historical data, modelling should contain a high degree of conservatism and interannual variation of historical data should be taken into account.	6.5.6
	3. Detail the expected emissions of particulates (PM_{10} and $PM_{2.5}$), oxides of nitrogen and sulphur dioxide, carbon monoxide, acid gases, organic compounds, metals, zinc oxide (nanoparticles), dioxins and furans under normal operation, worst case conditions and during commissioning. Describe how the expected emissions were predicted.	6.5.1; 6.5.2; 6.5.3; 6.5.4.
	4. Model the ground level concentrations of particulates (PM_{10} and $PM_{2.5}$), oxides of nitrogen and sulphur dioxide, carbon monoxide, metals, acid gases, organic compounds, dioxins and furans from the proposal in isolation and cumulatively using the background pollutant levels established in work item 2 at residential and neighbouring premises, taking into account any potential local industrial point sources, under normal operation, worst case conditions and during commissioning, as necessary.	6.5.7
	5. Compare predicted emissions and ground level concentrations with appropriate standards.	6.5.7
	6. Describe proposed management, monitoring and validation of predictions for all air emissions.	6.6
	7. Outline the outcomes/objectives, management, monitoring, trigger and contingency actions to ensure impacts are not greater than predicted, and do not pose an unacceptable risk to the health and amenity of the public or the environment.	6.6
	8. An application of the mitigation hierarchy to the impacts from the proposal upon identified environmental values and an assessment of the residual impacts after the mitigation measures have been implemented.	6.4
	9. Discussion of residual impacts, including as appropriate, monitoring programmes to measure residual impacts, and management programmes to further mitigate these residual impacts and to deal with circumstances where outcomes fall short of intended objectives.	6.4
	10. Describe the potential for odour to occur and the proposed management.	6.3.2
	11. Describe how the chosen technology meets best practice, and detail its track record of reliable operation (at a similar scale) in treating waste tyres.	6.7
	12. Describe the extent to which the EPA Advice to the Minister for Environment on the Environmental and Health Performance of Waste to Energy Technologies is applicable to the pyrolysis component of this proposal.	6.8

EPA objective	To maintain air quality for the protection of the environment and human health and amenity, and to minimise the emissions of greenhouse and other atmospheric gases through the application of best practice	
Relevant policy	The following policies have been considered in this PER:	
	EPA Policies and Guidance	
	EPA and Waste Authority (2013), Section 16(e) advice on the Environmental and Health Performance of Waste to Energy Technologies (Report 1468), Perth Western Australia. (This document provides guidance on the EPA's expectations for proposals that utilise pyrolysis technology).	Section 6.8 describes the extent to which the EPA Advice to the Minister for Environment on the Environmental and Health Performance of Waste to Energy Technologies is applicable to the pyrolysis component of the Proposal.
	EPA (2003) Guidance Statement No. 55: Implementing Best Practice in proposals Submitted to the Environmental Impact Assessment Process, Perth, Western Australia.	Guidance Statement No. 55 has been considered in the process design stage of the Proposal.
	Other Policies and Guidance	
	Department of Environment (2006), Air Quality Modelling Guidance Notes, Perth, Western Australia.	Air Quality Modelling Guidance Notes were taken into consideration in the modelling of emissions from the Proposal.
	National Environment Protection Measures standards and goals.	National Environment Protection Measures standards and goals were taken into consideration in the comparison of predicted ground level concentrations with relevant standards and guidelines.
	World Health Organisation Air Quality and Health guidelines.	World Health Organisation Air Quality and Health guidelines have been considered in the comparison of predicted ground level concentrations with relevant standards and guidelines, including: • World Health Organisation (WHO) 2000, *Air quality guidelines for Europe*, Second edition • World Health Organisation (WHO) 2005, *WHO air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide* – Global update 2005.
	Department of Health and DER, Relevant policy and air quality guidelines.	Relevant DoH and DER, Relevant policy and air quality guidelines have been considered in the comparison of predicted ground level concentrations with relevant standards and guidelines, including: • Acid Gas Criteria, Internal document, Toxicology WA DoH • Esperance Ni annual guideline value, DoH • *Air Quality Modelling Guidance Notes,* Department of Environment (2006).

Note that the ESD has used the terms “used” and “waste” in referring to the tyres to be processed in the Proposal. The Proponent submits that “end of life” (EOL) tyres are not a waste in the context of this Proposal and in consideration of the Waste Hierarchy, in that the materials within the EOL tyres are resources and not wastes. The Proponent has used the term end of life which accurately described the status of the tyres to be processed as part of the Proposal.

6.2 Required work

The results from the studies outlined in Table 11 inform the assessment of potential impacts of the Proposal on air quality and atmospheric gases. The report is presented in Appendix 2.

Table 11: Air quality and atmospheric gases studies completed for the Proposal

Investigation	Scope
Air quality assessment	A study of air emissions from the single point source emissions stack has been carried out using dispersion modelling in accordance with guidance notes provided by (2006) DER and more contemporary informal DER guidance. The assessment included direct impacts of emissions as well as cumulative impacts, where background air quality is considered in conjunction with the additional emissions from the Proposal. Key elements of the assessment included: • construction of a process mass balance to determine emissions from the single point source (emissions stack) • collation of background air quality data for the cumulative impact assessment • assembly of air quality standards (assessment criteria) relevant to impacts • identification of sensitive receptors • air dispersion modelling to generate predicted ground level concentrations (GLCs) of air emissions • comparison of predicted GLCs with air quality standards for direct and cumulative impact assessments. The results from this study which forms the basis for the assessment of the air quality factor are described in the following sections.

6.3 Potential impacts and risks

Atmospheric emissions from the Proposal have the potential to affect air quality, with a consequent impact on the health and amenity of persons at residential areas and neighbouring premises within the dispersion zone. The nearest sensitive receptors are located in the residential area approximately 600 m to the east of the Proposal site. Key emissions from the Proposal in respect of mass emission rates include:

- oxides of nitrogen (NOx)
- sulfur dioxide (SO_2)[2]
- carbon monoxide (CO)
- particulates.

As previously indicated in Table 5, tyres nominally contain 2% ZnO. Other heavy metals are also present in tyres, typically as contaminants in the ZnO used for tyre manufacturing. A range of metals were therefore also considered in the emissions assessment.

Trace levels of elemental chlorine and fluorine are reported in the literature as being present in tyre rubber, therefore emissions of hydrogen chloride (HCl) and hydrogen fluoride (HF) were also considered in the assessment.

Dioxins are not reported as constituents of tyre rubber but may be formed from combustion of natural gas in the TCU burners or residual process gas in the thermal oxidiser. As such, the assessment has considered dioxins emissions.

Low levels of volatile organic compounds (VOCs) may be emitted from combustion of natural gas and residual process gas. Estimates of VOC emissions as C2 to C6 hydrocarbons (i.e. ethane to hexane), benzene and toluene have been made using USEPA AP42 emission factors, with the assumption made that similar emission rates occur for combustion of process gas as for natural gas.

[2] The IUPAC has long ago adopted sulfur as the correct spelling of element 16 and sulphur is no longer favoured. As such, sulfur is used in this document when describing that element or compounds containing that element.

Polycyclic aromatic hydrocarbons (PAHs) are produced in the thermal processing of tyres and report to the oil fraction recovered from the process gas. Trace quantities of PAHs in oil carry-over with residual process gas will be destroyed in the thermal oxidiser.

6.3.1 Nanoparticles

Item 3 of the ESD specifies information be provided in respect of emissions of ZnO as manufactured nanoparticles. ZnO is added to tyre tread rubber precursors (butadiene and styrene) as an activator in the sulfur vulcanisation process. Manufacturer literature suggests typical particle size of ≥ 100 nm for ZnO used in tyre manufacturing[3],[4], which is at the upper end of the size range for nanoparticles (ASTM 2006, ISO 2008). ZnO with finer particle sizes is produced for other applications, e.g. sunscreens, but those materials are not typically used in tyre manufacturing.

Nanoparticle emissions were considered by New Energy Corporation (NEC) as part of the impact assessment for the East Rockingham Waste to Energy project (NEC 2013). EPA report 1513 (EPA 2014) advised the following in respect of nanoparticle emission impacts and risks:

> *In relation to nanoparticles, the EPA has received advice from the DoH that monitoring of nanoparticles is not required, however the DoH is observing developments of potential risks to health from leaching of particles from inappropriate handling of bottom ash. This position is supported in the EPA's s16 advice which recommends that nanoparticles be considered in the testing of bottom ash.*

Bottom ash will not be produced by the TRRF, therefore the potential for leaching of nanoparticles from the NEC project is not relevant to the Proposal. Emission and air quality standards are not available to assess impacts of nanoparticles on human health. Guidance is not available from any regulatory agencies in Australia for addressing nanoparticle emissions.

Technologies for monitoring nanoparticle emissions from industrial process stacks have also not been developed to a point where standard methods are available for that purpose.

In light of the DOH advice detailed above and the nominal particle size of ZnO used for tyre manufacturing being at the top end of the nanoparticle range, further investigation of the potential for nanoparticle size ZnO emissions from the Proposal is not considered warranted.

6.3.2 Odour

The primary source of odour from thermal treatment of tyres is the presence of sulfur species such as H_2S, thiols and organosulfides in process gases. These gases are not released to atmosphere and as such the Proposal provides an insignificant risk of odour emissions impacts at sensitive receptors. The tyre rubber odour typically observed when handling tyres will be present inside the TRRF building where tyre shredding occurs, however experience with Elan's existing tyre shredding operations at another site in Welshpool is that those odours are not sufficiently strong to cause odour nuisance outside the boundary of the premises. Further assessment of odour emissions from the Proposal is therefore not considered warranted.

6.4 Mitigation hierarchy

In accordance with the Administrative Procedures (GoWA 2012), consideration was given during the planning for the Proposal to avoid, minimise and rectify the potential impacts. These measures are summarised in Table 12.

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[3] *http://www.reade.com/products/zinc-oxide-powder-zno.*

[4] http://www.zopa.org/innovation.

Table 12: Application of the mitigation hierarchy to potential impacts on air quality and atmospheric gases

Potential impact	Avoid	Minimise	Rectify	Offset
NOx emissions	Not possible to avoid.	Low NOx burners to be installed. High temperature exhaust gases from stack facilitate high level of dilution of emissions.	Not required, predicted impacts are well within air quality standards.	Not required
SO_2 emissions	Not possible to avoid.	Process optimised to maximise sulfur reporting to char and oil, which minimises sulfur (as H_2S and organo-sulfides) in residual process gas and SO_2 emissions from thermal oxidiser. Kiln burners to be fired with natural gas, providing very low SO_2 emission rates. High temperature exhaust gases from stack facilitate high level of dilution of emissions.	Not required, predicted impacts are well within air quality standards.	Not required
CO emissions	Not possible to avoid.	Combustion conditions in kin and thermal oxidiser optimised to minimise CO formation. High temperature exhaust gases from stack facilitate high level of dilution of emissions.	Not required, predicted impacts are well within air quality standards.	Not required
Particulate emissions	Not possible to avoid.	Char fines entrained in process gas from TCU are captured in oil recovery circuit (condenser) – essentially a scrubber. High temperature exhaust gases from stack facilitate high level of dilution of emissions.	Not required, predicted impacts are well within air quality standards.	Not required
ZnO emissions	Not possible to avoid.	ZnO entrained in process gas from TCU are captured in oil recovery circuit (condenser) – essentially a scrubber. High temperature exhaust gases from stack facilitate high level of dilution of emissions.	Not required, predicted impacts are well within air quality standards.	Not required
Metal emissions	Very low levels in tyres essentially avoid risks from metals.	Metals associated with char fines entrained in process gas from TCU are captured in oil recovery circuit (condenser) – essentially a scrubber. Volatile metals (at TCU temperatures) will condense at low temperatures in the condenser and report to the oil. High temperature exhaust gases from stack facilitate high level of dilution of emissions.	Not required, predicted impacts are well within air quality standards.	Not required
Acid gases (HCl and HF)	Very low levels of chlorine and fluorine compounds in tyres essentially avoid risks from acid gases.	Any acid gases will be captured in oil fraction. High temperature exhaust gases from stack facilitate high level of dilution of emissions.	Not required, predicted impacts are well within air quality standards.	Not required
Dioxins	Very low levels of chlorine compounds in tyres and low levels of char fines in waste process gas essentially avoids (provides low risk of) dioxins formation from combustion of waste process gas in thermal oxidiser.	Dioxins formation minimised due to very low levels of chlorine and char fines in waste process gas. Negligible dioxins generated from combustion of natural gas in TCU combustion chamber. High temperature exhaust gases from stack facilitate high level of dilution of emissions.	Not required, predicted impacts are well within air quality standards.	Not required

Potential impact	Avoid	Minimise	Rectify	Offset
VOCs	Not possible to avoid.	Thermal oxidiser combustion conditions optimised to maximise destruction of VOCs in residual process gas. High temperature exhaust gases from stack facilitate high level of dilution of emissions.	Not required, predicted impacts of specific VOCs (hydrocarbons, BTEX) are well within air quality standards.	Not required
PAHs	Not possible to avoid.	Thermal oxidiser combustion conditions optimised to maximise destruction of organics in residual process gas. High temperature exhaust gases from stack facilitate high level of dilution of emissions.	Not required, predicted impacts of PAHs as BaP equivalents are well within air quality standards.	Not required

6.5 Assessment of predicted direct and indirect residual impacts

6.5.1 Operating scenarios

Three operating scenarios are expected for the operation of the Proposal – normal, start-up and shutdown. The emissions impact assessment has considered emissions from normal operations only, since these represent the greatest potential environmental risk for the Proposal. The physical and chemical processes in play during start-up and shutdown operations provide considerably lower risks. Details of the start-up and shutdown operations are provided below.

Details of the normal operations have been described in Section 2.10.

<u>Start-up</u>

The plant start-up involves the following operations:

- pre-start check of all operating control systems and resolution of any fault situations
- feed bin is charged with shredded tyre material
- TCU and thermal oxidiser combustion air fans are started
- cooling water flow is commenced
- thermal oxidiser burner ignited and stable combustion conditions established
- TCU burners ignited and temperature increased to 450 °C
- solids discharge screw rotation commenced
- solids conveyers started
- magnetic separator energised
- char pelletiser started
- shredded tyre feed commenced
- TCU heat tube temperature stabilised at nominal 600 °C as feed rate increased to normal operation set point
- thermal oxidiser combustion conditions adjusted to maximise efficiency and minimise emissions.

Air emissions during start-up are initially from combustion of natural gas and are then augmented from combustion of residual process gas. The test plant program has indicated TCU start-up will take in the order of 30 to 45 minutes to reach normal operating conditions. Emissions of pollutants derived from the tyre feed (such as ZnO, metals, acid gases, SO_2) will increase as the feed rates ramp up, to reach the emission rates predicted for normal operations. As such, the emissions impacts from start-up are considerably less than for normal operations, and the emissions profile for normal operations represent a conservative prediction of impacts during start-up.

<u>Shutdown</u>

Plant shutdown will be required for planned maintenance and outages of equipment, and will involve the following operations:

- shutdown supply of tyre shred to feed hopper and TCU
- isolate TCU burners to cease heat input
- cease rotation of the heat tube when the TCU combustion chamber temperature reaches nominal 150°C
- continue thermal oxidiser operation until the residual process gas flow ceases
- shut down thermal oxidiser
- shut down cooling water
- isolate conveyers and de-energise magnetic separator as necessary
- shutdown char pelletiser.

The char pelletiser can run independent of the TCU until the char inventory is run down. Similarly, the TCU can operate for some time without the char pelletiser on-line to build an inventory of char for pelletising.

Air emissions during shutdown will decline rapidly as the generation of residual process gas ceases. The test plant program indicated process gas generation is completed within 15 minutes after cessation of feed to the TCU and isolation of TCU burners. At that stage, the emissions are from combustion of natural gas in the thermal oxidiser. As such, the emissions impacts from shutdown are considerably less than for normal operations, and the emissions profile for normal operations represent a conservative prediction of impacts during shutdown.

6.5.2 Mass balance

A comprehensive mass balance has been developed from consideration of reported compositional data for EOL tyre materials, the proposed feed rate of those materials (2500 kg/h), and key process design parameters that influence the formation and fate of air emissions within the process.

Chemical compositional data for EOL tyres were obtained from the literature (EER 2006, NZ MfE 2016, Susa and Haydary 2012, CalRecovery 1995, Banar et al 2013, Rubber Manufacturers Association 2004, Islam et al, 2013, Roy et al 1998, Williams 2013, Shakya el al 2006). The fate of these substances within the TRRF process is determined from the chemical and physical conditions at each stage of the process.

As an example, sulfur containing additives in tyre rubber are volatilised in the initial stages of thermal processing with residual sulfur reduced to H_2S at higher temperatures. These volatile sulfur species report to the process gas stream, which when condensed report to the oil stream, with the remaining absorbing onto or within the char. Only the sulfur species which survive in the residual process gas are oxidised to generate SO_2 in the thermal oxidiser.

Small amounts of sulfur are also introduced into the process from combustion of natural gas in the kiln burners and SACTO burner. These have been included in the mass balance.

The distribution of sulfur from the EOL tyres and various products from the thermal processing of EOL tyres is:

- EOL tyres: 30.6 kg/h
- Char: 26.2 kg/h
- Oil: 3.3 kg/h
- Stack emissions: 1.2 kg/h

Similar process considerations have been made with respect to the chemistries of other chemical components of the shredded tyre materials to calculate the air emissions of other relevant parameters from the Proposal. Emissions from combustion of natural gas in the TCU combustion chamber and the thermal oxidiser have been calculated using emissions factors from US EPA (2016) and NPI (2011).

An emissions flow-sheet which illustrates the partitioning and reaction pathways of emissions precursors as considered in the mass balance is shown in Figure 5.

The mass balance data are summarised in Table 13.

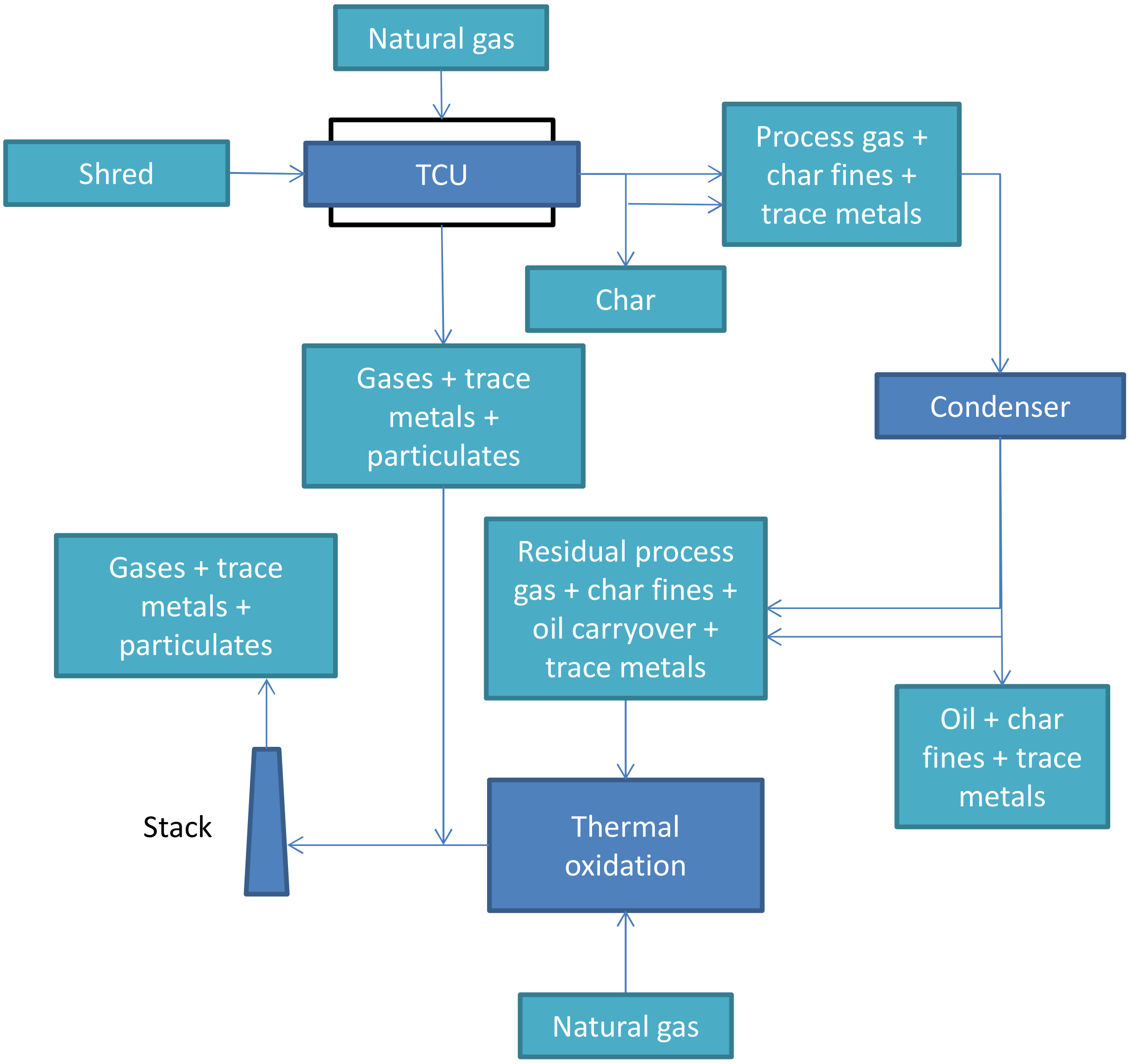

Figure 5: Emissions flow sheet

Table 13: Summary of mass balance

Parameter	Inputs to TCU (kg/h)	Basis	Source of information	Inputs to TCU combustion chamber (kg/h)	Outputs from TCU combustion chamber (kg/h)	Output from TCU (as char) (kg/h)	Output from TCU and input to condenser (as process gas) (kg/h)	Output from TCU and input to condenser (as char fines in process gas) (kg/h)	Oil output from condenser (kg/h)	Output from condenser and input to thermal oxidiser (char fines in residual process gas)	Output from condenser and input to thermal oxidiser (oil carryover in residual process gas)	Output from condenser and input to thermal oxidiser (residual process gas)	Input to Thermal oxidiser (as natural gas) (kg/h)	Output from Thermal oxidiser and input to stack (exhaust gas to stack) (kg/h)	Stack emission (kg/h)
EOL tyres	2.50E+03	Project design	Proponent	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aluminium	6.26E-01	0.025% Al in EOL tyres	Literature	0.00E+00	0.00E+00	6.14E-01	0.00E+00	1.25E-02	1.24E-02	1.25E-04	1.25E-04	0.00E+00	0.00E+00	2.51E-04	2.51E-04
Antimony	5.00E-03	0.0002% Sb in EOL tyres	Literature	0.00E+00	0.00E+00	4.9E-03	0.00E+00	1.00E-04	9.90E-05	1.00E-06	1.00E-06	5.00E-05	0.00E+00	2.00E-06	2.00E-06
Arsenic	2.00E-03	0.00008% As in EOL tyres	Literature	9.31E-07	9.31E-07	2.0E-03	0.00E+00	4.00E-05	3.96E-05	4.00E-07	4.00E-07	1.00E-04	1.46E-08	8.15E-07	1.75E-06
Barium	6.25E-03	0.00025% Ba in EOL tyres	Literature	0.00E+00	0.00E+00	6.1E-03	0.00E+00	1.25E-04	1.24E-04	1.25E-06	1.25E-06	6.25E-05	0.00E+00	2.50E-06	2.50E-06
Benzene	0.00E+00	Not component of EOL tyres	NA	0.00E+00	1.08E-05	0.00E+00	ND	0.00E+00	2.10E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.80E-05	1.80E-05
Beryllium	0.00E+00	Not component of EOL tyres	NA	2.60E-11	2.60E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.60E-11	2.60E-11
Butane	0.00E+00	Not component of EOL tyres	NA	1.15E-02	1.08E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.65E+00	1.44E-04	1.80E-02	1.80E-02
Cadmium	6.55E-03	0.00026% Cd in EOL tyres	Literature	5.12E-06	5.12E-06	6.4E-03	0.00E+00	1.31E-04	1.30E-04	1.31E-06	1.31E-06	6.56E-05	8.04E-08	7.82E-06	7.82E-06
Calcium	5.17E+00	0.21% Ca in EOL tyres	Literature	0.00E+00	0.00E+00	5.07E+00	0.00E+00	1.03E-01	1.02E-01	1.03E-03	0.00E+00	5.17E-02	0.00E+00	2.07E-03	2.07E-03
Carbon monoxide (CO)	0.00E+00	Not component of EOL tyres	NA	0.00E+00	1.12E-01	0.00E+00	1.60E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.74E-01	2.74E-01
Char	0.00E+00	Not component of EOL tyres	NA	0.00E+00	0.00E+00	8.02E+02	0.00E+00	1.62E+01	1.60E+01	1.62E-01	1.62E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chloride	3.13E+00	0.13% Cl in EOL tyres	Literature	0.00E+00	0.00E+00	3.06E+00	0.00E+00	6.25E-02	6.19E-02	6.25E-04	6.25E-04	1.56E-02	0.00E+00	1.25E-03	1.25E-03
Chromium	1.27E-01	0.0051% Cr in EOL tyres	Literature	6.51E-06	6.51E-06	1.24E-01	0.00E+00	2.54E-03	2.51E-03	2.54E-05	2.54E-05	1.27E-04	1.02E-07	5.74E-05	5.74E-05
Cobalt	3.21E-02	0.0013% Co in EOL tyres	Literature	3.78E-07	3.78E-07	3.14E-02	0.00E+00	6.42E-04	6.35E-04	6.42E-06	6.42E-06	3.21E-05	5.94E-09	1.32E-05	1.32E-05
Copper	3.89E-02	0.002% Cu in EOL tyres	Literature	3.96E-06	3.96E-06	3.81E-02	0.00E+00	7.78E-04	7.70E-04	7.78E-06	7.78E-06	3.89E-05	6.21E-08	1.96E-05	1.96E-05
Dioxins (TEQ)	0.00E+00	Not component of EOL tyres	NA	0.00E+00	2.3E-11	0.00E+00	0.00E+00	5.67E-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.30E-11	2.30E-11
Ethane	0.00E+00	Not component of EOL tyres	NA	7.07E-03	1.59E-02	0.00E+00	ND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.8.9E+01	8.88E-05	2.66E-02	2.66E-02
Fluoride	2.50E-02	0.001% F in EOL tyres	Literature	0.00E+00	0.00E+00	2.45E-02	0.00E+00	5.00E-04	4.95E-04	5.00E-06	5.00E-06	1.25E-04	0.00E+00	1.00E-05	1.00E-05
Hydrogen chloride (HCl)	0.00E+00	Not component of EOL tyres	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.61E-01	0.00E+00	1.29E-03	1.29E-03
Hydrogen fluoride (HF)	0.00E+00	Not component of EOL tyres	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E-03	0.00E+00	1.35E-05	1.35E-05
Hexane	0.00E+00	Not component of EOL tyres	NA	9.29E-06	9.23E-03	0.00E+00	ND	0.00E+00	3.22E+00	0.00E+00	0.00E+00	4.09E-01	1.17E-0	1.55E-02	1.55E-02
Iron (non- wire)	6.69E-01	0.027% Fe in EOL tyres	Literature	0.00E+00	0.00E+00	6.55E-01	0.00E+00	1.34E-02	1.32E-02	1.34E-04	1.34E-04	6.69E-04	0.00E+00	2.68E-04	2.68E-04
Lead	2.01E-01	0.0081% Pb in EOL tyres	Literature	2.32E-06	2.32E-06	1.97E-01	0.00E+00	4.03E-03	3.98E-03	4.03E-05	4.03E-05	2.01E-04	3.65E-08	8.29E-05	8.29E-05
Lithium	3.16E-03	0.00012% Li in EOL tyres	Literature	0.00E+00	0.00E+00	3.10E-03	0.00E+00	6.33E-05	6.26E-05	6.33E-07	6.33E-07	3.16E-06	0.00E+00	1.27E-06	1.27E-06
Magnesium	1.73E-01	0.0069% Mg in EOL tyres	Literature	0.00E+00	0.00E+00	1.69E-01	0.00E+00	3.45E-03	3.42E-03	3.45E-05	3.45E-05	1.73E-04	0.00E+00	6.90E-05	6.90E-05
Manganese	5.00E-03	0.0002% Mn in EOL tyres	Literature	1.77E-06	1.77E-06	4.90E-03	0.00E+00	1.00E-04	9.90E-05	1.00E-06	1.00E-06	5.00E-06	2.78E-08	3.80E-06	3.80E-06
Mercury	7.50E-04	0.00003% Hg in EOL tyres	Literature	1.13E-06	1.13E-06	7.00E-6	7.43E-04	1.50E-07	7.43E-04	1.50E-09	7.35E-06	3.75E-05	1.89E-08	7.51E-04	7.51E-04
Molybdenum	7.00E-03	0.00028% Mo in EOL tyres	Literature	0.00E+00	0.00E+00	6.90E-03	0.00E+00	1.40E-04	1.39E-04	1.40E-06	1.40E-06	7.00E-06	0.00E+00	2.80E-06	2.80E-06
Nickel	6.36E-02	0.0025% Ni in EOL tyres	Literature	9.76E-06	9.76E-06	6.24E-02	0.00E+00	1.27E-03	1.26E-03	1.27E-05	1.27E-05	6.36E-05	1.53E-07	3.54E-05	3.54E-05
Nitrogen	1.03E+01	0.41% N in EOL tyres	Literature	0.00E+00	0.00E+00	3.62E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nitrogen oxides (NOx)	0.00E+00	Not component of EOL tyres	NA	0.00E+00	2.32E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+000	0.00E+00	1.04E+00	1.04E+00
PAHs (as BaP)	0.00E+00	Not component of EOL tyres	NA	0.00E+00	0.00E+00	ND	4.93E-03	ND	4.98E-03	ND	4.98E-05	0.00E+00	0.00E+00	4.98E-06	4.98E-06
Particulate matter (PM)	0.00E+00	Not component of EOL tyres	NA	0.00E+00	4.26E-02	0.00E+00	0.00E+00	ND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.74E-02	7.74E-02
Pentane	0.00E+00	Not component of EOL tyres	NA	7.96E-03	1.33E-02	0.00E+00	ND	0.00E+00	3.22E+00	0.00E+00	0.00E+00	1.05E+00	0.00E+00	2.23E-02	2.23E-02
Potassium	4.50E-01	0.018% K in EOL tyres	Literature	0.00E+00	0.00E+00	4.40E-01	0.00E+00	9.00E-03	8.91E-03	9.00E-05	9.00E-05	4.50E-04	0.00E+00	1.80E-04	1.80E-04
Propane	0.00E+00	Not component of EOL tyres	NA	9.29E-03	8.20E-03	0.00E+00	ND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.59E+01	0.00E+00	1.37E-02	1.37E-02
Selenium	5.00E-02	0.002% Se in EOL tyres	Literature	5.13E-10	5.13E-10	4.90E-02	0.00E+00	1.00E-03	9.90E-04	1.00E-05	1.00E-05	2.50E-03	0.00E+00	2.00E-05	2.00E-05

Parameter	Inputs to TCU (kg/h)	Basis	Source of information	Inputs to TCU combustion chamber (kg/h)	Outputs from TCU combustion chamber (kg/h)	Output from TCU (as char) (kg/h)	Output from TCU and input to condenser (as process gas) (kg/h)	Output from TCU and input to condenser (as char fines in process gas) (kg/h)	Oil output from condenser (kg/h)	Output from condenser and input to thermal oxidiser (char fines in residual process gas)	Output from condenser and input to thermal oxidiser (oil carryover in residual process gas)	Output from condenser and input to thermal oxidiser (residual process gas)	Input to Thermal oxidiser (as natural gas) (kg/h)	Output from Thermal oxidiser and input to stack (exhaust gas to stack) (kg/h)	Stack emission (kg/h)
Silica (as Si)	1.83E+01	1.1% Silica in EOL tyres	Literature		0.00E+00	1.79E+01	0.00E+00	3.66E-01	3.62E-01	3.66E-03	3.66E-03	0.00E+00	0.00E+00	7.32E-03	7.32E-03
Silver	2.00E-04	0.000008% Ag in EOL tyres	Literature	0.00E+00	0.00E+00	1.96E-04	0.00E+00	4.00E-06	3.96E-06	4.00E-08	4.00E-08	2.00E-07	0.00E+00	8.00E-08	8.00E-08
Sodium	1.53E+00	0.061% Na in EOL tyres	Literature	0.00E+00	0.00E+00	1.49E+00	0.00E+00	3.05E-02	3.02E-02	3.05E-04	3.05E-04	1.53E-03	0.00E+00	6.10E-04	6.10E-04
Strontium	5.36E-03	0.00021% Sr in EOL tyres	Literature	0.00E+00	0.00E+00	5.26E-03	0.00E+00	1.07E-04	1.06E-04	1.07E-06	1.07E-06	5.36E-06	0.00E+00	2.15E-06	2.15E-06
Sulfur	3.06E+01	1.2% S in EOL tyres	Literature	3.40E-05	2.56E-03	2.67E+01	3.95E+00	5.24E-01	3.32E+00	5.24E-03	5.30E-01	6.32E-01	3.22E-05	1.17E+00	1.17E+00
Sulfur dioxide (SO2)	0.00E+00	Not component of EOL tyres	NA	0.00E+00	5.0E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.36E+00	2.36E+00
Titanium	4.88E-01	0.020% V in EOL tyres	Literature	0.00E+00	0.00E+00	4.78E-01	0.00E+00	9.75E-03	9.65E-03	9.75E-05	9.75E-05	4.88E-04	0.00E+00	1.95E-04	1.95E-04
Toluene	0.00E+00	Not component of EOL tyres	NA	0.00E+00	1.74E-05	0.00E+00	ND	0.00E+00	7.54E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.92E-05	2.92E-05
Vanadium	2.50E-03	0.0001% V in EOL tyres	Literature	0.00E+00	0.00E+00	2.45E-03	0.00E+00	5.00E-05	4.95E-05	5.00E-07	5.00E-07	2.50E-06	0.00E+00	1.00E-06	1.00E-06
Wire	4.31E+02	17% wire in EOL tyres. Assumes all wire reports to TCU, whereas shredding will remove some wire	Literature	0.00E+00	0.00E+00	4.31E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zinc	2.63E+01	1.1% ZnO in EOL tyres (as Zn)	Literature	1.34E-04	1.34E-04	2.57E+01	0.00E+00	5.25E-01	5.20E-01	5.25E-03	5.25E-03	0.00E+00	2.10E-06	1.06E-02	1.06E-02
Natural gas	0.00E+00	Not component of EOL tyres	NA	2.15E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.7 (for pilot burner)	0.00E+00	0.00E+00

Note that the values are in presented in Excel scientific notation, where (for example) 6.26E-03 refers to 6.26×10^{-3}.
ND = no data.

6.5.3 Test plant trial

Demonstration scale tests of EOL tyre thermal processing were carried out at an established test plant, which is approximately 1/25th commercial scale and includes key process elements of the TRRF. These elements include the feed system, thermal conversion unity (TCU), char and wire recovery, process gas recovery and thermal oxidiser. The test plant is instrumented to gather key process data (temperatures, pressures, flows) necessary for design optimisation, as well as access ports (valves) installed throughout the facility to facilitate sampling of process materials (oil and gas) for physical and chemical analyses. Air emissions sampling of NOx, CO, SO_2, CO_2, O_2, particulates and acid gases was carried out from the exhaust gas streams to provide test data for verification of mass balance calculations. The plant was operated on a continuous basis to ensure steady state conditions were achieved which mirror full scale conditions for a TRRF.

The test data were used to verify aspects of the mass balance and also confirm the sulfur mass flows used for the impact assessment. Samples of char have been analysed by CSIRO to determine mineral content and physical properties to assist in identifying desirable properties for beneficial uses. Oil samples have been analysed by the Centre for Energy (CfE) at the University of Western Australia and the Chemistry Centre of WA to determine the composition and key physical characteristics. The residual process gas was also analysed by CfE to confirm the composition and identify concentrations of sulfur species.

Key process data including temperatures, pressures, feed rates and associated operational performance data were obtained to assist in the detailed design of the commercial plant for the Proposal.

6.5.4 Emissions data

The emissions data obtained from the mass balance and test plant trials are presented in Table 14. These data have been used in dispersion modelling undertaken for the Proposal (Section 6.5.7).

Table 14: Emissions data for dispersion modelling

Emission	Units	Value	Source
Gases			
Nitrogen oxides	g/s	2.88E-01	Mass balance and test plant data
Sulfur dioxide	g/s	6.56E-01	Mass balance and test plant data
Carbon monoxide	g/s	7.60E-02	Mass balance and test plant data
Particulates			
Particulates (as PM_{10})	g/s	2.15E-02	Mass balance and test plant data
Particulates (as $PM_{2.5}$)	g/s	2.15E-02	Mass balance and test plant data
Acid gases			
Hydrogen chloride	g/s	3.57E-04	Mass balance and test plant data
Hydrogen fluoride	g/s	3.75E-06	Mass balance and test plant data
Metals			
Aluminium	g/s	6.96E-05	Mass balance
Antimony	g/s	5.56E-07	Mass balance
Arsenic	g/s	4.85E-07	Mass balance
Barium	g/s	6.94E-07	Mass balance
Beryllium	g/s	7.22E-12	Mass balance
Cadmium	g/s	2.17E-06	Mass balance
Calcium	g/s	5.75E-04	Mass balance
Chromium	g/s	1.59E-05	Mass balance
Cobalt	g/s	3.67E-06	Mass balance
Copper	g/s	5.42E-06	Mass balance
Iron	g/s	7.43E-05	Mass balance
Lead	g/s	2.30E-05	Mass balance

Emission	Units	Value	Source
Lithium	g/s	3.51E-07	Mass balance
Magnesium	g/s	1.92E-05	Mass balance
Manganese	g/s	1.05E-06	Mass balance
Mercury	g/s	2.09E-04	Mass balance
Molybdenum	g/s	7.78E-07	Mass balance
Nickel	g/s	9.78E-06	Mass balance
Potassium	g/s	5.00E-05	Mass balance
Selenium	g/s	5.56E-06	Mass balance
Silica (as Si)	g/s	2.03E-03	Mass balance and test plant data
Silver	g/s	2.22E-08	Mass balance
Sodium	g/s	1.69E-04	Mass balance
Strontium	g/s	5.96E-07	Mass balance
Titanium	g/s	3.27E-01	Mass balance
Vanadium	g/s	5.42E-05	Mass balance
Zinc oxide (as Zn)	g/s	2.95E-03	Mass balance
VOCs			
Ethane	g/s	7.39E-03	Mass balance
Propane	g/s	3.82E-03	Mass balance
Butane	g/s	5.01E-03	Mass balance
Pentane	g/s	6.20E-03	Mass balance
Hexane	g/s	4.29E-03	Mass balance
Benzene	g/s	5.01E-06	Mass balance
Toluene	g/s	8.11E-06	Mass balance
Semi-volatile organics			
Dioxins	g (TEQ)/s	6.39E-12	Mass balance
Polycyclic aromatic hydrocarbons	g (BaP)/s	1.37E-06	Test plant data

Note: values are displayed using Excel scientific format.

6.5.5 Other emission sources external to the Proposal

Traffic emissions are likely to be a significant contributor to background air quality in the area of the Proposal site due to the proximity of major transport routes. As an example, a first order estimate of emissions from 1 km of Roe Highway adjacent to the residential area east of the Proposal suggests NOx emission rate of 140 g/s, a CO emission rate of 430 g/s and SO_2 emission rate of 0.6 g/s for the average 43 seconds each vehicle takes to travel 1 km at 7 am peak hour.[5] The NOx and CO rates are 3 and 4 orders of magnitude greater than the Proposal emissions rates, respectively. The SO_2 emission rate is comparable with that from the Proposal. This example only considers emissions from traffic using 1 km of Roe Highway and does not include emissions from all other transport routes in the vicinity of the Proposal. As such the overall emissions burden from traffic on the transport routes is almost certainly far greater than that from the Proposal.

The National Pollutant Inventory (NPI) has been interrogated to identify industries in the Welshpool area which report emissions to air, for the substances of which present the more significant of the (low) impacts for the Proposal. More specifically, a comparison of predicted emission rates for NOx and SO_2 from the Proposal with the NPI data from other industries is shown in Table 15. The significance of vehicle emissions is illustrated by inclusion of emission rates for 1 km of Roe Highway.

[5] Estimates based on Main Roads traffic data and 1.3 g NOx per vehicle km travelled (VKT), and 3.9 g CO per VKT from Smit (2014).

Table 15: Comparison of NPI and the Proposal air emissions for NOx and SO_2

Emission	Total for all Welshpool industries (kg/y)	Proposal emissions (kg/y)	Emissions from 1 km of Roe Highway	Proposal emissions as percentage of existing NPI + 1 km of Roe Highway emissions
NOx	5.40E+04	9.09E+03	4.42E+06	0.2%
SO_2	2.73E+04	1.33E+04	1.89E+04	46.9%

This comparison shows that NOx emissions from the Proposal are insignificant in relation to existing sources in the Welshpool area. As previously discussed, the SO_2 emissions from the Proposal are of similar magnitude to existing sources and 1 km of Roe Highway. Actual impacts from traffic SO_2 emissions will be considerably greater when other major transport routes are included in the analysis.

Overall, the contributions of emissions from the Proposal to the ambient air at neighbouring locations are considerably less than other sources of significance.

6.5.6 Background air quality data and ambient air assessment criteria

An assessment of cumulative emissions impacts from the Proposal requires ambient air data from the area surrounding the Proposal site. Public domain ambient air quality data for the Welshpool area were not identified in searches carried out for this study. As a consequence, published data from a number of studies and from DER's monitoring network across the metropolitan area were examined to identify concentrations to use as backgrounds for the cumulative air emissions risk assessment as described in Section 6.5.7. As previously discussed, traffic emissions are likely to be a significant contributor to the background air quality and several of DER's stations are located in close proximity to major traffic routes.

The most recent published data from 2014 monitoring at DER stations were used for the cumulative air emissions assessment of NOx, SO_2, CO and particulates to capture the more recent impacts from traffic emissions. The reported concentrations for the respective time averages of regulatory interest from all stations from 2014 were pooled and the maximum values for NOx, SO_2 and CO were used as the background for the cumulative assessment. The 95^{th} percentile PM_{10} and $PM_{2.5}$ concentrations were used for the assessment of those parameters, since the maxima were a consequence of bushfire smoke emissions and are unlikely to be reflective of a background derived from vehicle emissions and other activities in the area.

This approach provides a conservative indication of the potential cumulative impact assessment of these pollutants for the Proposal.

Background data for metals were obtained from the *DER Midland Air Quality Study* (DER 2008) and the *Perth Traffic Corridor Study 2007-2008* (DEC 2008), which included data reported from a previous study in 2005-2006. Two other studies were considered as sources of background data –*Background Air Quality Monitoring in Kwinana 2005-2010* (DEC 2011) and *2007 Small to Medium Enterprise Air Quality Monitoring Project* (DEC, undated). However, both of these studies were intended to identify impacts from emissions sources which do not reflect the background air quality expected at the Welshpool area. As a consequence, data from those studies were not used to determine background air quality for the cumulative emissions assessment.

The maximum measured concentrations of metals of interest from the Midland and traffic corridor studies have been used for the cumulative impact assessment. The 95^{th} percentile acid gas concentrations from the Midland study were selected to account for higher concentrations due to direct impacts of emissions from the brickworks at some locations in that study. Ambient PAHs (polycyclic aromatic hydrocarbons) were measured in the traffic study and those data have also been used for the cumulative impact assessment.

Ambient data for dioxins are available from the National Dioxins Program (Department of Environment and Heritage 2004). Sampling was conducted in the Perth metropolitan area at Wattleup and Duncraig. The Duncraig site is influenced by traffic emissions whereas the Wattleup site may have some influence from industrial emissions, albeit the site is at the northern end of the Kwinana industrial area. Notwithstanding these differences, very similar maximum and average concentrations were observed from those locations, which are five orders of magnitude below the air quality standard (Table 16).

Table 16: Air quality assessment criteria and background concentrations – dioxins

Location	Maximum concentration (µg TEQ/m^3)	Mean concentration (µg TEQ/m^3)	Air quality standard (µg TEQ/m^3)
Duncraig	6.5E-08	1.4E-08	1.0E-03 (1-hour average)
Wattleup	5.5E-08	1.5E-08	

Note: TEQ concentrations calculated using WHO 1998 TEFs. Values are displayed using Excel scientific format.

A comparison of the reported background concentrations with air quality standards is shown in Table 17. Note that concentrations were not reported for some of the time averages in the various studies, and as a consequence no comparison is made with the standards with those time averages.

Table 17: Air quality assessment criteria and background concentrations

Emission	Assessment criteria averaging Period	Assessment criteria (µg/m3)	WA relevant guideline	Background concentration for impact assessment (µg/m^3)	% of assessment criteria
Gases					
NO_2	1-hour	246	AAQ NEPM (NEPC 2003)	90	37%
SO_2	1-hour	571.8	AAQ NEPM (NEPC 2003)	160	28%
	24-hour	228.7	AAQ NEPM (NEPC 2003)	26	11%
	Annual	57.2	AAQ NEPM (NEPC 2003)	5	9.0%
CO	8-hour	11 249	AAQ NEPM (NEPC 2003)	2175	19%
Particulates					
PM_{10}	24-hour	50	AAQ NEPM (NEPC 2003)	29.4	59%
$PM_{2.5}$	24-hour	25	AAQ NEPM (NEPC 2003)	14.1	56%
	Annual	8	AAQ NEPM (NEPC 2003)	8.1	101%
Acid gases					
Hydrogen chloride	1-hour	100	DOH 2007	27.5	28%
	1-hour	140	DER 2016	27.5	20%
Hydrogen fluoride	1-hour	100	DOH 2007	6.0	6.0%
Metals					
Aluminium	1-hour	No criteria	No criteria	5.15	NA
Antimony	1-hour	9	DER 2016	0.056	0.62%
Arsenic	1-hour	0.09	DER 2016	0.13	144%
	24-hour	0.03	DER 2016	0.053	177%
	Annual	0.003	DER 2016	No data	NA
Barium	1-hour	No criteria	No criteria	0.093	NA
Beryllium	1-hour	0.004	DER 2016	No data	NA
	Annual	0.00018	DER 2016	No data	NA
Cadmium	1-hour	0.018	DER 2016	No data	NA
Calcium	1-hour	No criteria	No criteria	No data	NA
Chromium	1-hour	9	DER 2016	0.031	0.34%
	24-hour	0.46	DER 2016	0.0123	2.7%
Cobalt	24-hour	0.092	DER 2016	No data	NA
Copper	24-hour	1	DER 2016	0.04	4.0%
Iron	1-hour	No criteria	No criteria	2.75	NA
Lead	Annual	0.5	NEPM	0.010	2.0%
Lithium	1-hour	No criteria	No criteria	No data	NA
Magnesium	1-hour	No criteria	No criteria	2.13	NA
Manganese	1-hour	18	NSW DECC 2006	0.055	0.31%
	Annual	0.14	DER 2016	0.01	7.1%
Mercury	1-hour	0.55	DER 2016	No data	NA
	Annual	0.18	DER 2016	No data	NA
Molybdenum	24-hour	11	DER 2016	No data	NA
Nickel	1-hour	0.14	DER 2016	No data	NA
	Annual	0.003	DER 2016	No data	NA
Potassium	1-hour	No criteria	No criteria	No data	NA
Selenium	1-hour	No criteria	No criteria	No data	NA
Silica (as Si)	24-hour	9.2	DER 2016	No data	NA
	Annual	2.7	DER 2016	No data	NA
Silver	1-hour	No criteria	No criteria	No data	NA
Sodium	1-hour	No criteria	No criteria	15.7	NA

Emission	Assessment criteria averaging Period	Assessment criteria (µg/m3)	WA relevant guideline	Background concentration for impact assessment (µg/m^3)	% of assessment criteria
Strontium	1-hour	No criteria	No criteria	No data	NA
Titanium	1-hour	No criteria	No criteria	0.24	NA
Vanadium	24-hour	0.92	DER WA	No data	NA
Zinc oxide (as Zn)	24-hour	46	DER WA	0.0961	0.21%
VOCs					
Ethane	1-hour	No criteria	No criteria	No data	NA
Propane	1-hour	No criteria	No criteria	No data	NA
Butane	1-hour	No criteria	No criteria	No data	NA
Pentane	1-hour	11	DER 2016	No data	NA
Hexane	1-hour	0.90	DER 2016	3.0	333%
Benzene	Annual	9.6	NEPM (Air Toxics) (NEPC 2004)	1.5	16%
Toluene	24-hour	3760	NEPM (Air Toxics) (NEPC 2004)	6	0.16%
	Annual	376	NEPM (Air Toxics) (NEPC 2004)	1.5	0.40%
Semi-volatile organics					
Dioxins (TEQ)	1-hour	2E-06	DER 2016	6.50E-08	3.3%
Polycyclic aromatic hydrocarbons (as BaP)	Annual	0.0003	NEPM (Air Toxics) (NEPC 2004)	0.00084	280%

Note: Some values are displayed using Excel scientific format.

Of note is that the background concentrations selected from the various air quality studies for $PM_{2.5}$, Arsenic, hexane and PAHs were found to exceed their respective air quality criteria. This does not imply that the background concentrations in the vicinity of the Proposal site pose an unacceptable risk to human health. The selected background concentrations inform the risk of Proposal emissions in relation to existing air quality as defined by the background concentrations selected for this assessment.

6.5.7 Dispersion modelling

Methodology

Dispersion modelling of emissions from the single point source emissions stack was carried out by SigmaTheta using the AERMOD atmospheric dispersion model. Meteorological data were obtained from the Perth Airport station. Full details of the modelling configuration are provided in the report from SigmaTheta (2016) located in Appendix 2.

The residential areas to east of the Proposal site was identified as sensitive receptors for the emissions impact assessment with industrial premises surrounding the remainder of the Proposal site.

Tabulated results are reported in the following sections for maximum predicted GLCs at sensitive receptors to the Proposal and at the boundary of the Proposal site (which is also the maximum predicted GLC anywhere is the modelling domain).

Results from dispersion modelling – direct impact assessment

The results from the dispersion modelling are summarised in Table 18 for the nearest sensitive receptor and site boundary. This includes a comparison with the respective assessment criteria to provide a direct impact assessment for the emissions of interest. No exceedances of the air quality criteria were observed for the maximum predicted GLCs. The most significant emissions impacts at sensitive receptors (residential areas) were from hexane (1-hour average at 2.9% of the criteria), PAHs (1-hour average at 2.8% of the criteria) and SO_2 (10-minute average at 1.1% of the criteria). The maximum predicted GLCs of these parameters at the Proposal site boundary were 33%, 31% and 13% of the air quality criteria, respectively.

Contour plots showing the dispersion patterns of emissions can be found in the SigmaTheta (2016) report provided in Appendix 2.

Results from dispersion modelling – cumulative impact assessment

A cumulative impact assessment has been conducted using the background concentration data (Table 17) and maximum predicted GLCs for direct impacts from the Proposal. The results of the cumulative impact assessment at sensitive receptors and the boundary of the Proposal site are presented in Table 19.

Exceedances of the respective air quality criteria are predicted at sensitive receptors for hexane (1-hour average at 337% of the criteria, PAHs (1-hour average at 283% of the criteria) and Arsenic (24-hour average at 176% of the criteria and 1-hour average at 147% of the criteria). Exceedances of the air quality criteria for these parameters were also predicted at the site boundary. A slight exceedance of the $PM_{2.5}$ annual average NEPM was predicted at sensitive receptors (101% of the NEPM) and site boundary (103% of the NEPM).

All of these exceedances were driven by relatively high background concentrations assigned to the respective parameters with insignificant contributions from the Proposal.

Table 18: Maximum predicted GLCs at nearest sensitive receptor and site boundary from direct emissions impacts

Emission	Assessment criteria averaging Period	Assessment criteria (µg/m3)	Maximum predicted GLC at sensitive receptors (µg/m^3)	Percentage of assessment criteria	Maximum predicted GLC at site boundary (µg/m^3)	Percentage of assessment criteria
Gases						
Nitrogen oxides (NOx)	1-hour	246	1.75	0.7%	19.8	8.0%
	Annual	61.6	0.037	0.06%	1.69	2.7%
Sulfur dioxide (SO_2)	10-minute	500	5.69	1.1%	64.6	13%
	1-hour	571.8	3.98	0.7%	45.2	7.9%
	24-hour	228.7	1.85	0.8%	30.8	13%
	Annual	57.2	0.0842	0.1%	3.86	6.7%
Carbon monoxide (CO)	15-minute	100000	0.61	0.0006%	6.91	0.007%
	30-minute	60000	0.21	0.0004%	3.56	0.006%
	1-hour	30000	0.46	0.002%	5.23	0.02%
	8-hour	11 249	0.31	0.0003%	4.36	0.04%
Particulates						
PM_{10}	24-hour	50	0.061	0.1%	1.01	2.0%
	Annual	20	0.0027	0.01%	0.127	0.6%
$PM_{2.5}$	24-hour	25	0.061	0.2%	1.01	4.0%
	Annual	8	0.0027	0.03%	0.127	1.6%
Acid gases						
Hydrogen chloride	1-hour	100	2.16E-03	0.002%	0.0246	0.02%
	1-hour	140	2.16E-03	0.002%	0.0246	0.02%
Hydrogen fluoride	1-hour	100	2.27E-05	0.00002%	2.58E-04	0.0003%
Metals						
Aluminium	1-hour	No criteria	4.22E-04	NA	4.79E-03	NA
Antimony	1-hour	9	3.37E-06	0.00004%	3.83E-05	0.0004%
Arsenic	1-hour	0.09	2.94E-06	0.003%	3.34E-05	0.04%
	24-hour	0.03	1.37E-06	0.005%	2.27E-05	0.08%
	Annual	0.003	6.22E-08	0.002%	2.85E-06	0.1%
Barium	1-hour	No criteria	4.21E-06	NA	4.78E-05	NA
Beryllium	1-hour	0.004	4.38E-11	0.000001%	4.97E-10	0.00001%
	Annual	0.00018	9.27E-13	0.0000005%	4.25E-11	0.00002%
Cadmium	1-hour	0.018	1.31E-05	0.07%	1.49E-04	0.8%
Calcium	1-hour	No criteria	3.48E-03	NA	3.96E-02	NA

Emission	Assessment criteria averaging Period	Assessment criteria (µg/m3)	Maximum predicted GLC at sensitive receptors (µg/m^3)	Percentage of assessment criteria	Maximum predicted GLC at site boundary (µg/m^3)	Percentage of assessment criteria
Chromium	1-hour	9	9.63E-05	0.001%	1.09E-03	0.01%
	24-hour	0.46	4.48E-05	0.01%	7.45E-04	0.2%
Cobalt	24-hour	0.092	1.04E-05	0.01%	1.72E-04	0.2%
Copper	24-hour	1.0	1.53E-05	0.002%	2.54E-04	0.03%
Iron	1-hour	No criteria	4.50E-04	NA	5.12E-03	NA
Lead	Annual	0.5	2.95E-06	0.0006%	1.35E-04	0.03%
Lithium	1-hour	No criteria	2.13E-06	NA	2.42E-05	NA
Magnesium	1-hour	No criteria	1.16E-04	NA	1.32E-03	NA
Manganese	1-hour	18	6.36E-06	0.00004%	7.23E-05	0.0004%
	Annual	0.14	1.35E-07	0.0001%	6.18E-06	0.004%
Mercury	1-hour	0.55	1.27E-03	0.2%	1.44E-02	2.6%
	Annual	0.18	2.68E-05	0.01%	1.23E-03	0.7%
Molybdenum	24-hour	11	2.19E-06	0.00002%	3.65E-05	0.0003%
Nickel	1-hour	0.14	5.93E-05	0.04%	6.74E-04	0.5%
	Annual	0.003	1.26E-06	0.04%	5.75E-05	2%
Potassium	1-hour	No criteria	3.03E-04	NA	3.44E-03	NA
Selenium	1-hour	No criteria	3.37E-05	NA	3.83E-04	NA
Silica (as Si)	24-hour	9.2	5.73E-03	0.06%	9.52E-02	1%
	Annual	2.7	2.61E-04	0.01%	1.19E-02	0.4%
Silver	1-hour	No criteria	1.35E-07	NA	1.53E-06	NA
Sodium	1-hour	No criteria	1.02E-03	NA	1.16E-02	NA
Strontium	1-hour	No criteria	3.61E-06	NA	4.10E-05	NA
Titanium	1-hour	No criteria	3.28E-04	NA	3.73E-03	NA
Vanadium	24-hour	0.92	7.84E-07	0.00009%	1.30E-05	0.001%
Zinc oxide (as Zn)	24-hour	46	8.32E-03	0.02%	0.14	0.3%
VOCs						
Ethane	1-hour	No criteria	0.0448	NA	0.509	NA
Propane	1-hour	No criteria	0.0231	NA	0.263	NA
Butane	1-hour	No criteria	0.0304	NA	0.345	NA
Pentane	1-hour	11	0.0376	0.3%	0.427	3.9%
Hexane	1-hour	0.90	0.0260	2.9%	0.295	33%
Benzene	Annual	9.6	6.43E-07	0.000007%	2.95E-05	0.0003%
Toluene	24-hour	3760	2.29E-05	0.0000006%	3.80E-04	0.00001%

Emission	Assessment criteria averaging Period	Assessment criteria (µg/m3)	Maximum predicted GLC at sensitive receptors (µg/m^3)	Percentage of assessment criteria	Maximum predicted GLC at site boundary (µg/m^3)	Percentage of assessment criteria
	Annual	376	1.04E-06	0.0000003%	4.77E-05	0.00001%
Semi-volatile organics						
Dioxins (TEQ)	1-hour	2E-06	3.87E-11	0.002%	4.40E-10	0.02%
Polycyclic aromatic hydrocarbons (as BaP)	Annual	3.0E-04	8.30E-06	2.8%	9.43E-05	31%

NA = not applicable. Some values are displayed using Excel scientific format.

Table 19: Maximum predicted GLCs at nearest sensitive receptor and site boundary from cumulative emissions impacts

Emission	Assessment criteria averaging Period	Assessment criteria (µg/m3)	Background concentration for impact assessment (µg/m^3)	Maximum predicted GLC at sensitive receptors (µg/m^3)	Percentage of assessment criteria	Maximum predicted GLC at site boundary (µg/m^3)	Percentage of assessment criteria
Gases							
Nitrogen oxides (NOx)	1-hour	246	90	91.7	37%	110	45%
	Annual	61.6	No data	NA	NA	NA	NA
Sulfur dioxide (SO_2)	10-minute	500	No data	5.69	1.1%	64.6	13%
	1-hour	571.8	160	164	29%	205	36%
	24-hour	228.7	26	27.9	12%	56.8	25%
	Annual	57.2	5	5.08	8.9%	8.9	15%
Carbon monoxide (CO)	15-minute	100 000	No data	NA	NA	NA	NA
	30-minute	60 000	No data	NA	NA	NA	NA
	1-hour	30 000	No data	NA	NA	NA	NA
	8-hour	11 249	2175	2170	19%	2174	19%
Particulates							
PM_{10}	24-hour	50	29.4	29.5	59%	30.4	60%
	Annual	20	No data	NA	NA	NA	NA
$PM_{2.5}$	24-hour	25	14.1	14.2	57%	15.1	60%
	Annual	8	8.1	8.1	101%	8.2	103%
Acid gases							
Hydrogen chloride	1-hour	100	27.5	27.5	28%	27.5	28%
	1-hour	140	27.5	27.5	20%	27.5	20%
Hydrogen fluoride	1-hour	100	6.0	6.0	6.0%	6.00	6.0%
Metals							
Aluminium	1-hour	No criteria	5.15	5.2	NA	5.2	NA
Antimony	1-hour	9	0.056	0.0565	0.6%	0.056	0.6%
Arsenic	1-hour	0.09	0.13	0.132	147%	0.13	147%
	24-hour	0.03	0.053	0.053	176%	0.053	176%
	Annual	0.003	No data	NA	NA	NA	NA
Barium	1-hour	No criteria	0.093	0.093	NA	0.093	NA
Beryllium	1-hour	0.004	No data	NA	NA	NA	NA
	Annual	0.00018	No data	NA	NA	NA	NA
Cadmium	1-hour	0.018	No data	NA	NA	NA	NA
Calcium	1-hour	No criteria	No data	NA	NA	NA	NA

Emission	Assessment criteria averaging Period	Assessment criteria (µg/m3)	Background concentration for impact assessment (µg/m^3)	Maximum predicted GLC at sensitive receptors (µg/m^3)	Percentage of assessment criteria	Maximum predicted GLC at site boundary (µg/m^3)	Percentage of assessment criteria
Chromium	1-hour	9	0.031	0.031	0.3%	0.032	0.4%
	24-hour	0.46	0.012	0.012	2.7%	0.013	2.8%
Cobalt	24-hour	0.092	No data	NA	NA	NA	NA
Copper	24-hour	1	0.04	0.0400	4.0%	0.0403	4.0%
Iron	1-hour	No criteria	2.75	2.75	NA	2.75	NA
Lead	Annual	0.5	0.010	0.0100	2.0%	0.010	2.0%
Lithium	1-hour	No criteria	No data	NA	NA	NA	NA
Magnesium	1-hour	No criteria	2.13	2.13	NA	2.13	NA
Manganese	1-hour	18	0.055	0.055	0.3%	0.055	0.3%
	Annual	0.14	0.01	0.010	7.1%	0.010	7.1%
Mercury	1-hour	0.55	No data	NA	NA	NA	NA
	Annual	0.18	No data	NA	NA	NA	NA
Molybdenum	24-hour	11	No data	NA	NA	NA	NA
Nickel	1-hour	0.14	No data	NA	NA	NA	NA
	Annual	0.003	No data	NA	NA	NA	NA
Potassium	1-hour	No criteria	No data	NA	NA	NA	NA
Selenium	1-hour	No criteria	No data	NA	NA	NA	NA
Silica (as Si)	24-hour	9.2	No data	NA	NA	NA	NA
	Annual	2.7	No data	NA	NA	NA	NA
Silver	1-hour	No criteria	No data	NA	NA	NA	NA
Sodium	1-hour	No criteria	15.7	15.7	NA	NA	NA
Strontium	1-hour	No criteria	No data	NA	NA	NA	NA
Titanium	1-hour	No criteria	0.24	0.24	NA	0.244	NA
Vanadium	24-hour	0.92	No data	NA	NA	NA	0.001%
Zinc oxide (as Zn)	24-hour	46	0.096	0.10	0.2%	0.234	0.5%
VOCs							
Ethane	1-hour	No criteria	No data	NA	NA	NA	NA
Propane	1-hour	No criteria	No data	NA	NA	NA	NA
Butane	1-hour	No criteria	No data	NA	NA	NA	NA
Pentane	1-hour	11	No data	NA	NA	NA	NA
Hexane	1-hour	0.90	3.0	3.0	337%	3.30	367%
Benzene	Annual	9.6	1.5	1.50	16%	1.50	16%

Emission	Assessment criteria averaging Period	Assessment criteria (µg/m3)	Background concentration for impact assessment (µg/m^3)	Maximum predicted GLC at sensitive receptors (µg/m^3)	Percentage of assessment criteria	Maximum predicted GLC at site boundary (µg/m^3)	Percentage of assessment criteria
Toluene	24-hour	3760	6	6.00	0.2%	6.00	0.2%
	Annual	376	1.5	0.600	0.2%	0.600	0.2%
Semi-volatile organics							
Dioxins (TEQ)	1-hour	2E-06	6.50E-08	6.50E-08	3.3%	6.54E-08	3.3%
Polycyclic aromatic hydrocarbons (as BaP)	Annual	0.0003	8.4E01-4	8.49E-04	283%	9.35E-04	312%

NA = not applicable. Note: Some values are displayed using Excel scientific format.

Dispersion modelling - summary

Overall, the predicted direct air emission impacts from the Proposal well below air quality criteria (standards) at sensitive receptors and the boundary of the Proposal site. Exceedances of air quality criteria are predicted for hexane, PAHs, Arsenic and $PM_{2.5}$ (annual average) when background concentrations are considered. However, those exceedances are a consequence of relatively high background concentrations assigned to these parameters for the assessment and not due to emissions from the Proposal.

These results show that the Proposal can satisfy EPA's objective for air quality in respective of no human health impacts.

Sensitivity analysis

The predicted GLCs from the dispersion modelling suggest a low risk of air quality impacts from the Proposal. Those results are a reflection of the inputs to the modelling, which include the composition of EOL tyres and the process operating conditions.

Key variables in those factors are the feed rate to the TRRF and the homogeneity of the tyre shred in respect of air emissions precursors such as sulfur, nitrogen and heavy metal content. The feed rate will be relatively constant and not expected to vary by more than ±10% from the specified rate (2500 kg/h) once normal operations are established after startup.

The bulk composition of types in terms of rubber, steel wire and fabric content varies from passenger tyres to truck tyres to OTR tyres. For example, typical wire content of passenger tyres is reported to be 16.5%, truck tyres 23% and OTR tyres 12% (EER 2006). The tyres are largely shredded as they are received which suggests some stratification of shredded tyre composition may occur if, for example, a large load of truck tyres is received. However, the Proposal includes a number of stages of shred handling prior to introduction into the TCU, which serves to reduce the variability in shred composition.

The proportion of these types of tyres in EOL tyre streams will vary depending on the nature of suppliers who provide the EOL tyres. One estimate from a 2009-2010 study shows passenger tyres constitute 42.5% of the EOL tyres (as EPUs), truck tyres 30.3% and OTR tyres 27.2% (Hyder 2012). These data provide a basis for assessing the sensitivity of the emission profile to the proportions of the respective types of tyres in the feed to the TCU.

The sensitivity of the emissions rates to the type of tyre shred feed has been assessed for the following scenarios:

1. Increase the feed rate by 10% (2500 kg/h to 2750 kg/h) to accommodate upper limit of variability in feed rate.
2. Assume feed is 100% passenger tyres (2500 kg/h).
3. Assume feed is 100% truck tyres (2500 kg/h).
4. Assume feed is 100% OTR tyres (2500 kg/h).

As discussed above, the variance in feed rate is not expected to exceed ±10%. As such the sensitivity analysis for scenario 1 provides a reasonable understanding of the potential impacts during normal operations. In contrast, the likelihood of the Proposal processing entirely one type of tyre at any time is very low, since the tyres are obtained from a large number of sources and the shredding and shred handling processes will serve to mix the shredded material prior to introduction into the TCU. As a consequence, the sensitivity assessment reflects the extremes of possible feed material which are highly unlikely to occur.

The 10% increase in feed rate gives rise to a similar increase in emissions for all parameters (data not shown). The results of the analyses of emission rates for the three different types of tyres (scenarios 2, 3 and 4) are summarised in Table 20. Note that the available compositional data for the three types of tyres is not as comprehensive as for mixed tyres reported in the literature. As a consequence the sensitivity analysis for the three types of tyres does not include values for all parameters previously described in this document.

Key findings from the sensitivity analyses are as follows:

- processing of 100% passenger tyres is predicted to decrease the Chromium and HCl emission rates for by 82 and 17%, respectively, but increase emission rate of ZnO by 29%. Emission rates for other parameters were unchanged or only slightly changed
- processing of 100% truck tyres is predicted to significantly decrease emissions for many parameters, with the largest decrease for HCl (38%)
- processing of 100% OTR tyres is predicted to increase emissions, with ZnO showing the most significant increase (85%). The most significant increases are predicted for metals and halides, which reflects the higher proportion of rubber and fabric (which contains more ZnO and associated heavy metal contaminants) in OTR tyres compared with steel wire used in other types of tyres.

The significance of the increase in emissions rates from the sensitivity analysis is demonstrated from comparison of the predicted GLCs for the four scenarios with air quality criteria. Predicted GLCs are all well below the air quality criteria for all types of tyres (Table 21) indicating the variability in composition of EOL tyre mixture processed in the Proposal will have negligible impact on air quality.

Table 20: Results of sensitivity analyses

Emission	EOL tyres - 2500 kg/h (base case)	100% passenger tyres – 2500 kg/h		100% truck tyres – 2500 kg/h		100% OTR tyres – 2500 kg/h	
	Emission rate (kg/h)	Emission rate (kg/h)	Change from base case	Emission rate (kg/h)	Change from base case	Emission rate (kg/h)	Change from base case
Nitrogen oxides (NOx)	1.04E+00	1.04E+00	0.0%	1.04E+00	0.0%	1.04E+00	0.0%
Sulfur dioxide (SO_2)	2.36E+00	2.36E+00	0.0%	2.36E+00	0.0%	2.36E+00	0.0%
Carbon monoxide (CO)	2.74E-01	2.74E-01	0.0%	2.74E-01	0.0%	2.74E-01	0.0%
PM_{10}	7.74E-02	7.74E-02	0.0%	7.74E-02	0.0%	7.74E-02	0.0%
$PM_{2.5}$	7.74E-02	7.74E-02	0.0%	7.74E-02	0.0%	7.74E-02	0.0%
Hydrogen chloride	1.29E-03	1.07E-03	-17.1%	8.05E-04	-37.6%	1.54E-03	19.4%
Hydrogen fluoride	1.35E-05	1.41E-05	4.4%	1.06E-05	-21.5%	2.03E-05	50.4%
Antimony	2.00E-06	2.09E-06	4.5%	1.57E-06	-21.5%	3.00E-06	50.0%
Arsenic	1.75E-06	1.78E-06	1.7%	1.57E-06	-10.3%	2.15E-06	22.9%
Cadmium	7.82E-06	7.93E-06	1.4%	7.25E-06	-7.3%	9.13E-06	16.8%
Chromium	5.73E-05	5.95e-05	-3.8%	4.63E-05	-19.7%	8.27E-05	44.0%%
Cobalt	1.32E-05	1.38E-05	4.5%	1.04E-05	-21.2%	1.96E-05	48.5%
Copper	1.95E-05	2.02E-05	3.6%	1.61E-05	-17.4%	2.73E-05	40.0%
Lead	8.28E-05	8.63E-05	4.2%	6.53E-05	-21.1%	1.23E-04	48.6%
Manganese	3.77E-06	3.86E-06	2.4%	3.34E-06	-11.4%	4.77E-06	26.5%
Mercury	7.51E-04	7.84E-04	4.4%	5.88E-04	-21.7%	1.13E-03	50.5%
Nickel	3.52E-05	3.63E-05	3.1%	2.97E-05	-15.6%	4.79E-05	36.1%
Vanadium	1.00E-06	1.04E-06	4.0%	7.83E-07	-21.7%	1.50E-06	50.0%
Zinc oxide (as Zn)	1.06E-02	1.34E-02	29.2%	1.03E-02	-2.8%	1.96E-02	84.9%

Note: Some values are displayed using Excel scientific format.

Table 21: Comparison of predicted GLCs from sensitivity analyses with air quality assessment criteria at nearest sensitive receptor

Emission	Averaging period	Assessment criteria (µg/m^3)	EOL tyres – 2500 kg/h	100% passenger tyres – 2500 kg/h	100% truck tyres – 2500 kg/h	100% OTR tyres – 2500 kg/h
			Percentage of criteria	Percentage of criteria	Percentage of criteria	Percentage of criteria
Gases						
Nitrogen oxides (NOx)	1-hour	246	0.71%	0.71%	0.71%	0.71%
	Annual	61.6	0.06%	0.060%	0.060%	0.060%
Sulfur dioxide (SO_2)	10-minute	500	1.14%	1.14%	1.14%	1.14%
	1-hour	571.8	0.70%	0.70%	0.70%	0.70%
	24-hour	228.7	0.81%	0.81%	0.81%	0.81%
	Annual	57.2	0.15%	0.15%	0.15%	0.15%
Carbon monoxide (CO)	15-minute	100 000	0.0006%	0.00061%	0.00061%	0.00061%
	30-minute	60 000	0.0004%	0.00035%	0.00035%	0.00035%
	1-hour	30 000	0.0015%	0.0015%	0.0015%	0.0015%
	8-hour	11 249	0.0028%	0.0028%	0.0028%	0.0028%
Particulates						
PM_{10}	24-hour	50	0.12%	0.12%	0.12%	0.12%
	Annual	20	0.01%	0.014%	0.014%	0.014%
$PM_{2.5}$	24-hour	25	0.24%	0.24%	0.24%	0.24%
	Annual	8	0.03%	0.034%	0.034%	0.034%
Acid gases						
Hydrogen chloride	1-hour	100	0.0020%	0.0018%	0.0013%	0.0021%
	1-hour	140	0.0020%	0.0013%	0.0010%	0.0015%
Hydrogen fluoride	1-hour	100	0.000020%	0.000024%	0.000018%	0.000036%
Metals						
Antimony	1-hour	9	0.000040%	0.000039%	0.000029%	0.000059%
Arsenic	1-hour	0.09	0.0030%	0.0033%	0.0029%	0.0041%
	24-hour	0.03	0.0050%	0.0046%	0.0041%	0.0057%
	Annual	0.003	0.0020%	0.0021%	0.0019%	0.0026%
Cadmium	1-hour	0.018	0.070%	0.074%	0.067%	0.086%
Chromium	1-hour	9	0.001%	0.0011%	0.00086%	0.0016%
	24-hour	0.46	0.010%	0.010%	0.0078%	0.015%
Cobalt	24-hour	0.092	0.010%	0.012%	0.0089%	0.018%
Copper	24-hour	1	0.002%	0.0016%	0.0013%	0.0022%
Lead	Annual	0.5	0.001%	0.000615%	0.00047%	0.00091%
Manganese	1-hour	18	0.00%	0.000036%	0.000031%	0.000046%
	Annual	0.14	0.00%	0.000099%	0.000085%	0.00012%
Mercury	1-hour	0.55	0.20%	0.24%	0.18%	0.36%
	Annual	0.18	0.01%	0.016%	0.012%	0.023%
Nickel	1-hour	0.14	0.04%	0.044%	0.036%	0.059%
	Annual	0.003	0.04%	0.043%	0.035%	0.059%
Vanadium	24-hour	0.92	0.00%	0.000089%	0.000067%	0.00013%
Zinc oxide (as Zn)	24-hour	46	0.02%	0.023%	0.018%	0.043%

Results from dispersion modelling – separation distance to sensitive receptors

The EPA 2005 guidance for separation distances for a used tyre storage facility, used tyre recycling facility and char production are 100-200 m, 500-1000 m and 1000 m, respectively (EPA 2005).

Relevant considerations identified by EPA for these categories are:

- gaseous emissions
- noise
- dust
- odour
- risk.

The Proposal site is located within an existing industrial area and is approximately 600 m from the nearest residential areas. An assessment has therefore undertaken to ensure that the risks to public health and amenity are acceptable and can be appropriately regulated and managed.

Based on the results of the air emissions assessment, the separation distance from the Proposal site to the nearest sensitive receptors is adequate to ensure that health or amenity will not be impacted as a result of the Proposal. In particular, acceptable air quality impacts are predicted at the boundary of the Proposal. As such there is a low risk of unacceptable impacts at the nearest residential area.

6.6 Management, monitoring and validation

6.6.1 Emissions management

Pollution control equipment incorporated into the design of the Proposal is outlined in Section 2.10.11. The following emissions management will be undertaken:

- low NOx burners will be installed on the TCU combustion chamber and the thermal oxidiser
- the process gas condenser will remove the majority of sulfides thereby reducing the SO_2 emissions from the thermal oxidiser
- the thermal oxidiser design provides for a minimum 2 second residence time at high temperature to ensure highly efficient combustion efficiencies
- a 15 m tall stack will be installed to ensure efficient dispersion of emissions
- stack emissions will be discharged at high temperature, providing good plume buoyancy for efficient dispersion of emissions.

The air emissions assessment indicates that these measures are sufficient to ensure acceptable air quality outcomes from the Proposal. In particular:

1. Dispersion modelling for normal operations shows no exceedances of the air quality criteria for the maximum predicted GLCs at the nearest sensitive receptors approximately 600 m from the boundary of the Proposal site.
2. Aside from hexane, As, PAHs and $PM_{2.5}$, no exceedances of the respective air quality criteria are predicted where the emissions from the Proposal are combined with background concentrations.
3. Those exceedances are driven by the background concentrations used for the assessment, with the contributions from the Proposal being insignificant in comparison.
4. Based on the above, additional pollution control measures are not considered necessary. The Proposal as designed will be sufficiently protective of human health and the environment.

6.6.2 Emissions testing

The assessment of air emission impacts has involved a mass balance derived emissions assessment and dispersion modelling to predict ground level concentrations of various pollutants. Those predictions will be validated by measurements of emissions from the emission stack once the Proposal is commissioned.

Stack testing for commissioning

Measurements of NOx, CO, SO_2, O_2 and CO_2 will be made during commissioning to assist in the optimisation process. At the completion of commissioning when the TRRF is operating under optimal conditions, a campaign of stack emission testing will be undertaken to formally validate predictions of emission concentrations and rates of all parameters considered in the air quality impact assessment.

All emissions testing will be carried out using appropriate sampling and analysis methods, with a National Association of Testing Authorities (NATA) accredited emissions testing company engaged for that work. Measurements of combustion gases for process optimisation will be made by Elan operations personnel, using a combustion gas analyser calibrated by a NATA accredited laboratory.

Campaign-based emissions monitoring

The findings from the commissioning stack testing will provide advice on emissions parameters of significance and an appropriate frequency for emissions testing for ongoing operation. Based on the level of risk predicted in the air emissions assessment, an appropriate frequency of stack testing (after the commissioning testing) would be biannual in the first year of operation, then annually thereafter should the first year's results be fully compliant with emission limits stated in the operating licence for the facility.

The parameters of interest for testing would be developed in consultation with relevant agencies.

6.6.3 Regulation under Part V of the *Environmental Protection Act 1986*

The Proposal will be a prescribed premises under Part V of the EP Act. As such, a works approval and licence with be required to construct and operate the Proposal. The TRRF is likely to be "prescribed" under Schedule 1 of the Environmental Protection Regulations 1987 as:

- **Category 37** - Char manufacturing: premises on which wood, carbon material or coal is charred to produce a fuel or material of a carbonaceous nature of enriched carbon content
- **Category 57** – used tyre storage (general): premises (other than premises within category 56 on which used tyres are stored).

Instruments (works approval and licence) under Part V of the EP Act can adequately manage and regulate the construction, commissioning and operational phases of the Proposal. Conditions relating to monitoring, management and emission limits can be applied to the Proposal to ensure that emissions are aligned with predictions and achieve relevant standards and guidelines.

6.6.4 Contingency

Where necessary, assumptions have been made in predicting emission rates in the mass balance. In most cases, those assumptions have been made on a conservative basis. This means that higher emission rates have been predicted than are likely to occur for many parameters. In addition, the maximum predicted ground level concentrations from the dispersion modelling have been found to be well below the air quality standards. As a consequence, the Proponent is confident of achieving the predicted emissions outcomes.

The risk of actual emissions being greater than predicted and exceeding air quality standards has been evaluated through a sensitivity analysis of EOL tyre inputs (refer to Section 6.5.7). That analysis considers variability in feed rate to the TRRF and the homogeneity of the tyre shred. Overall, the sensitivity analysis has shown variances in feed rate and feed composition will have no significant impact on air quality as a result of emissions from the Proposal.

Notwithstanding the very low risk of actual emissions exceeding air quality standards, the Proponent will develop and implement contingency plans in the event that the actual emission rates are significantly higher than those predicted. These plans would include an initial investigation to confirm results were valid and the status of operating conditions for the tests. If necessary, the stack testing would be repeated for relevant parameters (if the initial result was invalid) or repeated for all parameters if the operating conditions were outside normal specifications.

Should the initial investigation indicate that higher than predicted results were valid for normal operating conditions then the Proponent would immediately advise the regulator (i.e. DER). An appropriate action plan would be developed with DER involvement to identify risks of environmental harm and improvements that could be made to ensure acceptable emissions performance.

As indicated, the implementation of the contingency plan in the event of higher than predicted emissions are observed would be the subject of discussions with the DER and approval of the actions necessary to acceptable emissions outcomes at all times. A report on the investigations, assessments, proposed process modifications to reduce emission rates of relevant parameters and any other relevant information to emissions performance, would be provided to DER at an agreed time.

If exceedances of air quality standards are predicted from higher actual emission rates, then the plant would be shut down while the process and operations review was carried out, and improvements identified to reduce emissions of the relevant parameters to comply with air quality standards. The DER would be immediately notified and discussions held to develop action plan to deliver acceptable emissions outcomes. A report would be provided to DER for consideration prior to implementation of improvements and to facilitate approval for re-start of the plant. Additional emissions testing would be carried out to verify the success of the improvements, with the results reported to DER.

6.7 Best practice

EPA guidance *Implementing Best Practice in proposals submitted to the Environmental Impact Assessment process* (EPA 2003) has been considered in the selection of technology for the Proposal. The EPA's approach to application of best practice is summarised in the guidance document as follows:

> *The thrust of this Guidance Statement is that:*
>
> > *a) All relevant environmental quality standards must be met.*
> >
> > *b) Common pollutants should be controlled by proponents adopting Best Practicable Measures (BPM) to protect the environment (see 3.2 Guidance on application).*
> >
> > *c) Hazardous pollutants (like dioxins) should be controlled to the Maximum Extent Achievable (MEA), which involves the most stringent measures available. For a small number of very hazardous and toxic pollutants, costs are not taken into account (see 3.2 Guidance on application).*
> >
> > *d) There is a responsibility for proponents not only to minimise adverse impacts, but also to consider improving the environment through rehabilitation and offsets where practicable.*
>
> *The EPA will always encourage proponents to achieve best practice. In general, a proposal which embraces best practice, meets appropriate standards and EPA objectives would be recommended for approval.*

Best Practicable Measures are defined as:

> *…incorporates technology and environmental management procedures which are practicable, having regard to, among other things, local conditions and circumstances, including costs, and to the current state of technical knowledge, including the availability of reliable, proven technology.*
>
> *Best practice involves the prevention of environmental impact, or, if this is not practicable, minimising the environmental impact, and also minimising the risk of environmental impact, through the incorporation of Best Practicable Measures. No significant residual impact should accrue as a result of a proposal*

Maximum extent achievable (MEA) requirements are to apply for management of hazardous pollutants, which are defined as Class 3 substances from EPA Victoria State Environment Protection Policy (Air Quality Management) (known as the SEPP). Importantly, EPA advises that MEA measures:

> *…are not intended to apply at pollutant levels which do not pose a credible risk*

The TRRF technology described in this Proposal has been intentionally selected to provide best practice outcomes for processing of EOL tyres with emissions impacts such that “credible risks” are highly unlikely to eventuate.

Key features of the technology that provide best practice outcomes are as follows:

- energy efficiency design of the TCU (25% more efficient that conventional indirect-fired rotary kiln or screw augur technologies)
- use of low NOx burners in the TCU combustion chamber and thermal oxidiser
- optimised burner management system to maximise thermal efficiencies and minimise NOx and CO emissions
- high efficiency staged air cyclonic thermal oxidiser technology maximises combustion efficiency of residual process gas
- pyrolysis process minimises risk of dioxins formation in the TCU
- use of oil condenser provides high efficiency scrubbing of process gas to remove entrained char fines and minimise emissions of metals, acid gases and sulfur oxides
- installation of the TRRF inside a fully enclosed building which significantly reduces risks of noise impacts at noise sensitive receptors and reduces fire risk
- fully enclosed materials conveyors and handling systems within the building to minimise risk of fugitive dust emissions
- discharge of gaseous emissions at nominal temperatures from 300 to 400 °C from a 15 m stack will provide for efficient dispersion of emissions.

The air emissions assessment described in Section 6 demonstrates the benefits of these best practice measures with full compliance with ambient air quality standards for all emissions.

6.8 EPA advice to the Minister for Environment

EPA Report 1468 provides advice to the Minister for Environment on the environmental and health performance of waste to energy (WTE) technologies. The EPA advice was sought in response to a number of WTE proposals involving municipal solid wastes (MSW) that were being considered by the EPA at the time.

EPA Report 1468 defines waste to energy as:

> *'the process of converting waste products into some form of energy. This energy could be heat, steam or synthetic gas (syngas). These primary energy sources can either be used directly or further converted into products such as electricity or synthetic fuels. Waste to energy technologies transform the calorific energy in waste produced into usage energy.'*

The Proponent considers EOL tyres are a resource and not a waste. The Proposal does not convert waste products into electricity or synthetic fuels. Instead, valuable resources (oil, char and wire) are recovered from EOL tyres for on-selling to appropriate markets. These recovered products have a range of downstream uses. Furthermore:

- the Proposal will not produce heat, steam or syngas for generation of electricity
- the Proposal does not generate synthetic fuels from synthesis gas via a Fischer-Tropsch process or equivalent
- the materials of greatest commercial value are char and oil and as such, the process is optimised to maximise recovery of these materials

- the EOL tyre-derived char is a substitute for coal-derived carbonaceous materials used in steel making, with potentially advantageous properties for scrap steel recycling using electric arc furnace technologies in Australia and overseas
- the recovered oil will be sold into the petrochemical market as a feedstock for chemicals and solvent manufacturing or for blending into a refinery stream for conventional liquid hydrocarbon production
- the oil will not be converted to a synthetic fuel as part of the Proposal
- the steel wire is recovered for sale to the scrap metal recycling market
- the residual process gas will not be upgraded to synthesis gas (syngas)
- recuperative heat recovery to combustion air will be employed on the TCU to optimise the thermal efficiency of the process but not to generate steam.

Item 12 of the ESD advises the following in respect of EPA Report 1468:

> *Describe the extent to which the EPA Advice to the Minister for Environment on the Environmental and Health Performance of Waste to Energy Technologies is applicable to the pyrolysis component of this proposal*

The “pyrolysis component” of the Proposal is the TCU (thermal conversion unit), where the shredded EOL tyres are heated to high temperature in the absence of oil to thermally degrade the organic components of the tyre shred. Thermal degradation (pyrolysis) reactions do not occur elsewhere in the process components; in particular the tyre shred feed system, char recovery circuit, , oil condenser and oil storage, thermal oxidiser, TCU kiln combustion chamber, cooling tower, char recovery, pelletising and bagging, wire recovery and export.

The recommendations from EPA Report 1468 and the extent of applicability of the pyrolysis component of the Proposal to those recommendations are presented in Table 22.

Table 22: EPA recommendations for waste to energy technologies

Recommendation		Extent that the EPA recommendations apply to the pyrolysis component of the Proposal	Additional comments
1	Given the likely community perception and concern about waste to energy plants, a highly precautionary approach to the introduction of waste to energy plants is recommended.	As discussed above the TRRF Proposal is not a waste to energy plant. Recommendation 1 is not applicable to the pyrolysis component of the Proposal.	Elan has recognised that the TRRF Proposal has potential for community interest. As a consequence, Elan is engaging in stakeholder consultation and will use best practice technology to minimise risks and provide acceptable environmental outcomes.
2	As part of the environmental assessment and approval, proposals must address the full waste to energy cycle - from accepting and handling waste to disposing of by-products, not just the processing of waste into energy.	The Proponent considers that EOL tyres are a resource in the context of the TRRF Proposal. The Proposal does not involve a waste to energy cycle, in that energy is not produced. Recommendation 2 is not applicable to the pyrolysis component of the Proposal.	The Proposal will not generate by-products. Wastewater from cooling tower blow-down will be managed and regulated through other regulatory mechanisms.
3	Waste to energy proposals must demonstrate that the waste to energy and pollution control technologies chosen are capable of handling and processing the expected waste feedstock and its variability on the scale being proposed. This should be demonstrated through reference to other plants using the same technologies and treating the same waste streams on a similar scale, which have been operating for more than twelve months.	The Proposal is not a waste to energy proposal. Pollution control technologies are not required on the pyrolysis component of the Proposal, since process materials within the pyrolysis component are not released to the environment. Recommendation 3 is not applicable to the pyrolysis component of the Proposal.	The process design is such that air emission impacts from the Proposal are well below air quality standards. Air emissions from combustion of natural gas in the TCU kiln and residual process gas in the thermal oxidiser will be discharged to atmosphere via a stack. Those emissions and their impacts are minimised by use of: • 15 m stack and 300-400 °C discharge temperature to provide efficient dispersion • Low NOx burners in the TCU and thermal oxidiser • Removal of particulates, metals, acid gases, VOCs, and organosulfides from process gas from condensation of oil • High efficiency combustion of residual process gas in a thermal oxidiser to destroy residual organics.
4	Waste to energy proposals must characterise the expected waste feedstock and consideration made to its likely variability over the life of the proposal.	The Proposal is not a waste to energy proposal and as such, Recommendation 4 is not applicable to the pyrolysis component of the Proposal. The Proponent will only be processing EOL tyres, from which valuable resources will be recovered. No other feedstocks will be proposed in the facility.	The pyrolysis component of the Proposal will treat the shredded EOL tyres to generate char, wire and process gas. The design of that component will accommodate the variability in the types of EOL tyres processed. The variability in types of EOL tyres is a factor to be managed for the operation of the facility. A sensitivity analysis has been conducted for the various types of EOL tyres expected to be processed, to identify extent of change in environmental risks. The results show acceptable low levels of risk with air emissions compliant with ambient air quality standards for all operating scenarios.

Recommendation		Extent that the EPA recommendations apply to the pyrolysis component of the Proposal	Additional comments
5	The waste hierarchy should be applied and only waste that does not have a viable recycling or reuse alternative should be used as feedstock. Conditions should be set to require monitoring and reporting of the waste material accepted over the life of a plant.	The TRRF will process EOL tyres to recover (recycle) raw materials (char, oil and steel wire) for beneficial use. The Proposal does not involve processing residual wastes which cannot be reused or recycled. The Proponent considers EOL tyres as a resource in the context of the Proposal. Monitoring of the tonnage of EOL tyre feedstock will be carried out; however, the Proposal does not include monitoring of the types of EOL tyres accepted at the facility. The monitoring will be carried out upstream of the pyrolysis component. Therefore, Recommendation 5 is not applicable to the pyrolysis component of the Proposal.	The waste hierarchy as set out in the Waste Avoidance and Resource Recovery Act (2007) shows energy recovery at the bottom of the resource recovery sector and recycling at a level above. The definition of recycling is: *"converting waste materials back into raw materials for use in new products"* The definition of energy recovery (from thermal treatment) is: *"a thermal waste to energy plant which produces electricity, steam and/or heat as a form of energy recovery"* Those definitions indicate that the TRRF is a recycling (recovery) facility and not a waste to energy facility, mindful that EOL tyres are considered by the Proponent as a resource in the context of the Proposal. Furthermore, EPA report 1468 details six principles that the EPA and Waste Authority see as key to successful operation of waste to energy plants in WA. The fourth principle is: *"The waste sourced as input must target genuine residual waste that cannot feasibly be reused or recycled"* The Proposal does not involve processing residual wastes which cannot be reused or recycled.
6	Waste to Energy operators should not rely on a single residual waste stream over the longer term because it may undermine future recovery options.	The Proposal is not a waste to energy proposal. Residual wastes will not be processed. Recommendation 6 is not applicable to the pyrolysis component of the Proposal.	The intention of the Proposal is to process a single feed stream (EOL tyres).
7	Regulatory controls should be set on the profile of waste that can be treated at a waste to energy plant. Plants must not process hazardous waste.	The Proposal is not for a waste to energy plant and hazardous wastes will not be processed. Recommendation 7 is not applicable to the pyrolysis component of the Proposal.	Elan will only be processing EOL tyres, which are considered by the Proponent as a resource in the context of the Proposal.
8	In order to minimise the discharge of pollutants, and risks to human health and the environment, waste to energy plants should be required to use best practice technologies and processes. Best practice technologies should, as a minimum and under both steady state and non-steady state operating conditions, meet the equivalent of the emissions standards set in the European Union's Waste Incineration Directive (2000/76/EC).	The Proposal is not a waste to energy proposal. The pyrolysis component of the Proposal will not discharge emissions to atmosphere. As such the emission standards from the European Union's Waste Incineration Directive (2000/76/EC) are not relevant to the operation of the pyrolysis component of the Proposal. Recommendation 8 is not applicable to the pyrolysis component of the Proposal.	The Proposal involves use of best practice technologies and processes for recovery of resources from EOL tyres. Risks to human health and the environment from pollutants discharged from the Proposal are well managed by the process design.

Recommendation		Extent that the EPA recommendations apply to the pyrolysis component of the Proposal	Additional comments
9	Pollution control equipment must be capable of meeting emissions standards during non-standard operations.	The external heating of the pyrolysis component of the Proposal (the heat tube within the TCU) is carried out by natural gas burners projecting through the external walls of the TCU. The materials in the heat tube (char, process gas and partially pyrolysed EOL tyre shred) are not discharged to atmosphere and as such pollution control equipment is not required. Recommendation 9 is not applicable to the pyrolysis component of the Proposal.	Air emissions from combustion of natural gas in the TCU kiln will be discharged to atmosphere via a stack. The Proposal includes an assessment of the impacts of those emissions at sensitive receptors, which has demonstrated compliance with ambient air quality standards during all operating scenarios, namely startup, normal operations and shutdown.
10	Continuous Emissions Monitoring must be applied where the technology is feasible to do so (e.g. particulates, TOC, HCl, HF, SO2, NOx, CO). Non-continuous air emission monitoring shall occur for other pollutants (e.g. heavy metals, dioxins and furans) and should be more frequent during the initial operation of the plant (minimum of two years after receipt of Certificate of Practical Completion). This monitoring should capture seasonal variability in waste feedstock and characteristics. Monitoring frequency of non-continuously monitored parameters may be reduced once there is evidence that emissions standards are being consistently met.	The pyrolysis component of the Proposal does not discharge emissions to atmosphere. As such CEMS are not required. Recommendation 10 is not applicable to the pyrolysis component of the Proposal.	Air emissions from combustion of natural gas in the TCU kiln will be discharged to atmosphere via a stack. The air emissions assessment has shown compliance with ambient air quality standards during all operating scenarios under worst case meteorological conditions. As such, the risk to human health and the environmental is considered low. Installation of CEMS onto the stack for monitoring of TCU and thermal oxidiser emissions is not indicated from the low risks predicted for air emissions from the Proposal. The Proponent proposes to conduct stationary source emissions testing during commissioning to verify mass balance emissions predictions and impacts at sensitive receptors. The Proponent considers stationary source testing at an appropriate frequency as sufficient for monitoring of air emissions on an ongoing basis.
11	Background levels of pollutants at sensitive receptors should be determined for the Environmental Impact Assessment process and used in air dispersion modelling. This modelling should include an assessment of the worst, best and most likely case air emissions using appropriate air dispersion modelling techniques to enable comparison of the predicted air quality against the appropriate air quality standards. Background monitoring should continue periodically after commencement of operation.	The pyrolysis component of the Proposal does not discharge emissions to atmosphere and has no influence or relevance to background levels of pollutants at sensitive receptors. Recommendation 11 is not applicable to the pyrolysis component of the Proposal.	The stack emissions assessment has considered background levels of pollutants. Those background data were obtained from monitoring studies published by DER at various locations in the metropolitan area. Studies have not been conducted in the vicinity of the Proposal site. As such, a conservative approach has been adopted whereby the higher concentrations observed at other locations were used for the cumulative air emissions impact assessment from the Proposal. The NPI suggests that air emissions from other sources in the vicinity of the Proposal site are considerably greater than the Proposal emissions, in particular vehicle traffic emissions on the nearby major highways. As such a requirement for background monitoring to be conducted by the Proponent is unreasonable and not commensurate with the risk presented by the Proposal emissions.
12	To address community concerns, proponents should document in detail how dioxin and furan emissions will be minimised through process controls, air pollution control equipment and during non-standard operating conditions.	The pyrolysis component of the Proposal does not discharge emissions to atmosphere, including dioxins and furans. Recommendation 12 is not applicable to the pyrolysis component of the Proposal.	The potential for dioxins and furans to be formed in the combustion components (TCU kiln and thermal oxidiser) is low. The TCU burners will utilise natural gas as a fuel, which have a low dioxins emissions factor. The residual process gas will not contain dioxins and dioxins precursor organics, since that gas is produced from pyrolysis (in the absence of oxygen) of EOL tyres, which does not favour dioxins formation. Any dioxins in residual process gas will be destroyed in the thermal oxidiser.

Recommendation		Extent that the EPA recommendations apply to the pyrolysis component of the Proposal	Additional comments
13	Proposals must demonstrate that odour emissions can be effectively managed during both operation and shut-down of the plant.	The pyrolysis component of the Proposal does not discharge emissions to atmosphere, including odours. Recommendation 13 is not applicable to the pyrolysis component of the Proposal.	The primary source of odour from thermal treatment of tyres is the presence of sulfur species such as H_2S, thiols and organosulfides in process gases. These gases are not released to atmosphere and as such the Proposal provides an insignificant risk of odour emissions impacts at sensitive receptors.
14	All air pollution control residues must be characterised and disposed of to an appropriate waste facility according to that characterisation.	The pyrolysis component of the Proposal does not require air pollution control and therefore does not generate residues. Recommendation 14 is not applicable to the pyrolysis component of the Proposal.	
15	Bottom ash must be disposed of at an appropriate landfill unless approval has been granted to reuse this product.	The pyrolysis component of the Proposal does not generate bottom ash. The solid materials produced by the pyrolysis component (char) will be recovered as a valuable product and sold to customers. Recommendation 15 is not applicable to the pyrolysis component of the Proposal.	
16	Any proposed use of process bottom ash must demonstrate the health and environmental safety and integrity of a proposed use, through characterisation of the ash and leachate testing of the by-product. This should include consideration of manufactured nanoparticles.	The pyrolysis component of the Proposal does not generate bottom ash. Recommendation 16 is not applicable to the pyrolysis component of the Proposal.	Potential risk from manufactured nanoparticles that may be present in air emissions from ZnO in tyres is discussed in Section 6.3.1.
17	Long term use and disposal of any by-product must be considered in determining the acceptability of the proposed use.	The pyrolysis component of the Proposal does not generate by-products. Recommendation 17 is not applicable to the pyrolysis component of the Proposal.	Wastewater from the cooling tower blow-down will be disposed of at appropriate liquid waste facility.
18	Standards should be set which specify the permitted composition of ash for further use.	The pyrolysis component of the Proposal does not generate ash. Recommendation 18 is not applicable to the pyrolysis component of the Proposal.	
19	Regular composition testing of the by-products must occur to ensure that the waste is treated appropriately. Waste by-products must be tested whenever a new waste input is introduced.	The pyrolysis component of the Proposal does not generate by-products. Recommendation 19 is not applicable to the pyrolysis component of the Proposal.	The wastewater from the cooling tower blow-down will be assessed and treated as necessary to comply with acceptance requirements for liquid waste disposal facility.
20	Waste to energy plants must be sited in appropriate current or future industrial zoned areas with adequate buffer distances to sensitive receptors. Buffer integrity should be maintained over the life of the plant.	The Proposal is not for a waste to energy plant. The pyrolysis component of the Proposal will be located in an industrial zoned area in Welshpool. As previously discussed, no emissions are produced from the pyrolysis component and as such buffer distance considerations are not applicable to the pyrolysis component of the Proposal. Recommendation 20 is not applicable to the pyrolysis component of the Proposal.	Separation distances to nearest sensitive receptors have been shown to be more than adequate for air emissions and noise impacts. Predicted GLCs of air emissions are well below air quality standards under worst case meteorological conditions. Assigned noise levels are achieved at noise sensitive receptors in the neighbouring residential area.

Recommendation		Extent that the EPA recommendations apply to the pyrolysis component of the Proposal	Additional comments
21	For a waste to energy plant to be considered an energy recovery facility, a proposal must demonstrate that it can meet the R1 Efficiency Indicator as defined in WID.	The Proposal is not for a waste to energy plant. The exhaust gases from the TCU combustion chamber which houses the pyrolysis component of the Proposal includes recuperative heat recovery from exhaust gases to incoming combustion air. However, the pyrolysis component of the Proposal does not contemplate energy recovery. Recommendation 21 is not applicable to the pyrolysis component of the Proposal.	The R1 Efficiency Indicator is not considered applicable to the TRRF plant, since the proposed feed is EOL tyres and not municipal solid waste as indicated in EU Directive 2008/98/EC, which states that "*this includes incineration facilities dedicated to the processing of municipal solid waste only…*" (footnote to Recovery Operation R1, Annex II). A facility must achieve an R1 of > 0.65 to be considered as an energy recovery facility. The R1 Efficiency Indicator calculation considers energy associated with raising steam for electricity generation and/or export of heat. As the Proposal does not raise steam or export heat, the calculation would not be applicable. The R1 for the Proposal is zero since electricity and heat are not produced by the process, and therefore the Proposal does not qualify as an energy recovery facility.

6.9 Summary of predicted impacts

Having regard to the outcomes described above in relation to air quality, the Proposal is expected to achieve the EPA's objectives for air quality, in particular:

1. Dispersion modelling for normal operations shows emissions are well below the air quality criteria for the maximum predicted GLCs at the nearest sensitive receptors. The most significant emissions were hexane, PAHs and SO_2, with a maximum predicted GLCs for the relevant time averages being of 2.9%, 2.8% and 1.1% of the respective air quality criterion for direct impacts.
2. Maximum predicted GLCs at the Proposal site boundary were also well below air quality criteria, with the most significant emission (hexane) having a maximum predicted GLCs at the Proposal site boundary of 33% of the air quality criteria.
3. Emissions from the Proposal combined with background concentrations (i.e. cumulative emissions) at the sensitive receptors are well below respective air quality criteria, with the exceptions hexane (1-hour average at 337% of the criteria, PAHs (1-hour average at 283% of the criteria), Arsenic (24-hour average at 176% of the criteria and 1-hour average at 147% of the criteria) and $PM_{2.5}$ (103% of the criteria).
4. These exceedances are driven by the background concentrations selected for the assessment, which exceed the criteria. The contributions from the Proposal are insignificant.
5. A sensitivity analysis of EOL tyre inputs demonstrates that variances in feed rate and feed composition have no significant impact on air quality as a result of emissions from the Proposal.
6. The Proposal utilises best practice technologies, which include air pollution controls from use of low NOx burners, removal of pollutants from the process gases with the oil recovery system, use of a high efficiency thermal oxidiser for control of residual process gas emissions and efficient dispersion of hot (200-400 °C) exhaust emissions via a 15 m stack.
7. The outcomes of the air emissions assessment will be validated by stack testing and campaign based monitoring during commissioning and operation of the Proposal. The Proposal will also be regulated under Part V of the EP Act (works approval and licence).
8. Predicted GLCs of parameters which can give rise to odour impacts (such as SO_2, NOx and VOCs) are well below odour thresholds.
9. In considering the outcome as described, the Proposal is expected to meet the EPA objective for air quality - which is to maintain air quality for the protection of the environment and human health and amenity.

7. Other factors

7.1 Inland waters environmental quality – discharge of liquid wastes

The ESD identified Inland waters environmental quality as an 'other factor' to be concisely described and discussed. Specifically, the ESD required consideration of the discharge of waste.

7.1.1 Wastewater

Wastewater in the form of cooling tower blow-down will be produced by the Proposal.

The storage of EOL tyres will require management to ensure low fire risk as previously detailed. Bunding will be installed at the site to capture and contain firefighting wastewater in the event of fire.

Wastewater can be readily managed and regulated through other regulatory mechanisms.

7.1.2 Solid waste

No solid wastes are expected from the EOL tyre processing. Any solid wastes from general plant operations (office waste, packaging, end-of-life equipment and components) can be readily managed and regulated through other regulatory mechanisms.

7.1.3 Liquid wastes (hydrocarbons and chemical storage)

Significant quantities of chemicals, liquid fuels or solvents will not be stored and liquid hydrocarbon and chemical wastes will not be produced at the Proposal site. In addition, the Proposal site is covered by concrete and/or bitumen, which provides low risks for the small quantities of chemicals, liquid fuels or solvents that may be required.

The TRRF will operate in accordance with the *Dangerous Goods Safety Act 2004* and Regulations for the manufacture and storage of Dangerous Goods. The Proponent understands that a Dangerous Goods Licence will be required for the proposed storage of hydrocarbons (oil). Hydrocarbon and chemical storage is considered a minor environmental factor in relation to this application.

The Proponent will comply with the standards for hydrocarbon/chemical storage condition based on the Dangerous Goods Storage Licence and relevant legislation DMP. All substances will be stored in accordance with the Code of Practice for the storage and handling of dangerous goods.

7.2 Amenity

The ESD identified amenity as an 'other factor' to be concisely described and discussed. Specifically, the ESD required consideration of the generation of noise and odour. Odour is addressed in Section 6.3.2.

7.2.1 Noise

Environmental noise can cause disturbance to nearby residents, industrial and commercial operators if noise is above levels designated in state legislation and regulations. Operational noise is considered an environmental factor in assessing possible impacts of the TRRF. There is potential for noise to be generated by the shredder and TCU. The closest resident is 600 m from the proposed TRRF premises, which is a similar distance to sensitive receptors to the current operations. The Plant will be located within existing enclosed buildings which are expected to provide significant attenuation of noise emissions from plant and equipment.

A noise assessment was undertaken for the Proposal in 2016 by Lloyd George Acoustics (Appendix 2 Environmental studies). The purpose of the assessment was to determine the potential noise impacts to neighbouring industrial premises, as well as the more distant residential premises, in accordance with the *Environmental Protection (Noise) Regulations 1997* (Noise Regulations).

Predicted noise levels at the residential premises were found to be below the assigned levels during all modelled scenarios. In addition, the existing background noise levels recorded at these residential premises is sufficiently high enough to make the noise from the operation of the Proposal inaudible at these residential locations (Lloyd George Acoustics 2016).

Predicted noise levels are likely to exceed the assigned levels at both the east and west neighbouring industrial boundaries (Lloyd George Acoustics 2016). As such, noise monitoring will be undertaken to validate the results of the modelling and compliance with the Noise Regulations once the TRRF is operational. If noise levels exceed the assigned levels, then mitigation measures will be applied to reduce the noise to an acceptable level. The processing equipment for the TRRF will be installed and operated within an enclosed building. If necessary, acoustic insulation can be installed on the walls and inside the roof of the building to reduce noise emissions. In addition, acoustic enclosures can be installed on noise generating equipment such as blowers and fans. Importantly, the design of noise controls will be informed by the actual measurements, with modelling carried out if required to assess the expected reduction in noise levels for the proposed controls prior to installation.

Based on the above the Proposal is not expected to result in amenity impacts. Noise monitoring will be carried out to confirm acceptable noise outcomes.

8. Summary of environmental impact assessment

8.1 Environmental factors and management

Table 23 provides a summary of the assessment, management and predicted outcomes after the application of management measures. The predicted outcomes are also assessed against the relevant EPA objective for each preliminary key environmental factor.

Table 23: Summary of environmental impact assessment of key environmental factors

EPA objective	Existing environment	Potential impact	Environmental management	Predicted outcome	Compliance with EPA objective
Air quality and other atmospheric gases. To maintain air quality for the protection of the environment and human health and amenity, and to minimise the emissions of greenhouse and other atmospheric gases through the application of best practice	The Proposal site is located approximately 12 km of Perth CBD within the Welshpool industrial area. The Proposal site is zoned 'General Industry', under the City of Canning Town Planning Scheme 40. The Proposal site was previously utilised for a storage and wholesaling business and contains paved and hard panned lots. An existing warehouse occupies approximately half of the site. The nearest sensitive receptors are in the residential area 600 m to the east of the Proposal site. Emissions characteristics have been derived from a mass balance (i.e. accounting for material entering and leaving the process) and emissions testing from a trial plant. The emissions data obtained from the mass balance and test plant trials have been used in dispersion modelling to assess the potential impacts at sensitive receptors.	The key air emissions parameters from the Proposal in respect of significance of impacts are: • oxides of nitrogen (NOx) • sulfur dioxide (SO2) • carbon monoxide (CO) • particulates. The assessment also considered a range of metals, hydrogen chloride (HCl) and hydrogen fluoride (HF), dioxins, volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs). Dispersion modelling of emissions from the single stack was carried out using the AERMOD atmospheric dispersion model. The residential area to the east of the Proposal site has been identified as containing sensitive receptors, with industrial premises surrounding the remainder of the Proposal site. Modelling has addressed direct impacts from the Proposal and cumulative impacts where background emissions from other sources are considered. The worst-case impacts are presented to ensure that the assessment of emissions is highly conservative. Ambient air quality guidelines and standards are derived from the Ambient Air Quality NEPM, DER (Toxikos), WHO and the Department of Health. These are the same standards as used for other projects recently assessed by EPA. Direct impacts of NOx at the Proposal site boundary are predicted to be 8% of the hourly average NEPM and 2.7% of the annual NEPM, SO_2 impacts are 13%, 7.9%, 13% and 6.7% of the 10-minute, 1-hour, 24-hour and annual standards, respectively; and CO impacts are 0.04% of the 8 hour standard. The cumulative impacts of air emissions from the Proposal are insignificant. For example, the predicted NOx GLC from the Proposal combined with background concentrations is 4% of the NEPM at the boundary, with the background accounting for 37% of NEPM. The cumulative hourly average SO_2 GLC is 36% of the NEPM with the background accounting for 28% of the NEPM. High backgrounds of hexane, As, PAHs and $PM_{2.5}$ lead to exceedances of air quality standards for the cumulative assessment, with the emissions from the Proposal minor contributors.	The TRRF will utilise 'state-of-art' technology, designed for processing EOL tyres to recover valuable materials. The proposed process is fully contained and the only emissions to the environment will be from a single stack of sufficient height to maximise dispersion and dilution, and minimise ground level concentrations. Dispersion model predictions show Ground Level Concentrations of air emissions are well below the air quality standards under worst-case meteorological conditions for both direct impacts and cumulative impacts where background concentrations are included. The following emissions management will be undertaken: • low NOx burners will be installed on the TCU combustion chamber and the thermal oxidiser • the process gas condenser will remove the majority of sulfides thereby reducing the SO_2 emissions from the thermal oxidiser • the thermal oxidiser design provides for a minimum 2 second residence time at high temperature to ensure highly efficient combustion efficiencies • a 15 m tall stack will be installed to ensure efficient dispersion of emissions • stack emissions will be discharged at high temperature, providing good plume buoyancy for efficient dispersion of emissions.	Taking into consideration: • dispersion modelling using the results of a mass balance emissions assessment and test plant trials • worst case dispersion modelling has indicated acceptable air emissions outcomes • application of pollution control and monitoring. The Proposal is not expected to represent a significant impact to the air quality of the area and meets the EPA objective for air quality. Furthermore, air emissions from the Proposal can be adequately regulated and managed under Part V of the EP Act. Relevant limits, targets, monitoring and management actions can be applied through conditions on a works approval and operating licence.	After the application of monitoring and management measures, the EPA objective for air quality and atmospheric gases is expected to be met.

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8.2 Consistency with environmental principles

In 2003, the EP Act was amended to include a core set of Principles that are applied by the EPA in assessing proposals. These environmental protection principles listed in s 4a of the EP Act are set out in Table 24 together with a summary of how the Proponent has considered these principles in its design and planned implementation of the Proposal.

Table 24: Consistency with Principles of Environmental Protection

Environmental Protection Principle	Consideration given in the Proposal
1. **The precautionary principle** Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In application of this precautionary principle, decisions should be guided by – • careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and • assessment of the risk-weighted consequences of various options.	The impact assessment for this PER is based on detailed environmental investigations. Impact predictions have been made based technical experts modelling and all assumptions have been documented. Where there are areas of uncertainty regarding potential impacts, conservative assumptions have been made and documented to facilitate decision making. These assumptions will be reviewed through the monitoring and management outlined in the PER.
2. **The principle of intergenerational equity** The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.	Elan is aiming to provide a Proposal that facilitates the recovery of valuable materials from EOL tyres. Currently EOL tyres in Perth are either being stored in dedicated tyre storage facilities, disposed of in approved landfills or illegally dumped. The need for alternative uses for EOL tyres has long been recognised along with the need to both preserve valuable resources and to prevent environmental damage due to improper disposal. Tyres are approximately 60% hydrocarbon, and have a higher calorific value than fuel sources such as wood, coke and brown coal. The key benefits of the Proposal include the diversion of EOL tyres from landfill and the recovery, reprocessing and re-use of valuable resources. This Proposal will be occurring within an existing industrial area which is already cleared. The Proposal is not predicted to compromise the health, diversity and productivity of the surrounding environment. The Proposal offers a significant environmental and economic benefit.
3. **The principle of conservation of biological diversity and ecological integrity** Conservation of biological diversity and ecological integrity should be a fundamental consideration.	The conservation of biological diversity and ecological integrity is a major environmental consideration for the Proposal. This Proposal will be occurring within an existing industrial area that is already cleared. Detailed investigations have been undertaken on the potential impacts to air quality and amenity to ensure no adverse impacts. Stormwater runoff will also be managed to ensure no adverse impacts to inland waters. The PER provides a detailed analysis of potential impacts to these factors and ongoing monitoring and management of potential impacts will be integrated into the implementation of the Proposal. The Proposal has been designed to minimise potential impacts to the key environmental values of its locality.

Environmental Protection Principle	Consideration given in the Proposal
4. **The principles relating to improved valuation, pricing and incentive mechanisms** Environmental factors should be included in the valuation of assets and services. The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement. The user of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste. Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problem.	Elan accepts that the cost of the Proposal must include environmental impact mitigation, management, monitoring and maintenance activities. These requirements will be incorporated into the overall Proposal costs.
5. **The principle of waste minimisation** All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	The Proposal directly and intentionally addresses the principle of waste minimisation with the recovery of resources from EOL tyres. The only process wastes to be generated from the Proposal will be relatively small volumes of blow-down from the cooling tower.

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Appendix 1
Environmental Scoping Document

Environmental Protection Authority

GOVERNMENT OF WESTERN AUSTRALIA

ENVIRONMENTAL SCOPING DOCUMENT

PROPOSAL NAME:	TYRE RESOURCE RECYCLING FACILITY
ASSESSMENT NUMBER:	2093
LOCATION:	LOT 90, 9 FARGO WAY, WELSHPOOL
LOCAL GOVERNMENT AREA:	CITY OF CANNING
PROPONENT:	ELAN ENERGY MATRIX PTY LTD
PUBLIC REVIEW PERIOD:	4 WEEKS

1. Introduction

The above proposal is being assessed by the Environmental Protection Authority (EPA) under Part IV of the *Environmental Protection Act 1986* (EP Act) at the level of Public Environmental Review (PER). This Environmental Scoping Document (ESD) sets out the requirements for the environmental review of the proposal. The purpose of an ESD is to:

- provide proposal-specific guidelines to direct the proponent on the preliminary key environmental factors or issues that are to be addressed during the environmental review and preparation of the environmental review report;
- identify the required work that needs to be carried out; and
- timing of the environmental review.

The proponent must conduct the environmental review in accordance with this ESD and then report to the EPA in an environmental review report (PER document). As well as the proposal-specific requirements for the environmental review identified in this ESD, the PER document must also address the generic information requirements listed in section 10.2.4 of the EPA's *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2012* (Administrative Procedures). When the EPA is satisfied that the PER document adequately addresses both of these requirements, the proponent will be required to release the document for a public review period of four weeks.

The EPA is currently in the process of updating its Administrative Procedures. If application of these new procedures to the assessment of this proposal is neither appropriate nor practicable, the Administrative Procedures applying at the time the decision was made on the level of assessment for the proposal will apply to that proposal.

This ESD has been prepared by the EPA in consultation with the proponent, decision-making authorities and interested agencies consistent with EPA Environmental Assessment Guideline (EAG) 10 – *Scoping a proposal.* ESDs prepared by the EPA are not subject to public review. The ESD will be available on the EPA website (www.epa.wa.gov.au) upon endorsement and must be appended to the PER document.

2. The proposal

The subject of this ESD is Elan Energy Matrix Pty Ltd's (Elan Energy Matrix) proposal for the construction and operation of a Tyre Resource Recycling Facility. The proposal is located at Lot 60, 9 Fargo Way Welshpool, approximately 12 kilometres (km) south-east of Perth in the City of Canning. The land is zoned for industrial purposes. The regional location of the proposal is shown in Figure 1.

The proponent has an existing tyre storage and shredding operation nearby at Lot 106, 101 Dowd Street Welshpool, which is licensed by the Department of Environment Regulation (DER). The proponent intends to relocate the storage and shredding components to Lot 60, 9 Fargo Way Welshpool and this is currently being addressed through Part V of the EP Act by the DER. The tyre storage and shredding operation is existing and is not part of the current proposal under assessment by the EPA.

The proposal involves processing of shredded waste tyres using an indirect fired Thermal Conversion Unit (TCU) to produce carbon black, steel wire, oil and process gas. The residual carbon from thermal processing of the tyres and the oil will be recovered, with the char upgraded to carbon black for sale.

The key characteristics of the proposal are set out in Table 1, in accordance with EAG 1 – *Defining the key characteristics of a proposal.* The development envelope encompassing the physical elements of the proposal is delineated in Figure 2.

It should be noted that the key proposal characteristics may change as a result of implementation of the mitigation hierarchy by the proponent on account of the findings of studies and investigations conducted as part of the environmental review.

Table 1. Key Proposal Characteristics

Summary of the proposal	
Proposal Title	Tyre Resource Recycling Facility
Proponent Name	Elan Energy Matrix Pty Ltd
Short Description	The proposal is to construct and operate a Tyre Resource Recycling Facility at Lot 60, 9 Fargo Way Welshpool, approximately 12 kilometres southeast of Perth in the City of Canning. The proposal includes processing of shredded tyres using a thermal conversion unit to produce carbon black, steel wire, oil and gas.

Physical Elements		
Element	**Location**	**Proposed Extent**
Tyre Resource Recycling Facility (including a char upgrading plant)	Lot 60, 9 Fargo Way, Welshpool (Figure 1)	Constructed on 0.45 hectares cleared land within existing buildings.
Operational Elements		
Element	**Location**	**Proposed Extent**
Waste tyres processed	Lot 60, 9 Fargo Way, Welshpool (Figure 1)	Up to 60 tonnes per day.

3. Preliminary key environmental factors and scope of work

The key proposal characteristics in Table 1 have informed the identification of the preliminary key environmental factors for the proposal, in accordance with EAG 8 – *Environmental factors and objectives.* The preliminary key environmental factors for this proposal and the EPA's objective for each of those factors are identified in Table 2.

To provide context to the preliminary key environmental factors, Table 2 also identifies the aspects of the proposal that cause the factors to be key factors, and the potential impacts and risks likely to be relevant to the assessment. All of this in turn has informed the work required to be conducted in the environmental review.

Finally, Table 2 identifies the policy documents that establish how the EPA expects the environmental factors to be addressed in the environmental review and the PER document that follows. Impacts associated with proposals are to be considered at a local and regional scale, including evaluation of cumulative impacts, and provide details of proposed management/mitigation measures. This includes whether environmental offsets are required by application of the mitigation hierarchy, consistent with the Government of Western Australian (2014) WA Environmental Offsets Guidelines.

The EPA expects that the proponent will consider all relevant contemporary policy documents, including revisions or updates of the policy documents listed and any new, relevant policy that is published during the development of the PER.

Table 2 Preliminary key environmental factors and required work

Air Quality and Atmospheric Gases	
EPA objective	To maintain air quality for the protection of the environment and human health and amenity, and to minimise the emission of greenhouse and other atmospheric gases through the application of best practice.
Relevant aspects	Thermal processing of used tyres using an indirect fired Thermal Conversion Unit.

Potential impacts and risks	Emissions generated may impact residential areas and neighbouring industrial premises. Emissions include nitrogen oxides, sulphur dioxide, carbon monoxide, particulates (TSP, PM_{10} and $PM_{2.5}$) acid gases, metals, dioxins, volatile organic compounds.
Required work	1. Identify all atmospheric emissions from all potential points of discharge from the proposal. 2. Establish and predict the background pollutant levels to be used in cumulative modelling for particulates (PM_{10} and $PM_{2.5}$), oxides of nitrogen and sulphur dioxide, carbon monoxide, acid gases, volatile organic compounds, metals, zinc oxide, dioxins and furans at residential areas and neighbouring industrial premises, including the impacts of existing and proposed facilities. Where reliance is placed on historical data, modelling should contain a high degree of conservatism and interannual variation of historical data should be taken into account. 3. Detail the expected emissions of particulates (PM_{10} and $PM_{2.5}$), oxides of nitrogen and sulphur dioxide, carbon monoxide, acid gases, organic compounds, metals, zinc oxide (nanoparticles), dioxins and furans under normal operation, worst case conditions and during commissioning. Describe how the expected emissions were predicted. 4. Model the ground level concentrations of particulates (PM_{10} and $PM_{2.5}$), oxides of nitrogen and sulphur dioxide, carbon monoxide, metals, acid gases, organic compounds, dioxins and furans from the proposal in isolation and cumulatively using the background pollutant levels established in work item 2 at residential and neighbouring premises, taking into account any potential local industrial point sources, under normal operation, worst case conditions and during commissioning, as necessary. 5. Compare predicted emissions and ground level concentrations with appropriate standards. 6. Describe proposed management, monitoring and validation of predictions for all air emissions. 7. Outline the outcomes/objectives, management, monitoring, trigger and contingency actions to ensure impacts are not greater than predicted, and do not pose an unacceptable risk to the health and amenity of the public or the environment. 8. An application of the mitigation hierarchy to the impacts from the proposal upon identified environmental values and an assessment of the residual impacts after the mitigation measures have been implemented. 9. Discussion of residual impacts, including as appropriate, monitoring programmes to measure residual impacts, and management programmes to further mitigate these residual impacts and to deal with circumstances where outcomes fall short of intended objectives. 10. Describe the potential for odour to occur and the proposed management. 11. Describe how the chosen technology meets best practice, and detail its track record of reliable operation (at a similar scale) in treating waste tyres. 12. Describe the extent to which the EPA Advice to the Minister for Environment on the *Environmental and Health Performance of Waste to Energy Technologies* is applicable to the pyrolysis component of this proposal.
Relevant policy	<u>EPA Policies and Guidance</u> EPA and Waste Authority (2013), Section 16(e) advice on the *Environmental and Health Performance of Waste to Energy Technologies* (Report 1468), Perth

	Western Australia. (This document provides guidance on the EPA's expectations for proposals that utilise pyrolysis technology). EPA (2003) *Guidance Statement No. 55: Implementing Best Practice in Proposals Submitted to the Environmental Impact Assessment Process*, Perth, Western Australia. <u>Other Policies and Guidance</u> Department of Environment (2006), Air Quality Modelling Guidance Notes, Perth, Western Australia. National Environment Protection Measures standards and goals. World Health Organisation Air Quality and Health guidelines. Department of Health and DER, Relevant policy and air quality guidelines.

4. Stakeholder consultation

The EPA expects that the proponent will consult with stakeholders who are interested in, or affected by, the proposal. This includes decision-making authorities (DMAs), other relevant State government departments and local government authorities, environmental non-government organisations and the local community.

The proponent must document the stakeholder consultation undertaken and the outcomes, including any adjustments to the proposal and any future plans for consultation. This is to be addressed in a specific section of the PER document and, in addition, key outcomes of consultation are to be reported against the preliminary key environmental factors as relevant.

It is expected that as a part of the consultation with DMA's there will be discussion around each agency's specific regulatory approvals, and a demonstration that other factors can be managed by another regulatory body.

5. Other factors or matters

During assessment of proposals, other factors or matters will be identified as relevant to the proposal, but not of significance to warrant further assessment by the EPA, or impacts can be regulated by other statutory processes to meet the EPA's objectives.

These factors do not require further work as part of the environmental review, or detailed discussion and evaluation in the PER document, although they must be included in the PER document in a summarised, tabular format noting that the PER document will be subject to public review.

In some circumstances other factors, while not being considered as preliminary key environmental factors, may require greater emphasis in the PER document. This may be due to high public interest or at the request of another stakeholder, so that the potential impacts and management measures associated with the other factor are sufficiently articulated for the public review. For this assessment, the other factors that need to be concisely described and discussed in the PER document are:

- Inland Waters Environmental Quality – discharge of liquid wastes; and
- Amenity – generation of noise and odour.

It is also important that the proponent be aware that other factors or matters may be identified during the course of the environmental review that were not apparent at the time that this ESD was prepared. If this situation arises, the proponent must consult with the EPA to determine whether these factors and/or matters are to be addressed in the PER document, and if so, to what extent.

6. Agreed assessment timeline

Table 3 sets out the timeline for the assessment of the proposal agreed between the EPA and the proponent. Proponents are expected to meet the agreed timeline, and in doing so, provide adequate, quality information to inform the assessment.

Table 3 Assessment Timeline

Key Stages of Assessment	Draft Agreed Completion Date
EPA approval of ESD	9 November 2016
Proponent submits first adequate draft PER document	28 November 2016 (3 weeks)
Office of the Environmental Protection Authority (OEPA) provides comment on first adequate draft PER document	23 January 2017 (6+2 weeks)
Proponent submits adequate revised draft PER document	30 January 2017 (1 week)
EPA authorises release of PER document for public review	13 February 2017 (2 weeks)
Proponent releases authorised PER document for public review	20 February 2017 (1 week)
Public review of PER document	20 March 2017 (4 weeks)
EPA provides Summary of Submissions	10 April 2017 (3 weeks)
Proponent provides Response to Submissions	17 April 2017 (1 weeks)
OEPA reviews the Response to Submissions	15 May 2017 (4 weeks)
OEPA assesses proposal for consideration by EPA	3 July 2017 (7 weeks)
Preparation and finalisation of EPA assessment report (including two weeks consultation on draft conditions with proponent and key Government agencies)	7 August 2017 (5 weeks)

If any stage in the agreed timeline is not met or inadequate information is submitted by the proponent, the timing for the completion of subsequent stages of the process will be revised. Equally, where the EPA is unable to meet an agreed completion date in the timeline, the proponent will be advised and the timeline revised.

The proponent should refer to EPA's EAG 6 – *Timelines for environmental assessment of proposals* for information regarding the responsibilities of proponents and the EPA for achieving timely and effective assessment of proposals.

7. Decision-making authorities

At this stage, the EPA has identified the authorities listed in Table 4 as DMAs for the proposal. Additional DMAs may be identified during the course of the assessment.

Table 4 Decision-making authorities

Decision-making authority	Relevant legislation
Department of Environment Regulation	Part V of *Environmental Protection Act 1986* Works approval and licence
City of Canning	*Planning and Development Act 2005* Development approval

8. Parallel processing

The EP Act constrains DMAs from making any decision that could have the effect of causing or allowing the proposal to be implemented. However, the proponent is encouraged to pursue other approvals in parallel with the EPA's assessment noting that the constraint only relates to making an approval decision.

9. PER document

When the EPA is satisfied with the standard of the PER document (refer to section 4.4 of EAG 6) it will provide written authorisation for the release of the document for public review. The proponent must not release the PER document for public review until this authorisation is provided.

The proponent is responsible for advertising the release and availability of the PER document in accordance with instructions that will be issued to the proponent by the EPA. The EPA must be consulted on the timing and details for advertising.

Figure 1 – Regional location

Figure 2 – Development envelope

Figure 1: Proposal area – Lot 60, 9 Fargo Way, Welshpool.

Scale 1:2,000 at A4

0 10 20 30 40 50

Coordinate System: GDA 1994 MGA Zone 50

Author: JCruz

Legend

Lot 60 boundary

Existing cadastre

Roads

strategen ENVIRONMENTAL

Appendix 2
Environmental studies

ELAN ENERGY MANAGEMENT

Air Quality Assessment

Prepared for Strategen
By Sigma Theta
Date: 30 November 2016

VERSION CONTROL RECORD

Document File Name	Date Issued	Version	Author	Reviewer
Elan Energy - TRRF_v1.docx	1 July 2016	V1	M Sowden	P Forster
Elan Energy - TRRF_v2.docx	28 Nov 2016	V2	M Sowden	

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1. Introduction

1.1. Background

Elan Energy Management proposes to develop a Tyre Resource Recycling Facility (TRRF) to recover carbon black, wire and oil from the processing of used tyres. The TRRF will be operated at Lot 60, 9 Fargo Way, Welshpool, for 24 hrs per day, 7 days per week.

The TRRF will process shredded waste tyres using an indirect fired Thermal Conversion Unit (TCU) to produce char, steel wire, oil and gas; with the char upgraded to carbon black. Recovered products will be sold to Australian or international markets.

The process gas stream containing hydrogen, carbon monoxide and methane will be combusted in a high-efficiency thermal oxidiser (SACTO) with heat recovery installed to preheat combustion air for the TCU operation. Exhaust gases from the SACTO and the TCU combustion chamber will be discharged to atmosphere via a 15 m stack. The impacts from those emissions at nearby residential areas have been assessed using air dispersion modelling.

1.2. Purpose of this Report

This report presents the assessment of the potential air quality impacts arising from atmospheric emissions from the proposed development of the TRRF, including the approach, methodology and results of the air dispersion modelling. During operation, the project could emit trace components of SO_2, NO_x, HCl, heavy metals and dioxins to the air. Material handling operations occur inside a closed building and emissions from the stack have been considered in isolation. Regional background measurements were used to assess the cumulative impacts.

1.3. Site Description

The site is in a light industrial area of Welshpool bound by Roe and Leach highways to the east and west and Welshpool Road to the south. The nearest residential areas are approximately half a kilometre to the south-east and one kilometre to the south-west (Google Earth, 2016).

1.4. Topography

The site is situated approximately two kilometres from the base of the Perth hills. The topography is flat in the immediate vicinity of the site and there are no expected impacts from topography-induced wind-flows.

1.5. Climate and Meteorology

The nearby BOM site at the Perth airport is assumed representative of the climatology of the region. Coastal wind patterns influence local meteorological conditions creating a diurnal flow. Winds vary each season in direction and strength. Summer is the windiest, with westerly winds dominant in summer, and to a lesser extent in spring and autumn.

1.6. Flora/Fauna

Residential development has displaced the natural vegetation of the area. As such, no threatened species are expected in the immediate vicinity. However, there may be small colonies in the nearby, "bush forever", region along the Perth hills escarpment.

1.7. Project Description

Figure 1 depicts an overview of the site in relation to its neighbours. Batch loads of tyres and product will be supplied and collected at irregular intervals. The site is fully sealed and delivery vehicles movements have, therefore, not been considered large dust sources. All material handling will be done indoors and hence the only significant emission source is predicted from the stack emissions.

Taking into consideration the existing building heights, the proposed stack height of 15 m is slightly smaller than the “Good Engineering Practice” (US-EPA, 1981) guidance. Raising the stack height is not deemed feasible given the site location in relation to the airport. Building downwash was included in the modelling to account for the expected plume downwash.

The process is planned to run continually except for the occasional maintenance (or accidental) start-up and shutdown activities. Emission estimates were generated from information supplied by Strategen on 19 June 2016 and revised on 28th November 2016.

2. Air Quality Criteria

2.1. Ambient Air Quality Guidelines

In June 1998, the National Environment Protection Council (NEPC) set uniform standards for ambient air quality to allow for the adequate protection of human health and wellbeing. This was achieved via the creation of the National Environmental Protection (Ambient Air Quality) Measure (NEPM) (NEPC, 2003) which defined ambient air quality standards for criteria pollutants, including (but not limited to) NO_2, CO, SO_2 and particulates (as particles less than 10 µm in equivalent aerodynamic diameter, PM_{10}). Amendments were made to the Ambient Air Quality NEPM in 2015 to include advisory reporting standards for particles less than 2.5 µm in equivalent aerodynamic diameter ($PM_{2.5}$) (NEPC, 2015).

The Western Australian State Government has recommended the adoption of these NEPM standards for ambient air quality as part of the draft State Environmental (Ambient Air) Policy 2009 (WA-EPA, 2009). The NEPM standards are presented in Table 1.

Table 1: NEPM Ambient Air Quality Standards and Goals

Pollutant	Averaging Period	Standard	Units [1]	Goals [2]
NO_2	1-hour	0.12	ppm	1 day a year
	Annual	0.03	ppm	none
CO	8-hour	9.0	ppm	1 day a year
SO2	1-hour	0.20	ppm	1 day a year
	24-hour	0.08	ppm	1 day a year
	Annual	0.02	ppm	none
PM_{10}	24-hour	50	µg/m^3	5 days a year
$PM_{2.5}$ [3]	24-hour	25	µg/m^3	

Notes

1. µg/m^3 referenced to 0ºC, and 101.3 kPa.
2. Maximum number of allowable exceedances.
3. Advisory reporting standards.

2.2. Acid Gas, Metal and Dioxin Guidelines

In addition to the NEPM, various guidelines exist for other compounds and these are depicted in Table 2. This includes the DER's Environmental Risk Assessment Framework (DER, 2015) and the WA Health Guideline (2007) concentration reports. The WA Health Guideline (2007) report is based on a Department of Health internal document (*Acid Gas Criteria*, *Internal document, Toxicology WA Department of Health*, Shenton Park, WA (DOH, 2007)) (see (DER-W5925/2015/1, 2015)) which has been previously referenced in other air quality assessments submitted to DER.

Table 2: Air Quality Assessment Criteria

Substance	Period	Air Quality Standard (µg/m^3)	Reference
Aluminum	1-hour	No standard	
Antimony	1-hour	9	DER 2015
Arsenic	1-hour	0.09	DER 2015
	24-hour	0.03	DER 2015
	Annual	0.003	DER 2015
Barium	1-hour	No standard	
Beryllium	1-hour	0.004	DER 2015
	Annual	0.00018	DER 2015
Cadmium	1-hour	0.018	DER 2015
Calcium	1-hour	No standard	
Chromium	1-hour	9	DER 2015
	24-hour	0.46	DER 2015
Cobalt	24-hour	0.092	DER 2015
Copper	24-hour	1	DER 2015
Iron	1-hour	No standard	
Lead	Annual	0.5	NEPM
Lithium	1-hour	No standard	
Magnesium	1-hour	No standard	
Manganese	1-hour	18	NSW DECC 2006
	Annual	0.14	DER 2015
Mercury	1-hour	0.55	DER 2015
	Annual	0.18	DER 2015
Molybdenum	24-hour	11	DER 2015
Nickel	1-hour	0.14	DER 2015
	Annual	0.003	DER 2015
Potassium	1-hour	No standard	
Selenium	1-hour	No standard	
Silica (as Si)	24-hour	9.2	DER 2015
	Annual	2.7	DER 2015
Silver	1-hour	No standard	
Sodium	1-hour	No standard	
Strontium	1-hour	No standard	
Titanium	1-hour	No standard	
Vanadium	24-hour	0.92	DER WA
Zinc oxide (as Zn)	24-hour	46	DER WA
Dioxins (TEQ)	1-hour	6.39E-12	DER 2015
NO_x	1-hour	246	NEPM
	Annual	61.6	NEPM
SO_2	10-min	500	NEPM
	1-hour	571.8	NEPM
	24-hour	228.7	NEPM

Substance	Period	Air Quality Standard (µg/m^3)	Reference
	Annual	57.2	NEPM
CO	15-min	100000	NEPM
	30-min	60000	NEPM
	1-hour	30000	NEPM
	8-hr	11249	NEPM
HCl	1-hour	100	DOH 2007
	1-hour	140	DER 2015
HF	1-hour	100	DOH 2007
PM (as PM_{10})	24-hour	50	NEPM
	annual	20	NEPM
PM (as $PM_{2.5}$)	24-hour	25	NEPM
	annual	8	NEPM
Ethane	1-hour	No standard	
Propane	1-hour	No standard	
Butane	1-hour	No standard	
Pentane	1-hour	11	DER 2015
Hexane	1-hour	0.9	DER 2015
Benzene	Annual	0.0096	NEPM
Toluene	24-hour	3.77	NEPM
	Annual	0.38	NEPM
PAHs (BaP)	1-hour	0.0003	NEPM

Modelling Methodology

2.3. Air Dispersion Model

The air dispersion modelling has been conducted using the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) version 15181 (US-EPA, 2015). AERMOD is a United States Environmental Protection Agency (US-EPA) recommended air dispersion model that has been designed to support regulatory modelling programs in the United States. It is widely used throughout Australia and internationally for regulatory modelling applications.

AERMOD is a current-generation air dispersion model that incorporates concepts such as planetary boundary layer theory and advanced methods for handling complex terrain. AERMOD incorporates the Plume Rise Model Enhancements (PRIME) building downwash algorithms, which provide a more realistic handling of downwash effects than previous approaches.

2.4. Meteorological Data

The Bureau of Meteorology supplied five years of meteorological data (2010 to 2015) for the Perth Airport site situated approximately 20 km to the north (BOM, 2016). Figure 3 presents the wind roses for each season and a total combined annual rose. These were derived from the regional hourly average wind speed and direction data. Winds in the region are predominantly east and westerly winds as depicted in the wind roses. Figure 3, also depicts the seasonal wind fluctuations. During summer and spring, the winds are predominantly from the south-west and east, and relatively strong. In contrast, during winter, the winds are predominantly from the northeast, and winds tend to be lighter in strength.

Upper air data was extrapolation from surface meteorological parameters using the AERMET pre-processor in accordance with the protocol presented by Dr K Rayner at a CASANZ workshop (Rayner, 2011).

2.5. Modelling Approach

Air dispersion modelling was used to predict ground level concentrations (GLCs) across the model domain. The air quality impacts associated with emissions from the TRRF were considered in isolation and in combination with background sources (where available).

2.6. Model Parameterisation

AERMOD (Version 15181) was used to predict GLCs across the model domain. Owing to the distance to the nearest residences, a fine grid of 5 km x 5 km x 100 m was used. Terrain elevation data, 30 m resolution, for the model domain, was obtained from the US National Aeronautics and Space Administration's (NASA) Shuttle Radar Topography Mission (SRTM3/SRTM1), and incorporated into AERMOD using the AERMAP terrain processor.

Urban dispersion coefficients were used in the AERMOD simulation because of the proximity of residential houses in the immediate area. Three specific sensitive receptors sites, as depicted in Figure 2, were selected from an initial screening model run which identified where the maximum concentrations were predicted to occur in the residential area.

3. Atmospheric Emissions

This study has considered emissions from the TRRF under the proposed operating conditions. The stack parameters (Table 3), emission rates and background concentration (Table 4) used as inputs to the modelling were supplied by Strategen. No nearby significant sources of HCl or HF were identified in the National Pollution Inventory database. This study has considered the proposed stack both in isolation and cumulatively, using background concentration where available.

Table 3: Stack Parameters

Parameter	Value	Units
Height	15	m
Internal diameter	0.8	m
Velocity	15.4	m/s
Temperature	400	deg C

Table 4: Stack Emission Rates and Background Concentrations

		Background concentration (µg/m³)			
Substance	**Emission rate (g/s)**	**1-hour**	**24-hour**	**8-hour**	**Annual**
Aluminium	0.0000696	5.14975			
Antimony	0.000000556	0.0565			
Arsenic	0.000000485	0.13225	0.0529		No data
Barium	0.000000694	0.09325			
Benzene	0.00000501				1.5
Beryllium	7.22E-12	No data			No data
Butane	0.00501	No data			
Cadmium	0.00000217	No data			
Calcium	0.000575	No data			
Chromium	0.0000159	0.03075	0.0123		
CO	0.076	No data		2170	
Cobalt	0.00000367		No data		
Copper	0.00000542		0.04		
Dioxins (TEQ)	6.39E-12	0.000000065			
Ethane	0.00739	No data			
HCl	0.000357	27.5			
Hexane	0.00429	3			
HF	0.00000375	6			
Iron	0.0000743	2.746			
Lead	0.000023				0.01
Lithium	0.000000351	No data			
Magnesium	0.0000192	2.1265			
Manganese	0.00000105	0.055			0.01
Mercury	0.000209	No data			No data
Molybdenum	0.000000778		No data		
Nickel	0.00000978	No data			No data
NOx	0.288	90			No data
PAHs (BaP)	0.00000137	0.0008407			
Pentane	0.0062	0			
PM (as PM10)	0.0215		29.4		No data
PM (as PM2.5)	0.0215		14.1		8.1
Potassium	0.00005	No data			
Propane	0.00382	No data			
Selenium	0.00000556	No data			
Silica (as Si)	0.00203		No data		No data
Silver	2.22E-08	No data			
SO2	0.656	160	26		5
Sodium	0.000169	15.70375			
Strontium	0.000000596	0			
Titanium	0.0000542	0.24025			
Toluene	0.00000811		6		0.6
Vanadium	0.000000278		0		
Zinc oxide (as Zn)	0.00295		0.0961		

4. AERMOD Results

AERMOD results are presented in Table 5 describing maximum ground level concentrations (GLC's) along the plant boundary (maximum across modelling domain) and at the nearest receptors (Figure 1), for the pollutants of interest. These GLC's are compared to standard criteria, from Table 2, for the proposed stack. All pollutants are significantly below guideline limits at all grid points for all periods. As illustrated in Table 5, SO_2 and NO_x are the only substances of potential concern as other concentrations of compounds are predicted to be insignificant either in terms of cumulative impact or in relation to background concentrations. Isopleths of the predicted concentrations from the proposed stack for these two pollutants are presented in Figure 4 to Figure 11.

A detailed investigation of the isopleths noted that highest concentrations were predicted to occur at the nearest grid points to the proposed stack. Concentrations are predicted to drop rapidly reaching about 1 % of the guidelines at the nearest residential areas about 500 m away. As such, the predicted highest concentrations are related to modelling inaccuracies of near-source receptors and would usually be contained (and ignored) within the site boundaries. However, in the light-industrial region, there is no buffer and buildings extend to the property boundary.

5. Conclusions

Air dispersion modelling has been undertaken to assess the potential air quality impacts associated with emissions from the TRRF. The air dispersion model, AERMOD, has been used to predict GLCs across the model domain using the proposed stack configurations for the modelling assessment. In considering the stack in isolation, no significant exceedances of any standards were predicted. The highest predicted concentration relative to the standard was the daily SO_2 concentration at 13% of the NEPM standard with the second highest relative prediction of 8% for the hourly NO_x prediction. The cumulative assessment predicts that a number of substances may be near or exceed the standards. However, as depicted in Table 5, these high levels are due to existing background events and not the proposed operations. Predicted concentrations of SO_2 are expected to be similar in magnitude to current background levels (i.e. proposed operations could double ground level SO_2 concentrations) but remain well below the NEPM standards.

Near-source modelling abnormalities (i.e. within about 100 m from source) account for the highest predicted concentrations (in the table), but this drops rapidly to about a fifth of the site boundary concentrations at the nearest residential areas about 500 m away. The results of the modelling indicate that the air quality impacts due to emissions from the TRRF are predicted to be well below the relevant ambient criteria, at all grid locations, for all pollutants, and all averaging periods.

Table 5: Maximum Predicted Ground Level Concentrations (µg/m3)

				Residences (R1, R2 and R3)				Modelling Domain			
				Maximum		Cumulative		Maximum		Cumulative	
Substance	Period	Air quality standard (µg/m³)	Background concentration (µg/m³)	µg/m³	% of standard	µg/m³	% of standard	µg/m³	% of standard	µg/m³	% of standard
Aluminium	1-hour	No standard	5.14975	4.22E-04		5.15		4.79E-03		5.15	
Antimony	1-hour	9	0.0565	3.37E-06	0.0%	0.0565	0.6%	3.83E-05	0.00%	0.0565	0.63%
Arsenic	1-hour	0.09	0.13225	2.94E-06	0.0%	0.132	147%	3.34E-05	0.04%	0.132	147%
Arsenic	24-hour	0.03	0.0529	1.37E-06	0.0%	0.0529	176%	2.27E-05	0.08%	0.0529	176%
Arsenic	Annual	0.003	No data	6.22E-08	0.0%	6.22E-08	0.0%	2.85E-06	0.10%	2.85E-06	0.10%
Barium	1-hour	No standard	0.09325	4.21E-06		0.0933		4.78E-05		0.0933	
Beryllium	1-hour	0.004	No data	4.38E-11	0.0%	4.38E-11	0.0%	4.97E-10	0.00%	4.97E-10	0.00%
Beryllium	Annual	0.00018	No data	9.27E-13	0.0%	9.27E-13	0.0%	4.25E-11	0.00%	4.25E-11	0.00%
Cadmium	1-hour	0.018	No data	1.31E-05	0.1%	1.31E-05	0.1%	1.49E-04	0.83%	1.49E-04	0.83%
Calcium	1-hour	No standard	No data	3.48E-03		3.48E-03		0.0396		0.0396	
Chromium	1-hour	9	0.03075	9.63E-05	0.0%	0.0308	0.3%	1.09E-03	0.01%	0.0318	0.35%
Chromium	24-hour	0.46	0.0123	4.48E-05	0.0%	0.0123	2.7%	7.45E-04	0.16%	0.0130	2.8%
Cobalt	24-hour	0.092	No data	1.04E-05	0.0%	1.04E-05	0.0%	1.72E-04	0.19%	1.72E-04	0.19%
Copper	24-hour	1	0.04	1.53E-05	0.0%	0.0400	4.0%	2.54E-04	0.03%	0.0403	4.0%
Iron	1-hour	No standard	2.746	4.50E-04		2.75		5.12E-03		2.75	
Lead	Annual	0.5	0.01	2.95E-06	0.0%	0.0100	2.0%	1.35E-04	0.03%	0.0101	2.0%
Lithium	1-hour	No standard	No data	2.13E-06		2.13E-06		2.42E-05		2.42E-05	
Magnesium	1-hour	No standard	2.1265	1.16E-04		2.13		1.32E-03		2.13	
Manganese	1-hour	18	0.055	6.36E-06	0.0%	0.0550	0.3%	7.23E-05	0.00%	0.0551	0.31%
Manganese	Annual	0.14	0.01	1.35E-07	0.0%	0.0100	7.1%	6.18E-06	0.00%	0.0100	7.1%
Mercury	1-hour	0.55	No data	1.27E-03	0.2%	1.27E-03	0.2%	0.0144	2.6%	0.0144	2.6%
Mercury	Annual	0.18	No data	2.68E-05	0.0%	2.68E-05	0.0%	1.23E-03	0.68%	1.23E-03	0.68%
Molybdenum	24-hour	11	No data	2.19E-06	0.0%	2.19E-06	0.0%	3.65E-05	0.00%	3.65E-05	0.00%
Nickel	1-hour	0.14	No data	5.93E-05	0.0%	5.93E-05	0.0%	6.74E-04	0.48%	6.74E-04	0.48%
Nickel	Annual	0.003	No data	1.26E-06	0.0%	1.26E-06	0.0%	5.75E-05	1.9%	5.75E-05	1.9%
Potassium	1-hour	No standard	No data	3.03E-04		3.03E-04		3.44E-03		3.44E-03	

Substance	Period	Air quality standard (µg/m³)	Background concentration (µg/m³)	Residences (R1, R2 and R3) Maximum µg/m³	Residences Maximum % of standard	Residences Cumulative µg/m³	Residences Cumulative % of standard	Modelling Domain Maximum µg/m³	Modelling Domain Maximum % of standard	Modelling Domain Cumulative µg/m³	Modelling Domain Cumulative % of standard
Selenium	1-hour	No standard	No data	3.37E-05		3.37E-05		3.83E-04		3.83E-04	
Silica (as Si)	24-hour	9.2	No data	5.73E-03	0.1%	5.73E-03	0.1%	0.0952	1.0%	0.0952	1.0%
Silica (as Si)	Annual	2.7	No data	2.61E-04	0.0%	2.61E-04	0.0%	0.0119	0.44%	0.0119	0.44%
Silver	1-hour	No standard	No data	1.35E-07		1.35E-07		1.53E-06		1.53E-06	
Sodium	1-hour	No standard	15.7	1.02E-03		15.7		0.0116		15.7	
Strontium	1-hour	No standard	No data	3.61E-06		3.61E-06		4.10E-05		4.10E-05	
Titanium	1-hour	No standard	0.24025	3.28E-04		0.241		3.73E-03		0.244	
Vanadium	24-hour	0.92	No data	7.84E-07	0.0%	7.84E-07	0.0%	1.30E-05	0.00%	1.30E-05	0.00%
Zinc oxide (as Zn)	24-hour	46	0.0961	8.32E-03	0.0%	0.104	0.2%	0.138	0.30%	0.234	0.51%
Dioxins (TEQ)	1-hour	DER 2016	6.50E-08	3.87E-11		6.50E-08		4.40E-10		6.54E-08	
NOx	1-hour	246	90	1.75	0.7%	91.7	37%	19.8	8.1%	110	45%
NOx	Annual	61.6	No data	0.0370	0.1%	0.0370	0.1%	1.69	2.8%	1.69	2.8%
SO2	10-min	500	No data	5.69	1.1%	5.69	1.1%	64.6	13%	64.6	13%
SO2	1-hour	571.8	160	3.98	0.7%	164	29%	45.2	7.9%	205	36%
SO2	24-hour	228.7	26	1.85	0.8%	27.9	12%	30.8	13%	56.8	25%
SO2	Annual	57.2	5	0.0842	0.1%	5.08	8.9%	3.86	6.7%	8.86	15%
CO	15-min	100000	No data	0.608	0.0%	0.608	0.0%	6.91	0.01%	6.91	0.01%
CO	30-min	60000	No data	0.214	0.0%	0.214	0.0%	3.56	0.01%	3.56	0.01%
CO	1-hour	30000	No data	0.461	0.0%	0.461	0.0%	5.23	0.02%	5.23	0.02%
CO	8-hr	11249	2170	0.312	0.0%	2170	19%	4.36	0.04%	2174.4	19%
HCl	1-hour	100	27.5	2.16E-03	0.0%	27.5	28%	0.0246	0.02%	27.5	28%
HCl	1-hour	140		2.16E-03	0.0%	2.16E-03	0.0%	0.0246	0.02%	0.0246	0.02%
HF	1-hour	100	6	2.27E-05	0.0%	6.00	6.0%	2.58E-04	0.00%	6.00	6.0%
PM (as PM10)	24-hour	50	29.4	0.0606	0.1%	29.5	59%	1.01	2.0%	30.4	61%
PM (as PM10)	annual	20	no data	2.76E-03	0.0%	2.76E-03	0.0%	0.127	0.63%	0.127	0.63%
PM (as PM2.5)	24-hour	25	14.1	0.0606	0.2%	14.2	57%	1.01	4.0%	15.1	60%
PM (as PM2.5)	annual	8	8.1	2.76E-03	0.0%	8.10	101%	0.127	1.6%	8.23	103%
Ethane	1-hour	No standard	No data	0.0448		0.0448		0.509		0.509	

				Residences (R1, R2 and R3)				Modelling Domain			
				Maximum		Cumulative		Maximum		Cumulative	
Substance	Period	Air quality standard (µg/m³)	Background concentration (µg/m³)	µg/m³	% of standard	µg/m³	% of standard	µg/m³	% of standard	µg/m³	% of standard
Propane	1-hour	No standard	No data	0.0231		0.0231		0.263		0.263	
Butane	1-hour	No standard	No data	0.0304		0.0304		0.345		0.345	
Pentane	1-hour	11	No data	0.0376	0.3%	0.0376	0.3%	0.427	3.9%	0.427	3.9%
Hexane	1-hour	0.9	3	0.0260	2.9%	3.03	336%	0.295	33%	3.30	366%
Benzene	Annual	0.0096	1.5	6.43E-07	0.0%	1.50	15625%	2.95E-05	0.31%	1.50	15625%
Toluene	24-hour	3.77	6	2.29E-05	0.0%	6.00	159%	3.80E-04	0.01%	6.00	159%
Toluene	Annual	0.38	0.6	1.04E-06	0.0%	0.600	158%	4.77E-05	0.01%	0.600	158%
PAHs (BaP)	1-hour	0.0003	0.0008407	8.30E-06	2.8%	8.49E-04	283%	9.43E-05	31%	9.35E-04	312%

6. References

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7. Limitations

Sigma Theta prepared this report in accordance with the scope of work as outlined in our proposal to Strategen dated 24 February 2016 and in accordance with our understanding and interpretation of current regulatory standards.

The conclusions presented in this report represent Sigma Theta's professional judgment based on information made available during the course of this assignment, are true and correct to the best of Sigma Theta's knowledge, as at the date of the assessment.

Sigma Theta did not independently verify all of the written or oral information provided to Sigma Theta during the course of this investigation. While Sigma Theta has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided to Sigma Theta was itself complete and accurate. This report does not purport to give legal advice. Qualified legal advisors can only give this advice.

7.1. User Reliance

This report has been prepared exclusively for Strategen and may not be relied upon by any other person or entity without Sigma Theta's express written permission.

Appendix A: Figures

Figure 1: Overview of the proposed site

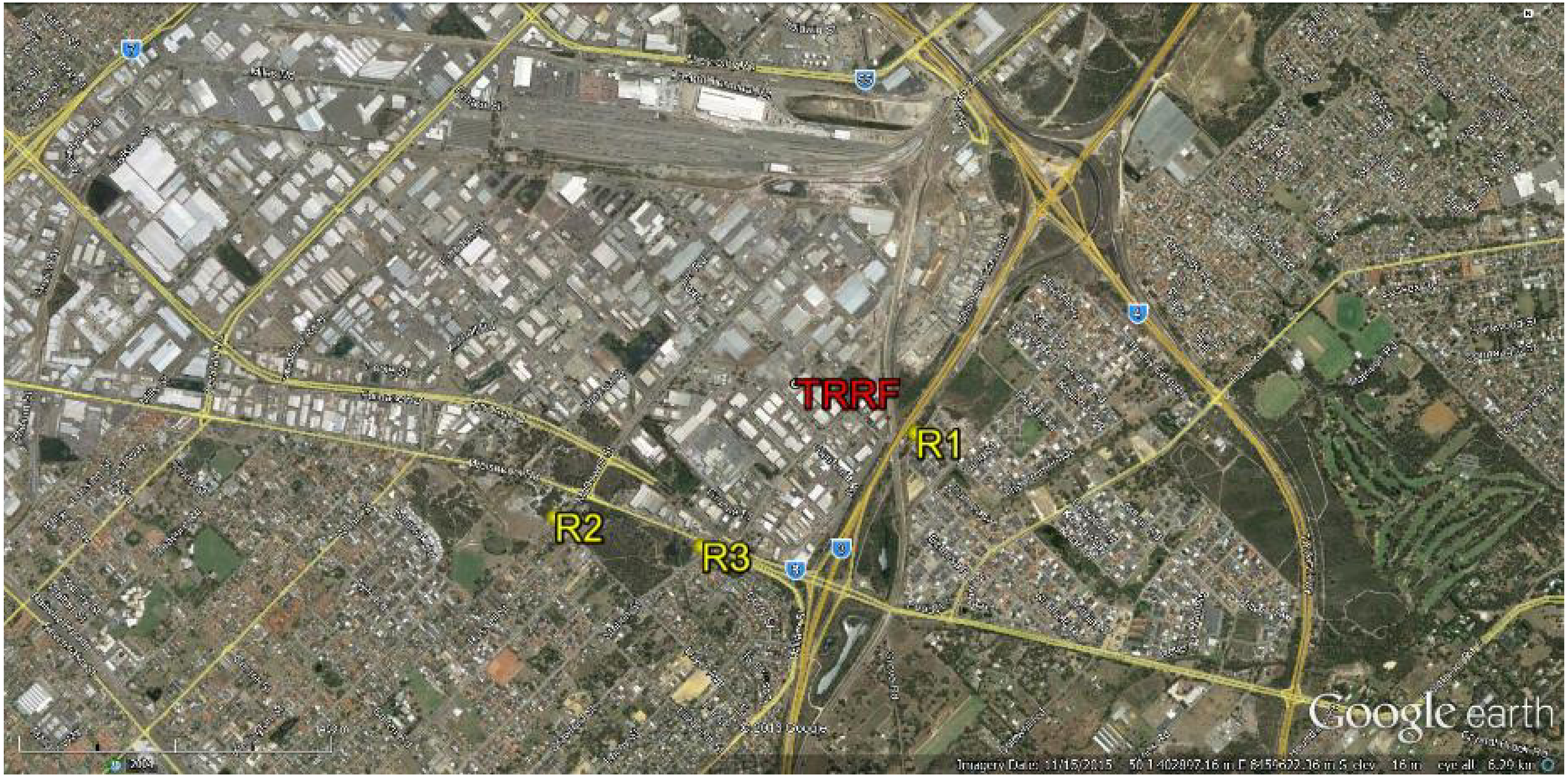

Figure 2: Aerial Overview of the Region

Source: (Google Earth, 2016)

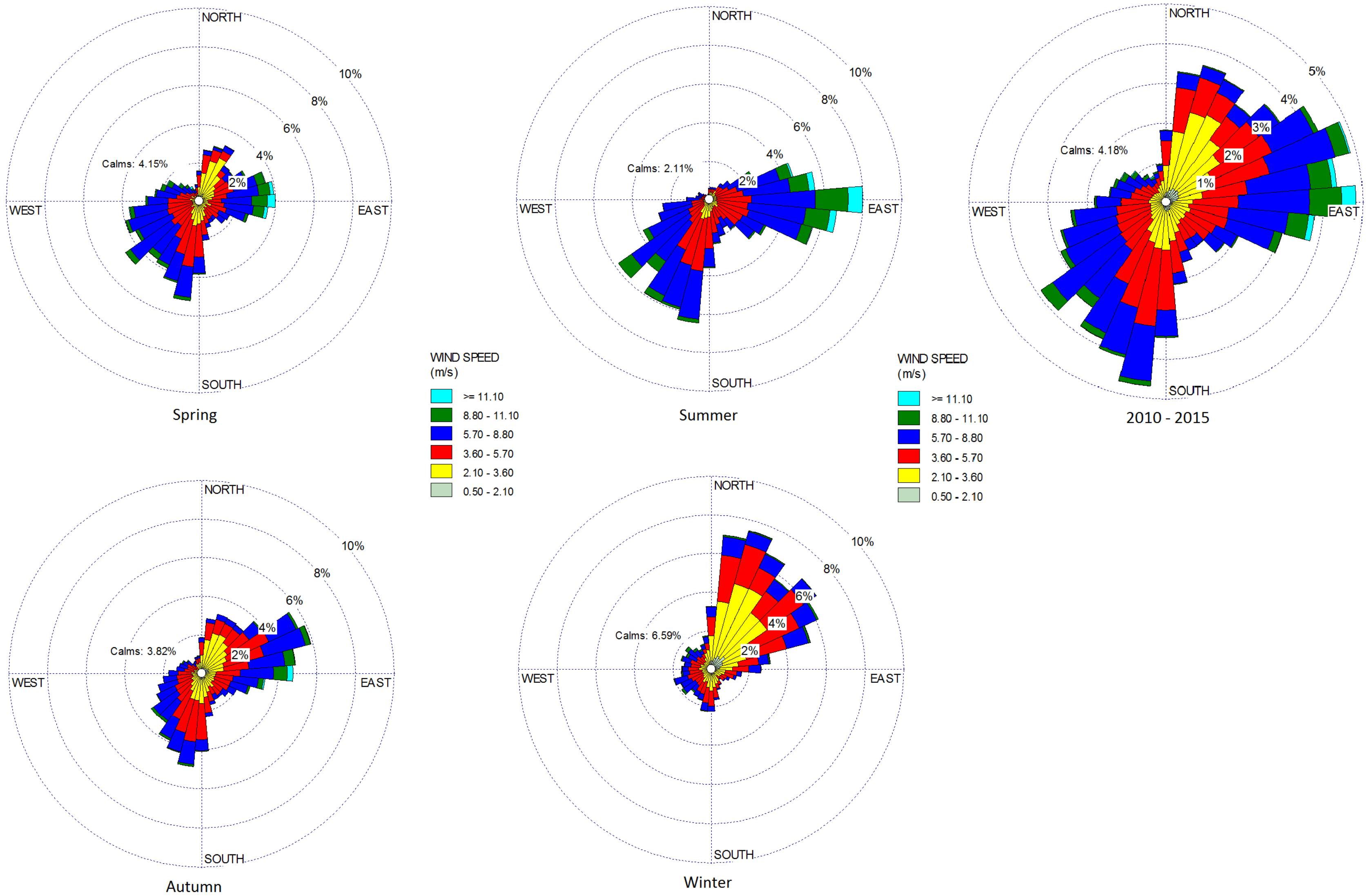

Figure 3: Wind Rose Perth Airport: Seasons and Annual

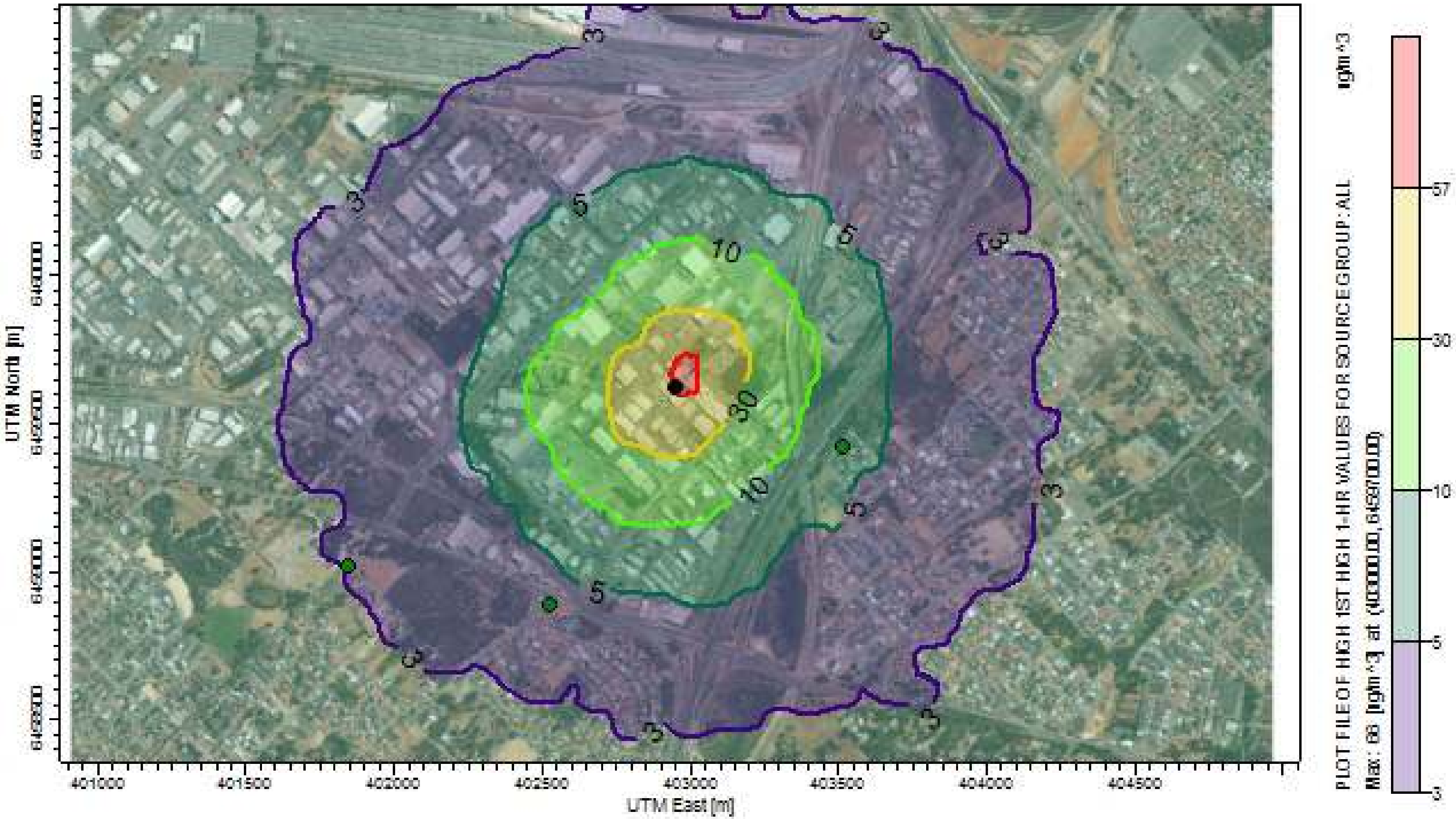

Figure 4: Maximum SO_2 1-hr Ground Level Concentration µg/m^3 (standard 572 µg/m^3)

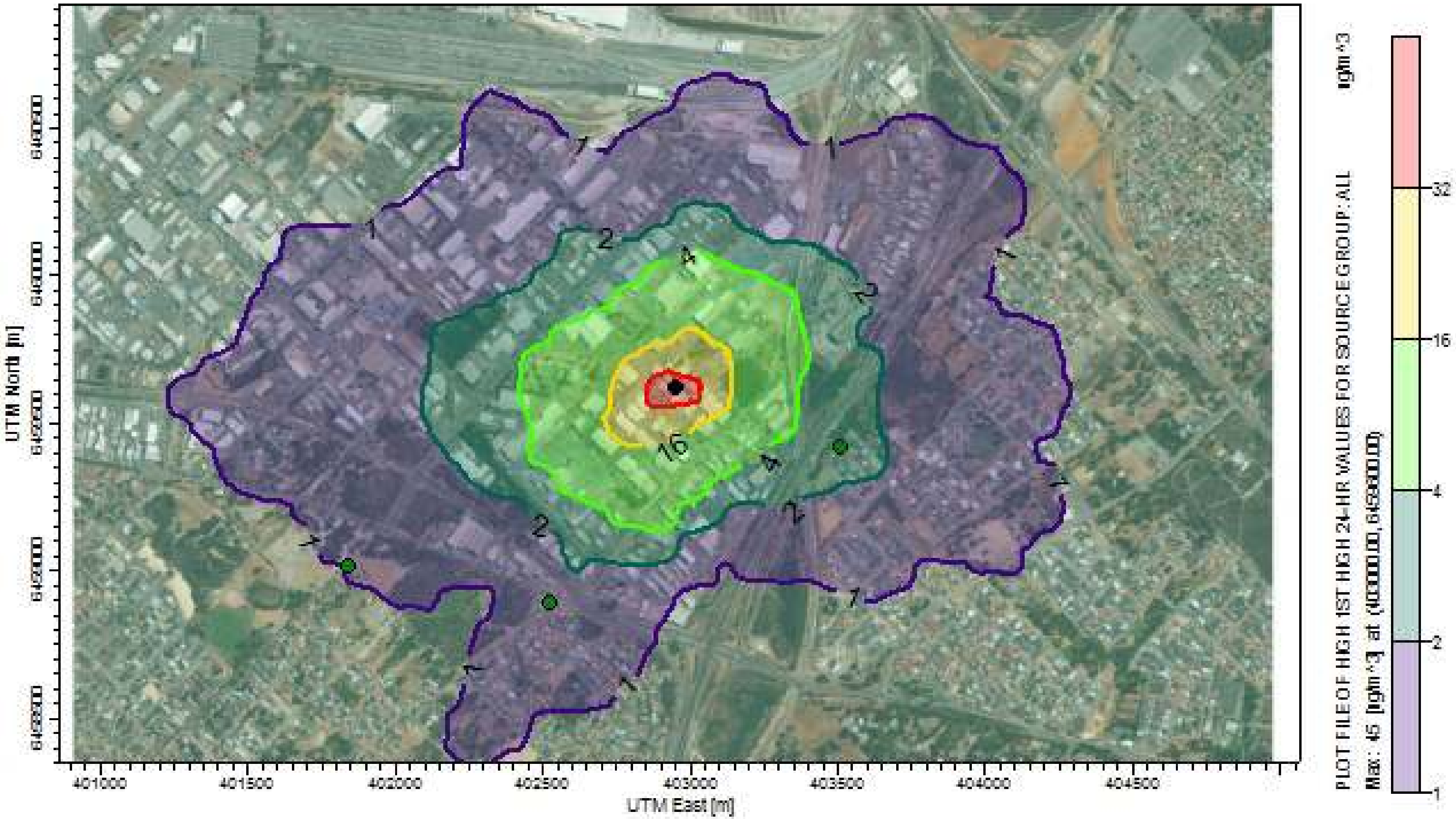

Figure 5: Maximum SO_2 24-hr Ground Level Concentration µg/m^3 (standard 229 µg/m^3)

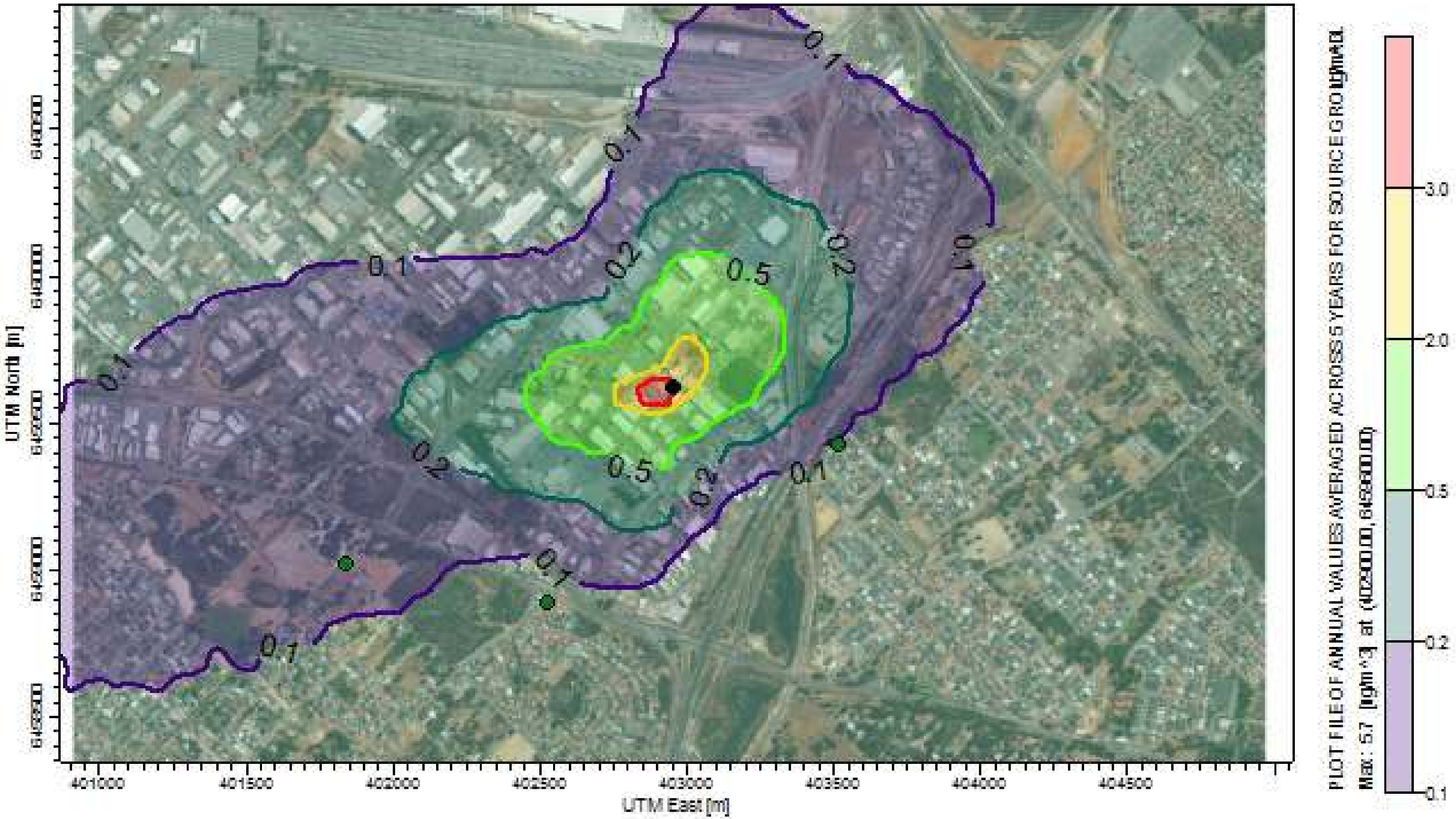

Figure 6: Annual Average SO_2 Ground Level Concentration µg/m^3 (standard 57.2 µg/m^3)

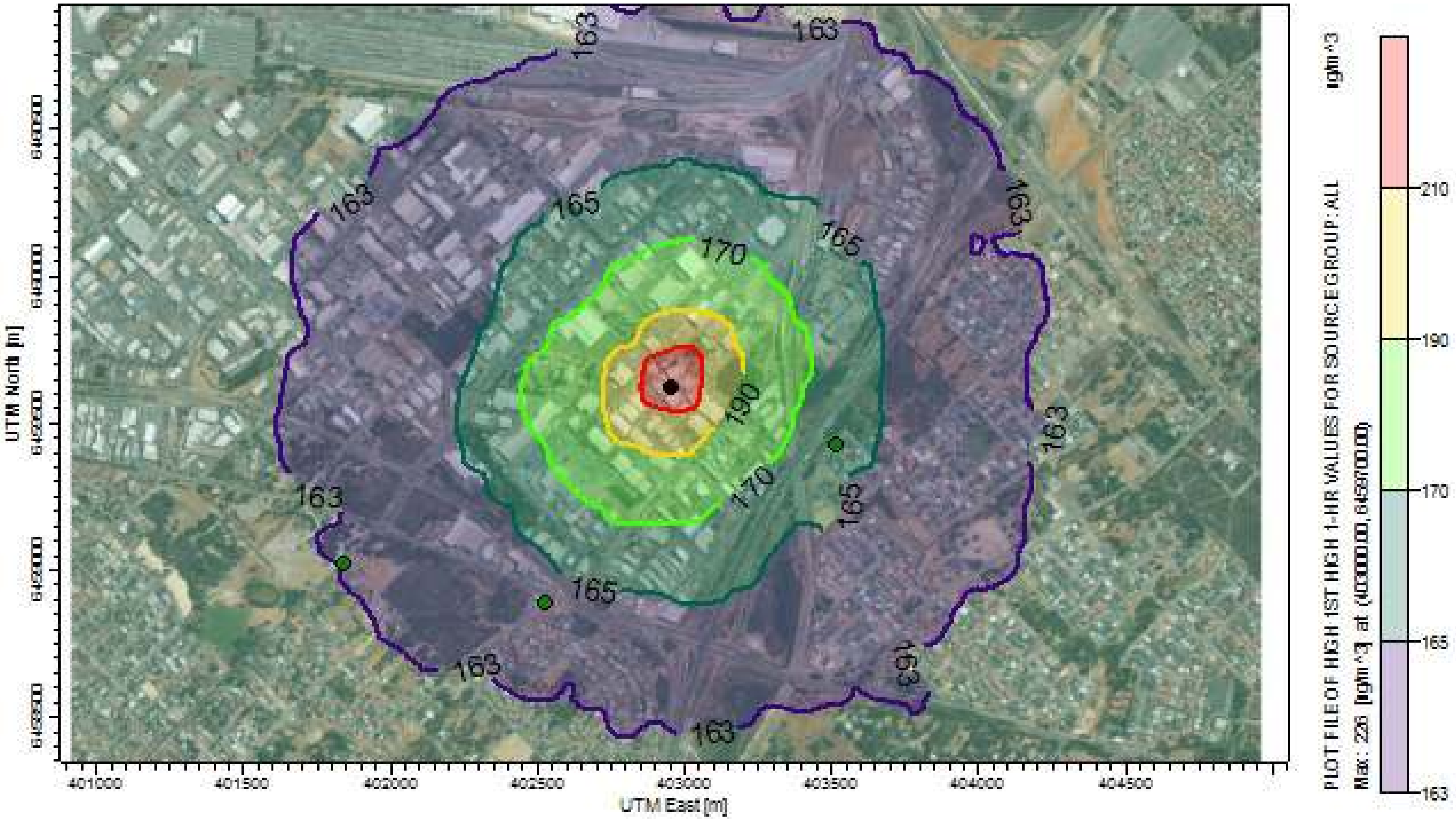

Figure 7: Cumulative SO_2 Maximum 1-hr Ground Level Concentration $\mu g/m^3$ (standard 572 $\mu g/m^3$)

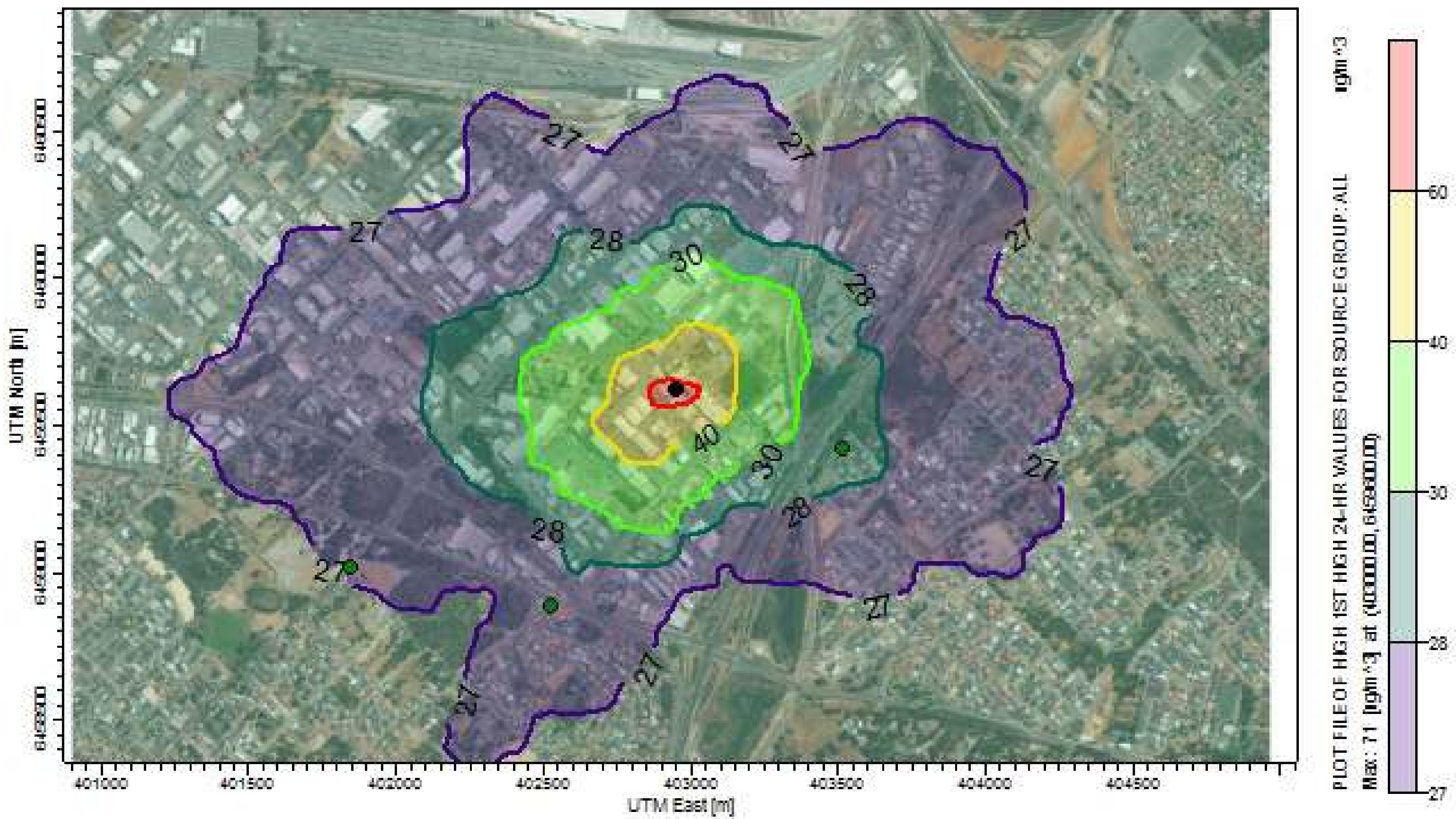

Figure 8: Cumulative SO_2 Maximum 24-hr Ground Level Concentration $\mu g/m^3$ (standard 229 $\mu g/m^3$)

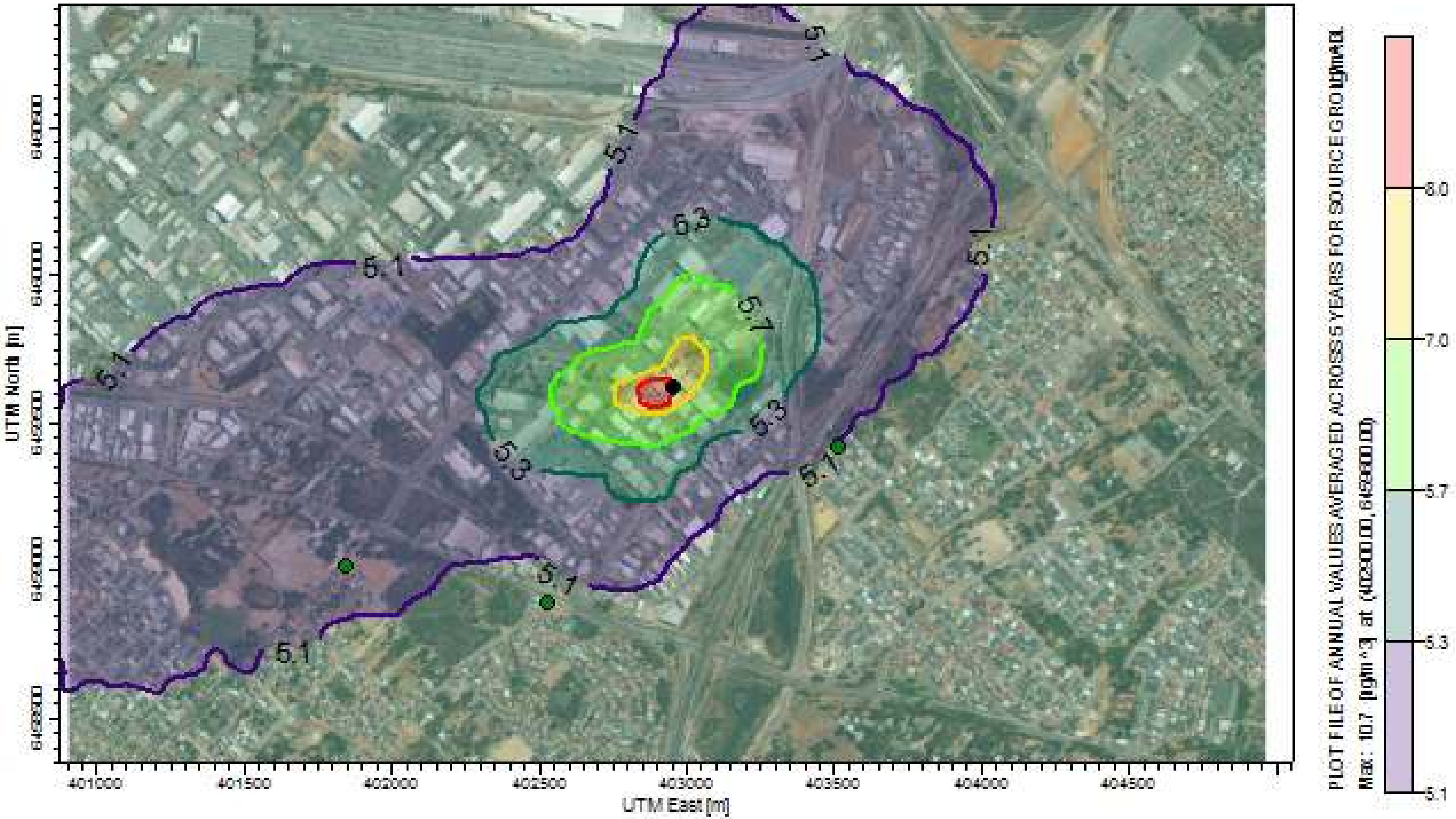

Figure 9: Cumulative SO_2 Annual Average 1-hr Ground Level Concentration µg/m^3 (standard 57.2 µg/m^3)

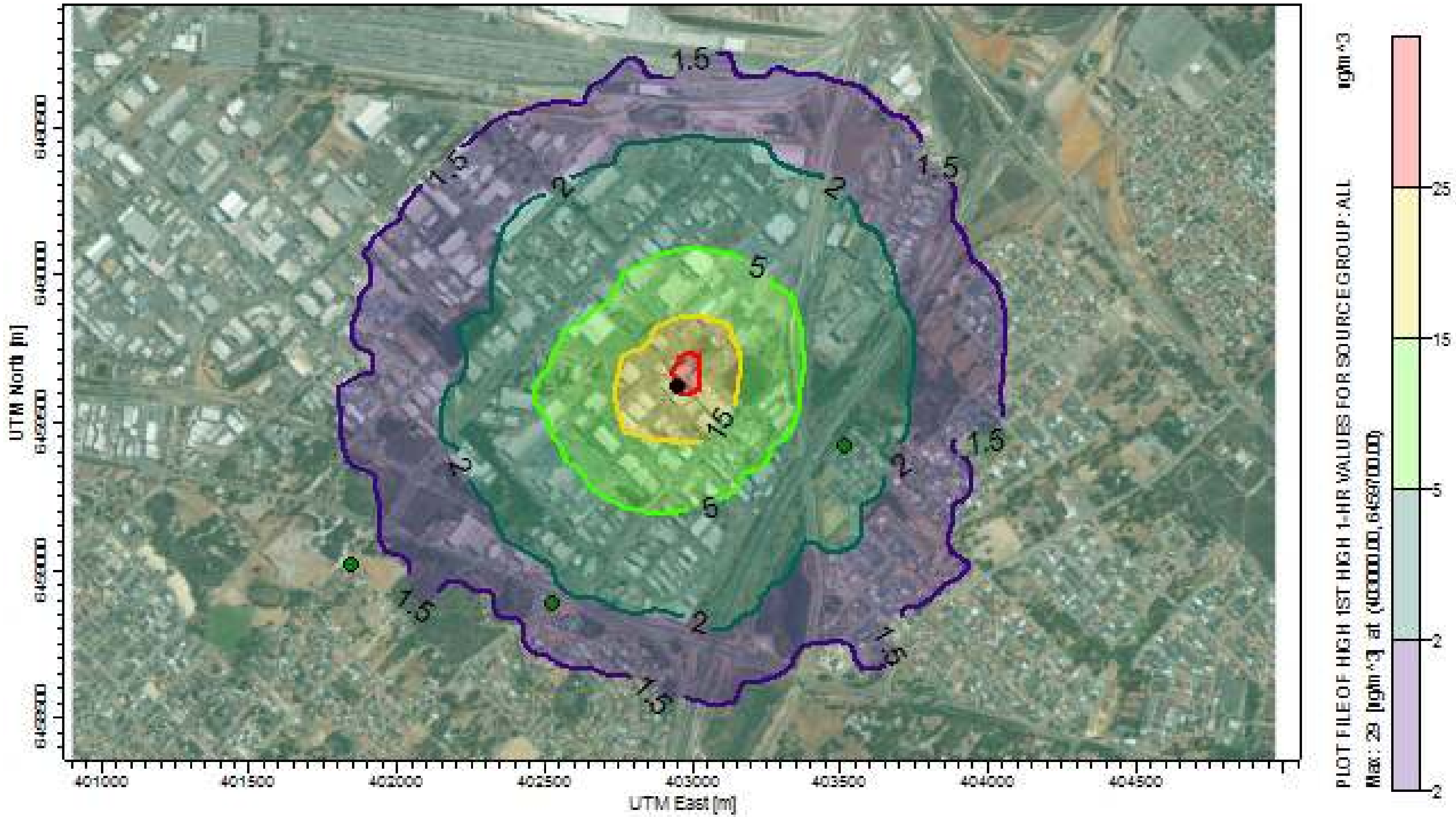

Figure 10: Maximum NO_2 1-hr Ground Level Concentration μg/m^3 (standard 246 μg/m^3)

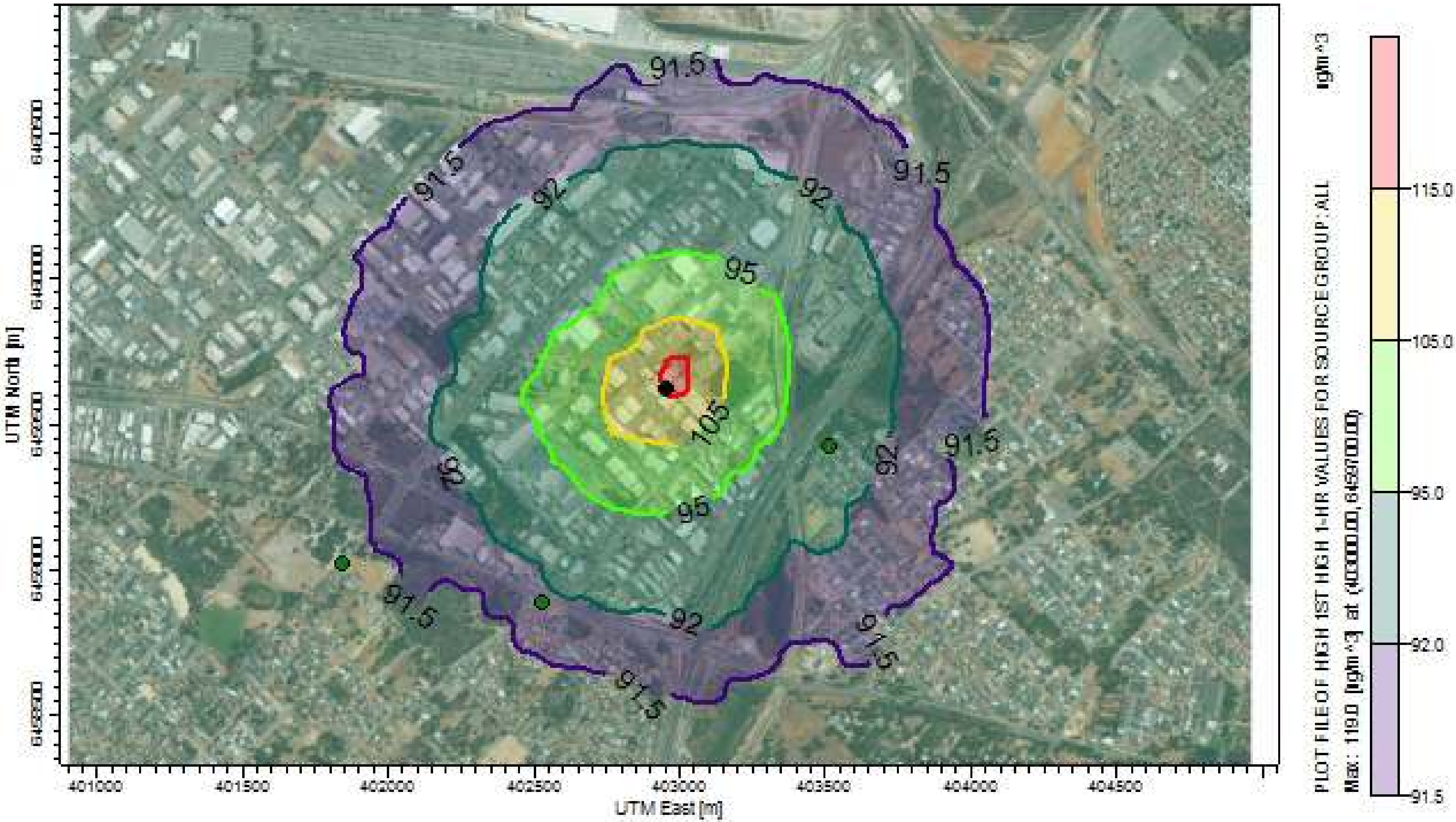

Figure 11: Cumulative Maximum NO_2 1-hr Ground Level Concentration μg/m^3 (standard 229 μg/m^3)

Appendix B: AERMOD Input File

```
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** AERMOD Input Produced by:
** AERMOD View Ver. 9.1.0
** Lakes Environmental Software Inc.
** Date: 28/06/2016
** File: 400Deg.ADI
****************************************

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** AERMOD Control Pathway
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CO STARTING
   TITLEONE 400Deg.isc
   MODELOPT DFAULT CONC
   AVERTIME 1 8 24 ANNUAL
   URBANOPT 1000000
   POLLUTID TRACER
   RUNORNOT RUN
   ERRORFIL 400Deg.err
CO FINISHED

****************************************
** AERMOD Source Pathway
****************************************
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** Source Location **
** Source ID - Type - X Coord. - Y Coord. **
   LOCATION STACK       POINT      402950.000  6459625.000      21.110
** DESCRSRC Stack
** Source Parameters **
   SRCPARAM STACK           1.0    15.000   673.150  15.40000     0.800

** Building Downwash **
   BUILDHGT STACK         8.00     8.00     8.00     8.00     8.00     8.00
   BUILDWID STACK        49.16    50.59    50.49    48.84    50.27    50.69
   BUILDLEN STACK        37.52    31.02    23.58    15.42    22.00    29.61
   XBADJ    STACK       -17.98   -14.74   -11.05    -7.03   -10.39   -14.29
   YBADJ    STACK        -0.01     0.12     0.26     0.38     0.50     0.59

   URBANSRC ALL
   SRCGROUP ALL
SO FINISHED

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** AERMOD Receptor Pathway
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RE STARTING
   INCLUDED 400Deg.rou
RE FINISHED

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** AERMOD Meteorology Pathway
****************************************
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** Profile File Path: ..\
   PROFFILE ..\Perth.PFL
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   UAIRDATA 1 2010
   SITEDATA 1 2010
   PROFBASE 23.0 METERS
ME FINISHED

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   RECTABLE 1 1ST
   RECTABLE 8 1ST
   RECTABLE 24 1ST
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   PLOTFILE 8 ALL 1ST 400DEG.AD\08H1GALL.PLT 32
   PLOTFILE 24 ALL 1ST 400DEG.AD\24H1GALL.PLT 33
   PLOTFILE ANNUAL ALL 400DEG.AD\AN00GALL.PLT 34
   SUMMFILE 400Deg.sum
OU FINISHED

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** Project Parameters
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** DESCPTN  UTM: Universal Transverse Mercator
** DATUM    World Geodetic System 1984
** DTMRGN   Global Definition
** UNITS    m
** ZONE     -50
** ZONEINX  0
```

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Environmental Noise Assessment

Proposed Tyre Shredding & Recovery Facility

9 Fargo Way, Welshpool

Reference: 16073675-01

Prepared for:
Elan Energy Matrix

Report: 16073675-01

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Position:	Project Director
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Date:	30 August 2016

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Appendices

1 INTRODUCTION

A Tyre Recovery facility is proposed at 9 Fargo Way, Welshpool – refer *Figure 1-1*. The facility operations include collection, shredding, and thermal processing of used tyres. The subject site and adjoining lots are zoned "General Industrial" with the nearest residential premises located to the east of Roe Highway, and south of Orrong Road.

This report details the assessment of noise impacts to neighbouring industrial premises as well as the more distant residential premises, in accordance with the *Environmental Protection Act 1986*, through the *Environmental Protection (Noise) Regulations 1997* (the Regulations).

Figure 1-1 Project Locality

Appendix B 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).

Regulation 7 defines the prescribed standard for noise emissions as follows:

"7. (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;

ii. impulsiveness; and

iii. modulation,

when assessed under regulation 9"

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…"

Tonality, impulsiveness and modulation are defined in Regulation 9. Noise is to be taken to be free of these characteristics 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 after the adjustments of *Table 2-1* 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

Note: The above are cumulative to a maximum of 15dB.

The baseline assigned levels (prescribed standards) are specified in Regulation 8 and are shown in *Table 2-2*.

Table 2-2 Baseline Assigned Noise 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
Industrial	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.

The influencing factor, applicable at the noise sensitive premises to the east (across Roe Highway) and south (across Orrong Road) has been calculated as 10 dB, as shown in *Table 2-3*. The transport factor has been calculated as 6 dB, due to Roe Hwy and Orrong Road being considered major roads (> 15,000 vehicles per day – 2015 traffic counts) within 100 metres of the residences. Note that the nearest residence is approximately 600 metres from the subject site.

Table 2-3 Influencing Factor Calculation

Description	Within 100 metre Radius	Within 450 metre Radius	Total
Industrial Land	0 dB 0 %	4 dB 40 %	4 dB
Commercial Land	0 dB 0 %	0 dB 0 %	0 dB
Transport Factor			**6 dB**
Total			**10 dB**

Table 2-4 shows the assigned noise levels including the influencing factor and transport factor at the receiving locations.

Table 2-4 Assigned Noise 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)	55	65	75
	0900 to 1900 hours Sunday and public holidays (Sunday)	50	60	75
	1900 to 2200 hours all days (Evening)	50	60	65
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	45	55	65
Industrial	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.

Figure 2-1 Neighbouring Industrial Premises

It must be noted the assigned noise levels apply outside the receiving premises and at a point at least 3 metres away from any substantial reflecting surfaces. Where industrial premises are concerned, noise is predicted to the nearest point on the boundary of the receiving lot.

It is noted the assigned noise 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*, which is 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 Environment 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.

3 METHODOLOGY

3.1 Background Noise Monitoroing

Site measurements were taken at 40 Magma Way as part of the Gateway WA post-construction noise monitoring program in June 2016. This measurement result is useful in determining approximate background noise levels at noise sensitive receivers.

Under the Regulations, there are certain requirements that must be satisfied when undertaking measurements and are defined in Regulations 19, 20, 22 and 23 and Schedule 4. In undertaking the measurements, these have been satisfied, specifically noting the following:

- All equipment holds current laboratory certificates of calibration that are available upon request. The equipment was also field calibrated before and after the Event and found to be within +/- 0.5 dB.
- The microphone is fitted with a standard wind screen.
- The microphone was at least 1.2 metres above ground level and at least 3.0 metres from reflecting facades (other than the ground plane).

3.2 Noise Modelling

Computer modelling has been used to predict the noise emissions from the site. The software used was *SoundPLAN 7.4* with the CONCAWE algorithms selected. These algorithms have been selected as they are one of the few that include the influence of wind and atmospheric stability. Input data required in the model are:

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

3.2.1 Meteorological Information

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 (0700-1900)
Temperature (^{o}C)	20
Humidity (%)	50
Wind Speed (m/s)	4
Wind Direction*	All
Pasquil Stability Factor	E

* Note that the modelling package used allows for all wind directions to be modelled simultaneously.

It is generally considered that compliance with the assigned noise levels needs to be demonstrated for 98% of the time, during the day and night periods, for the month of the year in which the worst-case weather conditions prevail. In most cases, the above conditions occur for more than 2% of the time and therefore must be satisfied.

3.2.2 Topographical Data

Topographical data was based on file data for the Welshpool area, originally from Landgate and incorporating the Gateway WA project.

3.2.3 Ground Absorption

Ground absorption varies from a value of 0 to 1, with 0 being for an acoustically reflective ground (e.g. water or bitumen) and 1 for acoustically absorbent ground (e.g. grass). In this instance, a value of 0.1 has been used as an average across the study area being mostly hard bitumen.

3.2.4 Source Sound Levels

The sound power levels used in the modelling are provided in *Table 3-2*. The tyre shredding noise is adapted from measurements taken at the existing Dowd Street facility, and the fan noise sources are adapted from a noise assessment of the proposed EMRC waste facility in Hazelmere. The noise sources are modelled to represent emissions via open roller doors in both the Main Shed and the TRRF shed (to the rear of the property). The configuration of each roller door, as advised by the management is as illustrated in *Figure 3-1*.

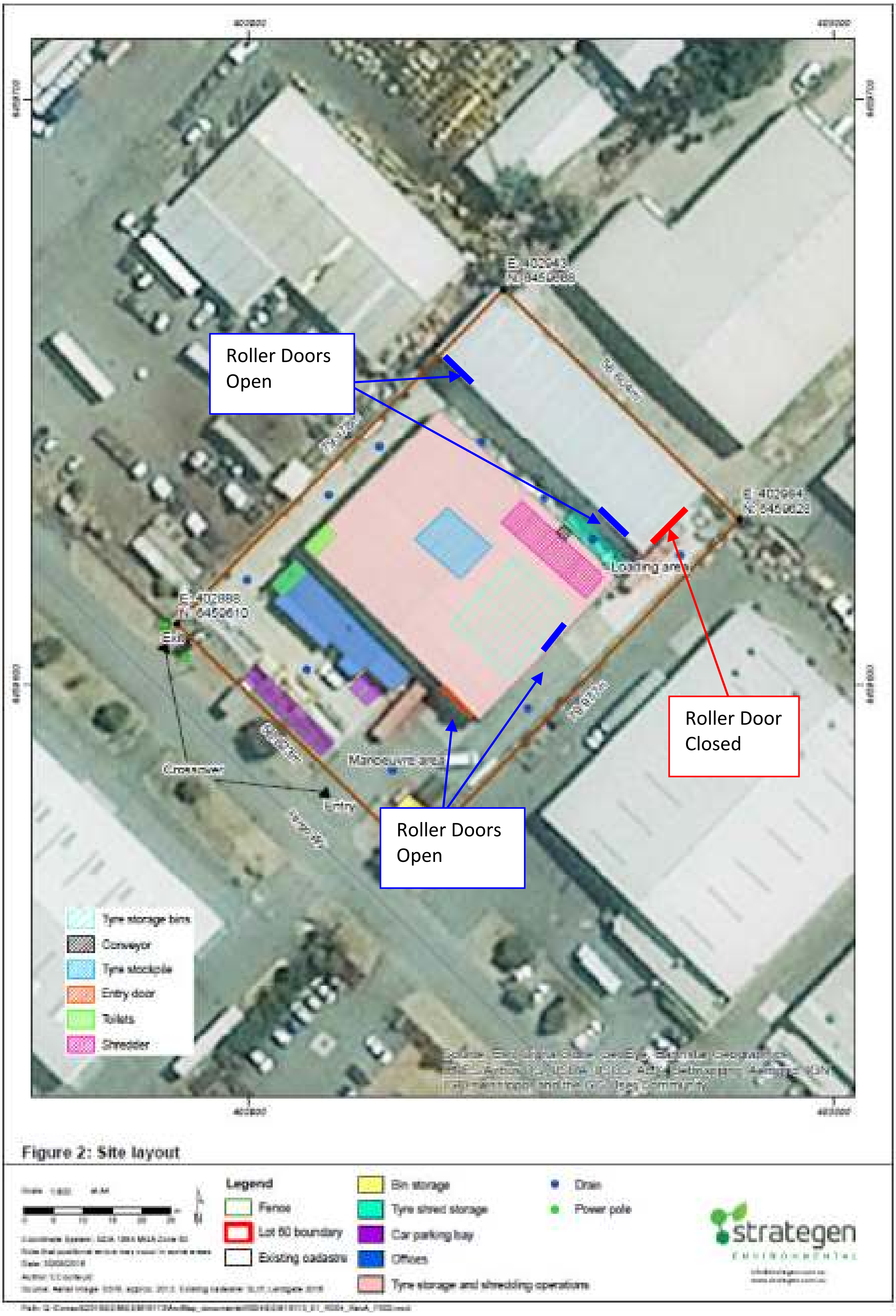

Figure 3-1 Roller Doors sources as Modelled

Table 3-2 Source Sound Power Levels

Description	Octave Band Centre Frequency (Hz)								Overall dB(A)
	31.5	63	125	250	500	1k	2k	4k	
Isuzu Diesel 12-Tonne Truck (High Idle) – L_{AMax}	-	96	101	96	97	101	99	95	**104**
Kiln Combustion Fan – L_{A10}	67	76	100	91	94	92	92	84	**102**
Cooling Air Fan – L_{A10}	90	98	99	93	88	88	85	84	**103**
SACTO Combustion Fan – L_{A10}	69	78	102	93	96	94	94	86	**104**
Tyre Shredder at Roller Door – L_{A10}	79	90	98	95	92	88	85	80	**94**

With regards to *Table 3-2*, please note the following:

- The Isuzu diesel truck is based on a measurement data of a similar truck as used on site, being of the same engine type and capacity.
- The combustion and cooling fans are located within the rear shed at the north of the site. The eastern roller door of the rear shed is assumed shut during operating hours.
- The Truck source is placed at the entry to the eastern boundary access lane, at a height of 1.5m above ground level. This is considered a worst-case position and the only time the engine noise would be anywhere near high idle.
- The tyre shredder noise level is based on a calibrated measurement of identical equipment at an existing facility.

The operating hours of the facility are 7.30am to 6.30pm Monday-Friday, therefore the applicable noise modelling scenarios are:

1. Day L_{A10} – Includes all plant noise as emitted from both sheds (refer *Figure 3-1*).
2. Day L_{Amax} – Includes all L_{A10} noise with 12-tonne truck at high idle near south-western boundary.

4 RESULTS

4.1 Noise Monitoring

The results of noise monitoring at 40 Magma Road, Wattle Grove are shown in *Figure 4-1*.

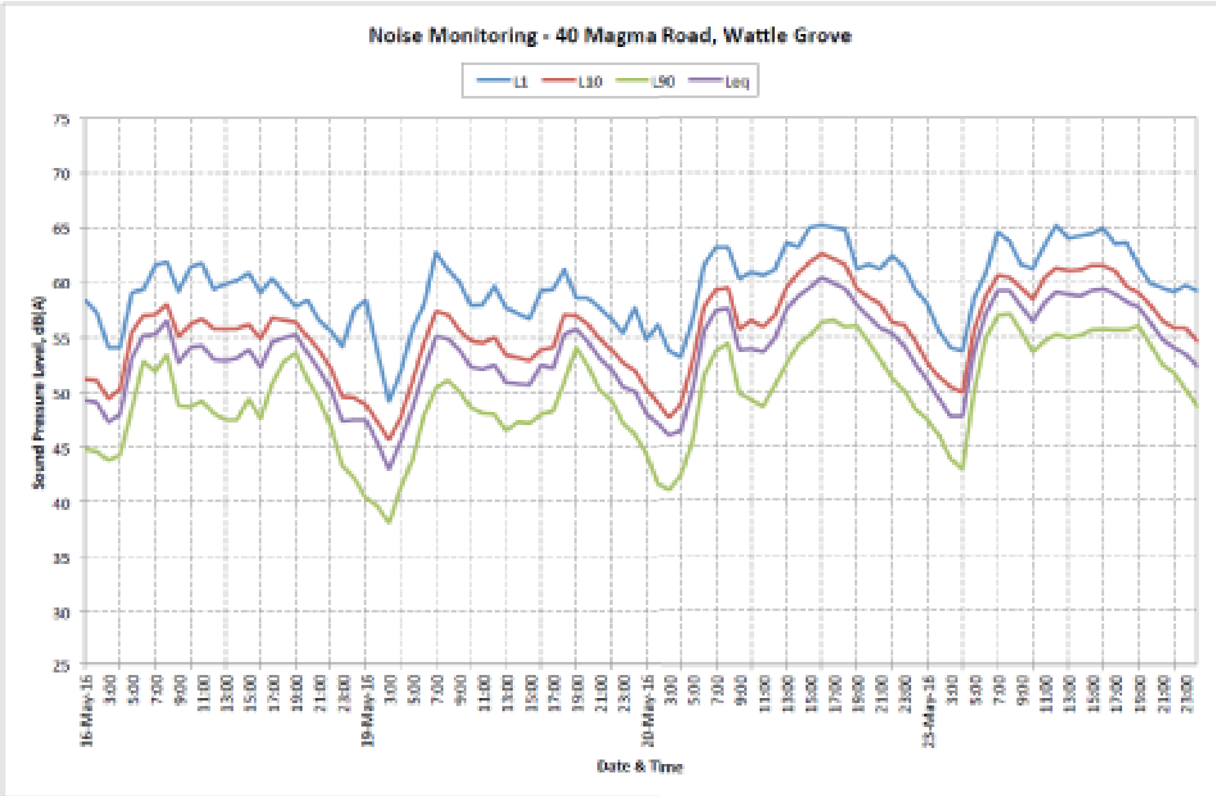

Figure 4-1 Existing Noise Levels at Residences

4.2 Noise Modelling

The results of the noise modelling are shown as noise level contour plots in *Figures 4-2 and 4-3* and discussed in *Sections 4.2.1 and 4.2.2* for each prediction scenario.

4.2.1 Scenario 1: Predicted Noise Day L_{A10}

The results of the L_{A10} Day scenario noise modelling are summarised in *Table 4-2.*

Table 4-1 Predicted Noise Levels, dB L_{A10}

Location	Tyre Shredding Shed	TRRF Shed	Combined Level	Critical Assigned Level, dB L_{A10}
Industrial A	51	67	67	65
Industrial B	48	41	49	65
Industrial C	47	43	48	65
Industrial D	69	59	69	65
Industrial E	60	29	60	65
Roe Hwy West Residences	14	15	17	55
Orrong Rd South Residences	15	16	18	55

The worst-case noise level of 69 dB L_{A10} is predicted to the boundary of Industrial D (being 7 Fargo Way) which exceeds the assigned level of 65 dB L_{A10}. Noise levels are also required to be at least 5 dB below the assigned level, to account for potential tonality or not being considered a significant contributor. Therefore noise levels must be reduced by at least 9 dB at the industrial boundary. Compliance is achieved at the residences.

The primary contributors to the exceedences are the south eastern door of the main shed and the western roller door of the TRRF shed. Therefore mitigation measures should be applied to this area.

4.2.2 Scenario 2: Predicted Noise Day L_{Amax}

The results of the L_{Amax} Day scenario noise modelling are summarised below in *Table 4-3.*

Table 4-2 Predicted Noise Levels, dB L_{Amax}

Location	Truck High Idle	Max Level*	Critical Assigned Level, dB L_{Amax}
Industrial A	63	67	90
Industrial B	64	64	90
Industrial C	63	63	90
Industrial D	80	80	90
Industrial E	67	67	90
Roe Hwy West Residences	25	25	75
Orrong Rd South Residences	28	28	75

*Maximum level includes the highest L_{A10} source from Scenario 1.

The worst-case noise level of 80 dB L_{Amax} is predicted to the boundary of Industrial D (being 7 Fargo Way). This is below the assigned level of 90 dB L_{A10} and is therefore compliant. Being 10 dB below the assigned level means that the noise is not a significant contributor and also if the noise was adjusted for tonality, compliance would still be achieved.

Figure 4-1

Predicted Noise level
L_{A10} dB

	= 45
	= 50
	= 55
	= 60
	= 65
	= 70
	= 75
	= 80
	= 85

Signs and symbols

Facility Buildings

9 Fargo Way, Welshpool - Tyre Recovery Facility - Predicted Noise Levels

L_{A10} Noise Level Contours - Mechanical Plant - Ground Floor

Lloyd George Acoustics
by Matt Moyle
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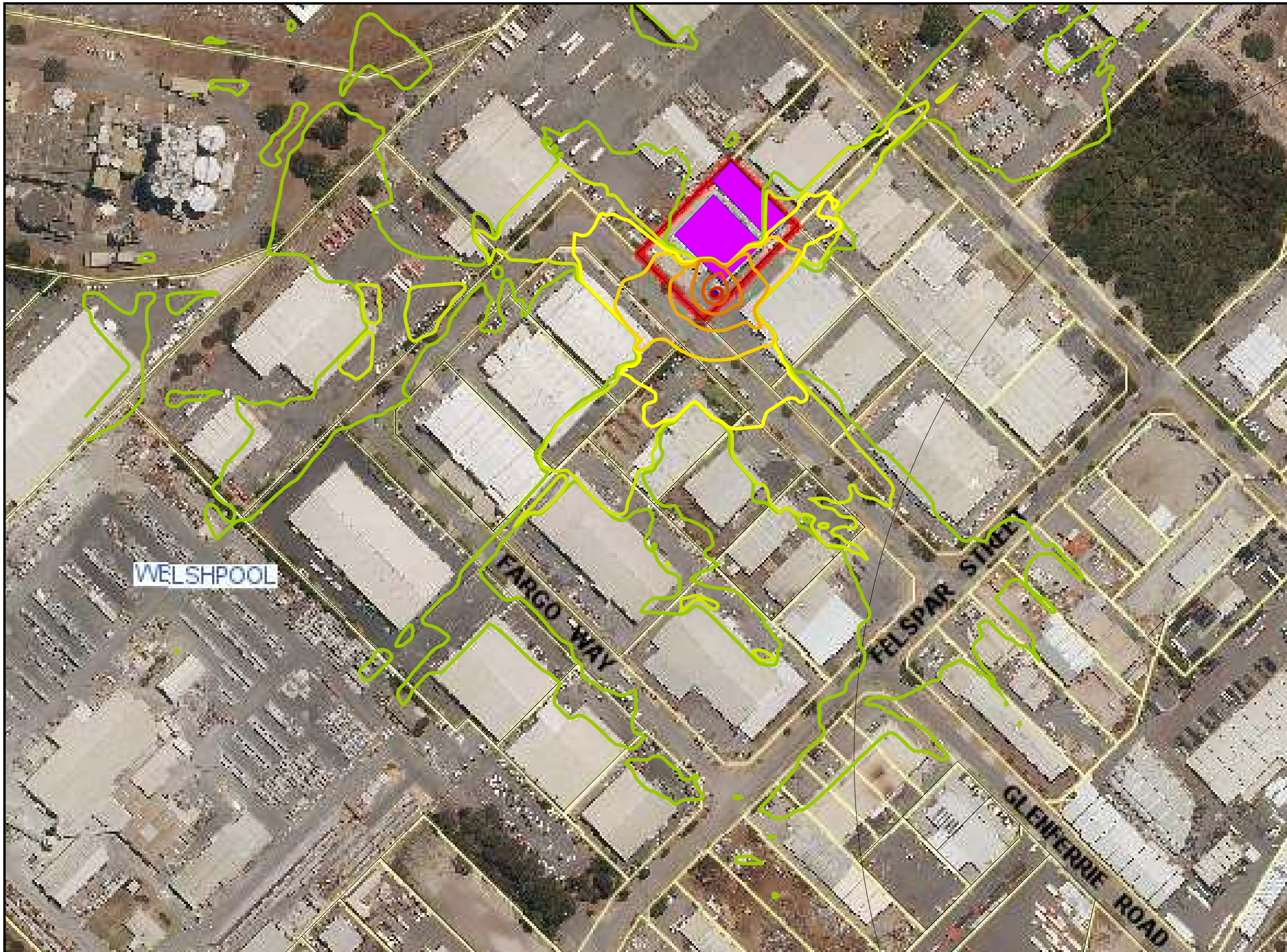
Figure 4-2



Predicted Noise level
L_{Amax} dB

- = 50
- = 55
- = 60
- = 65
- = 70
- = 75
- = 80
- = 85
- = 90

Signs and symbols

- Facility Buildings
- Truck Source

9 Fargo Way, Welshpool - Tyre Recovery Facility - Predicted Noise Levels

L_{Amax} Noise Level Contours - Ground Floor

Lloyd George Acoustics
by Matt Moyle
matt@lgacoustics.com.au
(61) 412 611 330

5 ASSESSMENT

Noise levels at residential premises are below the assigned level for all scenarios. Furthermore, the background noise level at 40 Magma Road, Wattle Grove indicates that noise from the facility would be inaudible at these residential locations.

The Day L_{A10} scenario is predicted to be exceeding the assigned levels at both east and west neighbouring industrial boundaries. These sites are designated “Industrial A” and “Industrial D,” being 11-15 Fargo Way and 7 Fargo Way, respectively. The exceedence, taking into account the +5 dB significant contribution factor or tonality, is between 7-9 dB. Therefore mitigation measures are required along these boundaries.

The Day L_{Amax} scenario, representing truck noise from a 12-tonne vehicle accelerating on site is compliant at all locations.

6 RECOMMENDATIONS

To achieve compliance, up to a 9 dB reduction is required to the overall L_{A10} noise level. To achieve this, the noise sources from within both sheds must be reduced at the east and west boundaries. It is understood that certain roller doors are generally shut during operations, however the assessment has conservatively modelled these as always open.

Additional mitigation is limited to barriers and source attenuation.

The following measures are therefore recommended to achieve compliance:

- Construct a 2.4m high barrier along the east and west boundaries. This barrier is to be solid and free of gaps and of minimum surface mass 15 kg/m^2. Masonry or block wall construction is suitable. The barrier should cover the length of the sheds as they are positioned on site;

  or

- Equipment such as fans contained within the sheds to be silenced/attenuated where possible and/or housed within enclosures such that an overall 9 dB reduction can be demonstrated at the site boundary.

The following measures are recommended as part of best practice:

- Consider lining the underside of the roof shed with insulation, in order to reduce noise levels within the shed by minimising reverberation. Any insulation is to either have no facing or a perforated type facing (i.e. not solid foil facing).
- Fit all mobile plant including trucks with broadband-type “croaker” reversing alarms.
- When not required for operations, management should investigate the closing or partial closing of roller doors on the east and west sides.

Appendix A

Site Plans

Figure 2: Site layout

Scale 1:800 at A4

0 5 10 15 20 25 m

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 30/08/2016
Author: CCourtauld
Source: Aerial image: ESRI, approx. 2012. Existing cadastre: SLIP, Landgate 2016.

Legend

- Fence
- Lot 60 boundary
- Existing cadastre
- Bin storage
- Tyre shred storage
- Car parking bay
- Offices
- Tyre storage and shredding operations
- Drain
- Power pole

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www.strategen.com.au

Path: Q:\Consult\2016\EEM\EEM16113\ArcMap_documents\R004\EEM16113_01_R004_RevA_F002.mxd

Appendix B

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 and sound power 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 levels 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 time weighting as specified in AS1259.1-1990. 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 time weighting as specified in AS1259.1-1990. This is used when assessing the presence of modulation only.

L_{APeak}
This is the maximum reading in decibels using the A frequency weighting and P time weighting AS1259.1-1990.

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

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

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

L_{A90}
An L_{A90} level is the A-weighted noise level which is exceeded for 90 percent of the measurement period and is considered to represent the "*background*" 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 20 000 Hz inclusive.

L_{Amax} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded at any time.

L_{A1} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 1% of the representative assessment period.

L_{A10} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 10% 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;

(b) is present for at least 10% of the representative.

Impulsive Noise

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

a variation in the emission of a noise where the difference between $L_{A\ peak}$ and $L_{A\ Max\ slow}$ 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.

Influencing Factor (IF)

$$= \frac{1}{10}\left(\%\ \text{Type A}_{100} + \%\ \text{Type A}_{450}\right) + \frac{1}{20}\left(\%\ \text{Type B}_{100} + \%\ \text{Type B}_{450}\right)$$

where:

$\%\ \text{Type A}_{100}$ = the percentage of industrial land within a100m radius of the premises receiving the noise

$\%\text{TypeA}_{450}$ = the percentage of industrial land within a 450m radius of the premises receiving the noise

$\%\ \text{Type B}_{100}$ = the percentage of commercial land within a100m radius of the premises receiving the noise

$\%\text{TypeB}_{450}$ = the percentage of commercial land within a 450m radius of the premises receiving the noise

+ Traffic Factor (maximum of 6 dB)

= 2 for each secondary road within 100m

= 2 for each major road within 450m

= 6 for each major road within 100m

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.

Background Noise

Background noise or residual noise is the noise level from sources other than the source of concern. When measuring environmental noise, residual sound is often a problem. One reason is that regulations often require that the noise from different types of sources be dealt with separately. This separation, e.g. of traffic noise from industrial noise, is often difficult to accomplish in practice. Another reason is that the measurements are normally carried out outdoors. Wind-induced noise, directly on the microphone and indirectly on trees, buildings, etc., may also affect the result. The character of these noise sources can make it difficult or even impossible to carry out any corrections.

Ambient Noise

Means the level of noise from all sources, including background noise from near and far and the source of interest.

Specific Noise

Relates to the component of the ambient noise that is of interest. This can be referred to as the noise of concern or the noise of interest.

Peak Component Particle Velocity (PCPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and in one of the three orthogonal directions (x, y or z) measured as a peak response. Peak velocity is normally used for the assessment of structural damage from vibration.

Peak Particle Velocity (PPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and is the vector sum of the PCPV for the x, y and z directions measured as a peak response. Peak velocity is normally used for the assessment of structural damage from vibration.

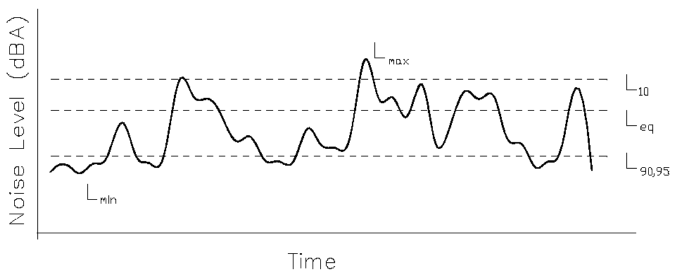
RMS Component Particle Velocity (PCPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and in one of the three orthogonal directions (x, y or z) measured as a root mean square (rms) response. RMS velocity is normally used for the assessment of human annoyance from vibration.

Peak Particle Velocity (PPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and is the vector sum of the PCPV for the x, y and z directions measured as a root mean square (rms) response. RMS velocity is normally used for the assessment of human annoyance from vibration.

Chart of Noise Level Descriptors



Typical Noise Levels