EAST ROCKINGHAM WASTE TO ENERGY FACILITY

ENVIRONMENTAL REVIEW DOCUMENT

ASSESSMENT NO. 2116

PREPARED FOR: NEW ENERGY CORPORATION, 12 PARLIAMENT PLACE, WEST PERTH, WA 6005

REPORT NUMBER: AP2017/171

REPORT VERSION: VERSION 2

REPORT DATE: 30 OCTOBER 2017

Invitation to make a submission

The Environmental Protection Authority (EPA) invites people to make a submission on the environmental review for this proposal.

New Energy Corporation Pty Ltd (New Energy) is proposing construct and operate a 101.8 MWt grate combustion system that will accept residual wastes to generate electricity. It is estimated that the plant will feed an estimated 28.2 MW of electricity into the South West Interconnected System.

The Environmental Review Document (ERD) has been prepared in accordance with the EPA's Procedures Manual (Part IV Divisions 1 and 2). The ERD is the report by the proponent on their environmental review which describes this proposal and its likely effects on the environment.

The ERD is available for a public review period of 4 weeks from 22 January 2018, closing on 19 February 2018.

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 Environmental Review 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 ERD. When making comments on specific elements in the ERD:

- 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: 19 February 2018.

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: 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 EPA Services at the Department of Water and Environmental Regulation on (08) 6364 7000.

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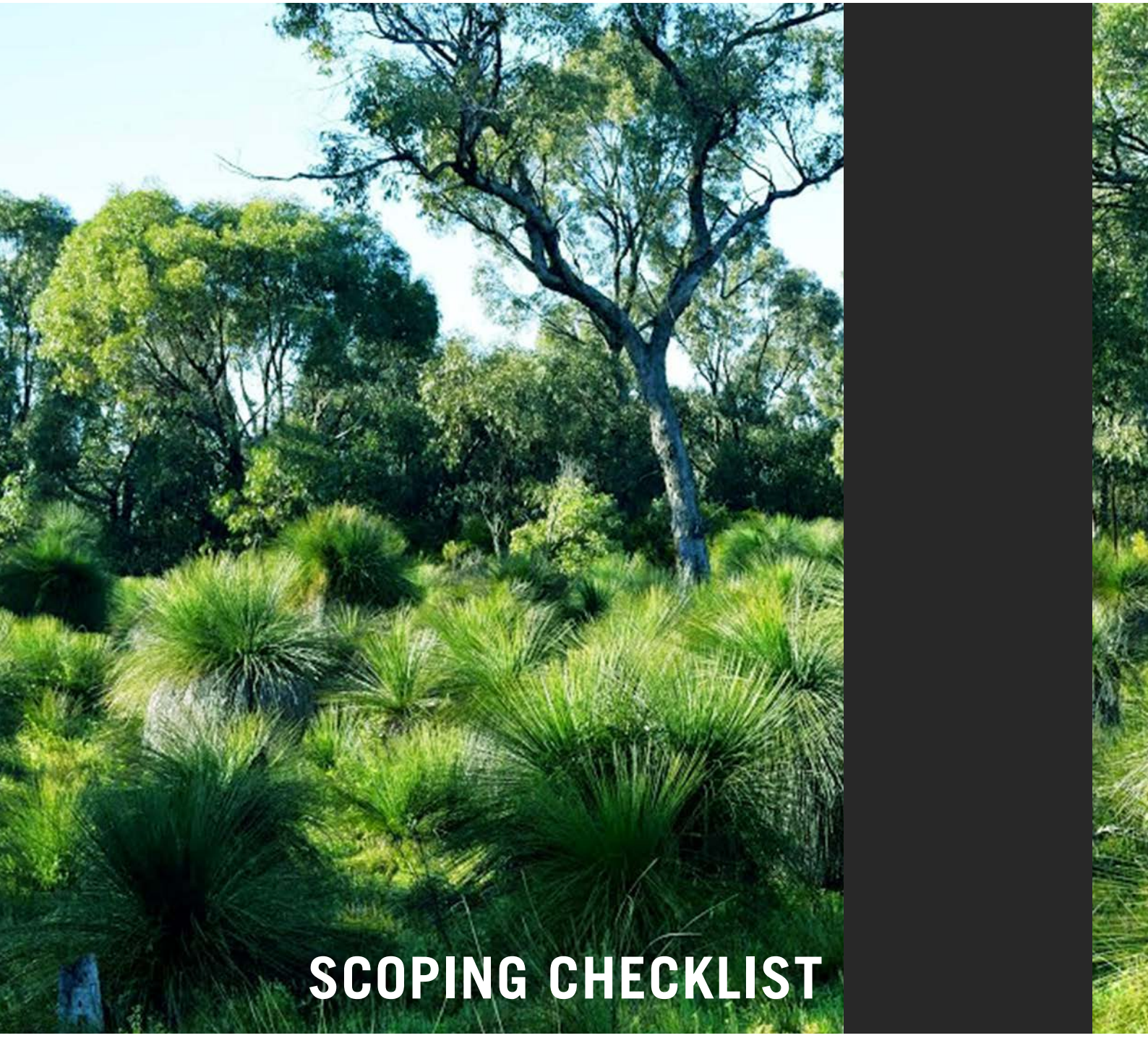

SCOPING CHECKLIST

Scoping checklist

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Air Quality (Emissions)			
1	Characterise the environment relating to the factor (e.g. identify values, types of surveys, baseline data collected).	4.2.3	121-124
2	Describe elements of the proposal which affect the environment (e.g. temporary construction verses operation, impacts/pressures, from the proposal)	4.2.4	124
3	Predict inherent and residual impacts before and after applying the mitigation hierarchy (i.e. considering points 1 and 2)	4.2.5	124-131
4	Describe proposed monitoring and managements to achieve predicted outcomes/objectives;	4.2.6	138-139
5	Identify offsets if appropriate, if a significant residual impact may remain after applying the mitigation hierarchy.	6	174
6	Identify all atmospheric emissions from all potential points of discharge from the proposal	4.2.4	124
7	Establish and predict the background pollutant levels to be used in cumulative modelling for particulates (PM_{10} and PM2.5), 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 known proposed facilities. Where reliance is placed on historical data, modelling should contain a high degree of conservatism and inter-annual variation of historical data should be taken into account.	4.2.3 4.2.5	121-124 124-131
8	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.	4.2.5.1-4.2.5.5 Appendix 7	131-133 Appendix 7
9	Model the ground level concentration 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 from the proposal in isolation and cumulatively using the background pollutant levels established in work item 7 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	4.2.5.1-4.2.5.5 Appendix 7	131-133 Appendix 7
10	Compare predicted emissions and ground level concentrations with appropriate standards.	4.2.5.1-4.2.5.5 Appendix 7	131-133 Appendix 7
11	Describe how the chosen technology meets best practice, and detail its track record of reliable operation (at a similar scale) to demonstrate how it meets the EPA's expectations documented in the environmental and health performance of waste to energy technologies.	2.6.5 and 2.6.6	81-88
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13	Numerical modelling of noise emissions (including consideration of existing background noise) to demonstrate compliance with the Environmental Protection (Noise) Regulations 1997.	4.3.4.1 Appendix 20	144-147 Appendix 20

Task No.	Required Work	Section	Page No.
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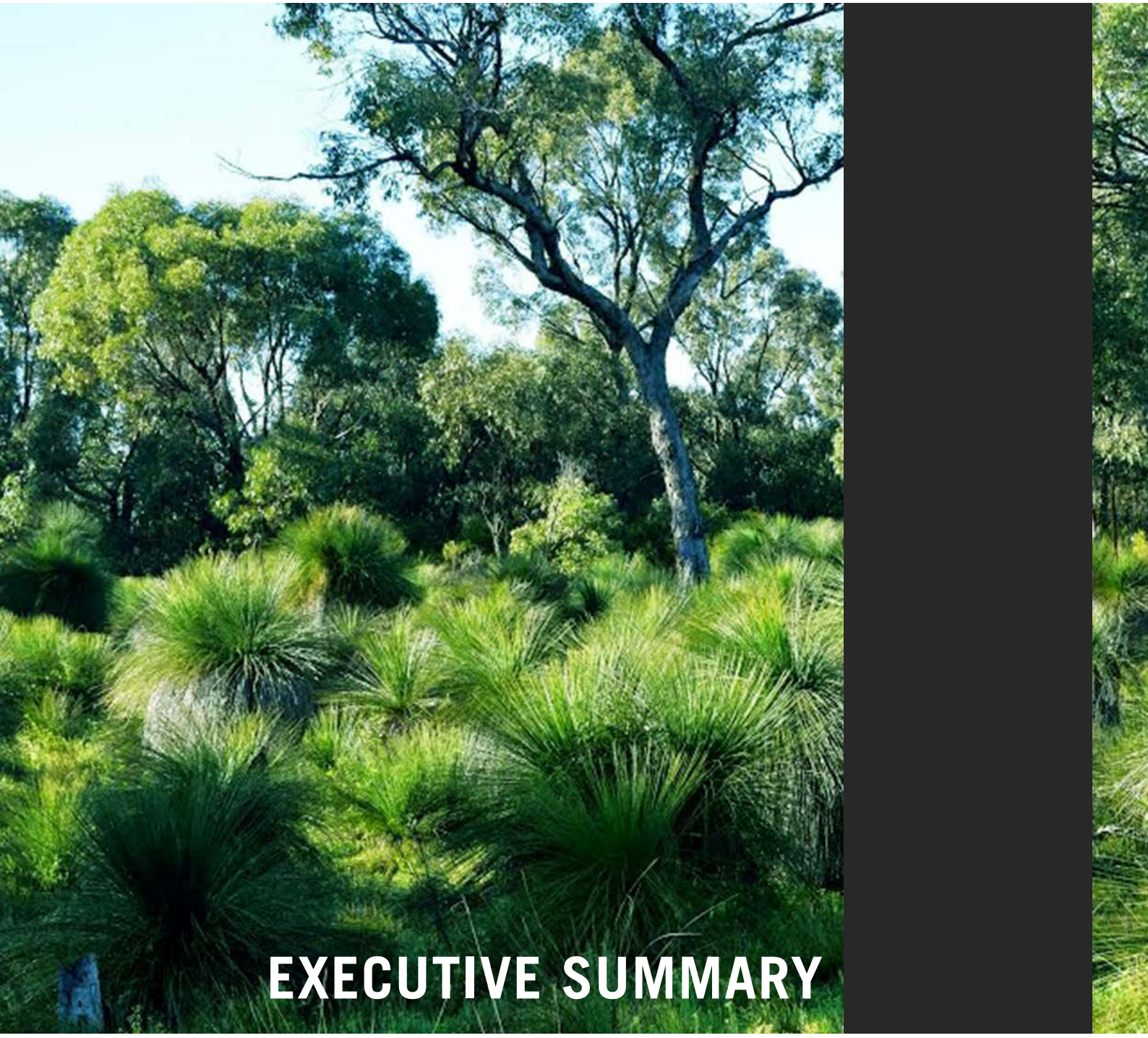

EXECUTIVE SUMMARY

Executive Summary

Introduction

New Energy Corporation Pty Ltd (New Energy) is a privately owned Australian company whose core business is the processing of waste into energy. New Energy offers its waste treatment facilities on the basis of a complete project package that incorporates feasibility studies, securing of regulatory approvals, project finance, technology delivery, operation and maintenance, as well as marketing of the process outputs of electricity and both recovered and recycled materials.

In 2015, New Energy secured approval from the Minister for the Environment to construct a waste to energy facility at its East Rockingham site (Lot 1 (No. 26) Office Road, East Rockingham) using gasification technology (EPA Report No. 1513 and Ministerial Statement 994). Since securing this approval, New Energy appointed an EPC contractor and completed a front end engineering and design study. The Company has also worked hard to secure waste contracts from local and regional Perth Councils that are needed to underpin a project of this nature. This has included participating in tenders, providing project briefings and conducting site visits to see the nominated gasification technology overseas. It is clear from these activities and lack of interest from Perth councils that:

- Perth Councils want the most proven waste to energy technology available with several reference facilities operating at large scale on municipal solid waste.
- They want sorting of MSW to occur on the kerbside through a three bin system rather than a dedicated dirty materials recovery facility as previously offered by New Energy.

In light of this feedback and with several upcoming large waste processing tenders over the next 12 to 18 months, New Energy is cognisant that it must be able to provide proven technology. For this reason, New Energy has partnered with Hitachi Zosen Inova (HZI) to revise its project design to utilise best practice grate combustion in order to be able to compete effectively with other players in the market. HZI will act as the EPC contractor and operator for the facility.

The proposed change in technology was referred to the Environmental Protection Authority (EPA) under Section 38 of the *Environmental Protection Act 1986*. The EPA assessed the referral and determined that a new assessment was warranted, with the assessment being set as Environmental Review – four week public review period.

Location

This Environmental Review Document (ERD) considers the proposal to establish a waste to energy plant at 26 Office Road (Lot 1 on Diagram 62220), East Rockingham. The site is located within the Rockingham Industrial Zone (RIZ).

This 10ha site was selected after extensive site analysis and consultation. The RIZ is near major haulage routes and existing power transmission infrastructure, is zoned for Industry and appropriately buffered to sensitive land uses such as residential areas. The site proposed for the facility abuts an area that has been assessed by the EPA as being environmentally acceptable for heavy industry through a Strategic Environmental Assessment (SEA) in 2011 (Assessment No. 1390). The site for this proposal was not included in the SEA as it was considered that the environmental values of the land did not present a significant risk associated with the establishment of the industrial area.

Project overview

New Energy Corporation proposes to establish a waste to energy facility at East Rockingham (Figure 3) using state of the art technology grate combustion which will take waste material that would otherwise be directed to landfill and convert the waste to electricity for use in the South West Interconnected System (SWIS) power grid. World best grate combustion technology will be used to ensure that noise, odour and exhaust emissions are within International guidelines.

The maximum capacity of the plant is 101.8 Megawatt Thermal (MWt) which will result in the generation of 31.4 MW of electricity. Of this, 3.2 MW is parasitic electricity required to operate the plant and the remaining

28.2 MW will be exported to the grid when the power station is operating at maximum capacity. The energy produced will be enough electricity to sustain more than 36,000 homes per year.

The maximum throughput of the plant is a function of the thermal capacity of the plant and the calorific value of the waste fed into the combustion system. Therefore, the actual volumes may vary somewhat. However, the basis of the design is that the plant will receive 300,000 tonnes per annum (tpa) of waste at an average calorific value of 9.773 MJ/kg. Higher volumes (up to 330,000 tpa) may be received if the average calorific values of the residual waste streams are lower than 9.773 MJ/kg. The main waste streams to be accepted will be MSW waste, residuals from MRFs handling Recyclables and C&I wastes, residuals from Mechanical Biological Waste Plants (MBTs). Other wastes may be accepted in the future where they are agreed for acceptance under the Department of Water and Environmental Regulation (DWER) Part V licensing process. Some bio-sludges from the nearby East Rockingham wastewater treatment plan may also be received at the plant.

The following wastes will not be accepted for processing at East Rockingham:

- Scheduled wastes such as Polychlorinated Biphenyls (PCBs) and Organochlorine Wastes;
- Asbestos;
- Highly corrosive or toxic liquids or gases such as strong acids or chlorine or fluorine;
- Explosive materials;
- Radioactive wastes; and
- Wastes which mechanically cannot be handled by the facility.

Any other wastes which are identified by staff as potentially hazardous to health or the environment will also be quarantined.

The Plant will operate seven days per week, 24 hours per day. Wastes from the general public will not be accepted at the facility. An automated gating system will be in operation for authorised vehicles using number plate scanning technology. Vehicles not authorized in the New Energy system will require authorisation prior to being granted access.

The combustion process will operate 7 days per week, 24 hours per day. It will be staffed with permanent employees based on a rotating 12 hour shift pattern. The operation includes:

- Receiving of waste;
- Mixing of waste in the bunker and feeding into the feed hopper;
- 24/7 operation of combustion, power generation, air pollution control systems;
- Operation of associated support systems for combustion (water treatment, chemical preparation etc.);
- Chemical receival;
- Spare parts receival;
- Ash and residue dispatch; and
- Maintenance of all systems (routine and annual overhaul)

The grate combustion system is designed for mixed waste and up to 10% sewage sludge. The specific thermal and static surface loads are important design parameters of the moving grate combustion, which has a proven low wear and long life time. The HZI air-cooled grate design is proven technology as it has been used in more than 500 plants internationally.

The furnace is designed for continuous waste combustion in the range between 60% and 100% of the thermal design load. Short-term peaks caused by the non-homogeneity of the waste are absorbed by the system.

The combustion control is fully automatic. The operator selects the desired set point and all control devices are handled by the control system. This ensures that the plant operates at optimum efficiency at all times, achieving desired environmental quality standards and maximising the life expectancy of the equipment.

The flue gas passes through a water tube boiler where it is cooled while the water of the closed water-steam cycle is transformed into superheated steam. The superheated steam is expanded in the turbine that drives a generator producing 31.4 MW of electricity. Almost 90% of the produced electrical power is exported to the Western Australian grid. The exhaust steam from the turbine condenses in the air-cooled condenser.

The proposed facility will use a dry flue gas cleaning system downstream of the boiler to control the air emissions. Hydrated lime is injected into the flue gas where it neutralises acidic components such as hydrogen chloride, hydrogen fluoride and sulphur dioxide. At the same injection point activated carbon is added to the flue gas that adsorbs dioxins and furans, gaseous mercury, and other components.

Downstream of the injection of the reactants, the flue gas passes through a fabric filter (bag filters) which trap fine particulates. Some of the spent lime is recycled to optimize the consumption of the reactants. Periodically, the fabric filters are cleaned by a reverse pulse of air, and the flue gas residues collected for disposal to an appropriate facility.

An induced draught fan maintains the flue gas flow through the process overcoming the pressure loss through the system. Before the cleaned gas is released to the atmosphere at the stack the emissions are monitored in the continuous emission monitoring system (CEMS). A further hot standby CEMS will also be provided to provide backup monitoring capabilities if there is a problem with the duty CEMS.

The energy from waste process is required to meet the emission criteria specified in the European Union's Industrial Emissions Directive (IED) for the following substances:

- Total particulates (dust) PM_{10};
- CO, acid and corrosive gases - hydrogen chloride (HCl), hydrogen fluoride (HF), sulphur dioxide (SO_2) and NOx;
- Heavy metals - cadmium (Cd), mercury (Hg), lead (Pb) and other heavy metals;
- Organic compounds - dioxins, furans and volatile organic compounds (VOCs).

Emissions from the stack will be monitored using certified CEMS for: particulates, CO, SO_2, HCl, oxygen (O_2), NOx and VOCs.

In addition to the continuous monitoring, periodic sampling and measurement will be undertaken for nitrous oxide (N_2O), HF, Cd, thallium (Tl), Hg, antimony (Sb), arsenic (As), Pb, chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni), vanadium (V), dioxins and furans and dioxin like PCBs.

Periodic measurements will be carried out typically four times in the first year of operation and twice per year thereafter. The frequency and extent of monitoring will be confirmed by the Department of Water and Environmental Regulation (DWER) in licence issued under Part V of the *Environmental Protection Act 1986*.

The bottom ash generated from the combustion of the waste will be transported to an undercover processing area via a covered conveyor. The initial storage area has approximately five days of storage capacity where the moisture content reduces from approx. 18% w/w down to 12% w/w to allow for easier processing. The stored ash will go through a process which sorts the aggregate according to fraction size and removes ferrous and non-ferrous metals. The recovered metals will be directed to an off-site metal recycling facility.

The treated bottom ash aggregate is transferred to a maturation area where the material is stored and periodically dampened with water and turned by front end loader. Maturation involves a reaction between atmospheric carbon dioxide with oxides in the ash in the presence of humidity (e.g. water) to form carbonates (some water may be added when there is insufficient atmospheric moisture). This process lowers the alkalinity of the ash to a level where is it acceptable for use as aggregate. The use of the treated aggregate is undertaken in other countries throughout Europe. In the United Kingdom, the use of treated aggregate is subject to the requirements of the UK Standard Rules SR2012 No. 13 of the *Environmental Permitting (England & Wales) Regulations 2010*
(Appendix 4). New Energy commits to working with the Department of Water and Environmental Regulation to adapt this Standard for the Western Australian context.

Should the use of the bottom ash not be deemed acceptable, the contingency will be to dispose of this material to an appropriately classed landfill facility.

Key components

Tables ES1 and ES2 provide a summary of the proposal and the key characteristics of the East Rockingham Waste to Energy project.

Table ES1: Summary of the Proposal

Proposal title	East Rockingham Waste to Energy Facility
Proponent name	New Energy Corporation Pty Ltd 12 Parliament Place WEST PERTH WA 6005
Short description	New Energy Corporation Pty Ltd (New Energy) is proposing construct and operate a 101.8 MWt grate combustion system that will accept residual wastes to generate electricity. It is estimated that the plant will feed an estimated 28.2 MW of electricity into the South West Interconnected System

Table ES2: Proposed extent of physical and operational elements

Element	Proposed extent
Physical elements	
Native vegetation clearing	10 ha
Construction period	Approximately 36 months
Life of plant	Notionally 30 years
Operational elements	
Thermal capacity	101.8 MWt
Generation capacity	31.4 MWe with an estimated 28.2 MWe fed into the SWIS
Input power	3.2 MWe Parasitic Load
Input water	Approximately 60,000 kL/annum from scheme water
Input waste throughput	300,000 tpa of residual wastes to be received on-site plus up to 30,000 tpa of sewage sludge for a total of up to 330,000 tpa
Feedstock waste	300,000 tpa of MSW and residual wastes (processed C&I and C&D waste and residuals from MBT and MRF) as well as up to 30,000 tpa of sewage sludge for a total of up to 330,000 tpa.
Waste disposal – off-site, recycling or reuse	Up to 68,800 tpa of bottom ash (wet) aggregate
Process wastes	
Flue gas treatment residues	9,920 tpa (dry) or 11,704 tpa (wet) disposed to landfill.

Wastewater	— Estimated 2.5 kL/day of wash down water.
	— Approximately 15 kL/day of reject water from the reverse osmosis plant which will be used for the bottom ash extractor.
	— Boiler feed water circuit blow down to be recycled.
	— The final disposal options will be determined at Works Approval Stage from following options:
	  — Re-use in the bottom ash handling circuit;
	  — Off-site disposal;
	  — Evaporation; or
	  — Thermal evaporation using waste heat.

Sewage/ grey water	On-site disposal via an aerobic treatment unit – to be approved by the City of Rockingham.

Element	Proposed extent
Emissions	— The key emissions will be air emissions from the stack. Off-gases from the plant are discharged to atmosphere after treatment in a gas cleaning system consisting of a dry reagent scrubbing system with absorbent injection system followed by a compartmentalised pulse jet fabric filter baghouse filtration (FFB). NOx emissions are controlled using a HZI's own SNRC technology. — The scrubbing system and combustion control will result in emission levels that will be fully compliant with the requirements of the IED. The ambient concentrations due to these emissions are shown through modelling (see Section 4.2) that they comply with relevant standards and will not contribute to a detrimental effect on the environment in the Rockingham and Kwinana air shed.

Project justification

The final decision to adopt waste to energy as the preferred approach was made after considering the need to reduce waste being directed to landfill in the Perth metropolitan area. The Waste Authority's Waste Strategy 2015 Targets indicate that despite increasing diversion of waste from landfill, the targets for all three major waste streams (MSW, C&I and C&D) are not being met. Without significant investment in waste management infrastructure, these diversion targets will not be met.

The New Energy waste to energy project complements existing recycling initiatives by targeting residual wastes that are currently being directed to landfill. The project captures these wastes as a feedstock to generate electricity to be fed into the SWIS network. The diversion of this waste away from landfill and the generation of electricity offers a net greenhouse benefit taking into account the gases generated from a conventional gas fired power plant as well as the greenhouse gases generated from the decomposition of the landfilled wastes.

The EPA's Section 16 advice on waste to energy recognises that this technology is a relevant method for addressing waste management in Western Australia and is preferred to landfilling of waste which is seen as the lowest form of management in the waste hierarchy.

New Energy has selected the HZI grate combustion system as the preferred technology for the following reasons:

- The technology has been proven, is in commercial operation around the world and is the most dominant waste to energy approach adopted on a global scale (more than 500 reference plants alone in operation using the HZI combustion technology)
- All of the components of the plant are proven and have demonstrated reliability
- The technology has been successfully operated using similar waste streams to what will be used at East Rockingham
- The technology has been proven to comply with the European Union's Incinerator Emissions Directive (IED) standards for emissions
- It is reliable, stable and combustion can be controlled within a large range of fuel composition
- HZI is a "turnkey" supplier of waste to energy projects meaning that they supply all technology used (not just the grate as other suppliers do) and take responsibility for constructing and commissioning the project as an EPC contractor
- HZI also operates waste to energy facilities, ensuring all the learnings of successfully operating plants internationally are integrated into the successful operation of the East Rockingham Project
- HZI is an established and proven entity in the waste management sector and was referenced by WSP (2013) as one of the leading companies in the waste to energy sector.

Project benefits

The project offers many benefits for the community, local government and industry, including the following:

- The project will manage the risk of increasing volumes and types of waste being generated in the Perth metropolitan region from adversely impacting the environment by diverting waste away from landfills
- The facility will recover energy in the form of electricity from waste streams that are currently landfilled. The facility will produce enough electricity to cater for around 36,000 households per year

- The facility will generate renewable energy to help reduce the State's dependence on fossil fuels
- Greenhouse gas emissions will be reduced by producing electricity from waste instead of landfilling the waste
- The renewable energy produced will be available 24/7 regardless of the time of day or weather conditions. A project of this nature provides genuine base load renewable energy
- The project provides private investment in much needed waste infrastructure
- The project will create 40 full-time jobs locally during operation as well as approximately 300 direct jobs during construction and an additional 750 jobs indirectly
- The project will diversify the generation of power in the Perth metropolitan area by using waste as a fuel
- The project supports the WA State Government's Waste Strategy by diverting residual MSW, C&I waste and C&D waste away from regional landfills.

Impact assessment

In its assessment of the referral, the EPA identified the following key environmental factors being relevant to the proposal:

- Air quality; and
- Social surroundings.

New Energy prepared an environmental scoping document (ESD) in accordance with EPA guidelines. A program of studies and information collection was outlined for inclusion in this ERD.

Table ES3 provides a summary of the potential impacts, the proposed mitigation measures that the predicted outcomes for the environmental factors considered in this ERD.

Table ES3: Summary of potential impacts, proposed mitigation and outcomes

Air quality	
EPA objective	To maintain air quality and minimise emissions so that environmental values are protected.
Policy and guidance	EPA Policy and guidance — Statement of Environmental Principles, Factors and Objectives — Factor Guideline – Air Quality — Environmental and health performance of waste to energy technologies (EPA Report 1468) Section 16 Advice, April 2013 — Guidance Statement No. 3 Separation Distances between Industrial and Sensitive Land Uses Other policies and guidance: — Air Quality Modelling Guidance Notes, Department of Environment March 2006

Potential impacts	The main emission points to the atmosphere will occur when the facility is operational and will be associated with the 60m main stack under normal operating conditions or emissions generated during commissioning, planned shutdown/maintenance or emergency shutdown (i.e. worst case conditions). Emissions of concern from waste to energy plants as reported in the literature are: — Oxides of nitrogen (NO_X); — Low levels of particulates, metals and volatile and semi-volatile organics including trace levels of dioxins; — Carbon Monoxide (CO); — Carbon dioxide (CO_2); — Formaldehyde and other hazardous air pollutants including dioxins and furans and other complex organic compounds (both halogenated and non-halogenated); — Heavy metals; — Water vapour; — Trace levels of acid gases including HCl and SO_X; and — Odour (addressed under Social Surroundings Environmental Factor). Additional sources of potential impacts to air quality include: — Gaseous emissions emitted during a fire in the waste bunker; — Particulate (i.e. dust) emissions during construction works; and — Generation of greenhouse gas emissions.
Mitigation	Avoid: — Appropriate siting of the facility to ensure adequate separation from sensitive receptors. — Selection of technology that is proven in over 500 reference plants and has demonstrated reliability. — Waste acceptance criteria that avoids hazardous wastes. Implementation of standard procedures around identification and handling of non-processible wastes. Minimise: — Efficient technology to maximise combustion efficiency and reduce waste products. Combustion control is fully automatic based on operator specified set points. — Adoption of air pollution control system to reduce emissions to meet the IED standards. — Use of a continuous emissions monitoring system (CEMS) to provide on-going monitoring of emissions generated. The facility will include a further hot standby CEMS. — Manage the commissioning process to ensure all components of the facility are functioning correctly before ramping up operation. Development and implementation of procedures around planned and unplanned shutdown management. — Prepare and implement a fire and emergency response plan in conjunction with local emergency authorities, ensuring staff are adequately trained, appropriate fire management measures are implemented such as perimeter firebreaks, automatic fire control systems, fire water storage tanks, firefighting equipment, etc. — Prepare and implement a Construction Environmental Management Plan to guide management of construction related impacts. Measures will address clearing, dust management, noise management, etc.
Outcomes	Residual Impact: The proposal will lead to small increases in background concentrations of air toxics in the Kwinana Airshed. The modelling has demonstrated that the increases as a result of the project are not significant to the extent that environmental or human health is compromised. Based on the avoidance and mitigation measures outlined above, it is expected that the proposal will meet the EPA's objective for Air Quality. Offset: As the EPA's objective for Air Quality will be met, New Energy is not proposing any offsets for this environmental factor.
Social surroundings	
EPA objective	To protect social surroundings from significant harm.

Policy and guidance	EPA Policy and guidance — Statement of Environmental Principles, Factors and Objectives. — Factor Guideline – Social surroundings — Environmental Protection (Noise) Regulations 1997. Guidance Statement No. 3 Separation Distances between Industrial and Sensitive Land Uses Other policies and guidance: — Odour Methodology Guideline, Department of Environmental Protection, Perth, WA March 2002
Potential impacts	The operation of the waste to energy facility at East Rockingham has the potential to generate noise and odour emissions which have the potential to impact the amenity of surrounding receivers. Noise associated with the waste to energy facility may be generated during: — The construction phase by machinery and equipment; — The Operational phase by plant and equipment. The main sources of odour for the project are the tipping hall when the doors open and close for truck entry and departure and from a 48m high shutdown stack used to vent internal odours from the waste bunkers when the combustion system is not operating.
Mitigation	Avoid: — Appropriate siting of the facility to ensure adequate separation from sensitive receptors. — Delivery of wastes in enclosed vehicles; — Provision of an enclosed waste bunker incorporating fast opening/closing doors to the waste receival area; — Maintaining the waste receival area under negative air pressure by drawing air from this area for injection into the combustion chamber where odorous emissions will be destroyed. Minimise: — During planned or unplanned shutdowns, the auxiliary fan will extract odorous air to a 48m stack for dispersal. — Prepare and implement a Construction Environmental Management Plan to guide management of construction related impacts. Measures will address clearing, dust management, noise management, etc. — Restrict construction to the hours between 7am and 7pm on any day which is not a Sunday or public holiday. Construction work will be undertaken in accordance with control of noise practices set out in Section 6 of AS 2346:1981 Guide to Noise Control on Construction Maintenance and Demolition Sites. All equipment used on the site will be selected and operated to minimise noise where feasible.
Outcomes	Residual Impact: — The modelling has demonstrated that the proposal is able to meet relevant noise and odour criteria, without impacting upon sensitive receptors. — Based on the avoidance and mitigation measures outlined above, it is expected that the proposal will meet the EPA's objective for Social Surroundings. Offset: — As the EPA's objective for Social Surroundings will be met, New Energy is not proposing any offsets for this environmental factor.

In addition to the above, other relevant factors were also identified. These factors have not materially changed from the assessment of the original proposal which was approved by the Minister for the Environment. These issues have been addressed in detail in Section 5 of this ERD, but are not considered to be significant in the context of the proposal. The issues identified included:

- Flora and vegetation – Impacts on native vegetation and flora through clearing of the 10ha site.
- Terrestrial fauna – Impacts on native fauna through clearing and development of the 10ha site.
- Hydrological processes – Potential changes to hydrological regimes through alteration to recharge and groundwater.
- Inland waters environmental quality – Potential impacts to groundwater quality through stormwater management and other discharges.
- Waste management – Disposal of generated waste products.

Disclaimer

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Quality assurance

Aurora Environmental has implemented a comprehensive range of quality control measures on all aspects of the company's operation.

An internal quality review process has been applied to each project task undertaken by us. Each document is carefully reviewed and signed off by senior members of the consultancy team prior to issue to the client.

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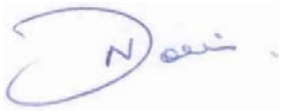
Reviewed by:	**Noel Davies** Principal Environmental Consultant	 Signature	30 October 2017 Date

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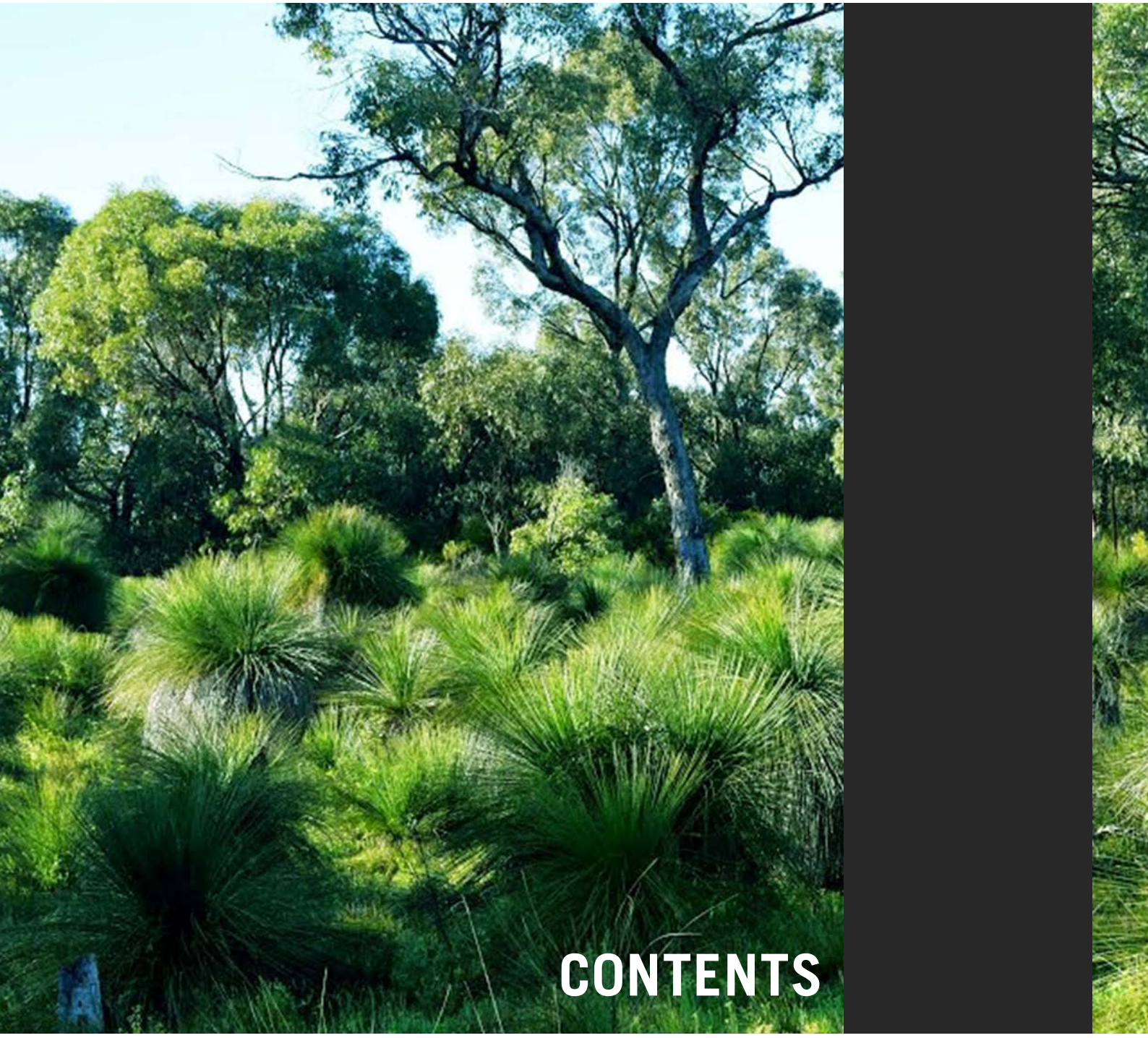

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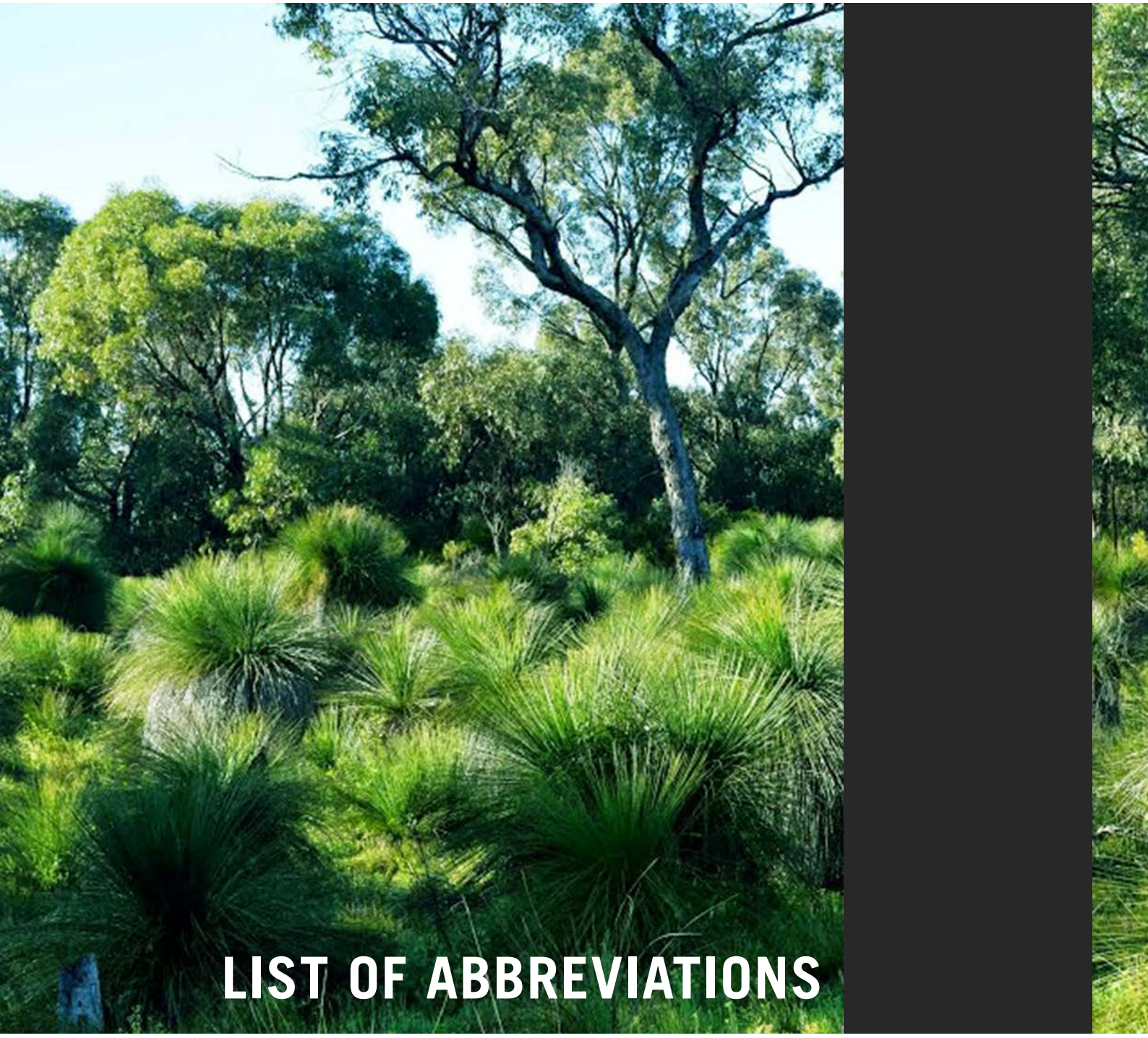

LIST OF ABBREVIATIONS

List of abbreviations

ASS	Actual Acid Sulfate Soils
ABS	Australian Bureau of Statistics
ADSL	Asymmetric Digital Subscriber Line
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environmental Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
APC	Air Pollution Control
ARI	Average Recurrence Interval
AS	Australian Standard
ASS	Acid Sulfate Soils
BAT	Best Available Technology
b/g	Background pollutant concentration
BGL	Below ground level
BTEX	Benzene, toluene, ethylbenzene and xylene
C&D	Construction and demolition
C&I	Commercial and industrial
CEM	Continuous emissions monitoring
CEMP	Construction Environmental Management Plan
CEMS	Continuous Emissions Monitoring System
CFD	Computerised Fluid Dynamics
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
$CO_{2\text{-}e}$	Carbon dioxide equivalent
CSI	Cockburn Saltwater Interface
CV	Calorific value
dB(A)	Decibels (A-weighting)
DEC	Department of Environment and Conservation
DoH	Department of Health (Western Australia)
DoW	Department of Water
DSD	Department of State Development (Western Australia)
DWER	Department of Water and Environmental Regulation
EMS	Environmental Management System
EPA	Environmental Protection Authority (Western Australia)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)
ERD	Environmental Review Document
ESD	Environmental Scoping Document
EU	European Union
FCT	Floristic community type
FFB	Fabric filter bag house filtration
H_2O	Water
ha	Hectare

HCl	Hydrogen chloride
HF	Hydrofluoric acid
Hg	Mercury
HM	Heavy Metals
IED	Incinerator Emissions Directive
ISO	International Standards Organisation
IUCN	International Union for Conservation of Nature
kg	Kilogram
KIA	Kwinana Industrial Area
KIC	Kwinana Industry Council
kL	Kilolitres
km	Kilometre
KWH	Kilowatt hour
m	Metre
MBT	Mechanical Biological Treatment
mg/L	Milligrams/litre
ug/m3	Micrograms per cubic metre
MJ	Mega joule
Mj/kg	Megajoules per kilogram
mm	Millimetre
MRF	Materials Recovery Facility
ms-1	Metres per second
µS/cm	Micro Siemens per centimetre
MSW	Municipal solid waste
MW	Mega watt
MWe	Megawatt electricity
MWt	Megawatt thermal
N_2O	Nitrous oxide
NATA	National Association of Testing Authorities
NEPM	National Environment Protection Measure
NGERS	National Greenhouse and Energy Reporting System
NH_3	Ammonia
Nm^3	Normal cubic metre
NO	Nitrous oxide
NOx	Oxides of Nitrogen
NSW DECC	New South Wales – Department of Environment and Climate Change
O_2	Oxygen
ou	Odour Unit
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated Biphenyls
PCDF	Polychlorinated dibenzofurans
PCCD/F	Polychlorinated dibenzodioxins/furans
PEC	Priority Ecological Community
PER	Public Environmental Review
PM	Particulate matter

$PM_{2.5}$	Particulate matter measuring 2.5µm or less
PM_{10}	Particulate matter measuring 10µm or less
ppb	Parts per billion
PVC	Polyvinyl chloride
RIZ	Rockingham Industrial Zone
RO	Reverse Osmosis
SCR	Selective catalytic reduction
SEA	Strategic Environmental Assessment
SNCR	Selective non-catalytic reduction
SOx	Oxides of Sulfur
SWIS	South West Interconnected System
TEC	Threatened Ecological Community
TDS	Total Dissolved Salts
TOC	Total organic carbon
tpa	Tonnes per annum
VOC	Volatile organic compounds
WA	Western Australia
WID	EU Waste Incineration Directive
WIN	Water Information Network
WWTP	Waste Water Treatment Plant

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01 INTRODUCTION

1. Introduction

1.1 Background

New Energy Corporation Pty Ltd (New Energy) is a privately owned Australian company whose core business is the processing of waste into energy. New Energy offers its waste treatment facilities on the basis of a complete project package that incorporates feasibility studies, securing of regulatory approvals, project finance, technology delivery, operation and maintenance, as well as marketing of the process outputs of electricity and both recovered and recycled materials.

In 2015, New Energy secured approval from the Minister for the Environment to construct a waste to energy facility at its East Rockingham site (Lot 1 (No. 26) Office Road, East Rockingham) using gasification technology (EPA Report No. 1513 and Ministerial Statement 994). Since securing this approval, New Energy appointed an EPC contractor and completed a front end engineering and design study. The Company has also worked hard to secure waste contracts from local and regional Perth Councils that are needed to underpin a project of this nature. This has included participating in tenders, providing project briefings and conducting site visits to see the nominated gasification technology overseas. It is clear from these activities and lack of interest from Perth councils that:

- Perth Councils want the most proven waste to energy technology available with several reference facilities operating at large scale on municipal solid waste.
- They want sorting of MSW to occur on the curbside through a three bin system rather than a dedicated dirty materials recovery facility as previously offered by New Energy.

In light of this feedback and with several upcoming large waste processing tenders over the next 12 to 18 months, New Energy is cognisant that it must be able to provide proven technology. For this reason, New Energy has partnered with Hitachi Zosen Inova (HZI) to revise its project design to utilise best practice grate combustion in order to be able to compete effectively with other players in the market. HZI will act as the EPC contractor and operator for the facility.

HZI has repeatedly demonstrated the suitability of its technology all over the world, with numerous facilities of a similar or larger scale than is proposed at the East Rockingham site. HZI continues to supply the latest waste to energy projects in developed markets such as the United Kingdom. In October 2016 they delivered the Buckinghamshire Project in the United Kingdom. This is a 300,000 tonne per annum project incorporating all the operational features and improvements learned from over 500 installations worldwide. This will ensure the East Rockingham Project, which will be the same size, will represent best available technology. HZI was also highlighted in the Environmental Protection Authority's Section 16 advice as "State of the Art Technology".

New Energy has engaged HZI to design, construct and operate the facility with the aim of supplying the grate-based combustion system with waste at the rate of 101.8 megawatt thermal (MWt). The facility will receive and treat municipal solid waste and residual waste from commercial and industrial (C&I) and construction and demolition (C&D) recycling activities. Its electrical generation capacity will be 31.4 MW with an estimated 28.2 MW fed into the SWIS. Assuming an average household consumption of 18.1 kWh/day, this represents enough energy to sustain over 36,000 homes for a year. The maximum throughput of the plant is a function of the thermal capacity of the plant and the calorific value of the waste incinerated. This is explained in detail in Section 2.6.1.

Importantly HZI will supply all the technology for the facility, be responsible for the construction of the facility as the engineering procurement and construction (EPC) contractor and joint venture with New Energy to operate the facility. This approach best utilises the experience HZI has developed from over 500 projects implemented internationally.

The Environmental Protection Authority (EPA) assessed a referral by New Energy and concluded that the revised proposal represents a significant departure from the approved gasification technology that the new proposal would be subject to a formal environmental impact assessment process guided by an Environmental Scoping Document (ESD) prepared by the Proponent (Appendix 1).

1.2 Purpose and scope

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

This Environmental Review Document (ERD) includes:

- An overview of the environmental review process (Section 1.5)
- A summary of key approvals required for the project (Section 1.6)
- A detailed description of the Proposal (Section 2)
- Justification for the project and an analysis of alternatives considered during the project development phase (Section 2.2)
- A description of the environmental and socio-economic setting (Sections 2.7 and 2.8)
- A description of the stakeholder engagement and consultation process (completed and proposed) (Section 3)
- A summary of the key environmental factors and an assessment of the environmental impacts associated with the proposal (Section 4)
- Discussion of other environmental factors relevant to the proposal (Section 5)
- Discussion of environmental offsets (Section 6)
- Discussion of matters of national environmental significance (Section 7)
- A holistic assessment of the impacts of the proposal on the whole environment (Section 8).

1.3 Objectives of the environmental review

The objectives of the environmental review are to:

- Place this proposal in the context of the local and regional environment
- Adequately describe all components of the proposal, so that the Minister for Environment can consider approval of a well-defined project
- Provide the basis of the proponent's environmental management program, which shows that the environmental impacts resulting from the proposal, including cumulative impact, are minimised and can be acceptably managed
- Communicate clearly with stakeholders (including the public and government agencies), so that the EPA can obtain informed comment to assist in providing advice to government
- Provide a document which clearly sets out the reasons why the proposal should be judged by the EPA and the Minister for Environment to be environmentally acceptable.

1.4 Proponent

The proponent's details are:

New Energy Corporation Pty Ltd

12 Parliament Place

WEST PERTH WA 6005

ABN: 16 139 310 053

ACN: 139 310 053

The key contact for this proposal is:

Mr Jason Pugh

New Energy Corporation Pty Ltd

12 Parliament Place

WEST PERTH WA 6005

(08) 9226 0722

Jason.Pugh@newenergycorp.com.au

1.5 Environmental impact assessment process

The *Environmental Protection Act 1986* is the primary legislative instrument for environmental assessment in Western Australia. It specifies procedures for assessment and appeal processes, including responsibilities and functions of the Western Australian Minister for Environment and the EPA. Under Part IV of the *Environmental Protection Act 1986*, the EPA is responsible for providing advice to the Minister for proposals assessed under Section 38 of the Act and considered by the EPA as likely to have a significant impact on the environment.

1.5.1 Referral

New Energy's proposal was referred to the EPA on 27 January 2017 under Section 38 of the *Environmental Protection Act 1986* and was advertised for public comment on 21 February 2017. The public submission period for the referral ended on 27 February 2017 during which five submissions were received. Based on the referral information and the public submissions, the EPA determined that the revised proposal should be formally assessed as *'Environmental review – four-week public review'* (Assessment No. 2116) with the Proponent being responsible for the preparation of the ESD.

Two environmental factors were identified by the EPA as being areas where further assessment is required. These were:

- Air quality; and
- Social surroundings.

1.5.2 Scoping

New Energy prepared the ESD in accordance with relevant EPA guidelines. The ESD (Appendix 1) was subsequently approved on 27 July 2017. No changes to the proposal have occurred since the referral or the ESD.

A program of studies and information collection was outlined for inclusion in this ERD.

1.5.3 Investigation and Document Preparation

The proponent has undertaken information collection, investigations and studies in line with the requirements of the ESD and documented relevant information in this ERD.

In some instances, previous studies in the immediate area and wider region have been referred to in relation to the site and this proposal.

In addition, specific studies were undertaken and management actions considered as outlined in the ESD.

1.5.4 Assessment

Once the EPA is satisfied that the ERD has been prepared in accordance with the requirements of the ESD, the public are invited to make comment on the proposal during an advertising period of four weeks.

The EPA collates the submissions and the proponent responds by providing clarification or additional information including potential amendments to the proposal. The EPA then assesses the proposal and may seek comment from the proponent and key government agencies on any draft recommended conditions. The EPA submits its Report to the Minister for Environment and publishes the Report.

The Minister for Environment makes the final determination on the proposal, including conditions to be set. The decision by the Minister can be appealed.

1.6 Other approvals and regulation

1.6.1 Land tenure and lease arrangements

The project is located at 26 Office Road (Lot 1 on Diagram 62220), East Rockingham (Figure 1). The land is part of the RIZ which was developed by the State Government (LandCorp). The site abuts land which has been the subject of SEA No. 1390 which assessed the environmental acceptability of heavy industry. The site was not included in the SEA area as it was not considered to have significant environmental constraints to Industrial development.

In February 2012, the DSD wrote to New Energy and LandCorp providing in principle support for the East Rockingham Waste to Energy project and instructed LandCorp to enter into negotiations to lease New Energy a 10ha site within the RIZ. LandCorp has subsequently confirmed the suitability of the preferred site for the project. The matter was endorsed at the LandCorp Board meeting in March 2012. LandCorp will notify Department of Regional Development and Lands of its intention to purchase the preferred site and subsequently draw up a commercial lease for New Energy
(Appendix 2). In the long term, New Energy will hold a lease for the property, with LandCorp maintaining ownership.

1.6.2 Zoning and Adjacent Land Uses

26 Office Road is zoned 'Industrial' in the Perth Metropolitan Region Scheme and 'Special Industry' in the City of Rockingham's Town Planning Scheme No. 2. A structure plan for the RIZ indicates that 26 Office Road is in Precinct 2 for 'Environmentally Acceptable Heavy Industry' (Taylor and Burrell, undated).

Heavy industry, light industry and commercial land uses predominate around the site, in line with the zoning of 'Industry' (Figure 2). Surrounding industries are shown in Figure 1 and include:

- Kwinana Port Bulk Jetty;
- Coogee Chemicals;
- Ausclad, Ravensdowne;
- Kaefer Novacoat;
- NHL Nickel;
- CBH Grain Terminal;
- Mintech Chemical Industries;
- Dorsal Fused Materials; and
- A gypsum and lime quarry.

A waste water treatment plant has been constructed by the Water Corporation to the south of the site. The majority of the RIZ to the south is currently undeveloped (Figure 1).

1.6.3 Decision Making Authorities and Key Approvals

Other than the Minister for the Environment, the key decision making authorities (DMAs) relevant to the proposal include:

- City of Rockingham;
- Department of Water and Environmental Regulation (DWER); and
- Economic Regulation Authority.

Subsequent to undergoing assessment under Part IV of the *Environmental Protection Act 1986*, Works Approvals and Licences under Part V of *Environmental Protection Act 1986* will be sought, pending the Minister for Environment's decision on whether the project may commence.

Development consent was previously given to the project by the City of Rockingham on 18th February 2015 after being assessed by the Metro South West Development Assessment Panel. This development consent will be updated to reflect the changes proposed in this ERD. Development, planning consent and building permit applications will be made to the City of Rockingham.

Table 1: Other approvals and regulation

Proposal activities	Land tenure / access	Type of approval	Legislation regulating the activity
Construction and operation of the waste to energy facility	Freehold / Lease to be signed by New Energy	Works approval and licence	Environmental Protection Act 1986 – Part V
Construction of the waste to energy facility	Freehold / Lease to be signed by New Energy	Development application and building licence	Planning and Development Act 2005 Building Act 2011

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THE PROPOSAL

02

2. The Proposal

2.1 Background

New Energy's proposal was referred to the EPA on 27 January 2017 under Section 38 of the *Environmental Protection Act 1986*. Based on the referral information and the public submissions, the EPA determined that the revised proposal should be formally assessed as *'Environmental review – four-week public review'* (Assessment No. 2116). The proponent prepared ESD (Appendix 1) was approved on 27 July 2017.

The description of the proposal is provided in Section 2.4. There have not been any changes to the proposal since the referral to the EPA or since the preparation of the ESD.

2.2 Justification

Since approval of the original proposal by the Minister for Environment, changes in waste management practice and the need to provide a commercially proven technology to the market has led to New Energy changing from the Entech gasification technology to a grate combustion system provided by HZI which has been used successfully around the world in over 500 projects. The selection of HZI will ensure the Project is supported from construction through to commissioning and successful operation.

Local and Regional Councils in Perth have signalled a clear intention to obtain a waste to energy solution for the residents they represent. This is evidenced by three of the five regional councils letting tenders for waste to energy services in the past 5 years. The tenders have expressed the desire of Perth councils to secure waste management solutions that deliver:

- Diversion of waste from landfill
- Recovery of energy from waste streams that are otherwise landfilled
- Greenhouse gas benefits
- Commercial benefits through lower gate fees and certainty of fees into the future.

2.2.1 Demand for waste management infrastructure

In Western Australia there continues to be a strong demand for waste management infrastructure to divert waste from landfill, with 3.6 million tonnes still being sent to landfill (Waste Authority, 2015).

The Waste Authority's Waste Strategy 2015 Targets indicate that despite increasing diversion of waste from landfill over the last five years, the targets for all three major waste streams (MSW, C&I and C&D) are not being met as summarised in Table 2.

Table 2: Landfill diversion

Recovery rate	Metropolitan MSW	C&I	C&D
2010-11	39%	28%	31%
2011-12	39%	40%	38%
2012-13	45%	45%	40%
2013-14	41%	45%	38%
2014-15	41%	52%	42%
Strategy Targets 2015	50%	55%	60%

Recent increases in the landfill levy are encouraging the recovery of some "easy to recover" materials, but without the corresponding investment in significant waste infrastructure there will be a plateau in diversion rates. This point is recognised in the Waste Authority's (2014) *Strategic Waste Infrastructure Planning Project* which states that "*the current waste and recycling infrastructure capacity is not sufficient to process the projected amounts of waste necessary to meet the waste diversion targets in the Waste Strategy.*"

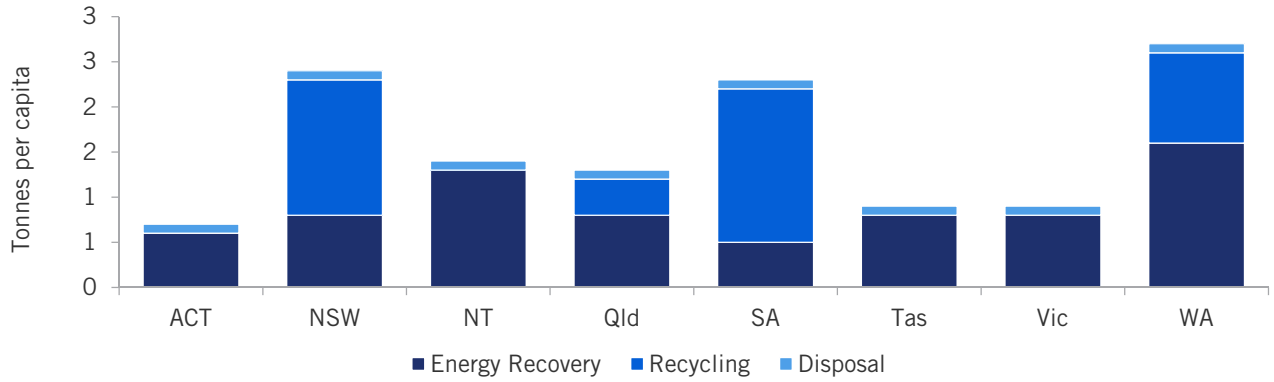
The Report also states:

"The population of the Perth metropolitan and Peel regions is projected to increase from an estimated 1.93 million in 2012/13 to around 2.20 million by 2019/20. The population of these regions could reach 3.5 million around the middle of the century. Assuming that the per capita generation rate remains static, it is projected that the total waste generation in the Perth metropolitan and Peel regions will be 5.5 million tonnes in 2014/15, increasing to around 6 million tonnes in 2020/21. When the population of Perth and Peel reaches 3.5 million people, waste generation could be over 9 million tonnes per year. The consequent increase in total waste generation will increase pressure on the capacity of existing waste management infrastructure and create a need for new waste infrastructure to meet future demand.

Achieving the waste diversion targets in the Waste Strategy will need a significant increase in recycling and recovery of waste, from a projected overall Perth and Peel landfill diversion rate of around 39% in 2011/12 to 56% in 2014/15 and 71% in 2019/20."

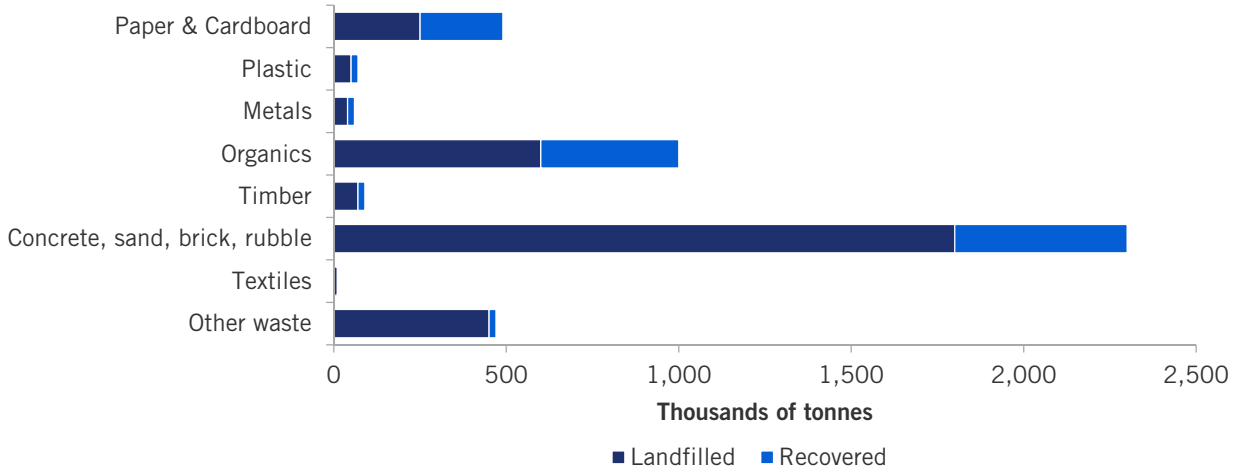
The total quantity of total waste generated in Western Australia has been relatively stable between 2011 and 2015, from around 6 million tonnes to 6.2 million tonnes (Waste Authority, 2012 and 2016). However, Western Australia has the highest rate of waste generation in the country at approximately 2.5 tonnes per capita per annum as per Chart 1 (Blue Environment, 2014).

Chart 1: Comparison of waste generated and recycling by Australian state/territory 2010/11



A breakdown of the wastes by material that are recovered or landfilled is shown in (Chart 2). The Waste Authority of Western Australia has identified that waste disposal to landfill is a poor use of resources and that the current waste and recycling infrastructure is insufficient to meet the future population's need in the medium to long-term (EPA, 2013). The utilisation of these materials (either via recycling or use in a waste to energy process) will significantly reduce the volume of waste going to landfill and reduce reliance on fossil fuels.

Chart 2: Estimated landfill disposal and recycling by material (2006/07)



Source: Waste Authority, 2010.

The Western Australian Waste Strategy aims to reduce the volume of materials going to landfill through increased recycling and other forms of recovery. When recycling is not an option, recovery of materials for production of energy is a desirable outcome in comparison to the disposal of waste to landfill. The Waste Strategy (Waste Authority, 2012) indicated that there would be potential strains on waste infrastructure in the next ten years unless there is less material sent to landfill. In addition, the number and capacity of facilities for sorting and managing recyclable materials are a limiting factor which contributes to materials being unnecessarily being sent to landfill (Waste Authority, 2012).

In response to the amount of carbonaceous waste being directed to landfill and the priorities identified in the Western Australia Waste Strategy (Waste Authority, 2012), New Energy is proposing to establish a waste to energy facility on land in the RIZ. In developing the project, New Energy has concentrated on:

- Adopting International Best Practice technology and management;
- Selecting reliable waste streams for which there is currently no economic alternative besides landfill;
- Maximising resource recovery via metals recycling and reuse of the bottom ash; and
- Minimising environmental impacts at each stage of the project.

2.2.2 Power from renewable energy South-West Western Australia

Energy and power generation globally are undergoing a generational transformation, as historically reliable and cost effective coal generation, providing base load energy for the past five decades, is being displaced by intermittent sources of generation such as solar and wind.

While these sources reduce greenhouse emissions and are generally a welcome addition to the generation mix in the State of Western Australia, these 'greener' sources of energy provide for a challenge in terms reliability of energy and the impact they have on the distribution and transmission systems given their intermittent nature.

The experience in South Australia and the east coast has been that as additional renewable is added to the grid, the base load energy generators have tended to become uneconomic and shut-down. The most significant of these generators is the Hazelmere power station, which shut down in July 2017. The flow on effect of this has been increased power outages, such as an outage of the entire stage of South Australia in February 2017 and significantly increased power prices on the east coast.

The Finkel review, commissioned by the Federal Government, in response to the South Australian power outage, has made clear recommendations to ensure the focus remains on reliable generation while slowly transitioning to cleaner sources of energy.

The West Australian experience is not as dramatic as South Australia, but renewable energy is being added at a significant pace in the State and it is likely to be the next phase of challenges faced in Western Australia in terms of energy. Synergy has announced in early 2017 that it will be retiring 380 MW of existing generation by 2019. The remainder of Synergy's coal generation is likely to be retired between 2020 and 2030 given the age of the existing plant.

Waste to energy represents a rare ability to mix generation from "green" generation given much of the energy is derived from biomass and waste while providing stable, base load generation and the associated renewable energy credits. This form of generation appears to provide the perfect bridge and ability for current retailers as they transition to a cleaner energy future.

2.2.3 Alternative Options

2.2.3.1 Waste Management Options

New Energy examined a range of options for meeting the waste management challenges facing the Perth metropolitan region. Options considered included:

- Provision of conventional lined landfill capacity with improved recycling and recovery options
- Development of mechanical-biological waste treatment (MBT) systems such as the Comporec system installed in Neerabup or the DiCom technology installed in Shenton Park
- A waste to energy facility.

The final decision to adopt waste to energy as the preferred approach was made after considering the needs and opportunities in the Perth metropolitan area, in particular:

- Landfilling of untreated waste is not an acceptable solution
- The limitation of landfill space in the Perth metropolitan area and the high quantities of residual municipal waste still going to landfill. In particular, the Tamala Park landfill has less than 10 years of landfill capacity remaining
- Signals from Perth councils that they wanted a world best available technology (BAT) waste to energy solution for their municipal solid waste (MSW). This included study tours to countries with established waste to energy markets, strategic waste management plans, conferences and tenders
- Trend towards recycling at source with multi-bin system (recyclables and organic bins) leaving only residual waste with low quantities of recyclables and organics
- The need for additional power transmission capacity in the region sourced from renewable energy sources that can provide reliable grid stable renewable energy.

After an extended evaluation period, including discussion with stakeholders, New Energy concluded that waste to energy offered the best solution to servicing the needs of the Perth metropolitan region for use of underutilised waste streams.

2.2.3.2 Waste to energy options

New Energy has been developing waste to energy projects over the last seven years and has a thorough understanding of the various thermal waste to energy technologies in the market. New Energy undertook a comprehensive evaluation process to select an appropriate waste to energy (thermal processing) technology for the facility in East Rockingham. This assessment included the following:

- Identification of a proven thermal conversion technology capable of delivering optimal commercial and environmental sustainability for the waste feedstocks available; and
- The most appropriate energy conversion technologies to convert carbonaceous energy to electrical energy.

2.2.3.3 Thermal conversion options

Thermal conversion systems are categorized on the basis of their air requirements. Combustion with exactly the amount of air needed for complete combustion is known as stoichiometric combustion (Tchobanaglous *et al*, 1993). The three thermal conversion systems based on air requirements are shown in Table 3.

Table 3: Representative thermal processing systems

Thermal conversion options	Air requirements	Examples
Combustion without pre-treatment	Stoichiometric or excess air	— Moving grate combustion of residual waste
Combustion with mechanical pre-treatment	Stoichiometric or excess air	— Refuse derived fuel in cement kiln
Pyrolysis with mechanical pre-treatment	No air	— Rotary kiln — Fluidised bed
Gasification with mechanical pre-treatment	Sub-stoichiometric air	— Vertical fixed bed — Horizontal fixed bed — Fluidised bed

Combustion involves burning fuels in excess air to produce a gas stream consisting primarily of carbon dioxide, nitrogen and water vapour and a solid waste steam (ash) with limited carbon and residual inorganic materials. Modern waste to energy facilities that use combustion technology are designed to BAT standards, are efficient and able to meet stringent air quality emissions targets.

Pyrolysis is the thermal conversion of waste in the complete absence of air. An external source of heat is required to drive the pyrolysis reactions. The three main fractions resulting from pyrolysis include:

- A carbon-enriched char consisting of almost mostly of carbon and all non-volatile material
- A liquid fraction (tar or bio-oil) containing complex oxygenated hydrocarbons
- A syngas containing primarily hydrogen, methane (CH_4), carbon monoxide (CO), carbon dioxide (CO_2) and various other small hydrocarbon gases depending on the temperature and characteristics of the material being pyrolysed.

Generally, pyrolysis is intended to produce a product – either char or oil or both – rather than energy. As the pyrolytic process itself requires the application of heat, the syngas is often burnt directly to provide this heat energy and there is no net energy export. The use of pyrolysis on mixed waste is not yet proven on a commercial scale. The technology risk was assessed to be too high and the quality of the products too low and uncertain for the East Rockingham project.

Gasification is the conversion of solid waste by thermal degradation under sub-stoichiometric conditions from its solid to gaseous phase to produce a volatile gas that is referred to as syngas. The volatile constituents of the syngas are primarily carbon monoxide, methane and short chain hydrocarbons. The syngas has high energy content and as such can be fired like natural gas for energy generation. The drive towards separation of recyclables at source in the Greater Perth area means that the previously proposed materials recovery facility (MRF) and Entech gasifier made this concept unviable for East Rockingham.

Moving grate combustion has been selected by New Energy as there are thousands of reference projects internationally using similar waste types at a similar scale. These plants have demonstrated their efficiency, are proven on mixed waste streams, can achieve acceptable environmental outcomes and are technically feasible and cost effective.

2.2.4 Selected technology

New Energy has selected the HZI technology (grate combustion, boiler, electricity production equipment and APC equipment) as the preferred technology for the following reasons:

- The technology has been proven, is in commercial operation around the world and is the most dominant waste to energy approach adopted on a global scale (more than 500 reference plants alone in operation using the HZI technology)
- All of the components of the plant are proven and have demonstrated reliability
- The technology has been successfully operated using similar waste streams to what will be used at East Rockingham
- The technology has been proven to comply with the IED standards for emissions
- It is reliable, stable and combustion can be controlled within a large range of fuel composition
- HZI is a “turnkey” supplier of waste to energy projects meaning that they supply all technology used (not just the grate as other suppliers do) and take responsibility for constructing and commissioning the project as an EPC contractor
- HZI also operates waste to energy facilities, ensuring all the learnings of successfully operating plants internationally are integrated into the successful operation of the East Rockingham Project
- HZI is an established and proven entity in the waste management sector and was referenced by WSP (2013) as one of the leading companies in the waste to energy sector
- Waste to energy systems such as the HZI grate combustion system have been identified by the EPA in its Section 16 advice as having a place in the waste hierarchy in Western Australia.

2.2.5 HZI grate combustion technology

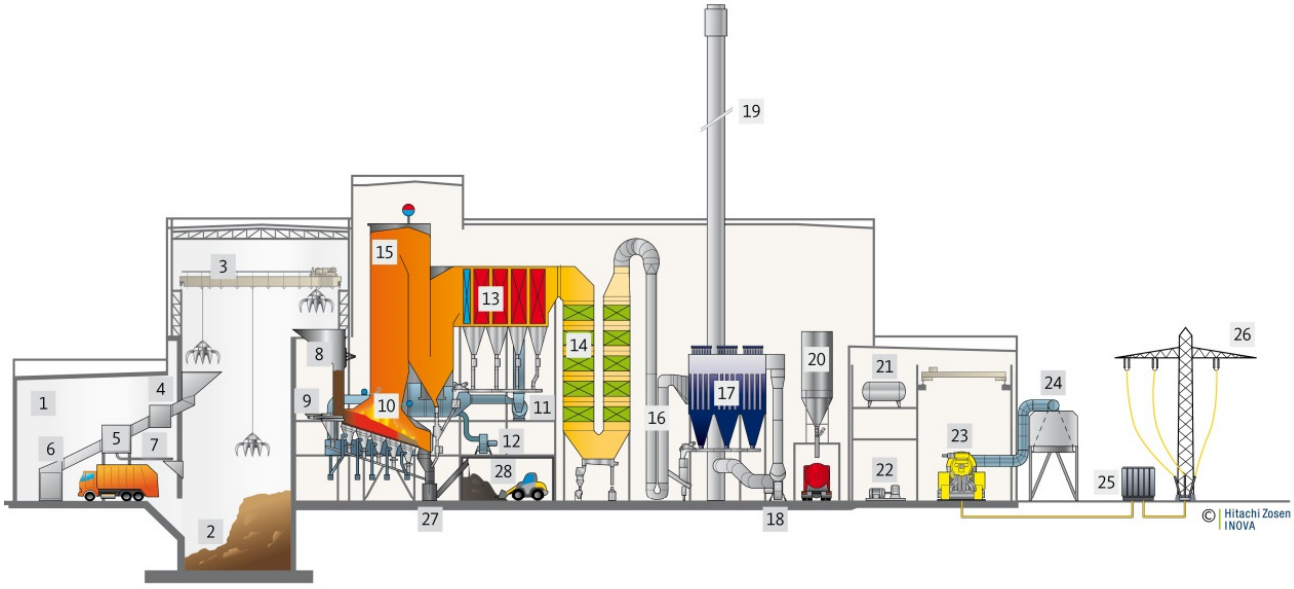
The proposed Rockingham waste to energy plant comprises a furnace equipped with the selective non-catalytic reaction (SNCR) process for control of nitrogen oxides (NOx), a HZI heat recovery boiler, an effective turbine-generator set for the heat utilisation and the HZI dry flue gas treatment system.

The following main process stages are integrated and represented in Plate 1:

- Waste handling
- Thermal treatment
- Heat utilisation
- Flue gas treatment
- Residue handling.

Plate 1 – Key process stages

Edinburgh/UK



Waste Delivery and Storage	Combustion and Boiler	Flue Gas Treatment	Energy Recovery	Residue Handling and Treatment
1 Delivery hall	8 Feed hopper	15 Ammonia injection	21 Feed water tank	27 Bottom ash extractor
2 Waste bunker	9 Ram feeder	16 Xerosorp Lime	22 Feed water pump	28 Bottom ash storage
3 Waste crane	10 HZI grate	17 Fabric filter	23 Condensing turbine	
4 Shredder	11 Primary air fan	18 Induced draught fan	24 Air cooled condenser	
5 Mechanical waste pretreatment	12 Secondary air fan	19 Stack	25 Transformer	
6 Baling	13 Six-pass boiler	20 Silos	26 Electricity export	
7 Pretreated waste conveyor	14 Economiser			

2.2.5.1 Process description

Wastes are brought to the facility by truck. The trucks will first pass the weighbridge, then drive to the tipping hall and unload the waste into the bunker. Parking and handling space is provided to cater for trucks up to a B-double.

The waste is thoroughly mixed in the bunker by an overhead crane and then fed into the feed hopper of the combustion line. The waste passes down a feed chute onto a HZI combustion grate. A ram feeder ensures steady feed, homogenous distribution over the grate width and an air tight combustion process. The moving grate mixes and agitates the waste to allow an optimal burnout of the diverse waste fractions. A fully integrated combustion control system ensures continuous adjustments of combustion conditions for the safest and most efficient operation possible.

The process reduces the waste volume received by up to 90%. The burnt out ash passes through the ash discharger. The bottom ash is conveyed to a treatment plant on site for processing. Several aggregate fractions from the treated bottom ash will be suitable for reuse by the construction industry or for use as cover material. Ferrous and non-ferrous material will be separated from the aggregates and recycled.

The combustion line contains a five-pass boiler with a thermal capacity of 101.8 MW (approx. 128 t/h of hot steam). Auxiliary fuel is used only for start-up and shut-down of the combustion process to ensure compliance with the IED, the successor of the WID. During operation, the burners are kept shut-off but are ready to fire at all times if we temperature in the post-combustion should drop below the required 850°C.

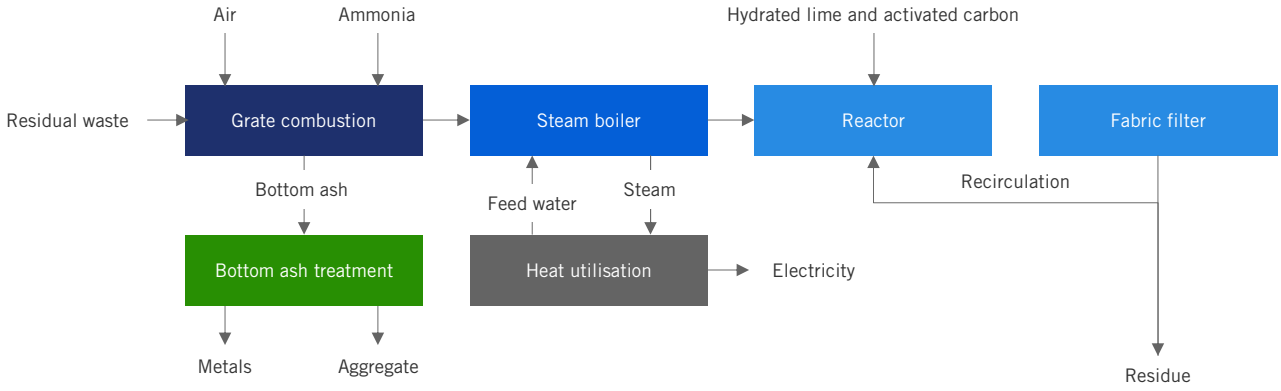
The flue gas passes through a water tube boiler where it is cooled while the water of the closed water-steam cycle is superheated. The superheated steam is then expanded by means of a turbo-generator producing 31.4

MW of electricity. Almost 90% of the produced electrical power is exported to the South West Interconnected System (SWIS). The other 10% is used to operate the plant.

Integrated in the heat recovery boiler, a HZI SNCR system reduces the NOx to the required level. Downstream of the boiler an HZI dry flue gas treatment is installed that consists of a lime and activated carbon injection, a dust reactor to intensify the mass transfer, and a fabric filter to separate and discharge the resulting flue gas treatment residues (FGTR). The air pollution control (APC) section ends with the ID fan and the stack. Reagents include aqueous ammonia solution (24.9%), hydrated lime, powdered and activated carbon. The APC system is consistent with BAT requirements specified in IED and has proven to be able to comply with emissions according to the IED. More detailed information on compliance with IED is presented in Section 2.6.5 and in particular Table 12.

Plate 2 provides a simplified overview of the combustion process, noting key inputs and outputs to the process.

Plate 2 – Simplified combustion process



Plates 3 and 4 below shows the preliminary design and layout of the plant.

Plate 3 – Indicative site layout looking North

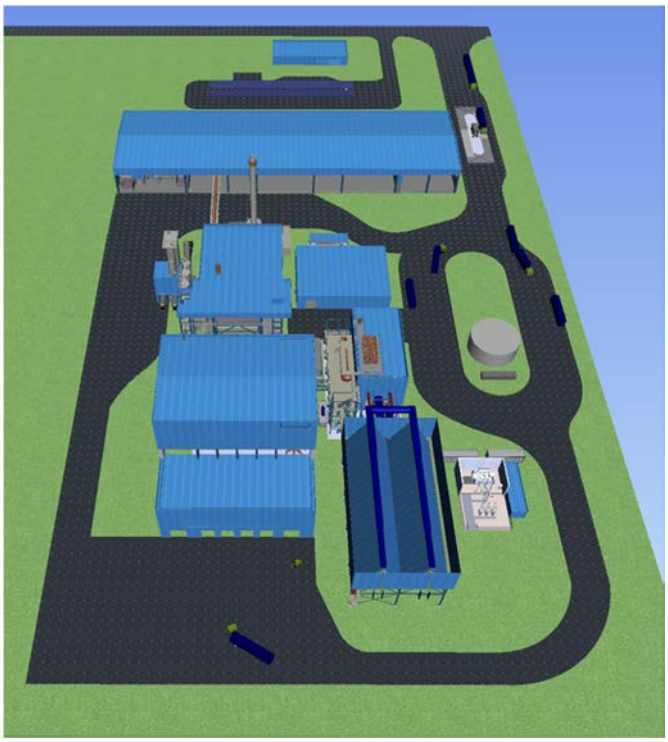
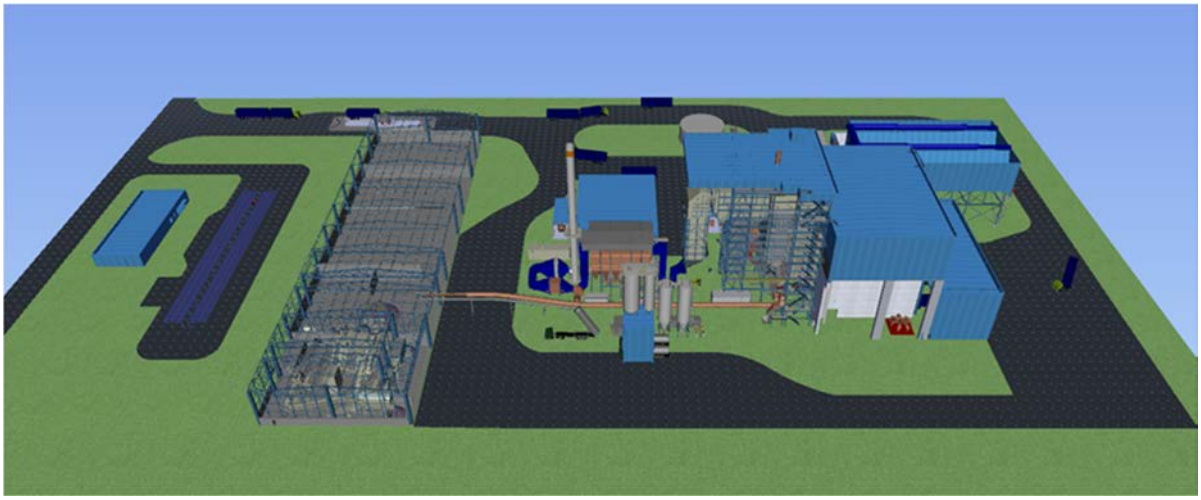


Plate 4 – Indicative site layout looking East with roof removed from bottom ash storage area



2.2.6 Lifecycle comparison of waste to energy against current waste disposal

This section examines the 'Life Cycle Comparison' of the New Energy waste to energy combustion plant and the current waste management method of disposal in the Perth metropolitan region. The diagram below looks at the possible inputs and outputs of solid waste management that make up the Life Cycle analysis.

New Energy considers that its proposed waste to energy facility at East Rockingham will provide significant life cycle benefits associated with waste management in the Perth region. While Perth is served by a relatively sophisticated waste network with waste disposal currently relying on landfill and mechanical biological treatment facilities, issues such as the premature filling of existing landfill sites, increasing distances to new and existing facilities, pressure from urban encroachment and the difficulty in obtaining approval for new landfills mean that diverting materials from landfill is a legitimate way to extend the life of these facilities and is the preferred choice for handling residual waste in the waste hierarchy. As a result of current waste management practices, there are several issues associated with landfilling:

- On-going release of the greenhouse gases CO_2 and CH_4 (which is approximately 25 times more radiatively active than CO_2)
- A long term environmental liability associated with partially decomposed waste that will take 20-50 years to breakdown and is likely to leave a long term legacy of contamination on the various sites with biogas and leachate release estimated in the hundreds of years, i.e. not sustainable.

In contrast, the New Energy proposal will ensure that the vast majority of solid waste will be directed to its waste to energy facility where:

- The carbonaceous fraction will be recovered for combustion and energy recovery producing up to 31.4 MW of electricity that would otherwise have required the combustion of fossil fuel with the associated release of greenhouse gases
- The bottom ash from the combustion process is matured and recycled as aggregate material
- Ferrous and non-ferrous metals will be recovered from the matured bottom ash for recycling
- Exhaust gases will be emitted to atmosphere via a sophisticated APC system which will ensure that there will be no adverse environmental or public health impacts
- An estimated net abatement of 9,180,858 tonnes of CO_2-e will be abated over the life of the project as described in Section 4.2.5.6. This abatement is achieved by diverting waste from landfill which would have produced 10,800,000 tonnes of CO_2-e over the life of the project through decomposition of the waste as well as a further 1,247,478 tonnes of CO_2-e that would be released during the generation of the equivalent 28.2 MW of electricity
- No environmental liabilities are left behind for future generations to manage at the closure of the facility.

When comparing the lifecycles of the two waste management alternatives the following conclusions can be drawn:

- **Total Cost:** landfilling practices are low tech, traditionally low cost and not sustainable. Therefore, they have historically been less expensive to establish than a waste to energy facility. However, when the true

cost to close and/or establish a new landfill is considered the cost advantage for the status quo is greatly reduced.

- **Net Energy:** the waste to energy plant is far superior to use of landfill for the following reasons:
  - Although waste to energy takes more energy to run, the energy recovered from the waste is used to run the plants and the process provides a net benefit over landfill alone.
  - Recycling provides a significant benefit in terms of energy required to remake a product as opposed to reusing some or part of the product. The waste to energy plant will recover metal and aggregates for reuse.
- **Air Emissions:** waste to energy has a net benefit over landfill alone, when comparing air emissions on a life cycle basis. This is due to:
  - Greenhouse gas emission benefits due to diverting waste from landfill and offsetting the use of fossil fuels for energy production.
  - Air emissions from waste to energy are controlled and monitored closely compared to most landfill emissions which are usually uncontrolled and can continue long after the landfill is closed.
- **Water Pollution:** The waste to energy plant has a significant advantage over landfill. All liquid emissions will be contained on site at the waste to energy plant and prevented from entering the environment in an uncontrolled way. Leachate will continue to be produced by the landfill long after its closure.
- **Residual Waste:** The waste to energy plant has a significant advantage over landfill. The FGTR produced represent only 3.3% of the total waste processed. This residue is organically inert and will be disposed at a licensed landfill of appropriate class. Landfilled waste breaks down over a long period of time.
- **Products:** The waste to energy project will recycle metals recovered from the bottom ash. Bottom ash will be treated for use as aggregate.
- **Energy Produced:** The waste to energy project will produce electricity for sale to the SWIS and steam for industrial use (subject to a suitable off-taker in the vicinity).

In summary, as a result of the New Energy proposal being implemented, the current long term legacy issues associated with waste management practices in the Perth metropolitan area will be improved with a management approach that will:

- Recover resources in the form of energy and recyclable metals; and
- Dispose of residual materials in a responsible manner, consistent with best environmental practice.

2.3 Site selection

In 2010, New Energy undertook a site selection investigation to determine the most feasible project sites in south-west Western Australia. New Energy worked closely with the Department of State Development (DSD) to investigate the logistics of this project. Recognised as a project that would be significant to Western Australia, New Energy obtained DSD endorsement and commenced liaison with LandCorp to identify a suitable site.

In February of 2011, DSD General Manager (Strategic Lands) confirmed the project would be a suitable land use for a strategic industrial area, subject to the project receiving regulatory approvals. A further proposal was then submitted to LandCorp with support from DSD, to set criteria for a suitable site within a strategic industrial area. New Energy also consulted the Kwinana and Rockingham Councils to ensure that the project concept was likely to be acceptable for location within their Councils (subject to development approval).

In June of 2011 the Board of LandCorp endorsed the New Energy proposal and identified a suitable 10ha site at 26 (Lot 1) Office Road, East Rockingham. New Energy currently has an Option to Lease (Appendix 2) over the site and the conversion of the Option to a Lease is subject to:

- Environmental approval
- Development Approval
- Securing of investment required for the Project.

The investigation was carried out in three phases, including a screening exercise and primary and secondary constraints analyses. The screening exercise identified areas that might offer potential project sites. The primary and secondary constraints analyses used available GIS data to identify sites of least constraint within

the identified areas. During each phase, the comparison of sites necessitated semi-qualitative assessment to identify strategic environmental and social issues and constraints.

The constraints used during the analysis are summarized in Table 4.

Table 4: Criteria used in the site selection process

Stage	Criterion	Description
Screening exercise	Area	— Perth Metropolitan Area — Minimum area of land required is 10ha.
	Biodiversity conservation	Not within a National, State or conservation park.
	Land use	— Not within or adjacent to a defence area (i.e. Army, Navy or Air Force training areas). — Not in close proximity to residential areas. — Within regional power generation industrial precinct. — Close to major existing power infrastructure. — Close to regional transportation routes. — Close to major sources of wastes. — Alignment with State and local Planning Strategies.
	Tourism	Not within or adjacent to premier tourism facilities, features or landmarks.
Primary constraints analysis	**Engineering**	
	Plant	— Minimum area of land required for the waste to energy plant is 10ha. — Land to be relatively level.
	Environmental	
	Biodiversity conservation	— World heritage areas were excluded. — National parks and marine parks were excluded. — State parks, state forests and conservation parks were excluded. — Nature, forest and water supply reserves were excluded. — Wetlands and major water bodies were excluded
	Socio-economic	
	Land use	— Water supply reservoirs, domestic and industrial slurry, tailings and effluent storage and treatment facilities were excluded. — Mines, quarries, and petroleum production facilities were excluded. — Land within 1 km of an airport or registered airfield was excluded. — Land within 1 km of a military base or training area was excluded.
	Heritage	— Sites listed in the Western Australia Heritage Register were excluded. — Sites listed in the Register of the National Estate were excluded.
	Public safety	— The minimum separation distance between the plant and: — Hospitals, nursing homes and schools was 2 km. — Residential and rural residential areas was 2 km.
Secondary constraints analysis	**Engineering**	
	Plant	Unconsolidated sediments and acid sulfate soils were to be avoided where possible, as they could significantly increase project cost.
	Environmental	
	Terrestrial ecology	Endangered and 'of concern' regional ecosystems (vegetation communities) were considered a high constraint.
	Socio-economic	
	Land use	— Compatibility with surrounding land uses, including landscape, visual and lighting issues was to be considered. — Impact on existing services and infrastructure, and future infrastructure requirements, was to be considered.
	Land tenure	— Freehold or leasehold land was required. — Crown or public land was considered highly constrained.

The East Rockingham site was selected after a thorough search and provides a number of benefits:

- The site is centrally located in terms of the sources of waste that are being targeted by New Energy as feedstock for the plant
- It is located within a Strategic Industrial area and is very well buffered from sensitive land uses and therefore is unlikely to suffer from urban encroachment given its location, the zoning of land surrounding it and the recognition of a large buffer around the RIZ in the Perth Metropolitan Region Scheme. This means noise and air emissions will be readily accommodated without unacceptable impacts to sensitive receptors
- It is located close to major road transport routes
- It is located in close proximity to gas pipelines and power transmission lines with sufficient capacity to accept the 28.2 MW of net electrical power that the facility will generate at full capacity
- The site is located in an area where there are few ecological constraints so that clearing will not result in significant impacts on flora or fauna
- There is no evidence of any sites of archaeological or ethnographic significance in the near vicinity
- Groundwater does not appear to represent a significant constraint as it is 3.85m BGL at its maximum levels.

2.4 Proposal description

2.4.1 Project overview

New Energy Corporation proposes to establish a waste to energy facility at East Rockingham (Figure 3) using state of the art technology grate combustion which will take waste material that would otherwise be directed to landfill and convert the waste to electricity for use in the SWIS power grid. World best grate combustion technology will be used to ensure that noise, odour and exhaust emissions are within International guidelines.

Waste to energy has a place in the waste hierarchy in Western Australia, particularly when taking into account the forecasted population growth, project increase in waste generation, diminishing landfill space and inadequate recycling and recovery infrastructure within the Perth metropolitan region. Research has shown that directing waste from landfill and converting it to energy has a net benefit in terms of greenhouse gas production and there is also the benefit of extending the life of valuable land fill sites. New Energy is positioned to be a leading provider of renewable energy in Western Australia. Waste to energy represents a grid stable source of base load, low cost renewable energy when compared to other renewable energy sources such as wind and solar energy.

In 2015, Western Australia generated over 6.2 million tonnes of waste, of which approximately 3.6 million tonnes was sent to landfill (Waste Authority Annual Report 2015-16). Landfill is the least desirable and least sustainable method of waste disposal. Table 5 shows that the 3.6 million tonnes sent to landfill consisted of construction and demolition (C&D) waste, MSW and commercial and industrial (C&I) waste.

Table 5: Composition of waste sent to landfill in Western Australia (2015)

Source	Volume
Construction and demolition waste	1.774 million tonnes
Municipal solid waste	1.083 million tonnes
Commercial and industrial waste	0.757 million tonnes

New Energy fully supports recycling and the proposed facility will target wastes that would otherwise end up in landfill. European countries who have the highest number of waste to energy projects also have the highest level of recycling activities.

With Perth's expected population growth, both power and waste infrastructure are under increasing pressure. The base point for this project is to process 300,000 tonnes of waste with an average calorific value of 9.773 MJ/kg, operating 8,000 hours per annum to generate electricity for 38,000 Perth homes.

Energy recovery is a vital waste treatment method that needs to be introduced to meet the objectives of the State Waste Strategy (Waste Authority of Western Australia, 2012). The facility will contribute to sustainable waste management in the Perth metropolitan region through the following initiatives:

- Investment in Best Practice waste technology
- Private investment
- Recycling initiatives
- Fit for purpose solutions
- Value adding opportunities
- Improvement in overall environmental outcomes compared with landfill.

New Energy's waste to energy project provides these initiatives through:

- Technology: the HZI grate combustion technology has been acknowledged in the EPA's Section 16 advice (EPA, 2013) as leading technology. It has been readily adopted across many countries, including numerous European nations
- Build own operate project: New Energy's partnership with HZI will see HZI build and operate the facility
- The facility will support existing recycling and alternative waste treatment activities in Perth by utilising their residual waste streams
- Waste to energy is a sound option for the Rockingham Industry Zone (RIZ) given the area's appropriate zoning, buffers and proximity to waste sources
- The project will value add by generating a significant amount of electricity for the SWIS
- Avoiding of disposal of residual wastes in unsustainable landfills
- Limited disposal with only 3.3% of the waste processed by the plant ending up as FGTR which will be disposed to an appropriately classed landfill.

2.5 Proposal location

New Energy selected its preferred site, 26 (Lot 1) Office Road, East Rockingham after extensive consultation with the Department of State Development, LandCorp, the City of Rockingham and City of Kwinana. The proposed site is located within the RIZ. It is approximately 5 kilometres (km) north-east of the Rockingham Town Centre, 22 km south of Fremantle and 34 km from the Perth City Centre (Figure 1) in the locality of East Rockingham. The site is 1.7 km east of the coast.

The site proposed for the facility abuts an area that has been assessed by the EPA as being environmentally acceptable for heavy industry through a Strategic Environmental Assessment (SEA) in 2011 (Assessment No. 1390). The New Energy site was not included in the SEA as the focus of the SEA was upon land that was potentially environmentally constrained, i.e. the New Energy site does not contain any significant environmental values.

The RIZ has been planned to support the growth of industry in the Rockingham/Kwinana area. Appropriate zoning and infrastructure plans are in place to allow environmentally approved projects to be located in the estate, which has ready access to roads, water, natural gas, power and port facilities.

The close proximity of the site to power transmission infrastructure and ready access to major road haulage routes were key factors in site selection as this will reduce the environmental and economic costs of operating the facility.

The nearest residence is approximately 1 km east of the site. Other residential areas include Medina and Leda (approximately 2.5 km east of the site), East Rockingham (2.5 km south-west) and Hillman (2.7 km south) (Figure 1).

The site is zoned 'Industrial' under the Metropolitan Region Scheme, with nearby areas zoned 'Industrial' and 'Special Industry' or reserved for various purposes including 'Railway' and 'Parks and Recreation' (Figure 2).

2.6 Proposal characteristics

2.6.1 Plant capacity

The maximum capacity of the plant is 101.8 MWt. That is, the feedstock entering the combustion chamber every second can have a maximum total calorific value of 101.8 MJ, which results in a feeding rate of 101.8 MJ/s, or 101.8 MW. This is thermal not electrical capacity, hence is it designated as 'MW thermal', or 'MWt'.

The electricity generated by the power station operating at 101.8 MWt is 31.4 MW electricity, or 31.4 Megawatt electricity (MWe). Of this, approximately 3.2 MW is parasitic electricity, required to operate the plant. Hence approximately 28.2 MW is exported to the grid when the power station is operating at maximum capacity.

A 101.8 MWt/31.4 MWe combustion and power generation process requires waste feed as shown in Table 6.

Table 6: 101.8 MWt combustion feed requirements

Waste Calorific Value (CV) MJ/kg	Annual Tonnage Required Into the Combustion Chamber for 101.8MWt TPA
8.9	330,000
9.773	300,000
13	225,000

The plant is designed to cater for a range of waste calorific values and designed to accept a nominal volume of 300,000 tpa of waste at an average 9.773 MJ/kg CV. The actual tonnage of waste received may vary from this depending on the average calorific value.

Waste will be accepted on site with the aim of supplying the combustion plant with waste at the rate of 101.8 MWt. Experienced crane operators with the aid of CCTV will identify and remove incompatible materials such as e.g. gas bottles, oversized material. The overall tonnage of waste to site will vary depending on the types of waste accepted and its energy content. Table 6 shows potential average calorific values of the waste and the maximum tonnes the plant could accept, acknowledging the plant is limited by a maximum thermal capacity of 101.8 MWt.

2.6.2 Wastes received on site

The tonnages and relative percentages of waste streams accepted at the facility will vary on a daily, weekly, seasonal and annual basis. The Plant has been designed to utilise 300,000 tonnes of waste at an average calorific value of 9.773 MJ/kg. Higher volumes of waste (up to 330,000 tpa) may be received if the calorific value of the waste received is lower than 9.773 MJ/kg. All waste received will be residual products that would be typically sent to landfill.

New Energy has worked closely with waste generators in the Perth metropolitan area to define an 'expected' waste specification that was used as the basis of design for this plant. That specification is detailed in the 'Waste Types and Volumes' and 'Detailed Waste Analysis' sections.

The composition of the expected waste specification has been developed by:

- Researching all available historical reports;
- Being a foundation member of the Waste Management Association of Australia (WMAA);
- Liaising with Local Councils;
- Liaising with major construction and industrial companies operating in the region; and
- Liaising with the Water Corporation.

2.6.2.1 Wastes types and volumes

The facility is designed to receive:

- Residual MSW from areas that have a two or three bin collection system
- Waste similar to MSW including residuals from point of origin collection programs and off-site facilities that are processing MSW, recyclables, C&I and C&D waste

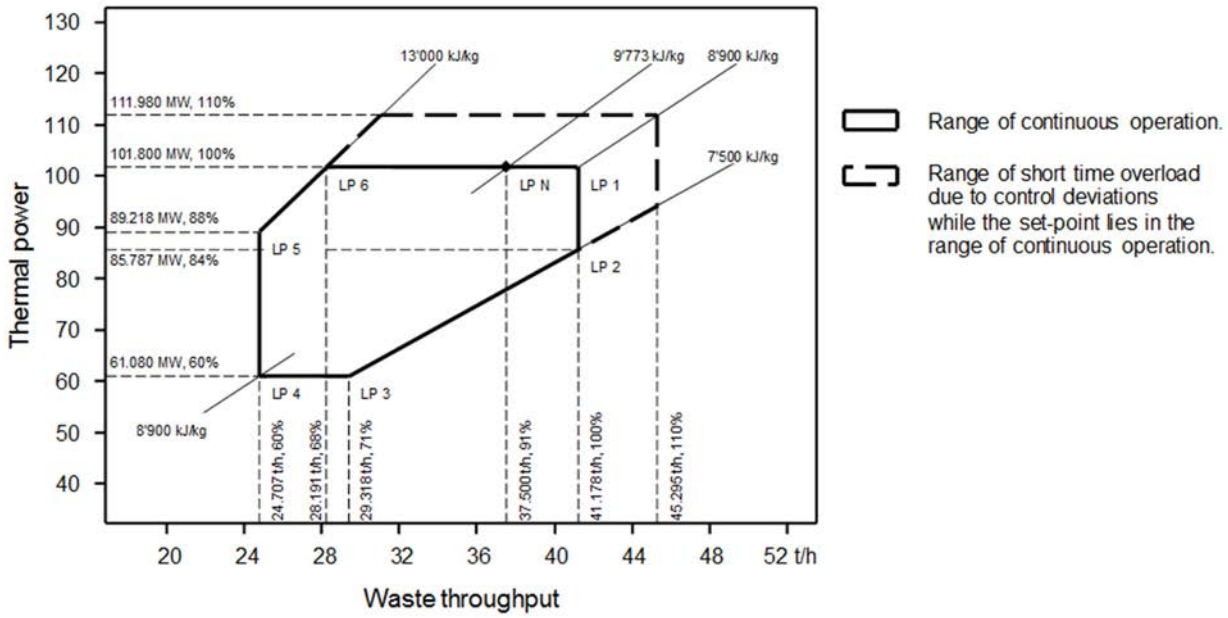
- Bio-sludge from the nearby East Rockingham Waste Water Treatment Plant to be delivered via pipeline or delivery by truck.

Table 7 represents the possible waste streams with corresponding calorific value to fit within the combustion diagram in Plate 5. The plant design will follow the combustion diagram. The combustion diagram of the East Rockingham facility (Plate 5) shows the flexibility on the calorific value of the waste that can be accepted.

Table 7: Waste streams

Waste streams	Volume (tonnes/annum)	Calorific value MJ/kg
Residual MSW (2 or 3 bin collections)	192,000	8.5
C&I residuals	30,000	8.4
MRF residuals	30,000	14.1
MBT and organics residual	48,000	13.0
Sewage sludge	30,000	-1.9
Total without sewage sludge	300,000	9.77
Total with sewage sludge	330,000	8.90

Plate 5 – Combustion diagram for the proposed facility



As waste streams and/or calorific value changes feed rate or waste composition is adjusted so that the total calorific value remains in a suitable range which allows the plant to be operated at maximum thermal load.

MSW: New Energy has participated in a tender from two regional Councils to process MSW from two or three bin collections at the facility, which would provide over 70% of the plant's capacity. Other Councils and Regional Councils have expressed an interest in supplying MSW to the facility. The project could process up to 300,000 tonnes of MSW (assuming an average CV of 9.773 MJ/kg) and the necessary operational controls have been incorporated within the design to ensure that all relevant environmental performance criteria are met if this was to occur.

MRF, MBT and organics residuals: The processing of mixed recyclables in MRF, mixed waste feed streams, MBT plants and organics processing in composting operations produce residual waste streams. These residual streams are currently sent to landfill. New Energy will be participating in a tender from a Regional Council that would see 16% of the plant's capacity be filled by MBT residuals that are currently going to landfill. This arrangement shows that composting and waste to energy can work effectively together.

C&I residuals: C&I waste is often collected as two types of streams; a mixed residual stream, which is sent to landfill, and a source-separated recyclables stream, collected by recycling companies. New Energy will be sourcing segregated C&I residuals streams which are currently sent to landfill as well as segregated residuals from C&I which was processed at a MRF. An example of this waste stream would be residual waste from the Instant Waste Management MRF located at Bayswater. Instant Waste Management operates a state of the art MRF in Bayswater to recycle C&D waste. The MRF recovers ferrous metals, PVC, wood, bricks, aggregate and sand. The remaining product, which is predominately plastic, contaminated cardboard, textiles and rubber is currently sent to landfill. This material can be diverted to the New Energy plant for energy recovery.

2.6.2.2 Detailed wastes analysis

New Energy provides the following breakdown of wastes and contaminant loads in the typical waste stream to be accepted at the facility. Table 8 provides breakdown of the key waste components contained in a typical 300,000 tpa residuals waste stream and 30,000 tpa of sewage sludge.

Table 8: Typical waste composition

Waste component description	MSW (tpa)	C&I residuals (tpa)	MRF residuals (tpa)	MBT residuals (tpa)	Sewage sludge (tpa)	Total (tpa)
Food	54,912	8,580	327	17	-	63,836
Green	48,768	7,620	0	1,704	-	58,092
Paper/card	21,696	3,390	5,354	99	-	30,539
Mixed plastics	15,744	2,460	5,198	22,335	-	45,737
PVC	0	0	0	0	-	0
Textiles	4,032	630	2,241	12,399	-	19,302
Metals	5,760	900	654	4,270	-	11,584
Glass (large)	12,480	1,950	0	196	-	14,626
Other inerts	9,312	1,455	2,521	235	-	13,523
Water	0	0	0	0	28,890	28,890
Sand, glass & ceramic fines	7,296	1,140	1,029	774	-	10,239
Wood	2,880	450	12,334	2,780	-	18,444
Rubber	0	0	249	0	-	249
Biosolids	0	0	0	0	1,110	1,110
Nappies	9,024	1,410	0	0	-	10,434
Bricks/rubble	0	0	0	2,955	-	2,955
Total	**192,000**	**30,000**	**30,001**	**47,999**	**30,000**	**330,000**

Information sourced from:

- Golder Associates – Western Australia Audit for C&I for 2007
- Water Corporation - Request for Proposal 2017
- Hofstede and Associates - Neerabup Residue Audit 2010
- Instant Waste Management Audit - C&D MRF residuals 2015
- Anne Prince Consulting - MSW Audit for EMRC 2009.

Table 9 presents an elemental analysis of the typical waste stream described in Table 8. The elemental analysis has been developed to ensure that NEC has a full understanding of the properties of the waste stream to be handled by the facility and ensure that the combustion system and air pollution control system can safely handle the wastes while complying with all relevant emission criteria.

Table 9: Ultimate analysis of typical waste

Description of feed	As received Wt (%)	As received Wt (tpa)	Moisture (%)	Ultimate Analysis (Dry Basis - % by Wt)									Ultimate Analysis as received, (Wet basis - TPA)										
				C	H	O	N	S	Cl	F	'Ash'	Fe/Al	C	H	O	N	S	Cl	F	HM	'Ash'	Fe/Al	Moisture	Total
Food	19.34	63836	75	48.0	6.4	37.6	2.6	0.4	0.0	0.0	5.0	0.0	7660	1021	6001	415	64	0	0	2	796	0	47877	63836
Green	17.60	58092	50	46.0	6.0	38.0	3.4	0.3	0.0	0.0	6.3	0.0	13361	1743	11038	988	87	0	0	0	1830	0	29046	58092
Paper/card	9.25	30539	10	43.4	5.8	44.3	0.3	0.2	0.0	0.0	6.0	0.0	11928	1594	12176	82	55	0	0	17	1632	0	3054	30539
Mixed plastics	13.86	45737	0	87.1	8.4	4.0	0.2	0.0	0.0	0.0	0.3	0.0	39757	3834	1826	91	0	0	0	56	81	0	91	45737
PVC	0.13	439	0	45.2	5.6	1.6	0.1	0.1	45.4	0.0	2.0	0.0	198	25	7	0	0	199	0	1	8	0	1	439
Textiles	5.85	19302	7	48.0	6.4	40.0	2.2	0.2	0.0	0.0	3.2	0.0	8616	1149	7180	395	36	0	0	17	558	0	1351	19301
Ferrous & aluminium	3.51	11584	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0	0	0	0	0	0	0	0	0	11583	0	11583
Glass (large)	4.43	14626	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0	0	0	0	0	0	0	0	14626	0	0	14626
Other inerts	4.10	13523	1	0.0	0.0	0.0	0.0	0.6	1.5	0.60	97.30	0.0	0	0	0	0	81	202	81	192	12899	0	68	13523
Water	8.75	28890	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	28890	28890
Sand, glass & ceramic fines	3.10	10239	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0	0	0	0	0	0	0	0	10239	0	0	10239
Wood	5.59	18444	12	49.6	6.0	42.7	0.2	0.0	0.0	0.0	1.5	0.0	8050	974	6931	32	0	0	0	0	243	0	2213	18444
Rubber	0.08	249	0	88.2	10.1	0.0	0.3	1.0	0.0	0.0	0.4	0.0	220	25	0	1	2	0	0	0	1	0	0	249
Bio-Solids	0.34	1110	38	21.9	2.6	13.8	1.7	0.9	0.2	0.0	59.0	0.0	151	18	95	11	6	1	0	1	406	0	421	1111
Nappies	3.16	10434	67	48.4	7.6	38.8	0.5	0.4	0.2	0.0	4.1	0.0	1672	262	1340	18	12	8	0	0	141	0	6980	10434
Bricks/Rubble	0.45	2956	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	200.0	0.0	0	0	0	0	0	0	0	0	2955	0	0	2956
Total	**100**	**33300**											**91614**	**10645**	**46592**	**2034**	**344**	**410**	**81**	**287**	**46416**	**11583**	**119992**	**330,000**

Element by mass (TPA)	Metals in Ash (excl. Ca, Si, Fe, Al), TPA																	
	Na	P	Be	Se	Mn	Zn	Pb	Cu	Cr	Ni	As	Mo	Sb	Ag	Cd	Tl	Hg	Hmets
	0.00	0.00	0.21	0.21	122.95	67.69	36.80	20.88	12.77	20.59	1.99	0.60	0.72	0.90	0.40	0.02	0.03	286.55

2.6.3 Waste definitions

The MSW, C&D and C&I groupings are common terminology in the waste industry, but do not define the waste sufficiently. New Energy will be seeking a licence to receive and process waste on site that meet Class III landfill criteria as defined in the document *Landfill Waste Classification and Waste Definitions 1996* (As amended December 2009). The main waste streams to be accepted will be MSW waste, residuals from MRFs handling Recyclables and C&I wastes, residuals from Mechanical Biological Waste Plants (MBTs). Other wastes may be accepted in the future where they are agreed for acceptance under the Department of Water and Environmental Regulation (DWER) Part V licensing process.

Although New Energy seeks approval to accept wastes meeting the definition of Class III wastes, the majority of waste will be MSW or residual materials derived from MSW. It is not proposed that the facility process materials such as soils or sludges contaminated with significant concentrations of heavy metals such as lead or arsenic soils. The sophisticated control and monitoring systems built into the system allows a safe combustion performance at all times with the proposed waste composition.

Excluded wastes

The following wastes will not be accepted for processing at East Rockingham:

- Scheduled wastes such as Polychlorinated Biphenyls (PCBs) and Organochlorine Wastes
- Asbestos
- Highly corrosive or toxic liquids or gases such as strong acids or chlorine or fluorine
- Explosive materials
- Radioactive wastes
- Wastes which mechanically cannot be handled by the facility.

Any other wastes which are identified by staff as potentially hazardous to health or the environment will also be quarantined.

2.6.4 Site management

2.6.4.1 Operating hours

The operating hours for the Site are summarised below:

- **Standard receivable hours:** The majority of waste will be delivered during standard receival hours, which are between 06:00 and 17:00 weekdays and between 07:00 and 12:00 on a Saturday. Some deliveries may occur outside of these hours, with this service to be available 24 hours/day, 7 days/week for pre-authorised vehicles.
- **Combustion:** continuous (24 hours/day, 7 days/week).
- **Bottom ash treatment:** 06:30-16:30, Monday to Friday and as needed outside of these hours.
- **Administration and waste education:** 08:00-17:00, Monday to Friday.

2.6.4.2 Waste acceptance

Waste deliveries will occur 24 hours a day, seven days a week. The majority of waste will be delivered by truck during standard receival hours.

On entering the site, the truck will pass through the automated gate control which has number plate scanning technology, weighed using the weighbridge and then will drive to the tipping hall.

To reduce the risk of excluded wastes being received at the site, the following measures will be implemented:

- Waste from the public will not be accepted
- Only pre-authorised vehicles will be permitted to enter the site on a 24-hour basis. Unauthorised vehicles will only be accepted during standard receival hours but must be verified before being

granted access to the site. If confirmation of the load's suitability is not obtained, the vehicle will be instructed to leave the facility without offloading or collecting wastes/residues

- Once authorised for entry to the facility, all commercial vehicles are directed to the weighbridge.
- Wastes are unloaded directly into the waste receival bunker and the grapple operator and floor supervisors inspect loads visually as they are tipped
- There may be instances where the delivery vehicle will be asked to unload away from the bunker to allow an inspection of the wastes and it may be possible the vehicle is required to stop unloading. This may be undertaken randomly or on suspicion that a vehicle is carrying non-processible wastes
- If wastes are removed on the basis that they are not considered to be processible wastes they will be placed at a location identified as the Collection Point at the Facility. Wastes that cannot be processed will be removed from the site and disposed at an appropriately classed facility.

2.6.4.3 Reception hall

The reception hall will be connected to the waste bunker but isolated from any other buildings. All trucks reverse into the reception hall and off-load the wastes directly into the waste bunkers. The waste bunkers will be designed for at least four days of waste storage.

The combustion air will be drawn from the bunker hence creating an under-pressure in the bunker and reception hall. When any automatically fast acting door to the reception hall is open to enable trucks going in or out, this under-pressure will result in ambient air flow into the reception hall and avoid odours escaping from the reception hall.

During maintenance periods or shut down periods, an auxiliary ventilation system will extract air at a rate of 10,000m^3/hour from above the waste bunker, discharging to a 48m high stack to ensure that odours from the reception hall are dispersed in a manner that ensures that relevant odour assessment criteria are met.

2.6.4.4 Waste bunker with overhead crane

One duty and one standby waste crane with integrated weighing cells will be installed capable of operating in automatic as well as manual mode. Full redundancy will be secured via two identical waste cranes that each alone is sufficient for feeding the hopper. The cranes will operate in automatic mode, feeding/mixing/moving, thus programmed for random homogenisation and mixing of waste when feeding is not required. The cranes shall be fitted with automatic weighing cells that feed data on the amount of waste placed in the hopper to the control system. A spare grab will be present to ensure a high degree of reliability.

2.6.4.5 Combustion

Overview

The combustion process will operate seven days per week, 24 hours per day. It will be staffed with permanent employees based on a rotating shift pattern to ensure adequate staff availability at all times.

The operation includes:

- Receiving of waste
- Mixing of waste in the bunker and feeding into the feed hopper
- 24/7 operation of combustion, power generation, air pollution control systems
- Operation of associated support systems for combustion (water treatment, chemical preparation etc.)
- Chemical receival
- Spare parts receival
- Ash and residue dispatch
- Maintenance of all systems (routine and annual overhaul)

Combustion system

The combustion system grate is designed for mixed waste and up to 10% sewage sludge. The specific thermal and static surface loads are important design parameters of the moving grate combustion, which has a proven low wear and long life time. The HZI air-cooled grate design is proven technology as it has been used in more than 500 plants internationally.

The specific design for Rockingham allows for wide variations in calorific value (7,500 to 13,000 kJ/kg and load (24.7 to 41.2 tph) in continuous operation.

The furnace is designed for continuous waste combustion in the range between 60% and 100% of the thermal design load. Short-term peaks caused by the non-homogeneity of the waste are absorbed by the system.

This design allows for the safe processing of the intended waste streams while accommodating fluctuations in waste composition and calorific value.

HZI combustion grate

Since 1938, HZI has built waste combustion grates, which have been steadily optimised until the present today, in regards of reliability, life time of the grate blocks, burn out of bottom ash and flue gas, maintenance, changing heating values of the waste etc.

The inclination of the grate in combination with its moving grate block rows guarantees a good mixing of the waste and thus an excellent burn out of the bottom ash. The grate block movement in co-flow to the waste makes the combustion process smooth and therefore easier to control. Furthermore, it reduces dust deposits in the boiler.

The moving grate consists of four individually driven zones that facilitate the different phases of the combustion process (drying, ignition, gasification and combustion of volatiles, char burn-out).

The process reduces the waste volume received by up to 90%. The burnt out bottom ash passes through the ash discharger and is transported via conveyor systems to the bottom ash treatment facility.

Combustion control system

The combustion control is fully automatic. The operator selects the desired set point and all control devices are handled by the control system. This ensures that the plant operates at optimum efficiency at all times, achieving desired environmental quality standards and maximising the life expectancy of the equipment.

2.6.4.6 Boiler for Heat Recovery

The flue gas passes through a water tube boiler where it is cooled while the water of the closed water-steam cycle is transformed into superheated steam.

The furnace and secondary combustion chamber comply with the two second retention time and 850°C temperature requirements of the IED and are equipped with auxiliary burners. Auxiliary fuel is used only for start-up and shut-down with the burners kept on hot standbyready to ensure compliance with the IED. Auxiliary firing is required very rarely if at all.

2.6.4.7 Bottom ash handling and treatment

The bottom ash treatment area is located south of the administration carpark and north of the waste to energy plant (Figure 3). The layout of the bottom ash treatment building is shown in Plate 6.

The bottom ash treatment building (Plates 6-9) is covered to provide protection from rain and direct solar radiation. Handling of the material will be completed under cover to reduce evaporative losses and minimise water requirements.

Appendix 3 contains photos of the bottom ash treatment plant at the HZI waste to energy project in Poznan (Poland).

Plate 6 – Bottom ash building layout

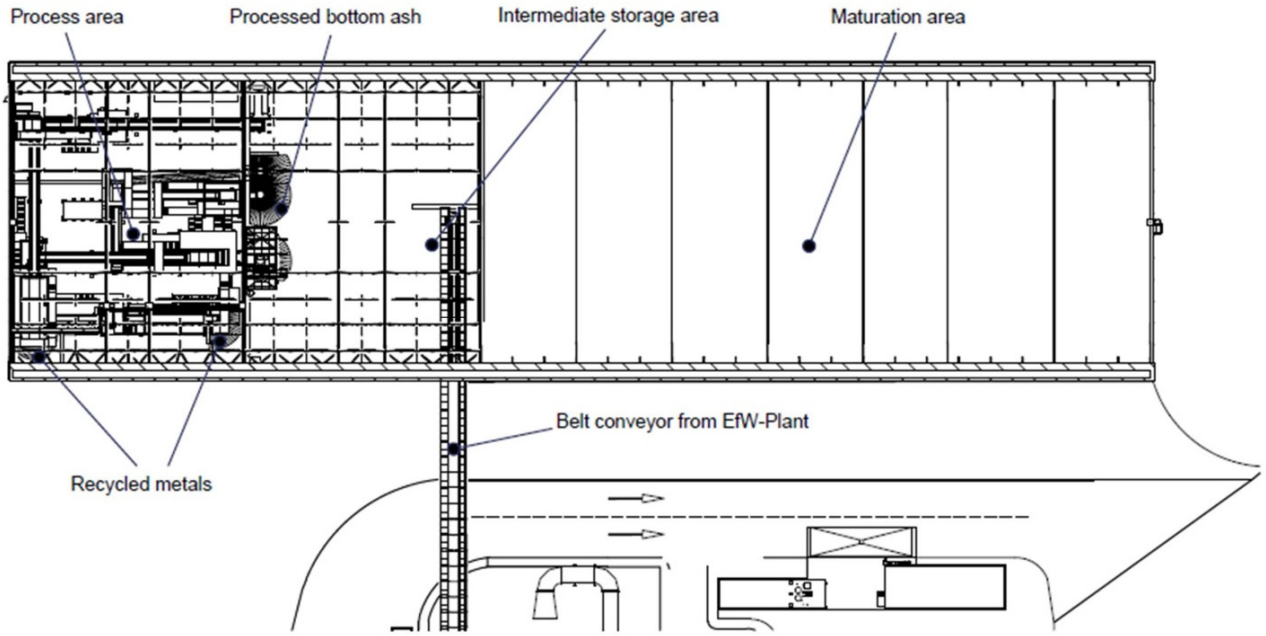


Plate 7: Top view of bottom ash treatment building

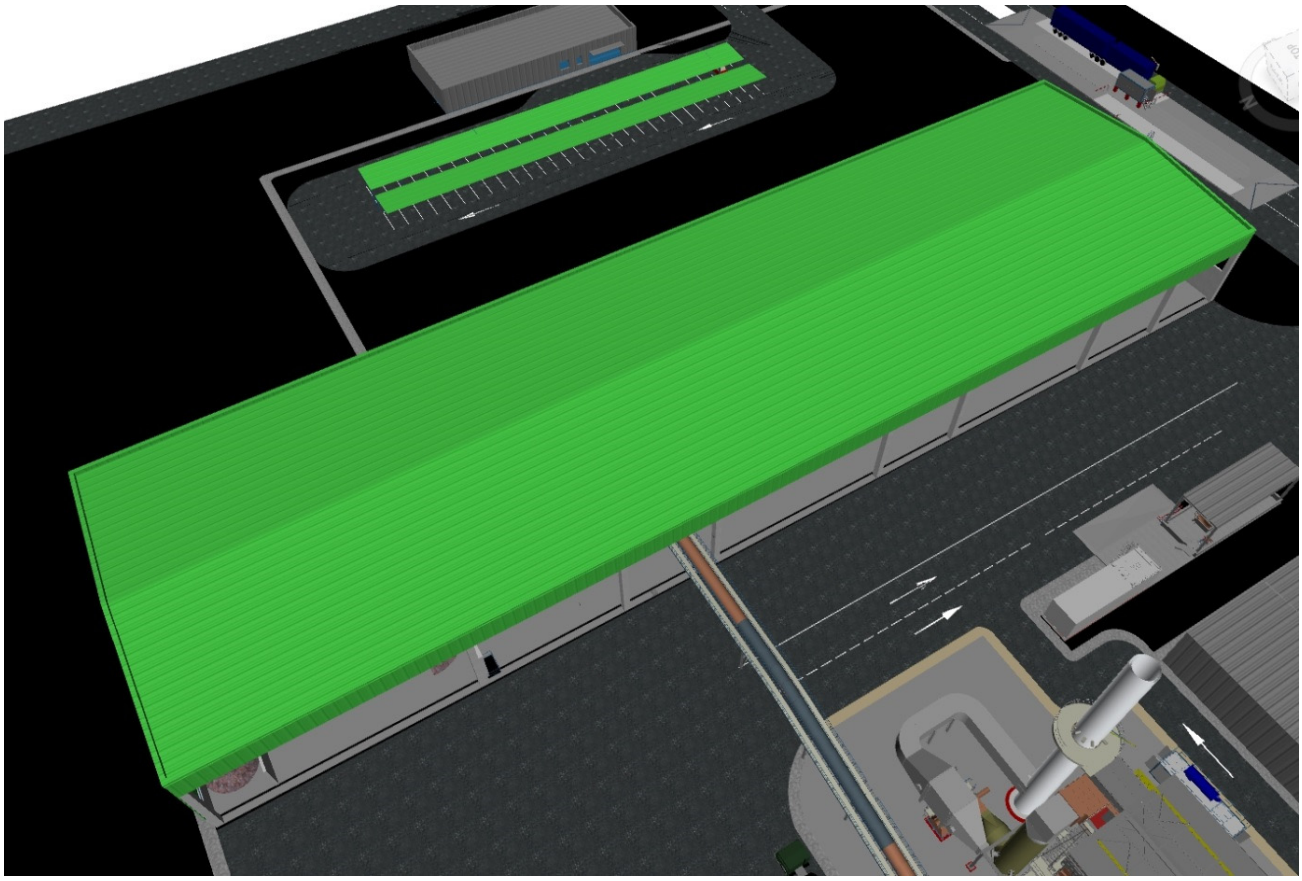


Plate 8 – 3D view of bottom ash treatment building

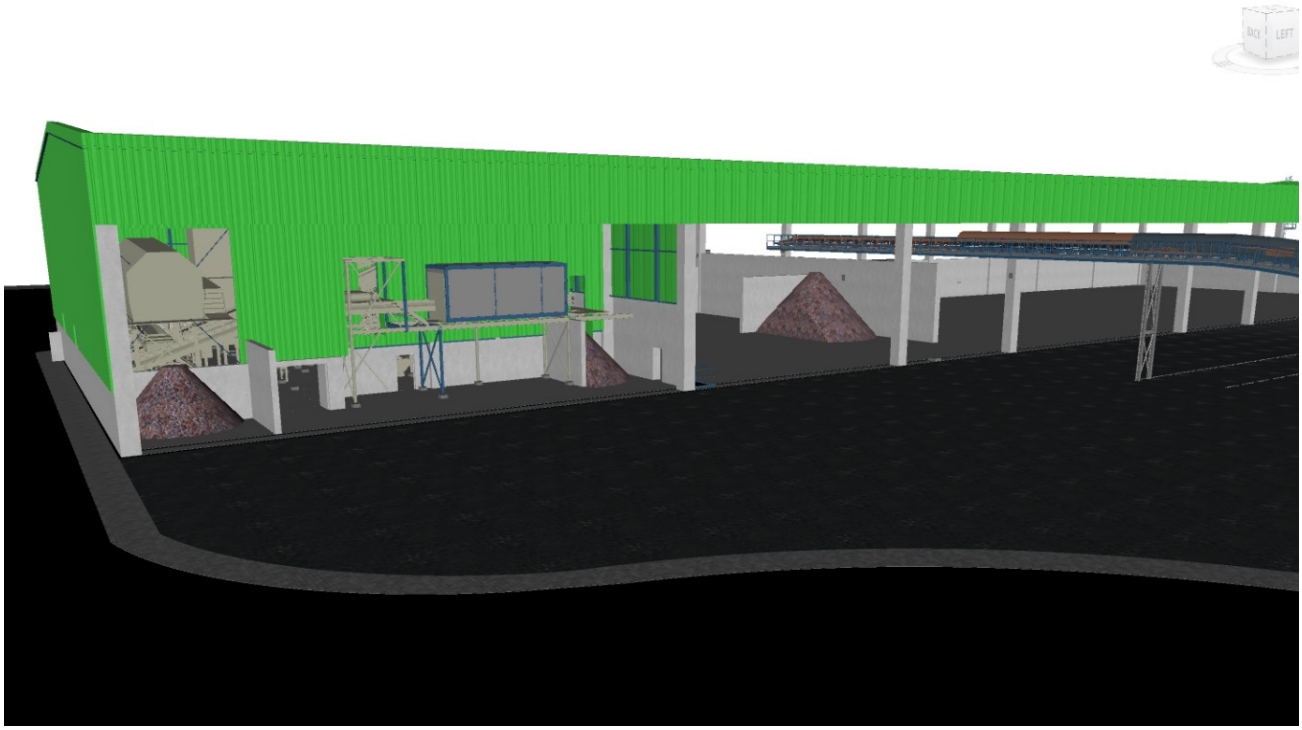


Plate 9 – Bottom ash treatment building cut-away

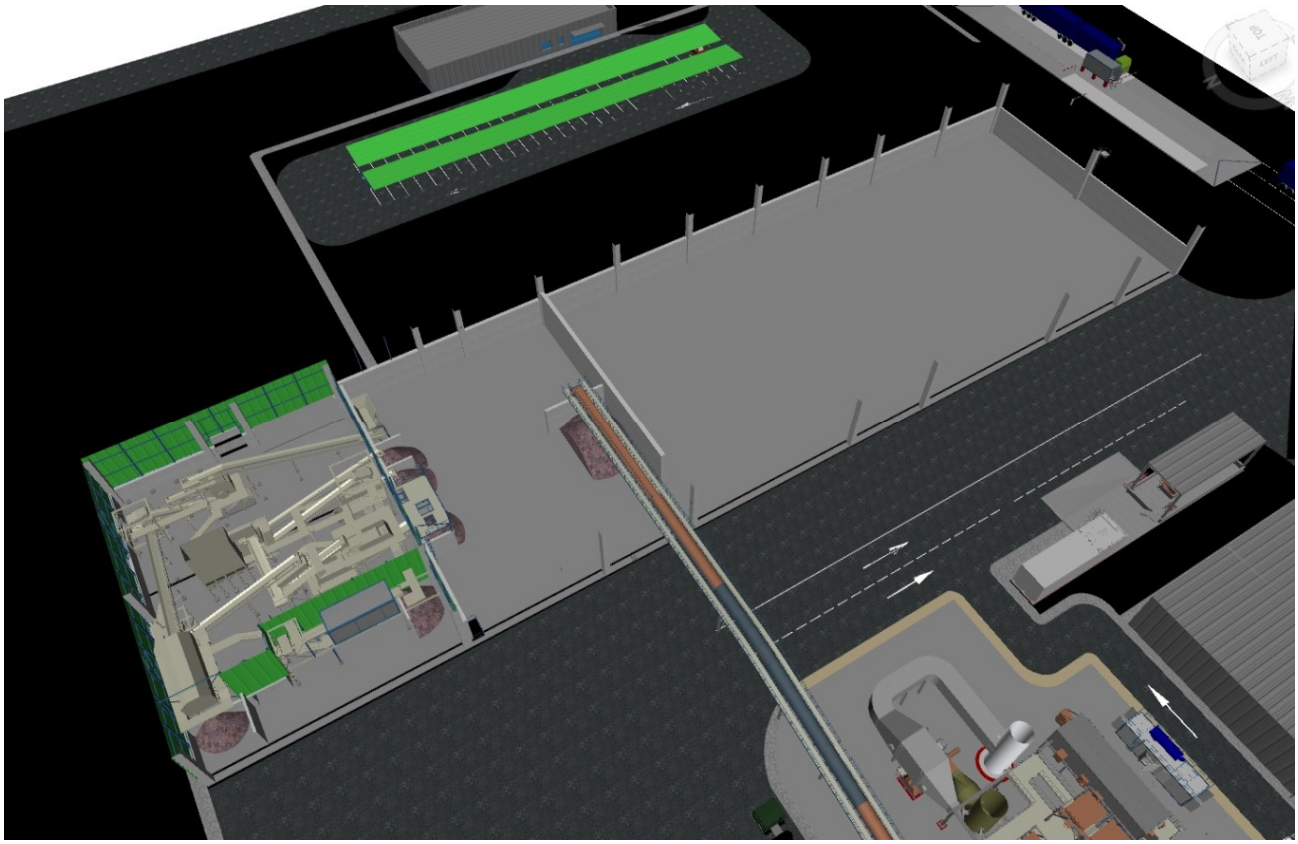
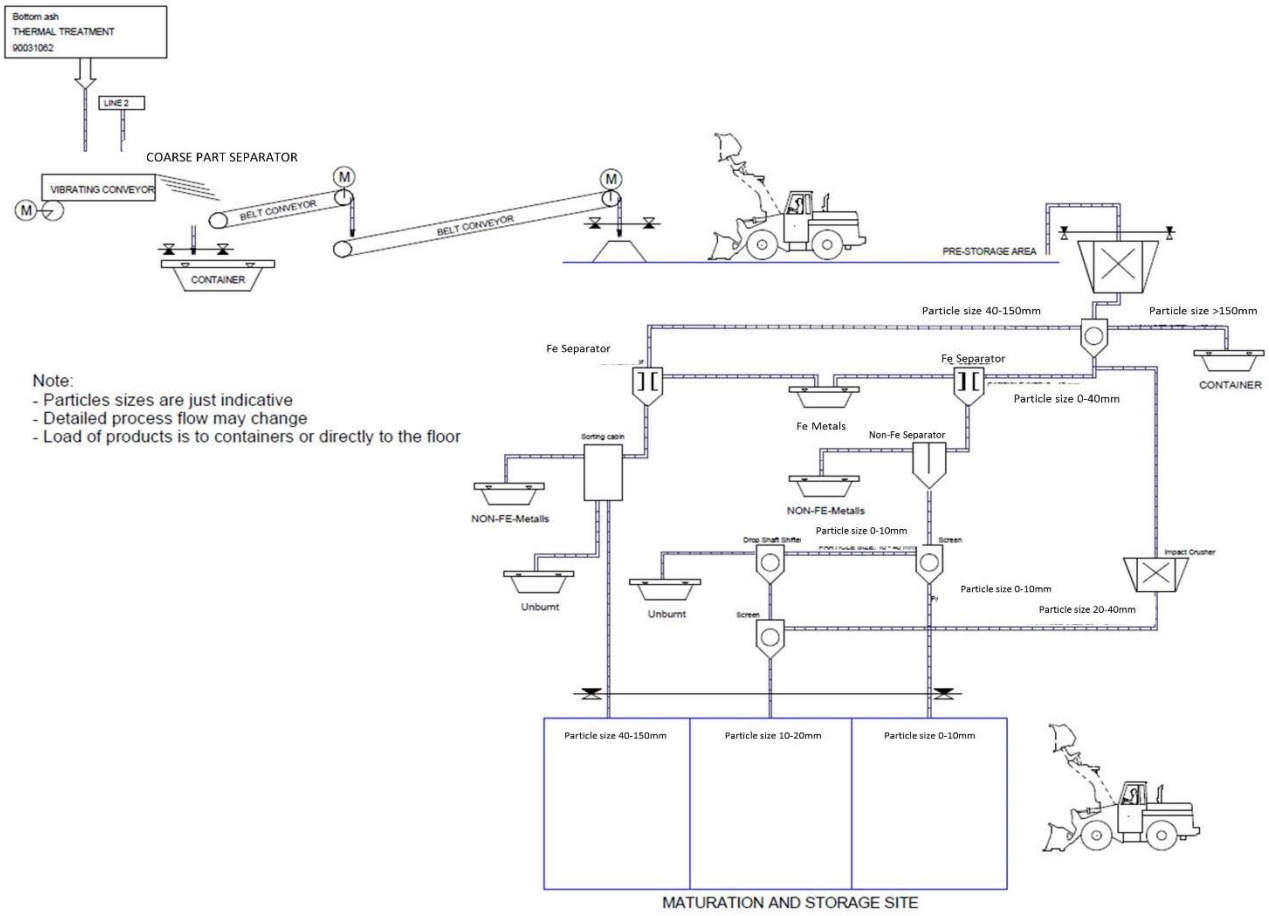


Plate 10 – Bottom ash handling process



The bottom ash treatment process is described below and outlined in Plate 10.

The bottom ash is directly transported to the process area without any intermediate handling via a covered conveyor. The material is conveyed into the initial storage area which has approximately five days of storage capacity where the moisture content reduces from approx. 18% w/w down to 12% w/w to facilitate easier processing. A wheeled loader is used to transfer the stored ash into a feed hopper which feeds a screen where the greater than 250 mm fraction is separated and directed to a storage hopper. The sub-250 mm fraction is directed to a polygon trommel where it is separated into several size fractions.

The plus-250mm fraction passes under an over-band magnet to recover ferrous metals while the middle fraction passes through a magnetic drum to separate ferrous metals. The finest fraction is first treated in a magnetic drum to extract the ferrous metals, followed by two eddy current separators in series for non-ferrous metal recovery. The separated ferrous and non-ferrous materials are stored in hoppers before being directed off-site to a metal recycling facility.

The treated bottom ash product is transferred to the maturation area which is enclosed on three sides by push walls. Wheel loaders are used to distribute, turn and move the bottom ash.

The treated bottom ash is matured which involves a reaction between atmospheric carbon dioxide with oxides in the ash in the presence of humidity (e.g. water) to form carbonates (some water may be added when there is insufficient atmospheric moisture). This process lowers the alkalinity of the ash to a level where is it acceptable for use as aggregate. The maturation process takes one to two months during which the material is occasionally turned and wetted as required by fixed water sprays to provide the necessary water to support the maturation process and to form a crust on the surface of the stockpiles to prevent dust generation.

Any wastewater generated from the bottom ash treatment area will be collected and stored in a lined sump. The collected water will be re-used in the maturation process for maintaining the moisture content of the ash, together with other water sources such as boiler water blowdown and collected rain water.

After the maturation process has completed, the bottom ash is ready for use as construction material. It will be periodically loaded by front end loaders to trucks and transported off-site for re-use.

In the United Kingdom, the use of treated aggregate is subject to meeting the requirements of the UK Standard Rules SR2012 No. 13 of the *Environmental Permitting (England & Wales) Regulations 2010* (Appendix 4). This Standard requires that treated bottom ash be subjected to a sampling and testing protocol. The protocol requires the plant operator to take an amount of bottom ash, equivalent in size to a truck load, from the bottom ash stream twice a month on randomly chosen days. The bottom ash is mixed and a 40 to 50 kg sample is removed for testing by an independent laboratory for a wide range of hazardous properties. The testing is designed to assess whether the bottom ash as contains concentrations of contaminants such as heavy metals that are high enough for the ash to be classed as hazardous. As the quantities of contaminants can vary between samples, the bottom ash from the plant is classed as evaluated on a statistical basis against agreed criteria, or if there is an experience shows that the main contaminants of concern are likely to be compounds of lead, copper and nickel.

Data collated from Environmental Services Association members in the United Kingdom from bottom ash samples taken in accordance to with the Sampling Protocol specified in the UK Standard showed that for 2011 and 2012 all bottom ash was classified as 'non-hazardous'.

2.6.4.8 Energy utilisation

The generated steam is transformed into electrical energy in a turbo-generator set that is used to cover the plant's own electricity needs and to feed the public electrical grid.

Steam turbine

The superheated steam is expanded in the turbine that drives a generator producing 31.4 MW of electricity. Almost 90% of the produced electrical power is exported to the Western Australian grid.

The turbine is equipped with a tap off point for steam export in case such an application is of commercial interest in the future.

Air-cooled condenser

The exhaust steam from the turbine condenses in the air-cooled condenser.

2.6.4.9 Flue gas cleaning

DeNOx system

The plant incorporates a non-catalytic deNOx system (SNCR) that uses injection of a reactant, i.e. aqueous ammonia or urea, to convert oxides of nitrogen to nitrogen and water. The main reaction that takes place can be briefly described as follows:

$$NH_2CONH_2 + 2\ NO + 1/2\ O_2 \rightarrow 2\ N_2 + CO_2 + 2H_2O$$

The reduction takes places within a temperature range of 850 to 950 °C. This range exists in the secondary combustion chamber of the furnace (the first pass of the boiler). In this area an aqueous ammonia solution is injected into the flue gas.

Temperatures higher than 1,000 °C trigger undesired secondary reactions according to the above formulas and are responsible for higher ammonia consumption. At temperatures below 800 °C the efficiency of NOx separation declines considerably and a large portion of the injected reactant is routed to the flue gas treatment system without having been used.

Thus, due to the changing temperature profile in the boiler, several injection levels are required. The system is therefore able to react and inject ammonia at the required amount and optimum temperature profile.

Dry flue gas cleaning

The proposed facility will use a dry flue gas cleaning system downstream of the boiler to control the air emissions. Hydrated lime is injected into the flue gas where it neutralises acidic components such as hydrogen chloride, hydrogen fluoride and sulphur dioxide. At the same injection point activated carbon is added to the flue gas that adsorbs dioxins and furans, gaseous mercury, and other components. Temperature

control from the boiler and inlet flue gas treatment is done via heat exchangers and by-pass system in the last pass of the boiler. The dry system is favourable with regards to energy efficiency and low water consumption.

Downstream of the injection of the reactants, the flue gas passes through a fabric filter (bag filters) which trap fine particulates. Some of the spent lime is recycled to optimize the consumption of the reactants. Periodically, the fabric filters are cleaned by a reverse pulse of air, and the flue gas residues collected for disposal.

An induced draught fan maintains the flue gas flow through the process overcoming the pressure loss through the system. Before the cleaned gas is released to the atmosphere at the stack the emissions are monitored in the continuous emission monitoring system (CEMS).

2.6.4.10 Plant emissions

The energy from waste process is required to meet the IED for concentrations of pollutants in the exhaust gas in the following substances:

- Total particulates (dust) PM_{10};
- CO, acid and corrosive gases - hydrogen chloride (HCl), hydrogen fluoride (HF), sulphur dioxide (SO_2) and NOx;
- Heavy metals - cadmium (Cd), mercury (Hg), lead (Pb) and other heavy metals;
- Organic compounds - dioxins, furans and volatile organic compounds (VOCs).

Emissions monitoring

Emissions from the stack will be monitored using certified CEMS for: particulates, CO, SO_2, HCl, oxygen (O_2), NOx and VOCs.

In addition to the continuous monitoring, periodic stack sampling and measurement will be undertaken for nitrous oxide (N_2O), HF, Cd, thallium (Tl), Hg, antimony (Sb), arsenic (As), Pb, chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni), vanadium (V), dioxins and furans and dioxin like PCBs.

These periodic measurements will be carried out typically four times in the first year of operation and twice per year thereafter. The frequency of testing may be reviewed or amended by the DWER in the Part V Works Approval/Licence.

The Facility will include a dedicated certified duty CEMS and a further hot standby CEMS which will ensure that there is continuous monitoring data available even if there is a problem with a duty CEMS system.

The process is supervised from the Control Room, with continuous process and emissions monitoring to ensure satisfactory operation and performance. The site staff will be fully trained in the use of the selected technology.

A list of projects for the last 10 years for plants built by HZI in compliance with the IED (Industrial Emissions Directive), the successor of WID, is provided in Appendix 5.

The CEMS offers the option to provide regular data updates to demonstrate compliance with approval requirements and compile reports over any chosen time period.

2.6.4.11 Water management

It is estimated that 60,000 kilolitres (kL) of water will be required per annum (approximately 180 kL/day) for the operation of the plant. The project feasibility has been developed based on use of scheme water. Water will be used for the following purposes:

The waste to energy process:

- Water steam cycle (approximately 70 kL/day)
- Bottom ash extractor (approximately 60 kL/day)
- Bottom ash maturation and auxiliary uses (approximately 30 kL/day)
- Other uses for e.g. staff, sanitary, maintenance, cleaning and washing, landscape maintenance, etc. (approximately 20 kL/day).

An indicative water balance for the plant is presented in Appendix 6. The waste to energy plant itself is basically neutral in its water balance, i.e. no surplus water discharge is required. During the operation of the

plant, if minor quantities of water require disposal, the first preference is to re-use the water elsewhere within the plant, e.g. storage in the fire-fighting tank, irrigation of landscaping, or use in the bottom ash treatment area.

To reduce the water needed from scheme supplies, stormwater will be captured from building roofs and stored for re-use.

Water management and reuse will be employed as outlined below:

- Where feasible, wash down water will be captured, filtered to remove solids and either re-used or injected into the bottom ash extractor
- Clean storm water runoff from hardstand areas will be directed to lined ponds for settlement before discharge to infiltration basins. The site will be designed to slope towards the various drainage swales and basins on the site. The drainage infrastructure will be designed to cater for the 10-year annual recurrence interval (ARI) events. The basin locations are shown conceptually in Figure 4. The sizing and design of these basins will be refined at the Works Approval stage via the preparation of a Site Drainage and Groundwater Management Plan for the facility
- The drainage and infiltration system will include a lined pond that will allow for the segregation of polluted water in case of an emergency or spill.

The water consumed in the administration building and ablutions areas will create wastewater which will be disposed on-site via an Aerobic Treatment Unit and infiltration system approved by the City of Rockingham.

Any other wastewater that cannot be recycled will be disposed off-site in accordance with the *Environmental Protection (Controlled Waste) Regulations 2004*.

Scheme water is of suitable quality for the most identified uses at the facility. However, boiler feed water will require treatment in a small reverse osmosis treatment plant to achieve very low dissolved solids levels (<50 milligrams per litre (mg/L)). The reverse osmosis plant will produce approximately 70 kL/day of high quality makeup water for the boiler feed circuit. A standby unit secures stable supply in case of shut down of the other unit, or during flushing. The high quality treated water will be directed to a storage tank before being used to top up the boiler feed circuit.

Approximately 10 kL/day of blowdown water from the boiler circuit will be directed to the bottom ash extractor for re-use.

Stormwater

Clean stormwater (as opposed to wash-down and treatment water) will be directed to lined detention basins where suspended materials will be removed. Water will then be discharged into vegetated infiltration basins and swales. A conceptual diagram depicting the location of the detention and infiltration basins is provided in Figure 4. The final size and location of the detention and infiltration basins will be confirmed in the Works Approval Application when the final engineering design of the facility is completed.

Sewage

A small amount of sewage will be generated by staff using the site. Sewage will be directed to an on-site Aerobic Treatment Unit and infiltration system approved by the City of Rockingham. Based on 40 employees, an annual sewage volume of approximately 1,314 kL/annum is expected to be generated. This has been calculated on the basis of 300L per person multiplied by a factor of 0.3 for commercial occupancy over 365 days.

2.6.4.12 Energy use

The projected maximum electricity demand required for the facility is 3.2 MW. This will be provided by on-site power generation, fueled by the combustion and energy recovery process.

2.6.4.13 Communication and safety systems

The proposed communications and security system will comprise of (but will not be limited to) the following:

- Phone
- Asymmetric Digital Subscriber Line (ADSL) internet connection
- Remotely monitored intrusion and movement activated alarm

- Distributed Control System with automatic dialing to a technical specialist in the event of a Priority 1 system alarm.

2.6.4.14 Site security and safety systems

A cyclone mesh security fence will be installed around the site boundary at the commencement of site works. A security gate will be locked at the end of every day. The site will be lit at night for security and safety reasons. Lighting will be designed and installed to comply with the *Australian Standard (AS) 4282-1997-Control of the Obtrusive Effects of Outdoor Lighting.*

Entry to most of the site will be restricted to employees and approved contractors (such as supply companies, security patrol etc.).

2.6.4.15 Traffic management

- Approximately 90 trucks (varying in capacity from 8.5 to 25 tonnes) will arrive at the facility per day to deliver wastes and to remove residues. This has been calculated using the following assumptions:
- 280,000 tonnes of MSW and C&I residuals being delivered by B-doubles, i.e. 280,000 / 25 = 11,200/year = 37.3 / day (300 days/year delivery) x 2 = 74.7 movements/day
- 20,000 tonnes of MSW being delivered by side lifting garbage trucks, i.e. 20,000 / 8.5 = 2,353/year = 7.8 / day (300 days/year delivery) x 2 = 15.7 movements/day

2.6.4.16 Waste management

Construction waste

The construction and operation of the project will result in the generation of minor quantities of solid and domestic waste peaking during construction. Waste produced during construction and operation will include:

- Topsoil and vegetative material from site clearing activities
- Construction materials and packaging wastes
- Spent hydrocarbon products
- Domestic waste
- Spent chemicals, solvents and paints
- Wood, plastic, metal and paper waste
- Wastewater from toilet and ablutions.

Operational waste

During operation, waste will consist of:

- FGTR for disposal to an appropriately classed landfill or alternative option as approved.
- Recyclable metals and aggregate for re-use
- Recyclables from staff and visitors
- Wastes from staff and visitors will be treated at the plant
- Sewage and greywater for disposal in on-site ATU.

Residue flows from the combustion process and air pollution control system, along with an indicative water balance that identifies wastewater quantities associated with the process is provided in Appendix 6.

Waste from maintenance or replacement of equipment will be managed on a case by case basis and be recycled or disposed in accordance with best practice and regulatory requirements.

Blow down water produced from the boiler will be recovered, treated and re-used where possible. However, when the desired water quality cannot be achieved for re-use, the blow down waste water will be managed via one of the following methods:

- Within the bottom ash treatment circuit for dust control and to promote maturation
- Thermal evaporation using waste heat from the combustion process
- Off-site disposal to an appropriately licensed facility if it cannot be accommodated on-site.

Sewage and greywater will be disposed to an on-site effluent treatment system to the satisfaction of the local authority.

2.6.4.17 Environmental management framework

New Energy is committed to the development of a company-wide Environmental Management System (EMS) consistent with the ISO 14001 framework. A compatible EMS will be developed for the East Rockingham Facility with careful consideration given to ensuring that the relevant management responsibilities between the company wide EMS and East Rockingham EMS are integrated.

The development of the EMS will be undertaken in parallel with the construction program so that key management and operational staff have the opportunity for input into the EMS and associated environmental management program, plans and procedures.

Key aspects of any EMS development are:

- A review of relevant legislation and key environmental issues and aspect
- Development of an organisational chart with allocation of responsibilities
- Development of a range of system and operational procedures that will guide the way the business will operate
- Implementation of a review process to examine both internal and external factors which will help to achieve a continuous improvement in performance
- Development of procedures that relate to change management. These procedures will control the way in which protocols and plans are developed under the EMS, how they can be improved and ensure such changes occur in accordance with statutory requirement, subject to internal review by New Energy.

External to the New Energy EMS and the associated plans and procedures will be a range of statutory requirements that will provide guidance and controls to ensure that all relevant monitoring, management programs and procedures are implemented. While New Energy will internalise responsibility for compliance with statutes through the EMS, it is committed to achieving and maintaining full statutory compliance at all times in a co-operative and open dialogue with regulatory agencies.

New Energy will provide monitoring results to the community. This will be achieved by publishing information on the company website.

New Energy will continue to monitor international best practice as part of its on-going operations to support the construction of new 'waste to energy' facilities within Australia and Internationally. Incorporation of improvements will be undertaken where changes are necessary to comply with changed emission standards or other policies and guidelines relevant to the operation of waste to energy facilities.

2.6.4.18 Environmental Monitoring Framework

New Energy is proposing a comprehensive monitoring framework that will operate throughout the life of the project. The framework will be developed in consultation with the DWER. The key areas of monitoring and reporting identified by New Energy are:

- Monitoring airborne emissions from the plant;
- Assessing and recording all waste feedstock inputs to the facility and combustion chamber;
- Assessing and recording all waste outputs (solid and liquid) to ensure they are managed appropriately; and
- Surveillance monitoring of ground and surface waters in the vicinity of the facility.

It is proposed that the final detail of the monitoring program is agreed in consultation with the DWER during the process of developing the Works Approval for the site which will be issued under Part V of the *Environmental Protection Act 1986.* Table 10 summarises the key commitments in relation to monitoring.

Table 10: Monitoring and reporting framework

Environmental factor	Monitoring regime	Reporting
Air emissions	CEMS system to provide continuous monitoring and logging of key combustion parameters including: — Temperatures at entry and exit of combustion chamber, boiler, air pollution control system and stack — Key combustion parameters in the combustion chamber including O_2, CO, CO_2, $H_2O_{(vap)}$ Emission quality at stack exit including particulates, NO_x and SO_x. $H_2O_{(vap)}$.	Monthly summary reporting on New Energy website. Annual summary report under licence.
	Routine stack testing will be undertaken quarterly in the first year of operation for the following parameters: — Particulates — HAPs (such as Heavy Metals) — NOx — SOx — Volatile Organic Compounds. The range of parameters and frequency of monitoring will be reviewed in conjunction with DWER after consideration of the first year of data (or sooner if necessary).	Monthly summary reporting on New Energy website Annual summary report under licence.
Water monitoring	**Groundwater** A minimum of four groundwater monitoring bores will be installed during the construction of the facility. The bores will be monitored quarterly for at least 12 months prior to the commencement of operation to establish background aquifer conditions and quarterly for the first year of operation. Thereafter, the monitoring frequency will be reduced to 6 monthly. The final suite of analytical parameters will be agreed with DWER as part of the Works Approval process but is expected to be consistent with the typical parameters monitored at landfills in WA.	Summary reporting on New Energy website. Annual summary report under licence.
	Surface Water Any standing water in the clean stormwater basins will be sampled after storm events and quarterly during the first year of operation. Subsequently, monitoring will be conducted six monthly (when standing water occurs). The final suite of analytical parameters will be agreed with DWER as part of the Works Approval process but is expected to be consistent with the typical parameters monitored at landfills in WA.	Summary reporting on New Energy website. Annual summary report under licence.
Waste assessment	**Waste Tracking and Reporting** New Energy will implement a waste tracking system and database for all wastes accepted at the site. This system tracks waste loads accepted at the facility and will be able to identify the final fate of specific loads of waste in order to be able to issue destruction certificates where requested by commercial clients.	Annual summary report on wastes accepted under licence.
	Feedstock Assessment New Energy will implement the following approach to feedstock assessment: — Wastes received will be weighed using an on-site weighbridge; — Wastes will be subject to visual assessment to identify and remove unsuitable or hazardous materials; New Energy will routinely monitor the contaminant loads, density, moisture content and calorific value of fuel bundles for the combustion chamber.	Internal management information available on request by DWER or during audits.

Environmental factor	Monitoring regime	Reporting
	Assessment of Residues All solid wastes resulting from the combustion process requiring off-site disposal will be assessed in accordance with the framework outlined in the document Western Australia Landfill Classification and Waste Definitions 1996 (as amended).	Summary report on New Energy website. Annual summary report on wastes disposed from the facility under licence.
Noise assessment	A noise survey to be completed during commissioning to demonstrate compliance with predicted noise levels.	Copy of noise assessment provided to DWER.
Greenhouse gas emissions	The volume of CO_2 will be monitored by the CEMS and logged to calculate annual emissions. These will be reported annually by New Energy, the details of which will be determined in the EMS. Regular waste audits will be undertaken to determine the biomass portion of waste processed at the site. This data will be used to calculate 'renewable energy certificates' and will be reported annually as required by the EMS.	Annual report published on New Energy website.

2.6.4.19 Summary of key characteristics

The key characteristics of the proposal are summarised in Table 11.

Table 11: Summary of key characteristics

Element	Proposed extent
Physical elements	
Native vegetation clearing	10 ha
Construction period	Approximately 36 months
Life of plant	Notionally 30 years
Operational elements	
Thermal capacity	101.8 MWt
Generation capacity	31.4 MWe with an estimated 28.2 MWe fed into the SWIS
Input power	3.2 MWe Parasitic Load
Input water	Approximately 60,000 kL/annum from scheme water
Input waste throughput	300,000 tpa of residual wastes to be received on-site plus up to 30,000 tpa of sewage sludge
Feedstock waste	300,000 tpa of MSW and residual wastes (processed C&I and C&D waste and residuals from MBT and MRF) as well as up to 30,000 tpa of sewage sludge.
Waste disposal – off-site, recycling or reuse	Up to 68,800 tpa of bottom ash (wet) aggregate
Process wastes	
Flue gas treatment residues	9,920 tpa (dry) or 11,704 tpa (wet) disposed to landfill.
Wastewater	— Estimated 2.5 kL/day of wash down water. — Approximately 15 kL/day of reject water from the reverse osmosis plant which will be used for the bottom ash extractor. — Boiler feed water circuit blow down to be recycled. The final disposal options will be determined at Works Approval Stage from following options: — Re-use in the bottom ash handling circuit; — Off-site disposal; — Evaporation; or — Thermal evaporation using waste heat.

Element	Proposed extent
Sewage/ grey water	On-site disposal via an aerobic treatment unit – to be approved by the City of Rockingham.
Emissions	The key emissions will be air emissions from the stack. Off-gases from the plant are discharged to atmosphere after treatment in a gas cleaning system consisting of a dry reagent scrubbing system with absorbent injection system followed by a compartmentalised pulse jet fabric filter baghouse filtration (FFB). NOx emissions are controlled using a HZI's own SNRC technology. The scrubbing system and combustion control will result in emission levels that will be fully compliant with the requirements of the IED. The ambient concentrations due to these emissions are shown through modelling (see Section 4.2) that they comply with relevant standards and will not contribute to a detrimental effect on the environment in the Rockingham and Kwinana air shed.

2.6.5 Compliance with best available technology

Recommendation No. 8 of the EPA's Section 16 advice advises that waste to energy plants should be required to use best practice technologies in order to meet the equivalent emissions standards in the European Union's Waste Incineration Directive (WID) (2000/76/EC). WID (200/76/EC) has been replaced by the European Union's Industrial Emissions Directive (IED) (2010/75/EC) to provide the framework that regulates air emissions from plants such as waste to energy facilities. IED (2010/75/EC) references the establishment of best available technology (BAT) reference (BREF) documents which form the basis against which permits to operate are approved. The adopted BREF document for waste incineration was released in 2006 (European Commission, 2006) has since undergone a review with a draft revision of the BREF for Waste Incineration released in May 2017.

An assessment of compliance against the draft BREF document is provided in Table 12.

Table 12: European Commission reference document on the best available techniques for waste (mg/normal m^3 or as stated)

Substance	Non-continuous samples	1/2 hour average	24 hour average	Comments
Total dust		1-20 (see note: split view 2)	1-5	**Proposal Compliant** In general the use of fabric filters gives the lower levels within these emission ranges. Effective maintenance of the dust control system is very important. Energy use can increase as lower emission averages are sought. Controlling dust levels generally reduces heavy metal emissions.
Hydrogen chloride (HCl)		1-50	1-8	**Proposal Compliant** Waste control, blending and mixing can reduce fluctuations in raw gas concentrations that can lead to elevated short term emissions. Modern dry or wet flue gas treatment systems routinely achieve the stated levels. The HZI dry flue gas technology is compliant and tolerant of fluctuations in flue gas quality.
Hydrogen fluoride (HF)		< 2 (see note: split view 2)	< 1	
Sulfur dioxide (SO_2)		1-150 (see note: split view 2)	1-40	
Nitrogen monoxide (NO) and nitrogen dioxide (NO_2) expressed as nitrogen dioxide for installations using SCR		40-300 (see note: split view 2)	40-100 (see note: split view 2)	**Proposal Compliant** Waste and combustion control techniques coupled with selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR)

NO and NO_2 expressed as nitrogen dioxide for installations not using SCR		30-350	120-180	generally result in operation within these emission ranges. The HZI SNCR system is compliant and tolerant of fluctuations in flue gas quality. The patented DyNOR™ technology achieves very high levels of NOx reduction while minimising reagent use and ammonia slip.
Gaseous and vaporous organic substances, expressed as toc		1-20	1-10	**Proposal Compliant** Techniques that improve combustion conditions reduce emissions of these substances. Emission concentrations are generally not influenced by the flue gas treatment system. HZI has a proven combustion control system and will provide all of the key system components providing increased levels of reliability and control.
Carbon monoxide		5-100	5-30	
Mercury and its compounds (as Hg)	<0.05	0.001-0.03	0.001-0.02	**Proposal Compliant** Adsorption using carbon based reagents is generally required to achieve these emission levels with many wastes - as metallic Hg is more difficult to control than ionic Hg. The proven HZI flue gas treatment system has proven track record in controlling Hg.
Total cadmium and thallium (and their compounds expressed as the metals)	0.005-0.05	0.001-0.03	0.001-0.02	**Proposal Compliant** See comments for Hg. The lower volatility of these metals compared to Hg means that dust and other metals control methods are more effective at controlling these substances.
Σ other metals	0.005-0.5			**Proposal Compliant** Best Practice techniques such as the use of high efficiency fabric filters with excess capacity that control particulate levels also control these metals. The HZI fabric filter is designed with up to 25% excess flow capacity to ensure that it is not excessively loaded.
Dioxins and furans (ng teq/Nm^3)	0.01-0.1			**Proposal Compliant** Combustion techniques destroy polychlorinated dibenzodioxins/furans (PCDD/F) in the waste. Specific design and temperature controls reduce de-novo synthesis. The HZI technology achieves very high destruction efficiencies though the very efficient grate combustion system and then minimises de-novo synthesis of dioxins and furans by achieving a rapid temperature drop to below 450°C (the temperature at which furans and dioxins are most likely to be produced). In addition to such

				measures, abatement techniques using carbon based adsorbents reduce final emissions to within this emission range. Increasing dosing rates for carbon adsorbents may give emissions to air as low as 0.001 but result in increased consumption and residues. HZI provide a proven integrated solution for grate, boiler design and flue gas cleaning and this provides greater confidence in BAT performance.
Substances not included in directive 2000/76/EC on waste incineration				
Ammonia (NH_3)	< 10	1-10	<10 (see split view 1)	**Proposal Compliant** Effective control of NOx abatement systems, including reagent dosing contributes to reducing NH_3 emissions. Wet scrubbers absorb NH_3 and transfer it to the waste water stream.
Benz(a)pyrene	There was insufficient data for these substances to draw a firm BAT conclusion on emission levels. However, the data provided in Chapter 3 indicates that their emission levels are likely to be low. PCB's, PAH's and benz(a)pyrene can be controlled using the techniques applied for PCDD/F. N_2O levels are determined by combustion technique and optimisation and SNCR optimisation where urea is used.			Techniques that control PCDD/F also control Benz(a)pyrene, PCBs and PAHs.
PCB's				
PAHs				Effective oxidative combustion and control of NOx abatement systems contribute to reducing N_2O emissions. The DyNOR™ system is proven in control of N_2O

Source European Commission (2006) - Table 5.2: Operational Emission Level Ranges Associated with the use of BAT for releases to Air from Waste Incinerators.

Notes:

The ranges given in this table are the levels of operational performance that may generally be expected as a result of the application of BAT - they are not legally binding emission limit values (ELVs)

Σ other metals + sum of Antimony (Sb), Arsenic (As), Lead (Pb), Chromium (Cr), Cobalt (Co), Magnesium (Mn), Nickel (Ni), Vanadium (V) and their compounds expressed as the metals.

Non-continuous measurements are averaged over a sampling period of between 30 minutes and 8 hours. Sampling periods are generally in the order of 4 - 8 hours for such measurements

Data is standardised at 11% oxygen, dry gas, 273K and 101.3kP.

Dioxins and furans are calculated using equivalence factors as in EC/2000/76.

When comparing performance against these ranges, in all cases the following should be taken into account; the confidence value associated with determinations carried out, that the relative error of such determinations increases as measurement concentrations decrease towards lower detection levels.

The operational data supporting the above mentioned BAT ranges were obtained according to the currently applied codes of good monitoring practice requiring measurement equipment with instrument scales of 0 3 times the Waste Incineration Directive End of Life Vehicles (WID ELV). For parameters with an emission profile of very low baseline combined with short peak emissions, specific attention has been paid to the instrument scale. For example changing the instrument scale for measurements of CO from 3 times the WID ELV to a 10 times higher value, has been reported in some cases, to increase the reported values of the measurement by a factor of 2 - 3. This should be taken into account when interpreting this table.

Split Views

BAT 35: based upon their knowledge of the performance of existing installations a few Member States and the Environmental non-government organisation (NGO) expressed the split views that the 24 hour NH_3 emission range associated with BAT should be <5 mg/Nm^3 (in place of the 10 mg/Nm^3).

BAT 35: One Member State and Environmental NGO expressed split views regarding the BAT ranges in table 5.2 (Air). These split views were based upon their knowledge of the performance of a number of existing installations and their interpretation data provided by the Technical Working Group and also of that included in the Best Available Techniques (e.g. Chapter 3). The final outcome of the Technical Working Group meeting was that the ranges shown in Table 5.2 but with the following split views recorded total dust 1/2 hour average 1 - 10 mg/Nm^3, NOx (as NO_2) using SCR 1/2 average 30 - 200 and 24hr average 30 - 100 mg/Nm^3. Hg and its compounds (as Hg) non-continuous 0.001 - 0.03 mg/Nm^3, Total Cd + Ti non-continuous 0.005 - 0.03 mg/Nm^3, dioxins and furans non-continuous 0.01 - 0.05 ng TEQ/Nm^3. Based on the same rationale, the Environmental NGO also registered the following split views: HF1/2 hour average <1 mg/Nm^3, SO2 1/2hr average 1 - 50 mg/Nm^3 and 24hr average 1 - 25 mg/Nm^3.

2.6.6 Assessment of HZI grate combustion against EPA section 16 advice

As indicated in Section 2.6.5, the HZI technology proposed by New Energy complies with best practice criteria adopted for waste to energy facilities in the European Union. New Energy is of the view that the design and operational philosophy adopted in developing the proposal for the East Rockingham facility is also entirely consistent with the conclusions and recommendations contained in the EPA's Section 16 Advice on Waste to Energy. Table 13 presents information in summarised form demonstrating how the proposal conforms with the 21 recommendations and two conclusions contained in the Section 16 advice.

Table 13: Summary of New Energy Compliance with EPA section 16 advice

EPA Section 16 conclusion / recommendation	Statement of compliance by New Energy
Conclusion 1 Waste to energy plants have the potential to offer an alternative to landfill for the disposal of non-recyclable wastes, with the additional benefit of the immediate capture of stored energy.	**Acknowledged and supported.**
Conclusion 2 It has been demonstrated internationally that modern waste to energy plants can operate within strict emissions standards with acceptable environmental and health impacts to the community when a plant is well designed and operated using best practice technologies and processes.	**Acknowledged and supported.**
Recommendation 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.	**Fully Compliant.** New Energy has adopted a cautious approach in developing the proposal and has ensured that it adheres to Best Practice and Best Available Technology in every aspect of the proposal.
Recommendation 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.	**Fully Compliant.** New Energy targets wastes that are currently being landfilled. All waste will come from collection systems which include separation at the source or have a prior recycling step. Ferrous and non-ferrous materials will be recovered from the process and recycled. The bottom ash from combustion will be treated and used as aggregate as undertaken throughout Europe. Only burnt-out flue gas treatment residues will go to landfill.
Recommendation 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.	**Fully Compliant.** New Energy's chosen HZI combustion technology is well suited to handling a heterogeneous feedstock. The HZI technology has been used in over 500 plants with many plants operating on the same waste streams at a similar scale. These plants have been shown to meet IED standards. Examples of reference projects are provided in Appendix 5.
Recommendation 4 Waste to energy proposals must characterise the expected waste feedstock and consideration made to its likely variability over the life of the proposal.	**Fully Compliant.** The ERD and appendices present a very detailed assessment of the proposed feedstocks. As stated previously, the HZI combustion technology is capable of handling a wide range of feedstocks, waste compositions, calorific values so that the plant can adapt to short-term changes and different waste streams over time.

EPA Section 16 conclusion / recommendation	Statement of compliance by New Energy
Recommendation 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.	**Fully Compliant.** The New Energy proposal will only process residual waste streams which have been source separated or gone through a separation process. This is consistent with the Waste Management Hierarchy.
Recommendation 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.	**Fully Compliant.** The New Energy proposal is based primarily on MSW from 2 or 3 bin collection systems but will also accept residual wastes from C&I, C&D, MRFs, MBTs, composting and biosolids.
Recommendation 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.	**Acknowledged.** Hazardous waste streams are excluded from processing as outlined in Section 2.6.3. Only wastes that have already gone through source separation or recycling operations will be accepted. Quality controls at the weighbridge will exclude radioactive waste and further controls will happen regularly through the crane operator of the waste delivered into the waste bunker.
Recommendation 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).	**Fully Compliant.** The New Energy facility is compliant with Best Practice. HZI's technology is proven as Best Available Technology. Refer to Section 2.6.5 for further information.
Recommendation 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.	**Fully Compliant.** The air quality assessment contained in Appendix 7 includes the best available information on background air pollutant levels. Ambient and source monitoring will be negotiated with DWER through the Part V assessment process. An indicative monitoring program is outlined in Sections 2.6.4.10 and 2.6.4.18.
Recommendation 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.	**Fully Compliant.** The HZI combustion system design and operating characteristics result in low production levels of dioxins and furans. When coupled with a flue gas cleaning system meeting Best Practice and BAT this means the New Energy facility complies with this recommendation. Refer to Section 2.6.5 for further information.
Recommendation 13 Proposals must demonstrate that odour emissions can be effectively managed during both operation and shut-down of the plant.	**Fully Compliant.** An odour assessment has been completed which demonstrates full compliance with odour assessment criteria. Refer to Appendix 7 for further information.
Recommendation 14 All air pollution control residues must be characterised and disposed of to an appropriate waste facility according to that characterisation.	**Fully Compliant.** New Energy has committed to a thorough assessment of the solid residues from the air pollution control system. Based on experience from similar reference plants, the residues collected will likely be disposed to a Class III facility.

EPA Section 16 conclusion / recommendation	Statement of compliance by New Energy
Recommendation 15 Bottom ash must be disposed of at an appropriate landfill unless approval has been granted to reuse this product.	**Fully Compliant.** New Energy has committed to a thorough assessment of the bottom ash from the combustion system in order to use the treated material as an aggregate. This approach is used in the United Kingdom in compliance with the well-proven UK Standard Rules SR2012 No. 13 of the Environmental Permitting (England & Wales) Regulations 2010 (Appendix 4).
Recommendation 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.	**Fully Compliant.** The proposal is based on the safe reuse of bottom ash in accordance with UK Standard Rules SR2012 No. 13 of the Environmental Permitting (England & Wales) Regulations 2010. New Energy has committed to a thorough assessment of all solid residues from the combustion system to demonstrate the suitability of the ash for use as aggregate.
Recommendation 17 Long term use and disposal of any by-product must be considered in determining the acceptability of the proposed use.	**Fully Compliant**. New Energy has committed to a thorough assessment of all solid residues from the combustion system and the Air Pollution Control System. The proposal is based on the safe use of bottom ash and disposal of flue gas treatment residues at an appropriate class of landfill.
Recommendation 18 Standards should be set which specify the permitted composition of ash for further use.	**Noted.** New Energy is proposing to use UK Standard Rules SR2012 No. 13 of the Environmental Permitting (England & Wales) Regulations 2010 as the basis of determining suitability for use of the ash. New Energy has committed to working with the DWER to adapt this Standard for the Western Australian context.
Recommendation 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.	**Fully Compliant.** New Energy has committed to a thorough assessment of the flue gas and all solid residues from the process. The proposal is based on a robust flue gas treatment system, the safe use of the treated bottom ash and disposal of the flue gas treatment residues at an appropriate class of landfill. If New Energy introduce new waste inputs outside the discussed feedstock, then an appropriate assessment will be carried out and discussed with DWER and approval obtained before acceptance of the waste stream commences.
Recommendation 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.	**Fully Compliant**. The issue of future zoning is a matter to be addressed by the WAPC and the City of Rockingham. Given the location of the site within the greater Kwinana Industrial Area and within a strategic industry zone, it is unlikely that the land hosting the facility will be rezoned during its commercial life.
Recommendation 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.	**Fully Compliant**. The R1 efficiency for the facility is 0.778 which exceeds the WID requirement of 0.65 (refer to Appendix 8 for approximate energy efficiency calculation and energy balance).

2.7 Local and regional context

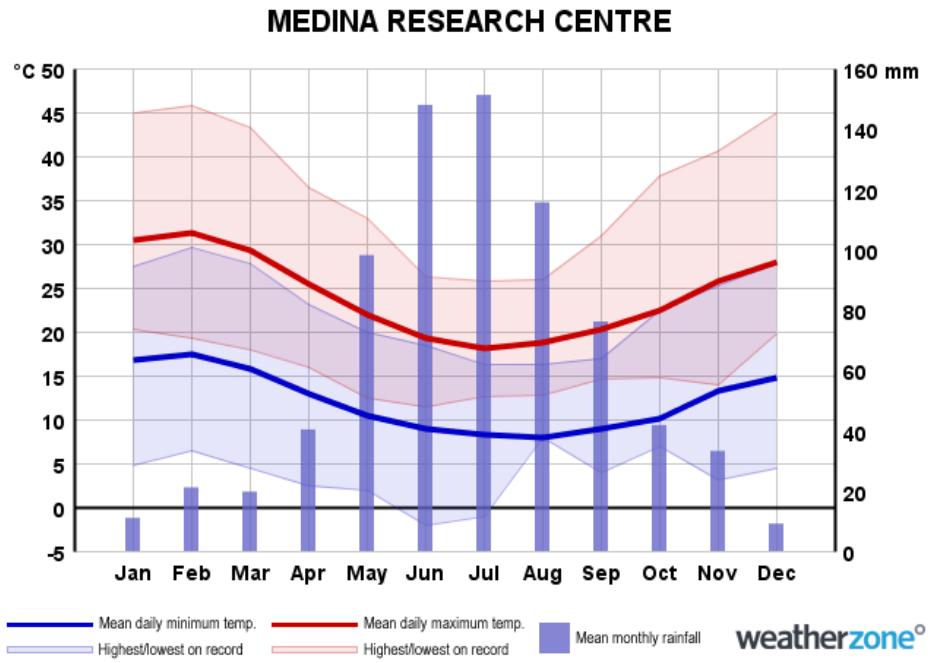
2.7.1 Climate

The region is characterised by a Mediterranean climate with mild wet winters and hot dry summers. The nearest weather data for East Rockingham has been summarised for Kwinana BP Refinery and Medina Weather Stations. A summary of the meteorological data relevant to the subject land is presented in Chart 3.

The mean daily maximum temperatures measured at the Medina weather station range from 18.2°C in July to 31.4°C in February. The mean daily minimum temperature measured at Kwinana BP Refinery ranges from 8.0°C in August to 17.5°C in February. The highest ever maximum temperature was measured at 45.8°C in 1991 and lowest minimum of -2.0°C in June of 1990.

The average rainfall is 767.6 mm per annum with the largest average rainfall in July (151. 6mm) and lowest average rainfall in December (10.6 mm). The highest rainfall recorded in a single year was 1022.2 mm in 1991 and lowest rainfall of 487.1 mm in 2010.

Chart 3: Annual climate averages



The month of January has the lowest mean relative humidity of 52% at 9am (measured at Kwinana BP Refinery), while February and March have the lowest humidity of 54% at 3pm. The months of June and July have the highest mean relative humidity, both of which are 74% at 9am and July has the highest humidity of 66% at 3pm.

Mean daily evaporation measured at the Medina research station ranges from a minimum of 1.8mm in June and July, to a maximum of 8.5mm in January. The total annual evaporation is approximately 1730mm, which exceeds annual rainfall by approximately 970mm.

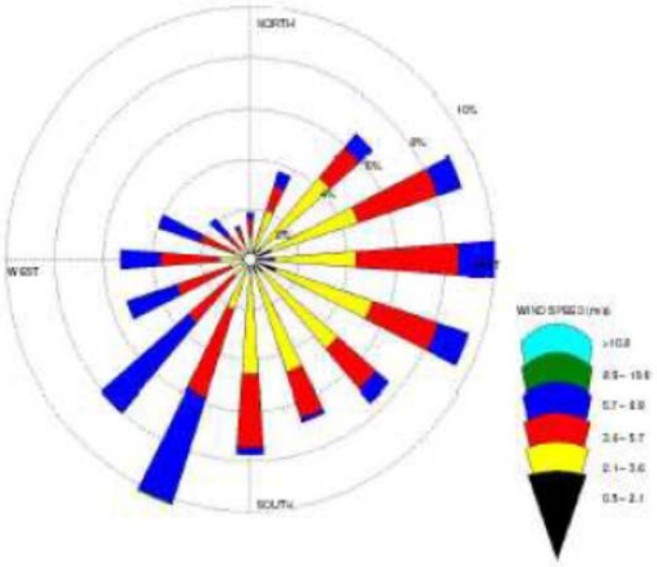
The annual wind roses based on data from the Hope Valley Meteorological Station (1980) is shown in Plate 11 (Cited in Coffey Environments, 2009a).

Winds in the Kwinana region result from both large-scale (synoptic) winds associated with low and high pressure systems, and local thermally influenced winds. Typically, strong offshore breezes occur during the daytime followed by corresponding onshore breezes as the land cools during the evening. This sea breeze/land breeze cycle is typical of coastal environments in the Perth Metropolitan Region (Coffey Environments, 2009a).

Synoptic winds in the Rockingham area are generally from the east quadrant. During spring and summer, the easterly winds are disrupted by the sea breeze from the south-west and south-south-west, which is generally an afternoon weather phenomenon (Coffey Environments, 2009a).

Summer winds tend to be relatively persistent and 50% of winds have speeds of 5 metres per second (ms^{-1}) to 9 ms^{-1}. Winds during winter are typically from the west and north quadrants. Winter winds are typically more variable with occasional periods of calm and strong storm winds. Fifty percent of winds have speeds of 2ms^{-1} to 7ms^{-1} (Coffey Environments, 2009a).

Plate 11 – Annual wind rose



Source: Coffey Environments (2009a).

2.7.2 Geomorphology and topography

The subject land is located on the coastal fringe of the Swan Coastal Plain and is associated with the Quindalup Dune System which comprises relic fore dunes of calcareous sands (Holocene origin) (Figure 5). It is at the northern end of the Rockingham-Becher Plain, which consists of a succession of beach ridges formed during deposition of sand parallel to the beach. At the northern end of the Rockingham-Becher plain (including the subject land), there appears to have been several phases of dune formation. This has resulted in an irregular pattern of beach ridges and poorly defined dunes and swales. This is apparent on the subject land with areas within the RIZ to the west having a more distinct dune and swale pattern due to their more recent formation. The subject land is very flat with an elevation of approximately 5m AHD (Figure 1) and shows little or no distinction between dunes and swales.

2.7.3 Geology and soils

The subject land is within the Perth Basin and Warnbro group (Department of Mines and Petroleum, 2008) and its geology reflects the area's history of coastal deposits and coastal dunes (Department of Mines and Petroleum, 2001).

Soils on the site comprise calcareous sands (S13: white medium grained, rounded quartz and shell debris, well sorted of aeolian origin) and form part of the Safety Bay Sand complex (Qhs) (Gozzard, 1983). These soils are typified by limesand with high permeability, low to medium erosion potential, medium slope stability and high ease of excavation (Gozzard, 1983).

2.7.3.1 Acid Sulfate Soils

Acid sulfate soils (ASS) are naturally occurring soils, sediments and peats that contain iron sulphides, predominantly in the form of pyrite materials (DER, 2015a). In an anoxic state, these materials remain benign and do not pose a significant risk to human health of the environment, but if disturbed and exposed to oxygen has the potential to cause environmental harm (DER, 2015a). In Western Australia, ASS are commonly associated with riverine, estuarine and coastal lowland areas, wetlands, flood plains, saline inland areas and beneath the watertable in podsolised sandy soils that contain limited amounts of carbonate materials (DER, 2015a).

ASS risk mapping for the Swan Coastal Plain shows the subject land as having no risk of ASS being present. Risks associated with the construction of the Facility will be determined during the licensing process (Part V of the *Environmental Protection Act 1986*). At this stage, it is expected that the site will have a sand pad constructed for the Facility which will reduce the risk of disturbing ASS.

2.7.3.2 Groundwater

The subject land is located within the Wellard sub-area of the Cockburn Proclaimed Groundwater Area as gazetted under the *Rights in Water and Irrigation Act 1914*, 2007). In this area, licences need to be obtained to extract groundwater, if allocation allowances are available.

The subject land is characterised by Pinjar Member sub-surface geology, which contains the Leederville formation. Groundwater in this groundwater area comprises an unconfined superficial aquifer, Rockingham Sand aquifer (present in places), the Leederville aquifer (semi-confined) and the Yarragadee (confined) aquifer (DoW, 2007).

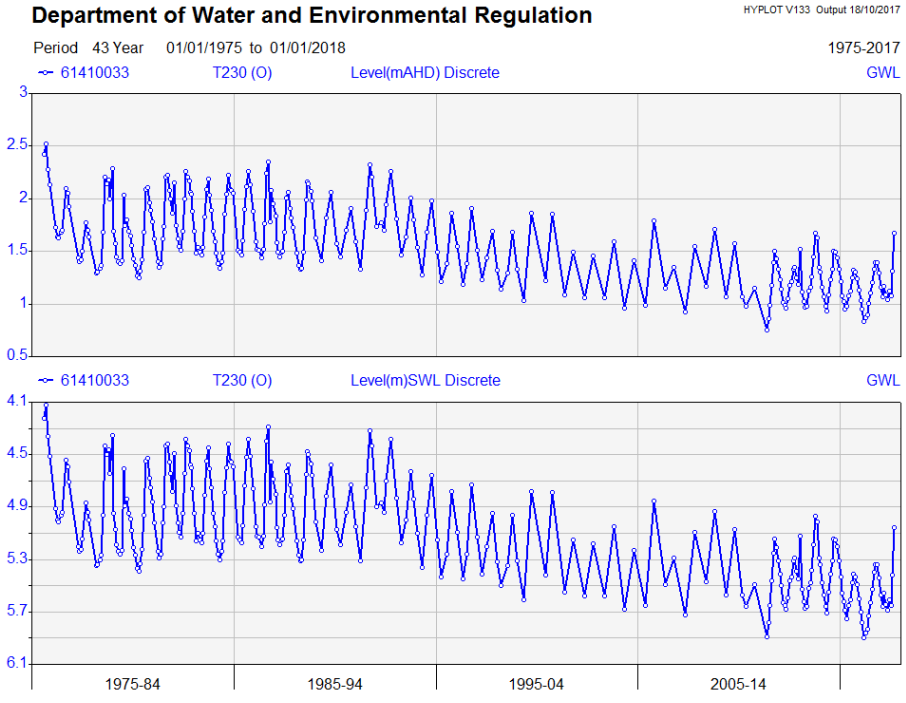
The maximum groundwater level in the area is 1.15 mAHD in the vicinity of the subject land (Figure 6) (Umwelt Environmental Consultants, 2009). Groundwater beneath the site flows from east to west, with the depth to maximum groundwater approximately 3.85 mBGL. Modelling by Umwelt Environmental Consultants (2009) and observations of groundwater monitoring bores in the area indicates that there has been a decline of approximately 1m in groundwater levels across the RIZ since 1990 (Plate 12).

2.7.3.3 Groundwater quality

DoW (2007) reported that is no evidence of groundwater salinity increasing on a regional scale for the aquifers in the Cockburn Proclaimed Groundwater Area. Private monitoring data (submitted through licence conditions) and department data collected and collated from the Cockburn Saltwater Interface bores (CSI-1/97, 2/97 and 3/97) indicate the seawater interface is about 500 m onshore, within the Kwinana Beach industrial area, where abstraction from the superficial aquifer is concentrated.

The mean TDS concentration of groundwater in the Cockburn Proclaimed Groundwater Area was 812mg/L with a maximum of 1,815mg/L and a minimum of 330mg/L. The Australian Drinking Water guidelines suggest that 1,000mg/L is acceptable for drinking based on taste. However, with minor treatment, water with a TDS of 2,000mg/L can be used as a drinking water supply (NSW DEC, 2007). The ANZECC guidelines suggest that concentrations of TDS below 3,000mg/L are generally acceptable for stock drinking purposes without loss of production. Based on this, it is considered that the groundwater in the RIZ is of a good quality and is potentially suitable for potable use.

Plate 12 – Long term groundwater levels (Department of Water Groundwater Bore 61410033)



Groundwater quality parameters have been recorded at the East Rockingham waste water treatment plant (WWTP) site (MW1, MW2, MW3, MW4, MW5, MW6; Figure 6) by ERM Australia (ERM, 2008). This site is approximately 1km south of the subject land. These results are included here as they are likely to reflect groundwater quality of the superficial aquifer within the RIZ. Parameters measured included pH, electrical conductivity, dissolved oxygen, redox potential and metals as shown in
Table 14.

Using this information, water quality in the RIZ can generally be described as follows:

- pH is generally neutral (between 7.36 and 7.72) and reflects a range of acceptable values for wetland systems (ANZECC, 2000) and drinking water guidelines
- Electrical conductivity ranged between 932µS/cm and 1,232µS/cm. This is within the range of acceptable values for wetland systems (ANZECC, 2000) and drinking water guideline values
- Dissolved oxygen values ranged between 0.19 and 1.95 mg/L, which was below criteria for wetlands systems and drinking water. This is considered to be typical of groundwater, which generally has lower values than surface water and drinking water and can be aerated to meet the relevant threshold criteria
- Temperature ranged between 20 °C and 21°C
- Redox potential ranged between -162 mV (which is indicative of reducing conditions) and 86 mV, which is indicative of oxidising conditions
- Background concentrations of copper, nickel and zinc are present in groundwater above the threshold criteria to protect 95% of freshwater species (ANZECC, 2000) and concentrations of nickel are present at concentrations in excess of the Australian drinking water guidelines (NHMRC, 2004). The concentrations of copper and nickel are only slightly above or below the respective human health and environmental threshold criteria, however, background concentrations of zinc appear to be significantly elevated when compared with the environmental threshold criteria
- All other analytes either have no threshold criteria or are below the human health and environmental threshold criteria
- Dissolved major cations and anions were generally low ranging between combined totals of 359 mg/L to 776 mg/L. These combined totals are indicative of total dissolved solids concentrations and suggest that the groundwater is of potable water quality.

Overall, the field chemical parameters and analytical results for the East Rockingham waste water treat plant site suggest that the water quality in the RIZ is suitable for drinking water purposes. Elevated concentrations of zinc are present above ANZECC freshwater criteria. However, these are likely to represent background concentrations rather than contamination. Receiving systems are likely to be conditioned to this natural water quality. These groundwater quality results are likely to be similar to the subject land given that upstream influences are similar and the areas are relatively undeveloped.

2.7.4 Wetlands

The Geomorphic Wetlands of the Swan Coastal Plain dataset does not show any wetlands on the subject land. However, RIZ area was assessed for wetlands as part of the SEA (Coffey Environments, 2009a). This assessment identified 35 wetlands with a small area comprising degraded Melaleuca huegelii vegetation on the western boundary of the subject land was identified as a wetland. (Figure 7). However, a site inspection by Aurora Environmental (19/10/2011; Plate 13) of the mapped wetland indicated that the affected area on 26 Office Road does not possess key wetland characteristics (such as a swale, expression of moisture or wetland indicator plant species). There is no evidence of expressions of surface water on the site.

Plate 13 – Area previously defined as a wetland

Table 14: Groundwater analytical results for East Rockingham WWTP

			Cations and Anions													Dissolved Metals									
			Alkalinity (Hydroxide) as CaCO3	Alkalinity (total) as CaCO3	Bicarbonate	Carbonate	Chloride	Sulphate	Anions Total	Calcium	Magnesium	Potassium	Sodium	Cations Total	Ionic Balance	Arsenic (Filtered)	Cadmium (Filtered)	Chromium (III+VI) (Filtered)	Copper (Filtered)	Iron (Filtered)	Lead (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Zinc (Filtered)	Sulphur as S
			µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L	mg/L	mg/L	meq/L	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			1000	1	1	1	1	1	0.01	1	1	1	1	0.01	0.01	0.001	0.0001	0.001	0.001	0.05	0.001	0.0001	0.001	0.005	1
ANZECC 2000 95%																	**0.0002**		**0.0014**		**0.0034**	**0.0006**	**0.011**	**0.008**	
NHMRC Aesthetic DWGs 2004							*250*	*250*					*180*						*1*	*0.3*				*3*	
NHMRC Health DWGs 2004								500								0.007	0.002		2		0.01	0.001	0.02		
Field_ID	**LocCode**	**Sampled_Date-Time**																							
DUP		6/23/2008	<1000	285	285	<1	95.8	23	9.84	94	23	4	54	9.07	4.07	0.005	<0.0001	<0.001	<0.001	<0.05	<0.001	<0.0001	0.008	**0.033**	23
MW1	MW1	6/23/2008	<1000	303	303	<1	97.3	23	10.2	94	23	4	55	9.11	5.67	0.005	<0.0001	0.002	**0.002**	<0.05	<0.001	<0.0001	0.009	**0.06**	23
MW2	MW2	6/23/2008	<1000	354	354	<1	185	10	12.9	91	26	2	108	11.5	5.84	0.004	0.0001	0.001	**0.002**	<0.05	<0.001	<0.0001	0.004	**0.068**	10
MW3	MW3	6/23/2008	<1000	338	338	<1	66.9	24	10.1	94	34	9	43	9.6	2.73	0.002	<0.0001	<0.001	<0.001	<0.05	<0.001	<0.0001	**0.013**	**0.049**	24
MW4	MW4	6/23/2008	<1000	205	205	<1	37.2	12	5.88	76	8	2	19	5.33	4.88	0.003	<0.0001	0.001	<0.001	<0.05	<0.001	<0.0001	0.002	**0.042**	12
MW5	MW5	6/23/2008	<1000	311	311	<1	148	29	12.2	85	42	3	91	11.7	2.16	0.005	<0.0001	<0.001	**0.002**	<0.05	<0.001	<0.0001	0.004	**0.044**	29
MW6	MW6	6/23/2008	<1000	334	334	<1	114	18	11	76	33	2	78	10	4.99	0.005	<0.0001	<0.001	0.001	<0.05	<0.001	<0.0001	**0.022**	**0.053**	18
RIN		6/23/2008	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.001	**0.0007**	0.001	<0.001	-	<0.001	<0.0001	<0.001	<0.005	-

Source: Coffey Environments (2009a)

2.7.5 Vegetation and flora

2.7.5.1 Biogeography

The subject land is located in the Swan Coastal Plain bioregion, one of 85 bioregions recognized under the Interim Biogeographic Regionalisation for Australia (Environment Australia, 2000). The bioregion comprises two sub-regions: the Dandaragan Plateau and the Perth subregions (Environment Australia, 2000). The subject land is located in the mid-western portion of the Perth sub-region which is defined as:

'The coastal plain is a 30km wide strip on the Indian Ocean coast, directly west of the Darling Scarp uplands running from Cape Naturaliste in the south to above the City of Perth. The plain mainly consists of fairly infertile sandy soils along with coastal sand dunes, river estuaries and a number of wetlands separated from the sea by the dunes. A number of rivers cross the plain from east to west from the Darling Scarp towards the sea including the Swan and its main tributary, the Canning.

The sediments of the Perth basin are Tertiary and Quaternary in age immediately below Perth and include incompletely consolidated sedimentary rock, limestones deposited by mineral springs and sandy limestones with abundant shelly material. Perth is situated on a set of sand dunes formed during the Pliocene-

Pleistocene during the last ice age. The dune topology results in an extensive north-south oriented chain of wetlands which are located in dune swales.'

2.7.5.2 Previous surveys

A vegetation mapping and flora survey has been undertaken over the RIZ by Dr Paul van der Moezel of ATA Environmental in January 2002, September 2004 and November 2005 (as summarised in Coffey Environments, 2009a and b). Trudgen and Weston (1998) surveyed five 10 x 10m quadrats in wetland vegetation as part of a larger survey.

2.7.5.3 Vegetation

The vegetation in the area is classified as part of the Rockingham System: *Shrublands – Scrub-heath on the Swan Coastal Plain* (Vegetation Association 3048; Beard's Pre-European Vegetation, Government of Western Australia, 2016). The 2016 Statewide vegetation statistics (Government of Western Australia, 2016) have been calculated for the likely original and remaining extent of this vegetation association and areas protected in the Conservation Estate (Table 15). These calculations indicate that 3,072.85 ha of the original 12,100.68 ha (25.39%) of this vegetation association is remaining. A total of 851.05 ha (27.69%) of the current extent is protected in International Union for Conservation of Nature (IUCN) Reserve Types 1-4, with an additional 2.32 ha in IUCN 5-6 reserves. IUCN areas are in the Department of Biodiversity, Conservation and Attractions' (DBCA) Conservation Estate and do not include Bush Forever, Regional Parks and other bushland reserves with purposes compatible with conservation. Definitions of IUCN reserves are included in Appendix 9.

Table 15: Vegetation association 3048 – 2016 Statewide vegetation statistics

Vegetation association 3048	
Pre- European extent	12,100.68 ha
Current extent	3,072.85 ha
% remaining	25.39%
IUCN 1-4 in Pre-European extent	927.68 ha
IUCN 1-4 in current extent	851.05 ha
% Pre-European extent in IUCN 1-4	7.67%
% Current extent in IUCN 1-4	27.70%
IUCN 5-6 in Pre-European extent	288.27 ha
IUCN 5-6 in current Extent	2.32 ha
Pre-European extent in all DBCA managed lands	1,26.30 ha
Current extent in all DBCA managed lands	863.52 ha
% Pre-European extent in all DBCA managed lands	10.13%
% Current extent in All DBCA managed lands	28.10%

Source: Government of Western Australia (2016). Note: IUCN Categories are described in Appendix 9. These areas do not include Bush Forever sites and other non-DBCA reserves which have a purpose compatible with conservation.

Vegetation on the subject land is representative of the Becher plain sub unit of the Quindalup Vegetation Complex based on broad geomorphological units and climate (Figure 8) as mapped by Heddle *et al.* (1980). More detailed vegetation mapping identified three vegetation types on 26 Office Road (Figure 9; Coffey Environments 2009a and b), including:

- **XpAf**: Xanthorrhoea preissii / Avena fatua Shrubland (9.1ha);
- **Mh**: Melaleuca huegelii Low Woodland (0.1ha); and
- **Ar**: Acacia rostellifera Tall Shrubland (0.8ha).

Vegetation types XpAf and Ar have affinities with Floristic Community Type (FCT) 29b (Gibson et al. 1994) which comprises *Acacia* shrublands on taller dunes and have also been recorded on sandy areas with low relief. The structure and dominant species of this FCT can be quite variable. Coffey Environments predicted that the *Xanthorrhoea preissii* Shrubland had an overstorey of *Melaleuca huegelii* prior to the site becoming relatively degraded (Coffey Environments 2009 a and b).

2.7.5.4 Vegetation condition

The condition of the vegetation on the site was assessed according to the condition rating scale of Bush Forever (Government of Western Australia, 2000). There is a high weed density in the vegetation on the subject land and the XpAf and Mh vegetation is 'Degraded' while the Ar vegetation is in 'Good to Degraded' Condition (Figure 9). Site conditions have not changed since the original assessment.

2.7.5.5 Conservation significant vegetation

The PER prepared for the original New Energy proposal at East Rockingham included database searches for potential presence of threatened ecological communities (TECs) and priority ecological communities (PECs) on the site and in the East Rockingham region.

Two TECs (at State and Commonwealth level) have been identified as potentially occurring in the vicinity of the subject land. One TEC is south of the subject land in an area that was subject to the RIZ SEA (Coffey Environments, 2009 a and b). The vegetation is classed as FCT19b and comprises Woodlands over Sedgelands in Holocene Dune Swales. A significant proportion of this vegetation (18.5 ha of 32 ha) has been protected in a conservation area within the RIZ (EPA, 2011). This vegetation type does not occur on the subject land. The second TEC is the Banksia Woodlands of the Swan Coastal Plain ecological community. This ecological community is not present on the subject land.

Vegetation on the subject land (types XpAf and Ar) has an affinity with Floristic Community Type 29b, which is listed as a PEC (DBCA, 2017). The PEC is categorised as Priority Three (i) which is defined as communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation'.

The subject land has not been identified in Bush Forever as containing vegetation that is regionally significant.

The following has been concluded about the vegetation on the subject land:

- The vegetation is in a relatively degraded condition;
- The Quindalup Vegetation Complex is currently well reserved in the Perth metropolitan region and locally in the RIZ (Table 16);
- FCT 19a is represented in the RIZ conservation area and Bush Forever sites within 10km of the subject land (Bush Forever Sites within 10km comprise No. 356, 377 and 355) and throughout the Perth metropolitan region (Table 17); and
- FCT 29b is not listed as a TEC.

Table 16: Representation of the Quindalup vegetation complex in nearby bush forever sites (within 10km)

Bush forever site	Reserve	Size (ha) & other vegetation complexes
341	Woodman Point	91.7 (Quindalup and Spearwood Dunes)
377	Port Kennedy	674.9 (Quindalup only)
355	Point Peron and Adjacent Bushland, Peron/Shoalwater Bay	107.1 (Quindalup only)
349	Leda and Adjacent Bushland, Leda	959.8 (also includes open water, some Serpentine river, Bassendean C &S, Karrakatta C & S, Cottesloe C & S)
356	Lake Cooloongup, Lake Walyungup and Adjacent Bushland Hillman to Port Kennedy	1617.5 (includes open water, Karrakatta C & S, Cottesloe C & S)
358	Lake Richmond, Rockingham	28.7 (also includes open water)

Table 17: Presence of floristic community Type 29b in RIZ conservation area and bush forever sites >10km away

Bush forever site / RIZ conservation area	Name
Rockingham RIZ	15ha in RIZ Conservation Area (of 114ha in the RIZ SEA area)
284	South West Link from Wilbinga to Yanchep National Park
312	Bold Park and Adjacent Bushland, City Beach
406	Wilbinga-Caraban Bushland
397	Coastal Strip from Wilbinga to Mindarie
322	Burns Beach Bushland
323	Links from Burns Beach Bushland to Neerabup National Park
325	Coastal Strip from Burns Beach to Hillarys
308	Trigg Bushland and Adjacent Coastal Reserve, Trigg/Scarborough
310	Floreat Beach Bushland, City Beach/Scarborough

2.7.5.6 Flora

A combined total of 166 plant species were recorded from the RIZ in the series of studies (Coffey Environments, 2009). A flora list for the RIZ is included in Appendix 10. Of the species recorded, 98 were native and 68 introduced. The high number of introduced species reflects the disturbed nature of the area. The surveys were undertaken in spring and summer so that perennial and ephemeral species were likely to be present. Coffey Environments (2009a and b) estimated that over 95% of the total flora were likely to have been recorded.

Families with the greatest representation of taxa are the Poaceae (Grass) family (20 taxa, including 15 introduced), the Asteraceae (Daisy) family (14 taxa, including 11 introduced), the Cyperaceae (Sedge) family (12 taxa) and the Papilionaceae family (10 taxa, including 5 introduced).

Three quadrats have been recorded close to the subject land (Figure 9, Appendix 11) and comprise:

Quadrat ER4:

Xanthorrhoea preissii/Acacia saligna Shrubland - 1-1.5m over *Avena barbata* Closed Grassland; Condition: Degraded; Soils: Brown sand;

Quadrat ER5:

Melaleuca huegelii Open Scrub 4-5m over *Bromus diandrus/Ehrharta longiflora* Closed Grassland to 1m. Condition: Degraded. Soils: Brown sand; and

Quadrat ER6:

Acacia rostellifera Open Shrubland 0.1m (1.5-2m pre-fire) over *Avena barbata/Euphorbia terracina* Grassland/Herbland 0.4-1m. Condition: Good – Degraded. Soils: Dark brown sand over limestone at about 0.5m depth.

Species found in these areas are summarised in Appendix 10 and the dominance of introduced species reflects the degraded condition of the vegetation.

2.7.5.7 Conservation Significant Flora

The PER prepared for the original New Energy proposal at East Rockingham included database searches for potential presence of conservation significant flora on the site and in the East Rockingham region. The species identified from the database search are provided in Appendix 12.

None of the significant species were identified in previous flora surveys conducted in the RIZ SEA area or on the subject land (Coffey Environments, 2009 a and b). Due to the absence of suitable habitat and the fact that the species have not been found during intensive surveys, it is therefore considered that conservation significant flora are unlikely to occur on the site.

A search of the Protected Matters database for 'Matters of National Environmental Significance' listed under the *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* indicates that *Centrolepis caespitosa* (Endangered) may occur in the area or the area may contain suitable habitat (Appendix 13).

Centrolepis caespitosa occurs in winter-wet clay pans dominated by low shrubs and sedges (Gilfillan and Barrett, 2004-2008). It is unlikely to occur on the subject land due to the absence of this habitat type.

2.7.6 Fauna

A vertebrate and invertebrate fauna survey of the RIZ, including the subject land was undertaken by ATA Environmental in 2005 and updated by Coffey Environments in 2008 (Coffey Environments, 2009 a and b). The surveys included desktop research, an eight-day vertebrate fauna survey, a survey for trees with hollows, an invertebrate trapping program over three months and a targeted survey for the Graceful Sun Moth (Coffey Environments, 2010).

2.7.6.1 Fauna habitat

The following fauna habitats were mapped on 26 Office Road (Coffey Environments 2009a and b):

- Xanthorrhoea preissii, Acacia rostellifera and A. saligna Shrubland (Highly Degraded)
- Acacia and Xanthorrhoea Shrubland (Disturbed)
- Melaleuca and Banksia Woodland (although no Banksia are present in this fauna habitat type on the subject land; Highly Degraded).

Fauna Habitat condition ratings vary across the subject land between 'Highly Degraded' and 'Disturbed' (as described by Coffey Environments 2009a and b) (Figure 10).

No trees with hollows were identified on the subject land.

2.7.6.2 Fauna species recorded

A complete list of vertebrate fauna recorded in the RIZ and similar habitats in the Perth metropolitan region is included in Appendix 14 with actual fauna recorded in the RIZ summarised in Table 18, including:

- 42 bird species
- 22 reptiles species
- One species of native mammal
- Introduced species such as rats, mice, cats, foxes and rabbits.

No bat activity was observed during night surveys.

Not all of these species are likely to be found on 26 Office Road due to the limited habitat types and the fact that the area is relatively degraded.

Amphibians

The hot dry conditions in December 2004 were not suitable for catching amphibians. Some of the frog species likely to be found in the area burrow underground and only emerge after heavy rain to forage and breed. Calls for *Heleioporus eyrei* were heard one evening during the night searches.

Reptiles

Reptile species caught in the RIZ during the December 2004 survey are listed in Table 18. Twenty-two species of reptiles were caught during the field survey. The most abundant reptiles were the skink, *Ctenotus fallens* and gecko, *Strophurus spinigerus*.

Mammals

Mammals caught and sighted are shown in Table 18. Three species of mammals were caught, only one of which was native (Southern Brown Bandicoot or Quenda). Numerous mice, rats, rabbits, a fox and a cat were either trapped or sighted in the survey.

Invertebrate Fauna

In addition to vertebrate fauna, an invertebrate fauna survey recorded:

- Five species of mygalomorph spiders, including *Missulena hoggi*, *Chenistonia tepperi*, *Teyl* 'waldockae', *Eucyrtops* sp. and *Kwonkan* sp.

- Two species of *Antichiropus* (millipedes)
- Four species of land snails, including *Helix aspersa*, *Theba pisana, Cochlicella acuta* and *Cochlicella Barbara*. Snails from the genera *Cernuella* and *Candidula* were also collected.

Mygalomorph spiders

Five species of mygalomorph spiders were collected during the 2005 survey. These were *Missulena hoggi*, *Chenistonia tepperi*, *Teyl* 'waldockae', *Eucyrtops* sp. and *Kwonkan* sp.

Missulena hoggi and *Chenistonia tepperi* occur widely in the metropolitan region and coastal plain environs and are not considered to be at risk. The *Eucyrtops* (juvenile specimen) is found in the PMR. The *Eucyrtops* sp. and *Kwonkan* sp. cannot unequivocally be attributed to a particular species as only juvenile specimens were recorded.

Teyl species 'waldockae' is not formally named. It has been collected by the Western Australia Museum from two urban coastal areas during surveys of urban bushland and is known also from Rottnest. The spiders are small, cryptozoic and vulnerable to soil disturbance and turnover of litter. Collection records of *Teyl 'waldockae'* suggest that elsewhere it is confined to the Quindalup Dune system of the Perth coastal plain and occurs in the interdune swales, i.e. in the low lying moisture holding areas. The two sites (Trigg Dunes and Woodman Point) surveyed by the Western Australia Museum in 1994 and 1995 both have some reserve status although the Trigg Dunes site has been burnt. However, it is not known where else in the Dune system the spider occurs, nor what its northern or southern geographic limits are. Habitats suitable for the species (Tuart woodland and *Melaleuca/Banksia littoralis* woodland) have been set aside in the RIZ conservation area and are found in nearby Bush Forever sites.

Millipedes

Two different species of *Antichiropus* were identified from the RIZ. The species *Antichiropus* 'GI' has been found in a variety of locations on the Swan Coastal Plain and adjacent regions. It is quite common in some woodland habitats on Rottnest Island and is also known from Garden Island, Cottesloe, Peppermint Grove, Bassendean, Darlington, Carabooda, and Nambung Nature Park. In the RIZ *Antichiropus* 'GI' was found at all four habitat types in the RIZ and is abundant within the region. The species *Antichiropus* 'UBS2' has been found across the Swan Coastal Plain from Hepburn Heights in the north, to East Rockingham and Parmelia in the south. It is also abundant in native vegetation habitats on the foothills of the Darling Scarp. In the RIZ *Antichiropus* 'UBS2' was found at all four habitat types and is abundant within the region.

Land snails

Four species of land snails were collected during the 2005 survey. They were *Helix aspersa*, *Theba pisana, Cochlicella acuta* and *Cochlicella barbara*. Snails from the genera *Cernuella* and *Candidula* were also collected. These species are not native and have been introduced from southern Europe, the Middle East and northern Africa.

Table 18: Vertebrate species recorded in the RIZ by habitat types^

Species	Habitat type			
	Acacia and xanthorrhoea shrublands (I)*	Tuart dominated woodlands (II)#	Melaleuca and Banksia Woodlands (III)*	Degraded shrublands (IV)*
Myobatrachidae (Ground frogs)				
Heleioporus eyrei	5	2	1	1
Agamidae (Dragons)				
Pogona minor	5	2	1	1
Rankinia adelaidensis chapmani	1	5		2
Elapidae (Elapid snakes)				
Demansia psammophis reticulate				
Pseudonaja affinis		1		
Gekkonidae (Geckoes)				
Gehyra variegata			1	
Strophurus spinigerus	15	3	8	6
Pygopodidae (Legless lizards)				
Aclys concinna				1
Delma grayii				1
Lialis burtonis			3	
Scincidae (Skinks)				
Acritoscincus trilineatum		1		1
Cryptoblepharus plagiocephalus	2	3	5	
Ctenotus australis	3	8	9	3
Ctenotus fallens	14	16	10	14
Egernia napoleonis			2	1
Hemiergis initialis initialis	2	8	9	3
Hemiergis quadrilineata		3		1
Menetia greyii		1	1	
Morethia obscura	2	13	3	6
Tiliqua rugosa		6	3	4
Typhlopidae (Blind snakes)				
Ramphotyphlops australis				1
Varanidae (Goannas)				
Varanus gouldii			1	
Varanus tristis		1		
Peramelidae (Bandicoots)				
Isoodon obesulus fusciventer (Southern Brown Bandicoot)	1	1		
Introduced Mammals				
Mus musculus (House Mouse)	69	52	35	88
Rattus rattus (Black Rat)	2			
Oryctolagus cuniculus (Rabbit)	Not specified	Not specified	Not specified	Not specified
Vulpes vulpes (Fox)	Not specified	Not specified	Not specified	Not specified
Felis catus (Cat)	Not specified	Not specified	Not specified	Not specified

Species	Habitat type			
	Acacia and xanthorrhoea shrublands (I)*	Tuart dominated woodlands (II)#	Melaleuca and Banksia Woodlands (III)*	Degraded shrublands (IV)*
Reptiles # of individuals	44	71	56	46
# of species	8	14	13	15
Mammals # of individuals	72	53	35	88
# of species	3	2	1	1

Note: ^ Reptiles and mammals only. For bird species see Appendix 14. * Vegetation type present on the subject land. # Vegetation type not present on the subject land.

2.7.6.3 Fauna of conservation significance

The PER prepared for the original New Energy proposal at East Rockingham included database searches for potential presence of conservation significant fauna that may be found on the site and in the East Rockingham region. The results of this search are included in Appendix 14.

Threatened and priority species that may potentially occur in the RIZ area are shown in Table 19 and include five Schedule 1 species, one Schedule 4 species, four Priority 3 species, four Priority 4 species and one Priority 5 species. The likelihood of the presence of listed species on the subject land is discussed below.

Table 19: Conservation significant fauna (within 5km of subject land)

Name	Common name	Conservation code	Class	Locality	Recorded in RIZ survey / likelihood of presence
Calyptorhynchus baudinii	Baudin's Cockatoo	Threatened Fauna (Schedule 1)	Bird	Rockingham	Not recorded in RIZ. This species utilises woodlands and areas further to the south in Western Australia. It is not likely to utilise the subject land.
Calyptorhynchus latirostris	Carnaby's Cockatoo	Threatened Fauna (Schedule 1)	Bird	East Rockingham, Medina	Not recorded in RIZ. There is limited suitable foraging habitat for this species on the subject land.
Diomedea chrysostoma	Grey-headed Albatross	Threatened Fauna (Schedule 1)	Bird	Kwinana Beach	Not recorded in RIZ. This species is unlikely to utilise the subject land due to its oceanic habitat requirements.
Macronectes giganteus	Southern Giant Petrel	Threatened Fauna (Schedule 1)	Bird	Kwinana Beach	Not recorded in RIZ. This species is unlikely to utilise the subject land due to its oceanic habitat requirements.
Tiliqua rugosa subsp. konowi		Threatened Fauna (Schedule 1)	Reptile	East Rockingham	Not recorded in RIZ. This species is confined to Rottnest Island.
Falco peregrinus	Peregrine Falcon	Other Specially Protected Fauna (Schedule 4)	Bird	East Rockingham	Not recorded in RIZ. This species is found across most of Australia, but only occurs in low densities and has a wide and patchy distribution. It favours hilly or mountainous country and open woodlands. This species may occasionally occur in the region and the subject land. However, the subject land does not represent crucial habitat.

Name	Common name	Conservation code	Class	Locality	Recorded in RIZ survey / likelihood of presence
Isoodon obesulus subsp. fusciventer	Southern Brown Bandicoot, Quenda	Priority Five-Conservation Dependent taxa	Mammal	East Rockingham, Cooloongup, Leda, Medina, Hope Valley, Kwinana Beach	This species has been recorded in the RIZ. Southern Brown Bandicoots prefer dense scrub (up to one metre high), often in or near swampy vegetation. They will often feed in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover. The vegetation on the subject land is not crucial habitat as it is too sparse and open to offer sufficient cover or foraging resources.
Charadrius rubricollis	Hooded Plover	Priority Four: Rare, Near Threatened and other taxa in need of monitoring	Bird	Cooloongup	Not recorded in RIZ. This species is unlikely to utilise the subject land due the absence of suitable habitat.
Hydromys chrysogaster	Water-rat	Priority Four: Rare, Near Threatened and other taxa in need of monitoring	Mammal	Medina	Not recorded in RIZ. The Water-rat generally occurs in association with permanent fresh or brackish water. This species is unlikely to utilise the subject land due to the lack of suitable habitat.
Macropus irma	Western Brush Wallaby	Priority Four: Rare, Near Threatened and other taxa in need of monitoring	Mammal	Wellard	Not recorded in RIZ. The optimum habitat for this species is open forest or woodland, particularly open, seasonally wet flats with low grasses and open scrubby thickets. It was not seen during any of the surveys/site visits. It was recorded in Leda Nature Reserve in 1989. This species is unlikely to occur in the RIZ or the subject land due to lack of suitable habitat.
Notoscincus butleri		Priority Four: Rare, Near Threatened and other taxa in need of monitoring	Reptile	East Rockingham	Not recorded in RIZ. Found near Dampier in the Pilbara Region, Western Australia. Habitat stony areas dominated by spinifex. This species is unlikely to occur in the RIZ or the subject land due to known distribution in Pilbara.
Lerista lineata		Priority Three: Poorly-known taxa	Reptile	Medina, Hope Valley, Kwinana Beach	Not recorded in RIZ. Found near Fremantle and adjacent Islands. Coastal heath and low shrublands. It is possible that this species may occur in the district, including the subject land. However, it was not detected in fauna surveys.
Neelaps calonotos	Black-striped Snake	Priority Three: Poorly-known taxa	Reptile	Cooloongup, Naval Base	Not recorded in RIZ. This species of snake favours sandy soils of coastal and near coastal dunes and sandplains supporting heath and banksia/eucalypt woodland. It is possible that this species may occur in the district, including the subject land. However, it was not detected in fauna surveys.

Name	Common name	Conservation code	Class	Locality	Recorded in RIZ survey / likelihood of presence
Pletholax gracilis subsp. edelensis		Priority Three: Poorly-known taxa	Reptile	East Rockingham	A burrowing species found in sandy coastal woodland but extending into a variety of other habitats in its range. Subspecies edelensis generally found in Shark Bay region. Sub species gracilis is generally found in lower west coast of Western Australia. It is possible that this species may occur in the district, including the subject land. However, it was not detected in fauna surveys.

A search has been undertaken of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Matters of National Environmental Significance database (Appendix 13) which indicates that species shown in Table 20 may occur in the area, or the area may contain suitable habitat. Of the species listed, one has been recorded in the RIZ (Rainbow Bee-eater) and one may traverse the subject land occasionally, although it does not represent critical habitat (Carnaby's Cockatoo).

Table 20: Matters of National Significance – FAUNA – EPBC Act (within 1km)

Name	Common name	Status	Comment
Birds			
Calidris canutus	Red Knot	Endangered, Migratory Wetlands Species, Listed Marine Species	Unlikely to be present as the species is found along coastal areas.
Calidris ferruginea	Curlew Sandpiper	Critically Endangered, Migratory Wetlands Species, Listed Marine Species	Unlikely to be present as the species mainly occurs on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewerage farms. These habitats are not found on the subject land.
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	Vulnerable	Not recorded in RIZ. Subject land does not contain breeding or significant foraging habitat.
Calyptorhynchus latirostris	Carnaby's Cockatoo	Endangered	Not recorded in RIZ. Subject land does not contain breeding or significant foraging habitat.
Leipoa ocellata	Malleefowl	Vulnerable, Migratory Terrestrial Species	This species is not likely to be found in the area due to urbanisation and lack of suitable habitat.
Limosa lapponica baueri	Bar-tailed Godwit	Vulnerable, Migratory Wetlands Species, Listed Marine Species	Unlikely to be present due to the absence of suitable habitat for this species. This wader forages in estuarine mudflats, beaches and mangroves.
Limosa lapponica menzbieri	Northern Siberian Bar-tailed Godwit	Critically Endangered	Unlikely to be present due to the absence of suitable habitat for this species. This wader forages in estuarine mudflats, beaches and mangroves.
Numenius madagascariensis	Eastern Curlew	Critically Endangered, Migratory Wetlands Species, Listed Marine Species	Unlikely to be present as the eastern curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. These habitats are not found on the subject land.

Name	Common name	Status	Comment
Pachyptila turtur subantarctica	Fairy Prion	Vulnerable, Listed Marine Species	Unlikely to be present as this species is a small seabird generally restricted to oceans and coastal areas. The species typically prefers small coastal islands.
Rostratula australis	Australian Painted Snipe	Vulnerable, Migratory Wetlands Species, Listed Marine Species	Not recorded in RIZ. This species is not likely to be found in the area due to urbanisation and lack of suitable habitat.
Mammals			
Dasyurus geoffroii	Chuditch, Western Quoll	Vulnerable	Not recorded in RIZ. This species is not likely to be found in the area due to urbanisation and lack of suitable habitat.
Pseudocheirus occidentalis	Western Ringtail Possum	Vulnerable	Not recorded in RIZ. This species is not likely to be found in the area due to urbanisation and lack of suitable habitat.
Migratory species, migratory terrestrial species, migratory wetland species & listed marine species			
Actitis hypoleucos	Common Sandpiper	Migratory Wetlands, Listed Marine Species	Unlikely as this species forages on the ground or in shallow water along coastlines and some inland wetlands. These habitat types are not found on the subject land.
Apus pacificus	Fork-tailed Swift	Migratory Marine Bird, Listed Marine Species	Not recorded in RIZ. This species is not likely to be found in the area due to urbanisation and lack of suitable habitat.
Ardea alba	Great Egret, White Egret	Migratory Marine Bird, Migratory Wetlands Species, Listed Marine Species	Not recorded in RIZ. This species is not likely to be found in the area due to urbanisation and lack of suitable habitat.
Ardea ibis	Cattle Egret	Migratory Marine Bird, Migratory Wetlands Species, Listed Marine Species	Not recorded in RIZ. This species is not likely to be found in the area due to urbanisation and lack of suitable habitat.
Calidris acuminata	Sharp-tailed Sandpiper	Migratory Wetlands, Listed Marine Species	This small wader is a summer migrant to Australia where it prefers the grassy edges of shallow inland freshwater wetlands. As this habitat type is not present on the subject land, it is unlikely that this species would be present.
Calidris melanotos	Pectoral Sandpiper	Migratory Wetlands Species, Listed Marine Species	Unlikely as this shorebird is most commonly found on mudflats with short grass or weedy vegetation. This habitat type is not found on the subject land.
Haliaeetus leucogaster	White-bellied Sea-Eagle	Listed Marine Species	Not recorded in RIZ. This species is not likely to be found in the area due to urbanisation and lack of suitable habitat.
Merops ornatus	Rainbow Bee-eater	Migratory Terrestrial Species, Listed Marine Species	Recorded in RIZ. Habitat not likely to be critical to ongoing viability of this species.
Motacilla cinerea	Grey Wagtail	Migratory Terrestrial Species, Listed Marine Species	Unlikely to be present. This species is always associated with running water when breeding, although they may use man-made structures near streams for the nest. Outside the breeding season, they may also be seen around lakes, coasts and other watery habitats. These habitats are not present on the subject land.

Name	Common name	Status	Comment
Pandion haliaetus	Osprey	Migratory Wetlands Species, Listed Marine Species	This species is unlikely to be found on the site. It may occasionally flyover the site. The osprey prefers to nest in any location near a body of water that has an adequate supply of fish.
Rostratula benghalensis (sensu lato)	Painted Snipe	Endangered, Listed Marine Species	Unlikely to be found on the subject land due to the absence of suitable habitat. The species is a shorebird that inhabits shallow, brackish or freshwater wetlands.
Sterna dougallii	Roseate Tern	Listed Marine Species	Unlikely to be present as this species is likely to be found associated with the ocean where it forages for fish.
Tringa nebularia	Greenshank	Migratory Wetlands Species, Listed Marine Species	The Greenshank is unlikely to be found on the site as there is no suitable habitat for the species. The Greenshank is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity.

2.7.6.4 Introduced fauna

Previous fauna surveys have recorded seven introduced fauna species (Coffey Environments 2009a and b):

- Spotted Turtle-dove (*Streptopelia chinensis*)
- Senegal Turtle-dove (*Streptopelia sengalensis*)
- Domestic House Mouse (*Mus musculus*)
- Black Rat (*Rattus rattus*)
- European Rabbit (*Oryctolagus cuniculus*)
- Fox (*Vulpes vulpes*)
- Feral Cat (*Felis catus*).

All of the introduced animals listed are 'Declared Animals' listed under the *Agricultural and Related Resources Protection Act 1976*. However, all except rabbits and foxes are 'Excluded from Declaration' (that is, declaration categories do not apply to these introduced animals). Rabbits and foxes are listed as needing to have numbers reduced and controlled.

2.7.7 Environmentally sensitive areas

Environmentally Sensitive Areas (ESA) are declared by the Minister for the Environment under Section 51B of the *Environmental Protection Act 1986* and includes:

- Declared World Heritage properties
- Areas included on the Register of the National Estate for its natural heritage values
- A defined wetland and the area within 50m of the wetland
- The area within 50m of rare flora
- The area covered by a TEC
- Bush Forever sites
- Areas covered by various Environmental Protection Policies.

An ESA is mapped over 26 Office Road and is associated with a TEC: Woodlands over Sedgelands in Holocene Dune Swales. The TEC does not occur on the site. A previous assessment by the EPA for the RIZ has resulted in portions of the TEC being protected in a conservation area. However, the entire area of TEC is not required to be retained and therefore the buffer area would not need to be protected.

2.7.8 Noise conditions

The industrial area surrounding the New Energy site has been planned to provide adequate buffers and zoning to reduce the risk of unacceptable impacts of noise on sensitive receptors such as residential areas. However, there has been concern in the community that cumulative noise from a number of industrial sources would have negative impacts on surrounding residential areas.

The Kwinana Industries Council (KIC) Noise Reference Group commissioned Herring Storer Acoustics to compare noise data from 2001 with information collected in 2005 to determine any changes in cumulative noise emission. The results of the 2005 update indicated that there had been a net reduction in noise emission levels to noise sensitive premises in the area (Herring Storer Acoustics, 2005). Noise reduction was a direct result of construction and noise reduction activities implemented during the previous four years. The reduction occurred despite the introduction of two new industry noise sources and increased plant and production levels.

The net positive changes in industrial noise emission levels have resulted in a reduction of the noise emission levels in regions surrounding the Kwinana Industrial Area (KIA) ranging from 0.3 dB(A) in Hope Valley to 2.5 dB(A) in Medina. Whilst an instantaneous change of 3 dB(A) is just perceptible by the human ear, it represents a 50% reduction in noise energy.

Amendments to the *Environmental Protection (Noise) Regulations 1997* gazetted on 5 December 2013 relaxed industry-to-industry noise levels in the KIA meaning that industrial receivers have higher assigned levels while maintaining protection for noise sensitive receivers such as residences.

An analysis of land uses surrounding the site has determined that the nearest residence is approximately 1km east of the site. Other residential areas include Medina and Leda (approximately 2.5km east of the site), East Rockingham (2.5km south-west) and Hillman (2.7km south) (Figure 1).

2.7.9 Air quality

The proximity of the KIA to residential areas has resulted in on-going concerns regarding air quality, particularly in the City of Kwinana. The major historical air quality issue in areas around the KIA has been sulfur dioxide (SO_2). When ambient SO_2 monitoring began in 1979, the 1 hour ambient concentrations occasionally exceeded 1,400 micrograms per cubic metre ($\mu g/m^3$) but more recently are generally less than 200 $\mu g/m^3$ (KIC, 2004).

A more detailed assessment of air quality is provided in Section 4.2 Appendix 7.

2.7.10 Light and visual landscape

The site occurs in a relatively flat coastal plain (approximately 5 mAHD) with residential areas 2.5 km to the west slightly elevated at approximately 17 mAHD. The visual landscape of the RIZ is characterised by existing commercial, industrial and road infrastructure with the balance comprising undeveloped land.

The nearest sensitive receptor is a single residence approximately 1km east of the site as well as the suburbs of Medina and Leda approximately 2.5km from the site. These areas are primarily influenced by existing street lighting to varying degrees. The site is located at a sufficient distance from these areas such that it is not likely to be intrusive for residents. Therefore, given the existing industrial activities and associated lighting, distance to sensitive receptors, the scale of the development (in terms of foot print and bulk) and New Energy's commitment to lighting that is designed and installed to comply with the *AS 4282-1997 - Control of the Obtrusive Effects of Outdoor Lighting,* it is considered unlikely that the light emanating from the site would be intrusive for adjacent residential areas.

2.7.11 Adjacent land uses

Heavy industry, light industry and commercial land uses predominate around the site, in line with the zoning of 'Industry'. Surrounding industries are shown in Figure 1 and include:

- Kwinana Port Bulk Jetty
- Coogee Chemicals
- Ausclad, Ravensdowne
- Kaefer Novacoat
- NHL Nickel

- CBH Grain Terminal
- Mintech Chemical Industries
- Doral Fused Materials
- A gypsum and lime quarry.

The East Rockingham waste water treatment plant has been constructed by the Water Corporation to the south of the site. The majority of the RIZ to the south is currently undeveloped (Figure 1).

2.8 Socio-economic context

2.8.1 Regional overview

Rockingham is a suburb and major commercial centre south-west of Perth city centre and south of Fremantle. It is located on the coast at the southern extremity of Cockburn Sound. The northern edge of Rockingham abuts the maritime and resource-industry installations of Kwinana and Henderson. The maritime and industrial activities have been strengthened by the dedication of areas to accommodate heavy industry, the presence of the Royal Australian Navy at Garden Island and major ship building and marine support services in the area.

The Rockingham local government area is moderately populated, with a total resident population of 125,114 people according to the 2016 census (ABS, 2017a). The population has increased significantly from 70,008 people living in the area in 2001 (ABS, 2017b). Increases in population are attributed to growing residential areas, increased employment due to industry and commercial expansion and the presence of the naval base.

The RIZ comprises 1,150 ha of land with appropriate buffers for industrial and a range of other uses, including warehousing, transport, logistics, medium to large fabricators and marine related industries. The RIZ is divided into seven precincts which are delineated for services/commercial, general industry, light industry, advanced materials, environmentally acceptable heavy industry and port related industry. The RIZ provides an important economic resource base to the region as it has access to the regional road transport network, and will assist in promoting economic growth along the south west trade and industry corridor.

2.8.2 Socio-economic profile

The Index of Relative Socio-Economic Disadvantage is derived from attributes such as low income, low educational attainment, high unemployment, jobs in relatively unskilled occupations and variables that reflect disadvantage rather than measure specific aspects of disadvantage (e.g. Indigenous and Separated/Divorced) (ABS, 2013).

High scores on the Index of Relative Socio-Economic Disadvantage occur when the area has few families of low income and few people with little training and in unskilled occupations. Low scores on the index occur when the area has many low income families and people with little training and in unskilled occupations. A high score reflects lack of disadvantage rather than high advantage.

Rockingham scores 1,012 on the Index of Disadvantage. This compares with Kwinana at 963, Fremantle at 1,024, Serpentine-Jarrahdale at 1,050, Cockburn at 1,043 and Peppermint Grove at 1,155 (highest Index score in Western Australia) for 2011 (ABS, 2013).

The construction value of the New Energy project is estimated to be $300 million, although no figures are currently available as to what proportion of this will be expended on local goods and services. It is anticipated that the project will generate 300 direct jobs through the construction phase and then on-going employment for at least 40 people during operation. Indirectly the project will create an estimated 750 additional jobs which will be supported in other industries outside of the Project.

2.8.3 Traffic and transport

The RIZ is well serviced in terms of road infrastructure and the main routes are highly utilised by heavy vehicles. The MRWA designated heavy vehicle routes in the vicinity of the RIZ include:

- Patterson Road
- Thomas Road
- Tonkin Highway

- Leach Highway.

With the increase in economic activity in the Rockingham and KIA, it is expected that use of road infrastructure will grow due to an increase in traffic volumes. Progressive upgrades to the heavy haulage routes have and will continue to alleviate some of these pressures.

2.8.4 Infrastructure

2.8.4.1 Water

The Water Corporation is responsible for the provision of potable water to users within the Perth metropolitan area. Water in the metropolitan area comes from three sources (Water Corporation, 2017):

- Surface water is obtained from dams (storage reservoirs). Surface water sources supply 7% of demand;
- Groundwater, supplying 46% of demand and is obtained from aquifers. Groundwater is treated at groundwater treatment plants prior to distribution; and
- Desalination, which supplies 47% of demand.

Total water use per day in Perth varies according to seasons, with higher use in summer and significantly less in winter (approximately 500 ML per day).

2.8.4.2 Wastewater

The Water Corporation's reticulated sewer infrastructure is not yet available at the site.

2.8.4.3 Power

The site is connected and serviced by the SWIS. An agreement will be negotiated with Western Power to connect to the grid. The power generated from the Plant will be available to any customer of the SWIS.

2.8.4.4 Gas

The RIZ is serviced for reticulated gas, which runs along Office Road.

2.8.4.5 Native title

LandCorp has provided New Energy verbal confirmation that Native Title has been extinguished over 26 Office Road, due to the fact that the site is freehold land.

2.8.4.6 Aboriginal heritage

A search of the Department of Planning, Lands and Heritage's (DPLH) Aboriginal Heritage Inquiry System did not identify any previously recorded archaeological or ethnographic sites as occurring within the New Energy site (Appendix 15).

New Energy is aware of its obligations under the *Aboriginal Heritage Act 1972* and will implement a heritage management protocol during site works. Should any additional heritage sites be identified during site works, New Energy will seek Section 18 clearance from the Minister for Indigenous Affairs.

2.8.4.7 European heritage

A search of the City of Rockingham (2012) Municipal Heritage Inventory confirmed that there are no reported heritage sites located within or adjacent to the New Energy site.

STAKEHOLDER ENGAGEMENT

03

3. Stakeholder engagement

3.1 Key Stakeholders

The key stakeholders identified for this project include the following:

- City of Rockingham
- Department of Water and Environmental Regulation
- Economic Regulation Authority
- General public

3.2 Stakeholder engagement process

New Energy remains committed to an open and transparent consultation process. The focus of the consultation process has been on engaging with stakeholders who are affected by, or are interested in the proposal. This has included the decision-making authorities, other relevant state (and Commonwealth) government agencies and local government authorities, the local community and environmental non-government organisations. Specific stakeholders consulted during the preparation of this ERD have included:

- City of Rockingham
- DWER
- Economic Regulation Authority
- General public.

Section 3.3 documents the consultation process, identifying the stakeholders consulted, the issues raised, any adjustments to the proposal and any future plans for additional consultation.

3.3 Stakeholder consultation

Table 21 summarises the stakeholder consultation completed to date for the project. Significant consultation has been undertaken since 2013. The stakeholders and community are entirely aware of this waste to energy project through previous Public Environmental Review processes and approvals and through Development approvals. The focus of this consultation is to update all stakeholders on the change of technology as described in Section 2.

Table 21: Stakeholder consultation

Stakeholder	Date	Issues / topics raised	Proponent response / outcome
Western Power	7/2/17	New Power Profile and grid connection	Plan agreed for update of Western Power connection.
City of Rockingham	10/2/17 22/2/17 17/8/17	Waste Supply Residue management Power	Very supportive as Project is located in the City of Rockingham.
City of Cockburn	10/2/17 21/2/17 16/6/17	Waste Supply HZI Site Tour	Very supportive. Council undertook tour of facility in UK.
South Metro Regional Council	22/2/17 26/7/17	Waste Supply	Supportive, alignment with waste strategy
Landcorp	2/3/17	Land use	Supportive
EPA Chairman	15/3/17	Update of technology	Noted the update on the proposal
Hon Roger Cook	12/4/17	Local member update	Interested and looking forward to more details
Premier Hon Mark McGowan	10/5/17	Local Member Update	Interested in local job and training creation

Stakeholder	Date	Issues / topics raised	Proponent response / outcome
Australian Renewable Energy Agency	26/6/17	Potential grant funding	Formal proposal to be lodged
East Metro and Mindarie Regional Councils	Various	Waste supply and power	Working towards tender award
WaterCorp	24/7/17	Disposal of biosolids and power	Participating in tender
Department of Jobs Tourism Science and Innovation (formerly DSD)	6/7/17	Consideration for Level 2 State Significance	Very supportive of the Project, awaiting information memorandum for project assessment
WA Treasury	17/8/17	Project introduction	Supportive of landfill diversion and commercial power purchase agreement with Synergy.

The community information and consultation strategy will be actioned during the public comment period of this ERD, comprising the following:

- Preparation of media releases and public notices
- Detailed information on the New Energy website
- Briefing of local newspapers
- Placement of public notices
- Holding public information sessions at the City of Rockingham as follows:
  - Three sessions: 09:30-11:30 hours; 13:30-15:30 hours; and 17:00-20:00 hours
  - One-on-one discussion format
  - Record names and contact details of attendees
  - Record comments, issues and concerns
  - Information handouts on the technology including reference plants, plant overview, 3D images of facility
- Following public information sessions, meet with key stakeholders, including local parliamentary representatives on outcomes of the community consultation and feedback to date
- Develop management response to comments, issues and concerns and respond to community and stakeholders as appropriate
- Document the outcomes of the community consultation program for submission to the EPA.

ENVIRONMENTAL PRINCIPLES AND FACTORS

04

4. Environmental principles and factors

4.1 Principles

Table 22 sets out how the principles of the *Environmental Protection Act 1986* have been considered in the design of the proposal.

Table 22: Environmental protection act principles

Principle	Consideration
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 — An assessment of the risk-weighted consequences of various options.	— The waste to energy facility has been subject to rigorous feasibility evaluation in terms of site selection and operational impacts. Based on knowledge of waste to energy technology, risk assessment has been undertaken for key and relevant environmental factors associated with the project. — A key aspect of the decision-making processes adopted during the development of the project was to identify a waste to energy technology with a proven track record of safely dealing with similar waste streams and similar scale of operation. This provides a high degree of confidence that the project can be implemented without adverse environmental impacts. — Specialist studies and site investigations have been sourced or conducted to inform the risk assessment process. — Modelling for noise, air emissions and greenhouse budgets have been undertaken to confirm that emissions comply with relevant environmental criteria and that the environment and community surrounding the proposed facility will be safeguarded.
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.	— New Energy recognises the importance of sustainable development and considers that this project will contribute positively to current and future waste management outcomes, with the added benefit of power generation and a net benefit in terms of greenhouse emissions. Implementation of this project will provide benefits for future generations and will not have a negative impact on health, diversity or productivity. — In terms of intergenerational equity, this project will divert 300,000 -330,000 tpa of solid waste that would otherwise have been directed to landfill where it would have been contained for decades while slowly degrading. It deals with the waste in a much shorter timeframe and in a safe manner. This means that the negative externalities of waste produced by this generation are dealt with as the waste is produced rather than being left to slowly decompose over time, sterilising land and leaving and ongoing environmental risk for future generations.

Principle	Consideration
3. 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 users 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 problems.	— New Energy recognises and accepts the costs of managing and monitoring the outcomes of the project, which have been factored into the feasibility of the facility. — In particular, this includes adopting an 'international best practice' in the design of the facility and its environmental controls. — When goods and services are procured during the construction and operational phases of the project, decisions will be made which incorporate valuation, pricing and incentive mechanisms. Decommissioning methodology will be determined using best practice methodology of the day and financial provisioning for decommissioning is built into the project's financial model.
4. The principle of the conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	— Site specific studies have been sourced or undertaken to determine the presence of Threatened and Priority flora, fauna and ecological communities. Long term planning for the site and a recent SEA indicates that the site is suitable for environmentally acceptable heavy industry.
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.	— Waste to energy technology is recognised by the EPA as a component of the waste hierarchy. The proposed Facility will take wastes that would otherwise be destined for disposal in landfill. Prior separation and recovery of recyclables will be managed via the current domestic two/three waste bin system in operation in Perth. The facility will also take residual waste from facilities that are processing MSW, C&I and C&D waste that would currently be directed to landfill, — Key wastes generated during the operation of the Facility are the bottom-ash residues remaining after combustion as well as the residues from the air pollution control system. Metals will be recovered from the bottom ash and recycled. HZI recycles the bottom ash generated from the combustion process for use as aggregate. This approach will be adopted at East Rockingham subject to the ash being suitable for the proposed use. Other remaining residues from the operation will be disposed to an appropriate landfill. — International experience demonstrates that countries that utilise waste to energy technology have greater rates of waste diversion from landfill.

4.2 Air quality

4.2.1 EPA objective

To maintain air quality and minimise emissions so that environmental values are protected.

4.2.2 Policy and Guidance

EPA Policy and guidance

- Statement of Environmental Principles, Factors and Objectives
- Factor Guideline – Air Quality
- Environmental and health performance of waste to energy technologies (EPA Report 1468) Section 16 Advice, April 2013
- Guidance Statement No. 3 Separation Distances between Industrial and Sensitive Land Uses

Other policies and guidance

- Air Quality Modelling Guidance Notes, Department of Environment March 2006

4.2.3 Receiving environment

The proximity of the Kwinana Industrial Area (KIA) to residential areas has resulted in on-going concerns regarding air quality, particularly in the City of Kwinana. The major historical air quality issue in areas around the KIA has been sulfur dioxide (SO_2). When ambient SO_2 monitoring began in 1979, the 1 hour ambient concentrations occasionally exceeded 1,400 micrograms per cubic metre (µg/m^3) but more recently are generally less than 200µg/m^3 (KIC, 2004).

The Kwinana Background Air Quality Study was initiated in 2004, by the then Department of Environment (DoE), to assess ambient concentrations of a class of pollutants known as 'air toxics' in the Perth metropolitan and selected regional areas (DEC, 2011). Phase 1 of the study ran from 2005 to 2006. Phases 2 and 3 of the study were conducted from 2007 to 2008 and 2009 to 2010, respectively, by the then Department of Environment and Conservation (DEC). The former Department of Environment Regulation (DER) conducted Phase 4 of the study from 2013 to 2014.

The parameters measured as part of the Study included VOCs, heavy metals, PAHs, carbonyl compounds, nitrogen dioxide (NO_2), ammonia (NH_3) and fine particles (particulate matter measuring 2.5 microns or less ($PM_{2.5}$)). The sampling was conducted over periods of 24 hours or longer using canisters and passive samplers (DER, 2015b). However, Phase 4 of the study utilised an Open-Path Fourier Transform Infrared (OP-FTIR) spectrometer due to its capability to provide short-term data and for a range of compounds simultaneously (DER, 2015b). The parameters monitored in Phase 4 of the study included NH_3 and targeted VOCs: acetaldehyde; acetone; benzene; carbon disulfide; ethylbenzene; formaldehyde; xylene; toluene; and a measure of the total VOCs (DER, 2015b).

The sampling sites were also selected in consultation with the community (DER, 2015). Ten sites were selected in the area surrounding the KIA, encompassing the Cities of Kwinana, Cockburn and Rockingham. Most sites were located within Area C (residential area) of the *Environmental Protection (Kwinana) (Atmospheric Wastes) Policy 1999* (Kwinana EPP). Some were located in Area B (buffer area) and one site within the industrial area (Area A).

It is difficult to compare the Phase 4 results with Phases 1 to 3 due to the different sampling methodology employed. Despite the difference in the sampling methods for the Phase 4 study, the DoH indicated that the measurements of the air toxics monitored in Phase 4 were well below the air quality criteria (DER, 2015b).

The levels of air toxics recorded during the three sets of studies (2005-06, 2007-08, 2009-10) were similar to ambient air quality levels found elsewhere in the Perth metropolitan area and were within health guidelines (except for acrolein, crotonaldehyde and methacrolein). The DoH advised that the levels of these materials were not sufficiently increased to cause a health concern for the majority of people. The DoH was unable to provide similar comments for Phase 4 as the levels measured were averaged over one-hour rather than 24 hours or annual averaging periods (DER, 2015b). For this reason, the sampling method employed in the Phase 4 study does not provide adequate data for direct comparison with air quality criteria (DER, 2015b), as

these are derived from point sampling aimed at evaluating short-term peaks which may be associated with complaints received.

In addition to the six-hour sampling sessions conducted, continuous monitoring for a one-month period was also conducted during Phase 4, to assess diurnal variations in air toxics. The continuous monitoring was conducted at a site within the industrial area as a suitable site within the residential area could not be located due to the inability to meet security concerns and OP-FTIR siting requirements.

Long term monitoring in the Kwinana air shed for $PM_{2.5}$ indicated that the highest 24-hour average concentration was 31.6 $\mu g/m^3$ on 18 July 2006 which was associated with bushfire and or fuel reduction burns to the south and/or east. The annual average for Kwinana and Rockingham was 7.5 $\mu g.m^3$ which is less than the National Environment Protection Measure (NEPM) advisory standard of 8 $\mu g/m^3$.

Results for 2005-06 NO_2 concentrations at Wattleup, Calista, Medina, North Rockingham, Duncraig and South Lake were less than 20% of the NEPM annual average of 30 parts per billion (ppb). During the 2009-10 study, the highest one-hour maximum NO_2 concentration recorded in the Kwinana study area was 49.2 ppb at Calista which was slightly higher than that reported at Hillman (43.1 ppb). These concentrations are less than 42% of the NEPM one-hour maximum of 120 ppb. There was little difference in the average concentrations across all five sites (13.2 to 19.7 ppb). In terms of the maximum value, no study site's maximum exceeded 41% of the NEPM annual standard of 30 ppb. Pollution roses compiled from the data do not indicate any particular direction that dominates as a source of NO_2. This is most likely due to the fact that the major contributor to NO_2 levels is motor vehicle exhaust fumes.

The annual average and maximum 24 hour averaged formaldehyde concentrations reported from the Hope Valley Site in the 2005-06 study were similar to Duncraig and less than those from Queens Building in the Perth central business district (CBD) over the same period. In the 2007-08 study, the annual average concentrations for acrolein, crotonaldehyde and methacrolein slightly exceeded the relevant guidelines. However, DoH advised that these data do no present sufficient evidence that public health was at risk and that future monitoring was recommended. The highest formaldehyde concentration (recorded from James Point and Thomas/Mason Road) was 15% of the NEPM guideline value of 10 $\mu g/m^3$. Slightly elevated levels of crotonaldehyde (4.7 and 5.6 $\mu g/m^3$) were recorded between 22 January 2008 and 29 January 2008. Elevated particle levels occurred throughout the Perth metropolitan region during this time, possibly due to bushfire smoke.

NH_3 levels during 2005-06 (Challenger site) were elevated on six occasions where the six day averaged NH_3 concentrations were greater than 40 $\mu g/m^3$. This occurred when the wind was coming from the east and/or south east. The annual average was 17 $\mu g/m^3$ or 10% of the United Kingdom Environmental Agency annual average guideline for ammonia. Results from 2007-08 showed that the highest seven-day averaged concentration recorded was 34 $\mu g/m^3$ at Orelia Oval. The source of the elevated ammonia is not known although winds were from the south west (KIA is to the west). All levels were well below the United Kingdom Environmental Agency annual average with the highest annual average NH_3 concentration of 14 $\mu g/m^3$ recorded at Kwinana Beach.

In the 2005-06 study, the highest maximum six-day concentration of all of the VOCs from the seven sites was reported for n-hexane and ethyl acetate, and the highest average six-day concentration was reported for toluene. The highest maximum and average six-day benzene, toluene, ethylbenzene and xylene (BTEX) concentrations were reported at the Kwinana Beach site. The average six-day concentrations of benzene, toluene and xylene were all well below the corresponding NEPM annual average monitoring investigation levels and the average six-day ethylbenzene concentrations were much lower than the World Health Organisation annual average guideline value. In the 2007-08 study, the highest maximum seven-day and average seven-day concentrations of all the VOCs from the fourteen sites was reported for pinene. In terms of BTEX, the highest maximum seven-day toluene and ethylbenzene concentrations were reported at James Point, and the highest maximum seven-day benzene and xylene concentrations were reported at the Kwinana Golf Course site. The highest average seven-day ethylbenzene and xylene concentrations were reported at the Kwinana Beach site, and the highest average seven-day benzene and toluene concentrations were reported at the James Point and Kwinana Container Terminal sites respectively. The average seven-day benzene, toluene and xylene concentrations from each of the 14 sites were well below the corresponding NEPM annual average monitoring investigation levels and the average ethylbenzene concentrations were much lower than the World Health Organisation annual average guideline value.

In the 2005-06 study, the highest concentration of metals for each site was sodium. This is not unusual given the close proximity of Perth to the Indian Ocean. The second highest was calcium at Hope Valley and Perth

and sulfur at Duncraig. In the 2009-10 study, the highest 24-hour concentrations across both Hillman and Calista were for sodium and calcium. As in the 2005-06 study, each element's maximum and average 24-hour concentration was less than the recommended guideline values.

The concentration of PAH's during the 2005-06 study was lower than all indicated guidelines. The sites with the highest annual concentration were Duncraig and Perth CBD most likely due to wood heater and motor vehicle influences respectively. Hope Valley recorded the lowest overall PAH concentration of the three sites. DOH advises that while the annual PAH levels remain below the air toxics guidelines health effects are very unlikely.

4.2.4 Potential sources of impact

The main emission points to the atmosphere will occur when the facility is operational and will be associated with the 60m main stack under normal operating conditions or emissions generated during commissioning, planned shutdown/maintenance or emergency shutdown (i.e. worst case conditions). In general, emissions of concern from waste to energy plants as reported in the literature are:

- Oxides of nitrogen (NO_X) consisting primarily of NO and to a lesser degree NO_2, NO_X is formed primarily from the oxidation of fuel bound nitrogen and nitrogen in the air;
- Low levels of particulates, metals and volatile and semi-volatile organics including trace levels of dioxins;
- Carbon Monoxide (CO) – formed from the incomplete combustion of the fuel;
- Carbon dioxide (CO_2);
- Formaldehyde and other hazardous air pollutants including dioxins and furans and other complex organic compounds (both halogenated and non-halogenated);
- Heavy metals;
- Water vapour;
- Trace levels of acid gases including HCl and SO_X; and
- Odour.

Additional sources of potential impacts to air quality include:

- Gaseous emissions emitted in the event of a fire in the waste bunker;
- Particulate (i.e. dust) emissions during construction works; and
- Greenhouse gas emissions associated with machinery/vehicles during construction, combustion of wastes to generate electricity during operation and transportation of wastes to and from the site.

Odour emissions from the plant are addressed in Section 4.3 of this report.

4.2.5 Assessment of impacts

An air modelling assessment has been conducted by Environmental Alliances Pty Ltd (ENVALL) (2017) (Appendix 7) for the impacts as a result of the operation of the waste to energy project. The objective of the air modelling was to ascertain ground level concentrations of air pollutants from the operation of the waste to energy facility. There is a number of air dispersion models used for regulatory assessments, with the choice of model dependent on the special dispersion issues that may be associated with a particular assessment. ENVALL (2017) considered that the special issues important in terms of model capability for the New Energy project were:

- Ability to incorporate the effect of building wakes on dispersion of elevated releases;
- The possible influence of the thermal internal boundary layer (TIBL) during onshore winds, on the dispersion of elevated releases; and
- Low level odour releases for which dispersion during low winds speeds is important.

Choice of Model

For the dispersion of elevated releases, the CSIRO's TAPM model was considered suitable as it has been specifically validated for the dispersion of elevated releases in the KIA (ENVALL, 2017). However, for low level releases, TAPM tends to over-predict low wind speeds and hence may under-predict dispersion from low level releases (ENVALL, 2017). Another dispersion model which has the capacity to handle the above considerations is the US EPA's CALPUFF model. CALPUFF (the Californian Puff model) is the US regulatory

model for "assessing long range transport of pollutants and their impacts and on a case-by-case basis for certain near-field applications involving complex meteorological conditions". Therefore, for this study ENVALL (2017) used:

- TAPM for elevated releases; and
- CALPUFF used for the odour assessment (elevated and low-level releases) – See Section 4.3.

Treatment of oxides of nitrogen concentrations

At release from combustion sources, NO_X is predominantly in the form of NO. In general, depending on the characteristics of the source (such as the fuel and combustion technology), approximately 5 to 30% of the NO_X is NO_2. After release, the NO is converted to NO_2 by chemical reactions, primarily involving ozone in the presence of sunlight and to a lesser extent, due to other reactive gases.

For the assessment, ENVALL (2017) ambient NO_2 concentrations were estimated using the Ozone Limiting Method as described in Appendix 3 of ENVALL (2017). This method assumes that 10% of the NO_X is emitted as NO_2. CEMS data from an operating plant using similar grate combustion technology and air pollution control in the United Kingdom (Appendix 17) show that for normal operations the average daily NO_2:NO_X from two lines has been 0.75% with 97.5% percentile NO_2:NO_X being 2.35%. Therefore the assumption that 10% of the emitted NO_X is NO_2used for modelling should be conservative.

Particulates

The size of particulates emitted from the main stack after treatment through the baghouse filter is expected to be small enough not to be significantly affected by gravitational settling, and hence were assumed to disperse passively.

Ambient air quality criteria

The considerations for environmental impact assessment of air quality are contained in the *Environmental Factor Guideline – Air Quality* (EPA, 2016a). The Guideline does not refer to specific air quality criteria, therefore the applicable criteria for substances assessed were selected on a hierarchical basic of criteria available from:

- The standards specified in the National Environment Protection Measure for Ambient Air Quality (NEPC 2016); and
- For others, those recommendations considered to be most applicable to the Western Australia, as follows:
- Recommendations in "Air Guideline Values for Selected Substances" (Prepared for WA Department of Environment and Conservation) (Toxikos, 2010);
- For HCl and HF only, "Acid Gases – Internal document" (WA DoH, 2007);
- "Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales" DEC NSW (2005) since these are referred to in as "Specific Consequence Criteria" in "Risk Assessments - Division 3, Part V, *Environmental Protection Act 1986*" (DER, 2017); and
- For Cobalt only, as no criteria in any of the above, recommendations in Toxikos (2009).

These are summarised in Table 23.

Table 23: Assessment criteria

Substance	Averaging time	Concentration (µg/m³)[a]	Reference
CO	8-hour	10,000	NEPC (2016)
NO_2	1-hour	246	NEPC (2016)
NO_2	1-year	62	NEPC (2016)
PM10	24-hour	50	NEPC (2016)
PM2.5	24-hour	25	NEPC (2016)
PM2.5	1-year	8	NEPC (2016)
SO_2	1-hour	570	NEPC (2016)
SO_2	24-hour	228	NEPC (2016)

Substance	Averaging time	Concentration (µg/m³)[a]	Reference
SO_2	1-year	60	NEPC (2016)
HCl	1-hour	100	WA DoH (2007)
HF	1-hour	100	WA DoH (2007)
TOC (as Benzene)	1-hour	29	DEC NSW (2005)
Dioxins and Furans	1-hour	0.000001	Toxikos (2010)
As	1-hour	0.09	DEC NSW (2005)
As	1-year	0.003	Toxikos (2010)
Cd	1-hour	0.018[(b)]	DEC NSW (2005)
Cd	24-hour	0.016[(b)]	Toxikos (2010)
Co	1-year	0.1	Toxikos (2009)
Cr(VI)	1-year	0.0002	Toxikos (2010)
Cr(III)	1-hour	10	Toxikos (2010)
Cu	1-hour	1	Toxikos (2010)
Hg	1-hour	1.8	DEC NSW (2005)
Hg	1-year	1	Toxikos (2010)
Mn	1-hour	18	DEC NSW (2005)
Mn	1-year	0.15	Toxikos (2010)
Ni	1-hour	0.18	DEC NSW (2005)
Ni	1-year	0.003	Toxikos (2010)
Pb	1-year	0.5	NEPC (2016)
Sb	1-hour	9	DEC NSW (2005)
Tl	1-hour	1	Toxikos (2010)
Tl	1-year	0.1	Toxikos (2009)
V	24-hour	1	Toxikos (2010)

a) For criteria originally specified on a volumetric basis, conversions to µg/m³ are at 0 atm, 25C.

b) With respect to the 1-hour criterion for Cd, Toxikos (2010) did not have a recommended 1-hour criterion but instead recommended a 24-hour average criterion of 0.02 µg/m³ with a footnote that this was a rounded up recommendation from 0.016 µg/m³. Assuming that 0.016 µg/m³ was the more precise recommendation, this would be approximately equivalent to a 1-hour average of 0.030 µg/m³, which is 67% higher than the final DoH 1-hour criterion of 0.018 µg/m³ used in this assessment.

c) DEC NSW criteria apply to 99.9 percentile of predicted concentration if using local meteorological data for modelling, however, for conservatism, this reports uses the maximum (100 percentile) predictions.

Background concentrations

Background concentrations for criteria pollutants were obtained from the DWER ambient monitoring report for 2016 (DWER, 2017). The nearest monitoring station measuring NO_2 and SO_2 were from measurements at the Rockingham air quality monitoring station (AQMS), approximately 3 km south-west of the site. The nearest monitoring station for CO, PM_{10} and $PM_{2.5}$ was South Lakes AQMS, approximately 16 km north-north-east of the site.

For 1-hour and 8-hour criteria, the 90th percentile of the daily peak concentrations over 2016 was used. For 24-hour criteria, the 90th percentile of the 24-hour average concentrations was used.

Table 24: Predicted Maximum Ground Level Concentrations

Substance	Averaging Time	Criteria Conc. (µg/m³) (a)	Assumed Background		Predicted maximum ground level conc. anywhere on Modelling Grid			
					From Proposal Only		From Proposal Including Background	
			Conc. (µg/m³) (b))	% of Criteria	From proposal (µg/m³)	% of Criteria	Inc. bgnd (µg/m³)	% of criteria
CO	8-hour	10,000	815	8.1	2.19E+01	0.2	8.37E+02	8.4
NO_2	1-hour	246	84	34.2	5.38E+01	21.9	1.38E+02	56.1
NO_2	1-year	62	10	15.4	1.00E+00	1.6	1.06E+01	17.0
PM_{10}	24-hour	50	24	48.6	2.17E+00	4.3	2.65E+01	52.9
PM_{10}	1-hour	25	15	58.4	7.02E-02	0.3	1.47E+01	58.7
$PM_{2.5}$	24-hour	25	12	46.4	9.78E-01	3.9	1.26E+01	50.3
$PM_{2.5}$	1-year	8	7.4	92.5	3.16E-02	0.4	7.43E+00	92.9
SO_2	1-hour	570	35	6.1	3.38E+01	5.9	6.84E+01	12.0
SO_2	24-hour	228	5.3	2.3	1.09E+01	4.8	1.62E+01	7.1
SO_2	1-year	60	2.7	4.4	3.51E-01	0.6	3.01E+00	5.0
HCl	1-hour	100	-	-	6.76E+00	6.8		-
HF	1-hour	100	-	-	6.76E-01	0.7	-	-
TOC (as Benzene)	1-hour	29	-	-	8.11E-01	2.8	-	-
Dioxins and Furans	1-hour	0.000001	-	-	6.76E-08	6.8	-	-
As	1-hour	0.09	-	-	3.38E-03	3.8	-	-
As	1-year	0.003	-	-	3.51E-05	1.2	-	-
Cd	1-hour	0.018	-	-	5.91E-03	32.9	-	-
Cd	24-hour	0.016	-	-	1.90E-03	11.9	-	-
Co	1-year	0.1	-	-	3.51E-05	0.0	-	-
Cr(VI)	1-year	0.0002	-	-	7.02E-06	3.5	-	-
Cr(III)	1-hour	10	-	-	6.08E-03	0.1	-	-
Cu	1-hour	1	-	-	4.39E-02	4.4	-	-
Hg	1-hour	1.8	-	-	3.38E-02	1.9	-	-
Hg	1-year	1	-	-	3.51E-04	0.0	-	-
Mn	1-hour	18	-	-	3.72E-02	0.2	-	-
Mn	1-year	0.15	-	-	3.86E-04	0.3	-	-
Ni	1-hour	0.18	-	-	3.38E-03	1.9	-	-
Ni	1-year	0.003	-	-	3.51E-05	1.2	-	-
Pb	1-year	0.5	-	-	2.07E-03	0.4	-	-
Sb	1-hour	9	-	-	3.72E-02	0.4	-	-
Tl	1-hour	1	-	-	8.45E-04	0.1	-	-
Tl	1-year	0.1	-	-	8.77E-06	0.0	-	-
V	24-hour	1	-	-	1.09E-03	0.1	-	-

a) For criteria originally specified on a volumetric basis, conversions to µg/m3 are at 0 atm, 20C.

b) Background concentrations from nearest available DWER air quality monitoring station (Rockingham).

For annual average criteria, the 50th percentile of the 24-hour average concentrations was used. Background concentrations are shown in (Table 24).

4.2.5.1 Assessment of Emissions from the Combustion System

The predicted maximum ground level concentrations anywhere from the proposal's air emissions are shown in Table 24.The maximum predicted concentration anywhere including background relative to its criterion is annual average $PM_{2.5}$ at 92.9%. However, the incremental contribution from the proposal is 0.4% with 92.5% of the criterion being from background. The relatively high annual average $PM_{2.5}$ background concentration is partly due to the method by which DWER measure $PM_{2.5}$ (ENVALL, 2017).

The second highest maximum predicted concentration anywhere including background relative to its criterion is annual average PM_{10} at 58.7%. The incremental contribution from the proposal is 0.3%, with 58.4% of the criterion being from background.

A similar outcome is for 24-hour PM_{10}. The maximum predicted concentration anywhere including background is 52.9% of the criterion, with the incremental contribution from the proposal being 4.3%, with 48.6% of the criterion being from background.

For 1-hour NO_2, the maximum predicted concentration anywhere including background is 56.1% of the criterion, with background already comprising 36.7% of the criterion.

For 1-hour Cd the maximum predicted incremental concentration anywhere from the proposal is 32.9% of the criterion. As noted in Table 24 the criterion adopted here is more stringent than proposed in Toxikos (2010).

The incremental predicted ground level concentrations of all other substances emitted from the main stack is less than 10% of their criterion.

Whilst SO_2 has traditionally been regarded as a pollutant of concern in the Kwinana airshed, the modelling results show that the contribution of the NEC facility is negligible in comparison to background levels and assessment criteria specified in the Kwinana Air Quality EPP and adopted for this assessment.

Nitrogen Dioxide

The predicted maximum 1-hour average NO_2 concentrations from the proposal only and from the proposal including background concentrations are shown in Figure 11. The highest concentrations tend to be towards the south-west of the facility. These impacts are determined by the stack location relative to the buildings/structures on site and consequent plume downwash under certain meteorological conditions.

Cadmium

The predicted maximum 1-hour average Cd concentrations from the proposal only are shown in Figure 11. The highest concentrations mainly occur approximately 1 km south-west of the facility. These impacts are determined by the stack location relative to the buildings/structures on site and consequent plume downwash under certain meteorological conditions.

Nanoparticles

The EPA Scoping Instructions required that New Energy address the issue of nanoparticles emissions from the facility and the potential for adverse impacts. Interest in nanoparticles has been sparked due to concerns being raised about potential health effects from nanoparticles used in a range of new products and technologies. These concerns arise primarily because of the fact that nanoparticles are small enough in size to interact with human and natural biological systems at a cellular scale.

DoH toxicologists have advised that there are no local regulatory requirements for assessment of nanoparticles from industrial facilities, including power generation and waste gasification technologies. That advice concluded that the immature status of health impact knowledge and absence of regulatory requirements precludes an assessment. Procedures and benchmarks for measurement in stack emissions and environmental and human health risk assessment have not been established.

At this stage there is little published data and no accepted assessment criteria relating to airborne emissions of nanoparticles from thermal processes such as combustion. In addition, New Energy and HZI have no basis on which to predict the rate of emission of nanoparticles from the East Rockingham facility. The previous PER for the East Rockingham project contained an overview of the current state of knowledge based on a

review of the relevant published literature. This approached was agreed with the DoH in a meeting with New Energy.

An extensively cited review of the literature in relation to health impacts associated with nanoparticles (both in terms of particles sourced from combustion and also in manufactured products) is presented in Oberdörster *et. al.* (2005). This review suggests that there is still significant debate about the factors that influence the level of health impact. There is agreement in the literature that as particles get smaller in size (towards the nano scale) their toxicity can increase. However, for particles with heterogeneous particle sizes and chemical compositions typical of particles derived from combustion sources there is still much uncertainty as to dose-response relationships. As a result, it is too early to establish regulatory criteria. In relation to manufactured materials, where there is uniformity of chemical composition and particle size, there is a clearer relationship and it appears that even for chemically inert materials such as gold there is significantly greater toxicity when dealing with nanoparticles.

A review of the relevant literature pertaining to nanoparticles and waste to energy was conducted by Synergetics (2012b). A brief summary the literature review findings are presented below.

There is no single definition of what constitutes a nanoparticle but the following definitions are presented for information:

> **'nanoparticle,** n—in nanotechnology, a sub-classification of ultrafine particle with lengths in two or three dimensions greater than 0.001 micrometre (1 nanometre) and smaller than about 0.1 micrometre (100 nanometres) and which may or may not exhibit a size-related intensive property.'

Nanoparticles also fall within the definition of an ultrafine particle:

> **ultrafine particle,** n—in nanotechnology, a particle ranging in size from approximately 0.1 micrometre (100 nanometres) to 0.001 micrometres (1 nanometre).

ISO also has a technical specification for the terminology associated with nanotechnologies (ISO, 2008). Nanoparticle is specified as a nano-object with 3 dimensions in the nano-scale where the nanoscale is defined as the size range from approximately 1 nm to 100 nm. Ultrafines are defined by ISO as particles with an equivalent diameter less than 100 nm and it is noted that most nanoparticles are also ultrafines as defined by their geometrical dimensions.

Some authors have a different definition of nanoparticles and ultrafines. However, these are not explicitly stated in all publications. Therefore, where the terms nanoparticle or ultrafine are used in the literature but not otherwise defined, it is assumed that the international definitions have been adopted and particles in the 100 nm range are being described.

While conducting the literature review, Synergetics (2012b) examined all identified studies concerning particles in the 100 nm i.e. ultra-fines as well as nanoparticles, since the health effects of these two categories of particles are likely to be similar. Hence the terms nanoparticles and ultrafine particles have been used interchangeably in this review, rather than adhering to the strict definition of a nanoparticle requiring at least 2 dimensions to be below 100 nm.

The published literature on the emission of nanoparticles is limited as the matter is still the subject of significant research. It is clear that all thermal combustion processes have the potential to emit nanoparticles and that the nature, quantity and chemical characteristics of these particles will vary greatly on depending on the nature of the thermal process and the fuels being used.

Accordingly, and in view of the concerns raised in the literature regarding the potential for as yet unquantified health and environmental impacts associated with the emission of nanoparticles, New Energy will:

- Incorporate a nanoparticle emissions monitoring program in the site monitoring program, with the details of the program to be developed in consultation with DWER through the Part V licensing process; and
- Assess developments in control techniques for nanoparticles emissions from fuel burning equipment on an on-going basis to determine whether modifications to the plant can be made to improve the capture efficiency of nano and ultrafine particles.

Summary

The most significant pollutants under normal operating conditions were NO_2, PM_{10} and $PM_{2.5}$ and are largely related to the high background concentrations. The modelling demonstrates that under normal operation the proposed waste to energy project at East Rockingham will not significantly increase the concentrations of relevant air toxic parameters above the existing background levels. As a result, the criteria concentrations will not be exceeded if proposal is implemented.

HZI's operational experience at its reference plants around the world demonstrates that the combustion system achieves high destruction efficiencies under wide range of operating conditions with minimal emission for toxic particulate matter or gaseous organic compounds. Appendix 18 provides an example of air quality monitoring data collected for the Greatmoor Waste to Energy Plant in the United Kingdom. The data from this facility is updated on the plant's website - http://www.greatmoor.co.uk/emissions-reports/.

4.2.5.2 Commissioning Scenario

Emissions during the commissioning phase will be lower than those predicted for normal operation. This is due to the implementation of a staged process for commissioning the plant whereby the plant is progressively ramped up to full scale operation. The staged process allows for rigorous testing and checks to ensure compliance with design specifications and to demonstrate reliability.

4.2.5.3 Emergency Scenario

The extensive operating experience with the HZI grate combustion system has allowed the refinement of the engineering design and control systems to ensure that even in emergency scenarios, emissions remain with environmental acceptable limits. In addition, the extensive operating experience with the equipment means that uncontrolled or unplanned shutdown is extremely rare. Operating experience with other similar plants shows that less than five unplanned shutdown events will occur each year.

The key aspects of the design which prevent excessive emissions during unplanned shutdowns are:

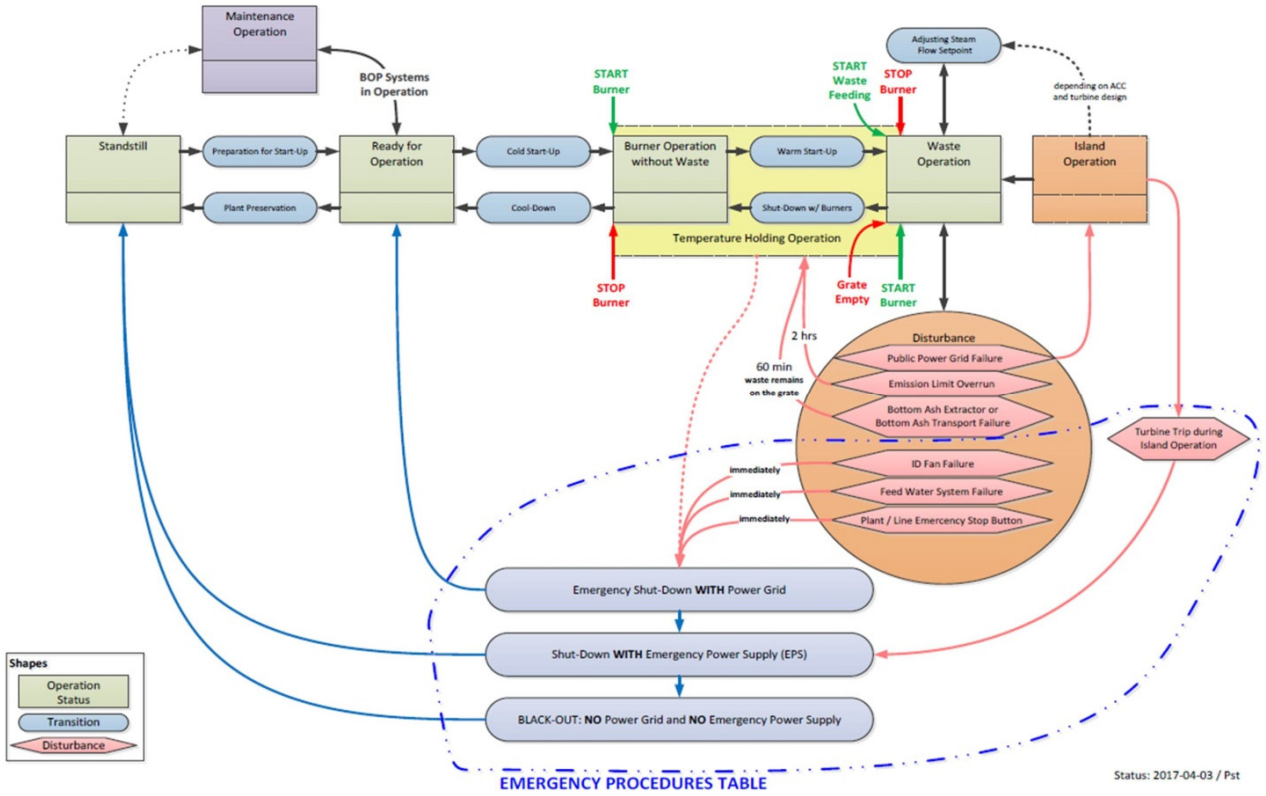
- The presence of multiple redundant power systems which eliminates the risk of an abrupt power failure. Three sources of power are available in the site:
  - On-site generation by the combustion system and associated power generation equipment;
  - External power from the SWIS; and
  - Back-up power from a standby diesel generator with sufficient power to maintain control of the primary combustion and control systems as well as the air pollution control system during emergency shut down.
- The air pollution control system incorporates backups for key systems to ensure there is no interruption to reagent feeds. Systems such as the baghouse are designed with spare capacity such that if an excessive emission is detected by the CEMS due to a failure of a bag, this bag can be isolated while maintaining performance for up to 24 hours with the bag being replaced while the baghouse continues to operate nominally.
- In the event of a disturbance to conditions in the grate combustor (e.g. gas bottle explosion), the system incorporates air control flaps that allow airflow to be restricted, instantaneously shutting down combustion. In such circumstances the burners are shut off and the induced draught fan either shut down or turned down to low flow. This means that the bed is damped down and produces minimal emissions and any emissions continue to be treated effectively in the air pollution control system. (Note: the combustion chamber is able to tolerate events such as a gas bottle explosion without causing damage).
- In the event of a total power failure of the internal power system and the SWIS (e.g. by lightning strike), the back-up power system comes on line and allows a controlled shutdown which involves the following steps:
  - Waste feed ceases;
  - The burners are shutdown;
  - The air flaps close restricting air flow through the combustion to reduce gas volumes and emissions; and

— The main induced draught fan is shut down and the standby system powers a low power auxiliary fan that directs minor volumes of exhaust gases though the air pollution control system which can also be powered by the standby power system.

- The CEMS system which monitors emissions performance is fully certified and incorporates a hot back up which ensure 100 % availability of the emissions monitoring system.

The effect of these design and management systems is that emissions during emergency shutdowns will not deviate from normal operations. Plate 14 is a flowchart of System Failure Operations. Additional information in relation to shut down responses in provided in Appendix 19.

Plate14 – Flowchart of System Failure Operations



4.2.5.4 Assessment of Emissions during Fire

While the threat of a significant fire on the New Energy facility is real, the risk and frequency of such an event at similar facilities is very low as demonstrated at other HZI reference facilities.

The uncontrolled combustion of stored waste in such a fire has the potential to produce a wide range of potentially toxic combustion products including dark and acrid smoke and soot, acid gases, heavy metals and various potentially hazardous organic compounds.

It is not possible to assess the impact of these emissions given the uncontrolled nature of the event and the number of variables that would influence the nature and intensity of a fire. Monitoring data collected by the former Department of Environment and Conservation from three similar fires in Perth (Bayswater, Canning Vale and Coogee) as reported in the media did not indicate that a serious threat was caused for the general public from such fires.

4.2.5.5 Particulates/Dust Emissions Generated During Construction

Given the small area of the site and the temporary nature of the construction phase, it is anticipated that there will not be any significant dust emissions generated during construction. Off-site impacts arising from dust emissions during construction will be temporary, localized and have a low impact on local amenity. Dust emissions can be managed via the implementation of conventional site management practices during construction as outlined in Section 4.2.6.

4.2.5.6 Greenhouse Gas Emissions

The major activities related to the project that will produce greenhouse gas emissions are:

- Greenhouse (i.e. CO_2 and N_2O) emissions from earthwork machinery and vehicle movements in the vicinity of the site during development and construction phase;
- Combustion of waste to generate electricity during the operational phase; and
- Transportation and distribution of fuel during the operational phase.

During the construction stage of the facility, greenhouse gas emissions will be equivalent to approximately 1,500 tonnes of CO_2-e/annum, based on diesel consumption of construction machinery.

However, these emissions will only occur for a relatively short period of time and are not considered to be significant in view of the expected life time of the facility.

Greenhouse gases relating to transport of waste has not been calculated in this case as it is considered that the establishment of the New Energy facility will not materially change the transport regime for waste in the region as the majority of wastes would have been transported to landfill facilities for disposal.

A University of Toronto study (Assamoi and Lawryshyn, 2011) compared the disposal of waste to landfill vs. combustion of MSW on the basis of the estimated environmental footprint of each option. The study concluded that waste to energy (via combustion) performed better environmentally and contributed to overall to a significant reduction in greenhouse gas emissions because of the displacement of power plant emissions (Assamoi and Lawryshyn, 2011). The study methodology was based on economic input/output, life-cycle analysis, greenhouse gas emissions, and air pollutant emissions.

Greenhouse gas emissions calculations for New Energy's East Rockingham project are presented in Table 25: Net Greenhouse gas emissions of the facility (operating at capacity) calculated as a kg of CO_2 over a 30 year period.

Table 25: Net Greenhouse gas emissions of the facility (operating at capacity) calculated as a kg of CO_2 over a 30 year period

Thermal power	101.78 MW
Flue gas flow	202,873 kg/hr
CO_2 content	11.2 vol-%
CO_2 flow	23,885 kg/hr
Annual operation	8,000 hrs/a
Annual CO_2 flow	191,108 tpa
Term	30 years
CO_2 During Term	5,733,240 t
Biogenic part (assumed)	50%
Non-biogenic part (assumed)	50%
Biogenic CO_2 during term	2,866,620 t
Non-biogenic CO_2 during term	2,866,620 t

Further assumptions:

- Waste delivery averaging 300,000 tpy over 30 years;
- Avoided CO_2 from landfill: 1.2 tonnes of CO_2-e per tonne of MSW[1];
- 28.2 MW electricity to grid x 8,000 h/y = 225,600 MWh/year or 812,160 GJ/year (multiply with 3.6 GJ/y / MWh/y;
- Avoided CO_2 from power generation (natural gas): 0.05133 t CO_2-e/GJ electricity[2].

Net Greenhouse Gas Emissions can then be calculated as:

[1] Factor for Avoided CO_2 from landfill has been taken from the National Greenhouse Accounts Factors Table 44 (MSW)- Australian National Greenhouse Accounts July 2014.

[2] Factor for Avoided CO_2 from Power Production (Natural Gas) has been taken from the National Greenhouse Accounts Factors Table 2 - Australian National Greenhouse Accounts July 2014.

- Non-biogenic CO_2 from the facility: 2,866,620 t CO_2-e;
- Avoided CO_2 from landfill: 1.2 x 9,000,000 = 10,800,000 t CO_2-e;
- Avoided $CO_2$from power production: 0.05133 x 812,160 = 1,247,478 t CO_2-e; and
- Net abatement of 9,180,858 t CO_2-e.

This means that replacing landfilling with a waste to energy solution will create a net abatement of 9,180,858 tons CO_2-e over a 30 year life for the facility assuming an average 300,000 tpa of waste to the facility.

4.2.6 Mitigation

4.2.6.1 Selecting Best Available Technology

Traditionally, waste to energy facilities have been regarded as presenting a significant risk for emitting air toxics in gaseous emissions discharged to atmosphere. These concerns primarily originated with plants used in Europe and Asia between 1960-1980 which have generally used 'dirty' technology. In the three decades since, there have been significant advances in:

- The monitoring of emissions;
- The understanding of health and environmental impacts associated with the emission of gaseous pollutants;
- The gas cleaning systems used to reduce emissions to acceptable level on a reliable basis; and
- The regulatory framework used to ensure facilities operate in accordance with Best Practice Standards.

New Energy has selected the HZI grate combustion system as the preferred technology for the following reasons:

- The technology is proven, is used in commercial operation around the world and is the most dominant waste to energy approach adopted on a global scale (more than 500 reference plants in operation using the HZI combustion technology);
- All of the components of the plant are proven and have demonstrated reliability;
- The technology has been successfully operated using similar waste streams to what will be used at East Rockingham;
- The technology has been proven to comply with the European Union's IED standards for emissions;
- It is reliable, stable and combustion can be controlled despite changes in fuel composition; and
- The HZI grate combustion system is recognised by the EPA in its Section 16 advice as leading combustion technology.

4.2.6.2 Construction Phase Impacts

Dust emitted during construction will be localised and temporary. The regular watering of unsealed roads, exposed surfaces and active construction areas will reduce and control these emissions. Major roads and access surfaces will be sealed and the restriction of vehicle movements will further reduce dust emissions from construction activities. As a result of the implementation of these management measures, dust emissions from construction activities will have a temporary, localised, low impact on public amenity.

New Energy will develop a CEMP prior to commencing construction works. The CEMP will provide detailed information on the control measures to limit dust emissions from the site during construction. The measures that will be applied will include *inter alia*:

- Controls over the extent of clearing and the size of soil stockpiles to minimise the exposed surface are that can contribute to dust lift-off;
- Controls over the flow of vehicular traffic on cleared areas to minimise dust lift-off during earthworks and construction;
- Use of water trucks and crusting agents to control dust emission from cleared areas and stockpile soils if necessary;
- Use of wind fencing to reduce surface wind velocities;
- Use of visual and hand held instrumentation as a management tool during construction to assess the effectiveness of dust controls;

- Implementation of complaints handling procedures to ensure a response to any identified off-site issues with 24 hours; and
- Cleared vegetation will be either be mulched for use on site to stabilise disturbed soil areas or directed for off-site disposal. There will be no burning of vegetation or waste on site during construction.

4.2.6.3 Management of Atmospheric Emissions

New Energy, in conjunction with HZI, has designed a facility that represents best available technology in terms of emission performance. This level of performance is achieved using a number of management and design features that are unique to the proposal. The key factors are:

- Careful selection and control of waste streams to be accepted at the facility;
- Acceptance of MSW and selected C&I and C&D wastes to avoid combustion of hazardous wastes;
- Management and packaging of feed stocks to provide a feed that is relatively uniform in calorific value, density, moisture content and chemical composition. This will assist with maintaining stable conditions during combustion;
- Use of the best available technology designed to meet the stringent EU IED in terms of design temperatures and residence times and also achieve destruction efficiencies for organics which exceed the IED requirements.
- Each component of the plant has been selected for high efficiency and reliability and represents best available technology. A key feature of the design to ensure that the highest possible reliability is that all key fans and pumps are provided with redundant backups that can be bought on line immediately in the event of a failure. The air pollution control system, including the bag filter has been designed with 25% excess capacity so that routine maintenance can be performed without a loss in efficiency or the need to shut down the combustion system; and
- A Continuous Emissions Monitoring System (CEMS) will be operational at the Plant to provide on-going monitoring of emissions generated from the facility. The Facility will also include a further hot standby CEMS which will ensure that there is continuous monitoring data available even if there is a problem with a duty CEMS system. The sophisticated CEMS will monitor, log and report on a range of parameters to provide strict control over process conditions. This will provide early warning of any non-standard operating conditions so that the process supervisors can initiate early action to prevent plant upsets. The CEMS will monitor the following parameters:
- Particulates;
- Carbon monoxide; Sulphur dioxide;
- Hydrogen chloride;
- Oxygen;
- Nitrogen oxides and volatile organic compounds.

Key air emission results of gas quality at the stack exit will be presented as average daily results over the month. On a quarterly basis during the first year of operations, routine stack testing will be undertaken for further compounds.

The range of parameters and the frequency of monitoring will be detailed in an Air Quality Monitoring Plan that will be agreed with the DWER licensing group prior to the commissioning of the plant. The parameters assessed and the frequency of monitoring will be reviewed in conjunction with the DWER aster consideration of the first year of data.

The final key element that will be implemented by New Energy to maintain the highest operational standards is the development and implementation of a comprehensive EMS that will incorporate detailed procedures and plans for:

- Waste acceptance criteria and procedures;
- Start up and shutdown of the facility;
- Operation of the facility in emergency conditions;
- All aspects of monitoring;
- Commissioning procedures; and
- Procedures for assessing and handling solid residues.

4.2.6.4 Management of Emissions during Emergency Shutdown

The issue of emissions during emergency shutdowns is discussed extensively in Section 4.2.5.3. The key objective for New Energy is to ensure that all environmental discharges remain with licence limits, even during unplanned emergency events. As indicated in Section 2.2.4, the proven nature of the HZI technology means that it has very high reliability with a proven track record that results in few unplanned shutdowns. In addition, the system design is based on a robust technology with a high degree of redundancy in key systems and failsafe behaviour which means there should be no circumstances under which emissions exceed those used for the modelling of normal operations.

4.2.6.5 Management of Emissions from Fires

The best approach to mitigating emissions from fire is prevention. New Energy commits to the preparation of a comprehensive Fire Management Plan which will include the following elements:

- External firebreaks around the site perimeter to prevent impacts by bush and scrub fires on the facility;
- An automatic fire detection and alarm system linked with automatic fire control systems in key areas;
- Fire water storage tanks at key locations on the site;
- An on-site fire and emergency plan which will be developed in conjunction with the local emergency authorities to ensure all necessary communication protocols are in place. The fire and emergency plan will also address staff training and regular fire drills to ensure a rapid and appropriate response to fires;
- A store of firefighting equipment on-site including specialised personal protective and self-contained breathing equipment; and
- The fire and emergency plan will also link to waste acceptance protocols for the facility to minimise the possibility that the facility will accept or handle highly reactive or explosive materials that may increase the risk of fires occurring.

4.2.6.6 Contingency Response for Breaches of Facility Emission Criteria

The set points for critical control parameters will be established on a conservative basis using information and experience from existing HZI facilities and the data derived from the East Rockingham facility during commissioning. This will ensure that the facility management system intervenes automatically to adjust these control parameters when they are at around 60% of the critical levels that may lead to non-compliant emissions. Visual and audible alarms will be triggered if monitoring suggests that parameters are exceeding 80% of the critical level. At this time the operator can manually intervene to initiate a staged response to prevent exceedance of emissions standards. Management actions include:

- Progressive or rapid reduction of waste feed to the combustion system;
- Shutdown of the combustion system if essential;
- Provision of additional fuel or air to the combustion system to ensure optimal destruction efficiency;
- Activating standby pumps or blowers as required to ensure that the air pollution control system continues to function optimally; and/or
- Increasing reagent flows in the air pollution control system as appropriate.

New Energy is confident that plant performance in terms of air emissions will be as described in this document as the plant design is based on established facilities using HZI grate combustion technology and using very conservative assumptions in terms of the contaminant loads present in the feed stocks.

In the event that air emissions cannot be made to meet design specification at design capacity, there are a range of possible contingency measures that can be implemented by New Energy as follows:

1. Waste loads can be permanently reduced or halted to reduce loads on the combustion system and air pollution control system;
2. Reagent feeds to the alkali scrubber and carbon injection system can be maintained at levels above design levels to improve performance;
3. The operation of the combustion system can be altered to achieve higher combustion temperatures to increase destruction efficiencies;
4. In the longer term, if necessary, individual elements of the air pollution control system can be scaled up in size to ensure that the facility can achieve design capacity while complying with design emissions performance; and

5. Finally, if the sub-optimal emission performance persists, New Energy has the option of diverting waste to storage or disposal areas until persistent performance problems are resolved.

New Energy is confident that these contingency actions, in conjunction with the inherently robust design and management procedures incorporated into the facility, will ensure that air emissions from the facility will not exceed the regulatory criteria agreed with DWER.

4.2.7 Predicted Outcome

The facility is well-sited on appropriately zoned land designated for industrial uses with adequate buffers to sensitive land uses. The modelling completed by ENVALL (2017) has demonstrated that the proposal will not significantly increase background concentrations of air toxics in the Kwinana Airshed to the extent that environmental or human health is compromised. The selection of the recognised best available combustion technology provided by HZI (as acknowledged in the EPA's Section 16 advice on waste to energy), which has a proven track record in achieving compliance with European Union's IED criteria, will ensure that the EPA's objectives with respect to air quality can be achieved. The provision of a sophisticated air pollution control system along with an advanced CEMS mean that the air emissions from the facility will meet the adopted air quality objectives.

Comprehensive fire and emergency response plans and sophisticated on-site fire systems will minimise the possibility of fires occurring and ensure that impacts associated with them are minimised to maximum extent feasible.

Finally, strict management controls will be implemented through a CEMP to ensure that dust emissions are controlled all times during the construction period and the EPA air quality objectives are also met at all times.

4.3 Social Surroundings (Noise and Odour)

4.3.1 EPA Objective

To protect social surroundings from significant harm.

4.3.2 Policy and Guidance

EPA Policy and Guidance

- Statement of Environmental Principles, Factors and Objectives.
- Factor Guideline – Social surroundings.
- *Environmental Protection (Noise) Regulations 1997.*
- Guidance Statement No. 3 Separation Distances between Industrial and Sensitive Land Uses.

Other policies and guidance:

- Odour Methodology Guideline, Department of Environmental Protection, Perth, WA March 2002

4.3.2.1 Receiving Environment

The industrial area surrounding the New Energy site has been planned to provide adequate buffers and zoning to reduce the risk of unacceptable impacts of noise on sensitive receptors such as residential areas. However, there has been concern in the community that cumulative noise from a number of industrial sources would have negative impacts on surrounding residential areas.

The Kwinana Industries Council (KIC) Noise Reference Group commissioned Herring Storer Acoustics to compare noise data from 2001 with information collected in 2005 to determine any changes in cumulative noise emission. The results of the 2005 update indicated that there had been a net reduction in noise emission levels to noise sensitive premises in the area (Herring Storer Acoustics, 2005). Noise reduction was a direct result of construction and noise reduction activities implemented during the previous four years. The reduction occurred despite the introduction of two new industry noise sources and increased plant and production levels.

The net positive changes in industrial noise emission levels have resulted in a reduction of the noise emission levels in regions surrounding the Kwinana Industrial Area (KIA) ranging from 0.3 dB(A) in Hope Valley to 2.5

dB(A) in Medina. Whilst an instantaneous change of 3 dB(A) is just perceptible by the human ear, it represents a 50% reduction in noise energy.

Amendments to the *Environmental Protection (Noise) Regulations 1997* gazetted on 5 December 2013 relaxed industry-to-industry noise levels in the KIA meaning that industrial receivers have higher assigned levels while maintaining protection for noise sensitive receivers such as residences.

An analysis of land uses surrounding the site has determined that the nearest residence is approximately 1km east of the site. Other residential areas include Medina and Leda (approximately 2.5km east of the site), East Rockingham (2.5km south-west) and Hillman (2.7km south) (Figure 1).

4.3.3 Potential Impacts

The operation of the waste to energy facility at East Rockingham has the potential to generate noise and odour emissions which have the potential to impact the amenity of surrounding receivers.

4.3.3.1 Noise Sources

Noise associated with the waste to energy facility may be generated during construction and operation phases. Other noise sources within the wider RIZ area also have the potential to generate noise emissions, which cumulatively could exceed the acceptable noise levels.

Noise will be generated from the plant and equipment at the Facility which may impact on the nearest noise sensitive premises (i.e. residences) to the project site, given that the facility will operate for 24 hours a day, seven days a week.

4.3.3.2 Odour Sources

Any plant handling putrescible waste materials, particularly MSW has the potential to emit odorous gases and impact the amenity of the surrounding area. By its nature, MSW will be odorous as it is collected weekly and therefore may sit inside 240 litre bins for several days which means decomposition is well advanced before the waste is tipped into the collection vehicle.

The main sources of odour for the project are the tipping hall when the doors open and close for truck entry and departure and from a 48m high shutdown stack used to vent internal odours from the waste bunkers when the combustion system is not operating.

4.3.4 Assessment of Impacts

4.3.4.1 Noise

Herring Storer Acoustics (HSA) has undertaken an assessment of the expected noise emissions from the proposed Waste to Energy Facility. The objective of the study was to assess noise emissions from the facility at noise sensitive premises surrounding the proposed site for compliance with the requirements of the *Environmental Protection (Noise) Regulations 1997*. The report is provided in Appendix 20.

Noise Modelling Methodology

Modelling of the noise propagation from the Facility was carried out using the noise modelling computer program, 'SoundPlan', which uses the theoretical sound power levels determined from measured sound pressure levels to calculate the noise level received at single point locations as well as using ambient noise levels to generate noise contours. Other input data for computer modelling included topographical data and the following default weather conditions for (Temperature of 15°C, relative humidity of 50%, wind speed of 3m/s and Pasquil stability class F).

Assessment Criteria

The *Environmental Protection (Noise) Regulations 1997* stipulate the allowable noise levels at any noise sensitive premises from other premises. For noise sensitive premises, the allowable noise level is determined by the calculation of an influencing factor, which is added to the baseline criteria set out in Table 1 of the Regulations. The baseline assigned noise levels are listed in Table 26 of this report. For commercial and industrial premises, the allowable noise levels are fixed.

Table 26: Baseline Assigned Outdoor Noise Levels

		Assigned Noise Levels		
	Time of Day	**LA_{10}**	**LA_{1}**	**$L_{A\ MAX}$**
Noise Sensitive Premises	0700-1900 hours – Monday to Saturday (Day)	45 +IF	55 +IF	65 +IF
	0900 - 1900 hours - Sunday & Public Holidays (Sunday / Public Holidays)	40 +IF	50 +IF	65 +IF
	1900 - 2200 hours - All days (Evening)	40 +IF	50 +IF	55 +IF
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	35 +IF	45 +IF	55 +IF
Commercial Premises	All hours	60	75	80
Industrial Premises	All hours	65	80	90

Notes: The L_{A10} noise level is the noise that is exceeded for 10% of the time.
The L_{A1} noise level is the noise that is exceeded for 1% of the time.
The L_{Amax} noise level is the maximum noise level recorded.
IF = Influencing Factor

The assigned noise levels are conditional on there being no annoying characteristics (or influencing factors (IF)), such as tonality, amplitude modulation or impulsiveness. If such characteristics exist, then any measured level is adjusted upwards accordingly. The adjustments that apply are shown in Table 27.

Table 27: Adjustments for annoying characteristics

Tonality	Modulation	Impulsiveness
+5dB	+5dB	+10dB

Note: These adjustments are cumulative to a maximum of 15dB.

As the Facility will operate during the night period, the noise received at the closest residence needs to comply with the assigned night period L_{A10} noise level of 35 decibels (A weighting) dB(A). However, as the facility is located within an industrial estate, noise received at a residence would need to be considered as not significantly contributing and acoustic criteria would be 5db(A) below the assigned noise level i.e. 30db(A).

It is understood that there are a few residences located within the Kwinana Industrial Area with the nearest dwelling approximately 1 km east of the site. At these residences, the influencing factor would, due to their location within Area B of the Kwinana Policy Area, be +10 dB and the assigned noise level would be as listed in Table 28.

Table 28: Assigned outdoor noise level – Residences within Kwinana industrial area

Premises receiving noise		Assigned Noise Levels		
	Time of Day	**LA_{10}**	**LA_{1}**	**$L_{A\ MAX}$**
Noise Sensitive Premises: Highly sensitive area	0700-1900 hours – Monday to Saturday (Day Period)	55	65	75
	0900 - 1900 hours - Sunday & Public Holidays (Evening Period)	50	60	75
	1900 - 2200 hours - All Days (Evening Period)	50	60	65
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	45	55	65

Noise received at these residences would also need to comply with the NOT "significantly contributing" requirements. Therefore, to comply with the regulatory requirements at these residences within the Policy Area, noise received from the facility during the night period would need to comply with an L_{A10} noise level of 40 dB(A).

Noise received at the neighbouring industrial premises would need to comply with the assigned L_{A10} noise level of 75 dB(A). Due to the close proximity of neighbouring industrial premises to this facility compared to other industries, noise received at the boundary of the neighbouring industries would be dominated by the

noise received from the waste to energy plant and the "significantly contributing" requirement would not be applicable. Therefore, the assigned L_{A10} noise level of 75 dB(A) is the applicable regulatory criteria at for the neighbouring residence.

Results

Single point calculations for noise received at closest residential premises located around the site indicate that the following could be experienced:

- North Rockingham – 28 dB(A);
- Hillman – 27 dB(A);
- Leda – 29 dB(A);
- Calista – 29 dB(A);
- Medina – 27 dB(A);
- Nearest Residence (approximately 1km east of the site) – 28 dB(A).

Based on the noise modelling, noise received at the neighbouring industrial premises, has been calculated at up to 65 dB(A). However, noise received at the neighbouring industrial premises could be tonal and a +5 dB(A) penalty is applied. Therefore, the adjusted noise level at the neighbouring industries would be 70 dB(A).

At the nearest residence (approximately 1km east of the site) the calculated noise level noise received would not be tonal or contain any other annoying characteristics. Therefore, no penalties would be applied to the calculated noise levels listed above.

The noise contour plot for the waste to energy facility is shown in Figure 12.

As the waste to energy facility would operate during the night period, noise received at the neighbouring residences located outside the Zone B of the Kwinana Industrial Area would need to comply with the assigned night period L_{A10} noise level of 35 dB(A). However, as the waste to energy facility is located within an industrial estate, noise received at a residence would need to be considered as NOT significantly contributing and acoustic criteria would be 5 dB(A) below the assigned noise level or 30 dB(A).

For those residences located within Zone B of the Kwinana Policy Area would, taking into account the requirements to be considered as NOT "significantly contributing" during the night period, need to comply with an L_{A10} of 40 dB(A).

Noise received at the neighbouring industrial premises would need to comply with the assigned L_{A10} noise level of 75 dB(A). Due to the close proximity of neighbouring industrial premises to this facility compared to other industries, noise received at the boundary of the neighbouring industries would be dominated by the noise received from the Waste to Energy Power Station and the "significantly contributing" requirement would not be applicable. Therefore, the assigned L_{A10} noise level of 75 dB(A) is the applicable regulatory criteria at for the neighbouring premises. Based on the noise modelling, noise received at the neighbouring industrial premises has been calculated at up to 65 dB(A). At this noise level, noise received at the neighbouring industrial premises would also comply with the Regulatory requirements, even if a +5 dB(A) penalty for tonality was applied.

As listed above, the noise received at the neighbouring residences is modelled to be more than 5 dB(A) below the assigned criteria and therefore would be considered as NOT significantly contributing and on this basis would be deemed to comply with the Regulations.

Given the above, noise emissions from the proposed power station comply with the Regulatory requirements at all times.

4.3.4.2 Odour

In order to assess whether the proposed odour management measures are adequate to prevent adverse impacts, ENVALL was commissioned to complete a screening assessment of odour impacts from the facility taking into consideration the study completed by The Odour Unit (TOU) (2013) for the previous New Energy proposal. The ENVALL (2017) report is included as Appendix 7.

The purpose of the study undertaken by ENVALL (2017) was to predict, using conservative assumptions, the potential ground level odour impacts from the proposed facility by modelling odour emissions based on a

range of odour emission scenarios. ENVALL used the CALPLUFF model to predict ground level concentrations from odour emissions from the receival hall and the 48m shutdown stack.

For the prediction of odour impacts, a key assumption is that the Bunker building and Receival Hall are air-tight except for the truck entry and departure doors in the Receival Hall.

Normal Operation

Main Stack

For normal operation, air taken from the bunker at 32.9 kg/s (27.3 m^3/s at 20°C) and is fed into the combustion system. Given the combustion temperature and flue gas residence times, odorants from the waste will be completely oxidised.

Fugitive Odour Releases

In the previous odour modelling study (TOU, 2013) an odour sampling dataset from a large waste transfer station (WTS) in metropolitan NSW was presented (see Table 29). This WTS accepts up to 400,000 tpa of MSW and commercial waste (compared to 300,000 tpa for the proposal), with at least 300 tonnes of waste remaining on the WTS floor daily. The waste is stored inside the WTS prior to being out-loaded into semi-trailers for landfill. Given that the WTS tipping floor is under forced extraction, it is reasonable to assume that the odour emissions sampled from this WTS air extraction system would be representative of the proposed New Energy facility (ENVALL, 2017).

Table 29: Odour concentrations sampled over 2005 – 2008 from NSW metropolitan Waste Transfer Station (capacity 400,000tpa of MSW) with forced air extraction

Odour concentrations from 13 samples collected from roof extraction fans (OU)	
395	609
609	892
395	956
512	2400
675	1350
832	320
776	

Source: TOU (2013)

From these results, TOU (2013) considered that an internal odour concentration of 2,000 ou in the waste bunker would be a conservative concentration to use for modelling purposes.

In order to verify that this is a "conservatively realistic" assumption, the total odour from the waste bunker being extracted to the combustion system can be compared to measured total odour from similarly managed waste facilities. A data set that has been recently used for odour assessments from waste handling are the results from odour emissions testing at the Clyde (waste) Transfer Terminal in NSW in August 2008. This facility handled predominantly putrescible general solid waste with some commercial and industrial waste. Four samples were taken from within the extraction stack for the building, in which 250 tonnes of waste was present on the tipping floor at the time of the sampling. The average odour concentration measured was 320 ou, with a mean stack gas flow rate of 88.7 m^3/s. The total odour emission rate (in this case being discharged untreated into the air via a 21m stack) was 28,384 ou.m^3/s.

For the New Energy internal odour concentration assumption of 2,000 ou and extraction rate of 27.3 m^3/s, the total odour being extracted to the combustion system) would be 54,600 ou.m^3/s, which is nearly double that measured at then Clyde terminal. On this basis, the assumption of an internal odour concentration of 2,000 ou inside the New Energy Bunker appears to be appropriately conservative.

It is expected that odours generated from waste in the New Energy Bunker, with a concentration of 2,000 ou as described, will subsequently mix with air inside the Reception Hall. There is expected to be minor odour emissions from the Reception Hall doors when open, due to the turbulence of the immediately surrounding external air and a "plunger" effect from ingoing and outgoing trucks. These emissions are very difficult to quantify. In the odour assessment of the NSW Banksmeadow Transfer Terminal which also incorporated forced extraction (Wilkinson Murray, 2014), an estimate of 5% of total odour emissions was considered "a

sensible and conservative assumption for fugitive emissions" arising from air lost through the door and small building leaks. This same assumption was also used previously for odour modelling from the Clyde Transfer Terminal, referred to previously.

For the New Energy proposal, 5% of the total odour intake to the combustion system is 27.3 m^3/s x 2000 ou x 0.05 = 2,730 ou.m^3/s.

As a comparison, the fugitive odour emissions assumed for the Phoenix Energy 400,000 tpa MSW waste to energy plant in Kwinana with similar internal odour extraction from the waste tipping area and rapid closing door technology to that proposed for New Energy, was 545 ou.m^3/s. This was stated in the Environ (2010) report as being based on "data supplied by the client".

Therefore, the assumed fugitive odour emission for the New Energy proposal of 2,730 ou.m^3/s is five times higher than that assumed for Phoenix Energy, and would therefore appear to be a conservative estimate.

The criteria currently used by the DWER to assess acceptable odour impacts from new proposals for sources other than wake-free stacks, which therefore applies to this proposal, is:

- C99.9, 1hr = 8 ou; and
- C99.5, 1hr = 2.5ou.

The "Cnn.n" denotes annual percentiles, i.e. "C99.9" is the 99.9th percentile of 1-hour average odour concentrations predictions. The 99.9th percentile is taken to be the 9th highest 1-hourly predicted odour concentration in the year. "C99.5" is the 99.5th percentile of 1-hour average odour concentrations predictions, taken to be the 44th highest 1-hourly predicted odour concentration in the year.

The modelling has shown that the C99.9, 1 hr = 8 ou residential criterion for odours is not predicted to be exceeded outside of the site anywhere at ground level (Figure 13). The C99.5, 1 hr = 2.5 ou residential criterion for odours is not predicted to be exceeded outside of the site anywhere at ground level (Figure 13).

The modelling has demonstrated the odour emissions from the plant under normal operating conditions will be negligible.

Combustion System Down Times

There are likely to be lower fugitive odour emissions during planned maintenance than during an unplanned shutdown, but in either case, the auxiliary forced ventilation system is activated, and the truck doors will be periodically open as waste deliveries continue. Therefore, there will be two sources of odour emissions – the shutdown stack and the Reception Hall doors.

Shutdown Stack

During all combustion system down times, an auxiliary forced ventilation system of approximately 10,000 m^3/hr (2.8 m^3/s) capacity will withdraw air from above the Bunker and direct it to a dedicated stack of 48m nominal height positioned at the south-west corner of the boiler room roof.

The odour generation rate from waste within the Bunker during combustion system down-times will most likely be lower than during normal operation, as the grabs will be operating less frequently - only to move waste away from the pit area where trucks drop off waste.

Assuming the same internal odour concentration as for normal operation, the shutdown stack odour emission rate will be 2.8 m^3/s x 2,000 ou = 5,600 ou.m^3/s.

Reception Hall Doors

Since the auxiliary mechanical ventilation system extraction rate is much lower than the 27.8 m^3/s extraction rate when the combustion system is operating, it is reasonable to expect that the volume of air released when the Reception Hall doors are opened will be higher than during normal operation (assuming there are no additional measures to restrict air flow from the Bunker to the Receival Hall by shutting some of the tipping bay doors).

The fugitive odour emission rate assumed for modelling is based on the multiple of the shutdown Bunker air extraction rate compared to the normal Bunker air extraction rate (27.8 m^3/s / 2.78 m^3/s = 10 times) applied to the fugitive odour emission rate for normal operation, that is 10 x 2,730 ou.m^3/s = 27,300 ou.m^3/s.

The highest odour emissions will occur during planned and unplanned maintenance when the auxiliary fan is discharging untreated air from the Bunker at 48m and the facility is continuing to receive waste. The predicted C99.9,1-hr=8ou and C99.5,1-hr=2.5ou criterion odour concentrations assuming continuous unplanned shutdown emissions over full year are shown in Figure 13. This is very conservative as this scenario is only expected to occur for less than 9% of the time.

The criteria concentrations extend approximately 748 m (on average) from the site as these arise from odour emissions through the (low level) doors, however the criteria are still easily met at the nearest residential areas (Figure 13).Mitigation

4.3.5 Mitigation

4.3.5.1 Noise

The Herring Storer Acoustics (2017) modelling demonstrates compliance with the allowable limits specified in the *Environmental Protection (Noise) Regulations 1997.* No additional buffers or treatments are likely to be required.

Construction work will be restricted to the hours between 7am and 7pm on any day which is not a Sunday or public holiday. Construction work will be undertaken in accordance with control of noise practices set out in Section 6 of *AS 2346:1981 Guide to Noise Control on Construction Maintenance and Demolition Sites.* All equipment used on the site will be selected and operated to minimise noise where feasible.

A handheld noise monitor will be available on site to record any reported noise excursions, either internally by staff or by members of the public. Any noise complaints will be addressed in the following manner:

- All complaints received in connection to the operation of the facility will be recorded by the duty operator, afterhours this will be the control room operator.
- Each complainant will receive a reference number so the complaint can be tracked and closed out within the appropriate time.
- All complaints will be followed up with the complainant to confirm the issue has been addressed.

The quantity of complaints and details on any major issues will be reported monthly and on a 12 month rolling basis.

A regular sample of noise readings will be recorded manually using the handheld noise monitor at predetermined locations across the site on a quarterly basis. These readings will be assessed and reported in the appropriate monthly report.

4.3.5.2 Odour

The risk of fugitive odour emissions from the Facility has effectively been eliminated through key design decisions including:

- Delivery of putrescible wastes in enclosed vehicles;
- The provision of an enclosed waste bunker incorporating an airlock design for the doors to the waste receival area; and
- Maintaining the waste receival area under negative air pressure by drawing air from this area for injection into the combustion chamber.

This approach means that under normal operational conditions, any potentially odorous gases are treated via the combustion system. Given the design destruction efficiency of the combustion system, it can be assumed that the stack will not represent an odour source. During plant shut downs, the auxiliary fan will extract odourous air to a 48 m stack. The modelling predicts that ground level odour concentrations will comply with the adopted assessment criteria.

During commissioning, the bunker building and reception Hall will be tested for air tightness using internal smoke flares during moderate-strong winds (i.e. static test with doors closed). Investigations using smoke flares will also be conducted to assess the effectiveness of the air extraction systems to restrict odour releases from the truck doors when opened for truck movements during the following conditions:

- Normal operation;
- With shutdown fan working; and

- During emergency shutdown when the system transitions from normal operation to the operation with shutdown fan

Odour testing of the shutdown stack will also be conducted during commissioning to validate the odour emission assumptions adopted for the modelling. If necessary, the ventilation system design or fan capacities can be adjusted so that ground level odour concentrations are consistent with modelled predictions.

Following the commencement of stable operations, field odour assessments outside the site boundary will be undertaken to verify the effectiveness of the odour control measures and predicted odour levels. Should odour levels exceed those predicted, options for odour, mitigation include:

- Installing an atomizer system to suppress odour (and dust) inside the Bunker during combustion system shutdowns;
- Constructing a semi-porous wind fence along the southern boundary engineered (based on distance to the Reception Hall doors) to provide an effective wind barrier during south-westerly wind, with supplementary landscape plantings on the fence line with quick growing species;
- Upgrading the capacity of the shutdown air extraction system; and/or
- Re-positioning the air extraction intake vents in the Bunker.

4.3.6 Predicted Outcome

The facility is well-sited on appropriately zoned land with adequate buffers to sensitive land uses.

The Herring Storer Acoustics (2017) modelling demonstrates compliance with the allowable limits specified in the *Environmental Protection (Noise) Regulations 1997*. No additional buffers or treatments are likely to be required.

The potential for odour impacts arising from the East Rockingham facility is assessed as being low due to the following factors:

- Putrescible waste will be delivered in enclosed vehicles and handled in enclosed facilities (the waste receival building) which will operate under negative pressure with the ventilation gases being used as feed air for the combustion process. This approach will effectively eliminate the odorous compounds in the ventilation area; and
- The waste receival building will be well sealed and equipped with automatic rapid operation doors for the ingress and egress of trucks. This will limit fugitive odour emissions to short period periods when the doors are opening and closing.

Given the above strategies, the EPA's objectives with respect to Social Surroundings will be achieved.

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OTHER ENVIRONMENTAL FACTORS OR MATTERS

05

5. Other environmental factors or matters

The EPA has identified the following environmental factors or matters relevant to the proposal that must be addressed:

1. Flora and vegetation – Impacts on native vegetation and flora through clearing of the 10ha site.
2. Terrestrial fauna – Impacts on native fauna through clearing and development of the 10ha site.
3. Hydrological processes – Potential changes to hydrological regimes through alteration to recharge and groundwater.
4. Inland waters environmental quality – Potential impacts to groundwater quality through stormwater management and other discharges.
5. Waste management – Disposal of generated waste products.

The above factors were considered as part of the original proposal that was approved by the EPA in 2015. The potential impacts associated with the project as outlined in the following sections are not materially different from those in the original proposal.

5.1 Flora and Vegetation

5.1.1 EPA Objective

To protect flora and vegetation so that biological diversity and ecological integrity are maintained.

5.1.2 Applicable Standards, Guidelines or Procedures

- Environmental Factor Guideline – Flora and Vegetation
- Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment.

5.1.3 Potential Sources of Impact

The construction of the waste to energy plant including associated earthworks will require the clearance of native vegetation on the site resulting in the direct loss of approximately 10ha of native vegetation. Based on vegetation and flora surveys there is the potential to impact on vegetation (types XpAf and Ar) which has an affinity with FCT 29b, a PEC (DBCA, 2017). This PEC is categorised as Priority Three (i) which are poorly known ecological communities defined as 'communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation' (DEC, 2017). No Threatened or Priority flora species are likely to be impacted by clearing.

The operation of the waste to energy plant has the potential to also generate other indirect impacts on surrounding flora and vegetation, including:

- The introduction or spread of weed species, particularly during site clearing and construction stages;
- Fire; and
- Spread of windblown rubbish.

5.1.4 Assessment of Potential Impact

The maximum area of native vegetation to be cleared on the site is estimated to be 10ha. This will provide sufficient area for the importation of fill material to raise the site to finished floor levels and to allow the construction of the plant and ancillary infrastructure.

The vegetation on the site has been assessed as belonging to Beard's vegetation association Rockingham System 3048. The current extent of this vegetation association is estimated at 3,072.85ha with 25.39% of its pre-European extent remaining and 7.03% within IUCN Reserves 1-4 (Government of WA, 2016). Additional areas have been protected as Bush Forever sites in the Perth metropolitan area, including 3,479.7ha (comprising Quindalup, Spearwood Dunes, Serpentine River, Bassendean Central and South, Karrakatta Central and South vegetation complexes, some open water and cleared areas.

The area to be cleared as part of this proposal equates to 0.3% of the remaining extent. Although this vegetation association has less than 30% remaining and less than 10% in IUCN reserves (2016 Statewide Vegetation Statistics; Government of WA, 2016) it is not considered that the clearing required for this project will have a significant impact on the vegetation association as a whole.

Although the vegetation on the site has an affinity with a Priority 3 PEC, it is not considered to be significant due to its highly modified state.

Based on the available information, it is considered that the clearing required for the construction of the waste to energy facility will not alter the conservation status of any significant flora. In addition, indirect impacts such as weed invasion, fire risk and windblown rubbish will be managed through the implementation of appropriate management measures as outlined in Section 5.1.5. In addition to this, surrounding areas are also likely to be developed for industrial purposes.

5.1.5 Proposed Mitigation/Management Measures

The area of native vegetation to be removed has been minimised as far as practicable. An area of 10ha is needed for earthworks, construction and operation of the waste to energy plant.

A Construction Environmental Management Plan (CEMP) will provide a framework for the environmental management of construction activities. The Plan will include strategies, procedures and work practices to avoid, mitigate or minimise impacts resulting during construction.

Prior to the commencement of clearing, the development envelope will be surveyed and demarcated so that areas outside of the project footprint are not inadvertently cleared.

Clearing will be undertaken in accordance with the following procedure:

- Machinery used to be cleaned and inspected for weeds prior to access to the site;
- Vegetation will be slashed and windrowed;
- The soil will be ripped to a depth of at least 200mm;
- Cross-ripping will occur to ensure even ripping over the site;
- Vegetation roots will be windrowed; and
- Vegetation will be removed for either mulching, reuse or disposal to an appropriate facility.

During construction, dust control measures will be implemented such as regular watering of exposed surfaces to mitigate fugitive dust emissions impacting surrounding vegetation and other users. Vehicle and equipment access will be restricted to designated access roads or within the construction site.

Following clearing, the site will be fenced using 1.8m ring lock fencing. This will provide a barrier that will ultimately trap any windblown rubbish within the premises. The fence will also prevent access from the waste to energy site into adjacent vegetated areas.

Clean fill will be sourced and any emerging weeds treated to reduce the risks associated with introducing weeds. The spread of weeds from the site will be managed through receival locations being mostly housed inside structures. This will substantially reduce the risk of weed dispersal. The proponent, as part of its site management program, will implement a Weed Management Program which will incorporate a routine inspection of the site and initiate weed control programs as required. If an infestation of invasive weeds in the immediate (e.g. 20m) vicinity of the site is recorded by the proponent, a weed control program will be implemented.

Although there is potential for fires to start from within the site, the risks associated with fire can be adequately managed by housing most facilities indoors and isolating high risk activities in separate buildings. Firefighting equipment will be provided on site to extinguish fires and will include firewater storage tanks. The proponent commits to the preparation of a Fire Management Plan in consultation with the City of Rockingham and the Department of Fire Emergency and Services. The Fire Management Plan will detail the following:

- Fire hazard awareness and management training including emergency response procedures;
- Provision of water cart on site during site works;
- Use of spark shields during construction where necessary;
- Restriction of vehicles to designated access roads or the construction site; and
- Provision of and maintenance of firefighting equipment.

5.1.6 Predicted Environmental Outcome

Based on the available information and with regard to the proponent's commitments, the predicted impacts to vegetation and flora associated with the construction and operation of the facility are considered minor. No flora of conservation significance have been previously recorded on the New Energy site. The Priority 3 PEC is highly modified and similar ecological communities are known from several to many sites, a significant number or area of which are not under threat of habitat destruction or degradation. Therefore, the EPA's objectives with respect to flora and vegetation are unlikely to be compromised.

5.2 Fauna

5.2.1 EPA Objective

To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.

5.2.2 Applicable Standards, Guidelines or Procedures

- Environmental Factor Guidelines – Terrestrial Fauna;
- Technical Guidance – Terrestrial Fauna Surveys;
- Environment Protection and Biodiversity Conservation Act 1999;
- Wildlife Conservation Act 1950; and
- Environmental Protection Act 1986.

5.2.3 Potential Sources of Impact

The potential impacts on fauna are:

- Direct loss of habitat due to site clearing and earthworks;
- Loss of, or injury to fauna; and
- Potential for the attraction of feral animals and pests.

5.2.4 Assessment of Potential Impact

Previous fauna surveys in the RIZ have documented the baseline characteristics of the fauna habitat and the assemblages on the site. Three habitat types have been recorded on the New Energy site – *Xanthorrhoea preissii, Acacia rostellifera* and *A. saligna* degraded shrubland (approximately 9ha), *Acacia* and *Xanthorrhoea* shrubland (approximately 0.8ha) and *Melaleuca* and *Banksia* woodland (approximately 0.2ha). Fauna habitat condition ratings vary across the site between 'Highly Degraded' and 'Disturbed' (as described by Coffey Environments 2009a and b).

The desktop review of relevant databases conducted for the original East Rockingham proposal indicated that there is limited potential for conservation significant fauna to utilise the site. Of the 28 species identified in the databases, only two species (Southern Brown Bandicoot and Rainbow Bee-eater) were recorded in the RIZ. The Southern Brown Bandicoot is unlikely to utilise the site due to lack of cover and suitable foraging habitat. The Rainbow Bee-eater is widely spread, not subject to currently identified threats and the site is likely to represent marginal habitat.

Species such as the Black Cockatoos were not recorded in the RIZ and it is considered that although they may periodically be found in the district, they are unlikely to utilise the site due to lack of suitable roosting and foraging habitat.

A targeted survey was carried out to determine the presence of the Graceful Sun Moth and its host, *Lomandra maritima*. These species were not present in the RIZ.

The following species are unlikely to utilise the site due to nearby urbanisation, lack of specific habitat requirements (e.g. marine species) or the habitat is marginal, modified and unlikely to provide key resources:

- Malleefowl (Leipoa ocellata);
- Australian Painted Snipe (Rostratula australis);
- Roseate Tern (Sterna dougallii);
- Fork-tailed Swift (Apus pacificus);

- Great Egret/White Egret (Ardea alba);
- Cattle Egret (Ardea ibis);
- White-bellied Sea Eagle (Haliaeetus leucogaster);
- Peregrine Falcon (Falco peregrinus);
- Grey-headed Albatross (Diomedea chrysostoma);
- Southern Giant Petrel (Macronectes giganteus);
- Hooded Plover (Charadrius rubricollis);
- Chuditch (Dasyurus geoffroii);
- Red-tailed Phascogale (Phascogale calura);
- Quokka (Setonix brachyurus);
- Water-rat (Hydromys chrysogaster);
- Western Brush Wallaby (Macropus irma);

The following species were identified as possibly occurring within 5km of the site:

- *Tiliqua rugosa subsp. konowi* - Usually only found on Rottnest Island. While records indicate that it has been recorded in East Rockingham, the species was not detected in fauna surveys;
- *Notoscincus butleri* – Usually only found in the Pilbara. While records indicate that it has been recorded in East Rockingham, the species was not detected in fauna surveys;
- *Lerista lineata* –records indicate that this species may be found in the area. However, the species was not detected in fauna surveys;
- *Neelaps calonotos* - records indicate that this species may be found in the area. However, the species was not detected in fauna surveys; and
- *Pletholax gracilis subsp. edelensis* – This species is generally found in the Shark Bay region. However, records indicate that this species may be found in the area. Subspecies *elegans* is more likely to occur in the Rockingham region. The species was not detected in fauna surveys.

The construction of the waste to energy plant will result in the direct loss of 10ha of *Xanthorrhoea preissii, Acacia rostellifera* and *A. saligna* shrubland (approximately 9ha), *Acacia and Xanthorrhoea* shrubland (approximately 0.8ha) and *Melaleuca* and *Banksia* woodland (approximately 0.2ha) in disturbed to highly degraded condition.

Given the protection of Quindalup vegetation in nearby areas it is considered unlikely that the proposed clearing of 10ha will not significantly impact on fauna species, even when considered in the context of other projects that are likely to occur in the RIZ.

The loss or injury to fauna at a local level resulting from site clearing, earthworks or vehicle collisions will not threaten fauna at a population level. In addition, the SEA process secured the most significant environmental features in the RIZ to create a 92ha conservation area.

5.2.5 Proposed Mitigation/Management Measures

The direct loss of 10ha of native vegetation is unavoidable in the development of the proposed facility. To minimise impacts to fauna, New Energy has minimised the footprint required for the facility.

New Energy commits to the preparation of a CEMP which will provide a framework for the environmental management of terrestrial construction activities. The Plan will include strategies, procedures and work practices to avoid, mitigate or minimise impacts resulting during construction. Key management measures to be implemented will include the following:

- Survey and demarcation of the clearing envelope to avoid clearing or disturbance beyond the site boundaries;
- Progressive clearing commencing from adjacent to cleared areas or roads towards vegetation outside of the site boundaries to encourage mobile fauna species to move into adjoining areas;
- Restriction of vehicles and equipment to designated access roads or within site boundaries; and
- Development and implementation of fauna protocols outlining management measures (e.g. identification, reporting protocol and requirements to avoid/collect/record) relating to conservation significant species.

The potential impacts associated with the attraction of feral animals and pests will be managed by:

- Constructing a secure boundary fence;
- Design of waste receival and handling areas within buildings; and
- Employment of a professional pest exterminator to reduce infestation of vermin if required.

5.2.6 Predicted Environmental Outcome

The proposed clearing is not considered significant at the regional level due to the protection of similar vegetation types in nearby conservation reserves and in light of previous environmental assessments (i.e. SEA for RIZ). The fauna species likely to be present on the New Energy site are not specifically reliant upon this degraded habitat and therefore the breeding and foraging resources are not likely to be significantly reduced through the implementation of this project.

Direct loss of fauna due to clearing, earthworks or vehicle strikes will not threaten fauna at a population level. All remaining impacts can be mitigated through the implementation of the management measures outlined in Section 5.2.5. On this basis, it is anticipated that the EPA's objectives with respect to fauna will not be compromised.

5.3 Hydrological Processes

5.3.1 EPA Objective

To maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.

5.3.2 Applicable Standards, Guidelines or Procedures

- Environmental Factor Guidelines – Hydrological Processes
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ, 2000).

5.3.3 Potential Sources of Impact

The potential impacts from the proposed Facility on hydrological processes include:

- Dewatering during construction; and
- Modification to the local water balance of the site by replacing vegetation with hardstand resulting in lower infiltration of rainfall and reduced groundwater recharge.

5.3.4 Assessment of Potential Impact

There are no natural surface water features on the site or within 1km of the site. The nearest surface water features to the New Energy site are man-made sumps and basins associated with industrial sites approximately 500m to the north.

The site is within the Wellard subarea of the Cockburn Proclaimed Groundwater Area as gazetted under the *Rights in Water and Irrigation Act 1914* (DoW, 2007). Groundwater in this area comprises an unconfined superficial aquifer, Rockingham Sand aquifer (present in places), the Leederville aquifer (semi-confined) and the Yarragadee (confined) aquifer (DoW, 2007).

The maximum groundwater level associated with the site is 1.15mAHD (Figure 6) (Umwelt Environmental Consultants, 2009). Groundwater beneath the site flows from east to west, with the depth to maximum groundwater approximately 3.85mBGL. Groundwater is discharged to Cockburn Sound, which is 1.7km to the west. Soils in the area are relatively permeable and allow for a high rate of infiltration.

Dewatering requirements are unknown at this stage. However, the volume of dewatering effluent to be generated during construction is expected to relatively low and for a limited duration during construction. The permeable nature of the soils at the site is suitable for re-infiltration of dewatering effluent following treatment (if required). If required, a dewatering licence under the *Rights in Water and Irrigation Act 1914* will be obtained prior to construction commencing.

By grading the site appropriately, clean stormwater generated on the site will be directed to lined treatment ponds to allow for settling of suspended materials prior to discharge into a system of swales and basins for infiltration. Given the relatively small size of the site, the expected stormwater volumes generated from the site will primarily be managed through on-site capture and infiltration using vegetated swales and infiltration basins. Stormwater volumes and swale/basin sizing will be investigated during detailed design.

5.3.5 Proposed Mitigation/Management Measures

The proponent commits to the preparation of a Site Drainage and Groundwater Management Plan which will outline the measures to be implemented during construction and operational phases. The dewatering requirements and stormwater volumes to be generated from the site will be documented in the management plan. Disposal options such as ponds, basins and swales including their sizing will be investigated and reported in the Site Drainage and Groundwater Management Plan.

Drainage and hydrology impacts will be managed in accordance with the *Water Quality Protection Note 52 – Stormwater Management at Industrial Sites* (DoW, 2010). However, as a guide the following initiatives will be implemented to minimise impacts on surface water and groundwater:

Construction:

- Sedimentation ponds will be utilised to capture surface run off to reduce erosion on the site; and
- A dewatering licence will be obtained prior to construction (if dewatering is required);
- Dewatering effluent will be infiltrated following treatment (if required) where possible.

Operation:

- Uncontaminated stormwater will be permitted to infiltrate into the ground where feasible;
- Drainage structures, bunded areas and sumps will be inspected weekly to ensure these are maintained and operated appropriately;
- A series of groundwater monitoring wells will be installed at the perimeter of the site with monitoring to commence prior to construction and continued on a regular basis during construction and operation of the waste to energy facility.

Further information about the monitoring program will be addressed in the Site Drainage and Groundwater Management Plan. However, the monitoring wells will be located up and down gradient of the waste to energy facility so that information relating to the groundwater conditions (groundwater levels and water quality) entering and leaving the site is collected quarterly for the first two years of operation and then twice yearly. Groundwater samples will be analysed by a National Association of Testing Authorities (NATA) accredited laboratory.

Documentation will be undertaken as part of licence reporting.

5.3.6 Predicted Environmental Outcome

Based on the available information and with regard to the proponent's commitments, the predicted impacts to hydrological processes are considered minor. Therefore, the EPA's objective is unlikely to be compromised.

5.4 Inland Waters Environmental Quality

5.4.1 EPA Objective

To maintain the quality of groundwater and surface water so that environmental values are protected.

5.4.2 Applicable Standards, Guidelines or Procedures

- Environmental Factor Guideline – Inland Waters Environmental Quality

5.4.3 Potential Sources of Impact

The potential impacts from the proposed Facility on inland waters environmental quality include:

- Contamination of groundwater from spills on site, drainage from waste storage or the inappropriate management of wastewater.

5.4.4 Assessment of Potential Impact

The New Energy facility has a limited potential to impact on groundwater quality in the vicinity of the site due to the fact that all wastes handled at the plant whether solid or liquid, are at all times transported in containers or covered vehicles and then discharged with enclosed buildings or tanks with impervious walls and floors.

The construction and operation of the waste to energy facility poses the following potential issues in regards to surface water and groundwater quality:

- Stormwater which is discharged from roofs and hardstand area could have trace levels of contamination from vehicle movements;
- The potential for leakage from liquid waste storage tanks;
- The possible discharge of contaminated water in the unlikely event of a significant fire occurring on-site;
- The physical presence of infrastructure with impermeable surfaces may increase the volume of runoff; and
- Generation of small volumes of wastewater (grey water and black water) from the administration building (kitchen and ablution facilities). The quantity of sewage produced on site in normal operations will be relatively small given staffing numbers.

All facilities, excluding the weighbridge, wash pad and car parking areas will be housed within buildings or under cover structures which will substantially reduce the risks of stormwater mixing with potential pollutants. Areas around these buildings and structures will be graded away from the buildings.

The potential for groundwater contamination from spills of petroleum hydrocarbons and chemicals is considered to be limited due to the low volumes proposed to be stored and used on-site and absence of a surface water body in the close vicinity. In addition, a majority of the site surface will comprise a sealed hardstand with bunding as appropriate. Notwithstanding this, lined ponds will be incorporated into the treatment train to quarantine any spills.

5.4.5 Proposed Mitigation/Management Measures

The quality of groundwater in the RIZ area is likely to be good and not presently affected by its proximity to the coast. This proposal does not include the use of groundwater by the facility and management of process and stormwater will ensure that impacts on groundwater quality are minimised to prevent the migration of pollutants to the superficial aquifer.

The native soils of the site are permeable and suitable for infiltration of treated stormwater. Clean stormwater will be directed to lined treatment ponds to allow for settling of suspended materials prior to discharge into a system of swales and basins for infiltration.

The proponent commits to the preparation of a Site Drainage and Groundwater Management Plan which will outline the measures to be implemented during construction and operational phases. The stormwater volumes to be generated from the site and pond, basin and swale sizing will be investigated and reported in the Site Drainage and Groundwater Management Plan.

Drainage and hydrology impacts will be managed in accordance with *Water Quality Protection Note 52 – Stormwater Management at Industrial Sites* (DoW, 2010). However, as a guide the following initiatives will be implemented to minimise impacts on soil, surface water and groundwater:

Construction:

- Sedimentation ponds will be utilised to capture surface run off to reduce erosion on the site; and
- During the construction phase when staffing numbers are higher all sewage effluent and waste water will be retained in holding tanks for off-site disposal by a licensed contractor;

Operation:

- Uncontaminated stormwater will be permitted to infiltrate into the ground where feasible;
- Drainage structures, bunded areas and sumps will be inspected weekly to ensure these are maintained and operated appropriately;

- Liquid chemicals stored on-site in excess of 200L will be kept in secure above-ground storage facilities with secondary containment and impermeable floors designed to contain a quantity of liquid chemicals or fuel equivalent to the volume of the largest container plus 10%;
- Waste receival, handling and storage areas will be conducted within buildings or undercover and each will be constructed with an impermeable floor to mitigate against the risk of contaminating stormwater and to reduce the risk of infiltrating contaminants to groundwater;
- Infrastructure which could leak or spill potentially contaminating substances (e.g. waste receival area, Ash Store, Maintenance Workshop) will be sealed and the liquids diverted to sumps. Liquid waste collected from the sumps will either be injected into the combustion system or collected for off-site disposal by a licensed liquid waste contractor;
- Blow down water from the steam circuit or cooling towers will be stored in bunded tanks and will either be:
  - Re-used to condition ash;
  - Fed into the combustion chamber; or
  - Directed for off-site disposal.
- The facility will have a sophisticated fire control system based on a fixed, automated sprinkler system that will be triggered in the event of a fire with the aim of controlling the fire while it is small. Initial containment of firewater in the waste receival building will occur within the waste receival pit.
- In the unlikely event that the pit overtops, potentially contaminated fire water will flow initially into the stormwater management system to lined detention basins before flowing in to infiltration basins or swales. The lined basins will be designed to allow the discharge points to be blocked to maximise the firewater storage capacity before there is a need to discharge potentially contaminated water into the environment.
- Spill Response Procedures will be implemented to deal with spillages and leaks within the operational area. The plan will include details on methods of containment, collection and disposal and training of personnel. Implementation of recovery procedures for chemical and hydrocarbon spillages will form part of the EMS;
- Sewage and grey water generated on the premises will be directed to an on-site aerobic treatment unit for disposal;
- Spills of contaminants, such as oil, process water or chemicals which occur outside of bunded areas will be cleaned up immediately where a risk of surface water contamination occurs, details will be recorded and reported to the Site Manager;
- All staff on the site will be made aware of the hazards associated with the stored hazardous substances and procedures to follow in the event of an emergency; and
- A series of groundwater monitoring wells will be installed at the perimeter of the site with monitoring to commence prior to construction and continued on a regular basis during construction and operation of the waste to energy facility.

Further information about the monitoring program will be addressed in the Site Drainage and Groundwater Management Plan. However, the monitoring wells will be located up and down gradient of the waste to energy facility so that information relating to the groundwater conditions (groundwater levels and water quality) entering and leaving the site is collected quarterly for the first two years of operation and then twice yearly. A range of inorganic and selected organic chemical parameters will be monitored and may include the following:

- pH;
- Conductivity;
- Total Dissolved Solids;
- Major anions and cations;
- Heavy metals (e.g. Arsenic, Cadmium, Chromium, Copper, Nickel, Lead, Zinc, Mercury);
- Nitrogen parameters (e.g. Total Nitrogen, Total Kjeldahl Nitrogen, Ammonia, Nitrate); and
- Total Phosphorus.
- Groundwater samples will be analysed by a National Association of Testing Authorities (NATA) accredited laboratory.

Documentation will be undertaken as part of licence reporting.

5.4.6 Predicted Environmental Outcome

Based on the available information and with regard to the proponent's commitments, the predicted impacts to inland waters environmental quality are considered minor. Therefore, the EPA's objective is unlikely to be compromised.

5.5 Waste

5.5.1 EPA Objective

There is no specific EPA objective with regard to waste management. However, it is assumed that this section requires that the proposal addresses the waste hierarchy and to ensure that the disposal of waste does not impact human health, water quality or ecological systems.

5.5.2 Applicable Standards, Guidelines or Procedures

- Waste Strategy for WA, Waste Authority March 2012.
- Landfill Waste Classification and Waste Definitions 1996 (As amended December 2009) Department of Environment and Conservation, WA.

5.5.3 Potential Sources of Impact

Wastes generated as a result of the project can be split into two main categories:

- Construction wastes; and
- Operational Wastes.

Construction of the Facility will result in the generation of solid and domestic waste. Its operation will generate the following classes of residues:

- Direct process outputs i.e. exhaust gases;
- Incinerator bottom ash including recyclable metals & aggregate;
- Flue gas treatment residues;
- Rejects and manually extracted outputs i.e. non-processible wastes;
- Municipal type wastes from the office/administrative building; and
- Liquid wastes such as sewage and greywater.

A further potential impact is that the facility could potentially accept waste that would otherwise be recyclable and use such materials as feedstocks. This would be contrary to the Waste Hierarchy.

The approach taken to ensuring that the acceptance of waste materials as feedstocks at the Facility is consistent with the Waste Hierarchy is addressed in Section 2.2 Project Justification and again in Section 7 – Holistic Impact Assessment. The key arguments presented are:

- Waste to Energy is higher in the Waste Hierarchy that disposal to landfill
- The Facility will primarily accept waste streams that are currently directed to landfill; and
- A significant percentage of the feedstocks to the Facility are non-recyclable residues from other waste treatment processes.

Direct process outputs from the Facility have been addressed in Section 4.2 of this ERD. The following sections addresses the other residual wastes listed above.

5.5.4 Assessment of Potential Impact

5.5.4.1 Construction Wastes

The construction of the Facility will result in the generation of minor quantities of solid and domestic waste. The wastes likely to be produced during construction will include:

- Topsoil and vegetative material from site clearing activities;
- Construction materials and packaging wastes;
- Spent hydrocarbon products;

- Domestic waste;
- Spent chemicals, solvents and paints;
- Wood, plastic, metal and paper waste; and
- Wastewater from toilet and ablutions.

5.5.4.2 Operational Wastes

Bottom Ash and Recyclable Metals

Bottom ash is the residue from the combustion process and has <3% carbon. Based on experience at other HZI plants, approximately 23% of the inputs to the Facility will be converted to bottom ash. Assuming the plant operates 8,000 hours per year and 300,000 tpa of waste input, this translates into a total bottom ash (including boiler ash) generation of 68,880 tpa or 8,610 kg/hr.

The bottom ash is mostly comprised of:

- Less than 1% of non-ferrous metals;
- Less than 10% ferrous metals;
- Less than 0.5% organic fraction; and
- Approximately 90% aggregate.

Samples from an operating plant in Europe have been tested in Australia and without further treatment, the bottom ash is suitable for disposal in a Class III landfill. However, with treatment the bottom ash will be suitable for use as aggregate. Further details relating to the use of the treated ash is provided in Section 5.5.5.3. A summary of the test results for the bottom ash is provided in Appendix 21.

Flue Gas Treatment Residues

The proposed facility will use a dry flue gas cleaning system downstream of the boiler to control the air emissions. Hydrated lime is injected into the flue gas where it neutralises acidic components such as hydrogen chloride, hydrogen fluoride and sulfur dioxide. At the same injection point, activated carbon is added to the flue gas to adsorb dioxins and furans, gaseous mercury, and other components. Downstream of the injection of the reactants, the flue gas passes through a fabric filter (bag filters) which trap fine particulates. Some of the spent lime is recycled to optimise the consumption of the reactants. Periodically, the fabric filters are cleaned by a reverse pulse of air, and the flue gas residues collected for disposal.

The flue gas residues will consist of spent lime, activated carbon used to capture volatile metals and any fine particulates generated from the burner train. It is estimated that the process will generate 1,240 kg/hr of dry flue gas treatment residues which equates to 9,920 tpa, or 1,463 kg/hr and 11,704 tpa of moistened residues.

Samples of flue gas treatment residues from an operating plant in Europe have been tested in Australia. This has indicated that the flue gas treatment residues are suitable for disposal in a Class III landfill. This material is slightly alkaline and to contain low levels of heavy metals such as lead, mercury and arsenic. A summary of the test results for the residue are provided in Appendix 21.

Non-processible waste

Wastes that do not meet the Facility's licence conditions, or wastes that cannot be processed will be rejected from the Facility. These wastes include:

- Scheduled wastes such as Polychlorinated Biphenyls (PCBs) and Organochlorine Wastes;
- Hydrocarbon sludges;
- Asbestos;
- Highly corrosive or toxic liquids or gases such as strong acids or chlorine or fluorine;
- Explosive materials; and
- Radioactive wastes.

If some of these wastes are received at the Facility, they will be quarantined and removed from the site for disposal to an appropriately licensed landfill. The expected quantities of these wastes are expected to be low

due to the measures to be implemented during the waste acceptance process as described detailed in Section 2.6.4.2.

Municipal Type Wastes

During operation, residual wastes from staff and visitors will be generated as well as wastes associated with maintenance or replacement of equipment. The quantities of these wastes are unknown, but are expected to be minor. These wastes will be directed for disposal on-site in the combustion system.

Liquid Wastes

It is estimated that 60,000 kL of water will be required per annum (approximately 180 kL/day) for the operation of the plant. The project feasibility has been developed based on use of scheme water. Water will be used for the following purposes:

- The energy from waste process:
- Water steam cycle (approximately 70 kL/day)
- Bottom ash extractor (approximately 60 kL/day)
- Bottom ash maturation and auxiliary uses (approximately 30 kL/day)
- Other uses for e.g. staff, sanitary, maintenance, cleaning and washing, landscape maintenance, etc. (approximately 20 kL/day).

The energy from waste plant itself is basically neutral in its water balance, i.e. no wastewater to be discharged as a result of the process. If during operation minor water quantities require disposal, the first priority is to re-use it elsewhere within the plant, e.g. for the fire-fighting tank, landscaping purposes or the bottom ash treatment area. There will be no on-site irrigation or infiltration of process effluent.

A small amount of sewage will be generated by staff using the site. Serage will be directed to an on-site aerobic treatment unit. Based on 40 employees, an annual sewage volume of approximately 1,314 kL per annum is expected to be generated. This has been calculated on the basis of 300L per person multiplied by a factor of 0.3 for commercial occupancy over 365 days.

5.5.5 Proposed Mitigation/Management Measures

The management of the outputs across the facility and to market or disposal is understood and will be implemented from the design stage through into operations.

5.5.5.1 Design

The Facility will be designed to include sufficient storage for any product or residue. The storage requirements will be based on the frequency of pickups for the removal of the product or residue to downstream processing facilities and the stability of the material as it is stored.

The storage of products and residues is paramount from an environmental and safety perspective as well as operationally. Ensuring separation in handling and reduction in co-mingled products is essential as this maximises the recyclability of the material recovered. The design allows for separate bunkers or bins for each of the expected outputs. The bunkers/bins will be located in an area of low vehicle or pedestrian traffic to allow risk free movement for the loader and trucks removing the material from site.

Storage bunkers or bin areas will be constructed of impermeable concrete, lined or manufactured as a steel bin and where required have provision for controlled drainage. Collected leachates will either be treated and recycled as wash-down water or managed with other liquid process wastes.

5.5.5.2 Construction

A CEMP will provide a framework for the environmental management of construction activities including waste management. The Plan will include strategies, procedures and work practices to avoid, mitigate or minimise impacts resulting during construction.

Wastes generated during the construction phase will be managed to prevent discharge to the environment. Wastes will be collected and stored appropriately and then disposed to the appropriately classed facility. Where possible, vegetative material will be chipped and re-used as mulch in landscaping. Sewage effluent

and greywater generated during construction will be retained in holding tanks for off-site disposal by a licensed contractor.

5.5.5.3 Operation

Bottom Ash Handling / Recyclable Metals and Aggregate

Bottom ash is extracted on a continuous basis from the combustion system via a water seal to prevent gaseous emissions and ensure that the bottom ash is wet and will not generate dust.

The material is transferred in a covered conveyor to a roofed and bunded facility used for storage, conditioning and treatment of the ash. All waste and storm water will be collected in a lined pond and re-used. The maturation area is enclosed by push walls.

The ash is stored in stockpiles for an initial period of two to three months to allow it to naturally stabilize and condition by exposure to the atmosphere. The maturation process involves a reaction between atmospheric carbon dioxide and the oxides contained in the ash in the presence of humidity (e.g. water) to form carbonates. This lowers the initial alkalinity to a level where is it acceptable for use as aggregate. During the maturation process the ash is occasionally turned by a front-end loader and may be wetted as required to assure sufficient humidity in the material as well as on the surface to prevent dust-blow off. Water from the lined pond, water from boiler water preparation as well as surface water from other areas of the facility will be used as part of this process.

The nature of the ash is such that the stockpiled material tends to crust and so it does not produce dust. In Europe and Britain this process is often conducted in the open to allow the material to interact with rainfall.

Once the material has been matured, it will be treated to produce a product that is suitable for:

- Road base;
- Backfill;
- Road base aggregate;
- Pipe bedding and drainage media;
- Fill material;
- A component of bituminous mixes; and
- Lightweight aggregate for masonry.

The treatment process commences with recovery of the mature ash using a front-end loader, the ash is loaded into the feed hopper where oversize material (i.e. greater in size than 250 mm) is separated. Material less than 250 mm in size is separated into several size fractions using a polygon trommel. The largest fraction passes under a band magnet, where ferrous components are separated. The middle fraction is similarly treated in a magnetic drum where also ferrous materials are captured. The finest fraction first passes through a magnetic drum to extract the ferrous materials and then treated in two Eddy current separators in series to separate non-ferrous metals. The separated ferrous and non-ferrous material is stored in bins under cover. The treated bottom ash leaves the bottom ash treatment building by belt conveyors and is directed for storage on an external bunded concrete pad.

In the United Kingdom, the use of aggregate from treated bottom ash is subject to meeting the requirements of the UK Standard Rules SR2012 No. 13 of the *Environmental Permitting (England & Wales) Regulations 2010*. In the absence of similar guidelines in Western Australia, New Energy commits to working with the DWER to adapt this Standard to suit the Western Australian context as a basis for assessing the suitability of the treated aggregate from the facility for safe use. The guidelines to be developed will include a recommended testing regime for the treated aggregate to ensure that it is safe for use. The testing requirements will be negotiated through the Part V licence conditions and integrated into New Energy's Environmental Management System (EMS).

The separated streams of aggregates and metals arising from the bottom ash treatment process will be sold into the recycling and reuse markets.

New Energy is in discussion with companies with existing operations in these markets. The companies have expressed an interest in taking the products from the Facility. Table 30 provides the quality requirements of the components/products recovered.

Table 30: Metals Quality Requirements

Recyclable	Market	Quality requirements
Ferrous metal	Allied/Sims/Amcor	3% contamination
Non-ferrous metal	Allied/Sims/Amcor	3% contamination
Aggregates	Construction and Civil sector (Boral and Hanson)	3% to 6% contamination

Product datasheets will be prepared for the aggregate materials (one per fraction) and for the metals (ferrous and non-ferrous) prior to commissioning of the plant. Each datasheet will contain details on the following:

- Description and Quantities – A high level description of the product and quantities to be handled.
- Compositional Analysis – A detailed ultimate analysis of the product including bulk density and size distribution.
- Material Flows – A description of fluidity of the product into or out of the specific product storage area. This will deal with whether stored in a bunker or bin and whether it is handled as a batch or continuous stream i.e. from a conveyor as it enters or exits the storage area.
- Quality Metrics – Details of the required quality i.e. level of contamination of the product.
- Quality Assessment – A description of tests to be undertaken to assess the quality of the product prior to shipping.
- Handling Considerations – Details of special requirements to safely handle the product.
- Loading Requirements – Details of the means for loading the product onto transport prior to removal from site.
- Transportation - Details of the means of transport. Highlight specific issues with any form of transport that is undesirable because of government regulations or handling requirements.
- Unloading Requirements - Details of the means for unloading the product off the transport once received at the destination.

In the event that agreement cannot be achieved for use of the treated aggregate from the Facility, the proposal will be modified so that the bottom ash will be stored in a dedicated ash bunker and loaded into trucks via a front end loader to a Class III facility. The bottom ash will be in a form that does not emit dust during transport or upon unloading.

Flue Gas Treatment Residues

Residues from the flue gas treatment process will be collected within a contained system integrated within the facility. The residue is stored on site in a purpose designed and built contained silo storage system. The system is controlled under the CEMS which monitors filling levels to inform the collection frequency. Prior to disposal from the site, the dry residue is dampened with water in a batch mixer located under the storage silo and is then loaded into trucks for disposal to an appropriately licensed facility.

Non-processible waste

The preferred approach to managing non-processible wastes (i.e. those wastes that do not meet the Facility's licence conditions, or wastes that cannot be processed) is to avoid accepting them in the first instance. To achieve this, the facility will incorporate the following measures:

- Only pre-authorised vehicles will be permitted to enter the site. Unauthorised vehicles will be directed to a holding area pending identification and characterisation of the origin and nature of the load. If confirmation of the load's suitability is not obtained, the vehicle will be instructed to leave the facility without offloading or collecting wastes/residues.
- Once authorised for entry to the facility, all commercial vehicles are directed to the weighbridge.
- All waste delivery vehicles are weighed at the weighbridge and their number plate is recorded via an automatic number plate recognition system
- Wastes are unloaded directly into the waste receival bunker and the grapple operator and floor supervises inspect each load visually as it is tipped.
- There may be instances where the delivery vehicle will be asked to unload away from the bunker to allow an inspection of the wastes and it may be possible the vehicle is required to stop unloading. This may be undertaken randomly or on suspicion that a vehicle is carrying non-processible wastes.

If wastes are removed on the basis that they are not considered to be processible wastes they will be placed at a location identified as the Collection Point at the Facility. Wastes that cannot be processed will be removed from the site and disposed at an appropriately classed facility.

Municipal Type Wastes

Residual wastes generated by staff and visitors will be collected in bins on-site and directed to the waste receival bay for use as feedstock.

Liquid Wastes

Sewage and greywater generated from the office and amenities building will be directed to an on-site aerobic treatment unit.

Wash down water will be collected in impermeable sumps and pumped to storage tanks. These tanks will have a bunded containment comprising 120% of the tank capacity. Where feasible, the collected wash down water will be filtered and re-used for wash down or injected into the bottom ash extractor.

If there is surplus water from the process, the first priority is to re-use the water elsewhere in the plant. Alternative disposal options may include evaporation through the combustion process, thermal evaporation using waste heat from the combustion process or off-site disposal to an appropriately licensed facility.

5.5.5.4 Measurements and Recording

The successful operation of the facility requires tracking of all outputs that enter and exit the facility. To accurately report on key performance indicators such as diversion rates from landfill, it will also be necessary to accurately track the flow of waste throughout the facility. New Energy is planning to use Mandalay Technologies to provide data capture, operational support software and analytical tools for the project. The Mandalay platform will record waste at key interfaces throughout the process.

New Energy will provide an annual report to DWER detailing all wastes accepted for treatment and how they were managed. This will include:

- The total waste received and processed at the facility;
- Total waste directed for combustion;
- Quantities of recovered metals and bottom ash sent to markets;
- The quantities and types of incompatible wastes and hazardous items recovered for disposal; and
- The quantities of the flue gas treatment residues generated disposed to landfill and its destination.

5.5.6 Predicted Environmental Outcome

New Energy anticipates that there will be minimal environmental impacts from waste handling procedures at the facility. This conclusion is reached on the basis of the facility design, operation and management procedures.

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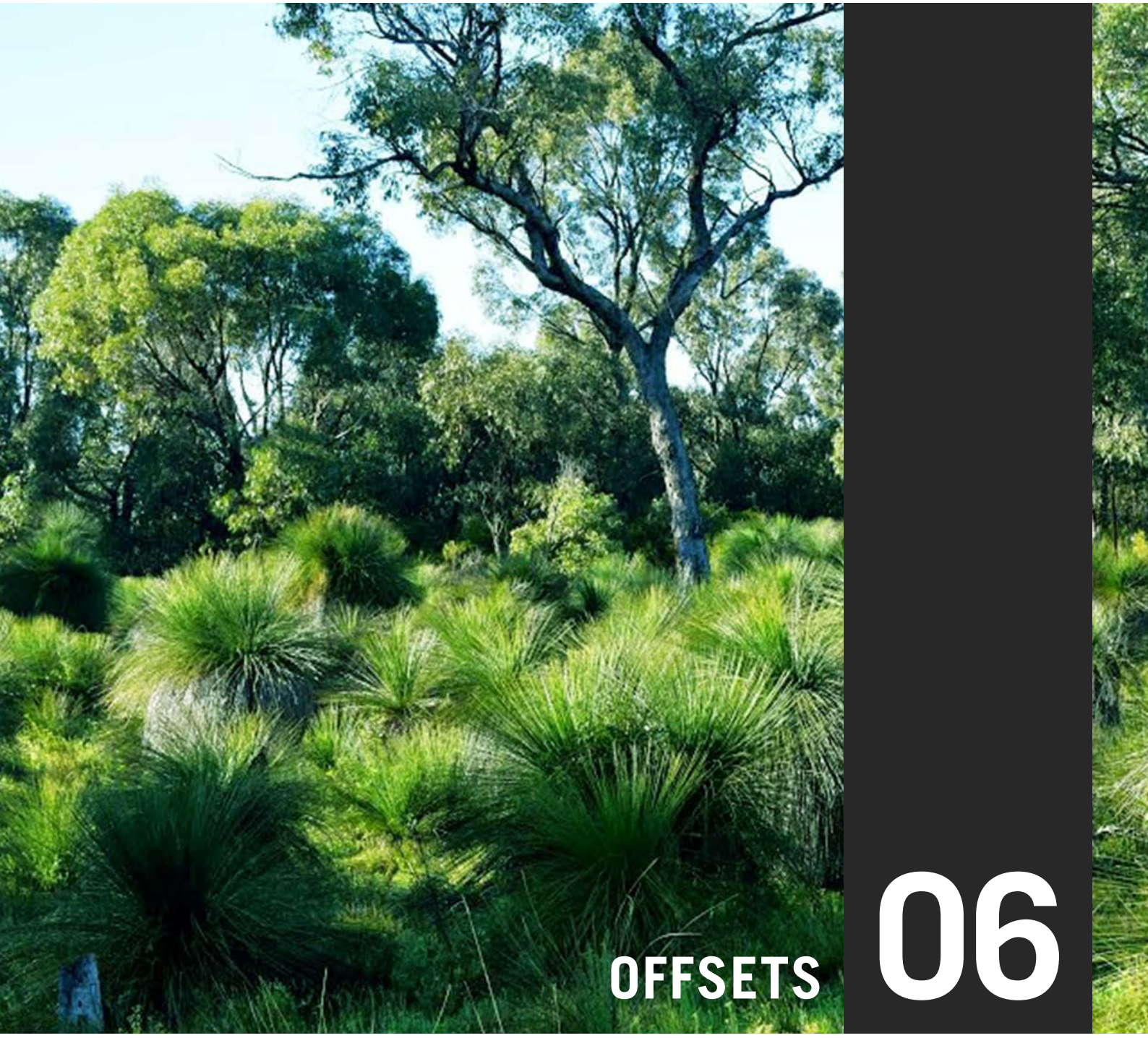

06 OFFSETS

6. Offsets

The EPA identified the following environmental factors as matters relevant to the proposal which required a thorough assessment in this ERD:

1. Air Quality
2. Social Surroundings (Odour and Noise)

The above factors were assessed in Section 4 of this report and the information presented confirmed that the project complies with relevant regulations, policies and criteria to the extent that the EPA objectives will not be compromised for these factors.

In addition to the above, the EPA identified other relevant environmental factors that needed to be addressed in the ERD. These included the following:

- Flora and vegetation – Impacts on native vegetation and flora through clearing of the 10ha site.
- Terrestrial fauna – Impacts on native fauna through clearing and development of the 10ha site.
- Hydrological processes – Potential changes to hydrological regimes through alteration to recharge and groundwater.
- Inland waters environmental quality – Potential impacts to groundwater quality through stormwater management and other discharges.
- Waste management – Disposal of generated waste products.

The other relevant factors outlined above were considered as part of the original proposal that was approved by the EPA in 2015. The potential impacts associated with the project as outlined in this ERD are not materially different from those in the original proposal where it was determined that the impacts would not comprise the EPA objectives with respect to these factors.

Given the management and mitigation measures as outlined in this ERD, New Energy does not anticipate any residual environmental impacts which would require the application of an environmental offset. Therefore, no environmental offsets are proposed for this project.

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HOLISTIC IMPACT ASSESSMENT

07

7. Holistic Impact Assessment

This ERD provides a detailed assessment of the potential environmental impacts and proposed environmental management strategies for relevant environmental factors. The ERD provides the information required to support the assessment of the environmental acceptability of the revised proposal by New Energy to construct and operate a waste to energy facility at 26 Office Road, East Rockingham. The project was previously referred for assessment and approved by the Minister for the Environment for implementation. The current assessment is required because of a decision by New Energy to adopt different technology which will utilise a proven moving grate combustion system rather than the high temperature gasification process originally proposed.

The environmental factors identified by the EPA for the revised proposal and described in the ESD have been considered against EPA objectives, as defined in EPA's (2016b) *Statement of Environmental Principles, Factors and Objectives*. The EPA advised that the environmental factors relevant to this Proposal are:

1. Air Quality.
2. Social Surroundings (Odour and Noise).
3. Flora and vegetation – Impacts on native vegetation and flora through clearing of the 10ha site.
4. Terrestrial fauna – Impacts on native fauna through clearing and development of the 10ha site.
5. Hydrological processes – Potential changes to hydrological regimes through alteration to recharge and groundwater.
6. Inland waters environmental quality – Potential impacts to groundwater quality through stormwater management and other discharges.
7. Waste management – Disposal of generated waste products.

The EPA advised that the factors identified at items 3- 7 above were considered as part of the original proposal that was approved by the Minister for the Environment in 2015 and that the potential impacts associated with the project as outlined in this ERD are not materially different from those in the original proposal.

The factors identified at items 1 and 2 above, have been assessed in the ERD. In undertaking the assessment, New Energy has considered the following principles outlined in the *Environmental Protection Act 1986.*

1. The precautionary principle;
2. The principle of intergenerational equity;
3. Principles relating to improved valuation, pricing and incentive mechanisms;
4. The principle of the conservation of biological diversity and ecological integrity; and
5. The principle of waste minimisation.

In developing the proposal, New Energy adopted the **Precautionary Principle** by considering the matters and requirements set down in the EPA'S Section 16e Advice to Government on Waste to Energy published in 2013 (EPA, 2013). Section 2.6.6 of this report describes how the proposal conforms with all of the recommendations set down in the Section 16 advice.

In selecting the HZI moving grate combustion technology for this project, New Energy was cognisant of selecting a technology with a large installed base of waste to energy facilities of an equivalent scale to the facility proposed at East Rockingham with a demonstrate track record of best practice performance dealing with similar feedstocks. The HZI technology was in fact one of the combustion technologies reviewed by the EPA in preparing its Section 16e advice report.

The feedstocks which will be accepted at the East Rockingham facility are all currently directed to landfill. Whilst a modern well designed landfill should not cause unacceptable environmental impacts, wastes in landfills are contained in a lined impoundment and remain a potential environment threat for decades following its placement. Securing waste within landfill relies on maintaining the integrity of liner and leachate management systems until the contained waste is stabilised and not biodegrading or producing leachates. Further, landfills effectively sterilise the land which they occupy for the foreseeable future. In contrast, a modern waste to energy facility such as that proposed by New Energy deals with waste

contemporaneously with the time it is produced and will divert away from landfill more than 95% of the waste that would ordinarily be delivered to landfill while enough electrical power for more than 38,000 homes. This is consistent with the ***Principle of Intergenerational Equity***.

The ***Principle relating to Valuation, Pricing and Incentive*** effectively embodies the principle that the polluter/user should pay the full environmental cost of any services or goods. As the East Rockingham proposal is inherently operating at the end of life for the goods used for feedstocks it can only address this matter by:

- Ensuring that it operates in a manner that meet environmental best practice;
- Fully complies with relevant policies and regulations;
- Fully costs the operation of the facility including environmental discharges and disposal of residues;
- As far as possible utilises feedstocks that would otherwise have gone to landfill; and
- Builds the cost of decommissioning of the facility and rehabilitation of the facility into the cost model for the facility.

As the facility meets international best practice and is operating competing commercially, waste charges fully reflect the current cost of environmental compliance. Unlike landfill, the East Rockingham waste to energy facility minimises the legacy costs associated with the long term storage of waste in lined landfill facilities while also producing sustainable electrical power.

In relation to the ***Principle of Conservation of Biological Diversity and Ecological Integrity***, although the facility does necessitate the clearing of some vegetation and associated fauna habitat, it has been located in an industrial area on a site that was earmarked for clearing. The EPA has previously acknowledged that the clearing of this vegetation is environmentally acceptable. It should also be noted that in the absence of this facility proceeding, some 7,500,000 tonnes of waste would otherwise have gone to landfill. This amount of waste would occupy almost 10,000,000 m^3 of volume and in a typical landfill would require landfill cells that would occupy at least 500,000 m^2 of area, around five times the area to be cleared for this project. This analysis ignores other reductions in environmental footprint due to avoiding the use of coal and gas to generate electricity and excavation of sand, limestone and hard rock by reusing the bottom ash for road base and fill.

This proposal is based on re-use of waste that is currently directed to landfill and therefore inherently operates higher in the Waste Hierarchy. Beyond this, the waste streams that are to be accepted are derived from facilities or systems where waste is segregated in order to recover recyclable materials. In particular:

- MSW is derived from local government operated kerbside waste collection systems which all involve as a minimum the recovery of dry recyclables and in the near future will involve the deployment of Food Organics and Garden Organics (FOGO) bins that will facilitate recoverable of wet compostable organic material.
- The majority of the remaining feedstocks will be derived as residual materials from the sorting of MSW, recyclables, C&I waste and C&D waste. As stated previously these residual waste streams are not currently recoverable and are directed to landfill.

In addition, the primary solid residue from the facility is the bottom ash which New Energy intends to process to produce an aggregate material for use in applications such as road base and fill. The ash treatment process uses a proven technology and will be conducted in accordance with a British Standard. New Energy will work with DWER to develop a locally equivalent standard before the facility is commissioned. Subject to acceptance, this will divert in excess of 68,000 tpa of waste.

In summary, the project diverts approximately 300,000 tpa of waste from landfill and will produce significant quantities of usable energy for supply to the SWIS. The project operates in accordance with the waste hierarchy, minimises waste to landfill and generally conforms to the ***Principle of Waste Minimisation*** by re-using treated bottom ash.

New Energy has developed this proposal in a manner intended to comply fully with the EPA's Section 16e advice on Waste to Energy Facilities. This has been achieved though:

- Careful site selection;
- Selection of a proven waste to energy technology with a large installed base of modern facilities that demonstrably operate in accordance with best practice;
- Selecting feedstock streams that currently are not recyclable and currently are disposed of to landfill;

- Developing a project which complements existing recycling initiatives and operations to increase waste diversion rates from landfill; and
- Adopting transparent approach to community and stakeholder consultation.

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08 REFERENCES

8. References

ABS, Australian Bureau of Statistics (2013). Socio-Economic Indexes for Areas 2011. Published by Australian Bureau of Statistics, Australia. Available online via: http://www.abs.gov.au/ausstats/abs@.nsf/mf/2033.0.55.001

ABS, Australian Bureau of Statistics (2017a). 2016 Census QuickStats: City of Rockingham. Available http://www.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/LGA57490.

ABS, Australian Bureau of Statistics (2017b). 2001 Census QuickStats: City of Rockingham. Available http://www.censusdata.abs.gov.au/census_services/getproduct/census/2001/quickstat/LGA57490?opendocument.

ANZECC and ARMCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

Assamoi, B. and Lawryshyn, Y. (2011). The Environmental Comparison of Landfilling vs. Incineration of MSW accounting for Waste Diversion. Published in Waste Management (2012) May; 32(5):1019-30.

Blue Environment (2014). Waste Generation and Resource Recovery in Australia: reporting Period – 2010/11, Final Report. A report prepared for the Department of Sustainability, Environment, Water, Population and Communities.

City of Rockingham (2012). Municipal Heritage Inventory. Report prepared September 2012.

Coffey Environments (2009a). Rockingham Industrial Zone – Strategic Environmental Assessment (Previously known as IP14 Area). Volume 1. Document EP2005/58. Prepared for Landcorp. Perth, Western Australia.

Coffey Environments (2009b). Rockingham Industrial Zone – Strategic Environmental Assessment (Previously known as IP14 Area). Volume 2. Document EP2005/58. Prepared for Landcorp. Perth, WA.

Coffey Environments (2010). Graceful Sun-Moth Assessment (*Synemon gratiosa*). Rockingham Industrial Zone. Document EP2010/086. Prepared for Landcorp. Perth, WA.

DBCA, Department of Biodiversity, Conservation and Attractions (2017). Priority Ecological Communities for Western Australia, Version 27. Available online - https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatened-ecological-communities. Department of Biodiversity Conservation and Attractions, Perth, Western Australia.

DEC, Department of Environment and Conservation (2011). Background Air Quality Monitoring in Kwinana 2005-2010: Technical Report. Report prepared by DEC Air Quality Management Branch, Perth, Western Australia.

DER, Department of Environment Regulation (2015a). Identification and investigation of Acid Sulfate Soils and Acidic Landscapes. Department of Environment Regulation, Perth, Western Australia.

DER, Department of Environment Regulation (2015b). Kwinana Background Air Quality Study: Phase 4 – 2013 to 2014. Department of Environment Regulation, Perth, Western Australia.

DER, Department of Environment Regulation (2017). Risk Assessments: Part V, Division 3, *Enviornmental rotection Act 1986.* Department of Environment Regulation, Perth, Western Australia.

DoH, Department of Health (2007). Acid Gases – Internal document. WA Department of Health, Perth, WA. (cited in Synergetics 2010).

Department of Mines and Petroleum (2001). 1:500,000 Regolith Map of WA. Geological Survey Division. Sourced from WA Atlas 3/2/2012.

DoW, Department of Water (2007). Cockburn Groundwater Area Water Management Plan. Water Resource Allocation Planning Series. Report No. WRAP 18. Perth, WA.

DoW, Department of Water (2010). Stormwater Management at Industrial Sites. Water Quality Protection Note No. 52. Department of Water, Perth, Western Australia.

Environment Australia (2000). Interim Biogeographical Regionalisation for Australia.

EPA, Environmental Protection Authority (2011). Rockingham Industrial Zone Strategic Environmental Assessment. Report No. 1390. Perth, Western Australia.

EPA, Environmental Protection Authority (2013). Environmental and Health Performance of Waste to Energy Technologies: Advice to the Environmental Protection Authority to the Minister for Environment under Section 16e of the *Environmental Protection Act 1986.* Report No. 1468. Environmental Protection Authority, Western Australia. April 2013.

EPA, Environmental Protection Authority (2016a). Environmental Factor Guidelines: Air Quality. Available - http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Guideline-Air-Quality-131216_2.pdf. Perth, Western Australia.

EPA, Environmental Protection Authority (2016b). Statement of Environmental Principles, Factors and Objectives. Environmental Protection Authority, Perth, Western Australia.

ENVALL, Environmental Alliances Pty Ltd (2017). Air Quality Impact Assessment of Proposed Waste Power Station in East Rockingham, Western Australia. Report prepared for Aurora Environmental. Draft 1a. Perth, Western Australia

ERM, ERM Australia Pty Ltd (2008). Rockingham Proposed Waste Water Treatment Plant, Hydrogeological and Hydrological Assessment, Rockingham, WA, Australia. Prepared for Water Corporation.

Gilfillan, S. and Barrett, S. (2004-2008). Matted Centroleis (*Centrolepis caespitosa*) Interim Recovery Plan No 159. Department of Environment and Conservation.

Government of Western Australia (2000). Bush Forever Volume 2. Directory of Bush Forever Sites. Published by the Department of Environmental Protection, Perth, Western Australia.

Government of Western Australia (2016). 2016 Statewide Vegetation Statistics. Department of Parks and Wildlife, Perth.

Gozzard, JR (1983). Rockingham part Sheets 2033 III and 2033 II. Perth Metropolitan Region, Environmental Geology Series, Geological Survey of WA.

ISO, International Standards Organization (2008). Technical Specification: Nanotechnologies-Terminology and definitions for nano-objects- Nanoparticle, nanofibre and nanoplate ISO/TS27687. International Standards Organisation Geneva, Switzerland.

Heddle E.M, Loneragan, O.W. and Havel, J.J. (1980). Vegetation of the Darling System. In Atlas of Natural Resources, Darling System, WA. Sourced via WA Atlas. https://www2.landgate.wa.gov.au/bmvf/app/waatlas/

Herring Storer Acoustics (2005). Cumulative Noise Model of the Kwinana Industrial Area. Prepared for Kwinana Industries Council. Reference: 4756-7-05023.

Herring Storer Acoustics (2017). Waste to Energy Power Station, East Rockingham – Environmental Acoustic Assessment. Report prepared for Aurora Environmental. Reference 22140-2-17194.

KIC, Kwinana Industries Council (2004). Committed to Improving Air Quality in the Kwinana Region. Published by Kwinana Industries Council, Western Australia.

NEPC, National Environmental Protection Council (2016). National Environmental Protection (Ambient Air Quality) Measure. As Amended. Prepared by the Department of the Environment. Canberra, ACT.

NHMRC, National Health and Medical Research Council (2004). Australian Drinking Water Guidelines.

DEC NSW, NSW Department of Environment and Conservation (2005). Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales. NSW DEC.

NSW DECC, NSW Department of Environment and Climate Change (2007). Report Into the Construction and Demolition Waste Stream Audit 2000-2005 Sydney Metropolitan Area. Department of Environment and Climate Change NSW.

Oberdörster, G., Maynard, A., Donaldson, K., Castranova, V., Fitzpatrick J, Ausman, K., Carter J., Karn, B., Kreyling, W, Lai., D, Olin, S., Monteiro-Riviere, N., Warheit, D., Yang, H. (2005). A report from the ILSI Research Foundation/Risk Science Institute Nanomaterial Toxicity Screening Working Group. Principles for characterizing the potential human health effects from exposure to nanomaterials: elements of a screening strategy. Particle and Fibre Toxicology 2005, 2:8. Available online: http://www.particleandfibretoxicology.com/content/2/1/8

Synergetics Environmental Engineering (2012a). Air Quality Impact Assessment for the Proposed Waste Gasification Power Station at East Rockingham, WA. Prepared for New Energy Corporation.

Synergetics Environmental Engineering (2012b). Review of Literature on Gasification Derived Nanoparticles. Prepared for New Energy Corporation.

Tchobanaglous, G., Theisen, H. and Vigil, S. A (1993). Integrated Solid Waste Management. McGraw Hill International. United State of America. pp.125 - 157 (1993).

TOU, The Odour Unit (2013). Desktop Dispersion Modelling – Assessment of Proposed Waste to Energy Facilities. Boodarie, Port Hedland and Rockingham, WA.

Toxikos (2009). Health Risk & Toxicological Assessment – Worsley Expansion Emissions. Document No. TR101208-J0, June 2009.

Toxikos (2010). Air Guideline Values for Selected Substances. Prepared for WA Department of Environment and Conservation. Toxikos Toxicology Consultants, Document Tr100409-JTRF. 29 June 2010.

Trudgen, M. and Weston, A (1998). The Conservation Significance of Seasonal Wetland Vegetation in Industrial Park 14, East Rockingham, WA. Prepared for the Department of Conservation and Land Management. December 1998.

Umwelt Environmental Consultants (2009). IP14 Area Geomorphology and Groundwater Investigation. Prepared for LandCorp. Report No. 2310/R01/V2/Final.

Waste Authority Western Australia (2010). Waste Strategy for Western Australia. Draft II. March 2010. Government of Western Australia.

Waste Authority of Western Australia (2012). Western Australian Waste Strategy: Creating the Right Environment. Waste Authority of Western Australia, Perth, Western Australia. March 2012.

Waste Authority of Western Australia (2014). Strategic Waste Infrastructure Planning Project. Waste and Recycling Infrastructure Plan for the Perth Metropolitan and Peel Regions Investigation Report. Waste Authority of Western Australia, Perth, Western Australia. June 2014.

Water Corporation (2017). Our Water Sources. Information from webpage, sourced 20 September 2017, via https://www.watercorporation.com.au/water-supply/our-water-sources?pid=res-wss-np-spw.

Wilkinson Murray (2014). Banksmeadow Transfer Terminal – Air Quality Impact Assessment".

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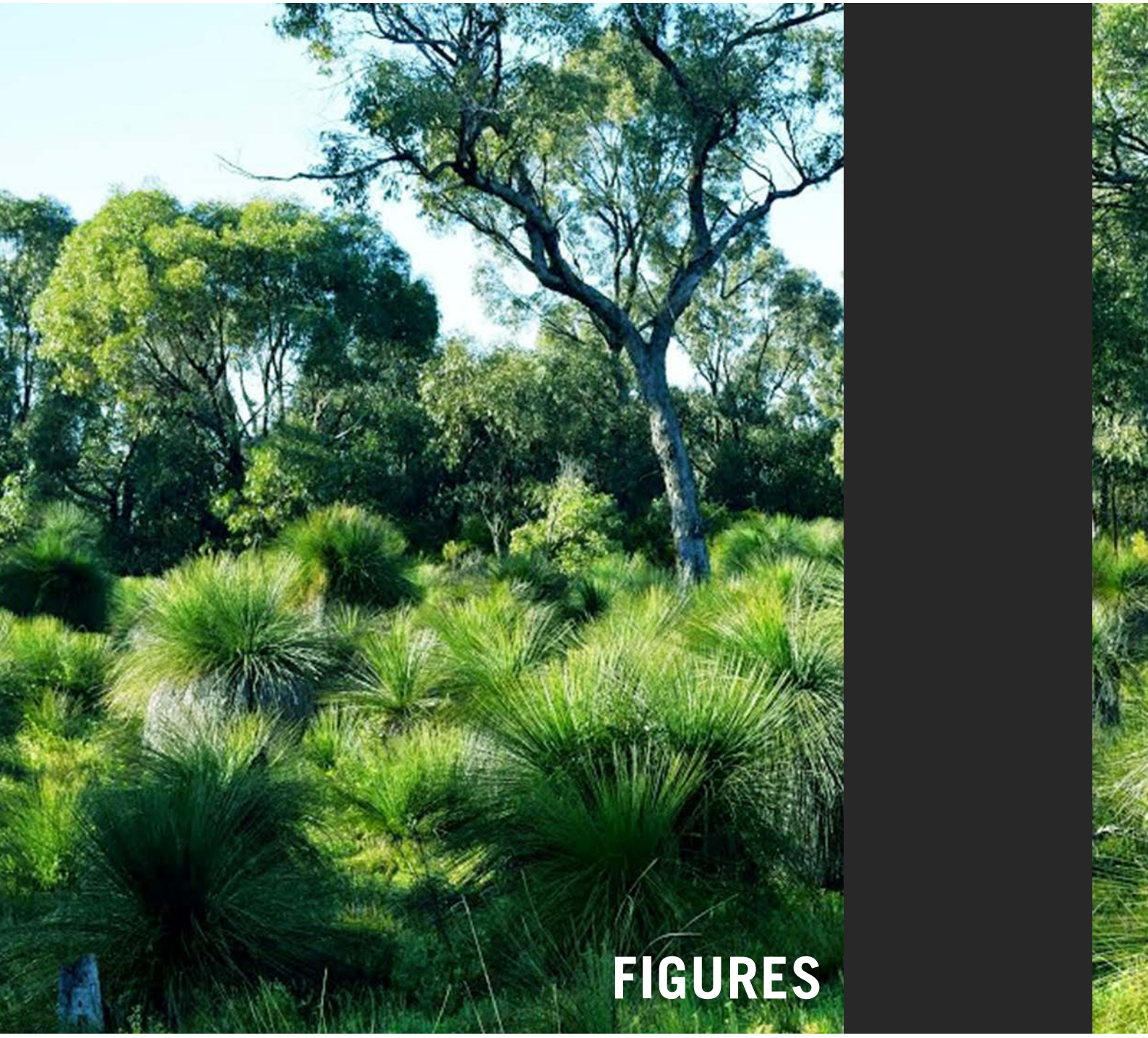
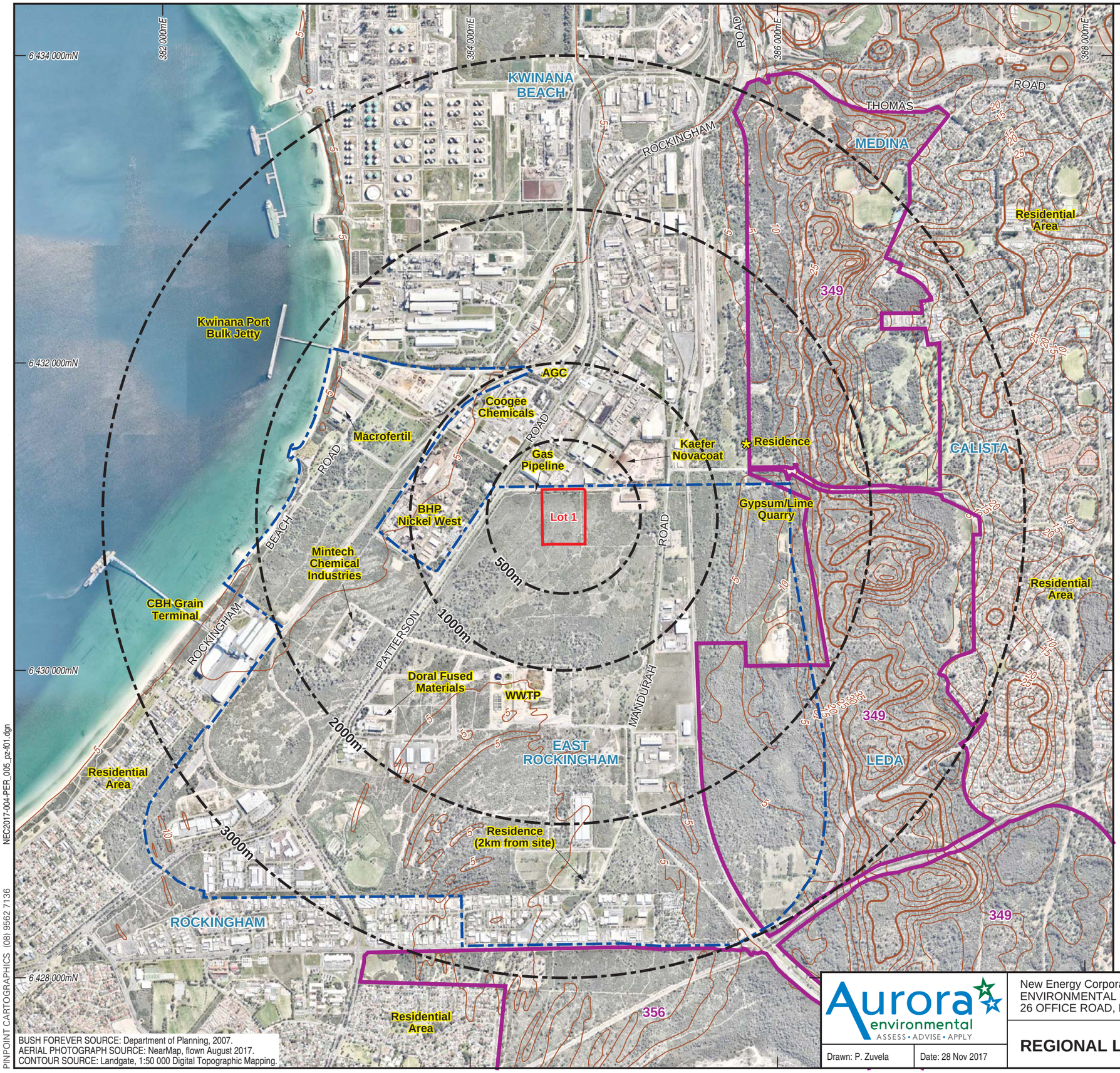


FIGURES

FIGURES



BUSH FOREVER SOURCE: Department of Planning, 2007.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown August 2017.
CONTOUR SOURCE: Landgate, 1:50 000 Digital Topographic Mapping.

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Drawn: P. Zuvela | Date: 28 Nov 2017

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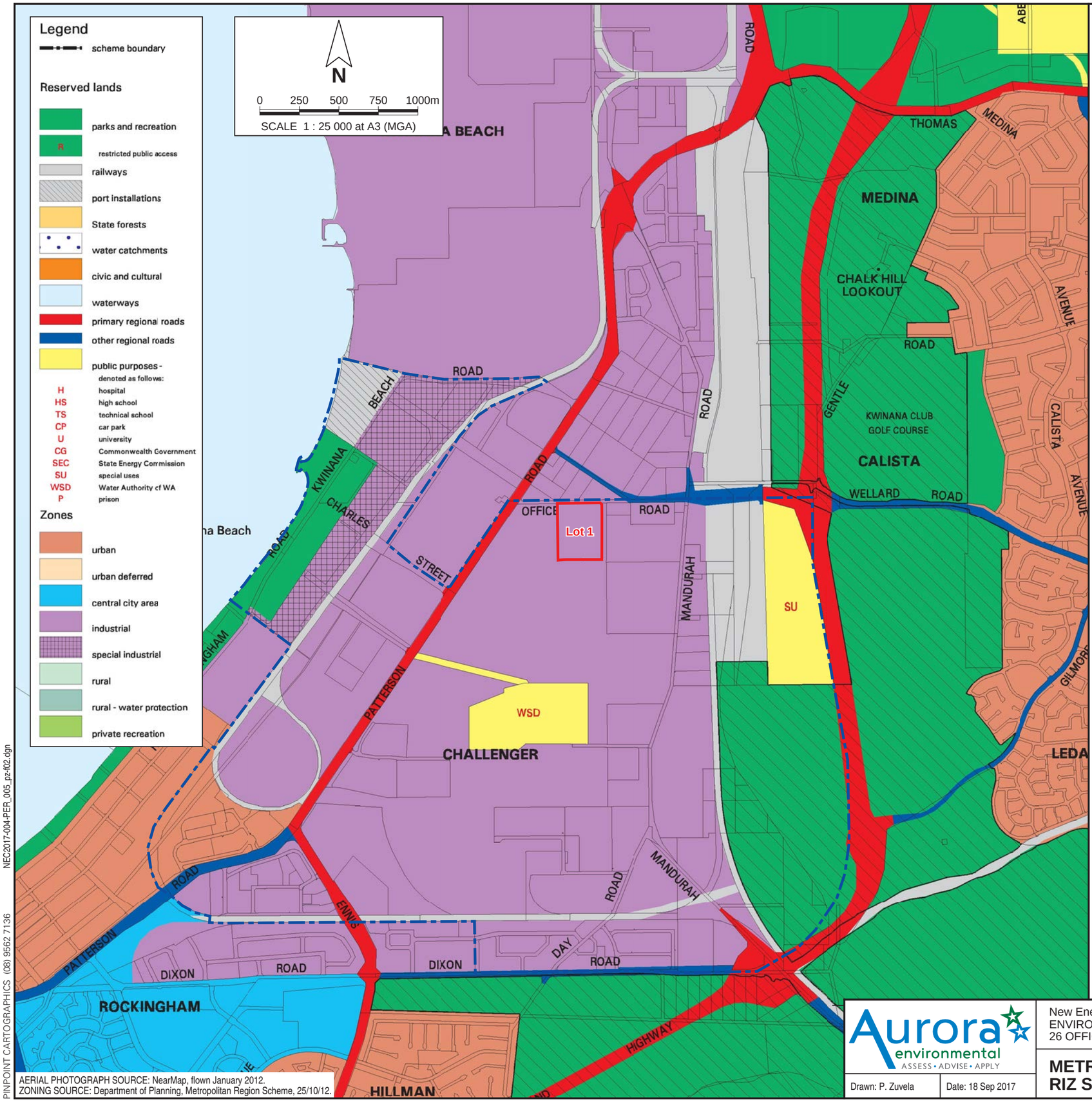
26 OFFICE ROAD, EAST ROCKINGHAM

REGIONAL LOCATION & SURROUNDING LANDUSE

Figure 1

Job: NEC2017-004

PINPOINT CARTOGRAPHICS (08) 9562 7136 NEC2017-004-PER_005_pz-f01.dgn



STRUCTURE PLAN

1 PRECINCT ONE - Port related industry
2 PRECINCT TWO - Environmentally Acceptable Heavy Industry
3 PRECINCT THREE - Advanced Material Park
4 PRECINCT FOUR - General Industry
5 PRECINCT FIVE - Light Industry
6 PRECINCT SIX - Wool Processing Precinct
7 PRECINCT SEVEN - Service Commercial Precinct

Garden Industrial Precinct
Service Corridor Waste
Water Treatment Site
Parkland Buffer

N
0 500 1000m
SCALE 1 : 50 000 at A3

STRUCTURE PLAN SOURCE: Taylor and Burrell.

Legend

Site Boundary

Rockingham Industrial Zone Boundary

PINPOINT CARTOGRAPHICS (08) 9562 7136 NEC2017-004-PER_005_pz-f02.dgn

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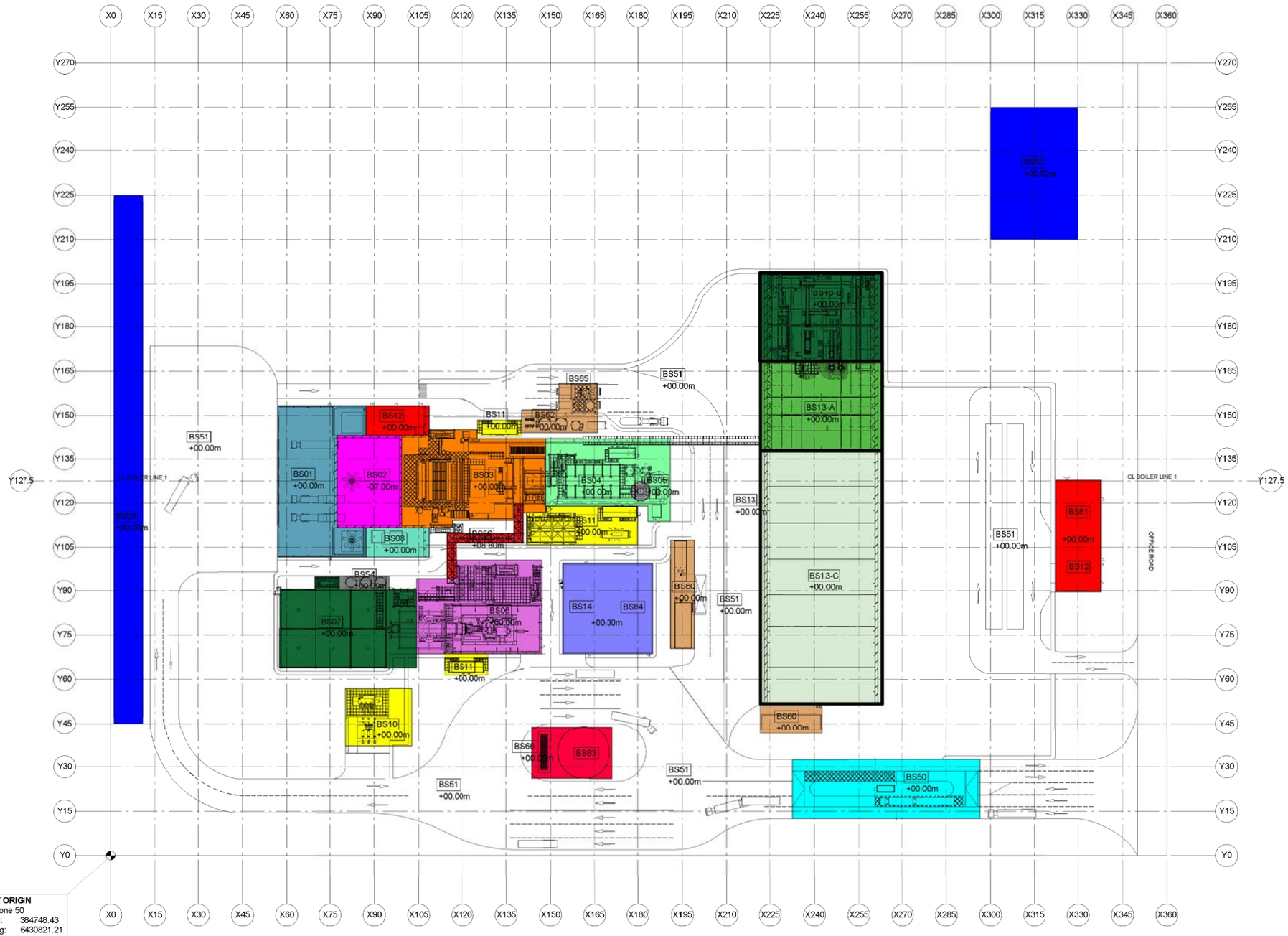
METROPOLITAN REGION SCHEME AND RIZ STRUCTURE PLAN

Figure 2

Job: NEC2017-004



Hitachi Zosen INOVA

SOURCE: Hitachi Zosen INOVA, Dwg. No. 40058600, Rev. 0.1 - 15-09-17.

N

0 10 20 30 40 50m

SCALE 1 : 1 500 at A3 (MGA)

LEGEND:

BS01	TIPPING HALL
BS02	WASTE BUNKER
BS03	BOILER HALL
BS04	FLUE GAS TREATMENT
BS05	STACK
BS06	TURBINE HALL
BS07	AIR COOLED CONDENSER
BS08	BOP AREA
BS10	HV TRANSFORMER / SUBSTATION
BS11	ELECTRICAL E-HOUSING
BS12	ADMINISTRATION BUILDING
BS13	BOTTOM ASH TREATMENT / BA
BS13-A	BA PRE TREATMENT STORAGE
BS13-B	BA PROCESS HALL
BS13-C	BA LONG TERM STORAGE
BS14	WORKSHOP
BS50	WEIGHT BRIDGE / GATE HOUSE
BS51	INFRASTRUCTURE
BS53	POND's
BS54	DEMINERALISED WATER PLANT
BS56	PIPE BRIDGE
BS60	STORAGE TANKS (CONSUMABLES)
BS61	VISITOR CENTER
BS62	SILOS
BS63	FIRE WATER TANK
BS64	STORAGE BUILDING
BS65	FGTR STABILIZATION PLANT
BS66	FIRE PUMP HOUSE

CHECKER

GRATING

SAFEDECK

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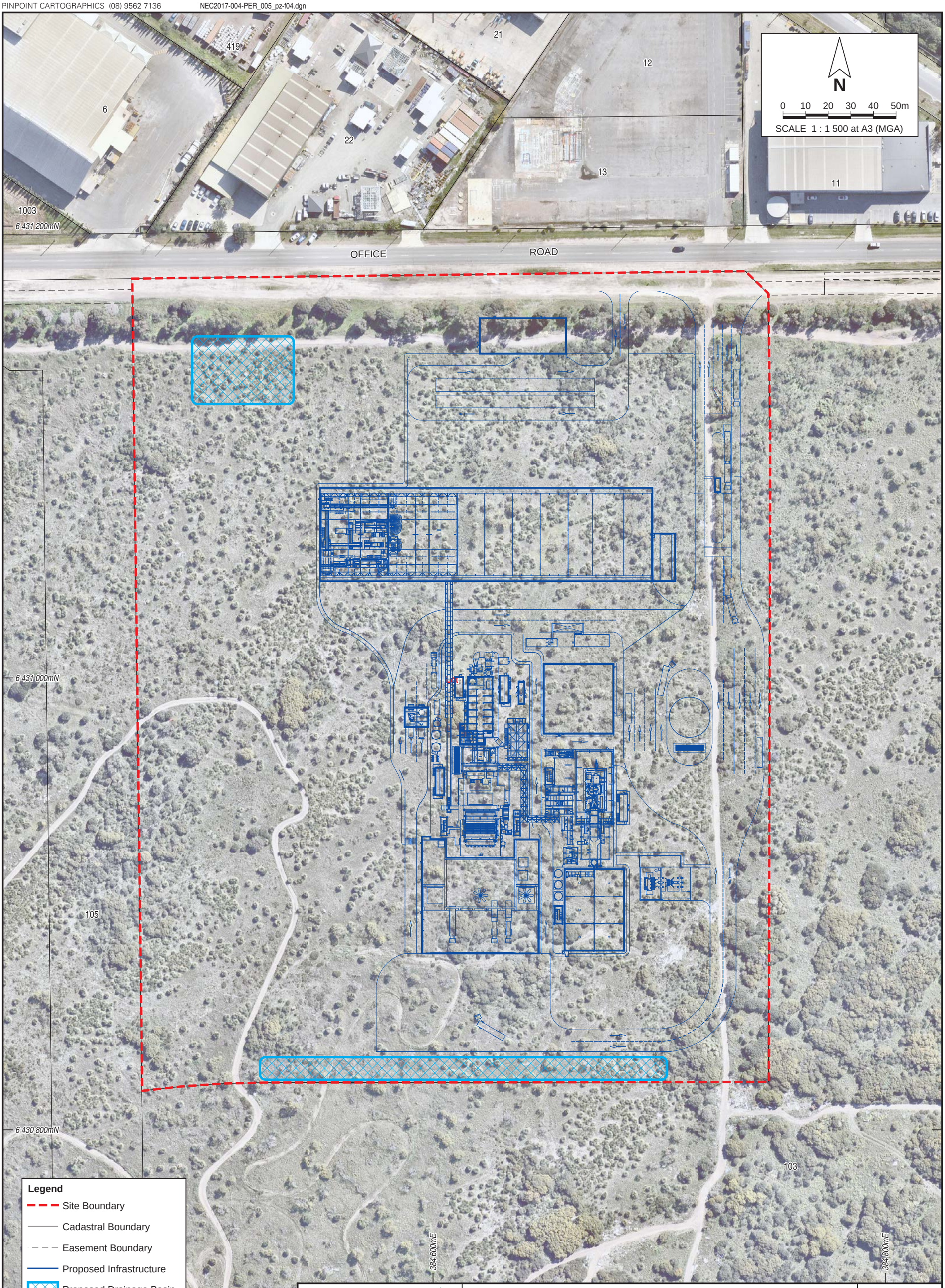
26 OFFICE ROAD, EAST ROCKINGHAM

PROPOSED SITE LAYOUT

Figure 3

Drawn: P. Zuvela | Date: 18 Sep 2017 | Job: NEC2017-004

PINPOINT CARTOGRAPHICS (08) 9562 7136 NEC2017-004-PER_005_pz-f03.dgn



CADASTRAL SOURCE: Landgate, September 2017.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown August 2017.
LAYOUT SOURCE: Hitachi Zosen INOVA, Dwg. No. 40058600, Rev. 0.1 - 15-09-17.

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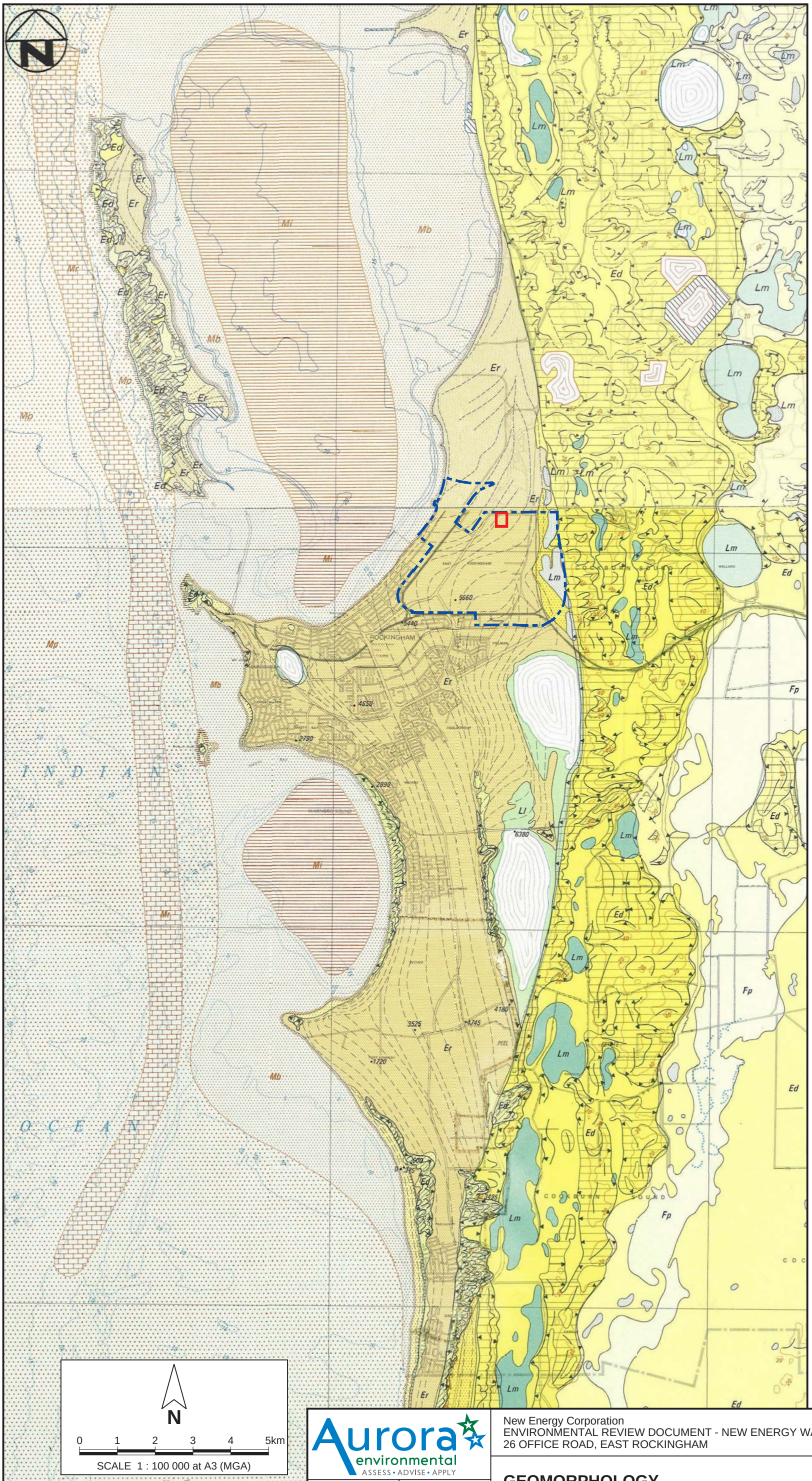
CONCEPTUAL DRAINAGE DESIGN

Figure 4

Job: NEC2017-004



GEOMORPHOLOGICAL CLASSIFICATION

- Ed — Parabolic and nested parabolic dunes, Quindalup Dunes
- Er — Relic foredune sequence, high level, Holocene
- Er — Relic foredune sequence, low level, Holocene
- Er — Relic foredune sequence, Pleistocene/Holocene
- Ed — Degraded surface of eolian origin, Spearwood Dunes
- Ed — Degraded surface of eolian origin, Bassendean Dunes
- Lm — Marsh in interbarrier depression, high level
- Lm — Marsh in interbarrier depression, low level
- Lm — Marsh in interdunal swale
- Ep — River floodplain and undifferentiated river terraces – mostly reclaimed
- Ft — River terraces, where indentified
- Lake
- Mb — Submarine bank
- Mp — Submarine shelf
- Mi — Submarine basin
- Mr — Zone of submerged beach rock
- Ar — Limestone bar
- Ab — Sand banks and spits
- Ap — Estuary floor

SLOPES

- $0^0 - 3^0$
- $3^0 - 10^0$
- $10^0 - 20^0$
- $20^0 - 30^0$

FEATURES

- Prominent ridge
- Sharp convex break of slope
- Sharp concave break of slope
- Relic foredune trend lines
- Cliff
- Erosional scarp

The geomorphological classification comprises a single capital letter which denotes the origin of the material and a lower case letter which represents the morphology.

ORIGIN

- *E*..... eolian
- *L*..... lacustrine
- *F*..... fluvial
- *A*..... estuarine
- *M*..... marine

MORPHOLOGY

- *d*..... dune
- *p*..... plain
- *m*..... marsh
- *i*..... depression
- *r*..... ridge
- *t*..... terrace
- *b*..... bank

Legend

- Site Boundary
- Rockingham Industrial Zone Boundary

SOURCE: Geological Survey of WA,1985.

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Figure 5

GEOMORPHOLOGY

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N

0 250 500 750 1000m

SCALE 1 : 25 000 at A3 (MGA)

Legend

- Site Boundary
- Rockingham Industrial Zone Boundary
- Groundwater Contour
- DoW Bore Location
- ERM Bore Location

NOTE:
Groundwater levels are in m AHD.

SOURCE: Umwelt Environmental Consultants.

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GROUNDWATER CONTOURS

Figure 6

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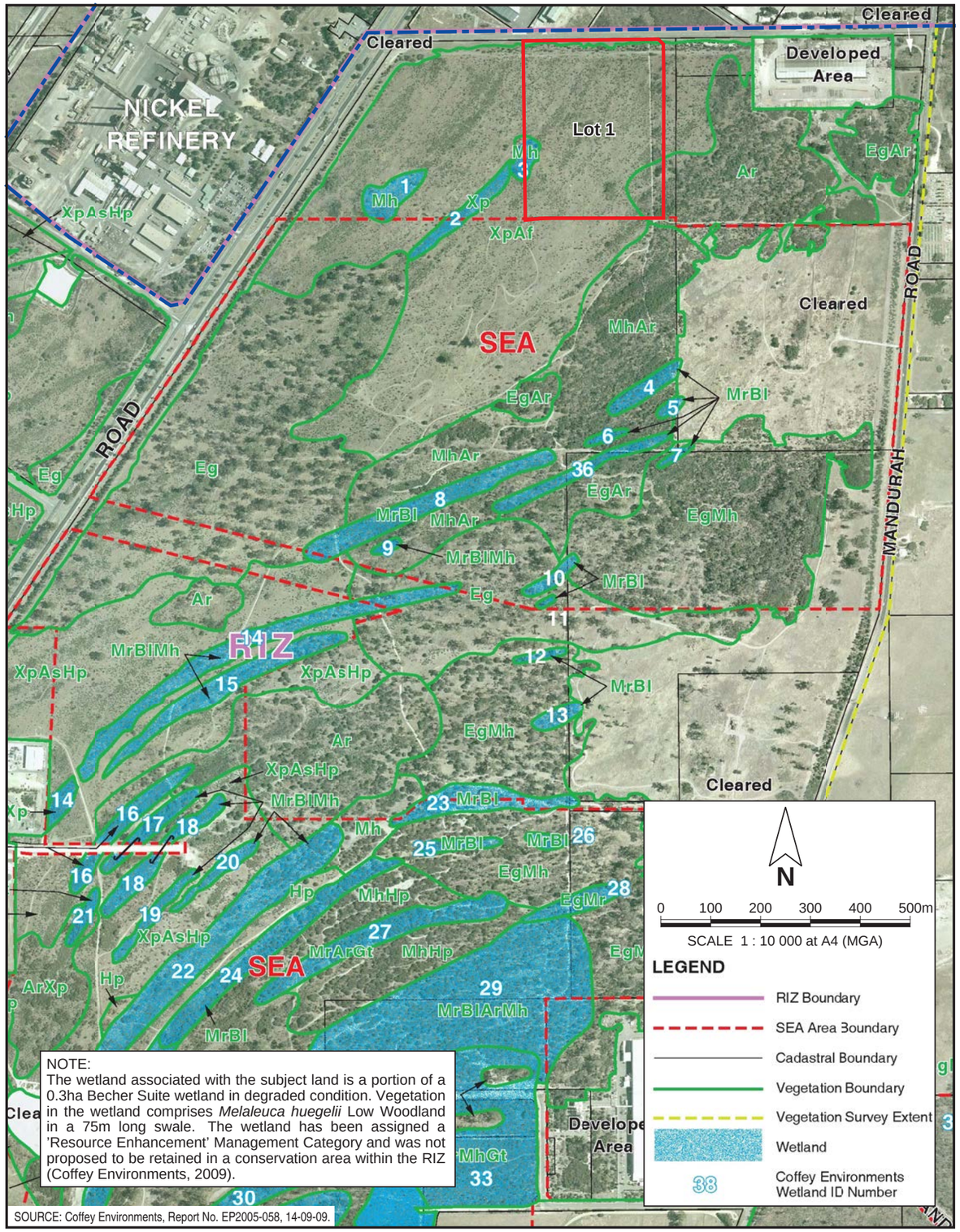

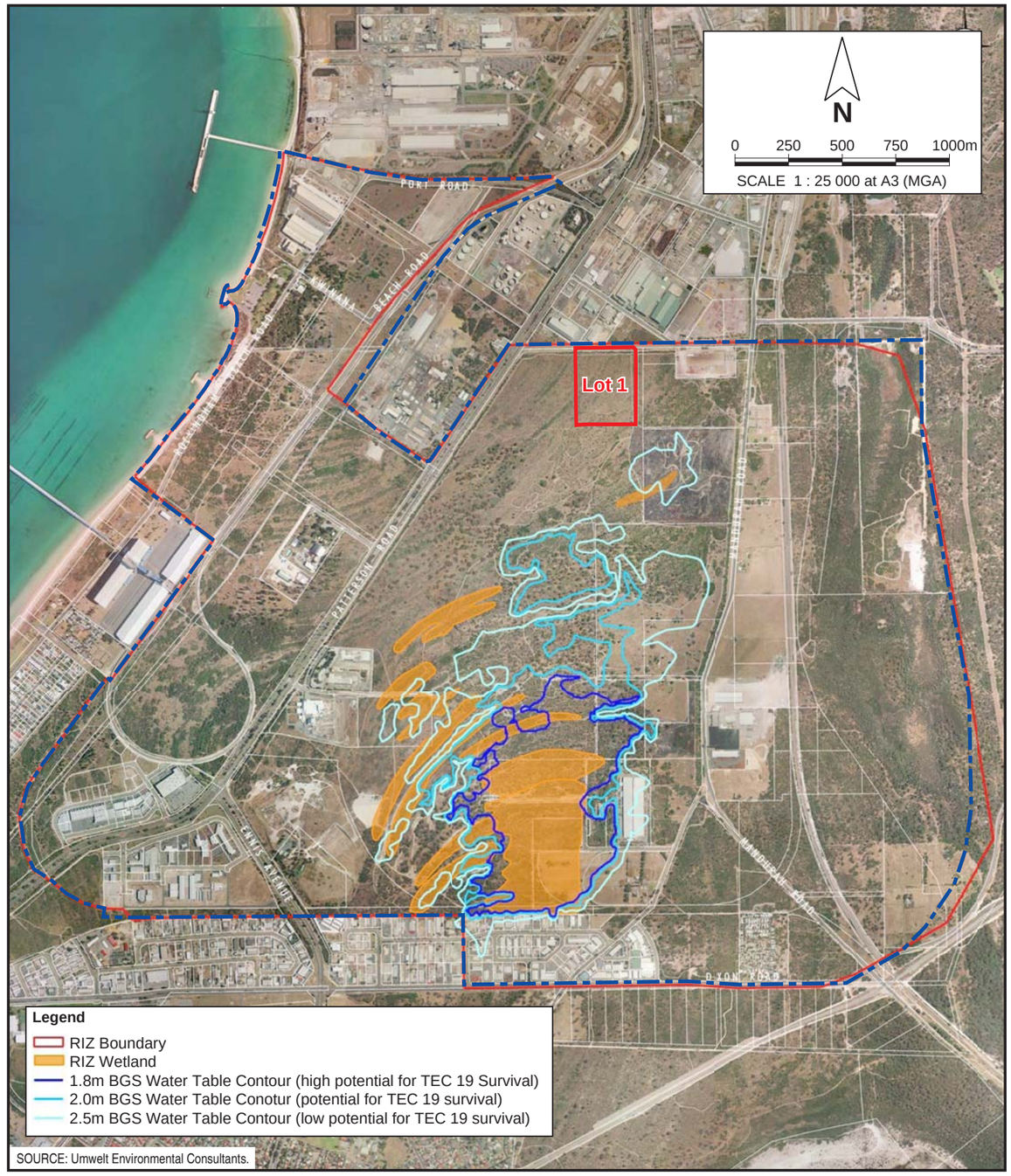

NOTE: The northern portion of the RIZ is likely to experience a drop in groundwater levels due to reduced rainfall, which indicates that TEC 19 has a low potential for survival in the medium to long term.

Legend

Site Boundary

Rockingham Industrial Zone Boundary

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WETLANDS

Figure 7

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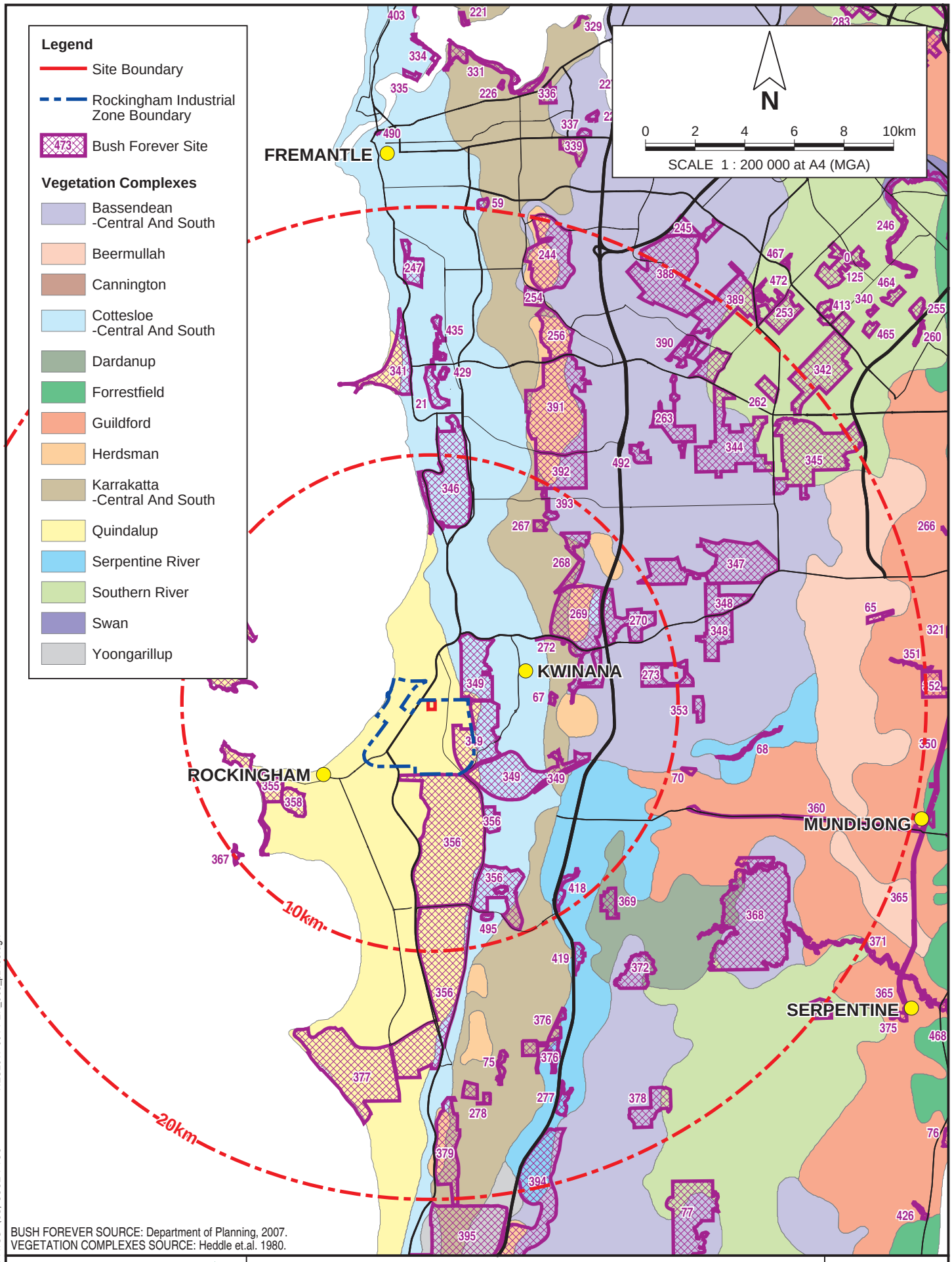

BUSH FOREVER SOURCE: Department of Planning, 2007.
VEGETATION COMPLEXES SOURCE: Heddle et.al. 1980.

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Figure 8

VEGETATION COMPLEXES AND BUSH FOREVER SITES

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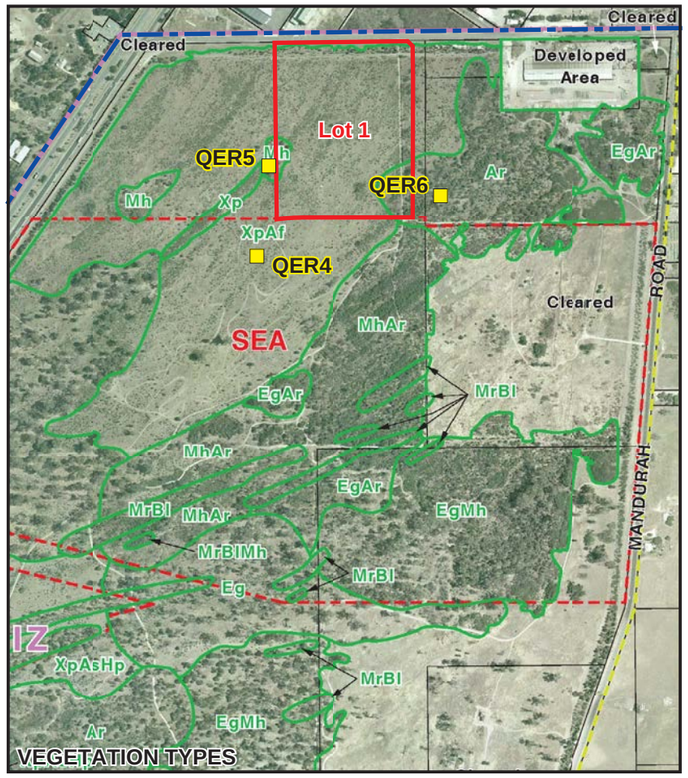
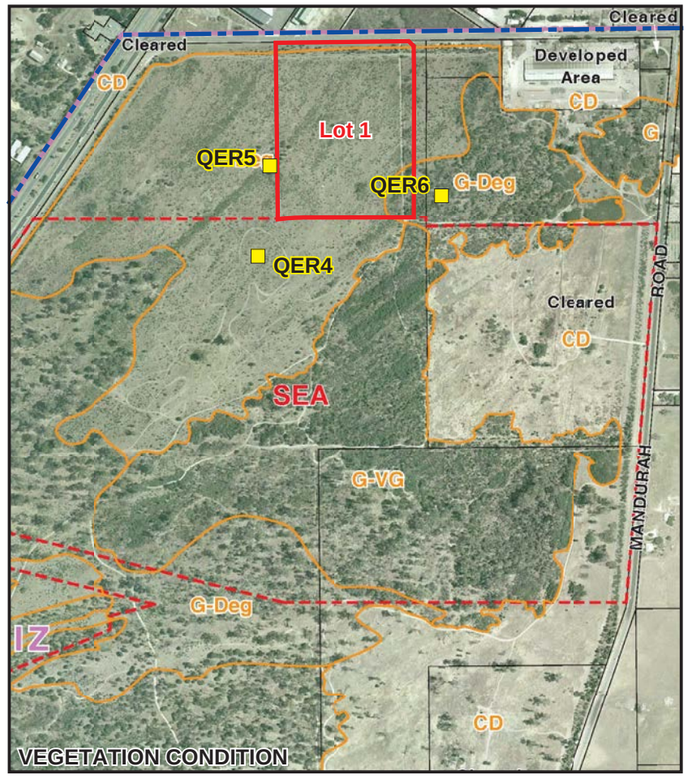
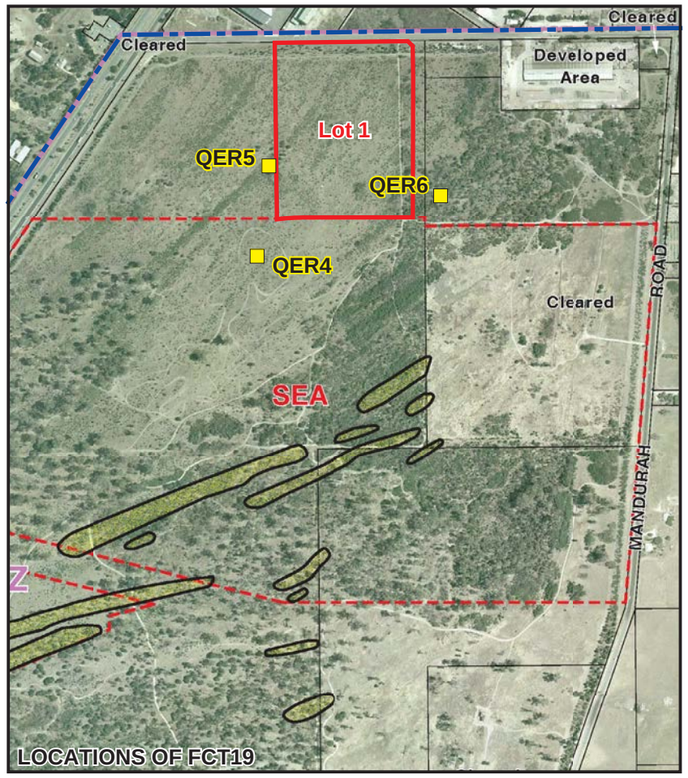
PINPOINT CARTOGRAPHICS (08) 9562 7136 NEC2017-004-PER_005_pz-108.dgn







VEGETATION TYPES LEGEND

Eg	*Eucalyptus gomphocephala* Woodland
EgAr	*Eucalyptus gomphocephala* Open Woodland over *Acacia rostellifera* Shrubland
EgMh	*Eucalyptus gomphocephala* Open Woodland over *Melaleuca huegelii* Shrubland
EgMr	*Eucalyptus gomphocephala* Open Woodland over *Melaleuca rhaphiophylla* Shrubland
Ar	*Acacia rostellifera* Tall Shrubland
ArHp	*Acacia rostellifera / Hakea prostrata* Shrubland
Mh	*Melaleuca huegelii* Low Woodland
MhAr	*Melaleuca huegelii / Acacia rostellifera* Tall Open Shrubland
MhHp	*Melaleuca huegelii* Open Woodland over *Hakea prostrata* Shrubland
MrBlArMh	*Melaleuca rhaphiophylla / Banksia littoralis / Acacia rostellifera / Melaleuca huegelii* Low Open Woodland
MrGt	Melaleuca rhaphiophylla / Gahnia trifida Woodland
MrMhGt	Melaleuca rhaphiophylla / Melaleuca huegelii / Gahnia trifida Woodland
MrArGt	Melaleuca rhaphiophylla / Acacia rostellifera / Gahnia trifida Shrubland
MrBl	Melaleuca rhaphiophylla / Banksia littoralis Shrubland
MrBlMh	Melaleuca rhaphiophylla / Banksia littoralis / Melaleuca huegelii Shrubland
MrArMh	Melaleuca rhaphiophylla / Acacia rostellifera / Melaleuca huegelii Shrubland
BlAr	Banksia littoralis / Acacia rostellifera Low Woodland
Xp	Xanthorrhoea preissii Shrubland
XpAf	Xanthorrhoea preissii / Avena fatua Shrubland
XpAsHp	Xanthorrhoea preissii / Acacia saligna / Hakea prostrata Shrubland
Hp	Hakea prostrata Shrubland

LEGEND

- RIZ Boundary
- SEA Area Boundary
- Cadastral Boundary
- Vegetation Condition Boundary

VEGETATION CONDITION
(Legend Source: BUSH FOREVER Govt. of W.A.)

P	Pristine.
Ex	Excellent.
VG	Very Good.
G	Good.
Deg	Degraded.
CD	Completely Degraded.

NOTE: For full description see text.

LEGEND

- RIZ Boundary
- SEA Area Boundary
- Cadastral Boundary
- FCT19 Boundary

N

0 100 200 300 400 500m

SCALE 1 : 12 500 at A3 (MGA)

Legend

- Site Boundary
- Rockingham Industrial Zone Boundary
- Quadrat Location

SOURCE: Coffey Environments, Report No. EP2005-058, 14-09-09.

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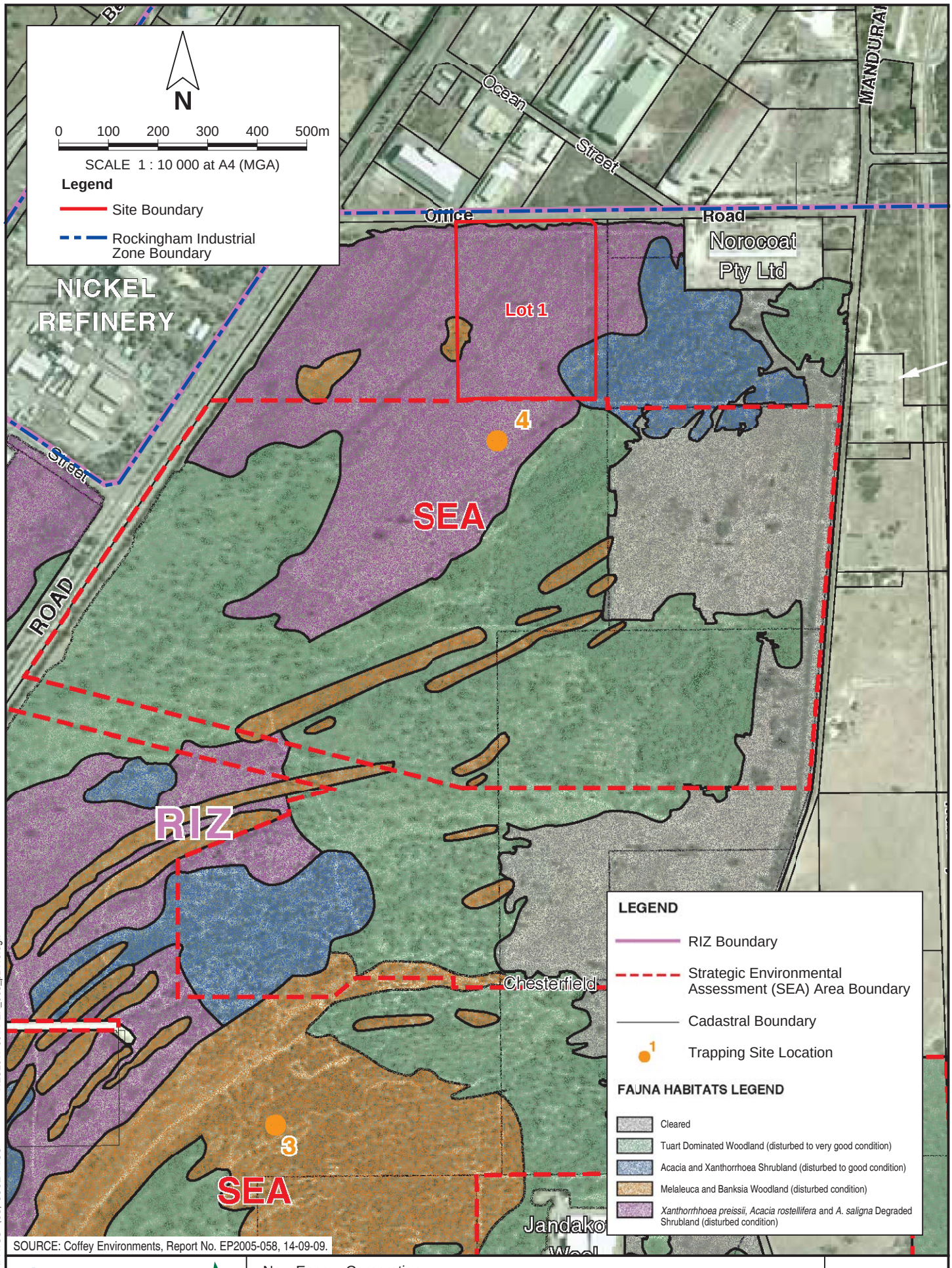
26 OFFICE ROAD, EAST ROCKINGHAM

VEGETATION, FLORA AND TEC SURVEYS

Figure 9

Job: NEC2017-004



SOURCE: Coffey Environments, Report No. EP2005-058, 14-09-09.

PINPOINT CARTOGRAPHICS (08) 9562 7136 NEC2017-004-PER_005_pz-f10.dgn

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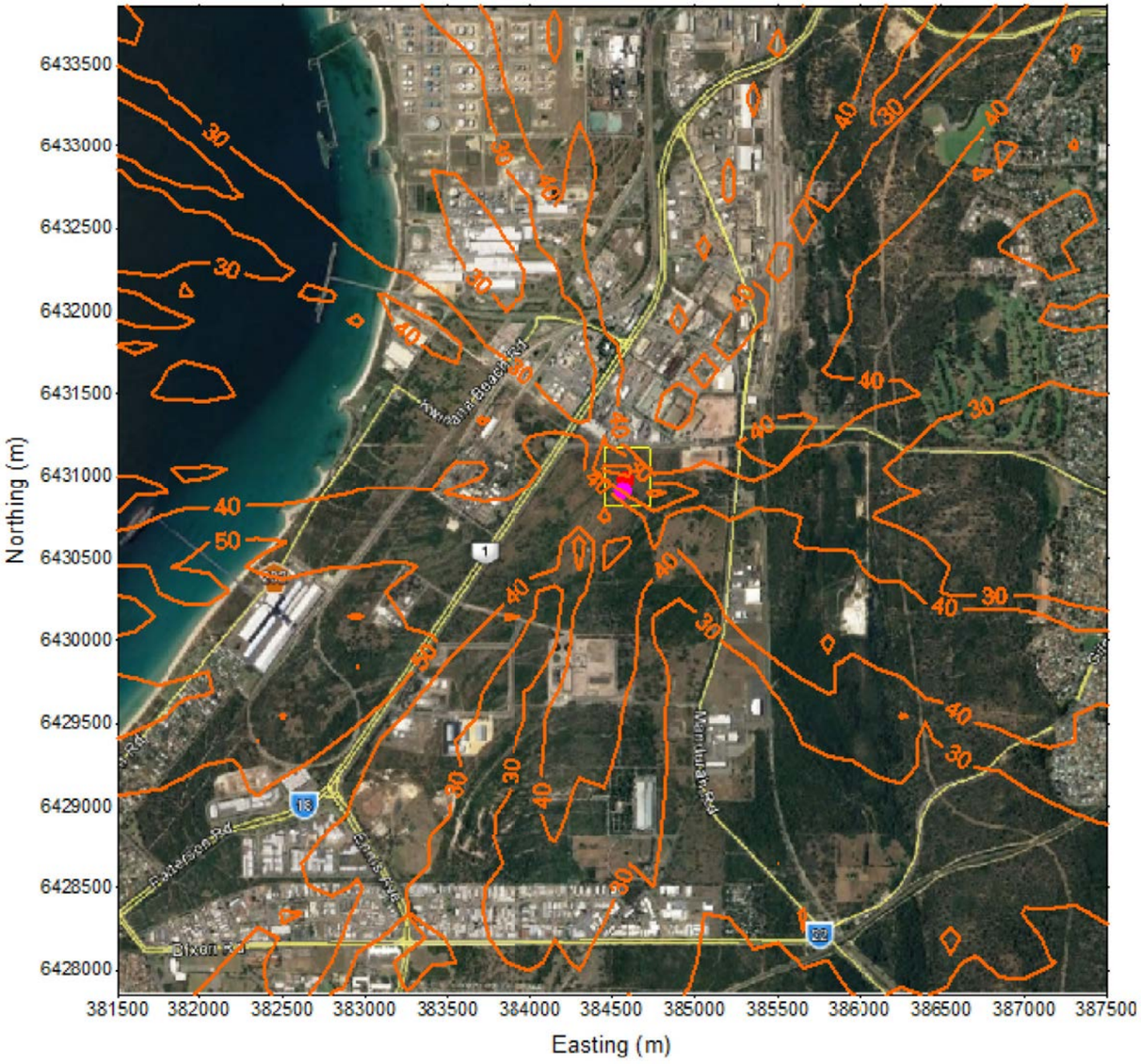
Figure 10

FAUNA HABITAT

Drawn: P. Zuvela | Date: 29 Oct 2017 | Job: NEC2017-004

Predicted Maximum 1 Hour Nitrogen Concentration from Proposal (µg/m³)



Predicted Maximum 1 Hour Cadmium Concentration from Proposal (µg/m³)

0 250 500 750 1000m

SCALE 1 : 35 000 at A3 (MGA)

SOURCE: Envall, Rpt No. L7059, Figure 5 & 7.

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Figure 11

PREDICTED MAXIMUM 1-HOUR AVERAGE NITROGEN DIOXIDE AND CADMIUM CONCENTRATIONS

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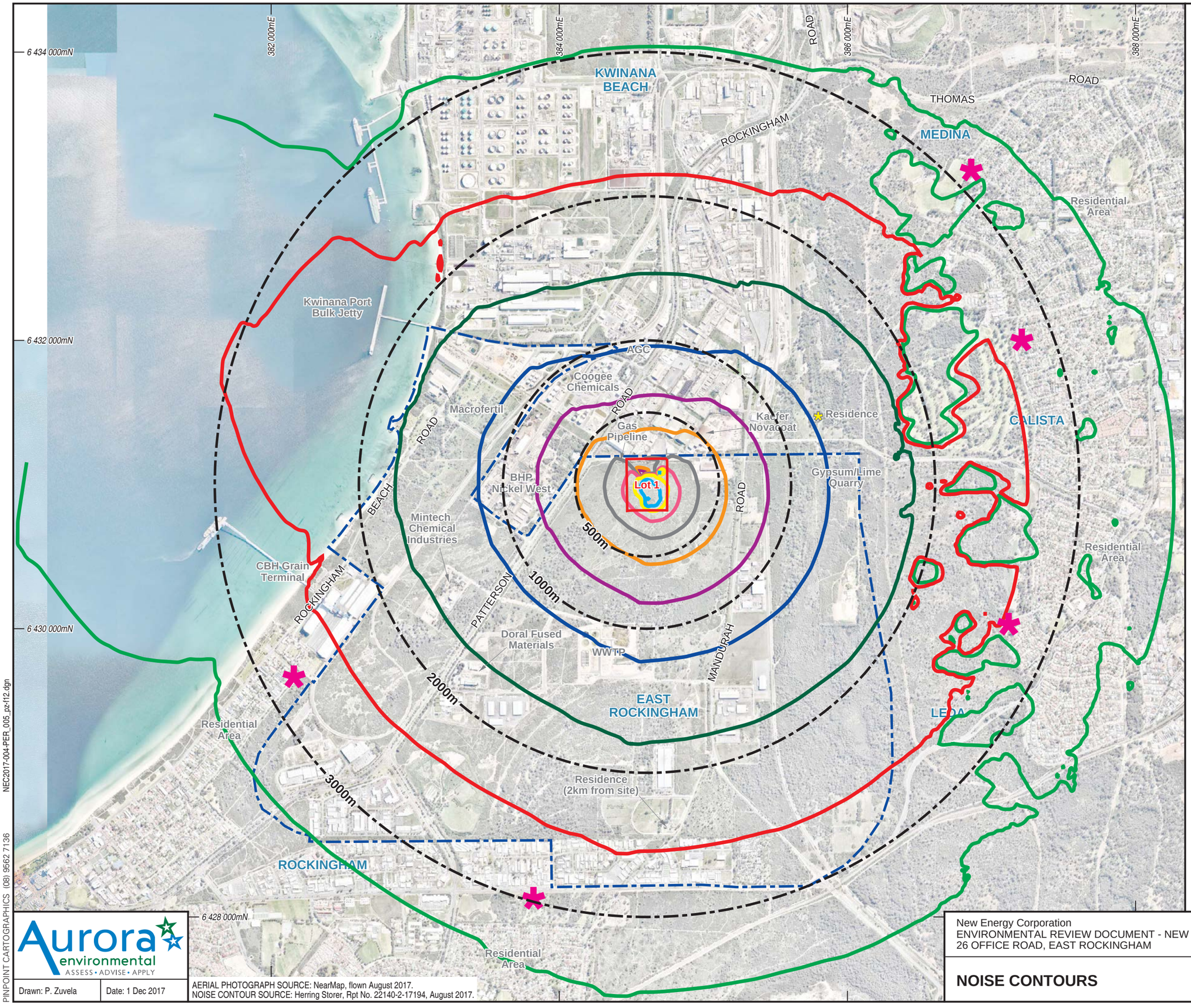

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Drawn: P. Zuvela | Date: 1 Dec 2017

AERIAL PHOTOGRAPH SOURCE: NearMap, flown August 2017.
NOISE CONTOUR SOURCE: Herring Storer, Rpt No. 22140-2-17194, August 2017.

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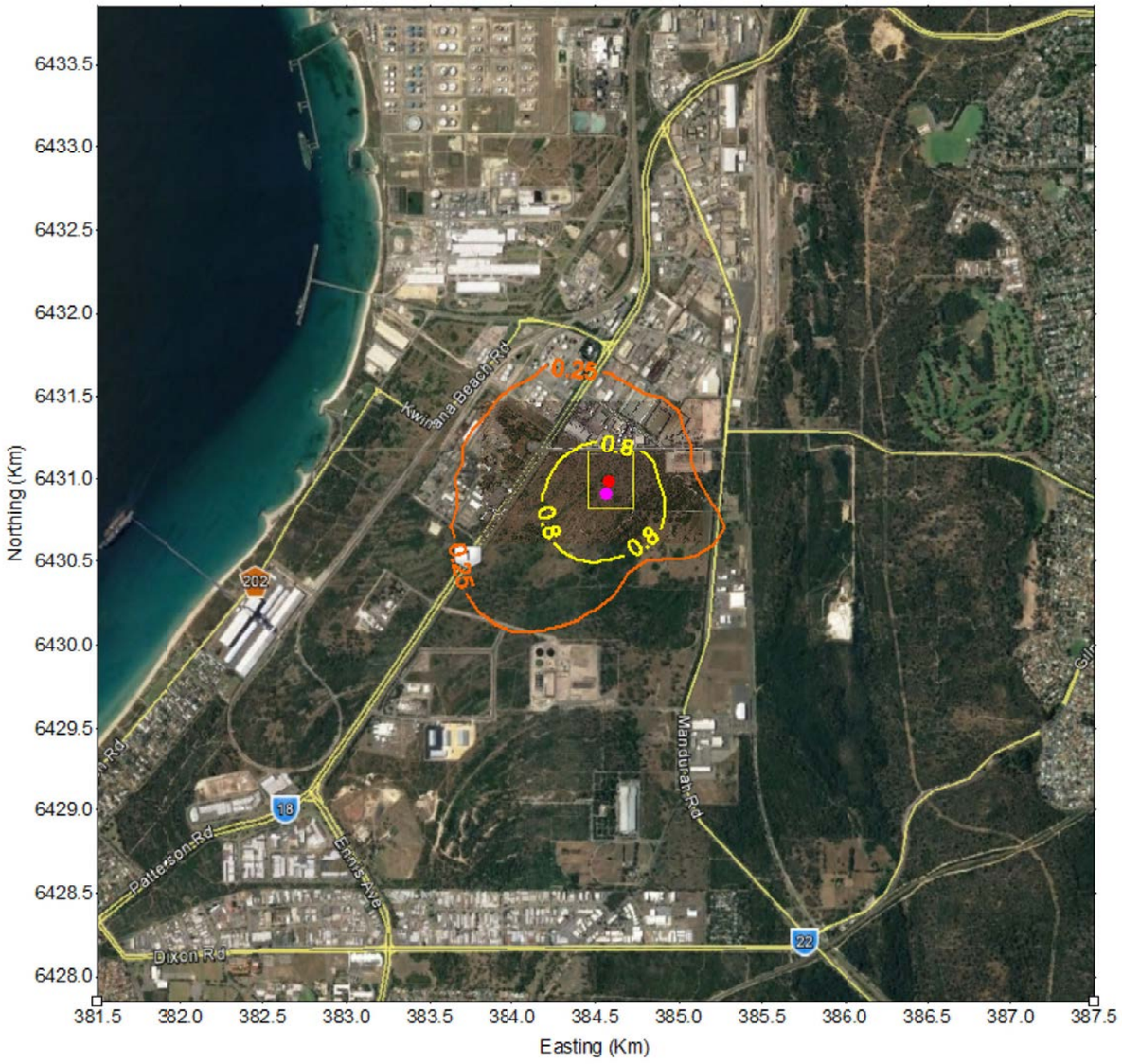
26 OFFICE ROAD, EAST ROCKINGHAM

NOISE CONTOURS

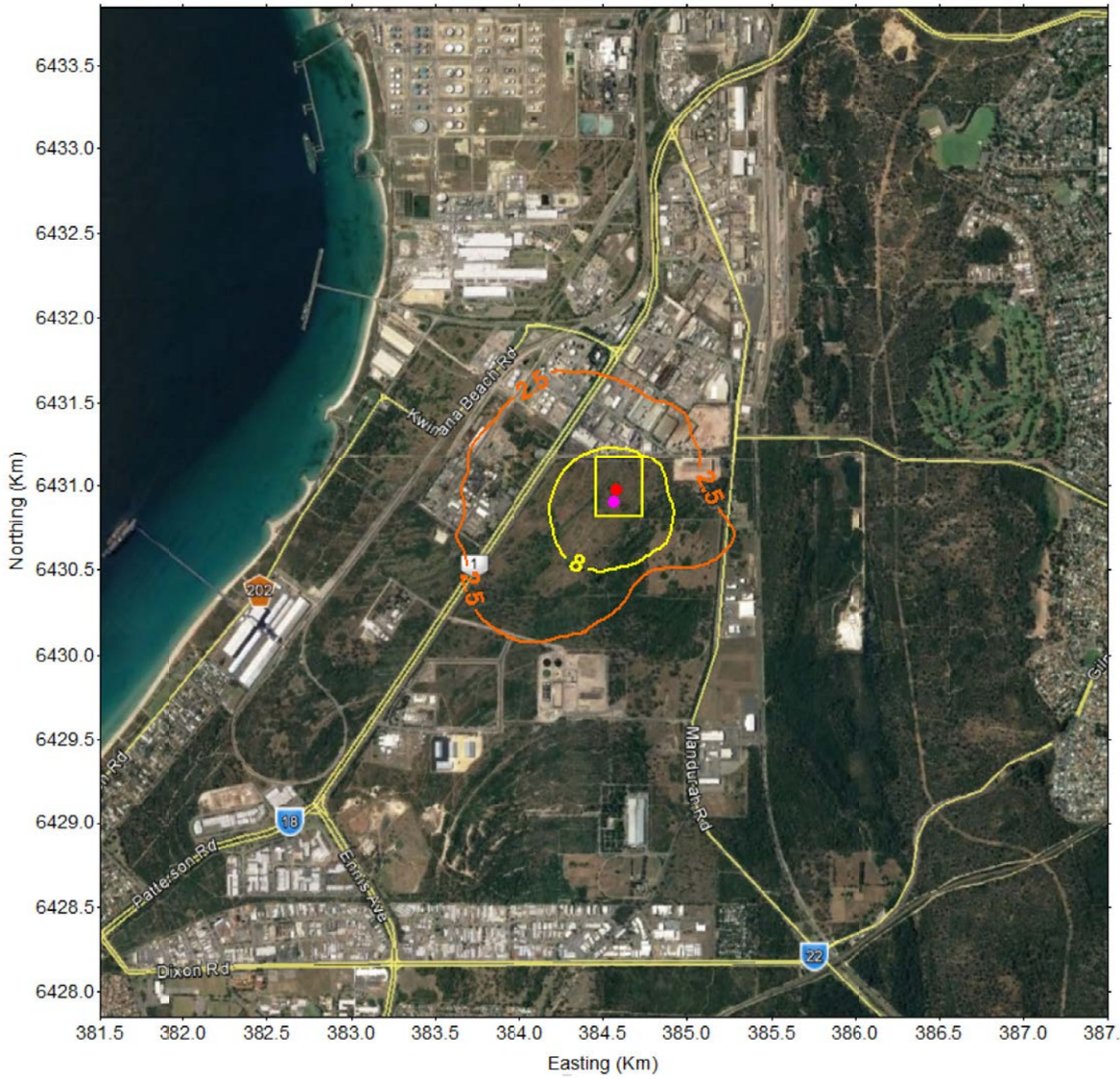
Figure 12

Job: NEC2017-004

Predicted Odour Concentration During Normal Operation



Predicted Odour Concentration During Combustion System Down Times



N

0 250 500 750 1000m

SCALE 1 : 35 000 at A3 (MGA)

SOURCE: Envall, Rpt No. L7059, Figure 8 & 9.

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ODOUR CONTOURS

Figure 13

Drawn: P. Zuvela | Date: 21 Sep 2017 | Job: NEC2017-004

PINPOINT CARTOGRAPHICS (08) 9562 7136 NEC2017-004-PER_005_pz-f13.dgn