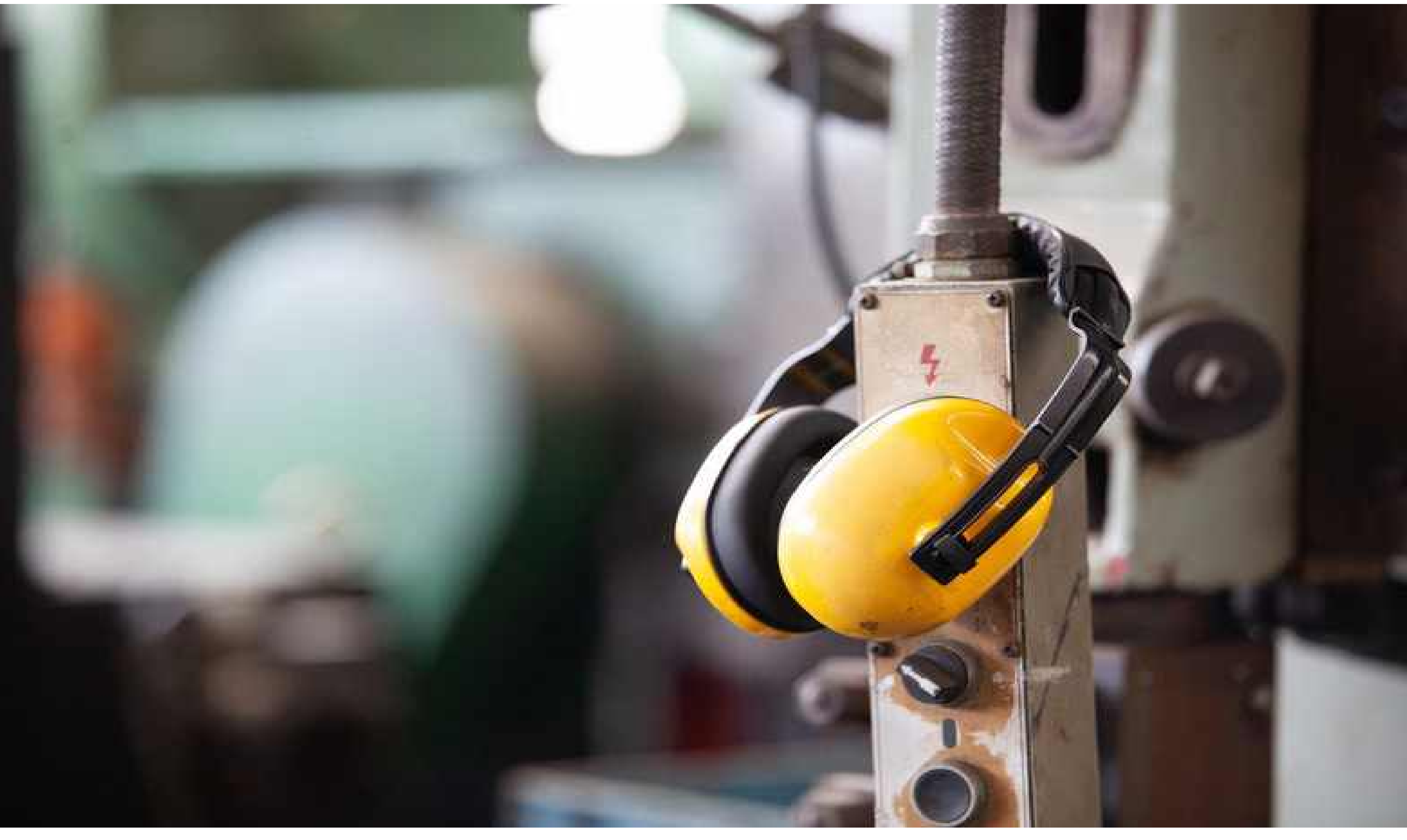
Attachment 6A – Emissions and Discharges

Works Approval Application

Chairay Sustainable Plastic Co.

21 March 2025

→ **The Power of Commitment**



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1. Introduction

Chairay Sustainable Plastic Co (Chairay) is the recipient of a grant from the Recycling Modernisation Fund (RMF), to support the development of new recyclable plastics reprocessing infrastructure to recycle polyolefin and polyester plastics (such as PET, HDPE and polypropylene) in the Perth metropolitan region.

Chairay are proposing to establish a mixed plastics reprocessing facility, for the purpose of processing Polyethylene Terephthalate (PET), High-Density Polyethylene (HDPE), Polypropylene (PP) and mixed plastics (MP) that are not of a single resin or polymer type. The facility will comprise of mechanical plastic sorting machinery and plastic flaking, washing and pelletising lines.

The new facility will have capacity to reprocess up to 15,000 tonnes per annum (tpa) of recycled Polyethylene Terephthalate (PET), High-Density Polyethylene (HDPE), Polypropylene (PP) and mixed plastics (MP) that are not of a single resin or polymer type.

To develop reprocessing capacity as soon as possible, development of the facility has been divided into two phases, with:

- Phase 1 - to include MP sorting, HDPE, PP flaking, pelletising, and plastics storage.
- Phase 2 - expected to commence six months later and expand the footprint of the lease within the existing "Warehouse A" building to include PET flaking.

A Works Approval and Licence will be required for the facility as it will be a Prescribed Premises under Schedule 1 of the *Environmental Protection Regulations 1987*, with the facility's activities being categorised under the following Prescribed Premises activity and design capacity threshold:

Category Number	Description	Category Production or Design Capacity	Proposed Design Capacity
61A	Solid waste facility: premises (other than premises within category 67A) on which solid waste produced on other premises is stored, reprocessed, treated, or discharged onto land.	1,000 tonnes or more per year	15,000 tonnes/year
62	Solid waste depot: premises on which waste is stored, or sorted, pending final disposal or re-use.	200 tonnes or more per year	1,000 tonnes/year

2. Emissions, Discharges, and Waste

2.1 Emissions

An air quality assessment has been undertaken and is included in Appendix A.

2.1.1 Point-source air emissions

During the installation and operation of plant infrastructure, there will be point-source air emissions from delivery vehicles (approximately 5 heavy vehicle movements/day), which are not expected to have any significant impact to surrounding environmental, industrial or residential receptors.

Point-source air emissions of volatile organic compounds (VOCs) will also be generated from the pelletising plant in the facility. The pelletising process applies heat to the cleaned plastics at approximately 250^{0}C – 300^{0}C, which melts the plastics to allow extrusion through die(s) to form pellets. During this process VOCs and associated odour (see below) are likely emitted by thermal degradation of plastic polymers. There is limited information available on the emission rates of VOCs and health risks from plastic pelletising, although the emission rates are believed to be low, but studies[1] [2] [3] indicate there is a potential health risk to workers from long-term exposure to VOCs.

Chairay will therefore proactively implement the control and monitoring measures outlined in Table 1. Implementation of these measures will accurately determine the VOC emissions profile of the process, and inform the need for mitigations, thereby reduce the potential long-term exposure risk to workers inside the facility.

Table 1 Proposed control and monitoring measures to minimise air emissions

#	Control and Monitoring Measure
1	Air quality monitoring will be undertaken during commissioning and time limited operations to determine baseline emissions of VOCs from the pelletising plant, and indoor air quality for VOCs within the facility processing building.

Implementation of the mitigation measures in Table 1 will reduce the likelihood of fugitive VOC emissions escaping to the atmosphere beyond the facility building through small gaps and openings in the building structure. For any VOC emissions that do escape, odour dispersion modelling (see Section 2.1.2) indicates that any fugitive odour/VOCs emissions will disperse quickly and are unlikely to impact surrounding industrial or residential receptors.

2.1.2 Fugitive odour emissions

Site operations will likely be a source of potential odour emissions from processing, specifically from pelletising of plastic and process wastewater. An odour impact assessment has been undertaken for the proposed activity and is provided in Appendix A . Results from this assessment indicated that odours generated from the facility, at a modelled fugitive odour emission rate of 875 ou/s under normal operations (8-hour day, 5-days per week) will not adversely impact any receivers within the facility's local industrial area or potential residential receptors located outside the industrial area (Figure 1).

Even under a very conservative assessment scenario where the fugitive odour emission rate was multiplied by five (5x) to represent an odour emission of 4,375 ou/s, the model predictions (Figure 2) also indicated that any odour observation outside of the Facility's building are unlikely to pose any risk of odour nuisance to nearby premises in the industrial area or potential residential receptors located outside the industrial area.

[1] Ren et al, 2024. **Characterization of VOC emissions and health risk assessment in the plastic manufacturing industry - ScienceDirect**
[2] Yamochita et al, 2007. **VOC emissions from waste plastics during melting processes (researchgate.net)**
[3] Yorifuji et al, 2012. **Does Open-air Exposure to Volatile Organic Compounds near a Plastic Recycling Factory Cause Health Effects? - Journal of Occupational Health**

Figure 1 ***Predicted Ground Level Odour Strength Isopleths (contours) of Fugitive Odour Losses @ 875 ou/s.***

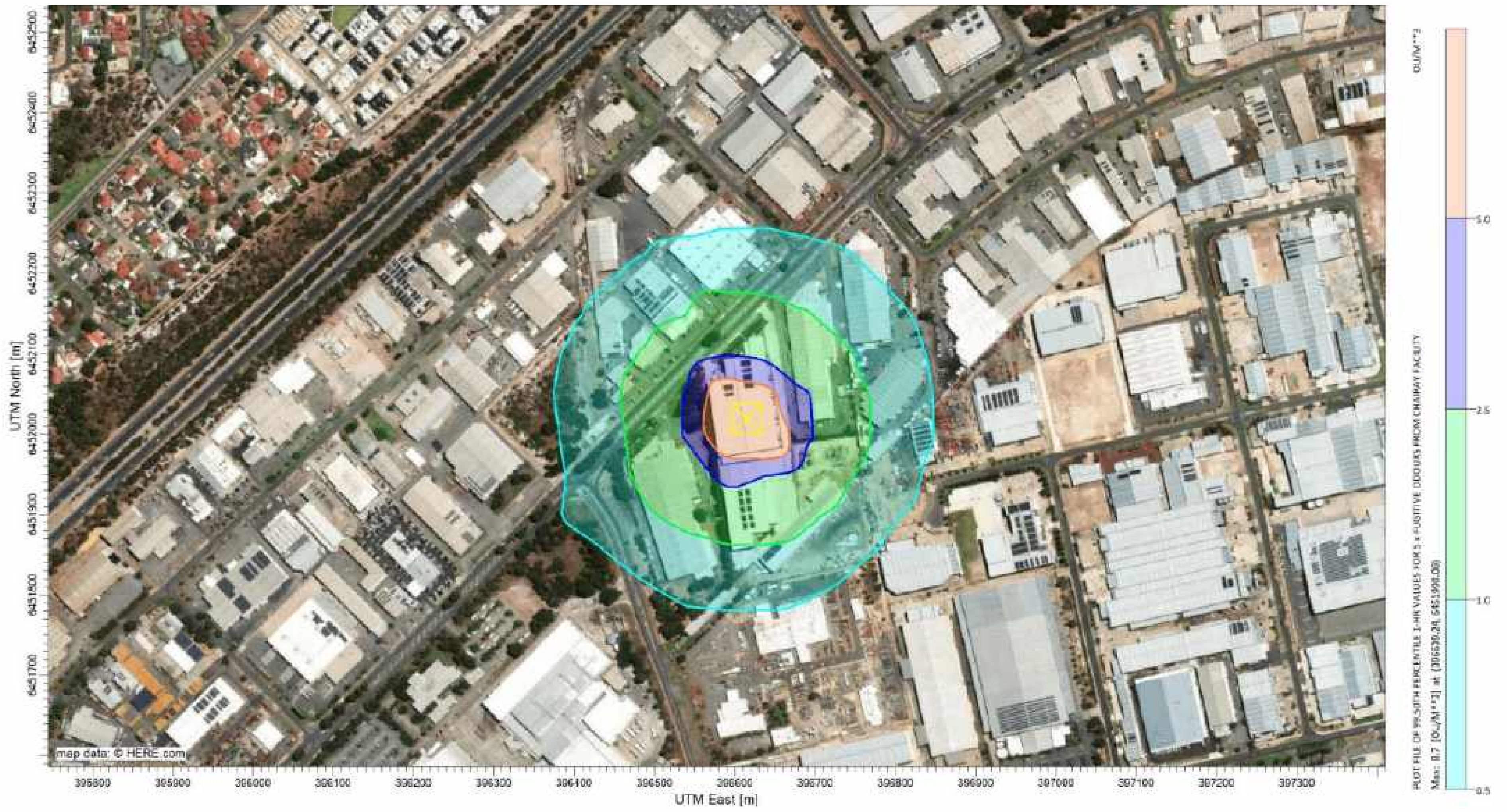

Figure 2 ***Predicted Ground Level Odour Strength Isopleths (contours) of 5 x Fugitive Odour Losses @ 4,375 ou/s.***

2.1.3 Fugitive dust emissions

Dust emissions are not expected to be significant as the facility is in an established industrial area with access via sealed roads and all vehicle access roads and building aprons within the site are concreted. As the mechanical processing is undertaken indoors, there would be limited potential for dust emissions escaping the building and therefore the facility is not expected to have a significant impact on nearby environmental, industrial or residential receptors.

2.1.4 Light emissions

During operation, no night works are proposed to be undertaken and as such there is no external lighting associated with the proposal. Therefore, no light emissions are expected from the operation of the facility. Apart minimal site security night lighting that is likely to be put in place around the building, light emissions from the facility are not expected to impact nearby environmental, industrial or residential receptors.

2.1.5 Noise emissions

A detailed noise modelling study has been undertaken for the proposed activity and is included in Appendix B.

The study considered worst-case scenarios, assuming all major noise-generating equipment would operate simultaneously and continuously. Two modelling scenarios were evaluated:

1. With the facility's roller doors south of the building closed (Scenario 1), and
2. With the facility's roller doors south of the building open (Scenario 2).

The results show that the predicted noise levels at adjacent residential receptors comply with their corresponding assigned limits (LA10 ranging from 43 to 53 dB(A) for night time and day time) operations.

For the industrial premises adjacent to the waste facility, the two buildings directly to the east and west of the warehouse may experience exceedance of noise limits (LA10 65 dB(A)) only at their boundary sections exposed to the outdoor loading area. Other surrounding industrial premises are predicted to experience noise levels within acceptable limits. Noise contour maps for each scenario modelled are presented in Figure 3 and Figure 4.

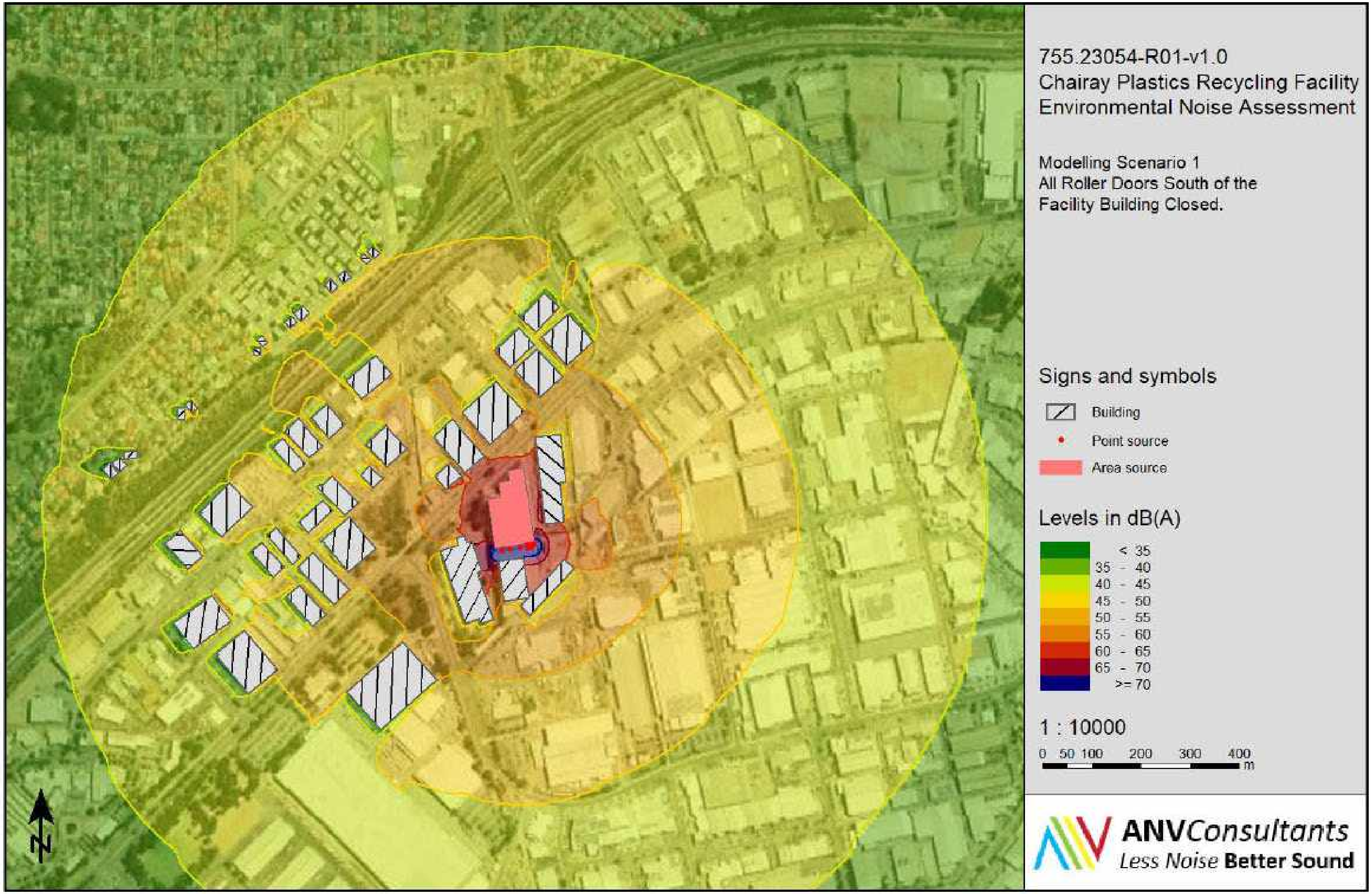

Figure 3 *Scenario 1 – modelled noise levels from the facility building with doors closed*

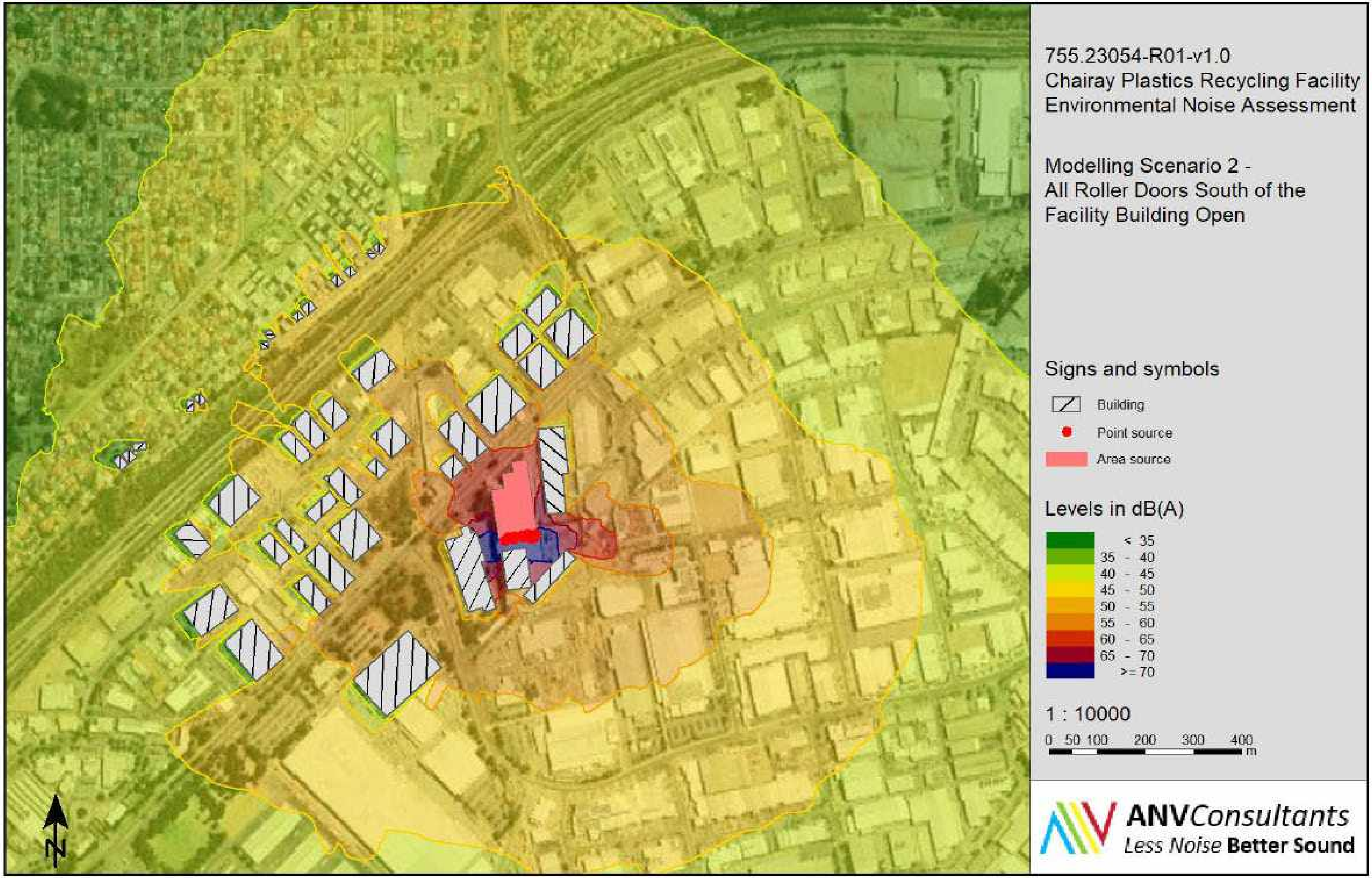

Figure 4 *Scenario 2 - modelled noise levels from the facility building with doors open*

Table 2 lists noise mitigation and management measures proposed to be implemented to ensure any risk of excessive noise emissions from the operation of the proposed plastic recycling facility will meet compliance.

Table 2 Proposed controls to manage noise emissions

Proposed control	
1	Ensure the performance of the specified installed soundproofing for shaft shredder, crusher, horizontal dehydrator and stripping machine is as per currently expected performance.
2	Keep all roller doors closed as much as possible during operation of fixed machinery/equipment and mobile plant inside the warehouse
3	Avoid noise-generating fixed plant and mobile equipment operating simultaneously as much as practicable.
4	Observe and consider the need for additional lining of the internal walls and ceiling of the warehouse with acoustic absorptive materials to reduce internal reverberation and increase acoustic absorption.
5	Undertake commissioning testing of individual noise-generating equipment to ensure their noise emissions are not excessive when compared with the noise modelling assumptions.
6	Undertake compliance monitoring at nearby sensitive receptors once the facility is fully operating, to ensure overall operational noise compliance, and through implementation of relevant improvement measures, if required.

2.2 Discharges

2.2.1 Treated wastewater

Wastewater generated from processing at the facility (approximately 30 ML/year) will be treated on-site prior to planned discharge of treated wastewater directly to a sewer servicing the site. An application to obtain a Trade Waste permit has been submitted to the Water Corporation. The wastewater treatment plant (WWTP) will be situated within an engineered containment bund. Thus, no environmental impact to surrounding receptors is expected.

2.2.2 Stormwater

Unprocessed recyclable plastic materials and products from processing within the facility will be temporarily stored within the building and therefore will not be exposed to rainfall or generate contaminated runoff. Stormwater runoff (hardstand and roofed runoff) generated from the site will be directed to existing drainage sumps and an infiltration grid (see site stormwater management plans in Attachment 8A) for discharge into ground as authorised under the current Development Approval from the City of Canning. Likely contaminants entrained in the stormwater runoff (particularly from hardstand areas) will be hydrocarbons, heavy metals, pathogens, sediments, and general debris. The discharge of stormwater runoff into the ground will likely filter out many of these contaminants before the discharge encounters underlying groundwater. In addition, the site is not located within an Environmentally Sensitive Area or within proximity to any Public Drinking Water Source Areas. Thus, the environmental impact of any site stormwater runoff discharge to ground is considered likely to be low.

2.3 Waste

Operations on the site will produce solid waste in the form of sludge from the wastewater treatment plant (approximately 600 tonnes/year) and plastic residue waste (approximately 6,000 tonnes/year) that will be removed off-site and disposed of to an appropriately licensed facility.

2.4 Unplanned events

2.4.1 Firewater runoff and containment

Fire water used to suppress fires at plastic recycling facilities is considered contaminated and poses a risk to contaminating the receiving environment (i.e., soil, groundwater) if not contained and disposed of safely.

A fire water containment assessment has been undertaken for the site (refer to Attachment 8A) to assess the total volume of fire-fighting water required to be retained to meet DFES requirements (specifically, DFES Guidance Note GN04), and to provide a conceptual strategy setting out how the fire water containment requirement will be achieved. DFES requires all fire water discharge from sprinklers and hydrants during a fire emergency event to be contained on site.

The containment strategy considered a two-stage assessment approach, with Option 1 being preferred, and Option 2 to be progressed if Option 1 is found to be unworkable:

– Option 1. Bunding to contain fire water discharge from sprinklers and hydrants within the existing building and infrastructure footprint.
– Option 2. Blind off all soak wells within the containment zone and provide external below ground storage and containment system for fire water discharge. Provide automated diversion on the stormwater drainage system linked to the fire alarm system to divert water from stormwater infiltration cells to the containment storage.

With implementation of the proposed fire water containment system, the risk of an uncontrolled discharge of fire water contaminating the receiving environment is considered to be low.

2.4.2 Spills, ruptures, and loss of containment

Potential unplanned and uncontrolled discharges of hazardous liquids pose a risk to contaminating the receiving environment (i.e., soil, groundwater) if not contained. Certain fluids that will be stored and used in the WWTP are categorised as being hazardous and require bunding under ASA/NZ 3780: the Storage and handling of corrosive substances.

Up to 322.2 m^3 (322,200 L) of interconnected wastewater and chemical storage tanks capacity will be located on site on the southern side of the warehouse, partially protected from rainfall by the existing roofed awning projecting from the building. Wastewater and treatment chemicals will be stored in fourteen various sized poly tanks (refer to Table 2; Attachment 3B), which will be located within a bunded enclosure. In the even of a loss of containment, the bund will be designed to store at least 110% (355 m^3) of the interconnected volume (322.2 m^3), in accordance with DWER guidance on wastewater containment bunding (refer to Bund Design Memorandum; Attachment 8C).

With implementation of the proposed bund design, the risk of an uncontrolled discharge from a spill, rupture or loss of containment from storage tanks at the WWTP is considered low.

3. Risk Assessment

An environmental risk assessment (Table 6) has been undertaken for the potential emissions and discharges discussed in the preceding section, which are associated with the installation/commissioning and operation of the Project. The risk assessment has been conducted in accordance with the DWER *Guidance Statement: Risk Assessments* (released by the then named Department of Environmental Regulation in 2017) as shown in Table 3.

Table 3 Risk rating matrix

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

The following criteria are used to determine the likelihood (Table 4) and consequence (Table 5) of a risk event occurring.

Table 4 Likelihood descriptors

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

Table 5 Consequence descriptors

Consequence	Consequence description	
	Environment	Public Health and Amenity
Severe	• On-site impacts: catastrophic • Off-site impacts (local scale): high level • Off-site impacts (wider scale): mid level • Mid to long term or permanent impact to an area of high conservation value or special significance	• Loss of life • Adverse health effects: high level or ongoing medical treatment • Local scale impacts: permanent loss of amenity
Major	• On-site impacts: high level • Off-site impacts (local scale): mid level • Off-site impacts (wider scale): low level • Short term impact to an area of high conservation value or special significance	• Adverse health effects: mid level or frequent medical treatment • Local scale impacts: high level impact to amenity
Moderate	• On-site impacts: mid level • Off-site impacts local scale: low level • Off-site impacts wider scale: minimal	• Adverse health effects: low level or occasional medical treatment • Local scale impacts: mid level impact to amenity
Minor	• On-site impacts: low level • Off-site impacts (local scale): minimal • Off-site impacts (wider scale): not detectable	• Local scale impacts: low level impact to amenity
Slight	• On-site impacts: minimal	• Local scale impacts: minimal impacts to amenity

The potential emissions, sources, pathways and receptors that have been identified for the construction and operation of the Project are outlined in Table 6. This table also identifies the potential impacts, proposed controls and associated risk ratings.

Table 6 Risk assessment of potential emissions, discharges, and waste generated from proposed activities to construct and operate the facility

Risk Events: Emission/Discharge/Waste	Development Phase	Potential Pathway	Potential Receptors	Potential Adverse Impacts	Proposed Controls	Likelihood Rating	Consequence Rating	Residual Risk Rating	Reasoning
Point-source air emissions (VOCs) (including odour)	Installation/commissioning Operations	Air and wind dispersion	Workers inside of the facility building Industrial/residential receptors	Public health and amenity impacts	Refer to Table 1	Almost certain	Slight	Medium	Mitigation and monitoring measures proposed (Table 1) will likely reduce long-term exposure risk to workers inside the facility.
			Nearby industrial/residential receptors			Almost certain	Slight	Medium	Site operations will likely generate some fugitive VOC/odour emissions, but modelling indicates these will disperse quickly and are unlikely to impact nearby industrial/residential receptors.
Fugitive dust emissions	Installation/commissioning Operations		Industrial/residential receptors Nearby environmental (flora & fauna)		None proposed	Unlikely	Slight	Low	Operations will occur indoors, and outside areas are hardstand (minimal dust generation)
Light emissions	Installation/commissioning Operations				None proposed	Rare	Slight	Low	Night operations will not occur at the facility and apart from minimal site security lighting, there will be no significant light emissions from the facility at night.
Noise emissions	Installation/commissioning Operations				Refer to Table 2	Almost certain	Slight	Medium	Mitigation and monitoring measures proposed (Table 2) will likely reduce noise levels to within acceptable limits at adjacent residential receptors.
Wastewater discharge	Installation/commissioning Operations	No pathway	-	No impact – treated wastewater will be discharged to trade waste sewer servicing the site					
Stormwater discharge	Installation/commissioning Operations	Infiltration into soil and groundwater	Soil and groundwater	Soil, groundwater and surface water contamination	None proposed	Possible	Slight	Low	Entrained contaminants in stormwater runoff will likely be filtered out by soil before encountering groundwater. Site is also not located within a recognised Environmentally Sensitive Area or Public Drinking Water Source Area.
Waste	Installation/commissioning Operations	No pathway	-	No impact – Solid waste will be removed off-site and disposed of to a landfill facility					
Unplanned events									
Firewater runoff	Installation/commissioning Operations	Firewater enters site stormwater system, infiltration into soil and groundwater	Soil and groundwater	Soil, groundwater and surface water contamination	Installation of a fire water containment system that will prevent any firewater discharge to ground	Possible	Slight	Low	Fire water will be contained on the site and isolated from normal site stormwater runoff discharging to sumps and ground. Contained firewater will be removed off-site for disposal at an appropriately licensed treatment facility.
Spills, ruptures, and loss of containment	Installation/commissioning Operations	Discharge enters site stormwater system, infiltration into soil and groundwater	Soil and groundwater	Localised contamination of soil and groundwater	All storage tanks on the site will be located within a bunded area	Possible	Slight	Low	Any potential unplanned spill, rupture and/or loss of containment of containment of storage tanks at the WWTP will be contained by bunding that will be installed to prevent any runoff into stormwater sumps and ground.

Appendix A

Air Quality Assessment

EAQ Consulting

EMISSIONS ASSESSMENT OF PROPOSED PLASTICS REPROCESSING FACILITY

204 BANNISTER ROAD, CANNING VALE WA 6155

Emissions Assessment of Proposed Plastics Reprocessing Facility

204 Bannister Road, Canning Vale WA 6155

Prepared for: Chairay Sustainable Plastic Co P/L

Project Ref: EAQ-24017
September 2024

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1 Background

Environmental & Air Quality Consulting Pty Ltd (EAQ) was engaged by Chairay Sustainable Plastic Co P/L (Chairay), the proponent, to undertake an Emissions Assessment (the Assessment) of Chairay's proposed Plastics Reprocessing Facility (the Facility) to support Chairay's Works Approval and Development Application processes.

The Facility will receive and reprocess High-Density Polyethylene (HDPE), Polyethylene Terephthalate (PET), Polypropylene (PP) plastics and mixed plastics with a capacity throughput of up to 21,000 tonnes per annum. A Facility of this size, assuming capture of all the relevant materials, will be able to manage the total projected 12,500t annually plastic materials which have been affected by the Council of Australian Governments (COAG) export ban in Western Australia.

The planned sorting and reprocessing capacities for plastics at the Facility are:

- Mixed Plastics – 6,000 tonnes sorting,
- HDPE – 6,000 tonnes flaking
- PET – 6,000 tonnes flaking, and
- PP – 3,000 tonnes flaking

The process is almost entirely automated using static machinery where the raw materials flow along a series of process steps and conveyor lines, and involves:

- Receivals of baled plastics to the Facility from external vendors,
- Debaling of the plastics (machine),
- Optical sorting for separation (machine),
    - Low quality plastics diverted from process to Waste to Energy, landfill etc.
- Manual sorting (picking line) to ensure adequate separation,
    - Low quality plastics diverted from process to Waste to Energy, landfill etc.
- Magnetic current to remove metals etc (machine),
- Crushing / shredding / milling / pressing (machine),
- Hydration / Water Bath i.e., washing (machine),
- Dehydration i.e., drying (machine),
- Flaking (machine),
    - Flakes can be used directly in the manufacture of new products.
- Pelletising (plastics heated to $250^{0}C$ – $300^{0}C$ to melt and further extruded to make pellets, and
- Final packaging of flakes and pellets in Bulka bags for export.

The Mixed Plastics bales are a large uncertainty, and Chairay estimates up to 40% may result in residual waste. Residual waste will be destined for energy recovery at either the East Rockingham or Kwinana WTE facility. This residual waste will primarily comprise of low value plastics such as PS, mixed polymer, nylon, and EOL plastics.

Emissions from the recycling of these plastics are generally negligible as dusts are managed through the hydration / water bath steps, and process vapours are only aligned to the pelletising process due to heating of the plastics. Residual odours from 'dirty' plastics would be evident, although these residual odours would be no different to a Materials Recovery Facility (MRF) and/or a Container Deposit Scheme depot, where the plastics originate from in bale form.

The process cycle is illustrated in Figure 1-1.

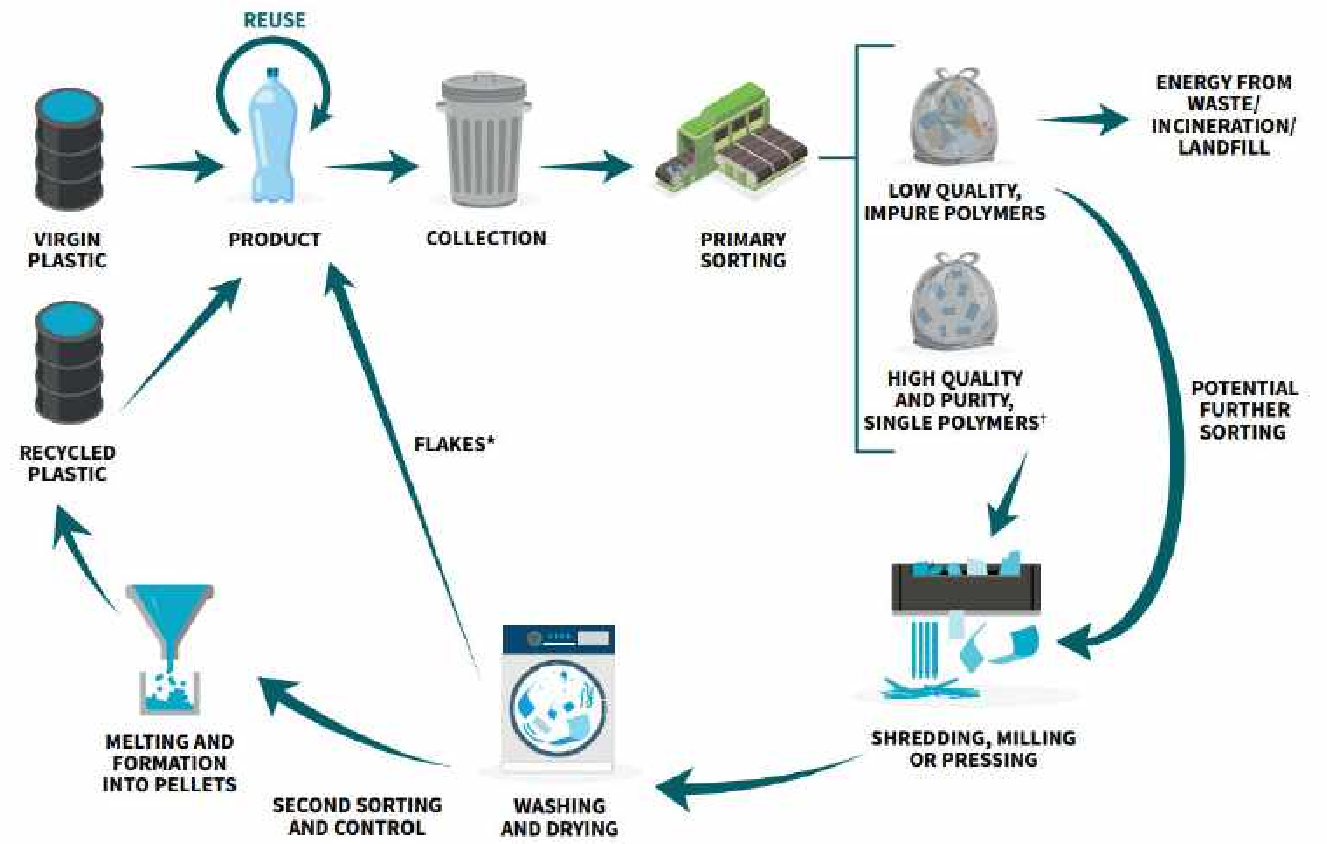


Figure 1-1: Reprocessing of Plastics Life Cycle

1.1 Operational Hours

The Facility will be operational on weekdays only between the hours of 8AM – 4PM (i.e., 8 hours daily). Given this, any odour emissions, either residual or within the process, can only occur during these daytime hours.

1.2 Legislative Context

The proposed Facility will be a Prescribed Premise and licensed pursuant to the Western Australian Environmental Protection Regulations 1987 under Schedule 1 Part 1 of the Environmental Protection Act 1986, and most likely assigned as **Category 62 - Solid waste depot:** *premises on which waste is stored, or sorted, pending final disposal or re-use.*

The Western Australia (WA) Environmental Protection Authority 2005 Guidance for the Assessment of Environmental Factors document, *Separation Distances between Industrial and Sensitive Land Uses* (EPA, 2005), recommends a buffer separation distance of 200 metres (m) for Category 62 activities, with noise, dust and odour the primary impacts of consideration. The WA Department of Water and Environmental Regulation (DWER) is the key agency for approvals related to noise, dust and odour.

The 200 m recommended buffer separation distance applies to Industrial and Sensitive Land Uses, where Sensitive Land Uses are described in the EPA 2005 document as:

Land uses considered to be potentially sensitive to emissions from industry and infrastructure include residential developments (including subdivisions either established or in the planning framework), hospitals, hotels, motels, hostels, caravan parks, schools, nursing homes, child care facilities, shopping centres, playgrounds, and some public buildings. Some commercial, institutional and industrial land uses which require high levels of amenity or are sensitive to particular emissions may also be considered "sensitive land uses". Examples include some retail outlets, offices and training centres, and some types of storage and manufacturing facilities.

The EPA recommended buffers imply that where the separation distance is not met, a further scientific assessment of applicable emissions should be undertaken to support the application and thus inform the risk of health and amenity impacts at the nearest receptor.

1.3 The Site

The Site is a proposed to be located at 204 Bannister Road, Canning Vale WA 6155. The Site, which is currently being re-developed, will comprise of two high-grade industrial and logistics facilities of which Chairay's Site will be located within one of these facilities.

The Site is within the City of Canning under the Local Planning Scheme (LPS) Zone General Industry. There is no existing and/or future redevelopment planning schemes of the Site's industrial area.

The nearest urban area is > 500 m to the north-west of the Site's Facility, and therefore the Facility satisfies the EPA, 2005 Industrial and Sensitive Land Uses recommended separation distance of 200 m, where the sensitive receptor is urban, or future urban.

Noting that the Facility satisfies the DWER's Odour guidance (2019) odour screening separation distance of 200 m with respect to the nearest urban (or non-compatible land use) sensitive receptor, and has no special case factors that apply to the Facility that would otherwise increase odour impacts beyond the screening distance, notwithstanding, the Assessment will address the risk of the pelletising process odour emissions impacting on nearby industrial receptors.

The Locality of the Site is illustrated in Figure 1-2.

Figure 1-2: Proposed Chairay Plastics Reprocessing Facility

2 Process Odours

Given the Facility does not require a detailed odour analysis, an operational odour analysis (OOA) has not been undertaken, nor would it be useful to provide one given the lack of odour expected from the entire process.

The activities at the Facility are not expected to emit malodours from the handling and processing of the plastics (excluding pelletising) given that all the plastics received will be sourced from MRF's and/or Container Deposit Scheme depots. Plastics can be considered as inert with respect to odorous contamination when received to the Facility.

MRF's and Container Deposit Scheme depots are established throughout the Perth metropolitan Area and have posed no risk for odour impacts from their activities. This is evidenced by the existing DWER licenses for these MRF facilities where only 'non-conforming odour causing materials' are discussed within the licenses (where applicable), and the materials are required to be removed from the recyclables stream at the 'first sorting position' and subsequently removed from the site operations that day.

'Non-conforming odorous materials' would be identified and excluded from the recyclables stream as part of the Facility's overall waste acceptance and refusal procedures.

2.1 Pelletising Odour Emissions

Prior to the pelletising process the plastics have been cleaned (washing and drying) and further sorted ready for flaking or pelletising.

The pelletising process applies heat to the cleaned plastics at approximately 250^0C – 300^0C, which melts the plastics thus allowing extrusion through die(s) to form pellets.

Chairay does not envisage any need for process odour mitigation given the odour emissions' volume will be low. Notwithstanding, Chairay has considered two odour mitigation routines based on the technology providers operational knowledge of the process. These routines are:

1) The steam and vapours given off from pelletising will be diverted through pipework, pass through cold water to produce condensate inside the pipework, and the final emission 'bubbled' through water to collect the condensate. The condensate water is then diverted to the Facility's wastewater treatment process where screens remove any entrained solids, and membrane filtration to clean the process waters to the required specification before discharge.
2) Carbon Filtration may be installed to capture and treat the VOC/odour emissions if the diversion of the vapours to the wastewater process is superseded.

Given the design of the Facility and its automation, there is a negligible risk of full-strength process odours from pelletising escaping to atmosphere beyond the Facility building. In the event of any VOC/odour losses, these would be in the form of low volume fugitive losses from small gaps and openings in the building structure.

To this end, EAQ has assumed some odour losses from pelletising and considered these as a fugitive volume source emission from the Facility. Odour emissions are discussed further in Section 3.

2.2 Process Wastewater

As per Chairay's design overview, "it is expected that for every 1 metric ton of recycled material, approximately 2 metric tons of wastewater will be generated. For every 1 ton of wastewater, there will be about 20-30 kilograms of sludge (with 80% moisture content). For example, assuming a daily processing of 6 metric tons of recycled material during commissioning, an estimated 12 metric tons of wastewater will be discharged into the wastewater treatment system, with approximately 240-360 kilograms of sludge produced. The water recovery rate is estimated to be 95%".

Flow meters will be installed to measure raw water inlet flows and treated discharge flows. The process water sludge will be bagged, weighed and removed from Site through external contractor. The operation and transportation within the wastewater treatment process be controlled using PLC technology.

2.2.1 Wastewater Controls for Unexpected Emissions & Discharges

- Initially, a physical treatment method will be employed, involving primary sedimentation, fine screening, oil-water separation, and the removal of suspended solids (SS) and oils from wastewater contaminants. Control measures include adjusting retention times, disk rotation speeds, and screen mesh sizes,
- A chemical treatment approach will be used, including neutralisation (acid-base neutralisation), coagulation, flocculation, and flotation to remove SS as well as BOD/COD and adjust the water's pH level. Control measures involve monitoring pH values, retention times, and mixing speeds, among others,
- A biological treatment method, such as the activated sludge process, will be applied, involving sedimentation primarily to remove BOD from the water. Control measures include monitoring dissolved oxygen levels, retention times, and the food-to-microorganism ratio, among others,
- Advanced treatment methods like ceramic membrane filtration will be employed to further remove BOD and SS from the water,
- Water quality testing instruments will be procured to conduct functional tests on the autonomous wastewater treatment units,
- Monitoring devices will be installed at the discharge point to include monitoring of flow rate, SS (suspended solids), COD (chemical oxygen demand), and continuous recording of these parameters (with data stored on a computer). Additionally, an abnormality notification system will be established to alert in case of any irregularities, and
- Water quality testing instruments will be procured to conduct functional tests on other wastewater treatment units.

3 Odour Emissions Assessment

The total process area of the Facility building is 8,300 m^2. The maximum height of the building is 10 m, and therefore the approximate volume of the Facility's building is 83,000 m^3.

The pelletising line takes up < 5% of the overall floorplan i.e., < 415 m^2.

Assuming the total volume surrounding the pelletiser is 1,245 m^3 (415 m^2 x 3 m in height), the odour emissions from pelletising would disperse into this volume, where this volume makes up 1.5 % of the total building volume.

The uncontrolled air emission rate from the pelletising process is unknown.

Contemporary buildings in Australia are built to achieve an optimum ventilation/infiltration rate. This is not always the case with industrial buildings where air exchanges are often required to ensure worker comfort due to heat etc.

Fugitive air losses from small gaps and openings in new buildings may represent up to 10% of the overall downwind wall area when assuming the building is designed for relative airtightness with no requirement to introduce air changes for worker comfort, and assuming no doorways opened.

Using the Facility's largest wall area of approximately 2,250 m^2 (225 m long x 10 m high), a 10% loss of fugitive air would be through 225 m^2 of wall void.

CSIRO reports the leakage rate of new homes, on average, to be 6.9 $m^3/hr/m^2$@50Pa

Assuming the Facility's building has a leakage rate of 10 $m^3/hr/m^2$ across a 225 m^2 void, the air emission rate would be 0.0028 m^3 per second per m^2. Applying this to the 225 m^2 void, the leakage rate would be 0.625 m^3/s.

Further assuming the wind direction remained constant for an 8-hour shift, the maximum process fugitive air losses over an 8-hour day would be 18,000 m^3 of air from the Facility, which is approximately 22 % of the total building volume.

There is no data for odour concentration emissions from the pelletising process.

Previously, EAQ has undertaken odour sampling and testing works for a Rotomould facility to the south of the Perth Metropolitan area. This site does not have a DWER prescribed premises licence.

The Rotomould facility takes plastic flakes and pellets and uses these to manufacture plastic products such as plumbing pipework and fittings, plastic manhole pits etc. The Rotomould facility operates 24-hours a day and emits plastic vapour odours from an untreated stack to atmosphere.

The most recent public domain emissions report for this Rotomould facility was in May 2024 and reported the following key parameters for odour emissions:

- Maximum odour concentration of 1,400 odour units (ou) per m^3 (i.e., ou.m^3)
- Maximum temperature of emissions of 194^0C, and
- Maximum moisture content of 4.1 %.

Importantly, the odour emissions from the Rotomoulding process would be elevated compared to those pelletising emissions since the Rotomould process heats and forms the products over a longer period of time.

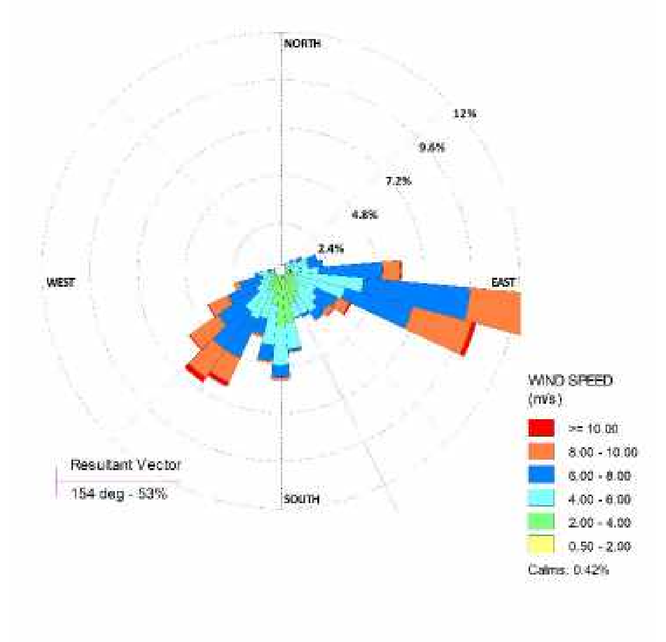
Assuming an odour concentration of 1,400 ou.m^3 applied to a daily volume loss of 18,000 m^3 of air (0.625 m^3/s), the odour emission rate would be 875 ou/s over the 8-hour working day, 5 days per week.

- This odour emission rate of 875 ou/s has been assessed using the Aermod dispersion model to predict the ground level odour strength within the industrial area surrounding the Facility.

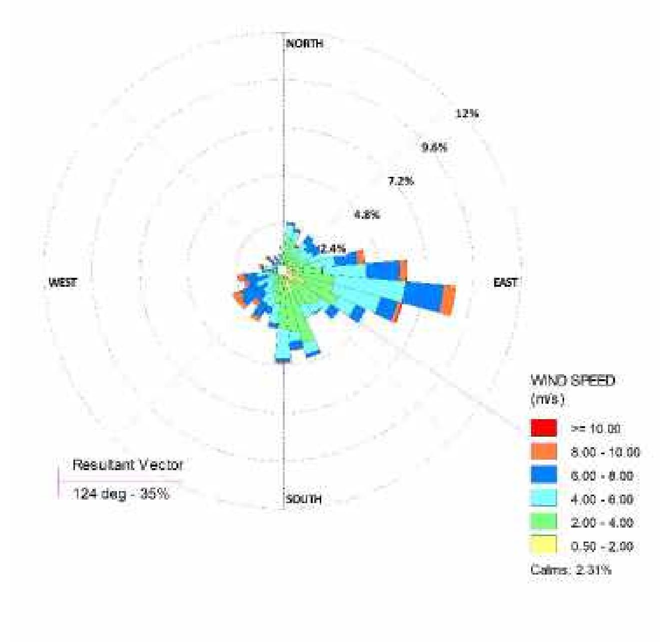
3.1.1 Meteorology & Dispersion Modelling

A 2023 annual dataset of meteorology was developed for the locality using surface observations from the Jandakot AERO Bureau of Meteorology (BoM) Automatic Weather Station (AWS) and CSIRO's TAPM prognostic model for upper air characteristics. The Jandakot BoM AWS is < 5 kms west of the Site and representative of the assessment domain.

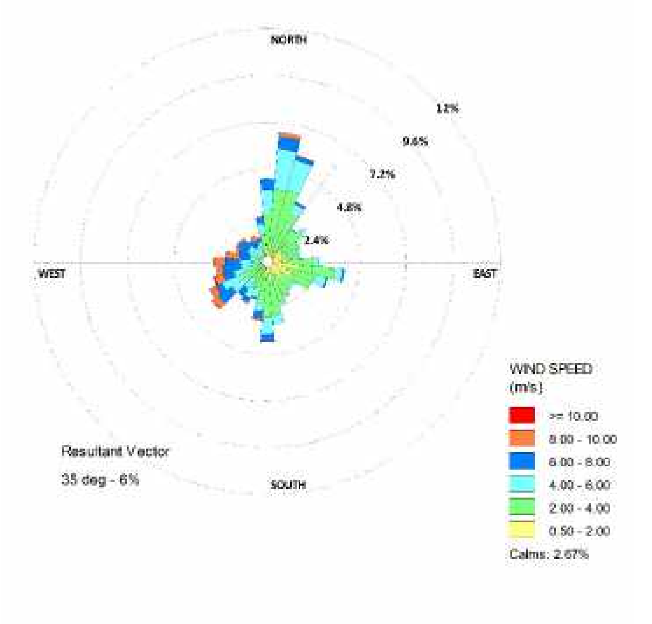
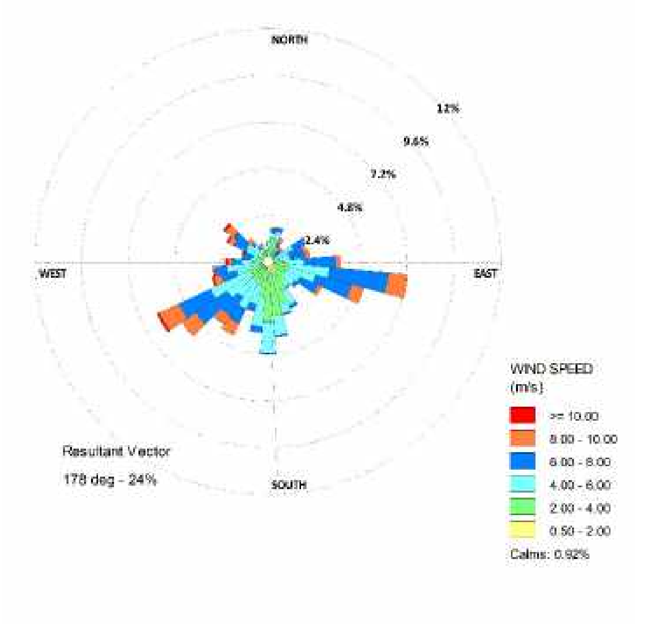
The Facility's locality annual meteorological trend has a south-east wind vector (i.e., average direction and speed vector), with typical prevailing easterly winds in the AM and south to south-westerly winds in the PM. These winds are of course reliant on annual seasonal trends of which are illustrated below.



Summer



Autumn

	
Winter	Spring

In summer the winds have a prevailing vector from the south, south-west; in autumn the vector prevails from the south-east; in winter the vector prevails from the north-east and spring the vector prevails from the south.

Based on these prevailing vectors the stronger wind speeds occur in summer and spring from the east and south-west, have prominent wind speeds from the east in autumn, and typically lower wind speeds in winter (ignoring storm events).

Given the location of the closest urban sensitive receptors are to the northwest, albeit at > 500 m from the Facility, the occurrence of seasonal winds impacting these receptors would be most likely during summer and autumn whose resultant vectors are both from the southeast quadrant.

Appendix A presents the development of the 2023 annual meteorological dataset and the selection of the 2023 year as representative of the Facility's locality.

The 2023 dataset for Jandakot was input into the Aermet module of the Aermod model to derive surface (SFC) and profile (PFL) meteorology for the modelling.

The Aermet & Aermod Input Files are presented in Appendix B.

3.1.2 Dispersion Modelling Limitations

By definition, air quality models can only approximate atmospheric processes. Many assumptions and simplifications are required to describe real phenomena in mathematical equations. Model uncertainties can result from:

- Simplifications and accuracy limitations related to source data;
- Extrapolation of meteorological data from selected locations to a larger region; and
- Simplifications to model physics to replicate the random nature of atmospheric dispersion processes.

Models are reasonable and reliable in estimating the maximum concentrations occurring on an average basis. That is, the maximum concentration that may occur at a given time somewhere within the model domain, as opposed to the exact concentration at a point at a given time will usually be within the ±10% to +/- 40% range (US EPA, 2003).

Typically, a model is viewed as replicating dispersion processes if it can predict within a factor of two, and if it can replicate the temporal and meteorological variations associated with monitoring data. Model predictions at a specific site and for a specific hour, however, may correlate poorly with the associated observations due to the above-indicated uncertainties. For example, an uncertainty of 5° to 10° in the measured wind direction can result in concentration errors of 20% to 70% for an individual event (US EPA, 2003).

4 Chairay Facility Odour Assessment Results

The Assessment of fugitive odour losses from the Chairay Plastics Reprocessing Facility, specifically those odours generated from the pelletising line, at an odour emission rate of 875 ou/s, has shown that the predicted ground level odour strength will not adversely impact any receivers within the Facility's industrial area.

This result was expected.

The fugitive odour emissions were then multiplied by five (5x) to represent an odour emission loss of 4,375 ou/s. once again, the model predictions indicate that any odour observation outside of the Facility's building are unlikely to be recognised by observers and therefore further unlikely to pose any risk of odour nuisance within the Facility's industrial area.

These predictions have been assessed at the 99.5th percentile of the annual period I.e., worst 44th hour with odour emissions being constant (i.e., 24 hours a day).

Figure 4-1 and Figure 4-2 illustrate the emissions' scenario of 875 ou/s, and the subsequent 5 x scenario of 4,375 ou/s respectively.

The Facility will only operate the pelletising process for 40 hours per week, 2,080 hours per year, and therefore applying the 99.5th percentile to these hours means the worst 11th hour is assessed.

However, the operational hours are within daytime/daylight hours and therefore the risk of ground level odours is much less than those hours outside of daytime hours.

This is due to, among others, convective dispersion of ground level odour plumes and increased mixing heights. Together these atmospheric conditions improve vertical mixing of odour plumes whilst also allowing the plume to travel higher above ground level. These conditions markedly improve dispersion compared to those evening, night and early morning hours. These conditions are also enhanced during the warmer seasons where convective mixing it as its peak.

Based on the estimated fugitive odour losses during a n 8-hour working day, over a 5-day working week (weekends excluded), and given the modelling predictions suggest that odours are unlikely to be recognised beyond the boundary of the Chairay Facility:

- EAQ recommends that the risk of an odour impact at the nearest industrial or urban sensitive receptor is **Low**.

Figure 4-1: Predicted Ground Level Odour Strength Isopleths (contours) of Fugitive Odour Losses @ 875 ou/s.

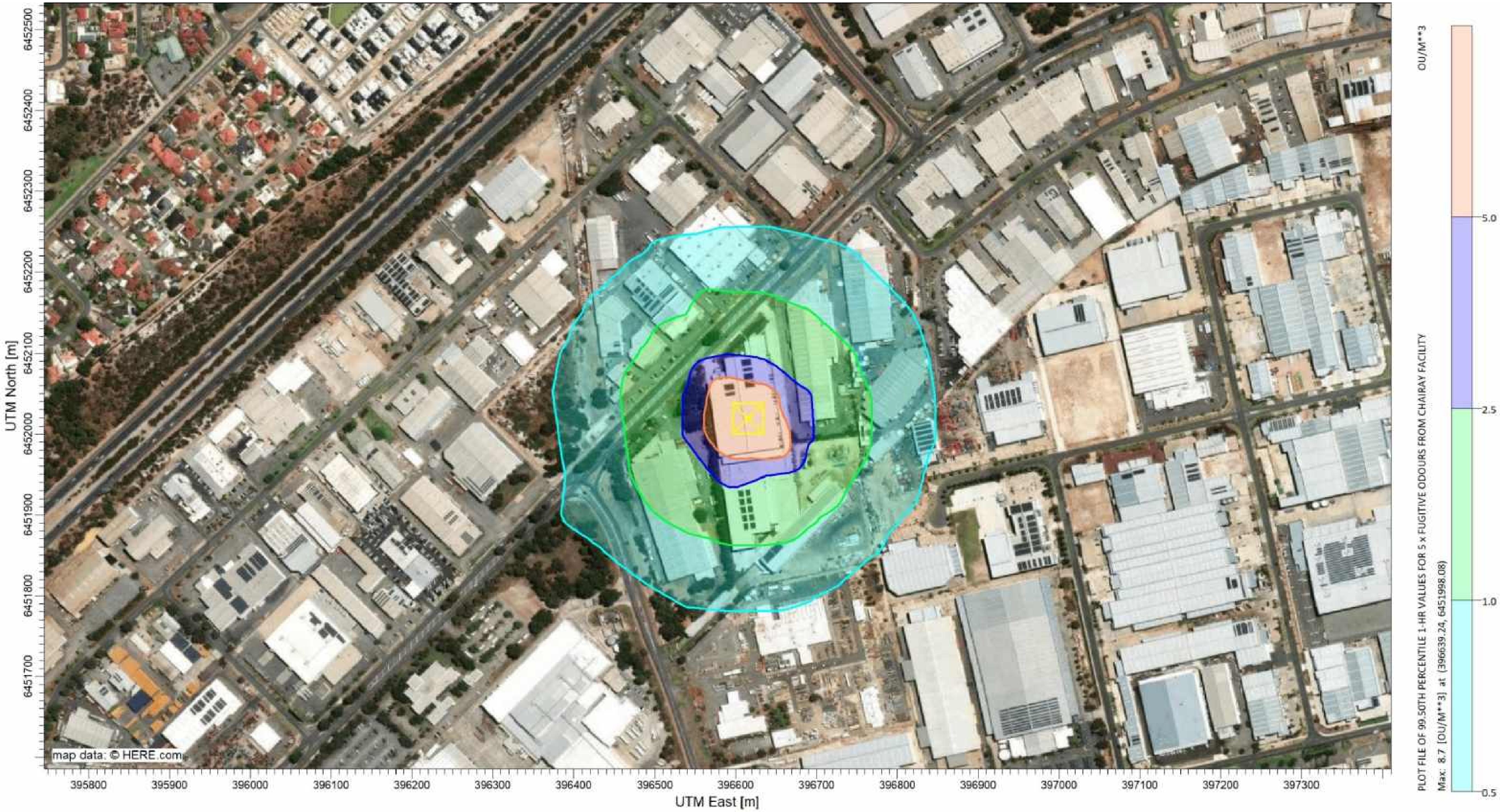


Figure 4-2: Predicted Ground Level Odour Strength Isopleths (contours) of 5 x Fugitive Odour Losses @ 4,375 ou/s.

Appendix A: Meteorological Development & Representative Year

1 Meteorology

The nearest Bureau of Meteorology (BoM) Automatic Weather Station (AWS) to the Canning Vale Locality is Jandakot AERO (Station 009172). Surface observations have been reviewed for this BoM AWS.

To derive additional parameters required to develop a 3-dimensional meteorological (met) dataset suitable for dispersion modelling, and to account for any notable variability in met parameters between the Site and nearest BoM AWS(s), CSIRO's The Air Pollution Model (TAPM) was utilised to develop a prognostic met file for the locality that was then further used to supplement the development of the final met dataset.

To determine which annual met period/s were the most representative of the locality, the Jandakot AERO station was assessed for its most recent 5-year met trends (2019-2023).

1.1 Representative Meteorological Period

When undertaking dispersion modelling of air pollutants, the wind vector (speed and direction) is critical in determining the magnitude of the ground level impacts downwind of an emission source(s).

Temperature is also critically important within dispersion modelling for representation of vertical mixing influences (convective mixing), and inversion layers within the domain assessed by the dispersion model. Rainfall also has importance regarding dust deposition rates, and empirically when determining odour impacts at ground level.

Five years of the latest annual data is sourced from the nearest, or multiple, BoM AWS(s). Any erroneous data and blank data cells are filtered and removed to ascertain the percentage of useful data recovery for each annual period. The data is arranged into annual observations and the primary *vector* of wind is sorted into 'bins' of wind speed and direction, for example:

2023		CHECK #	8760			
WD↓ WS→	0	2	4	6	>6	TOTAL
0	0	0	0	0	0	0
90	0	308	649	468	355	1780
180	0	578	1136	818	847	3379
270	0	197	696	816	995	2704
360	0	110	267	237	283	897
TOTAL	0	1193	2748	2339	2480	8760

Each of the individual five years was compared to the corresponding five-year trend for wind direction and speed, and a statistical analysis using the *chi-squared* relationship (goodness-of-fit) was undertaken.

The *chi-squared* value is a single number that shows how much difference exists between observed counts and the counts expected if there were no relationship at all in the population.

For determining the representative met year, each of the annual periods of grouped wind speed and direction are compared to the averaged dataset of all five years of grouped wind speed and direction. A **low value** for *chi-squared* means there is a high correlation between two sets of data. In theory, if the observed and expected values were equal ('no difference') then *chi-square* would be zero — an event that is unlikely to happen in real life.

Comparing the annual periods of 2019 – 2023 inclusive for the Jandakot AERO BoM AWS and deriving the representative year based on the ***vector of wind***, the representative year derived using the *chi-squared* relationship was as follows:

BoM AWS *chi-squared* Outcomes

Annual Period	Jandakot AERO *chi-squared*
2019	98.5
2020	39.7
2021	43.4
2022	62.2
2023	**36.0**

The 2023 annual period was found to be the best-fit for long term meteorological trends, and the results are illustrated in **Figure 1**.

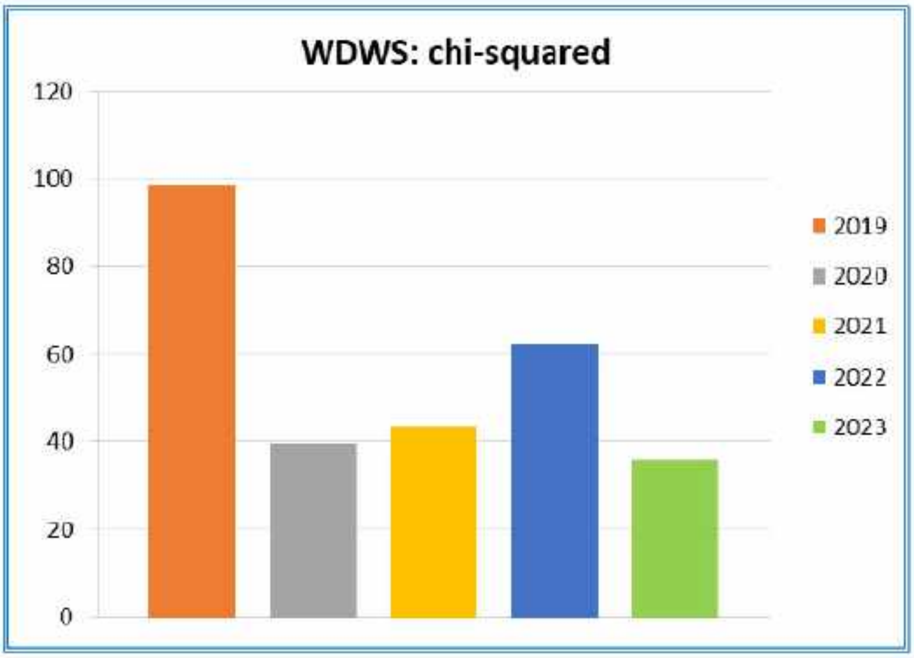


Figure 1: Statistical *chi-squared* for Wind Speed vs Wind Direction

To further clarify the use of the 2023 annual period as the representative year, the statistical *t-Test* was used to compare the ***scalar values*** of temperature and thus determine if there is a significant difference between the means of a single annual period and that of the five-year trend. The ***t-Test*** results are illustrated in **Figure 2**.

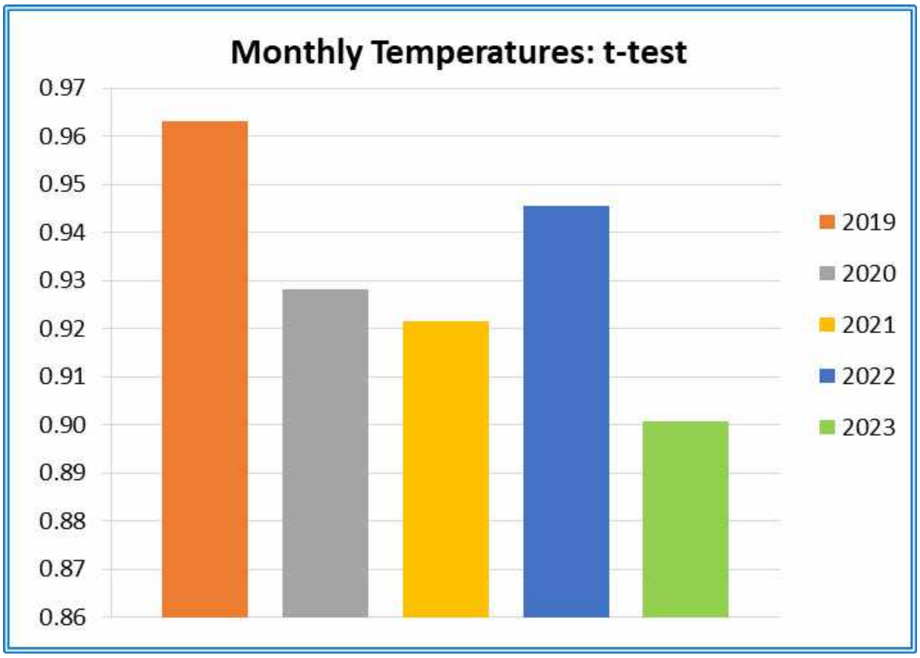


Figure 2: Statistical *t-Test* for Monthly Average Temperature

Considering the *chi-squared* results agreed with the *t-Test*, the use of the 2023 annual period was chosen accordingly.

The TAPM model was then ran for the annual period and all missing data from the surface observations were interpolated for small gaps, and gap filled using TAPM for larger data gaps.

2 Meteorological Configuration

The TAPM (v4.0.4) model produces a 3D data tile representative of surface and upper air met characteristics with the following setup:

- 41 grid points (nx, ny);
- Five nests with the outer grid spacing (dx1, dy1) of 30 kms and subsequent nests approximately 1/3rd of the preceding nest (30, 10, 3, 1.0, 0.3 km); and
- 25 vertical grid levels.

NOTE: The secondary innermost nest (1.0 km spacing) was extracted in full for the annual met period given the locality's terrain lacked complexity.

3 Meteorological Characteristics

3.1 Temperature

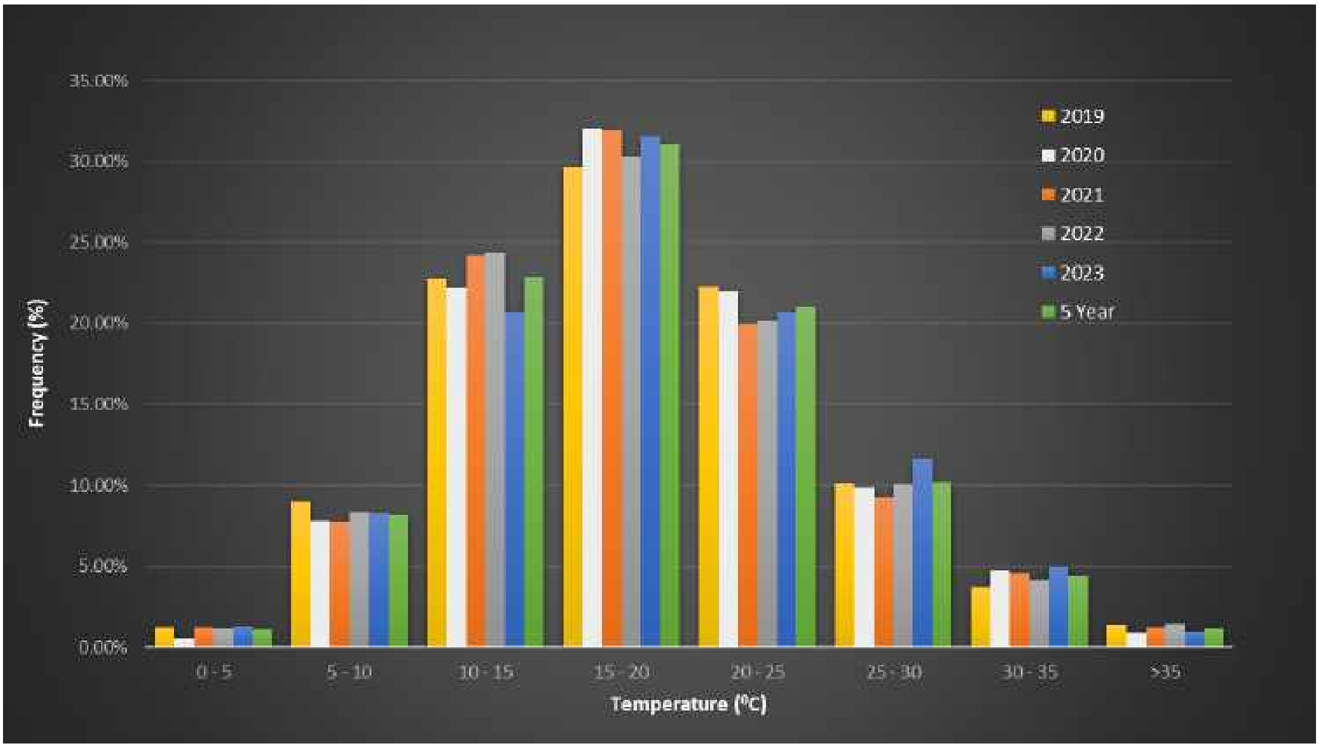


Figure 3: Annual Temperature Frequency Trends against the 5-Year Trend

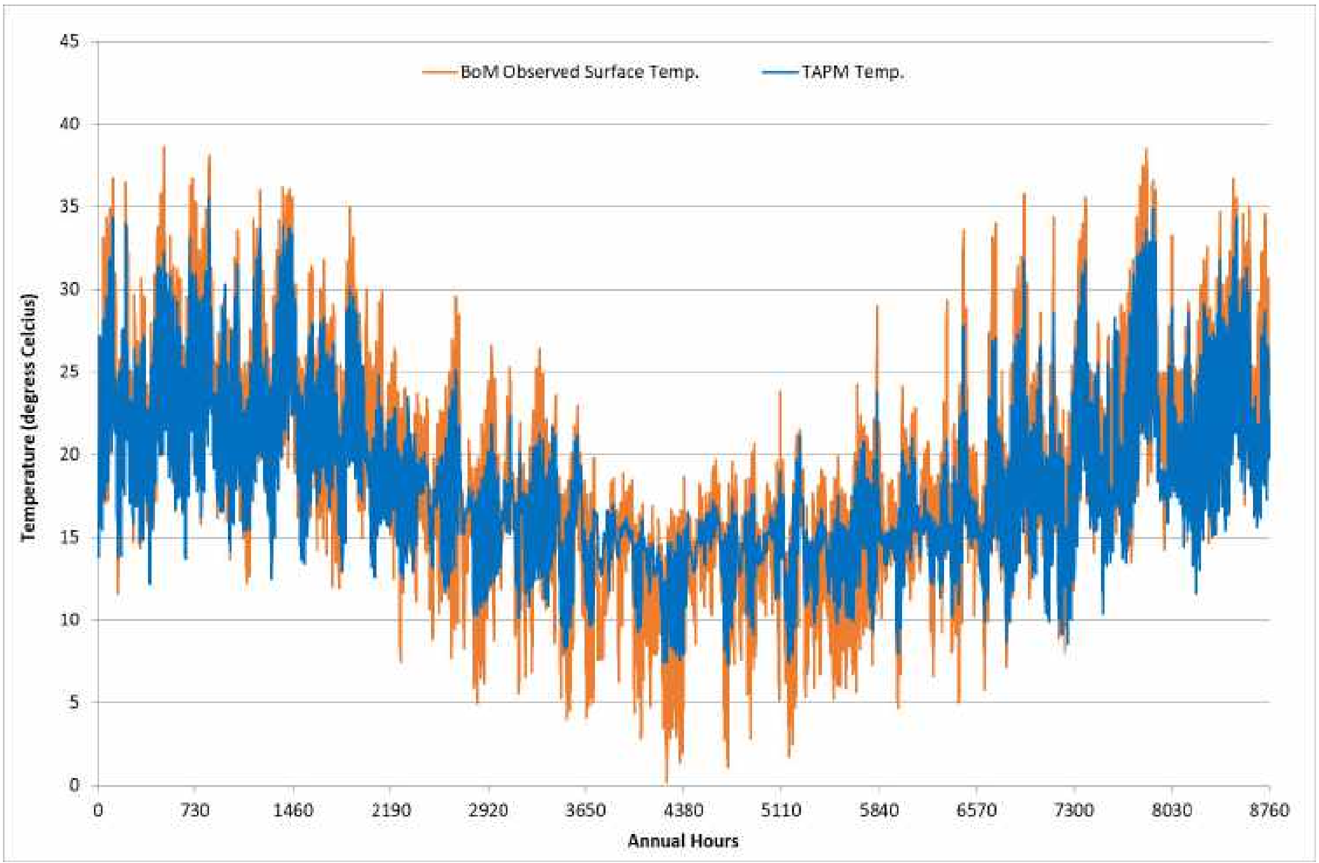


Figure 4: 2023 Observed Temperatures (Jandakot AERO BoM AWS) versus TAPM Prognostic 2023

Figure 4 shows that TAPM temperatures representative of Layer-1 (i.e., at 10 metres) tend to under-predict the higher temperatures over the annual period and over-predict the lower temperatures in the cooler seasons when compared to surface observations at 10 metres from the Jandakot AERO BoM AWS. As a result, the observed temperatures from Jandakot AERO were used in the modelling.

3.2 Wind Speed

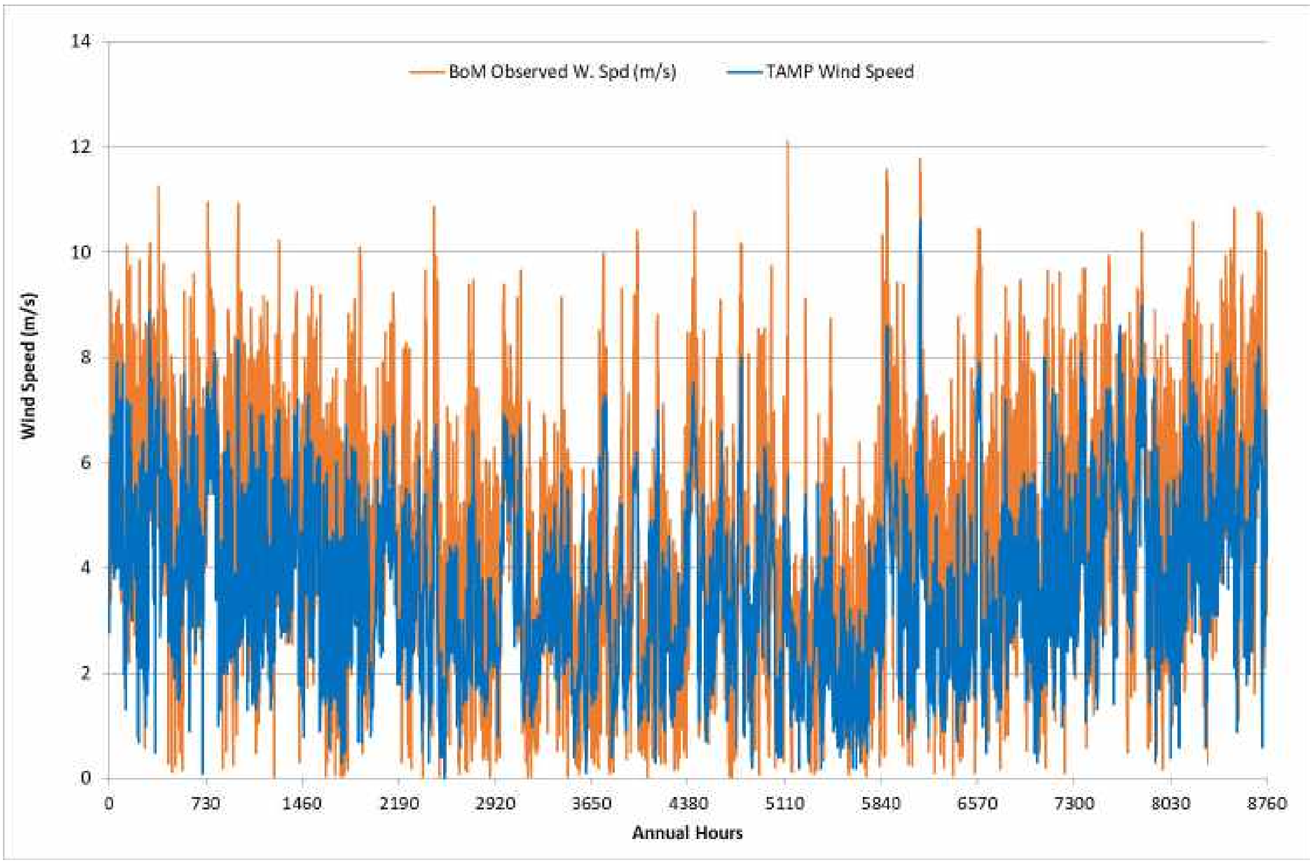


Figure 5: 2023 Observed Wind Speed (Jandakot AERO BoM AWS) versus TAPM Prognostic 2023

Figure 5 also illustrates that TAPM tends to under-estimate higher wind speeds, with better correlation to lower wind speeds. Again, the observed winds from Jandakot AERO were used in the modelling.

The resultant windrose of wind speed versus direction for the locality, taken from the Jandakot AERO 2023 BoM AWS observations is illustrated in **Figure 6**, with a resultant wind vector from the south-east.

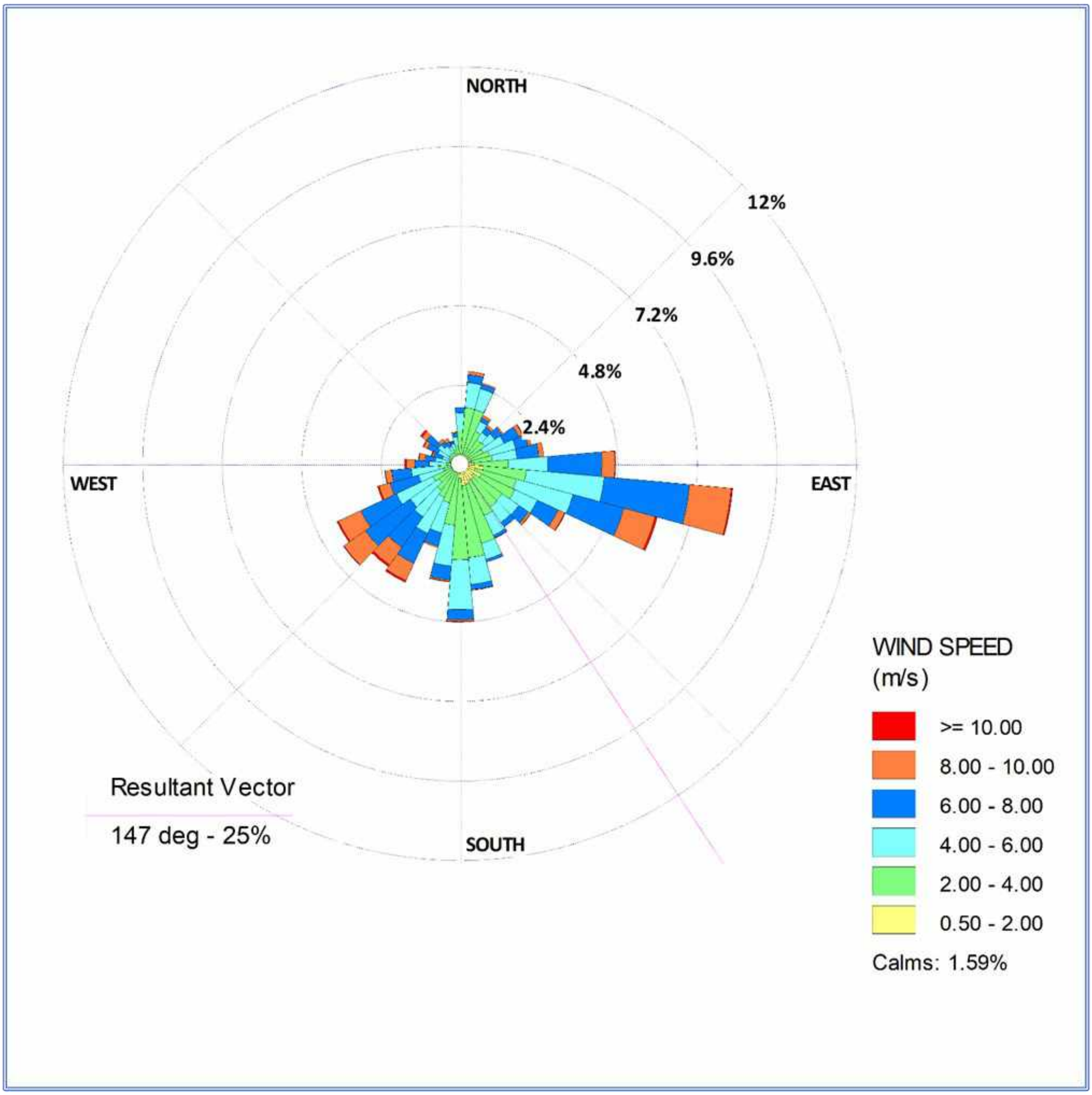


Figure 6: 2023 Observed Wind Speed & Direction Characteristics (Jandakot AERO BoM AWS)

Appendix B: Modelling Files

```
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** AERMOD View Ver. 12.0.0
** Lakes Environmental Software Inc.
** Date: 19/09/2024
** File: S:\EAQ Consulting\PROJECTS\PROJECTS 2024\24017_Chairay Plastics\Reports\config.inp
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****************************************
**
**
****************************************
** AERMOD Control Pathway
****************************************
**
**
CO STARTING
   TITLEONE D:\MyAERMOD\24017.isc
   TITLETWO Chairay Plastics Recycling (204 Bannister Road, Canning Vale)
   MODELOPT DFAULT CONC
   AVERTIME 1
   POLLUTID ODOUR
   RUNORNOT RUN
   ERRORFIL 24017.err
CO FINISHED
**
****************************************
** AERMOD Source Pathway
****************************************
**
**
SO STARTING
** Source Location **
** Source ID - Type - X Coord. - Y Coord. **
   LOCATION VOL1         VOLUME     396615.060  6452018.980       25.100
** DESCRSRC Chairay Facility
** Source Parameters **
   SRCPARAM VOL1             875.0     3.000     8.605     4.651

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** Variable Emission Scenario: "Scenario 2"
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   EMISFACT VOL1         HROFDY 0.0 1.0 1.0 1.0 1.0 1.0
   EMISFACT VOL1         HROFDY 1.0 1.0 1.0 1.0 1.0 0.0
   EMISFACT VOL1         HROFDY 0.0 0.0 0.0 0.0 0.0 0.0
   CONCUNIT 1 OU/S OU/M**3
   SRCGROUP ALL
SO FINISHED
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** AERMOD Receptor Pathway
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**
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RE STARTING
   INCLUDED 24017.rou
RE FINISHED
**
****************************************
** AERMOD Meteorology Pathway
****************************************
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   SURFILE 24017.SFC
** Profile File Path: D:\MyAERMOD\24017\24017\
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   UAIRDATA 0 2023
   SITEDATA 9172 2023
   PROFBASE 26.0 METERS
ME FINISHED
**
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** AERMOD Output Pathway
****************************************
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   RECTABLE 1 1ST
   MAXTABLE ALLAVE 100
** 1-Hour Binary POSTFILE for the Percentile/Rolling Average Option
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** Auto-Generated Plotfiles
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   SUMMFILE D:\MyAERMOD\24017\24017\24017.sum
OU FINISHED
**
**
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** Percentile/Rolling Average
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** ROLLOPTN OFF
** SKIPCALM OFF
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** Project Parameters
****************************************
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** DESCPTN  UTM: Universal Transverse Mercator
** DATUM    World Geodetic System 1984
** DTMRGN   Global Definition
** UNITS    m
** ZONE     -50
** ZONEINX  0
**
```

Appendix B

Noise Assessment

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Chairay Plastic Recycling Facility

Environmental Noise Assessment

Prepared for:

Chairay

Providing 'Sound' Solutions

Picture Source: Chairay

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Basis of Report

This report has been prepared by ANV Consultants Pty Ltd (ANV Consultants) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Chairay (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from ANV Consultants.

ANV Consultants disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

Document Control

Reference	Date	Prepared	Checked	Authorised
755.23054-R01-v1.0	14 October 2024	B Li	W Wen	B Li

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1 Introduction

1.1 Background

Chairay is planning to develop a plastics recycling facility in Western Australia. This development project has high strategic importance to enable WA and Australia to achieve its resource recovery targets and support already established infrastructure such as the Container Deposit Scheme and Material Recycling Facilities.

An operational environmental noise assessment is required for the project, as part of the supporting documentation for the Development Approval application to the local council (i.e. City of Canning), as well as for the Environmental License application to the Department of Water and Environmental Regulation (DWER).

1.2 Site locality

The proposed facility is to be located at Warehouse A, 204 Bannister Road, Canning Vale Western Australia. Located in the heart of Canning Vale's industrial precinct, 204 Bannister Road comprises two high-grade industrial and logistics facilities of 8,300sqm (Warehouse A) and 3,250sqm (Warehouse B).

The Canning Vale industrial precinct is situated in close proximity to Fremantle Port, is adjacent to Roe Highway and in turn provides ease of access to Perth's key arterial road network, including Kwinana Freeway, Tonkin and Leach Highways, all of which provide direct access to Perth Airport, Kewdale Freight Terminal and the surrounding suburbs of Perth.

The site locality and the site plan are provided in **Figure 1** below.

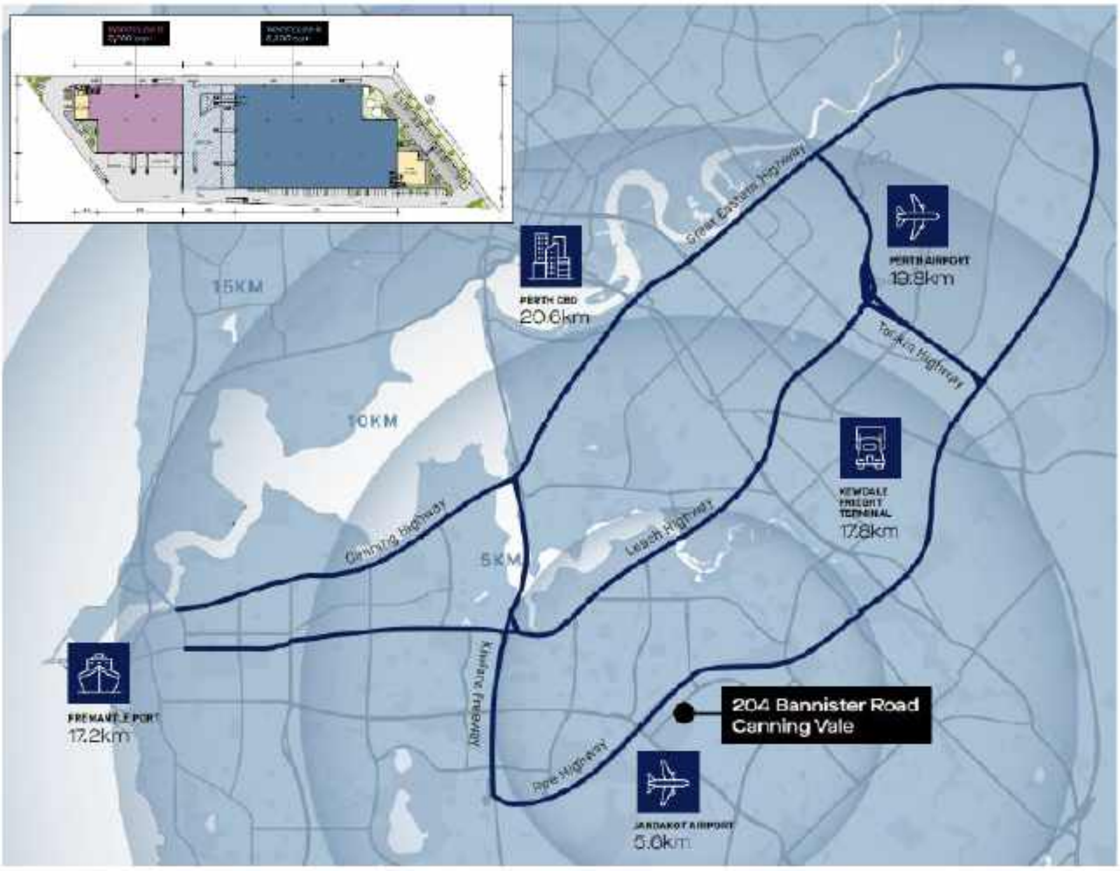


Figure 1 Site locality and site plan

1.3 Scope of works

Chairay has engaged with ANV Consultants Pty Ltd (ANV) to undertake this operational environmental noise assessment. The scope of works for this assessment is outlined as follows:

- Undertake a desktop review to assess site surroundings and identify adjacent sensitive receptors.
- Define assigned noise levels at identified noise sensitive receptors based on City of Canning’ local council zoning scheme, as per state noise regulations.
- Develop 3-D noise models for the typical operational scenarios and predict received noise levels at adjacent noise sensitive receptors. The typical site noise generating operational activities includes the fixed processing plant equipment and the mobile equipment utilised during operations.
- Assess the noise compliance by comparing the predicted noise levels against assigned noise levels, taking into account potential cumulative noise impact from adjacent industrial / commercial operations.
- Where required, in-principle noise mitigation and management measures will be outlined for consideration.
- Provide an operational environmental noise assessment report outlining the modelling and assessment methodology and findings of the subsequent noise impact assessment.

It should be noted that baseline noise monitoring at the adjacent noise sensitive receptors is not part of the scope for this study. However, the existing noise environment will be assumed based on a conservative consideration from a noise impact assessment perspective.

1.4 Applicable documents, guidelines and regulations

The following documents are applicable to this noise study:

- Relevant documents in relation to the project provided by Chairay.
- Western Australia Environmental Protection Act 1986.
- Western Australia Environmental Protection (Noise) Regulations 1997.
- Guideline – Assessment of environmental noise emissions, Department of Water and Environmental Regulation, May 2021.

2 Assessment criteria

2.1 Environmental Protection (Noise) Regulations 1997

The operational noise emissions from the proposed recycling facility are governed by the state noise regulations, namely the *Environmental Protection (Noise) Regulations 1997* (the Regulations).

Regulation 8 within the Regulations sets out the maximum allowable noise levels ('assigned noise levels') based on different time of day and land use (i.e. noise sensitive premises, commercial and industrial type premises), applicable at the premises receiving the noise. The assigned noise levels of various parameters (L_{A10}, L_{A1} and L_{Amax}) are also dependent on influencing factor (IF) calculated in accordance with the regulations as detailed in Schedule 3 of the Regulations, taking into account the area of industrial and commercial land and the presence of major roads within a 100 m and 450 m radius around the noise receiver.

A summary of the assigned noise levels from Regulation 8 is presented in **Table 1** below.

Table 1 Assigned noise levels

Type of premises receiving noise	Time of day	Assigned noise level, dB(A)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area (i.e. noise sensitive premises at locations within 15 metres of a building directly associated with a noise sensitive use)	7:00 am to 7:00 pm Monday to Saturday ('Day')	45 + IF	55 + IF	65 + IF
	9:00 am to 7:00 pm Sunday and public holidays	40 + IF	50 + IF	65 + IF
	7:00 pm to 10:00 pm all days ('Evening)	40 + IF	50 + IF	55 + IF
	10:00 pm on any day to 7:00 am Monday to Saturday and 9:00 am Sunday and public holidays ('Night')	35 + IF	45 + IF	55 + IF
Noise sensitive premises: any area other than highly sensitive area (i.e. Noise Sensitive premises at locations further than 15 metres from a building directly associated with a noise sensitive use)	All hours	60	75	80
Commercial premises	All hours	60	75	80
Industrial and utility premises other than those in the Kwinana Industrial Area	All hours	65	80	90
Industrial and utility premises in the Kwinana Industrial Area	All hours	75	85	90

Regulation 7 within the Regulations also requires that the noise character received at sensitive receivers must be 'free' of annoying characteristics of tonality, modulation and impulsiveness. If these characteristics cannot be reasonably and practicably removed, then a series of adjustments to the measured or calculated received levels are set out, and the adjusted level must comply with the assigned level. The adjustments are set out in **Table 2** and are further defined in Regulation 9(1) and as below:

- Tonality is defined in Regulation 9(1) as being present where the difference between the A weighted sound pressure level in any one third octave band and the arithmetic average of the A weighted sound pressure levels in the two adjacent one third octave bands is greater than 3 dB in terms of $L_{Aeq,T}$ where the time period

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

- Modulation is defined as a variation in the emission of noise that:
- Is more than 3 dB $L_{A, Fast}$ or is more than 3 dB $L_{A, Fast}$ in any one third octave band
- Is present for at least 10% of the representative assessment period, and
- Is regular, cyclic and audible
- Impulsiveness is defined as present where the difference between $L_{A, peak}$ and $L_{Amax, S}$ is more than 15 dB when determined for a single representative event.

Table 2 Table of adjustments

Adjustment where noise emission is not music (adjustments are cumulative to a maximum of 15 dB)			Adjustment where noise emission is music	
Where tonality is present	Where modulation is present	Where impulsiveness is present	Where impulsiveness is not present	Where impulsiveness is present
+5 dB	+5 dB	+10 dB	+10 dB	+15 dB

2.2 Adjacent receivers and assigned noise levels

The adjacent receivers associated with the proposed plastics recycling facility include the industrial premises surrounding the facility, within the Caning Vale industrial precinct, and residential premises across Roe Highway in the northwest direction of the facility site.

The facility site and the nearest representative receivers are indicated in Error! Reference source not found., with their corresponding assigned noise levels outlined in **Table 3**.

Figure 2 The recycling facility site (red colour) and adjacent representative receivers (Source: Google Earth)

Table 3 Summary of adjacent receivers and their corresponding assigned noise levels

<table>
<tr><th rowspan="2">The adjacent representative receivers</th><th rowspan="2">Notes</th><th rowspan="2">Influencing factor, IF</th><th colspan="3">Assigned noise level, LA10, dB(A)</th></tr>
<tr><th>Day</th><th>Evening</th><th>Night</th></tr>
<tr><td>1</td><td>Residential - 34 Kinship St, Willetton</td><td rowspan="6">8
6 - major road (Roe Highway) within a 100m circle.
2 - 40% industrial zone within a 450 m circle.</td><td rowspan="6">53</td><td rowspan="6">48</td><td rowspan="6">43</td></tr>
<tr><td>2</td><td>Residential - 36 Affinity Wy, Willetton</td></tr>
<tr><td>3</td><td>Residential - 18 Affinity Wy, Willetton</td></tr>
<tr><td>4</td><td>Residential - 29 Tippett Ct, Willetton</td></tr>
<tr><td>5</td><td>Residential - 17 Tippett Ct, Willetton</td></tr>
<tr><td>6</td><td>Residential – 14 Pallas Pl, Willetton</td></tr>
<tr><td>7</td><td>Industrial – 191 Bannister Rd, Canning Vale</td><td rowspan="4">N/A</td><td rowspan="4" colspan="3">65</td></tr>
<tr><td>8</td><td>Industrial – 210 Bannister Rd, Canning Vale</td></tr>
<tr><td>9</td><td>Industrial – 61 Baile Rd, Canning Vale</td></tr>
<tr><td>10</td><td>Industrial – 198 Bannister Rd, Canning Vale</td></tr>
</table>

3 Noise modelling methodology

3.1 Modelling algorithm

A 3D noise model was developed based on the modelling platform SoundPLAN 9.0. The software allows the use of various internationally recognised noise prediction algorithms, accounting for sound intensity losses due to distance attenuation, atmospheric absorption, ground absorption and shielding provided by solid structures or terrain.

The prediction method ISO 9613-2[1], as implemented in the SoundPLAN software platform, has been selected for this assessment. ISO9613-2 defines a general-purpose noise prediction method that has been well established as the primary international standard for calculating environmental noise from commercial and industrial sources. The method predicts noise levels under the conservative conditions that are in favour of sound propagation from the source to the receiver (and consequently increase receiver noise levels). Threse conditions comprise either:

- A wind direction from the noise source to the receiver, or
- A moderate ground-based thermal inversion (a condition when temperatures increase with height above ground, as may occur on clear and still night).

The general noise model parameters used within SoundPLAN platform are presented in **Table 4.**

Table 4 Noise model parameters

Variable	Parameter used
Calculation method	ISO 9613-2 prediction method
Ground absorption coefficient	0.1 – relatively hard ground for industrial area 0.5 – relatively soft ground for residential area (0 represents hard ground and 1 represents soft ground)
Reflections	3rd order maximum reflections
Ground topography	Open-sourced Shutter Radar Topography Mission (SRTM) elevation data imported via Google Map, with a resolution of approx. 90 meters.
Receiver heights	1.5 m above ground level
Operating scenarios	Worst case scenario with all relevant equipment operating simultaneously
Temperature	20°C
Relative humidity	50%
Stability class	E
Air pressure	1,013 mbar
Meteorological conditions	Downwind condition (from the source to receiver) in favour of sound propagation

[1] International Organization for Standardization 1996, Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation, ISO 9613- 2:1996, International Organization for Standardization, Geneva, Switzerland.

3.2 Site operation and noise sources

The proposed plastic recycling operation is predominantly inside the Warehouse A, Warehouse A, 204 Bannister Road, Canning Vale Western Australia. The site is anticipated to operate during daytime only on weekdays, from 8am to 4pm.

Based on information provided by Chairay, the site operation involves both the mobile equipment fleet both inside and outside of the warehouse, and the fixed plant equipment within the warehouse area. For the fixed plant equipment, Chairy plans to operate two separate sorting lines of machinery with low powered conveyors connecting the different processing stages. The fixed and mobile plant equipment used in the plastic recycling plant modelling is summarised in **Table 5** and **Table 6** respectively.

The HP motor units associated with water treatment plant outside the warehouse are provided in **Table 7**.

For the fixed plant equipment inside the warehouse and the HP motor units outside the warehouse, their sound power levels are calculated based on the sound pressure levels measured at a distance of 2 m from the plant surface, as per relevant international standard ISO 3746:2010[2]. The dimensions of the fixed plant equipment are based on site layout drawings provided by Chairay.

The sound power levels for the mobile plant equipment are provided by Chairay directly.

The one-octave band sound power spectral levels for each equipment item are provided in **Appendix B**.

Table 5 Fixed plant noise sources inside the warehouse

Fixed plant equipment	Quantity	SPL @ 2m, dB(A)	SWL, dB(A)	Source
Single Shaft Shredder	1	90	109	Chairay
Crusher	2	92	110	
Horizontal dehydrator	2	100	120	
Stripping machine	1	100	120	
Pellestising	1	87	110	

Table 6 Mobile equipment outside the warehouse

Mobile equipment	Quantity	SWL, dB(A)	Source
2.5t Electric Forklift	1	90	Chairay (Wood SWL Library)
Side Loader Truck	1	105	
Idle Truck	1	100	

Table 7 Water Treatment plant outside the warehouse

Fixed plant equipment	Quantity	SPL @ 2m, dB(A)	SWL, dB(A)	Source
5 HP motor	1	82	96	Chairay
7.5 HP motor	2	85	99	
1 HP motor	1	53	67	
2 HP motor	1	54	68	

[2] ISO 3746:2010 Acoustics – Determination of sound power levels and sound energy of noise sources using sound pressure – Survey method using an enveloping measurement surface over a reflecting plane.

3.3 Modelling scenarios and assumptions

The noise modelling has considered the two scenarios as described in **Table 8** below, i.e. the roller doors south of the facility building being either fully closed or fully left open, to account for the noise breakout difference from the roller door areas as a result of the noise-generating equipment operating inside the facility building.

Some additional assumptions regarding the locations of the mobile equipment and the water treatment plant outside of the facility, the positions of the fixed plant equipment inside the facility, as well as the general warehouse building characteristics are outlined below:

- Mobile equipment units are assumed to be located within the external loading area south of the facility warehouse building.
- HP motor units are assumed to be located on the bottom left outside the facility building under the canopy.
- The internal surfaces of the warehouse building are assumed to be reflective, with the sound transmission ratings of the partitions (walls and ceilings) of minimum Rw 31 dB / STC 32 dB. On this basis, the noise breakout from the building partitions, as a result of the fixed equipment operations inside the building, are predicted.

Table 8 Modelling scenarios

Scenario	Description
1	The operation of the site facility under the worst-case consideration, i.e. all noise-generating equipment operating simultaneously and continuously. All roller doors south of the facility building closed.
2	The operation of the site facility under the worst-case consideration, i.e. all noise-generating equipment operating simultaneously and continuously. All roller doors south of the facility building left open.

4 Results and discussions

4.1 Results

The predicted noise levels at the adjacent representative receivers for the two modelling scenarios considered are presented in **Table 9** below. The compliance assessment against the corresponding assigned level for each receiver is also provided.

The modelled noise contour plots for the two modelling scenarios covering the adjacent industrial and residential areas are provided **Appendix C**.

Table 9 Modelling results and the compliance assessment

<table>
<tr><th rowspan="2">The adjacent representative receivers</th><th rowspan="2">Assigned level, L_{A10}, dB(A)</th><th colspan="4">Predicted noise levels</th></tr>
<tr><th>Scenario 1</th><th>Compliance (Yes / No)</th><th>Scenario 2</th><th>Compliance (Yes / No)</th></tr>
<tr><td>1</td><td rowspan="6">53</td><td>47.0</td><td rowspan="6">Yes</td><td>48.4</td><td rowspan="6">Yes</td></tr>
<tr><td>2</td><td>47.0</td><td>48.6</td></tr>
<tr><td>3</td><td>46.3</td><td>47.2</td></tr>
<tr><td>4</td><td>44.5</td><td>45.5</td></tr>
<tr><td>5</td><td>44.6</td><td>45.1</td></tr>
<tr><td>6</td><td>42.0</td><td>42.6</td></tr>
<tr><td>7</td><td rowspan="4">65</td><td>60.9</td><td>Yes</td><td>61.1</td><td>Yes</td></tr>
<tr><td>8</td><td>65.5</td><td>Exceedance, by up to 1 dB</td><td>72.4</td><td>Exceedance, by up to 7 dB</td></tr>
<tr><td>9</td><td>64.2</td><td>Marginal compliance</td><td>65.8</td><td>Exceedance, by up to 1 dB</td></tr>
<tr><td>10</td><td>50.1</td><td>Yes</td><td>52.3</td><td></td></tr>
</table>

4.2 Discussion

4.2.1 Compliance assessment

As can be seen from the modelling results in **Table 9** above, the predicted received noise levels at representative residential receptors are all compliant with their corresponding assigned levels. Due to the dominant noise contribution from the noise breakout from the warehouse facility building, the predicted received level differences at each receptor between the two modelling scenarios with all roller doors either shut or open are less than 2 dB.

For the industrial premises adjacent to the waste facility, the two premises directly east and west of the warehouse facility building have the potential to exceed noise limit of 65 dB(A) for their boundary sections directly exposed to the noise emissions from the outdoor mobile equipment, motor equipment and noise breakout from the roller door units. Other industrial premises surrounding the facility site are predicted to have received noise levels compliant with the noise limit, as the existing buildings provide sufficient shielding effects to attenuate noise transmissions between the facility source emissions and those premises.

It should be noted that the modelling scenarios are based on the worst-case considerations with all major noise-generating equipment items assumed to operate simultaneously. However, in reality this is highly unlikely to occur. Moreover, keeping roller doors closed as much as possible when not being operating is another effective approach to achieve noise compliance for adjacent industrial premises.

4.2.2 Tonality assessment

It is predicted that the risk of tonality being present from the noise emissions of the facility operation and received at adjacent residential and industrial premises is low. This is because no obvious tonal characteristics from the fixed and mobile equipment within the facility, and the expected strong masking effects from the existing noise environment dominated by adjacent road traffic (i.e. Roe Highway) and other existing industrial operations.

4.2.3 Noise mitigation and management measures

A range of noise mitigation and management measures as below are recommended to ensure any risk of excessive noise emissions from the operation of the proposed plastic recycling facility could be managed to achieve noise compliance:

- Ensure the performance of the specified sound-proof for shaft shredder, crusher, horizontal dehydrator and stripping machine is as per currently expected.
- Keep all roller doors closed as much as possible during times where the fixed equipment plants inside the warehouse are operating
- Avoid noise-generating fixed and mobile equipment plants operating simultaneously as much as practicable.
- Consider additional lining of the internal walls and ceiling of the warehouse with absorptive materials to reduce internal reverberation and increase acoustic absorption.
- Undertake commissioning testing of individual noise-generating equipment to ensure their noise emissions are not excessive compared with the noise modelling assumptions.
- Undertake compliance monitoring at adjacent receptors of interest once the facility is fully operating, to ensure overall operational noise compliance, through implementation of relevant improvement measures if required.

5 Conclusions

A detailed noise modelling study has been conducted for Chairay's proposed plastic recycling plant at Warehouse A, 204 Bannister Road, Canning Vale, Western Australia. The study considered worst-case scenarios, assuming all major noise-generating equipment would operate simultaneously and continuously. Two modelling scenarios were evaluated: one with the facility's roller doors south of the building open and one with them closed.

The results show that the predicted noise levels at adjacent residential receptors comply with their corresponding assigned limits. For the industrial premises adjacent to the waste facility, the two buildings directly to the east and west of the warehouse may exceed noise limits only at their boundary sections exposed to the outdoor loading area. Other surrounding industrial premises are predicted to experience noise levels within acceptable limits.

A range of practical noise management measures is recommended to address any potential risks of excessive noise emissions from the proposed plastic recycling facility.

APPENDIX A

A Glossary of acoustics terms

A.1 Acoustics Terms

The following table describes key terms used in this report.

Table 10 Acoustics Terms and their definitions

Terms	Definition
dB	Decibel, a unit of sound or vibration which is described as a ratio of the result to a fixed reference value. All sound pressure levels (LpA, LA, LAeq etc.) quoted in this report are referenced to 20 micro Pascals (dB re 20µPa).
	Vibration velocity levels (L_v) quoted in this report are referenced to 1 nanometre per second (dB re 10-9 m/s), noting that some US criteria use dB re 10^{-6} in/s.
Sound Power Level (SWL or L_W)	A logarithmic ratio of the acoustic power output of a source relative to 10^{-12} watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
Sound Pressure Level (SPL or Lp), or Noise Level	A logarithmic measure of the effective pressure of a sound relative to a reference value, defined in dB (decibel). The commonly used reference sound pressure in air is 20 µPa, which is often considered the threshold of human hearing.
A-weighting	The process by which noise levels are corrected to adjust for the non-linear frequency response of the human ear.
Time Weighting	The exponential averaging method used to adjust a measurement instrument's response to fluctuating signals over time. It essentially applies a "filter" to the signal, emphasizing or deemphasizing certain aspects of the signal based on the chosen **time constant**: - **Fast (F)**: Has a time constant set at 125 milliseconds. It provides a fast-reacting reading suitable for measuring sounds that do not fluctuate too rapidly - **Slow (S)**: With a time constant of 1 second, this is used for measuring average sound levels where the sound fluctuates rapidly, making it difficult to read with a fast response - **Impulse (I)**: Specifically designed for measuring sounds with sharp peaks (like gunshots or fireworks). It has a shorter time constant (around 35 milliseconds) than the Fast response to capture the brief, intense nature of such sounds.
L_{Amax}	The maximum A-weighted noise level associated with a sampling period.
L_{A1}	The A-weighted noise level exceeded for 1% of a given measurement period. This parameter is often used to represent the typical maximum noise level in a given period.
L_{A10}	The A-weighted noise level exceeded for 10% of a given measurement period and is utilised normally to characterise average maximum noise levels.

Terms	Definition
L_{Aeq}	The A-weighted average noise level. It is defined as the steady noise level that contains the same amount of acoustical energy as a given time-varying noise over the same measurement period.
L_{A90}	The A-weighted noise level exceeded for 90% of a given measurement period and is representative of the average minimum background noise level (in the absence of the source under consideration), or simply the "background" level.
Octave Frequency Band, One-Third Octave Frequency Band	Sound spectrums are usually represented in octave or one-third octave frequency bands rather than in narrow frequency bands. This frequency representation is linked to the perception of sound by a human ear and it allows a compression of the amount of information. An octave frequency band is defined as when the upper band frequency is twice the lower band frequency. A one-third octave band as a band whose upper band-edge frequency is the lower band frequency times the cube root of two.

A.2 Noise Chart

Sound consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. Noise is often used to refer to unwanted sound. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms. The symbol 'A' represents A-weighted sound pressure level (SPL): the weighting is designed to better represent the hearing ability of the average listener at each frequency.

The ability to discern a change in noise level varies between individual listeners, however it is reasonable to suggest that a change of up to 3 dB in the level of a sound is difficult for most people to detect, and a 3 dB to 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change corresponds to an approximate doubling or halving in loudness and is readily noticeable.

The following table presents examples of typical noise levels.

Table 11 Guide to sound pressure level ranges for selected environments (dB re 20µPa)

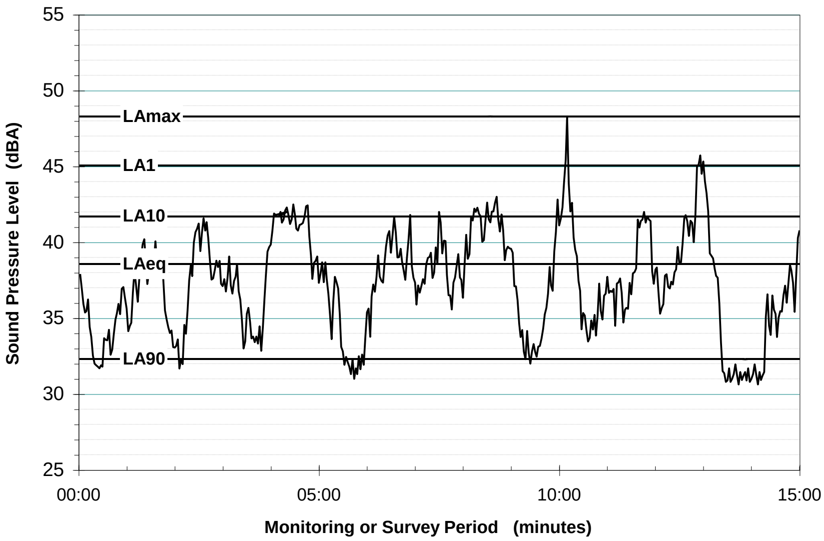
L_{Aeq}, dB	Representative noise sources	Subjective Evaluation
140	Military jet engine at 30 metres	Intolerable. Onset of pain.
130	Disaster warning siren at 1 metre	
120	Jet aircraft take-off	Very loud.
110	Rock concert	
100	Angle grinder	Loud.
90	Heavy industrial factory	
80	Kerb side of busy street	Noisy
70	Loud radio or television	
60	Department stores	Moderate
50	General office areas	

40	Boardroom or private office	Quiet
30	Bedroom at night	Very quiet
20	Recording studio	Almost silent
10	Human breathing at 3 metres	
0	Threshold of typical hearing	

L_{Aeq} values represent an energy average of sound over time and are basic indicators of loudness. However, for sounds that vary in level over time are commonly described in terms of the statistical exceedance levels L_{AN}, where L_{AN} is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the L_{A1} is the noise level exceeded for 1% of the time, L_{A10} the noise exceeded for 10% of the time.

The following figure presents a hypothetical 15-minute noise monitoring, illustrating various statistical noise levels of interest.

Figure 3 Various noise parameters during a hypothetical 15-minute noise monitoring period



Relevant noise parameters are:

- **L_{A1}** The noise level exceeded for 1% of the 15-minute interval.
- **L_{A10}** The noise level exceeded for 10% of the 15-minute interval. This is commonly referred to as the average maximum noise level.
- **L_{A90}** The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.
- **L_{Aeq}** The A-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

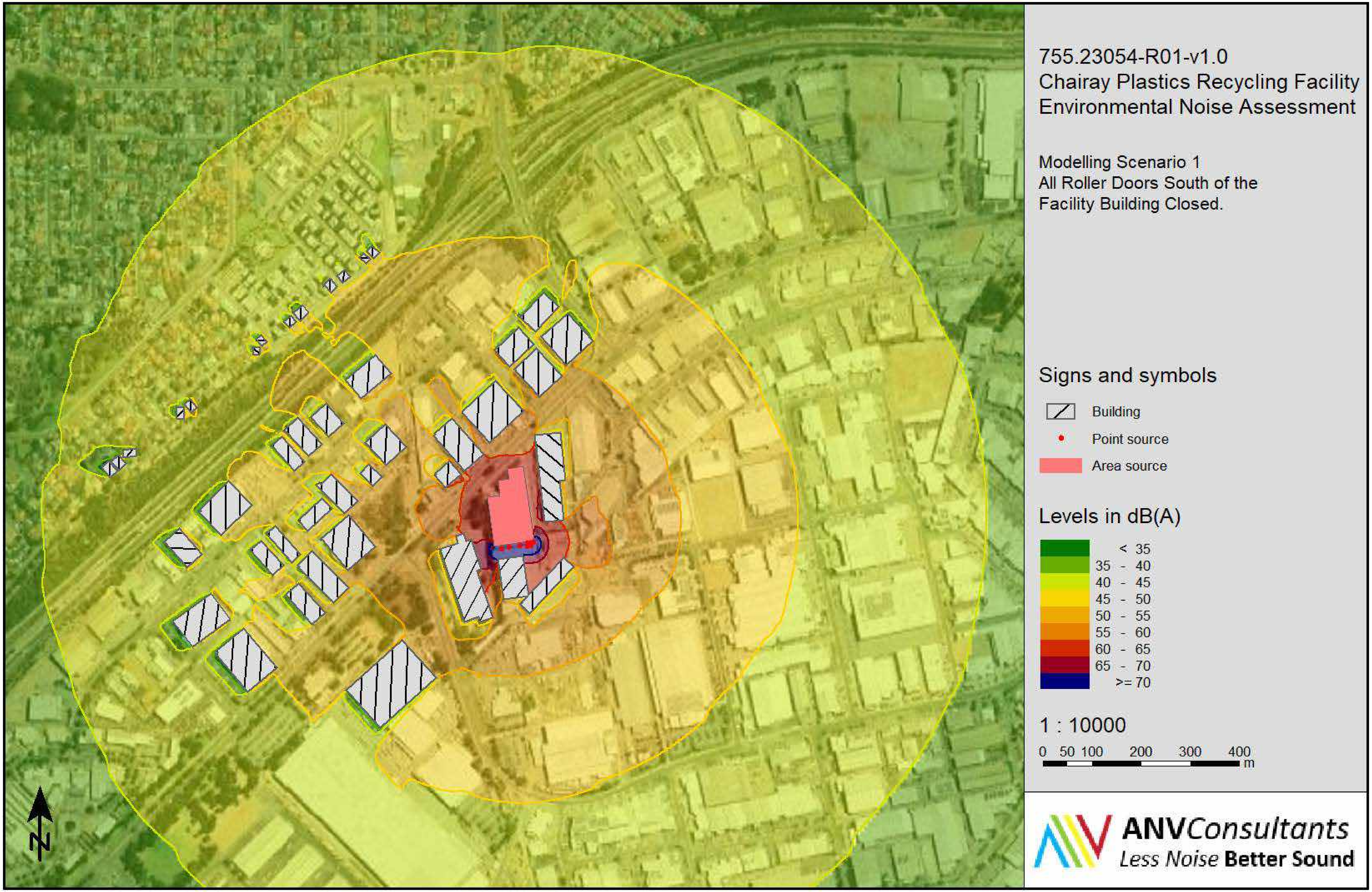
APPENDIX B

B Equipment Noise Data

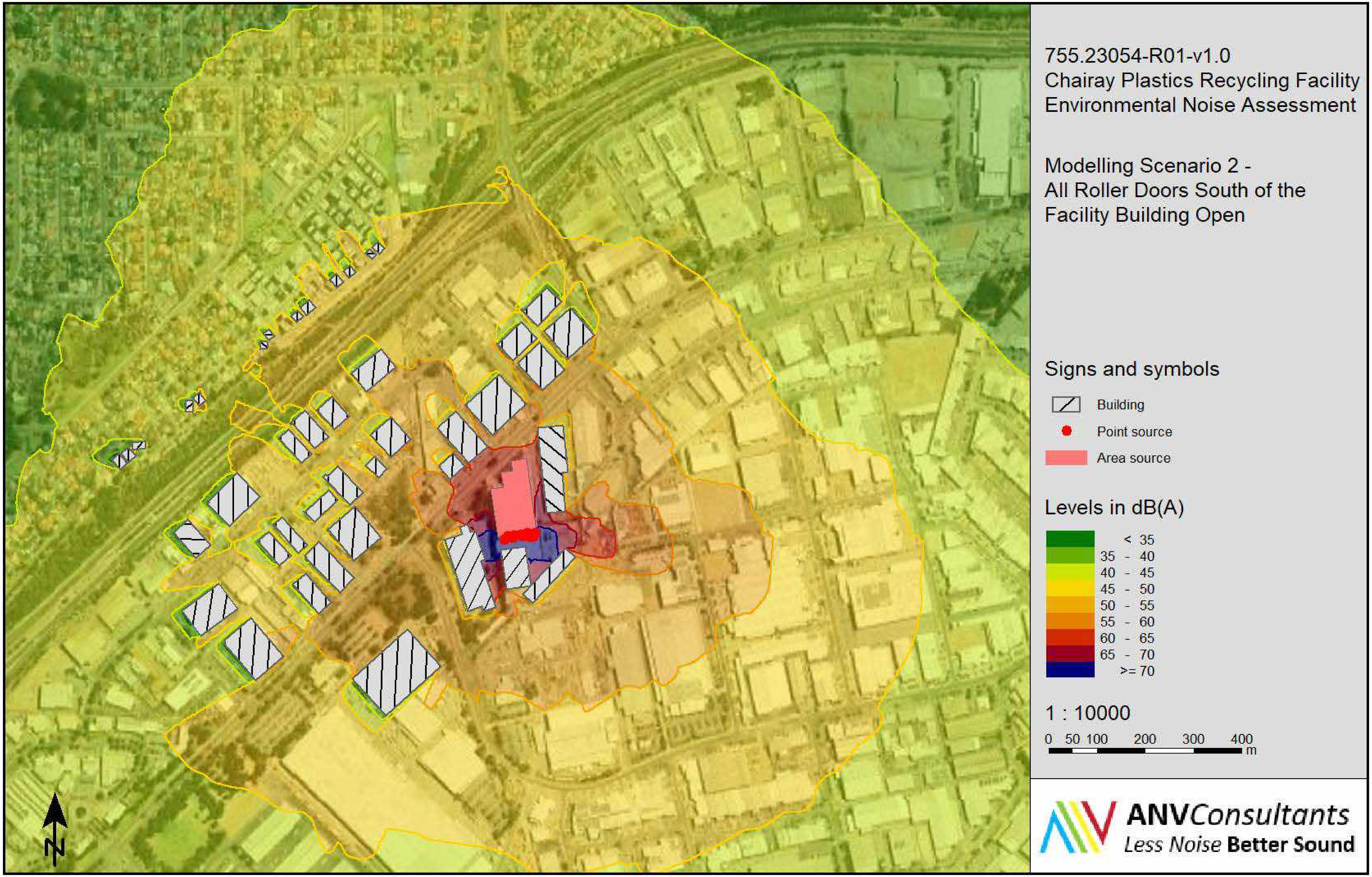
Equipment	SWL, dB(A)	Octave Band Spectra in dB(Z), Central Frequency in Hz								
		31	63	125	250	500	1k	2k	4k	8k
Fixed Plants										
Single Shaft Shredder (X1)	109	106	112	105	106	104	106	100	98	97
Crusher (X2)	110	107	113	106	107	105	107	101	99	98
Horizontal dehydrator (X2)	120	116	122	115	116	114	116	110	108	107
Stripping machine (X1)	120	116	122	115	116	114	116	110	108	107
Pellestising (X1)	110	107	113	106	107	105	107	101	99	98
Mobile Plants										
2.5t Electric Forklift (X1)	90	-	83	83	83	83	83	83	83	83
Side Loader Truck (X1)	105	-	103	102	100	101	102	97	91	82
Idle Truck (X1)	100	-	98	97	95	96	97	92	86	77
Water Treatment plant										
5 HP motor (X1)	96	-	101	94	88	91	92	90	83	76
7.5 HP motors (X2)	99	-	104	97	91	94	95	93	86	79
1 HP motor (X1)	67	-	72	65	59	62	63	61	54	47
2 HP motor (X1)	68	-	73	66	60	63	64	62	55	48
Warehouse Roof / Wall Noise Transmission Loss										
Roof / Wall Steel Sheet, Rw 31 / STC 32	-	-18	-15	-16	-20	-30	-34	-35	-38	-42

APPENDIX C

C Noise Contours



755.23054-R01-v1.0
Chairay Plastics Recycling Facility
Environmental Noise Assessment
Modelling Scenario 1
All Roller Doors South of the
Facility Building Closed.
Signs and symbols
Building
Point source
Area source
Levels in dB(A)
< 35
35 - 40
40 - 45
45 - 50
50 - 55
55 - 60
60 - 65
65 - 70
>= 70
1 : 10000
0 50 100 200 300 400
m
N
ANVConsultants
Less Noise Better Sound


755.23054-R01-v1.0
Chairay Plastics Recycling Facility
Environmental Noise Assessment
Modelling Scenario 2 -
All Roller Doors South of the
Facility Building Open
Signs and symbols
Building
Point source
Area source
Levels in dB(A)
< 35
35 - 40
40 - 45
45 - 50
50 - 55
55 - 60
60 - 65
65 - 70
>= 70
1 : 10000
0 50 100 200 300 400
m
N
ANVConsultants
Less Noise Better Sound

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