UPM

SHOTTON MILL

MRRF Extract System BAT Noise Assessment

RP AC 03
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CONFIDENTIAL

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MRRF Extract System BAT Noise Assessment

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1 INTRODUCTION

1.1 SCOPE

1.1.1. This report presents the methodology and findings of work carried out to inspect current processes and practices to determine whether best available techniques (BAT)[1] to control noise are currently employed, and to provide advice on further measures that could be implemented, should they be warranted. Specifically, the work described herein relates to extract plant on the east side of the Materials Recovery and Reclamation Facility (MRRF) building, following comments from Natural Resources Wales (NRW) relating to a tonal sound heard outside the site boundary.

1.1.2. In brief, the methodology comprises the following aspects:

- A site visit on 11 January 2021 to review the current practices and processes, and obtain sound level measurements at positions near to the MRRF extract plant to determine its individual noise contribution.
- Noise modelling to quantify the noise level emitted by the MRRF extract plant that is likely to occur at the nearest noise sensitive receptors.
- A detailed review of the current practices and processes in relation to the MRRF extract plant to examine whether they constitute BAT or if it would be appropriate for any alternative or additional techniques to be employed.

1.1.3. Quantifying noise levels or demonstrating that noise has been successfully restricted to certain numerical values is not strictly necessary in a review of the BAT. However, noise measurements and predictions are useful contextually and help to identify whether any potential impacts might justify a more thorough review of current practices and processes.

1.1.4. This report is necessarily technical in nature, and a glossary is provided in Appendix A to assist the reader.

1.2 SITE SETTING

The UPM Shotton site is located on Weighbridge Road in the Deeside Industrial Park. A plan showing the location of the site in relation to noise-sensitive properties is presented in Appendix B.1 and a plan of the site is presented in Appendix B.2. Figure 1-1 shows the location of the MRRF in relation to the UPM site.

1.3 NATURAL RESOURCES WALES CORRESPONDENCE

1.3.1. The BAT assessment and sound level measurements described herein have been carried out in response to the following comments received from Natural Resources Wales by email on 27 November 2020:

[1] In this report, Best Available Techniques (BAT) are as defined in '*Best Available Techniques (BAT) Reference Document for the Production of Pulp, Paper and Board*' (2015) which forms part of the Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control)

"Officers walked the length of Weighbridge Road starting at the front of PM2 and toward the disused railway crossing, finally heading South along Weighbridge Road along UPM's eastern site boundary. A highly prominent tone was detected that became increasingly loud as officers walked further south. Measurements taken to the rear of the MRF identified the tone at 150Hz with harmonics at 300, 450 and 600 Hz, based on previously supplied reports we believe that the source may be the MRF Compressor.

The 150, 300 and 450 Hz tones were not present in Burton, suggesting that the MRF compressor is not the source of the 600Hz tone identified at the same location. Note – the measurements at the complainant's property and the site were not running in parallel.

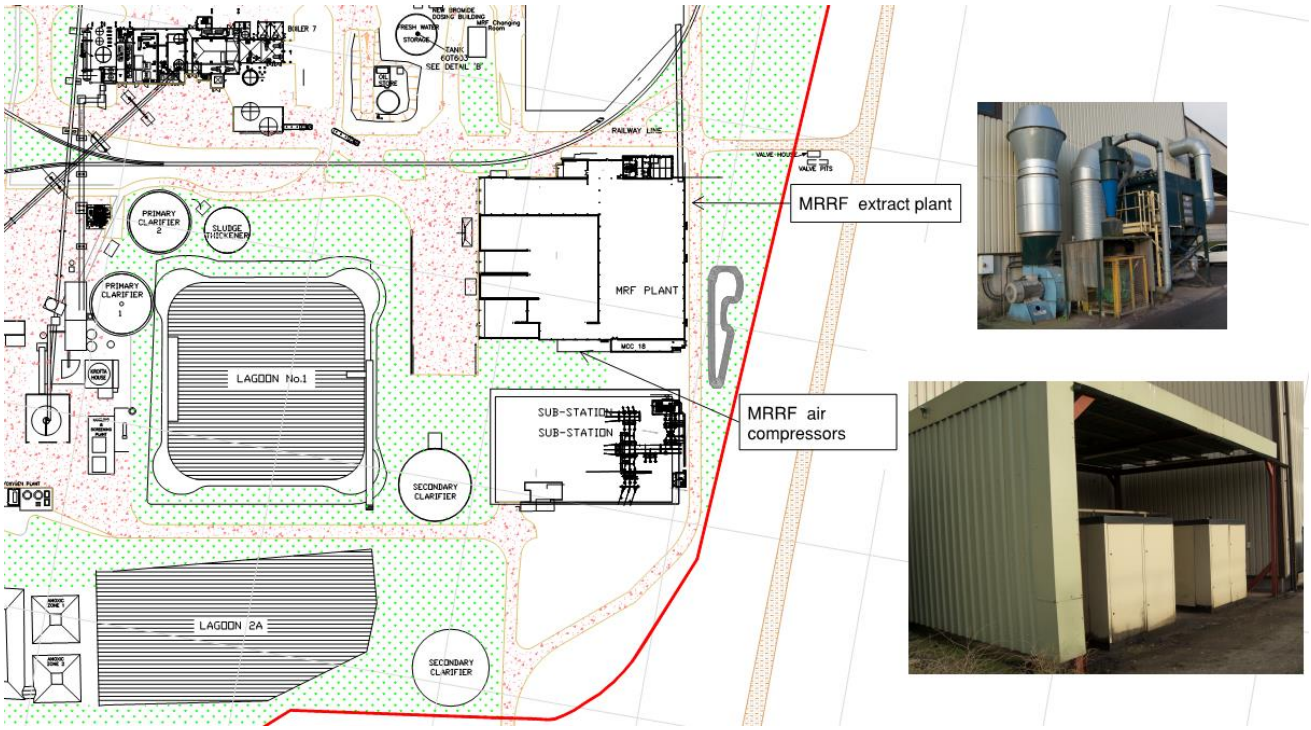
Action - In the opinion of NRW Officers, the tonal noise from the MRF constitutes a pollution outside of the site boundary and therefore we seek a BAT demonstration from UPM for plant/equipment generating this tone. Please do so by 31/01/21."

1.4 SUMMARY OF M.R.R.F. EXTRACT PLANT

1.4.1. It has since been clarified in conjunction with UPM that the plant referred to as the 'MRF compressor' is an air extraction system on the east side of the MRRF building. Separate air compressors are located on the south side of the building but would not be visible from the location on Weighbridge Road described in the correspondence above.

1.4.2. The locations of the MRRF plant are shown on the site plan below.

Figure 1-1 – Excerpt from UPM site plan showing locations of MRRF extract plant and air compressors



1.4.3. The photograph in Figure 1-2 below shows the MRRF extract plant and is annotated to indicate the different process stages to separate dust from the extracted air.

Figure 1-2 – Annotated photograph showing stages of air extraction and dust separation

1.4.4. The dominant noise source is the main extract fan (blue) and motor (grey), although sound can also be heard from the ductwork and associated transition pieces, particularly sections which are directly connected to the fan.

1.4.5. Occasionally, a short hiss is audible from a second smaller fan (below the filter unit) which blows a reverse air jet onto the filter to dislodge dust from the filter.

1.4.6. When stood very close to the plant, it is possible to hear small pieces of debris rattling down the ductwork, although this is not audible at distances beyond a few metres.

1.4.7. The ventilation louvre on the left side of Figure 1-2 is not part of the extract plant and was not audible at the time of the survey.

1.4.8. The MRRF is in use 24 hours a day, 7 days a week, in 12-hour shifts. The plant is not required during staff breaks, and therefore runs for approximately 8 hours in each 12-hour shift. The plant does not run during the following periods:

- 09:30 – 10:30
- 13:15 – 14:40
- 16:30 – 17:30
- 21:30 – 22:30
- 01:15 – 02:40
- 04:30 – 05:30

2 GUIDANCE AND STANDARDS

2.1.1. The evaluation of the application of BAT does not necessarily require a consideration of potential impacts on receptors. Instead, the focus of a BAT assessment is on whether or not an operator is using the best techniques available to reduce the environment impacts from a given process.

2.1.2. The term 'available' in BAT refers to the fact that a technique must be not just available as a product or practice, but also appropriate and proportionate to the process or plant itself. For example, a technique to reduce noise that would not physically fit on the site, would incur unacceptable financial cost, or would hinder maintenance access to processes or machinery, would not be BAT because it would not be considered to be available for that operation.

2.1.3. BAT is referenced extensively in the Industrial Emissions Directive (IED) 2010/75/EU (below) and the Environment Agency's Horizontal Guidance for Noise, both of which are discussed below. It is noted that the IED originates from the European Union (EU), which the United Kingdom has now left. However, the following statement[2] from NRW indicates that the Directive should still be followed:

"Welsh Government has said there will be no change to the level of environmental protection, nor to environmental standards in Wales. UK government has also committed to maintaining environmental standards."

2.1.4. On the basis of this statement, it is considered that the following guidance remains applicable in respect of emissions from the UPM Shotton site.

2.2 B.R.E.F. DOCUMENT FOR THE PRODUCTION OF PULP, PAPER AND BOARD

2.2.1. A series of BAT Reference (BREF) documents covering different industrial processes scheduled under the Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control) are available to assist with the environmental regulation of those processes.

2.2.2. BREF documents currently supersede any national guidance. The relevant document for UPM Shotton is 'Best Available Techniques (BAT) Reference Document for the Production of Pulp, Paper and Board' (2015) which, as there no other BREFs referred to in this work, will be referred to herein as 'the BREF'.

2.2.3. The guidance in this document relevant to noise comprises two main sections, which are summarised below.

2.2.4. Chapter 8.1.9 'Emissions of noise' (BAT17) outlines a series of techniques to reduce emissions of noise from pulp and paper manufacturing and states that 'BAT is to use a combination of the

[2] From https://naturalresources.wales/about-us/news-and-events/statements/eu-exit/?lang=en (retrieved 18 January 2021)

techniques'. These techniques are discussed specifically in relation to the UPM Shotton site in section 4.5, so are not reproduced here.

2.2.5. Chapter 2.9.13 '*Reduction of noise'* provides more specific examples of sources of noise likely to be found at a paper mill and the means by which noise from those processes can be controlled. This chapter also provides examples of the cost of implementing noise control measures, based on case studies at various plants in Europe.

2.3 HORIZONTAL GUIDANCE FOR NOISE PART 2 – NOISE ASSESSMENT AND CONTROL

2.3.1. For permitting purposes, the UPM Shotton site is regulated by Natural Resources Wales (NRW), which continues to follow the Environment Agency's 'Horizontal Guidance for Noise Part 2 – Noise Assessment and Control'.

2.3.2. *Horizontal Guidance for Noise Part 2*[3] sets out the requirements for the assessment and control of noise from industrial sources. The document outlines permit conditions and regulation of noise emissions. It also describes the principles of:

- noise measurement and prediction;
- the control of noise by design;
- operational and management techniques; and
- abatement technologies.

2.3.3. The over-riding consideration is that best available techniques (BAT) should be used to reduce any noise impacts from the process. The guidance also requires that noise is assessed in accordance with BS 4142:2014.

2.4 BRITISH STANDARD 4142:2014+A1:2019

2.4.1. The scope of this work does not include a full BS 4142 assessment. Furthermore, a BS 4142 assessment is not currently possible because no background sound levels have been measured at receptors. However, some of the principles and terminology are relevant, so a brief summary of the standard is therefore presented below.

2.4.2. BS 4142:2014+A1:2019[4] provides an assessment method for sound arising from commercial sound sources, including external plant and on-site vehicle movements and unloading, at residential receptors. It uses a relative assessment approach whereby the predicted commercial sound level (suitably penalised for annoyance character if appropriate) is compared with the prevailing background sound level. A summary of the BS 4142 approach is set out as follows:

- Establish the specific sound level of the source(s).
- Measure the representative background sound level.

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[3] *Horizontal Guidance for Noise Part 2 – Noise Assessment and Control* (version 3, June 2004), Environment Agency

[4] BS 4142:2014 +A1:2019 Methods for rating and assessing industrial and commercial sound, British Standards Institute

- Correct the specific sound level for on-time and interferences if necessary.
- Rate the specific sound level to account for distinguishing characteristics.
- Estimate the impact by subtracting the background sound level from the rating level.
- Consider the initial estimate in the context of the sound and its environs.

2.4.3. The representative background sound level should be established by measurements at the receptor locations.

2.4.4. The specific sound level is rated using the following penalties:

- Tonality up to 6 dB
- Impulsivity up to 9 dB
- Other sound characteristics up to 3 dB
- Intermittency 3 dB

2.4.5. An initial estimate of the impact of the specific sound is obtained by subtracting the measured background sound level from the rating level as described in section 11 of BS 4142. The results of this comparison are assessed on the basis of the following guidance:

- Typically, the greater the difference, the greater the magnitude of the impact.
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

2.4.6. The specific factors that should be taken into account in the consideration of context are as follows:

- The absolute level of the sound.
- The character and level of the residual sound compared to the character and level of the specific sound.
- The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.

2.4.7. The method described in BS 4142 specifically states that it is "*not intended to be applied to the derivation of indoor sound levels arising from sound levels outside, or the assessment of indoor sound levels*" (section 1.3).

2.5 ISO 9613-2:1996

2.5.1. ISO 9613-2:1996[5] describes a method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. It is described in BS 4142 as “a validated method of calculating sound levels”, and its calculation procedures are implemented in most noise modelling software, including CadnaA which is discussed herein.

2.6 BRITISH STANDARD 8233:2014

2.6.1. BS 8233:2014[6] provides information on the design of buildings that have internal acoustic environments appropriate to their functions. It deals with control of noise from outside the building, noise from plant and services within it, and room acoustics for non-critical situations. It is not directly applicable to industrial noise but provides typical noise levels for inside and outside residential properties. These are not adopted as criteria in this report but are useful for contextual consideration of the sound levels predicted at residential receptors. These noise levels are summarised as follows.

Table 2-1 – Summary of guideline residential noise levels from BS 8233

Description	Sound level
Outdoors – daytime (e.g. gardens, balconies)	50 – 55 dB $L_{Aeq,16hr}$
Indoors – daytime (e.g. living room)	35 – 40 dB $L_{Aeq,16hr}$
Indoors – night-time (bedroom)	30 – 35 dB $L_{Aeq,8hr}$

[5] ISO 9613-2:1996 ‘*Acoustics — Attenuation of sound during propagation outdoors — Part 2: General method of calculation’,* International Organization for Standardization
[6] BS 8233:2014 ‘*Guidance on sound insulation and noise reduction for buildings’*, British Standards Institute

3 QUANTITATIVE ASSESSMENT

3.1 INTRODUCTION

3.1.1. The aims of the quantitative assessment are to examine the noise contribution from the MRRF extract plant in question, and to consider its significance at receptor locations. This will provide an indication as to whether the sound sources associated with the plant are significant at receptor locations in order to contextualise the sound levels in the subsequent BAT review (see section 3.7.3 below).

3.2 METHODOLOGY OVERVIEW

3.2.1. Sound level measurements were made during the site visit to quantify the sound levels and characteristics produced by the MRRF extract plant. These include measurements of sound levels close at various distances from the plant.

3.2.2. Those measurements have been used to inform a noise model that predicts the sound levels emitted from the site at the site boundary and at nearby noise sensitive receptors.

3.2.3. The guidance in BS 4142 was taken into account during the measurement process and the prediction of noise levels drew from both BS 4142 and ISO 9613-2. However, it is not a “BS 4142 assessment” for a number of reasons which include the absence of comparisons between predicted process sound levels with background sound levels at the receiver positions.

3.3 SPECIFIC SOUND LEVEL MEASUREMENTS

SUMMARY

3.3.1. Sound levels were made during a site visit on 11 January 2021. Sound level measurements were made in general accordance with the method described in BS 4142, using Class 1 sound level meters as defined in BS EN 61672-1[7], and field calibrators meeting Class 1 specifications as defined in BS EN IEC 60942:2018[8].

MEASUREMENT EQUIPMENT

3.3.2. The equipment used to undertake the sound level measurements is as follows.

Table 3-1 – Summary of sound level measurement equipment

Equipment Description	Manufacturer & Type No.	Serial No.	Calibration Due Date
Sound Level Meter	01dB-METRAVIB Solo Master	60531	08 September 2021
Pre-amplifier	01dB-Stell PRE 21 S	16422	
Microphone	Microtech Gefell GmbH MCE212	333438	
Calibrator	01dB-Stell Cal 21	1558662	26 November 2021

[7] BS EN 61672-1:2013 *Electroacoustics. Sound level meters. Specifications*
[8] BS EN IEC 60942:2018 *Electroacoustics. Sound calibrators*

3.3.3. The sound level meter was subject to field calibration tests prior to and on completion of the measurements using the field calibrator. No significant drift occurred (< 0.1 dB).

WEATHER CONDITIONS

3.3.4. Weather conditions during the site visit were acceptable for environmental noise monitoring and can be summarised as follows:

- Dry
- Low to still wind speeds
- Temperature: 9 ^{o}C

MEASUREMENT LOCATIONS

3.3.5. Sound level measurements were made at a range of distances from the extract plant and at a single position close to the compressors. All measurement positions were made at a height of approximately 1.5 metres.

Table 3-2 – Summary of sound level measurement positions

Measurement no.	Distance from source	Description
1	8 m from fan, 2m from filters	Measurement direction parallel to the east façade of the MRRF building
2	5 m from fan	At a 45^{o} angle w.r.t. the MRRF building façade
3	5 m from fan	Perpendicular to the east façade of the MRRF building
4	5 m from fan	At a 45^{o} angle w.r.t. the MRRF building façade
5	24 m from fan	Near the north end of the grassed area, at a 45^{o} angle w.r.t. the MRRF building façade
6	14 m from fan	In the grassed area, approximately 20^{o} angle w.r.t. the MRRF building façade
7	13 m from fan	Perpendicular to the east façade of the MRRF building
8	14 m from fan	In the grassed area, approximately 20^{o} angle w.r.t. the MRRF building façade
9	18 m from fan	In the grassed area, approximately 45^{o} angle w.r.t. the MRRF building façade
10	80 m from fan	At the eastern end of an access road leading to Weighbridge Road, outside the UPM boundary fence. Position had a line-of-sight to the extract plant.
11	3 m from compressors	At the south side of the MRRF building, 3 m from the edge of the canopy over the two compressors, equidistant from both compressors.

SOUNDSCAPE DURING SPECIFIC SOURCE MEASUREMENTS

3.3.6. The MRRF extract fan dominated at measurement positions 1 - 10. The compressors dominated the sound environment at position 11. It is considered that no other sound sources contributed to the sound environment at the measurement positions adopted.

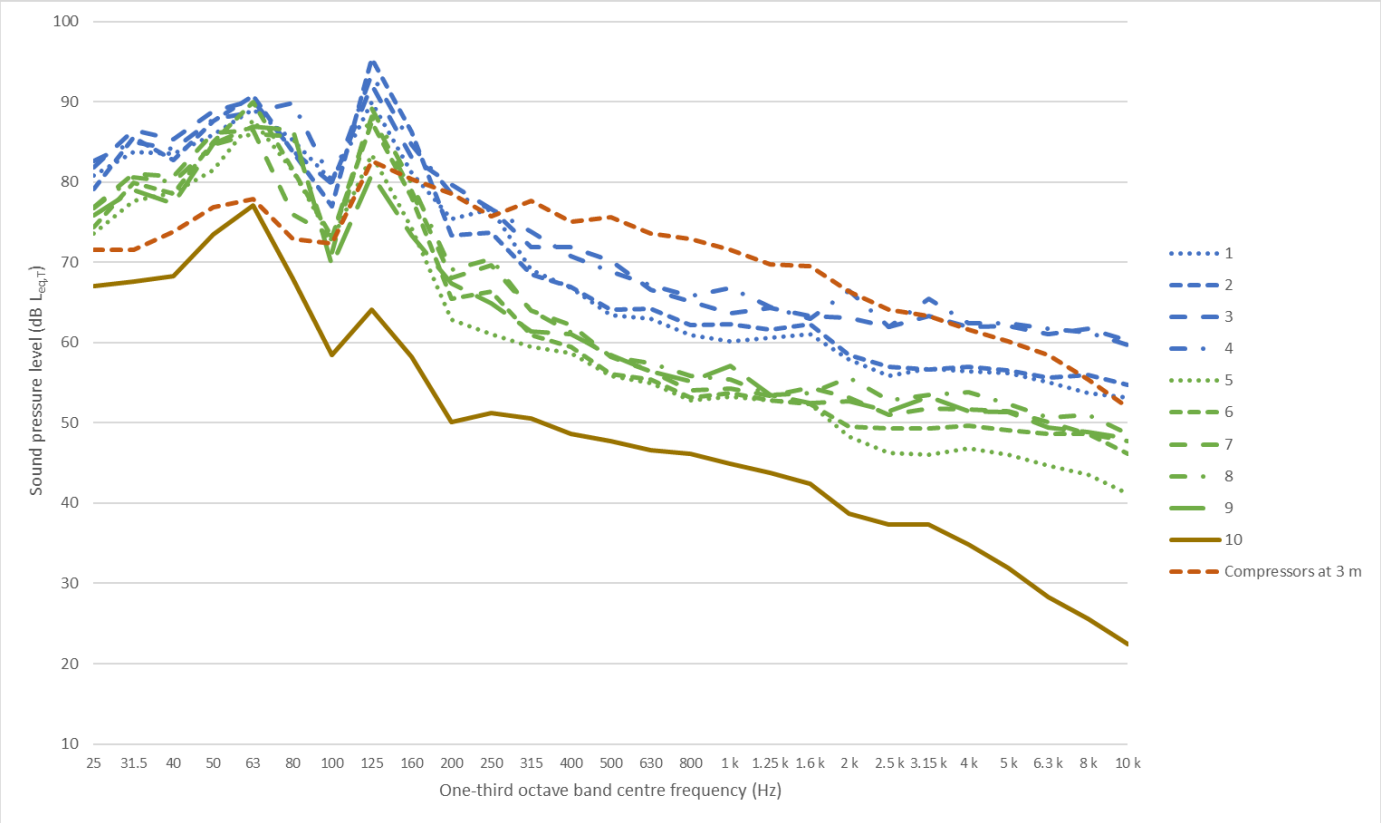
RESULTS

3.3.7. The A-weighted sound measurement results are summarised in Table 3-4, and one-third octave spectral data are presented in Figure 3-1

Table 3-3 – A-weighted specific sound level measurements

Position	Specific sound level dB L_{Aeq}
1	77.7
2	81.0
3	80.6
4	81.3
5	70.4
6	73.6
7	74.2
8	75.2
9	70.7
10	57.6
11	81.6

Figure 3-1 – Third-octave band sound pressure level data



3.3.8. The compressor spectrum is provided for reference only and demonstrates that the compressors do not exhibit the tonal sound characteristics described in the NRW email (see section 1.3) and are therefore not part of the BAT assessment described below.

3.3.9. It is also noted that the main peaks in the spectra presented above are in the 31.5, 63 and 125 Hz third-octave bands, rather than in the 150, 300 and 450 Hz third-octave bands reported by NRW. Notwithstanding that discrepancy it is considered that the MRRF extract plant is the most likely

source of the sound, given the location described by NRW. It is also noted that a previous measurement presented in Figure 3-1 of an earlier WSP report entitled "*BAT Assessment for Noise*"[9] indicated peaks in the 160 and 315 Hz third-octave bands and an A-weighted sound pressure level approximately 1 dB higher than was measured on 11 January 2021.

3.3.10. The precise frequencies at which peaks occur could feasibly vary depending on fan speed and air flow which, in turn, could be affected by aerodynamic aspects such as the performance of the filter and the size(s) of debris that may exist in the filter or ductwork.

3.4 NOISE MODEL

3.4.1. A computerised noise model of the site and the surrounding area was created using the CadnaA noise prediction software (version 2020 MR1), which implements calculations to predict the effects on noise propagation of geometric spreading, topography, screening, meteorological conditions and information provided regarding the sources of noise. Calculations were carried out in accordance with ISO 9613-2 which assumes a moderate downwind condition in all calculations, as recommended in section 9 of the same standard.

MODELLING SETTINGS

3.4.2. The following modelling settings and source data were incorporated:

- Default ground absorption: G=0; localised areas of agricultural land/fields: G=0.9;
- Two orders of reflection (buildings are reflective);
- ISO 9613 propagation model;
- Residential receptors located at first floor (4.0m) of façade facing plant;
- Predicted levels are free-field;
- Ground topography based on 2 m LIDAR composite data from OS OpenMap (note: no topographic data available for the area to the west of the A548 where the road crosses the River Dee. Default model ground height = 0 m);
- Building locations derived from OpenStreetMap;
- Heights of dwellings assumed to be 8m to apex; and
- Heights of buildings at UPM Shotton are based on information provided by the client and by local observation.

3.5 PREDICTED SOUND LEVELS

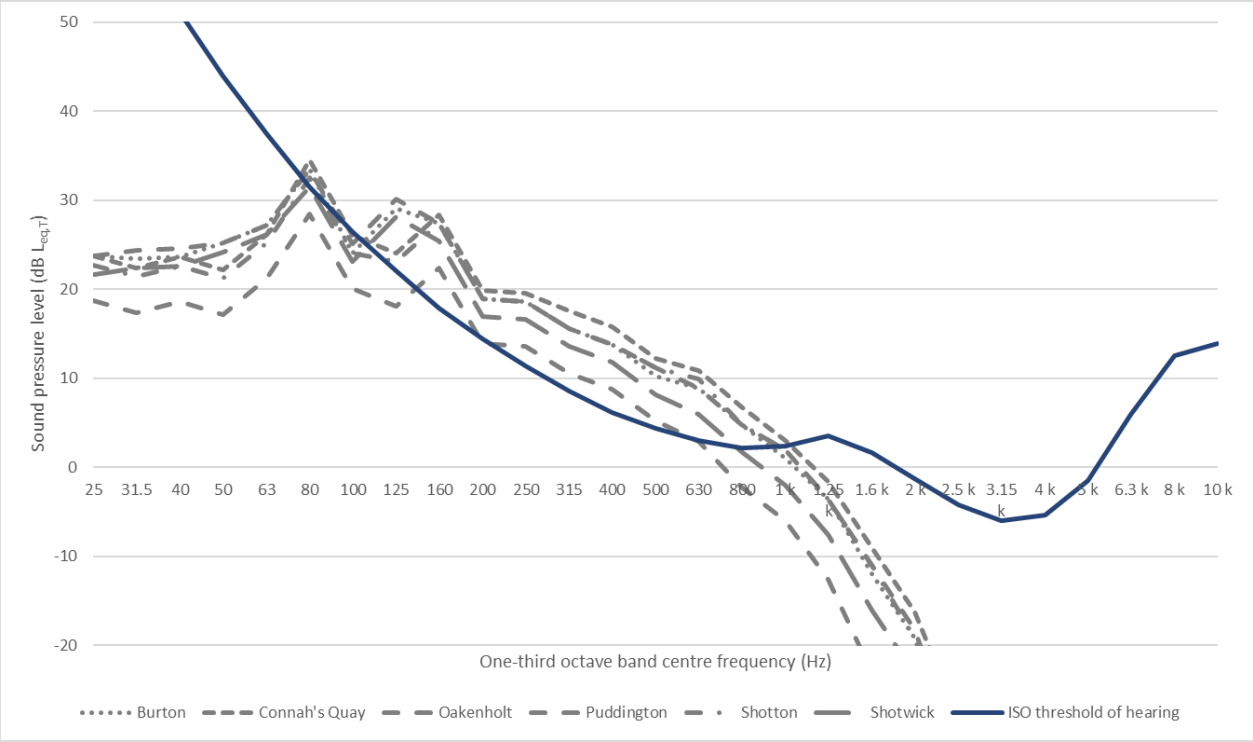
3.5.1. The A-weighted specific sound levels predicted at the nearest residential receptors are summarised in Table 3-4 and one-third octave band spectra are shown in Figure 3-2. The spectral results are plotted against the ISO 226 threshold of hearing curve to provide context in terms of the likely audibility of the predicted sound levels.

[9] "UPM Shotton Mill BAT Assessment for Noise" (ref: 70065921 RP AC 02). WSP UK Ltd (2020)

Table 3-4 – Predicted sound levels at nearest residential receptors

Receptor	Coordinates (decimal latitude, longitude)	Specific sound level, dB L_{Aeq}
Connah's Quay	53.22303, -3.06563	21.0
Shotton	53.21448, -3.04023	19.7
Shotwick	53.23928, -2.99549	19.7
Puddington	53.25287, -3.01287	20.6
Burton	53.25926, -3.02825	20.3
Dwellings near Oakenholt	53.23111, -3.09847	14.8

Figure 3-2 – Third-octave band specific sound level spectra predicted at nearest residential properties



3.6 UNCERTAINTY

Where it has been necessary to make assumptions in the assessment described above, these have been precautionary, to ensure a robust assessment. These are summarised as shown in Table 3-5, along with an estimate of the likely uncertainty (positive values indicate a potential over-estimation of the total specific sound level).

Table 3-5 – Summary of uncertainty estimation

Source of uncertainty	Lower bound of impact uncertainty (under-estimation)	Upper bound of impact uncertainty (over-estimation)
ISO 9613-2 calculation method for predictions (from Table 5 of ISO 9613-2:1996)	-3 dB	+3 dB
Measuring specific sound levels of individual sources on an active site where other noise sources are operational	0 dB	+1 dB
Variation in source sound level noted in section 3.3.9	-2 dB	+2 dB
Derivation of specific source SWLs using measurements	-3 dB	+3 dB
Adverse wind direction as implemented in the noise model	0 dB	< +1 dB

3.6.1. The principle of uncertainty estimation is not that one should assume all uncertainty deviations to occur simultaneously (in either polarity). However, it can be seen from the above that uncertainty is generally estimated to be greater in the direction that would result in an over-estimation of the specific sound's impact than an under-estimation (and therefore supports a precautionary assessment). On this basis, and considering the overall low levels of uncertainty (all estimates are within 3 dB in either direction), it is not considered necessary to apply any uncertainty corrections to the results.

3.7 DISCUSSION

3.7.1. The predicted noise levels are low and indicate a low likelihood of tonal components being significant at receptor locations. It can also be seen that the A-weighted sound levels are significantly (29 – 40 dB) lower than the outdoor residential sound levels set out in BS 8233.

3.7.2. If 13 dB attenuation is assumed for an open window (also from BS 8233), the sound levels predicted inside dwellings would be approximately 2 – 8 dB, so would, in all cases, be significantly lower than the indoor sound levels from the same standard. With windows closed, the indoor sound levels could be assumed to be at least 5 dB lower for single glazing or 10 dB lower for double glazing.

3.7.3. Whilst background sound levels have not been measured at the nearest receptors, it is considered virtually inevitable that the specific levels presented in Table 3-4 would be below the background sound levels.

3.7.4. On the basis that the quantitative assessment is indicative of a low (or no) impact at receptors (without having yet considered whether effective BAT is in use for this specific plant) it could be concluded that the MRRF extract plant does not require any noise-reduction programmes or that any such programmes would need to have a very strongly beneficial cost/benefit ratio to be justified or considered.

3.7.5. The next section of this report reviews whether or not BAT is currently in use, whether it is effective, and whether any improvements should be made.

4 REVIEW OF BEST AVAILABLE TECHNIQUES IN USE

4.1.1. During the site visit on Monday 11 January 2021, inspections were made of the MFFR extract system to determine how BAT are applied to control noise emissions and to determine whether any further measures might be appropriate and/or necessary for BAT to be in place.

4.2 SITING OF THE FAN

4.2.1. The MRRF extract fan is located outside the MRRF for the following reasons:

- To minimise noise exposure to employees working in the MRRF
- To optimise dust collection from, and maintenance of, the system and to minimise the risk of employee exposure to dust'; and
- To ensure a supply of cool air to keep the fan motor cool.

4.2.2. The specific location of the fan on the east side of the MRRF locates it close to the east site boundary, on a side that adjoins other industrial uses. The choice of location is a fundamental example of BAT having been adopted, as it means that the process is in keeping with the area.

4.2.3. The MRRF extract plant is approximately 2.4 km from the nearest residential properties which are at Shotton. This distance provides substantial reductions in noise due to geometric spreading. Noise is further reduced at many of the nearest noise-sensitive properties by screening provided by the intervening buildings, including the MRRF and others on the UPM site.

4.2.4. It was noted that the site boundary is bound by an access road that is used infrequently, mainly by goods vehicles such as refuse lorries. There is no accessible footpath, and it is deemed to be non-sensitive to noise. On the opposite side of this access road is the Park Adfer waste-to-energy facility which is also non-sensitive. No significant noise from Park Adfer was audible at the time of the site visit.

4.3 NOISE CONTROL MEASURES

4.3.1. The following measures to reduce noise from the MRRF extract plant were observed during the inspection:

- Extract ductwork includes an in-duct attenuator;
- Circular ductwork reduces noise break-out compared to rectangular ductwork;
- Transition pieces and connectors between fans and ductwork are rigid steel, reducing break-out compared to flexible couplings; and
- The plant is at ground level and close to the façade of the MRRF building to maximise acoustic screening to receptors to the west.

4.3.2. It is noted that although the steel transition pieces and connectors reduce noise break-out from the ductwork, they could increase transmission of vibration from the fan casing into the connected ductwork. The fan itself was noted to be the dominant noise source and it is therefore concluded that the benefits of reducing break-out would most likely outweigh any additional noise caused by the extra vibrational energy in the ductwork walls. It is also noted that adding flexible connectors between the fan and ductwork would also require dense acoustic lagging to be installed to avoid additional noise break-out via the connector. This would require careful selection to ensure that it also provides adequate weatherproofing. It is concluded that this measure would not be justified,

given that the fan itself was the dominant noise source, and considering the low sound levels predicted at the nearest noise-sensitive receptors.

4.4 PRACTICES TO REDUCE NOISE

4.4.1. The following practices help to reduce noise emissions from the MRRF extract plant:

- The plant is switched off when not in use;
- A reverse air jet cleans the filter regularly to minimise the risk of blockages and excessive pressure restrictions on air flow; and
- Plant is subject to regular UPM inspection and maintenance regimes as is the rest of the site.

4.5 SUMMARY OF B.A.T. IN RELATION TO B.R.E.F. REQUIREMENTS

4.5.1. Section 8.1.9 '*Emissions of noise*' in the BREF states that BAT is to use a combination of processes that reduce the emissions of noise. These are reproduced below along with comments on how those measures apply to the review described above.

Table 4-1 – Summary of BAT in use in relation to BREF Requirements

	Technique	Description	Applicability to UPM Shotton
a	Noise-reduction programme	A noise-reduction programme includes identification of sources and affected areas, calculations and measurements of noise levels in order to rank sources according to noise levels, and identification of the most cost-effective combination of techniques, their implementation and monitoring	Noise predictions have previously been carried out (by others) for all new fixed plant installed at the site, using current noise modelling prediction methods as appropriate to the significant distances between the site and its nearest sensitive receptors. Results of these assessments indicated a sufficiently low impact (after mitigation as necessary) that no further monitoring was necessary.
			The measurements and modelling presented here also indicate that noise from the plant is sufficiently low that a programme of noise reduction is not warranted, considering the availability of further noise reduction measures.
b	Strategic planning of the location of equipment, units and buildings	Noise levels can be reduced by increasing the distance between the emitter and the receiver and by using buildings as noise screens.	The MRRF extract plant is at least 2.4 km from its nearest noise-sensitive receptors, which provides substantial attenuation of sound, as is demonstrated through the quantitative assessment above.
			Plant is located at ground level so that its noise emissions are screened by the other buildings.
c	Operational and management techniques in buildings containing noisy equipment	This includes:	
		Improved inspection and maintenance of equipment to prevent failures	All equipment is subject to regular inspection and maintenance to reduce the risk of failure and minimise noise emissions. Filter is cleared automatically by a reverse air jet to minimise dust build-up that can restrict the air flow and increase noise.

		Closing of doors and windows of covered areas	N/A
		Equipment operation by experienced staff	All equipment is operated and maintained by experienced and knowledgeable staff
		Avoidance of noisy activities during night-time	The MRRF operates 24-hours a day, but the extract system is switched off during staff break periods to reduce noise.
		Provisions for noise control during maintenance activities	Staff are made aware of noise sensitivities. Any noisy maintenance works are carried out during the day.
d	Enclosing noisy equipment and units	Enclosure of noisy equipment, such as wood handling, hydraulic units, and compressors in separate structures, such as buildings or soundproofed cabinets, where internal-external lining is made of impact-absorbing material.	N/A – plant location is outdoors for the reasons discussed above and the equipment is not 'noisy' in terms of the resultant levels at receptor locations.
e	Use of low-noise equipment and noise-reducers on equipment and ducts		Atmosphere side attenuator fitted to extract fan. Steel transition pieces and couplings and circular ductwork minimise noise break-out from ducts.
f	Vibration insulation	Vibration insulation of machinery and decoupled arrangement of noise sources and potentially resonant components	For this type of plant, vibration isolation (e.g. spring mountings) would have very little effect on airborne sound as the plant is supported directly on the ground which is practically non-resonant.
g	Soundproofing of buildings	This potentially includes:	
		- Sound-absorbing materials in walls and ceilings	Not applicable as the plant is located outdoors.
		- Sound-isolating doors	Not applicable as the plant is located outdoors.
		- Double-glazed windows	Not applicable as the plant is located outdoors.
h	Noise abatement	Noise propagation can be reduced by inserting barriers between emitters and receivers. Appropriate barriers include protection walls, embankments and buildings.	The plant benefits from substantial screening from the MRRF building due to its location.

		Suitable noise abatement techniques include fitting silencers and attenuators to noisy equipment such as steam releases and dryer vents	The MRRF extract plant incorporates the following noise abatement: atmosphere side attenuator, circular ductwork, steel transition pieces. The possibility of using flexible duct connectors has been considered. From an initial appraisal it appears likely that such equipment would not be justified as the fan itself is the dominant noise source (rather than the ductwork) and it would therefore not result in a significant reduction of noise. On this basis, it is considered that this option is not an *available* technique at this time, although it may be considered if/when extraction plant is renewed.
i	Use of larger wood-handling machines to reduce lifting and transport times and noise form logs falling onto log piles or the feed table		N/A to this plant
j	Improved ways of working, e.g. releasing logs from a lower height onto the log piles or the feed table; immediate feedback of the level of noise for the workers		N/A to this plant

4.6 SUMMARY

From the above comparison it can be seen that the MRRF extract plant meets the majority of the relevant BREF recommendations. It is concluded that where BAT processes from the BREF are not currently in use on this specific item of plant, those techniques are not 'available' at the present time, as they would represent a disproportionate cost and disruption compared to the potential benefit.

5 CONCLUSIONS

A detailed technical review has been undertaken at the UPM Shotton paper mill of the techniques employed to reduce noise from the Materials Recycling and Reclamation Facility (MRRF) extract plant, in accordance with the principles of BAT (Best Available Techniques) as defined in the Industrial Emissions Directive 2010/75/EU and the Environment Agency's *Horizontal Guidance for Noise*.

It has been noted that the determination of BAT is not directly related to noise level measurements or predictions, but in this case both have been used in order to identify the potential impacts on residential receptors and to identify whether any sources of noise associated with the plant might justify a more thorough review of current controls.

Sound level measurements have been obtained from positions close to the MRRF extract plant, and the results have been used to calibrate a noise model that predicts the noise emitted from the plant at the nearest residential receptors.

The predicted noise levels have been found to be low and, by themselves, would not justify changes to current practices and processes.

A review of the BAT has been undertaken, based on a thorough inspection of all practices and processes. Where potential mitigation techniques are not currently employed, it has been found that their use would have a very low benefit in terms of sound level reductions, resulting in a disproportional financial and operational impact, thus rendering them not *available* (as defined in BAT) for use on this plant.

Given the low noise levels predicted at receptors and the lack of additional feasible and available techniques, it is concluded that the plant already demonstrates effective BAT. No justification or necessity has been identified for changing the current practices or processes in relation to the MRRF extract plant.

Appendix A

TECHNICAL GLOSSARY

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble) and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq}, L_{A90} etc, according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

An indication of the range of sound levels commonly found in the environment is given in the following table.

Typical sound levels found in the environment

Typical Sound Level	Example Location
0 dB(A)	Threshold of hearing
20 to 30 dB(A)	Quiet bedroom at night
30 to 40dB(A)	Living room during the day
40 to 50 dB(A)	Typical office
50 to 60 dB(A)	Inside a car
60 to 70 dB(A)	Typical high street
70 to 90 dB(A)	Inside factory
100 to 110 dB(A)	Burglar alarm at 1m away
110 to 130 dB(A)	Jet aircraft on take off
140 dB(A)	Threshold of pain

Glossary of Terms

Term	Description
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2x10-5Pa).
$L_{Aeq,T}$	LAeq is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A - weighted fluctuating sound measured over that period.
L_{Amax}	LAmax is the maximum A - weighted sound pressure level recorded over the period stated. LAmax is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
L_{10} and L_{90}	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The Ln indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L10 is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L90 is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L10 index to describe traffic noise.
Free-field Level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and away from buildings.
Fast	A time weighting used in the root mean square section of a sound level meter with a 125millisecond time constant.
Slow	A time weighting used in the root mean square section of a sound level meter with a 1000millisecond time constant.
Ambient Sound Level	The all-encompassing noise level measured in $L_{Aeq,T}$. The Ambient Sound Level incorporates background sounds as well as the industrial source noise under consideration.
Residual Sound Level	The Ambient Sound Level in the absence of the industrial source noise under consideration, measured in $L_{Aeq,T}$.
Specific Sound Level	The sound level measured in $L_{Aeq,T}$ attributed to the industrial noise source under consideration alone.
Background Sound Level	The sound level in the absence of the industrial source noise under consideration, measured in L_{A90}.

Appendix B

PLANS

Appendix B.1

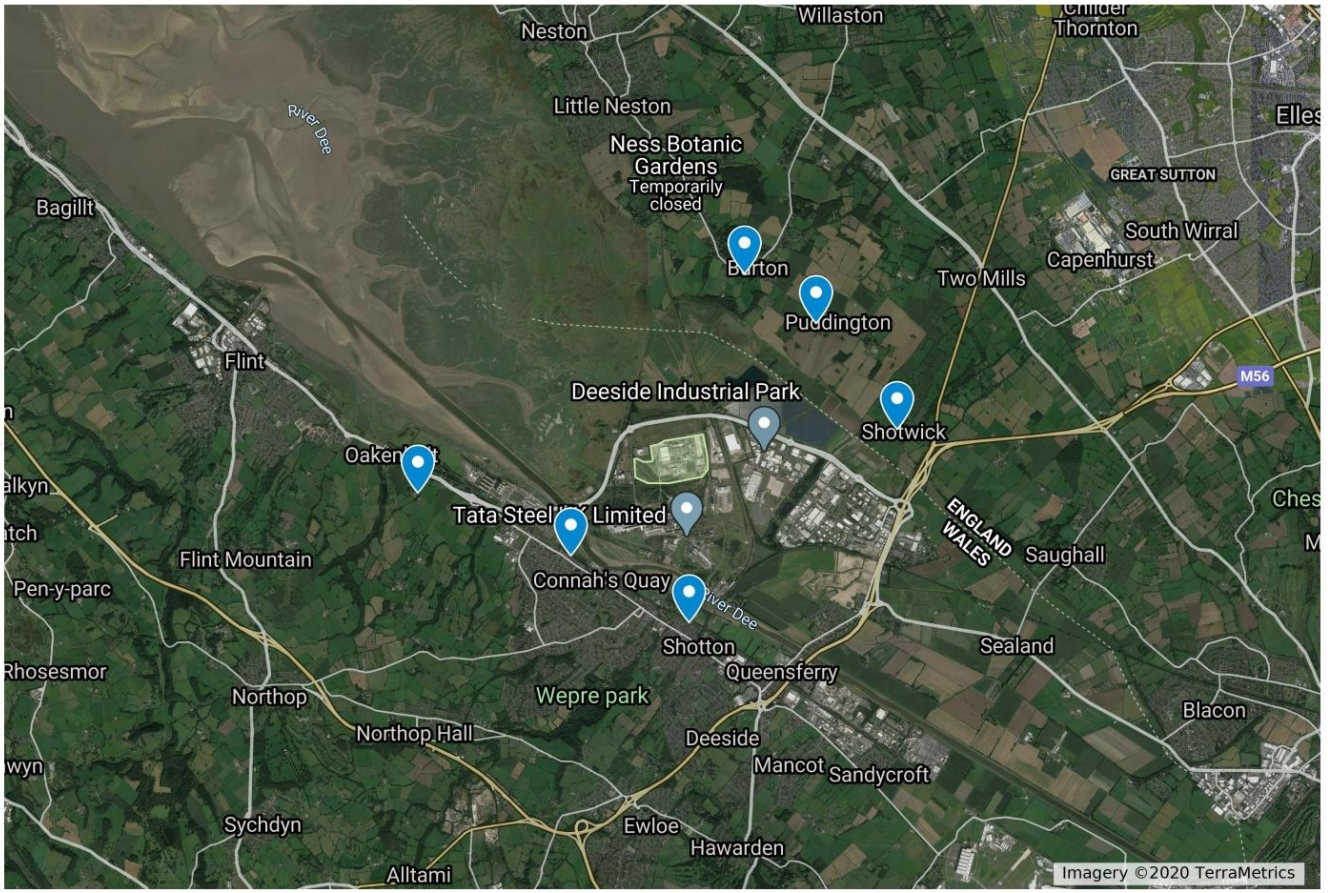
LOCATION PLAN

UPM site

UPM Shotton site location

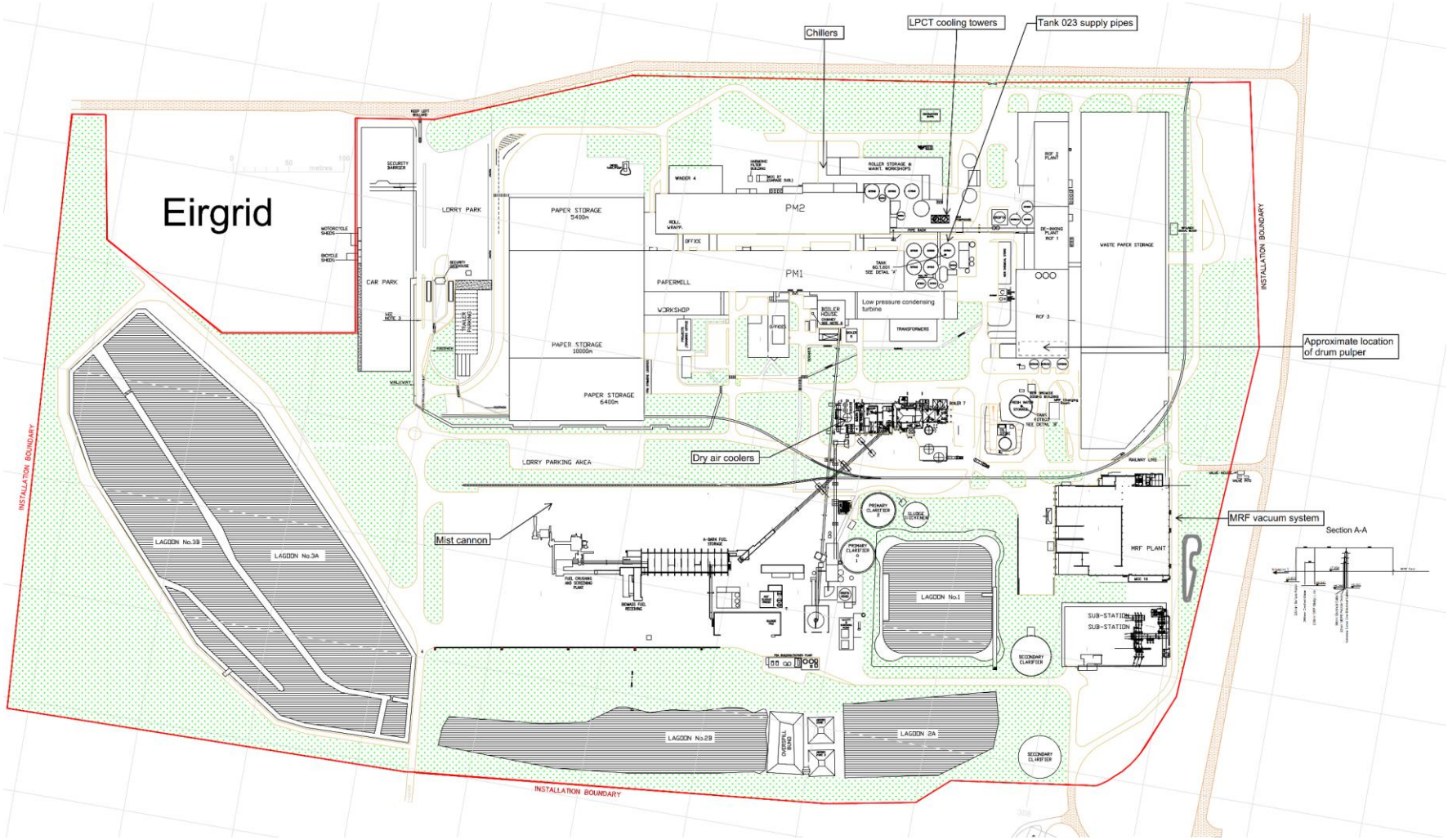
Receptors

- Connah's Quay
- Shotton
- Shotwick
- Puddington
- Burton
- Oakenholt



Appendix B.2

SITE PLAN


Chillers
LPCT cooling towers
Tank 023 supply pipes
Eirgrid
LORRY PARK
CAR PARK
PAPER STORAGE 5400m
PAPER STORAGE 10000m
PAPER STORAGE 6400m
PM2
PM1
PAPERMILL
WORKSHOP
Low pressure condensing turbine
TRANSFORMERS
WASTE PAPER STORAGE
RCF 3
Approximate location of drum pulper
INSTALLATION BOUNDARY
Dry air coolers
LORRY PARKING AREA
Mist cannon
MRF vacuum system
Section A-A
MRF PLANT
LAGOON No.3B
LAGOON No.3A
LAGOON No.1
LAGOON No.2B
LAGOON 2A
SUB-STATION
SECONDARY CLARIFIER
INSTALLATION BOUNDARY

Appendix C

LIMITATIONS

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