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MONA OFFSHORE WIND PROJECT

Preliminary Environmental Information Report

Volume 7, annex 22.3: Operational noise

Image of an offshore wind farm

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Final

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Glossary

Term	Meaning
A-weighting	A frequency weighting devised to attempt to account for the fact that human response to sound is not equally sensitive to all frequencies. It consists of an electronic filter in a sound level meter which attempts to build this variability into the indicative sound level reading so that it will correlate, approximately, with the human response.
Ambient sound level, $L_{Aeq,T}$	The steady sound level which, over a period of time T, contains the same amount of A-weighted sound energy as the time varying sound over the same period. Also known as the equivalent continuous sound pressure level.
Attenuation	The reduction in magnitude of sound energy.
Background sound level, $L_{A90,T}$	The A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using fast time-weighting, F, and quoted to the nearest whole number of decibels.
Broadband	A sound with energy distributed across a wide range of frequencies. Used to describe a single-figure sound level.
Decibel (dB)	The ratio between two physical quantities, typically expressed as a logarithmic power ratio.
Dimensionless	A pure number having no units attached and having a numerical value that is independent of whatever system of units may be used to derive it.
Directivity	A measure of the change in sound level with the direction of a source.
Ground factor, *G*	A dimensionless parameter which allows for the consideration of the acoustic properties of the ground surface between a sound source and the receptor.
Hemispherical radiation	The emission of sound throughout a hemisphere in the presence of a single reflective surface (e.g. the ground). Corresponds to a radiation loss of 8dB.
Impulsivity	A method for describing how sudden or sharp a sound of short duration is. Examples of impulsive sounds include bangs or gun shots.
Intermittency	A measure of the 'on/off' nature of a sound source which may result in higher perceptibility at a receptor.
Noise	An unwanted or unexpected sound.
Ordnance datum	A means for deriving altitude on maps. Usually presented as the height above sea level.
Porosity	A The ratio of space or holes and the total volume of a material. A means of defining the ability of a material to allow sound to transmit through it.
Propagation	The transmission of acoustic energy through a medium via a sound wave.
Residual sound level l	The ambient sound level at a receptor in the absence of influence from the sound source under assessment.
Sound	Fluctuations of pressure within a medium (gas, solid or fluid) within the audible range of loudness and frequencies which excite the sensation of hearing.
Specific sound level, L_s	Specific Sound Level, $L_{Ar,Tr.}$ The equivalent continuous A-weighted sound pressure level produced by the specific noise source at the assessment location over a given reference time internal, T_r.
Spectrum	The presentation of sound in terms of the amount of energy at different frequencies.
Tonality	A method to account for the dominance of a single frequency in a sound's spectrum which may be more perceptible at a receptor.

Acronyms

Acronym	Description
AIS	Air Insulated Switchgear
BS	British Standard
GIS	Gas Insulated Switchgear
ISO	International Organisation for Standardisation
MDS	Maximum Design Scenario
OS	Ordnance Survey

Units

Unit	Description
dB	Decibel
kV	Kilovolt
m	Metres

1 OPERATIONAL NOISE

1.1 Introduction

1.1.1.1 This operational noise technical report provides the methodology and results of 3D acoustic modelling. The report will inform the assessment of noise and vibration impacts in volume 3, chapter 22: Noise and vibration of the Preliminary Environmental Information Report (PEIR).

1.1.1.2 The purpose of the operational noise report is to identify and assess the noise impacts on nearby noise sensitive receptors within the noise and vibration study area due to the operation of the Onshore Substation for the Mona Offshore Wind Project.

1.1.1.3 No detailed information regarding the Mona Onshore Substation layout and associated plant is yet available. As such, this report contains details of an initial assessment assuming all plant is situated externally and is unmitigated. This represents the maximum design scenario for the PEIR and a detailed assessment of operational noise impacts will be undertaken in the Environmental Statement.

Study area

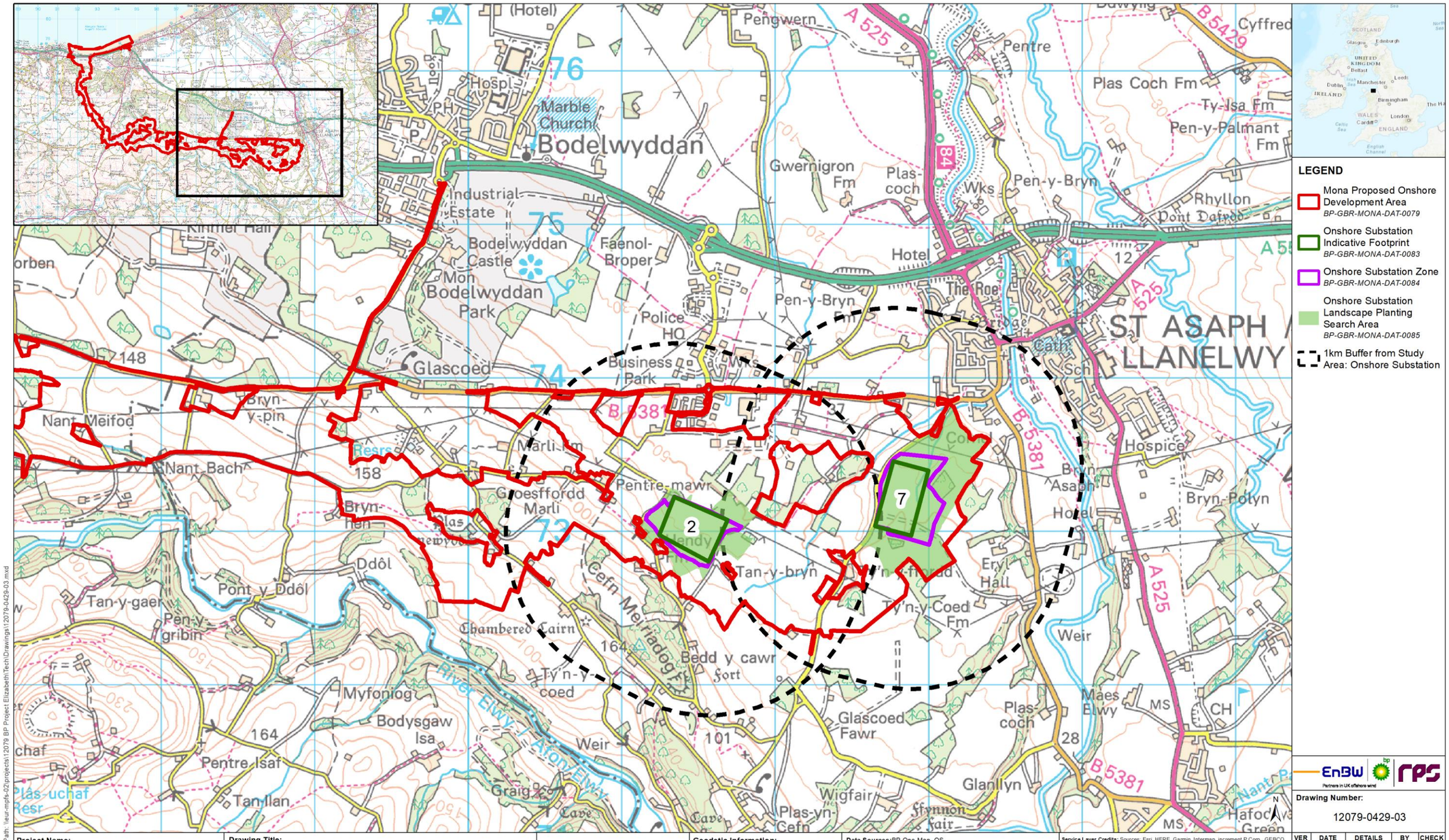
1.1.1.4 The Mona Offshore Wind Project noise and vibration study area will focus on receptors (landward of Mean High Water Springs (MHWS)) where potential impacts are most likely to occur on receptors sensitive to noise and vibration.

1.1.1.5 The Mona Onshore Substation is the only continuous operational noise source which may impact the amenity of nearby receptors.

1.1.1.6 The noise and vibration study area relevant to this technical report is defined as:

- The area of land to be temporarily or permanently occupied during the construction, operations and maintenance and decommissioning of the Mona Offshore Wind project (hereafter referred to as the Mona Proposed Onshore Development Area)
- Noise sensitive receptors located within 1km of the Mona Onshore Substation.

1.1.1.7 The above descriptors are those set out in the Mona Offshore Wind Farm Environmental Impact Assessment Scoping Report (Mona Offshore Wind Ltd, 2022) and are presented graphically in Figure 1.1 below. The number of receptors and their location in relation to the noise and vibration study area are identified in volume 7, annex 22.2: Construction noise of the PEIR.



Project Name: MONA OFFSHORE WIND PROJECT	**Drawing Title:** NOISE STUDY AREA: ONSHORE SUBSTATION OPTIONS	0 250 500 m	**Geodetic Information:** Datum: OSGB 1936 Projection: British National Grid Scale@379mmx231mm: 1:25,000	**Data Sources:** BP One Map, OS	**Service Layer Credits:** Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community	**Drawing Number:** 12079-0429-03		

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Figure 1.1: Noise study area.

1.2 Methodology

1.2.1 Assessment methodology

1.2.1.1 Noise levels during the operation of the Mona Onshore Substations at the nearest receptors have been predicted from a 3D acoustic model. The predicted noise levels have been assessed with reference to the guidance in BS 4142:2014+A1:2019 – 'Methods for rating and assessing industrial and commercial sound'.

1.2.1.2 The nearest receptors are presented graphically in Figure 1.2 and Figure 1.3 for options 2 and 7 of the Mona Onshore Substation, respectively.

British Standard 4142:2014+A1:2019

1.2.1.3 BS 4142:2014+A1:2019 – 'Methods for rating and assessing industrial and commercial sound' provides a method for rating industrial and commercial sound and method for assessing resulting impacts upon people. The method is applicable to fixed plant installations, sound from industrial and manufacturing process and other associated activities.

1.2.1.4 In summary, this standard provides guidance on determining 'rating sound levels' by correcting the 'specific sound level' from the site or operations under consideration for acoustic character corrections such as tonality, impulsivity, and intermittency. The standard provides the following corrections to be applied where each is appropriate:

- "*Tonality -For sound ranging from not tonal to prominently tonal the Joint Nordic Method gives a correction of between 0dB and +6dB for tonality. Subjectively, this can be converted to a penalty of 2dB for a tone which is just perceptible at the noise receptor, 4dB where it is clearly perceptible, and 6dB where it is highly perceptible.*
- *Impulsivity - A correction of up to +9dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3dB for impulsivity which is just perceptible at the noise receptor, 6dB where it is clearly perceptible, and 9dB where it is highly perceptible.*
- *Intermittency - When the specific sound has identifiable on/off conditions, the specific sound level should be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time. … If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied.*
- *Other sound characteristics - Where the specific sound features characteristics that are neither tonal nor impulsive, nor intermittent, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied*."

1.2.1.5 An initial estimate of the impact of the source is obtained by subtracting the measured background sound level from the rating sound level of the proposed plant. Background sound levels at the receptors were identified from a baseline sound survey undertaken in November 2022 (see annex 22.1: Baseline sound survey technical report of the PEIR).

1.2.1.6 The representative background sound levels at each receptor are presented in Table 22.11 of volume 3, chapter 22: Noise and vibration of the PEIR. The local sound climate at receptors near the Mona Onshore Substation location was noted to be low.

1.2.1.7 In particular, the representative background sound levels $L_{A90,T}$ at measurement position on the land of Tyn-y-Ffordd Newydd (position LT8 in volume 7, annex 22.1: Baseline sound survey technical report of the PEIR) were determined to be 27 dB and 25 dB during the day and night-time, respectively.

1.2.1.8 Section 11 of BS 4142:2014+A1:2019 states the following:

'Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including the following.

1) The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.

Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night."

1.2.1.9 Based on the above, at receptors where this background sound level is representative, an absolute noise limit of 30dB(A) has been used in the assessment of operational noise impacts to provide a pragmatic and achievable limit.

1.2.1.10 This limit may be contextualised by allowing for a typical loss of 12 dB(A) due to a partially open window. A noise level of 30 dB(A) externally results in an internal noise level of 20 dB(A) which is more than 10 dB(A) below the internal ambient noise criteria of 30 dB $L_{Aeq,8h}$ outlined in BS 8233:2014 – 'Guidance on sound insulation and noise reduction for buildings' (appropriate in bedrooms to provide suitable conditions for sleeping).

1.2.1.11 Acoustic character corrections are applied to the specific sound level at the receptor, as presented in Appendix B.

1.2.1.12 Typically, the greater the difference between the measured background sound level and the rating sound level, the greater the magnitude of the impact. The operational noise criteria adopted for the Mona Offshore Wind Project are presented in Table 22.18 of volume 3, chapter 22: Noise and vibration of the PEIR and in Table 1.1 below for brevity and ease of reference.

Table 1.1: Operational noise criteria (Table 22.18 of volume 3, chapter 22: Noise and vibration of the PEIR.

Magnitude of impact	BS 4142:2014+A1:2019 semantic description	Difference Δ between rating sound level $L_{Ar,Tr}$ and background sound level $L_{A90,T}$ (dB)
High	A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.	Δ ≥ 10

Magnitude of impact	BS 4142:2014+A1:2019 semantic description	Difference Δ between rating sound level $L_{Ar,Tr}$ and background sound level $L_{A90,T}$ (dB)
Medium	A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.	5 ≤ Δ < 10
Low	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.	0 ≤ Δ < 5
Negligible		-10 ≤ Δ ≤ 0
No change	-	Δ < -10

1.2.1.13 All nearby receptors are residential and are thus considered to be of **medium** sensitivity, as discussed in section 22.9 of volume 3, chapter 22: Noise and vibration of the PEIR.

1.2.1.14 A contextual assessment of the likely impacts is then required to assess the significance of the effect. The matrix used for the assessment of the significance of the effect is presented in Table 22.14 of volume 3, chapter 22: Noise and vibration of the PEIR and in Table 1.2 below for brevity and ease of reference.

Table 1.2: Matrix used for the assessment of the significance of the effect.

Sensitivity of Receptor	Magnitude of Impact				
	No Change	Negligible	Low	Medium	High
Negligible	No change	Negligible	Negligible or Minor	Negligible or Minor	Minor
Low	No change	Negligible or Minor	Negligible or Minor	Minor	Minor or Moderate
Medium	No change	Negligible or Minor	Minor	Moderate	Moderate or Major
High	No change	Minor	Minor or Moderate	Moderate or Major	Major
Very High	No change	Minor	Moderate or Major	Major	Major

1.3 Acoustic modelling methodology

1.3.1.1 A 3D acoustic model has been constructed using the SoundPLAN v8.2 software package. This software implements the outdoor sound propagation method detailed within ISO 9613-2:1996: 'Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation'. Sound levels have been predicted under light down-wind conditions based on hemispherical radiation with corrections added for atmospheric absorption, ground effects, screening, and source directivity, where each is appropriate. This standard is widely accepted as the industry-standard model.

1.3.1.2 The maximum design scenario (MDS), as outlined in Table 22.19 volume 3, chapter 22: Noise and vibration of the PEIR, is that all Mona Onshore Substation plant will be situated externally on the southwest boundary of the Mona Onshore Substation option 2 footprint and the eastern boundary of the option 7 footprint due to the relative proximity of the closest noise-sensitive receptors to the plant. It is unlikely that this will be the case and a full assessment will be undertaken once detailed plant design information is available.

1.3.1.3 The input parameters relevant to the Mona Offshore Wind include the following.

1.3.2 Local topographical features

1.3.2.1 Variable local topography can affect the 'line of sight' of a receptor to the source and result in greater or fewer obstacles between the source of noise and the receptor such as ground cover, hills, and buildings**.**

1.3.2.2 The receptors and other buildings which may provide screening effects have been obtained by importing OS Mastermap Topography Layer for the Onshore Substation option locations.

1.3.2.3 A digital ground model has been calculated using detailed OS Terrain 5 data for the both Onshore Substation option locations. It is understood from the Project Design Envelope (PDE) that the Mona Onshore Platform Area will be levelled to a height of 64m above Ordnance Datum for Onshore Substation option 2 and 53m above Ordnance Datum for Onshore Substation option 7. The elevation data has been altered to account for this.

1.3.3 Ground effects

1.3.3.1 Sound propagating outdoors comprises direct waves travelling straight from source to receiver and reflected waves which interact with the ground. Harder surfaces reflect more sound thereby resulting in enhanced noise levels at the receptor. Softer surfaces (such as grass, trees, or vegetation) have a higher porosity and thus can absorb reflected waves resulting in lower noise levels at the receptor.

1.3.3.2 The acoustic properties of the ground are accounted for using the ground factor *G* which is a dimensionless parameter between 0 and 1. ISO 9613-2:1996 specified a ground factor of 0 for hard surfaces and 1 for porous surfaces.

1.3.3.3 The area surrounding the Mona Onshore Substation options is predominantly grassland and woodland and thus has been assigned a ground factor of $G = 1$.

1.3.3.4 The Mona Onshore Substation Platform area is assumed to comprise hard ground with a ground factor of $G = 0$.

1.3.4 Plant strategy and layout

1.3.4.1 The primary model input is the source noise levels of the proposed plant strategy and the operating conditions for the Mona Onshore Substation.

1.3.4.2 Detailed information on the plant strategy and layout is not yet available, however an indicative plant strategy is outlined in section Table 1.3 along with the typical noise

levels. Spectral shapers have been applied to the levels below which have been obtained from operational noise assessments for similar schemes (Hornsea Project Three, East Anglia TWO, Dudgeon and Sheringham). The full spectra are presented in Appendix A.

Table 1.3 Indicative plant strategy for the Mona Onshore Substation.

(1) Typical heights have been assumed based on data used in similar operational noise assessments undertaken as part of the Environmental Statements for other offshore wind projects.

Plant item	Quantity	Height (1) (m)	A-weighted sound power level, L_W dB(A)
400/275/33 kV Super Grid Transformer (SGT) incl. Coolers	3	11	90
275 kV Shunt Reactor incl. Coolers	3	9	90
400kV Shunt Reactor incl. Coolers	2	9	90
Dynamic Reactive Power Compensator (SVC) Phase Reactors	9	5	85
Dynamic Reactive Power Compensator (SVC) Coolers	3	3	90
2x 33kV Mechanically Switched Reactors (MSR)	18	5	85
275 kV Filter	3	10	85
400kV Filter	2	10	85
33/0.4 kV Auxiliary Transformer	3	2	80
DRC Heating, Ventilation and Air Conditioning Units	3	3	80
Control Building Heating, Ventilation and Air Conditioning Units	4	3	80

1.3.4.3 It is likely that some plant items will operate continuously 24 hours a day whilst other plant items will operate intermittently depending on demand. In the absence of detailed design information, the MDS is formed on the assumption that all plant items operate for 24 hours a day.

1.3.4.4 The spectral shapes from similar plant which have been applied to the broadband sound power levels in Table 1.3 highlight that the Super Grid Transformers and Shunt Reactors may have tonal components to their noise emission spectra at low frequency which could potentially cause disturbance to nearby receptors. As such, where these plant items are most influential to the overall receptor noise level, a correction of +4dB has been applied corresponding to 'clearly perceptible' in terms of BS 4142:2014+A1:2019.

1.3.4.5 In addition to the above tonality corrections, at receptors where the specific sound level (without acoustic character corrections) exceeds the representative background sound level, a correction of +3dB correction has been applied to account for the potential perceptibility of the intermittent operations of the Mona Onshore Substation plant. This represents the MDS.

1.3.4.6 The total correction at the closest receptors where the Super Grid Transformers and Shunt Reactors contribute most to the predicted level and the overall predicted level exceeds the background sound level, accounting for tonality and intermittency, is +7 dB. As above, this represents the MDS.

1.3.4.7 Whilst no specific substation plant layout is yet available, mitigation measures will be adopted as part of the design process to aid in the reduction of noise from the Onshore Substation plant at nearby receptors.

1.3.4.8 The plant layout will be designed to reduce noise impacts as much as is reasonably practicable and additional mitigation measures such as acoustic enclosures, attenuators, and acoustic barriers may be implemented as part of the Mona Offshore Wind Project. The exact measures will be determined as the design progresses; however, a conservative loss has been included in the acoustic model to account for the potential reduction achieved by the aforementioned mitigation measures.

1.3.4.9 The losses for each measure and where they have been applied are presented in Table 1.4 below.

Table 1.4: Indicative noise mitigation measures.

Plant item	Acoustic Mitigation Measure	Broadband Insertion Loss (dB)
400/275/33 kV Super Grid Transformer (SGT) incl. Coolers	Enclosure	20
275 kV Shunt Reactor incl. Coolers	Enclosure	20
400kV Shunt Reactor incl. Coolers	Enclosure	20
Dynamic Reactive Power Compensator (SVC) Phase Reactors	Silencer	10
Dynamic Reactive Power Compensator (SVC) Coolers	Silencer	10
2x 33kV Mechanically Switched Reactors (MSR)	Silencer	10
275 kV Filter	Silencer	10
400kV Filter	None	0
33/0.4 kV Auxiliary Transformer	Silencer	10
DRC Heating, Ventilation and Air Conditioning Units	Silencer	10
Control Building Heating, Ventilation and Air Conditioning Units	Enclosure	20

1.3.4.10 Despite some of the above sources being predominantly low frequency in their emission spectrum, the above losses are deemed reasonable. Assuming an acoustic enclosure or plant building having a façade construction comprising 70mm of brick only (ignoring internal linings and cavities), a typical loss at 63 Hz is 32 dB which is well above the values assumed.

1.3.5 Noise sensitive receptors

1.3.5.1 The nearest noise sensitive receptors are presented graphically in Figure 1.2 and Figure 1.3 for Onshore Substation option 2 and Onshore Substation option 7. The relative distance of each receptor to the substation boundary is presented in Table 1.5 below.

Table 1.5: Distance of noise sensitive receptors to Onshore Substation boundary.

OPTION 2

Receptor	Distance to Onshore Substation boundary (m)
Hen-Dy	29
Pentre Meredydd	83
Tyddyn Meredydd	46
Tan-y-Bryn Uchaf	269
Pentre Bach	112
Pentre Mawr	338
1 to 5 Pentre Mawr	341
Graig Lwyd	443
Waen Meredydd	482
Trebanog	545
Groesffordd Farm	519
Bryn Arian	676
Tyn-y-Ffordd Newydd	589
Denbighshire Crematorium	747
Tyn-y-Ffordd Bach	673
Tyddyn Eos	738
Tyn-y-Cau	687
Coed yr Esgob	664
Cae Cogau	719
Garreg-Wen	820
Derwendeg	931
Squirells Lodge	786
Plas yr Esgob	743
Tyn-y-Ffordd Fawr	861
Gwelfryn	732
Camrau	935
Maes	786
Tyn-y-ffordd	744

OPTION 2

Receptor	Distance to Onshore Substation boundary (m)
Tan-y-Graig	819

OPTION 7

Receptor	Distance to Onshore Substation boundary (m)
Pen-y-Clink	185
Cae yr Haul	281
Bryn Esgob	328
Coed yr Esgob	346
Tyn-y-Ffordd Fawr	313
Bro Havard	409
Lyons Eryl Hall Caravans	263
Squirells Lodge	509
Eryl Hall	456
The Cottage	604
Tyn-y-Cau	637
Plas yr Esgob	624
Llys y Wennol	629
Tyn-y-Ffordd Bach	583
Rhos Aber	879
Derwendeg	921
Tyn-y-Ffordd Newydd	874

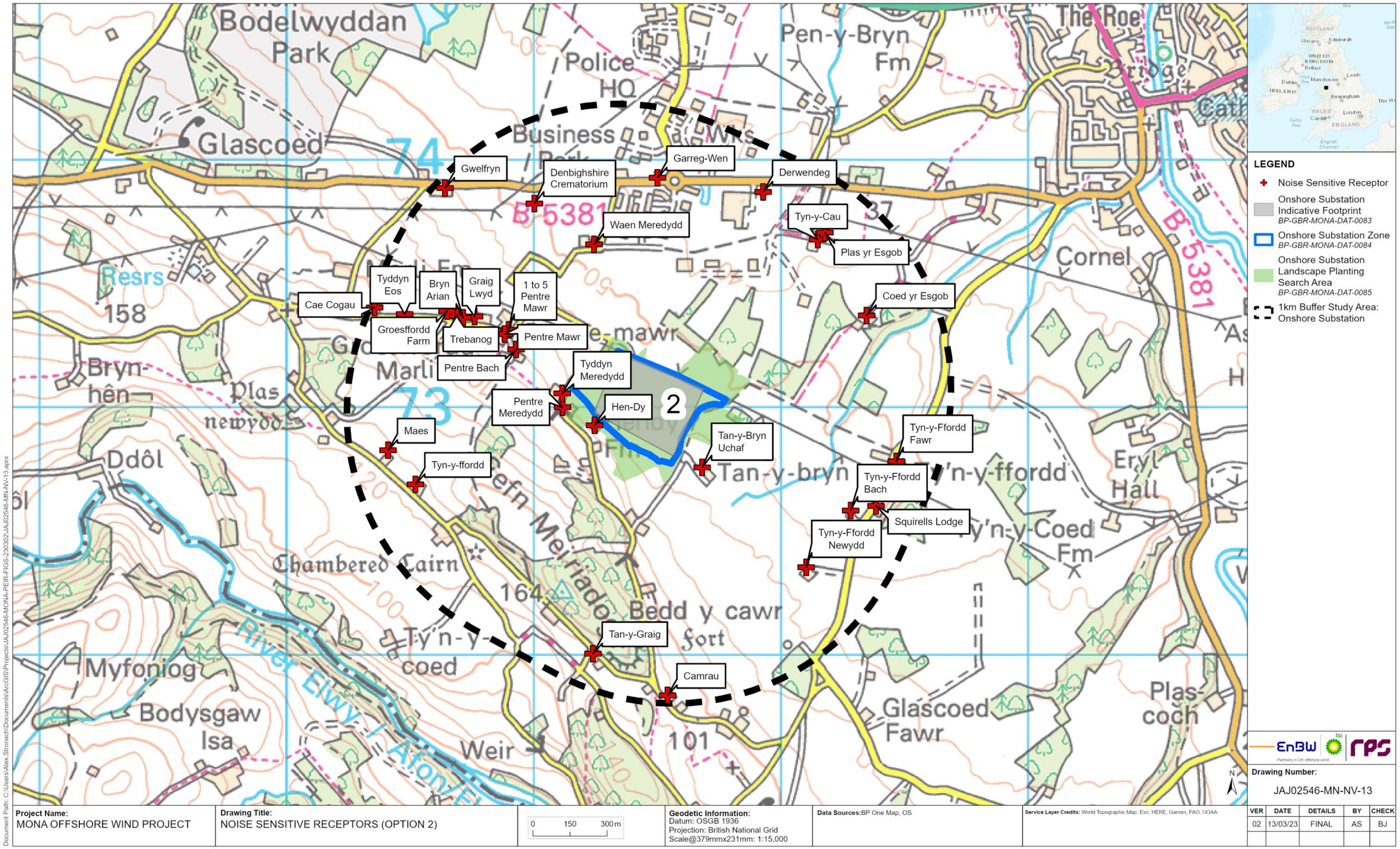

Figure 1.2: Noise sensitive receptors within the noise study area for the Mona Onshore Substation (option 2).

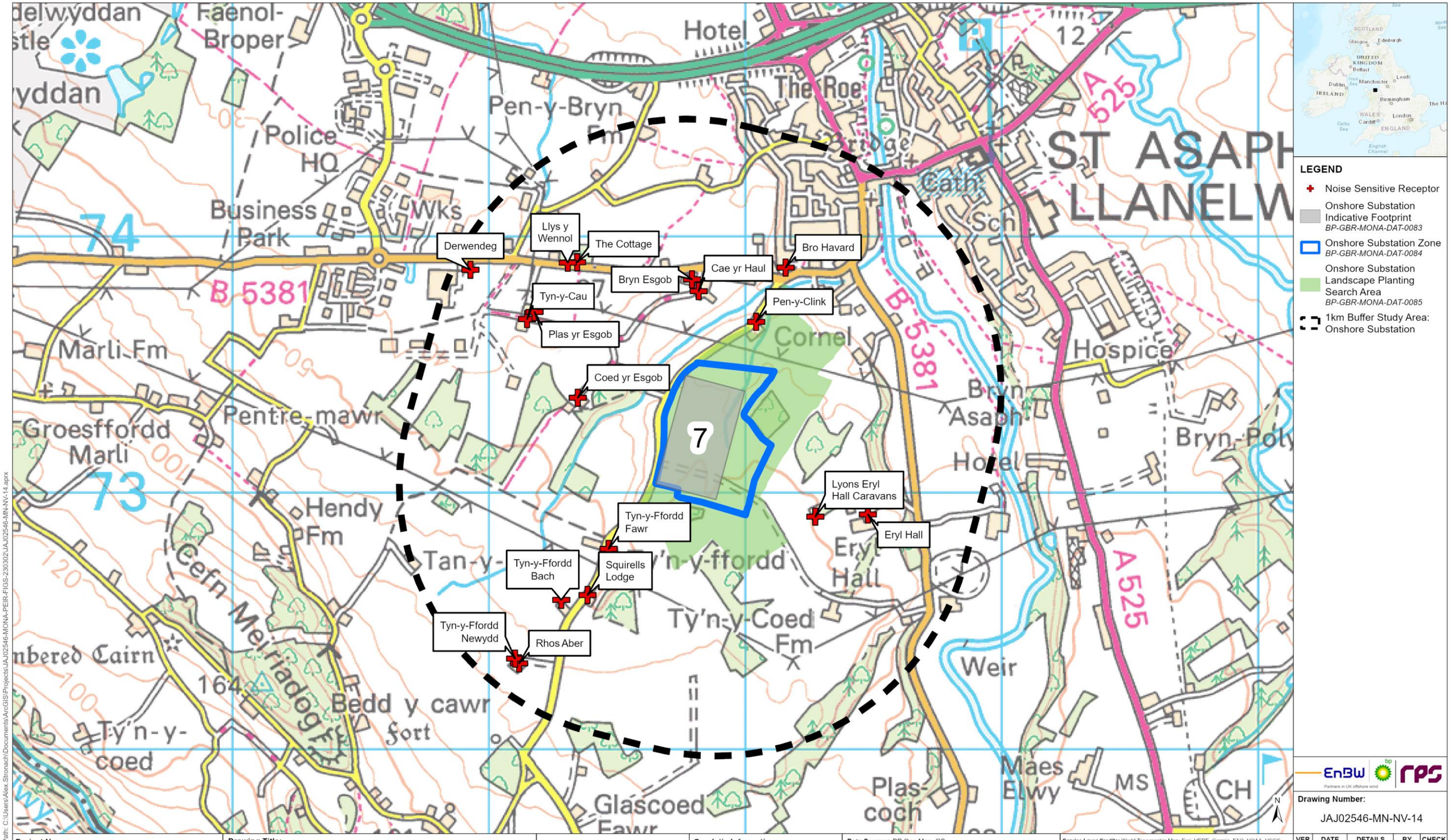

Figure 1.3: Noise sensitive receptors within the noise study area for the Mona Onshore Substation (option 7) .

1.4 Operational noise model output and assessment

1.4.1.1 The results of the operational noise assessment are presented in Appendix B in tabular form. It has been assumed that the substation plant will be continuously operational 24-hours a day and thus the impacts below are based on an assessment against the night-time background sound levels and absolute sound levels at the relevant receptors.

1.4.1.2 The nearest noise-sensitive receptors are closer to Onshore Substation option 2 than Onshore Substation option 7. In the absence of mitigation, Onshore Substation option 2 results in high impacts at the following receptors:

- Hen-Dy
- Pentre Meredydd
- Tyddyn Meredydd
- Tan-y-Bryn Uchaf
- Waen Meredydd

1.4.1.3 Unmitigated, Onshore Substation option 7 results in high impacts at the following receptors:

- Pen-y-Clink
- Cae yr Haul
- Bryn Esgob
- Coed yr Esgob
- Tyn-y-Ffordd Fawr

1.4.1.4 The inclusion of indicative mitigation measures shows the impacts can be reduced to medium at Hen-Dy and low/negligible at all other receptors for Onshore Substation option 2. The impacts are reduced to negligible at all receptors for Onshore Substation option 7.

1.5 Next Steps

1.5.1.1 As the design of the Onshore Substation progresses, the proposed plant strategy and layout will be refined. Consultation will be sought with Denbighshire County Council to establish appropriate mitigation measures to aid in the reduction of operational noise emission levels.

1.5.1.2 The acoustic model will be updated to include the updated parameters and a detailed assessment of the noise impacts will inform the type and level of mitigation required.

1.5.1.3 Depending on the substation engineering option selected (GIS or AIS), some plant items will be installed internally within buildings. The façade sound insulation will be specified to mitigate noise breakout from the proposed plant items.

1.5.1.4 Noise from equipment situated externally can be mitigated via good design and, if necessary, the specification of acoustic barriers around sections of the Mona Onshore Substation footprint perimeter.

1.6 References

Mona Offshore Wind Ltd (2022) Mona Offshore Wind Project EIA Scoping Report. Available: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010137/EN010137-000011-EN010137%20-%20Scoping%20Report.pdf. Accessed December 2022.

British Standards Institution (2019) 'British Standard 4142:2014+A1:2019 – *'Methods for rating and assessing industrial and commercial sound'.*

British Standards Institution (2014) 'British Standard 8233:2014– *'Guidance on sound insulation and noise reduction for buildings'.*

International Organisation for Standards (1996) *'ISO 9613-2:1996 – Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation'.*

Appendix A: Operational Noise Model Source Spectra

Table 1.6: Operational noise model input spectra

Plant Item	Sound Power Level (dB) at Octave Band Centre Frequency (Hz)								dB(A)
	63	125	250	500	1k	2k	4k	8k	
400/275/33 kV Super Grid Transformer (SGT) incl. Coolers	99	94	91	87	84	81	79	77	**90**
275 kV Shunt Reactor incl. Coolers	89	94	92	87	86	79	69	59	**90**
400kV Shunt Reactor incl. Coolers	55	100	66	76	78	50	50	52	**85**
Dynamic Reactive Power Compensator (SVC) Phase Reactors	88	88	92	87	86	80	69	59	**90**
Dynamic Reactive Power Compensator (SVC) Coolers	47	99	75	84	27	26	26	28	**85**
2x 33kV Mechanically Switched Reactors (MSR)	83	88	93	78	60	40	40	38	**85**
275 kV Filter	83	88	93	78	60	40	40	38	**85**
400kV Filter	101	92	78	68	62	54	52	72	**80**
33/0.4 kV Auxiliary Transformer	84	89	76	76	75	72	65	64	**80**
DRC Heating, Ventilation and Air Conditioning Units	80	77	74	71	68	65	77	73	**80**
Control Building Heating, Ventilation and Air Conditioning Units	89	94	92	87	86	79	69	59	**90**

Appendix B: Operational Noise Assessment

Table 1.7: Baseline (unmitigated) operational noise assessment for the Onshore Substation option 2

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
Hen-Dy	37	35	51	51	7	58	58	21	23	High	High
Pentre Meredydd	37	35	45	45	7	52	52	15	17	High	High
Tyddyn Meredydd	37	35	45	45	7	52	52	15	17	High	High
Pentre Bach	37	35	38	38	3	41	41	4	6	Low	Medium
Tan-y-Bryn Uchaf[(i)]	30	30	35	35	7	42	42	12	12	High	High
1 to 5 Pentre Mawr	37	35	34	34	3	37	37	0	2	Low	Low
Pentre Mawr	37	35	34	34	7	41	41	4	6	Low	Medium
Waen Meredydd	33	30	33	33	7	40	40	7	10	Medium	High
Graig Lwyd	37	35	32	32	3	35	35	-2	0	Negligible	Low
Trebanog	37	35	31	31	0	31	31	-6	-4	Negligible	Negligible
Bryn Arian	37	35	31	31	0	31	31	-6	-4	Negligible	Negligible
Denbighshire Crematorium	33	30	30	30	3	33	33	0	3	Low	Low
Groesffordd Farm	37	35	30	30	0	30	30	-7	-5	Negligible	Negligible
Tyn-y-Cau	33	30	28	28	0	28	28	-5	-2	Negligible	Negligible
Tyn-y-Ffordd Bach[(i)]	30	30	28	28	3	31	31	1	1	Low	Low
Tyddyn Eos	37	35	28	28	0	28	28	-9	-7	Negligible	Negligible
Tyn-y-Ffordd Newydd[(i)]	30	30	28	28	3	31	31	1	1	Low	Low
Coed yr Esgob	36	31	28	28	0	28	28	-8	-3	Negligible	Negligible
Garreg-Wen	38	32	28	28	0	28	28	-10	-4	Negligible	Negligible
Derwendeg	38	32	27	27	0	27	27	-11	-5	Negligible	Negligible
Gwelfryn	38	32	27	27	0	27	27	-11	-5	Negligible	Negligible
Plas yr Esgob	36	31	27	27	3	30	30	-6	-1	Negligible	Negligible
Squirells Lodge[(i)]	30	30	27	27	3	30	30	0	0	Low	Low
Cae Cogau	37	35	26	26	0	26	26	-11	-9	Negligible	Negligible
Tyn-y-Ffordd Fawr	34	30	26	26	0	26	26	-8	-4	Negligible	Negligible
Camrau[(i)]	30	30	25	25	3	28	28	-2	-2	Negligible	Negligible

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
Maes	37	35	23	23	0	23	23	-14	-12	Negligible	Negligible
Tyn-y-ffordd[(i)]	30	30	16	16	0	16	16	-14	-14	Negligible	Negligible
Tan-y-Graig[(i)]	30	30	14	14	0	14	14	-16	-16	Negligible	Negligible

Table 1.8: Mitigated operational noise assessment for the Onshore Substation option 2.

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
Hen-Dy	37	35	35	35	5	40	40	3	5	Low	Medium
Pentre Meredydd	37	35	31	31	5	36	36	-1	1	Negligible	Low
Tyddyn Meredydd	37	35	30	30	5	35	35	-2	0	Negligible	Low
Pentre Bach	37	35	26	26	3	29	29	-8	-6	Negligible	Negligible
Tan-y-Bryn Uchaf[(i)]	30	30	25	25	5	30	30	0	0	Low	Low
1 to 5 Pentre Mawr	37	35	22	22	3	25	25	-12	-10	Negligible	Negligible
Pentre Mawr	37	35	21	21	5	26	26	-11	-9	Negligible	Negligible
Waen Meredydd	33	30	21	21	5	26	26	-7	-4	Negligible	Negligible
Graig Lwyd	37	35	20	20	3	23	23	-14	-12	Negligible	Negligible
Trebanog	37	35	20	20	0	20	20	-17	-15	Negligible	Negligible
Bryn Arian	37	35	19	19	0	19	19	-18	-16	Negligible	Negligible
Denbighshire Crematorium	33	30	18	18	3	21	21	-12	-9	Negligible	Negligible
Groesffordd Farm	37	35	17	17	0	17	17	-20	-18	Negligible	Negligible
Tyn-y-Cau	33	30	17	17	0	17	17	-16	-13	Negligible	Negligible
Tyn-y-Ffordd Bach[(i)]	30	30	17	17	3	20	20	-10	-10	Negligible	Negligible
Tyddyn Eos	37	35	17	17	0	17	17	-20	-18	Negligible	Negligible
Tyn-y-Ffordd Newydd[(i)]	30	30	17	17	3	20	20	-10	-10	Negligible	Negligible
Coed yr Esgob	36	31	17	17	0	17	17	-19	-14	Negligible	Negligible
Garreg-Wen	38	32	16	16	0	16	16	-22	-16	Negligible	Negligible
Derwendeg	38	32	16	16	0	16	16	-22	-16	Negligible	Negligible
Gwelfryn	38	32	16	16	0	16	16	-22	-16	Negligible	Negligible
Plas yr Esgob	36	31	16	16	3	19	19	-17	-12	Negligible	Negligible

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
Squirells Lodge[i]	30	30	16	16	3	19	19	-11	-11	Negligible	Negligible
Cae Cogau	37	35	16	16	0	16	16	-21	-19	Negligible	Negligible
Tyn-y-Ffordd Fawr	34	30	15	15	0	15	15	-19	-15	Negligible	Negligible
Camrau[i]	30	30	15	15	3	18	18	-12	-12	Negligible	Negligible
Maes	37	35	14	14	0	14	14	-23	-21	Negligible	Negligible
Tyn-y-ffordd[i]	30	30	7	7	0	7	7	-23	-23	Negligible	Negligible
Tan-y-Graig[i]	30	30	5	5	0	5	5	-25	-25	Negligible	Negligible

Table 1.9: Baseline (unmitigated) operational noise assessment for the Onshore Substation option 7.

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
Pen-y-Clink	38	32	38	38	7	45	45	7	13	Medium	High
Cae yr Haul	38	32	36	36	7	43	43	5	11	Medium	High
Bryn Esgob	38	32	36	36	7	43	43	5	11	Medium	High
Coed yr Esgob	36	31	35	35	3	38	38	2	7	Low	Medium
Tyn-y-Ffordd Fawr	34	30	34	34	7	41	41	7	11	Medium	High
Bro Havard	38	32	33	33	3	36	36	-2	4	Negligible	Low
Lyons Eryl Hall Caravans	30	30	33	33	3	36	36	6	6	Medium	Medium
Squirells Lodge	38	32	32	32	0	32	32	-6	0	Negligible	Low
Eryl Hall	33	30	31	31	0	31	31	-2	1	Negligible	Low
The Cottage	36	31	31	31	0	31	31	-5	0	Negligible	Low
Tyn-y-Cau	38	32	30	30	0	30	30	-8	-2	Negligible	Negligible
Plas yr Esgob	30	30	30	30	0	30	30	0	0	Low	Low
Llys y Wennol	30	30	30	30	0	30	30	0	0	Low	Low
Tyn-y-Ffordd Bach	38	32	30	30	0	30	30	-8	-2	Negligible	Negligible
Rhos Aber	30	30	27	27	0	27	27	-3	-3	Negligible	Negligible
Derwendeg	30	30	27	27	0	27	27	-3	-3	Negligible	Negligible
Tyn-y-Ffordd Newydd	30	30	26	26	0	26	26	-4	-4	Negligible	Negligible

Table 1.10: Mitigated operational noise assessment for the Onshore Substation option 7.

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
Pen-y-Clink	38	32	38	38	7	45	45	7	13	Medium	High
Cae yr Haul	38	32	36	36	7	43	43	5	11	Medium	High
Bryn Esgob	38	32	36	36	7	43	43	5	11	Medium	High
Coed yr Esgob	36	31	35	35	3	38	38	2	7	Low	Medium
Tyn-y-Ffordd Fawr	34	30	34	34	7	41	41	7	11	Medium	High
Bro Havard	38	32	33	33	3	36	36	-2	4	Negligible	Low
Lyons Eryl Hall Caravans	30	30	33	33	3	36	36	6	6	Medium	Medium
Squirells Lodge	38	32	32	32	0	32	32	-6	0	Negligible	Low
Eryl Hall	33	30	31	31	0	31	31	-2	1	Negligible	Low
The Cottage	36	31	31	31	0	31	31	-5	0	Negligible	Low
Tyn-y-Cau	38	32	30	30	0	30	30	-8	-2	Negligible	Negligible
Plas yr Esgob	30	30	30	30	0	30	30	0	0	Low	Low
Llys y Wennol	30	30	30	30	0	30	30	0	0	Low	Low
Tyn-y-Ffordd Bach	38	32	30	30	0	30	30	-8	-2	Negligible	Negligible
Rhos Aber	30	30	27	27	0	27	27	-3	-3	Negligible	Negligible
Derwendeg	30	30	27	27	0	27	27	-3	-3	Negligible	Negligible
Tyn-y-Ffordd Newydd	30	30	26	26	0	26	26	-4	-4	Negligible	Negligible