

Annex I

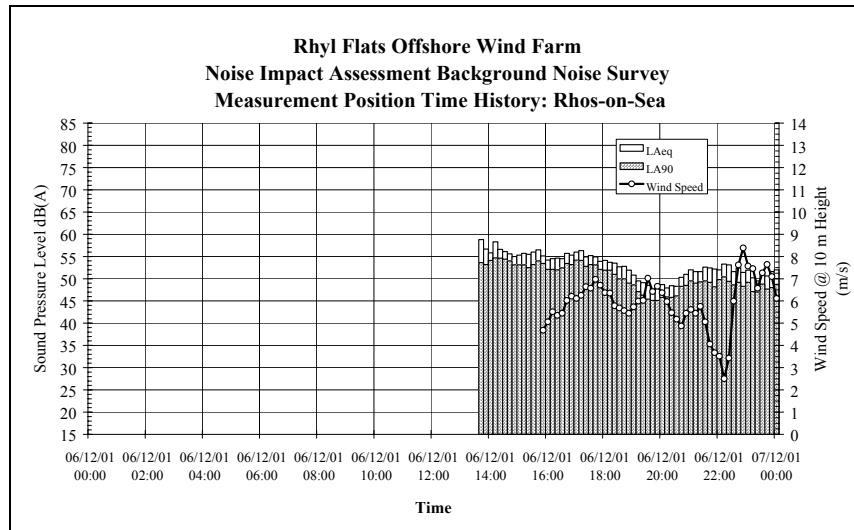
Airborne Noise Assessment:  
*Supporting Information and  
Calculations*

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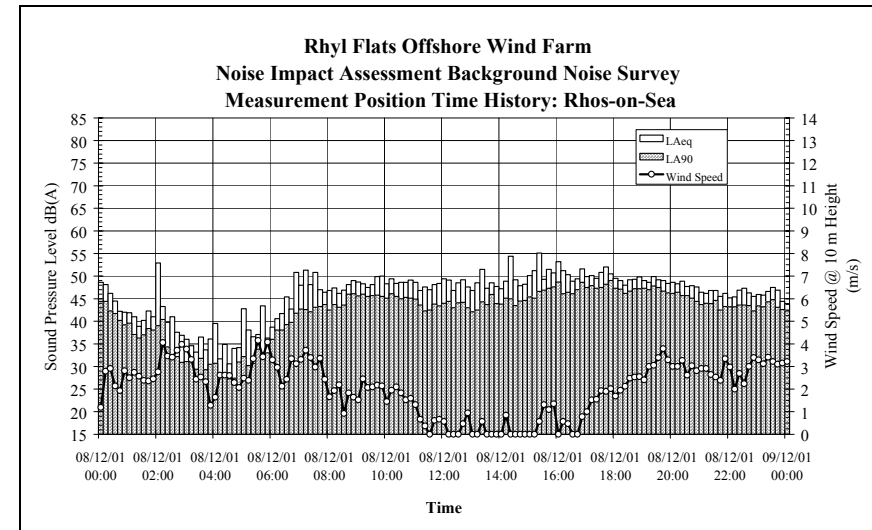
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- Annex I3 - Assessment of Wind Turbine Noise Levels
- Annex I4 - Substation Noise Measurement Data
- Annex I5 - Planning Policy, British Standards and Other Guidance

*ANNEX N1*

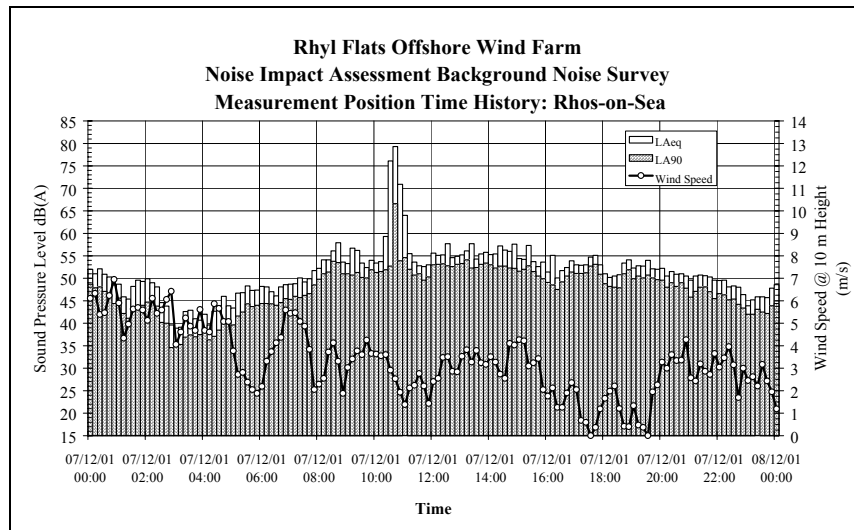
*TIME HISTORIES OF MEASURED BACKGROUND NOISE DATA*



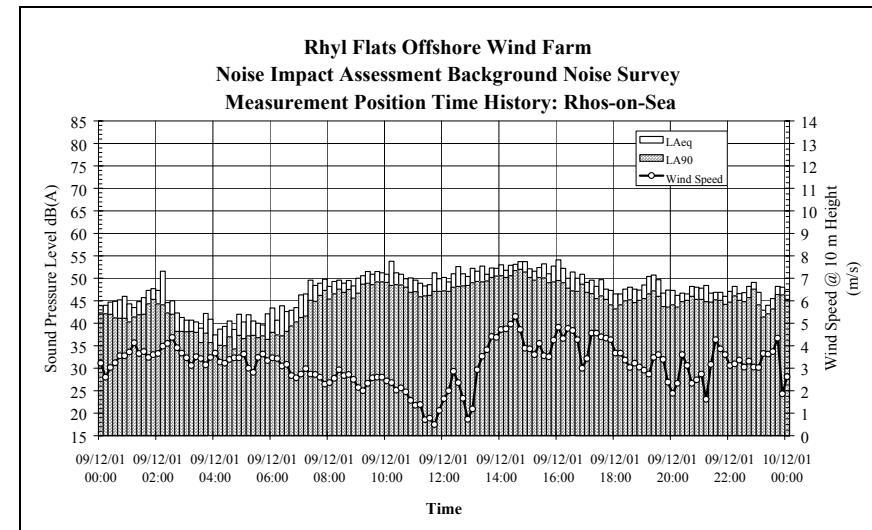
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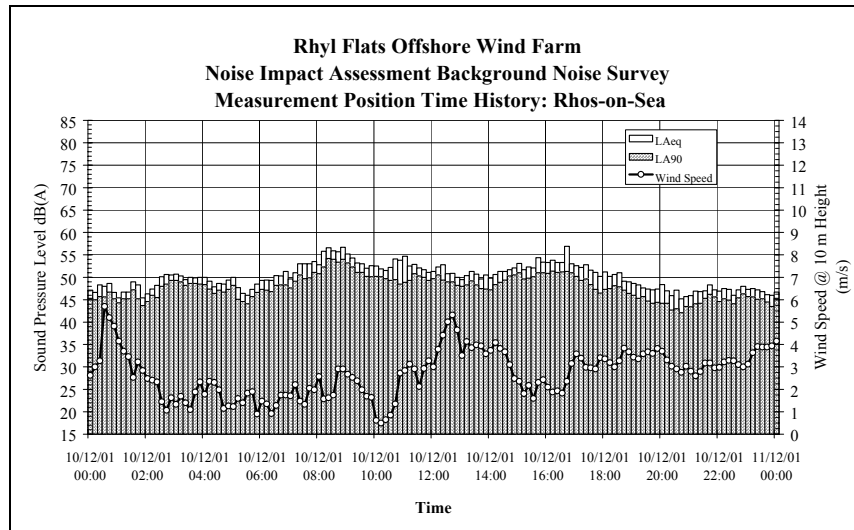
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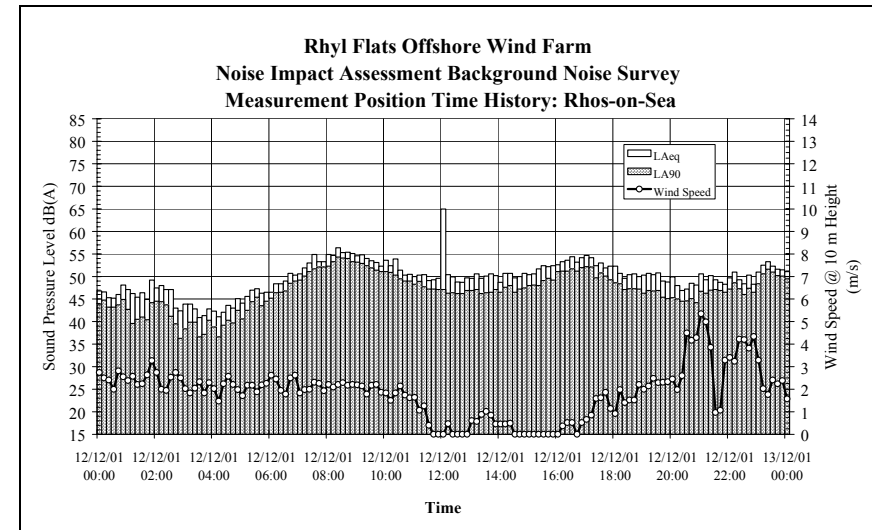
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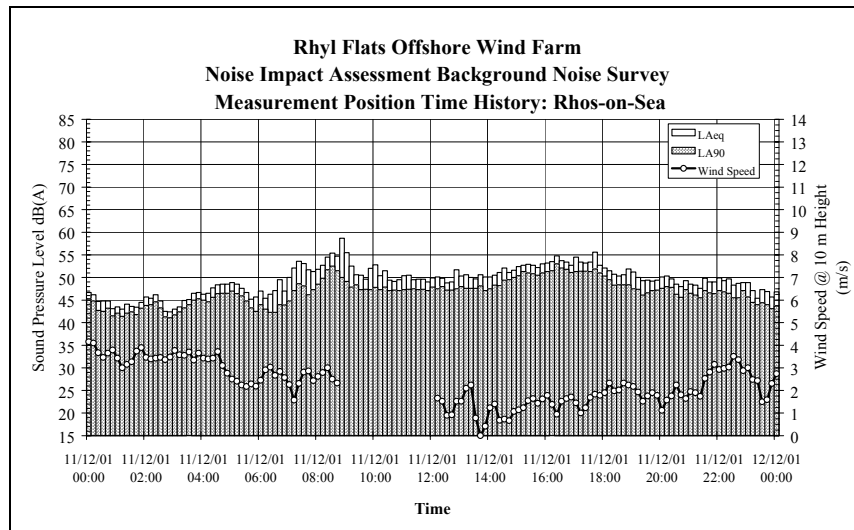
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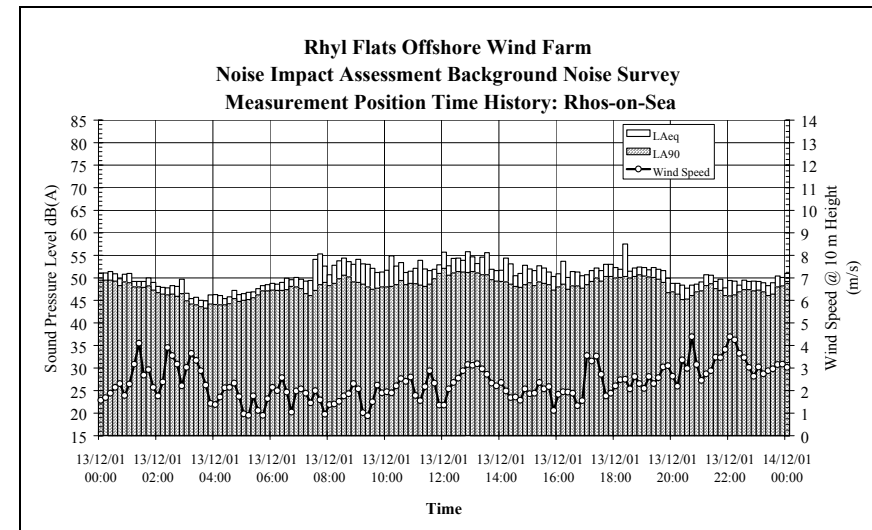
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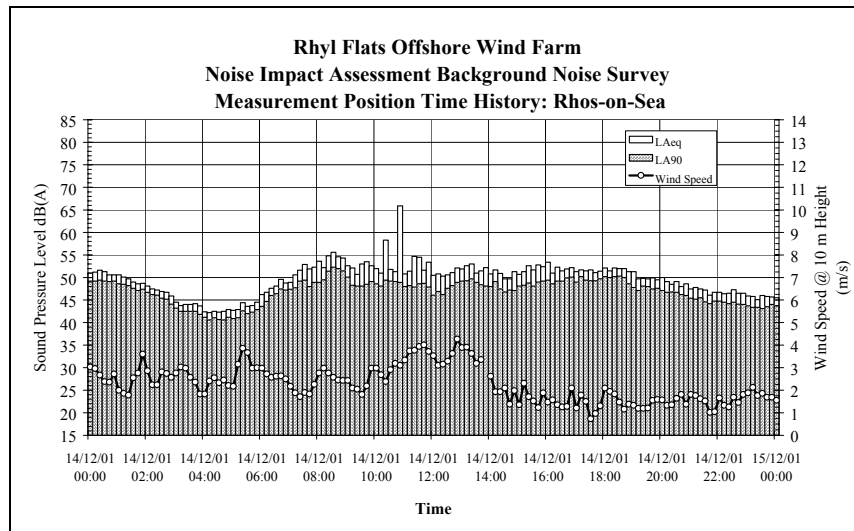
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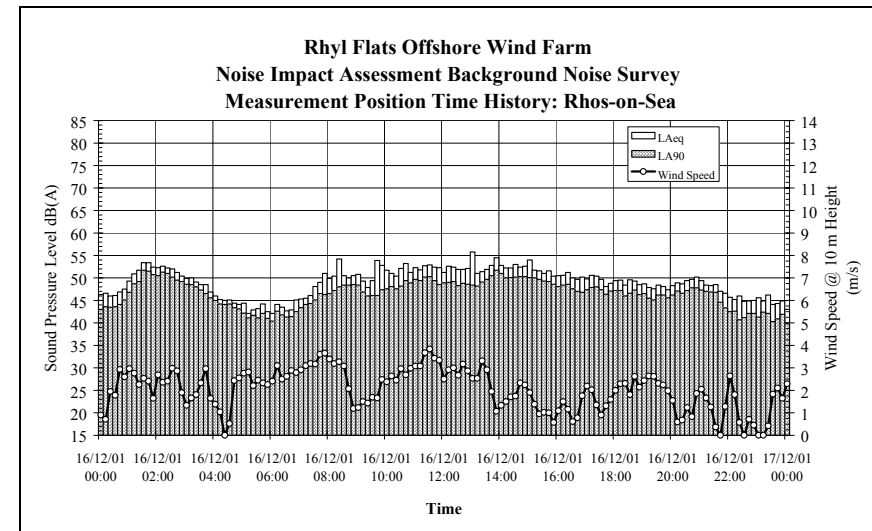
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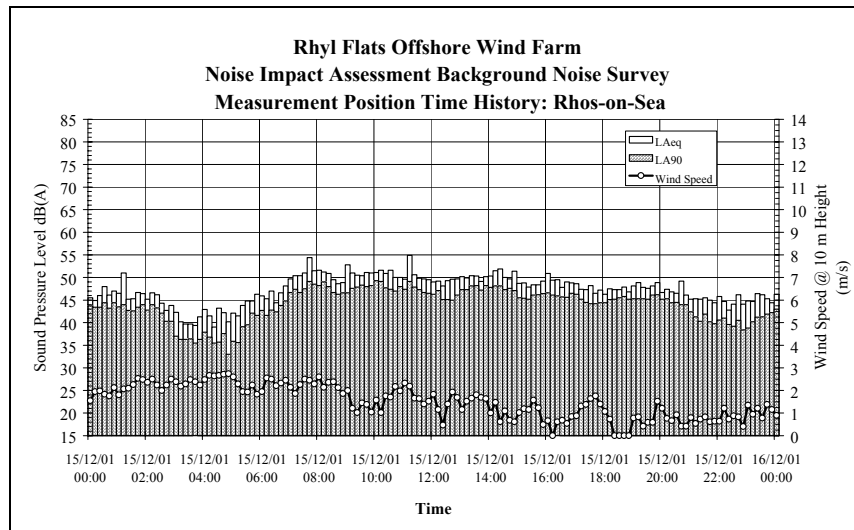
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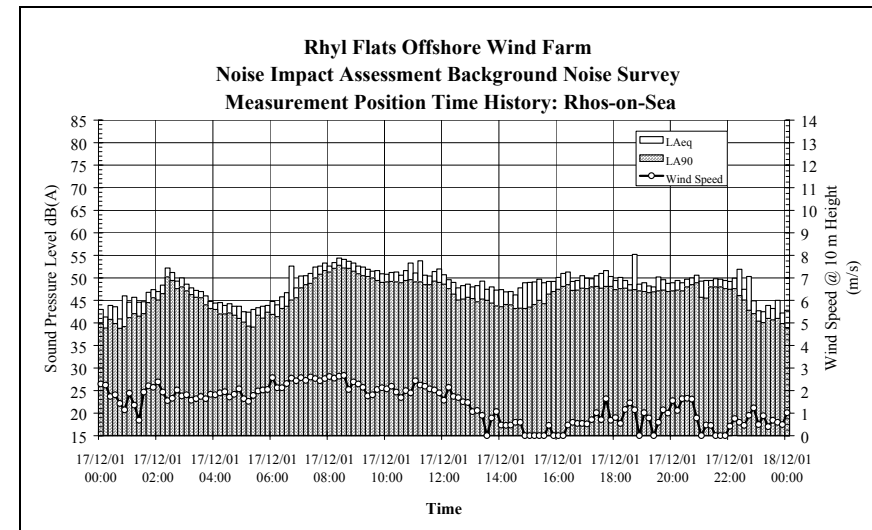
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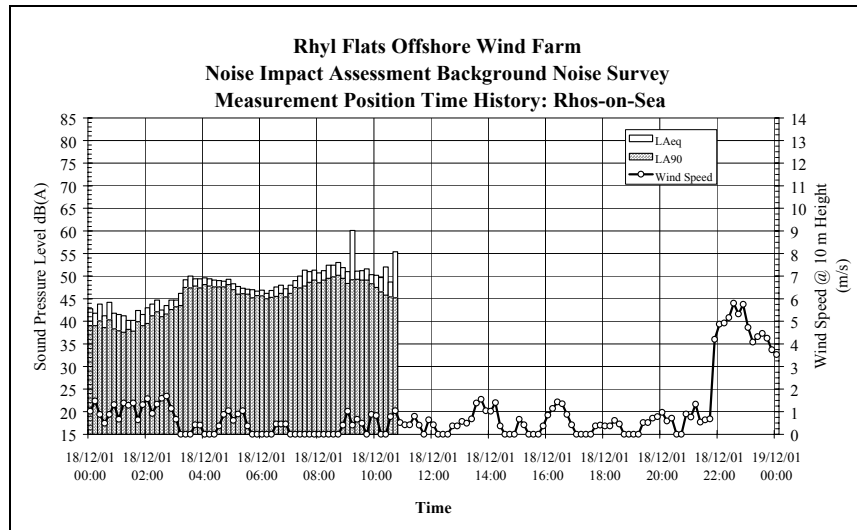
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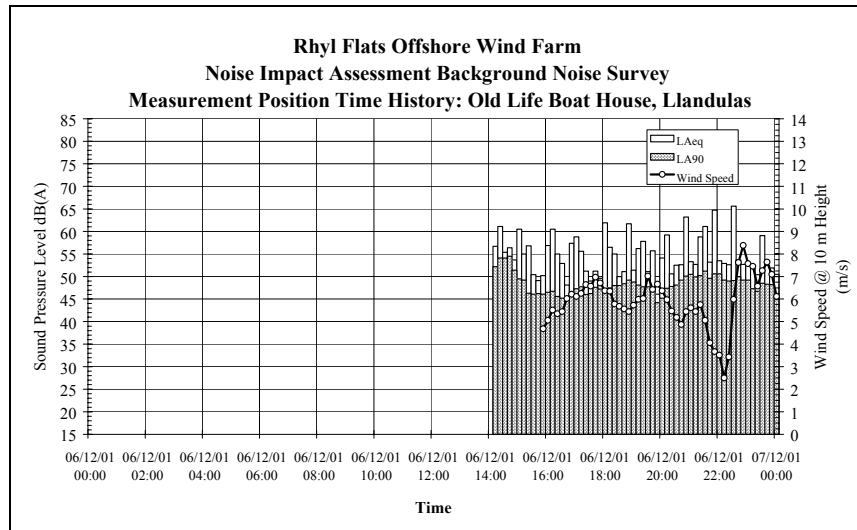
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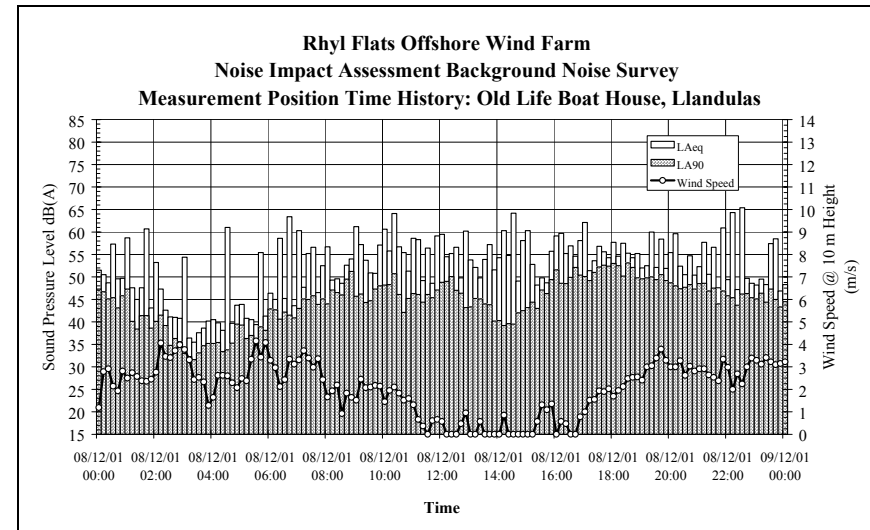
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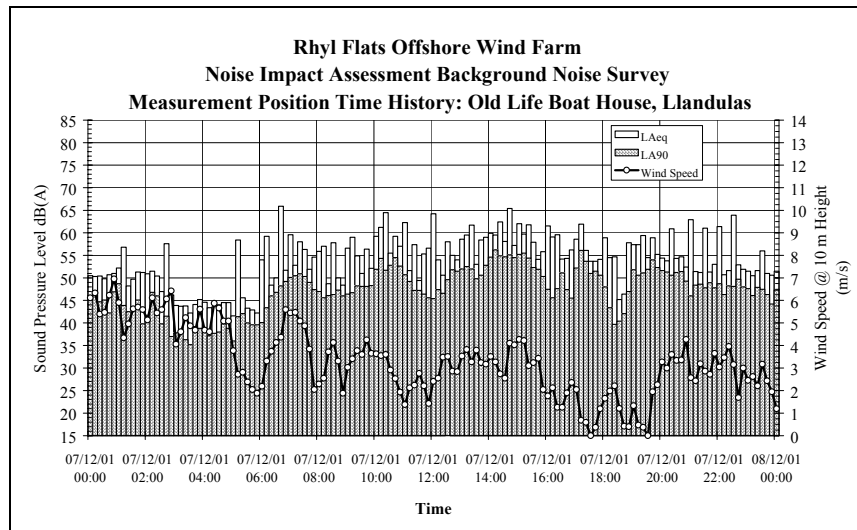
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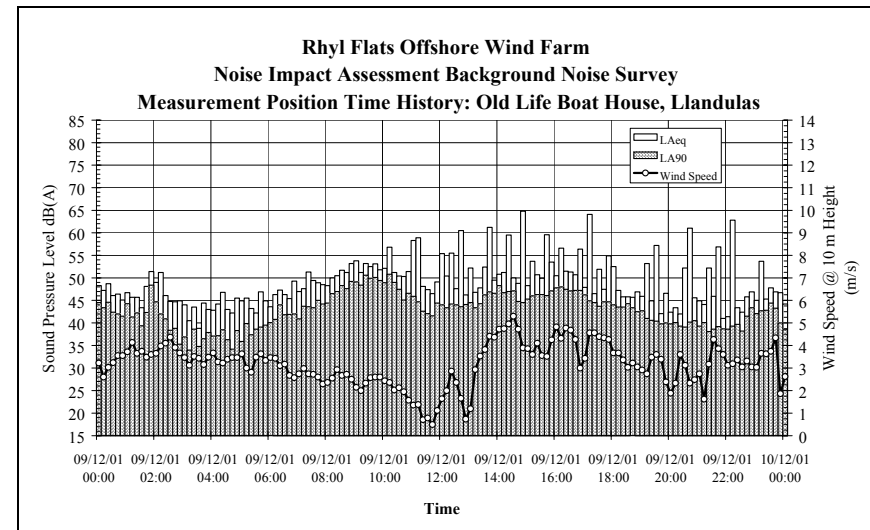
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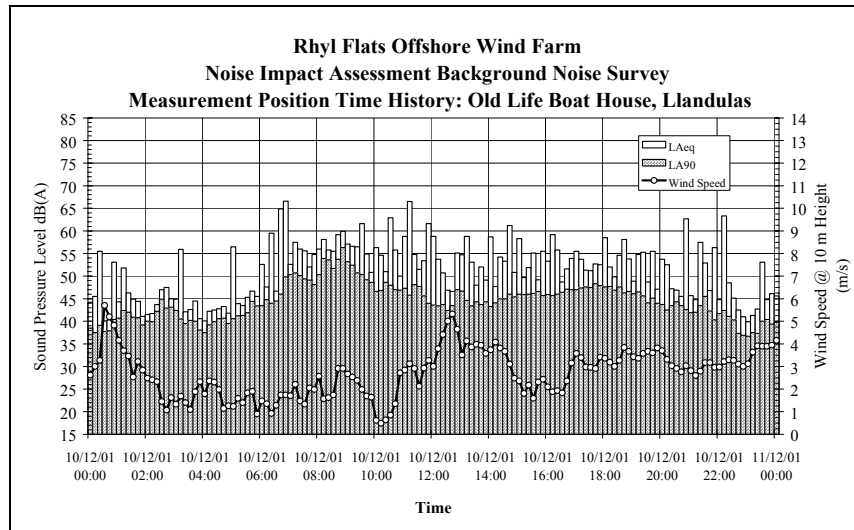


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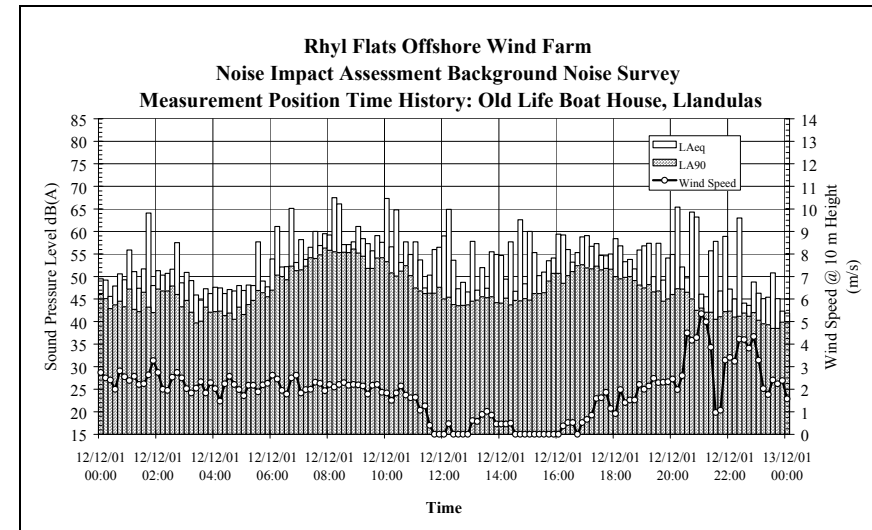


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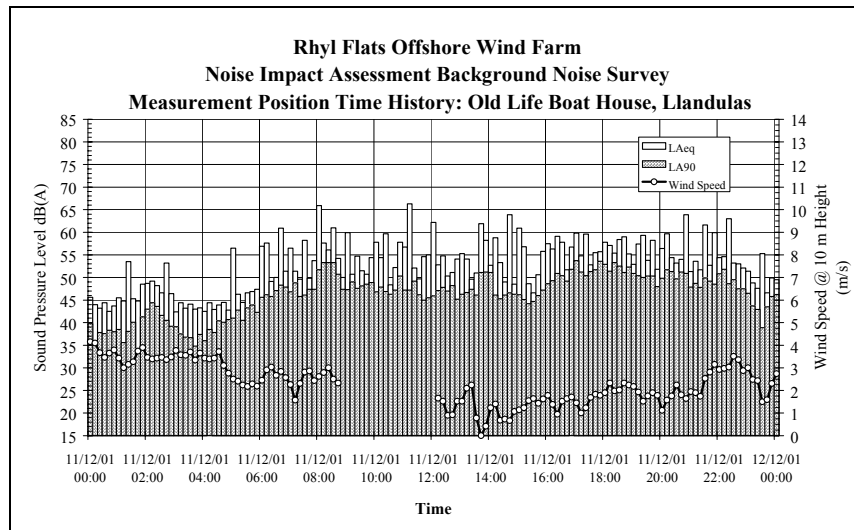




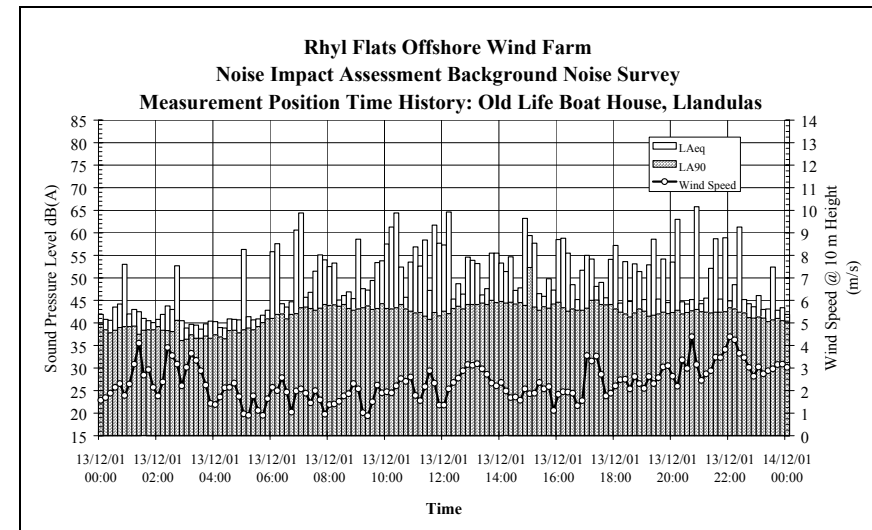
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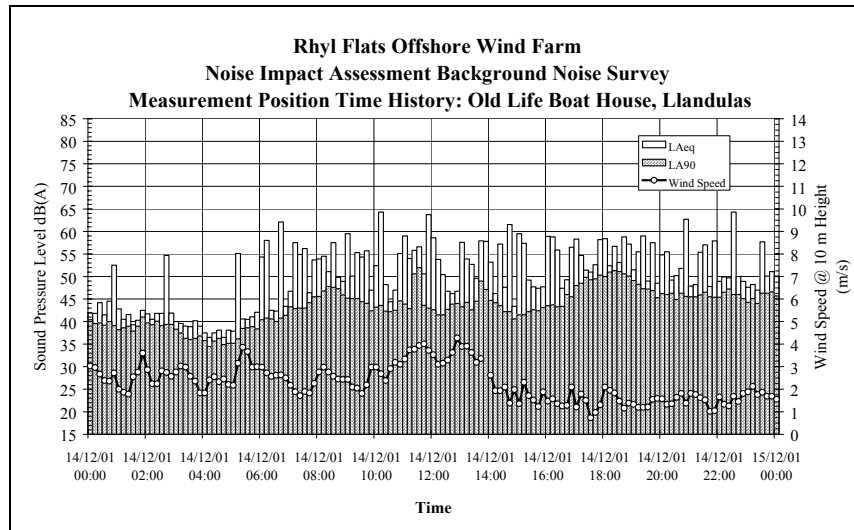
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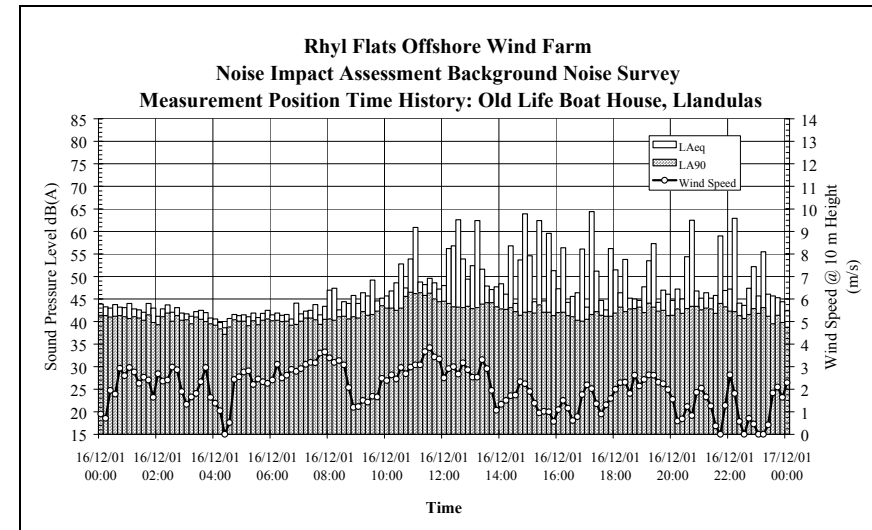
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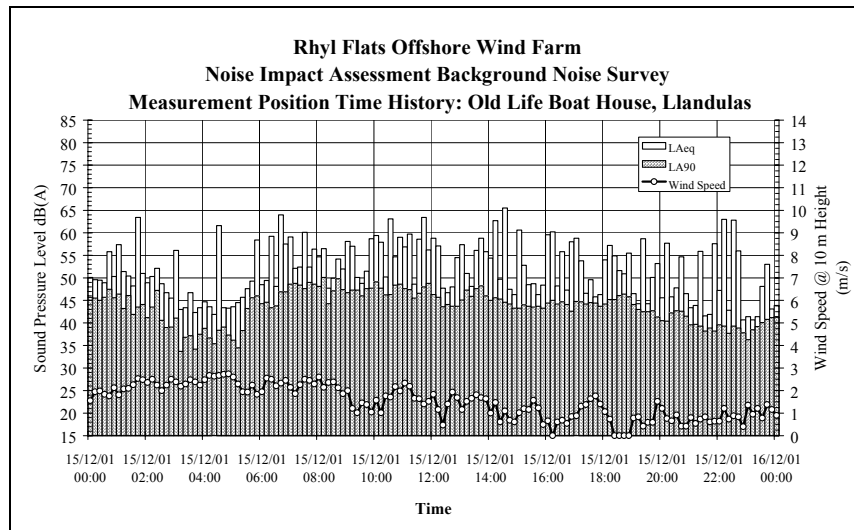
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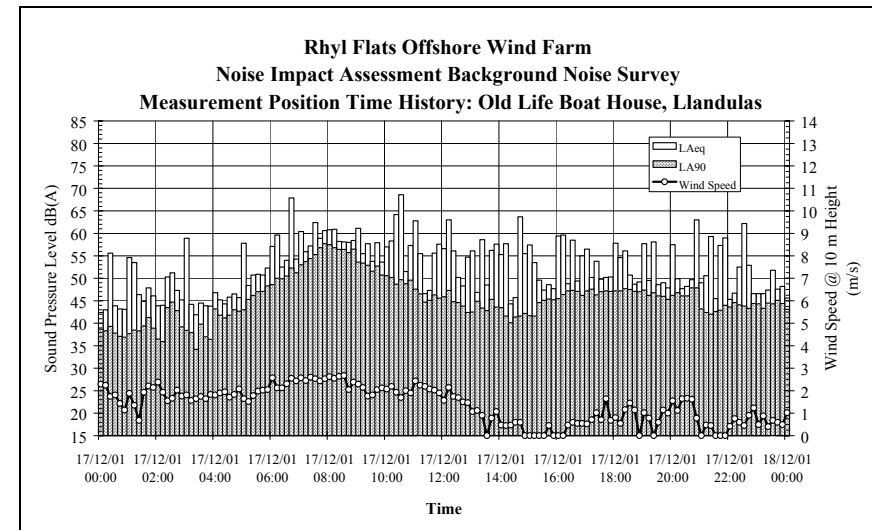
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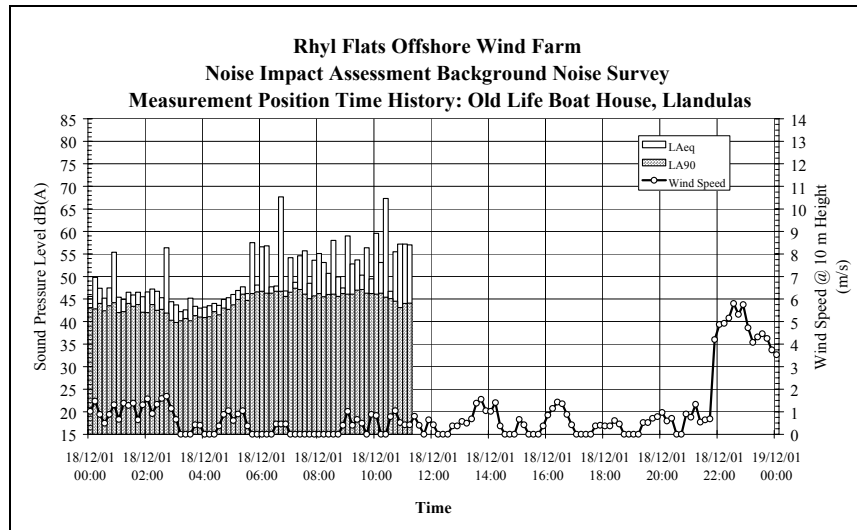
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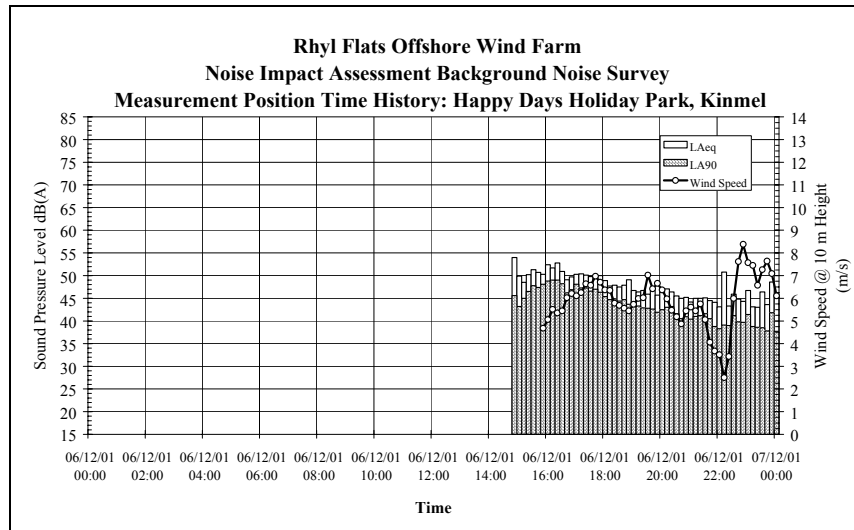
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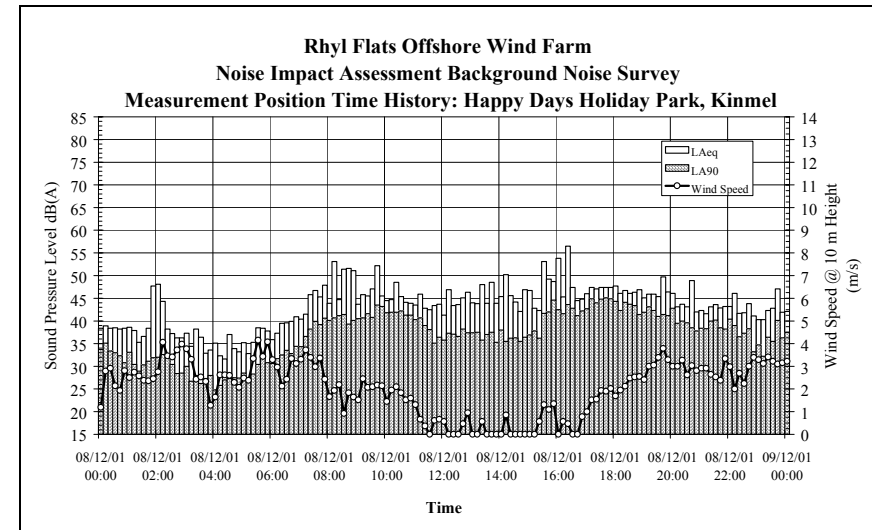
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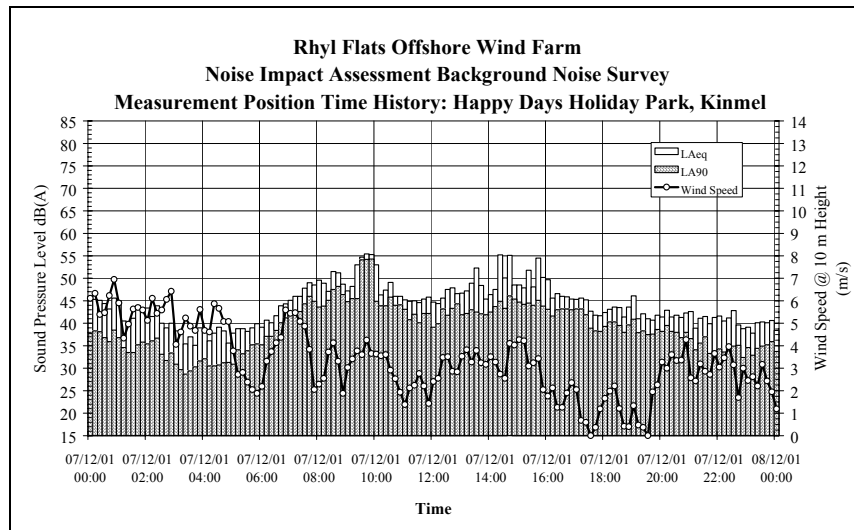
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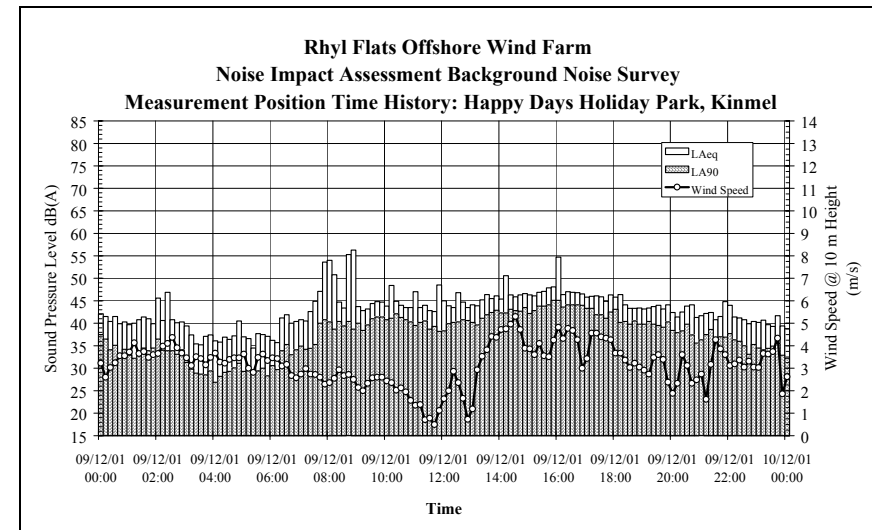
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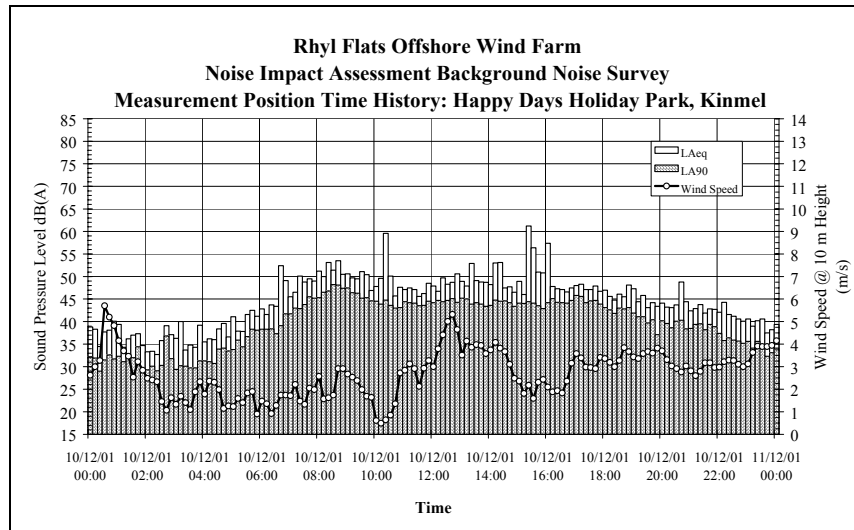
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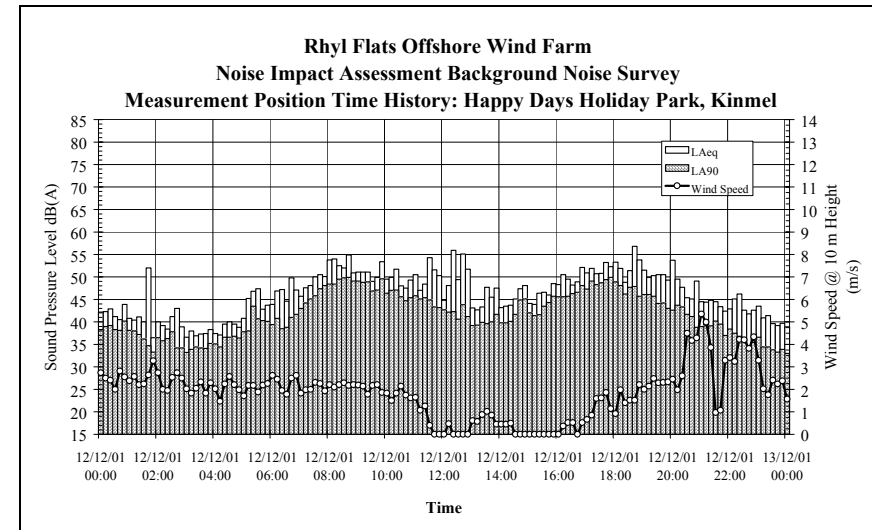
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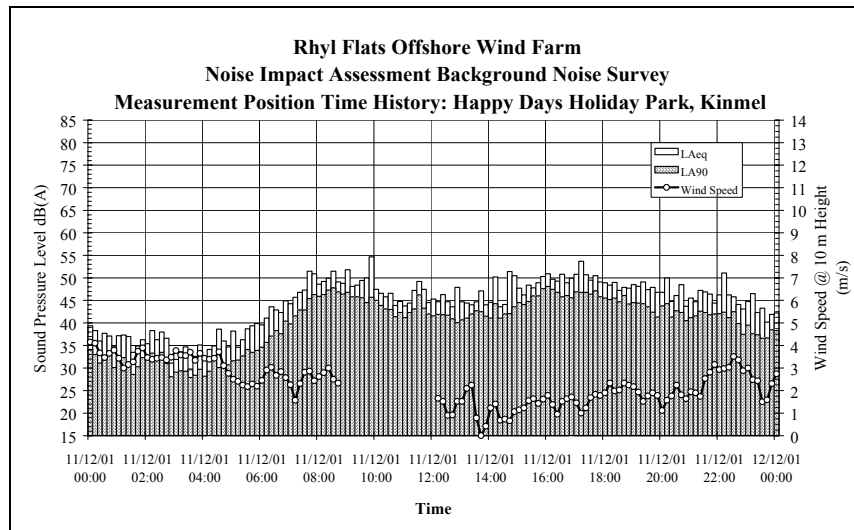
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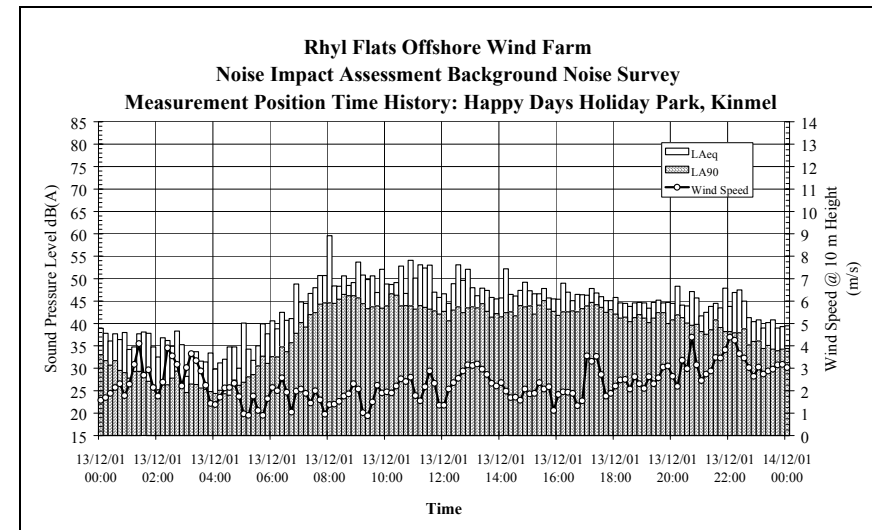
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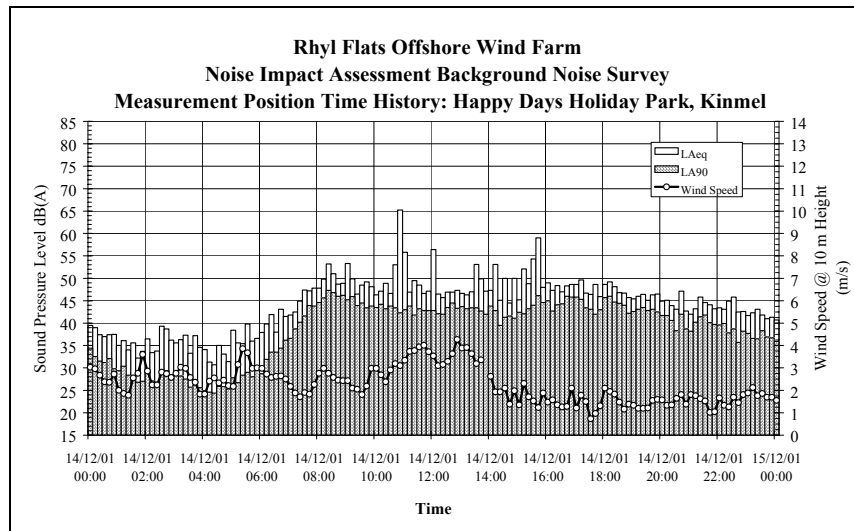
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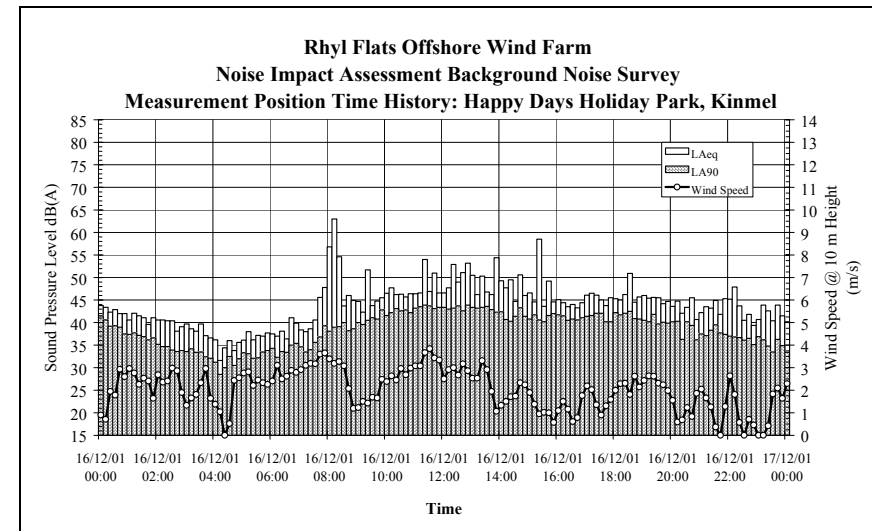
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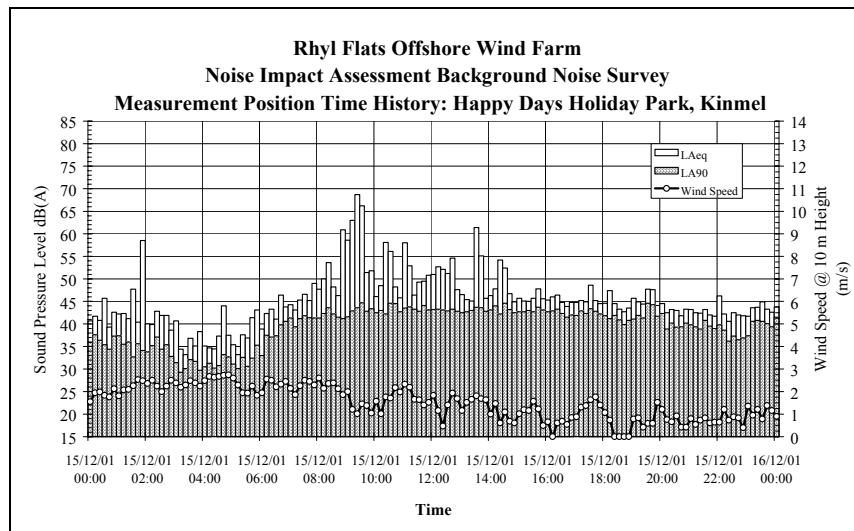
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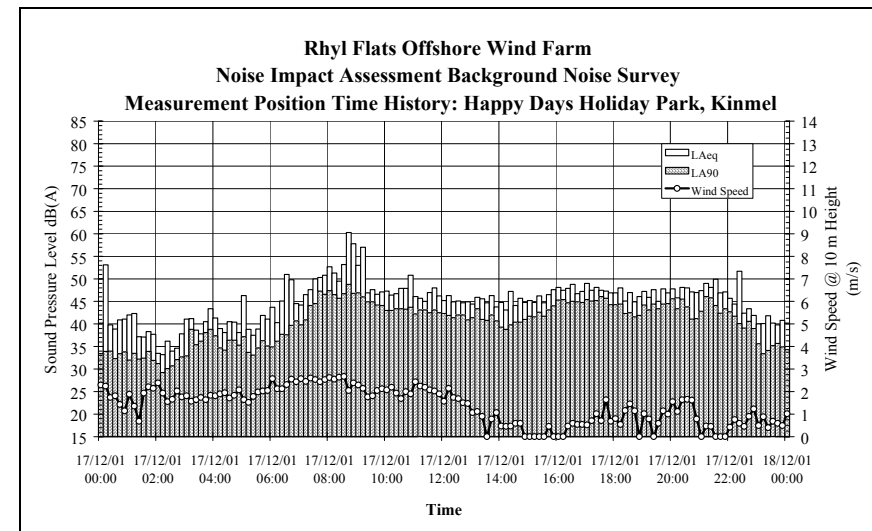
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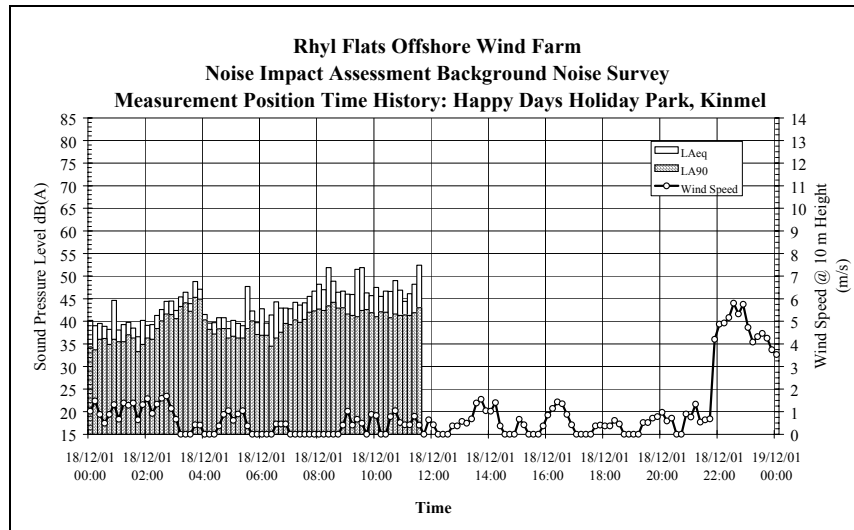
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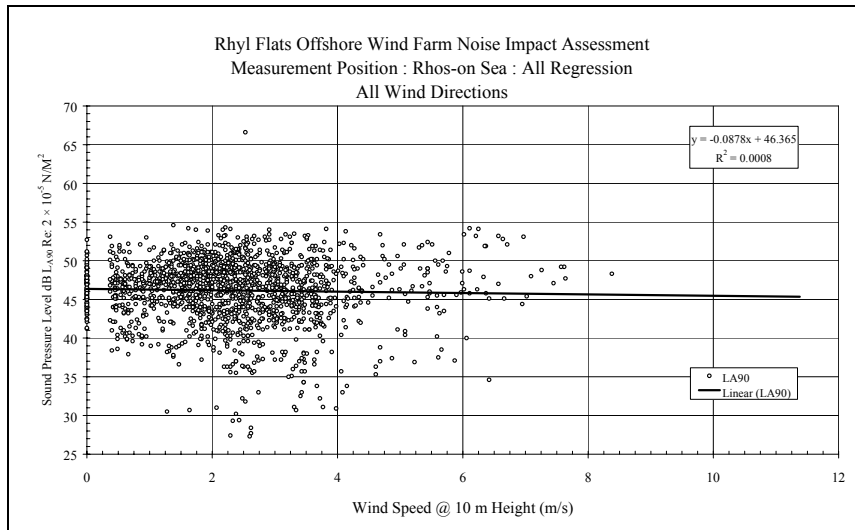


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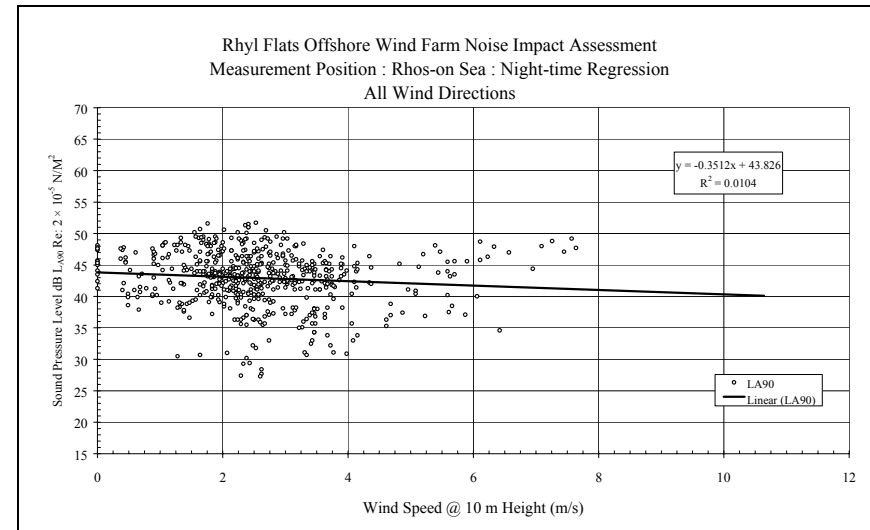
*ANNEX N2*

*REGRESSION ANALYSIS OF MEASURED BACKGROUND NOISE DATA*

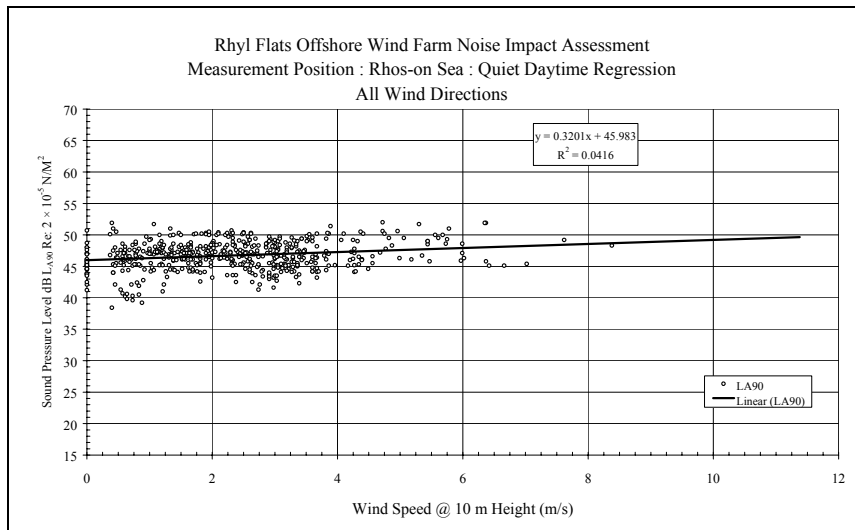




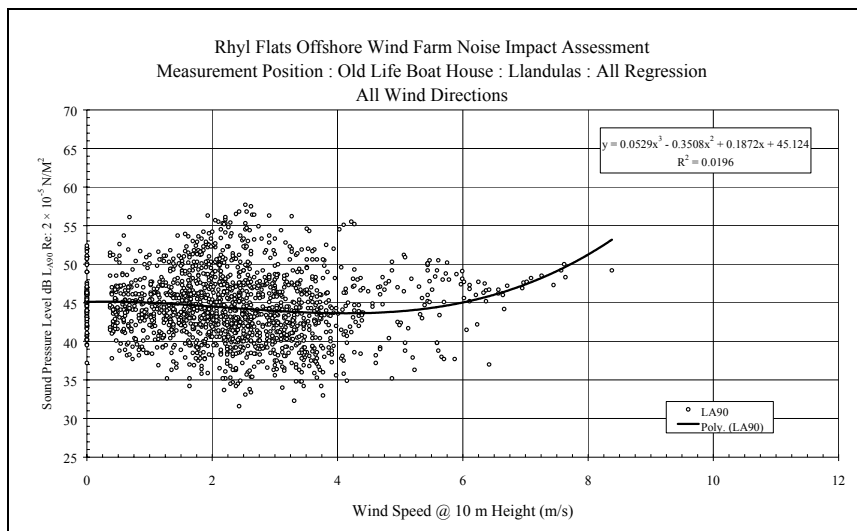
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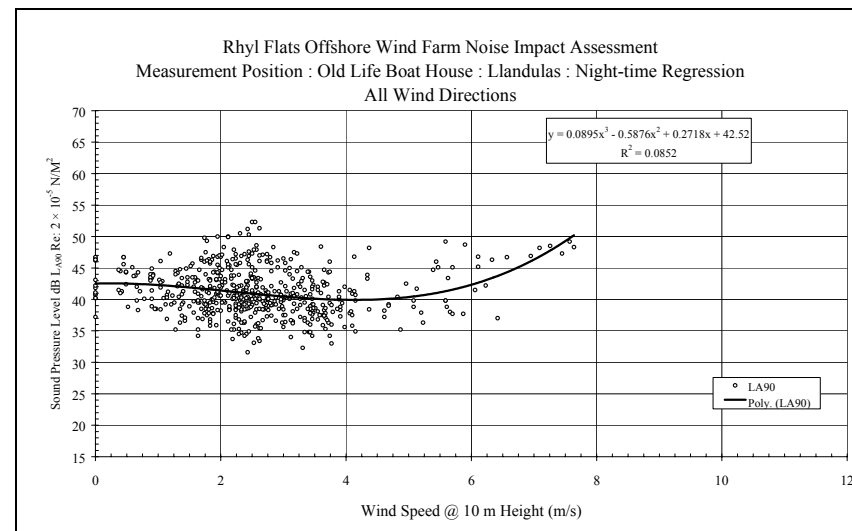
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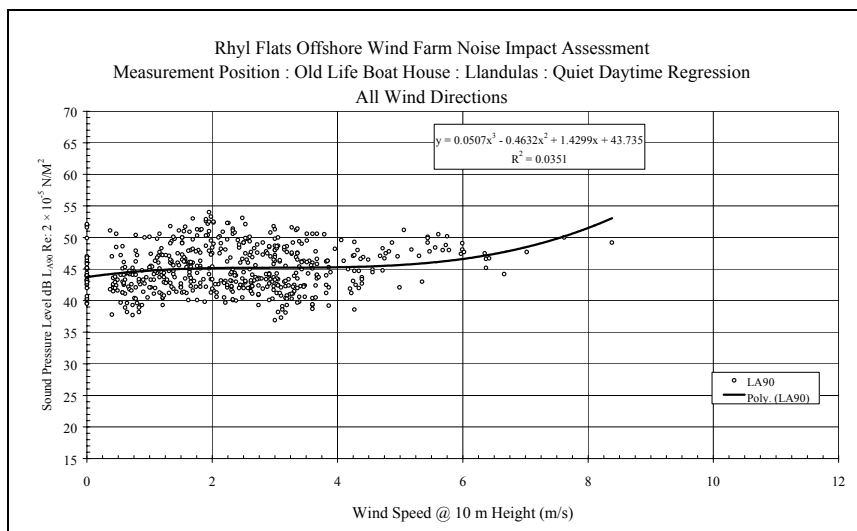
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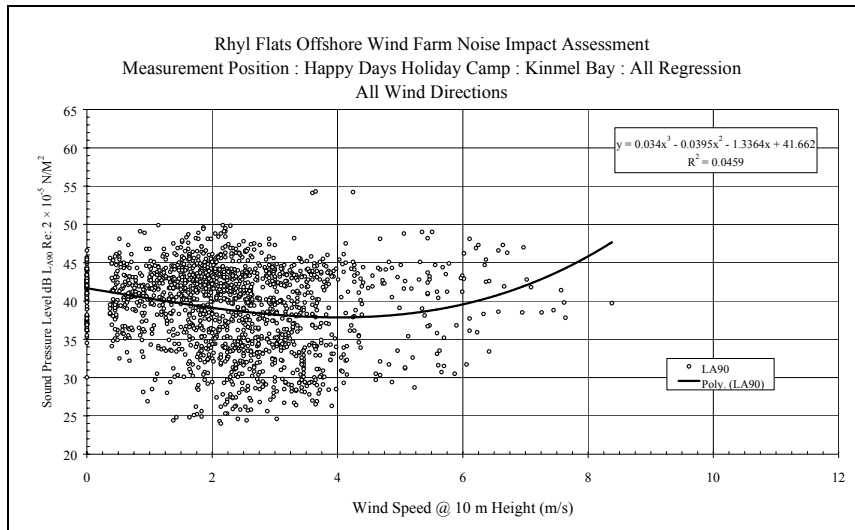
Rhyl Regression / 4



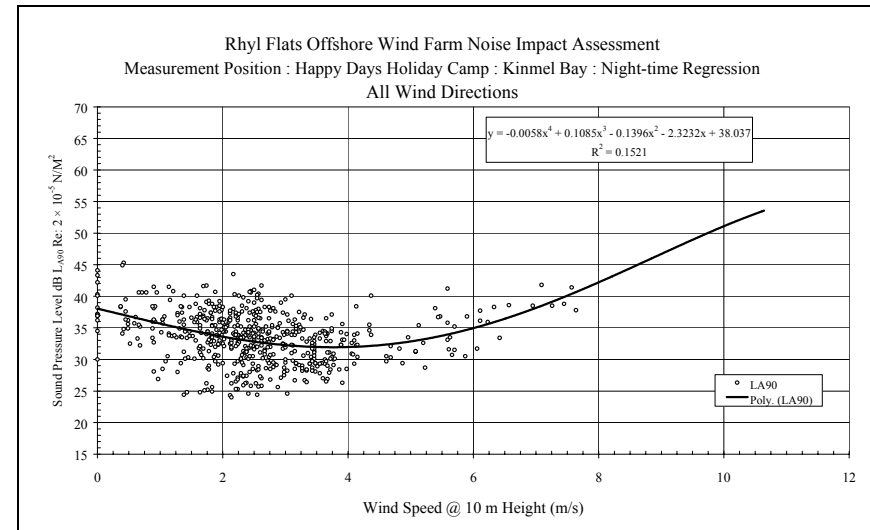
Rhyl Regression / 6



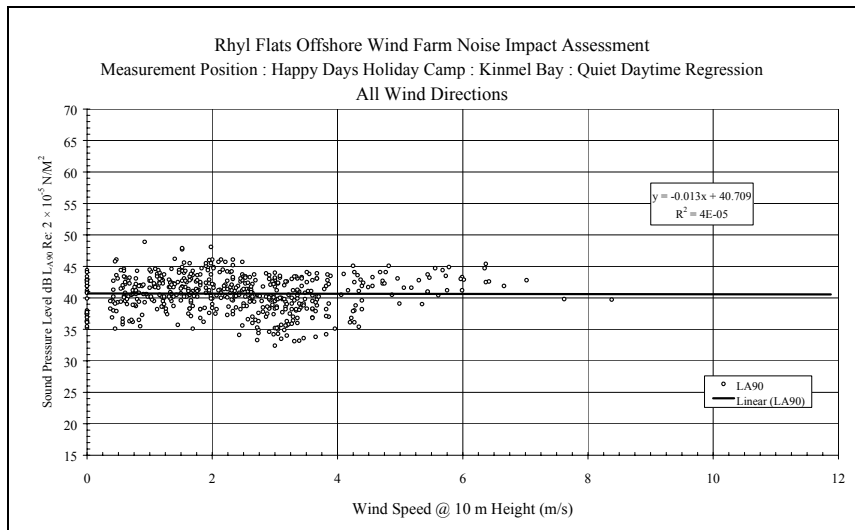
Rhyl Regression / 5



Rhyl Regression / 7



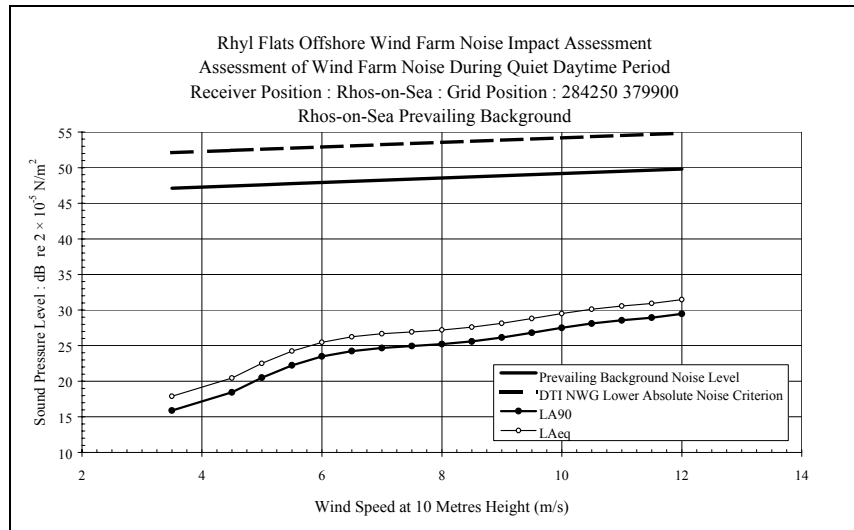
Rhyl Regression / 9



Rhyl Regression / 8

*ANNEX N3*

*ASSESSMENT OF WIND TURBINE NOISE LEVELS*



**Rhyl Assessment / 1**

**Quiet Daytime Assessment at Rhos-on-Sea**

**DTI NWG Recommendations**

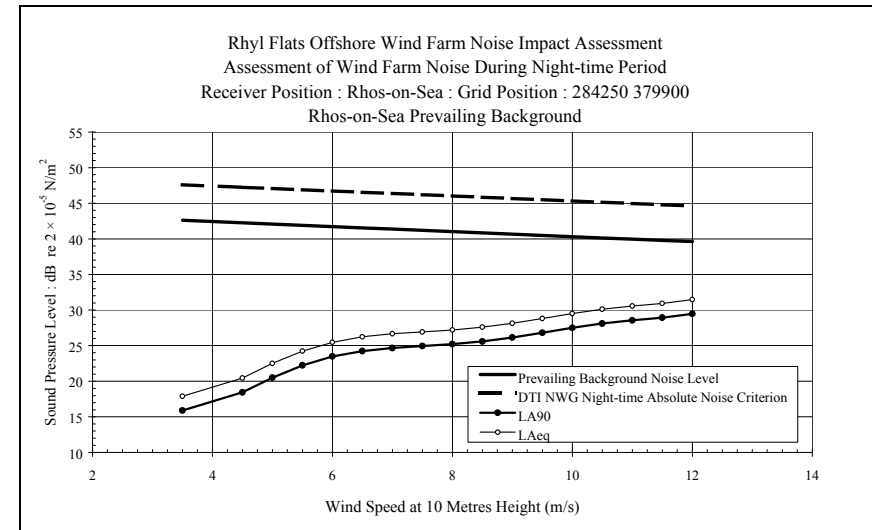
Figure Rhyl Assessment / 1 details the predicted  $L_{A90}$  and  $L_{Aeq}$  noise levels at Rhos-on-Sea. The predicted levels indicate that the proposed offshore wind farm noise levels will lie below the Lower Quiet Daytime Level Criteria proposed by the DTI NWG.

**Audibility Assessment**

The proposed offshore wind farm is unlikely to be audible at this location when down wind of the proposed site.

**BS 4142 Assessment**

An assessment using the BS 4142 : 1997 rating system would describe the incident rated noise levels as providing a positive indication that complaints are unlikely when downwind of the site.



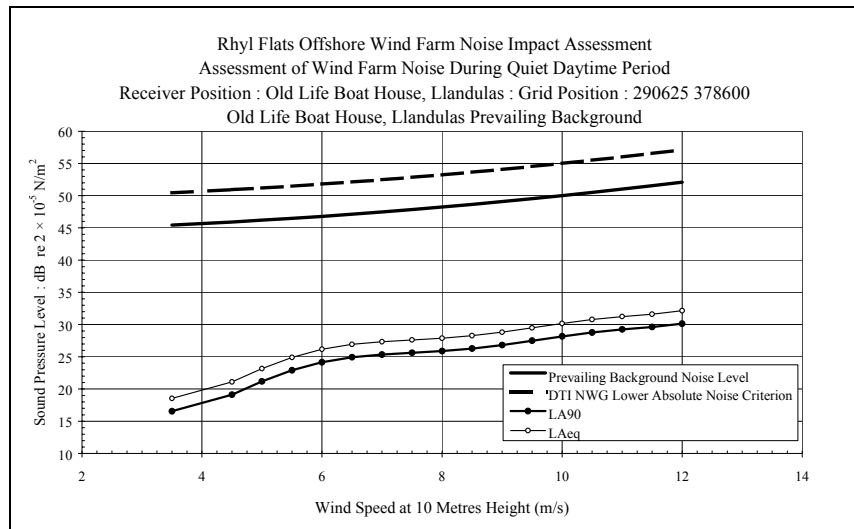
**Rhyl Assessment / 2**

**Night-time Assessment at Rhos-on-Sea**

Figure Rhyl Assessment / 2 details the predicted  $L_{A90}$  and  $L_{Aeq}$  noise levels at Rhos-on-Sea. The predicted offshore wind farm noise levels meet the requirements of the DTI NWG Recommendations for Night-time operation to protect the sleep of neighbours.

**Sleep Disturbance Assessment**

Predicted internal noise levels due to turbine operation will range from 8 dB  $L_{Aeq}$  at cut-in wind speeds up to 21 dB  $L_{Aeq}$  at a wind speed of 12 m/ when windows are open for ventilation. With windows closed, internal noise levels due to turbine operation are unlikely to exceed 10 dB  $L_{Aeq}$  at a wind speed of 12 m/s.



**Rhyl Assessment / 3**

**Quiet Daytime Assessment at the Old Life Boat house, Llandulas**

**DTI NWG Recommendations**

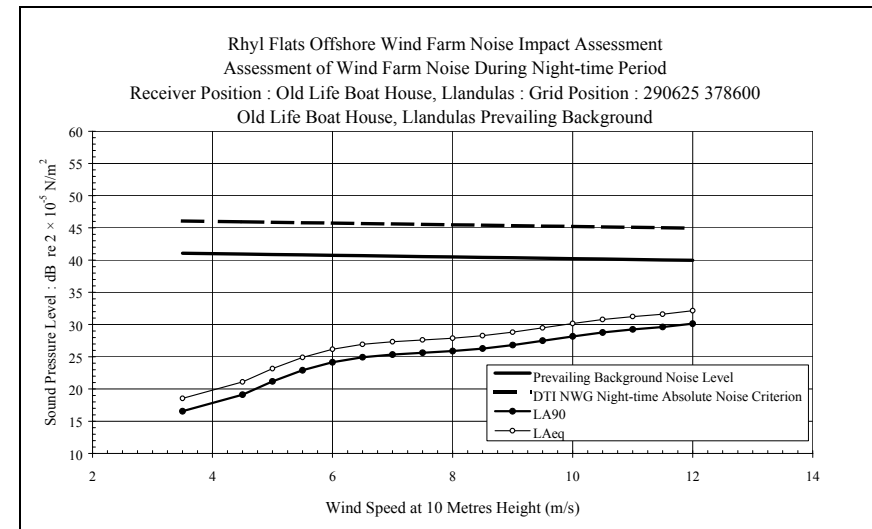
Figure Rhyl Assessment / 3 details the predicted  $L_{A90}$  and  $L_{Aeq}$  noise levels at the Old Life Boat House, Llandulas. The predicted levels indicate that the proposed offshore wind farm noise levels will lie below the Lower Quiet Daytime Level Criteria proposed by the DTI NWG.

**Audibility Assessment**

The proposed offshore wind farm is unlikely to be audible at this location when down wind of the proposed site.

**BS 4142 Assessment**

An assessment using the BS 4142 : 1997 rating system would describe the incident rated noise levels as providing a positive indication that complaints are unlikely when downwind of the site.



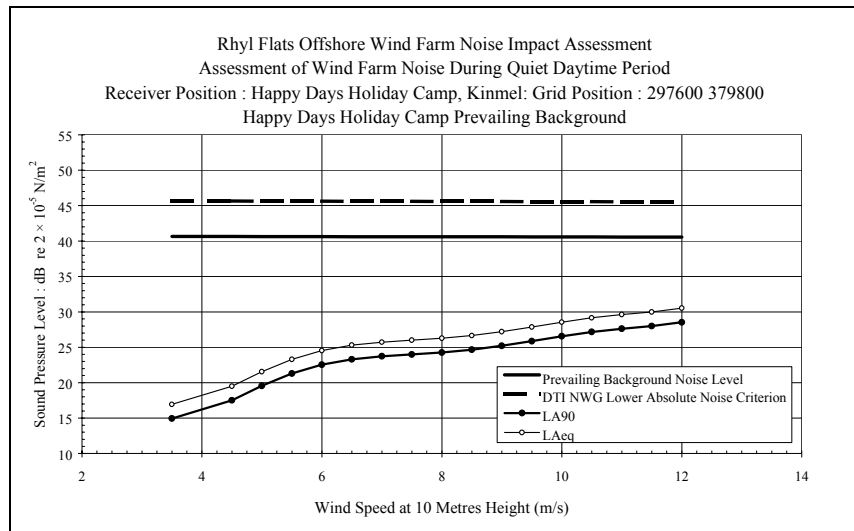
**Rhyl Assessment / 4**

**Night-time Assessment at the old Life Boat house Llandulas**

Figure Rhyl Assessment / 4 details the predicted  $L_{A90}$  and  $L_{Aeq}$  noise levels at the Old Life Boat house, Llandulas . The predicted offshore wind farm noise levels meet the requirements of the DTI NWG Recommendations for Night-time operation to protect the sleep of neighbours.

**Sleep Disturbance Assessment**

Predicted internal noise levels due to turbine operation will range from 8 dB  $L_{Aeq}$  at cut-in wind speeds up to 22 dB  $L_{Aeq}$  at a wind speed of 12 m/ when windows are open for ventilation. With windows closed, internal noise levels due to turbine operation are unlikely to exceed 10 dB  $L_{Aeq}$  at a wind speed of 12 m/s.



**Rhyl Assessment / 5**

**Quiet Daytime Assessment at Happy Days Holiday Camp, Kinmel**

**DTI NWG Recommendations**

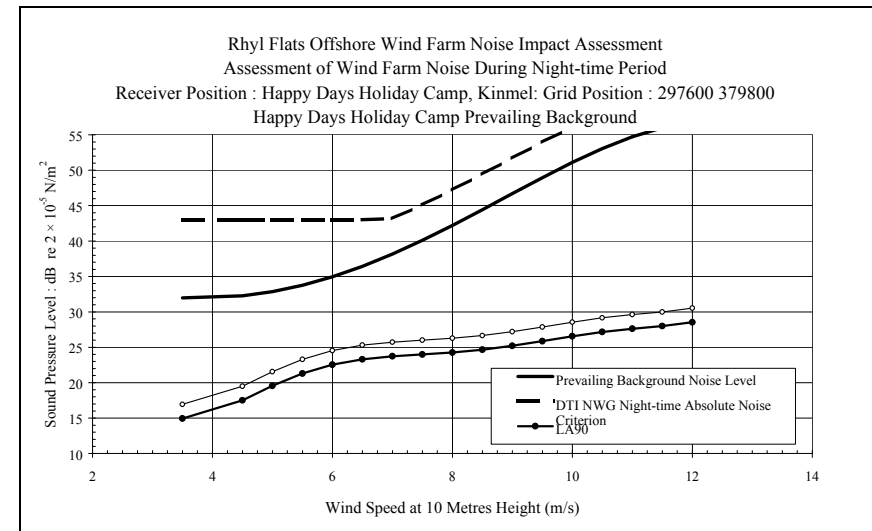
Figure Rhyl Assessment / 5 details the predicted  $L_{A90}$  and  $L_{Aeq}$  noise levels at Happy Days Holiday Camp, Kinmel. The predicted levels indicate that the proposed offshore wind farm noise levels will lie below the Lower Quiet Daytime Level Criteria proposed by the DTI NWG.

**Audibility Assessment**

The proposed offshore wind farm is unlikely to be audible at this location when down wind of the proposed site.

**BS 4142 Assessment**

An assessment using the BS 4142 : 1997 rating system would describe the incident rated noise levels as providing a positive indication that complaints are unlikely when downwind of the site.



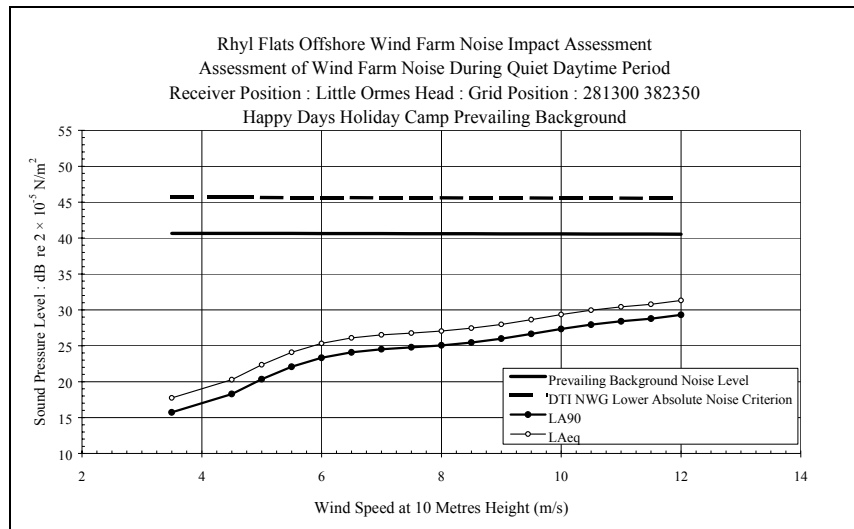
**Rhyl Assessment / 6**

**Night-time Assessment at Happy Days Holiday Camp, Kinmel**

Figure Rhyl Assessment / 6 details the predicted  $L_{A90}$  and  $L_{Aeq}$  noise levels at Happy Days Holiday Camp, Kinmel . The predicted offshore wind farm noise levels meet the requirements of the DTI NWG Recommendations for Night-time operation to protect the sleep of neighbours.

**Sleep Disturbance Assessment**

Predicted internal noise levels due to turbine operation will range from 7 dB  $L_{Aeq}$  at cut-in wind speeds up to 20 dB  $L_{Aeq}$  at a wind speed of 12 m/ when windows are open for ventilation. With windows closed, internal noise levels due to turbine operation are unlikely to exceed 10 dB  $L_{Aeq}$  at a wind speed of 12 m/s.



**Rhyl Assessment / 7**

**Quiet Daytime Assessment at Little Ormes Head**

**DTI NWG Recommendations**

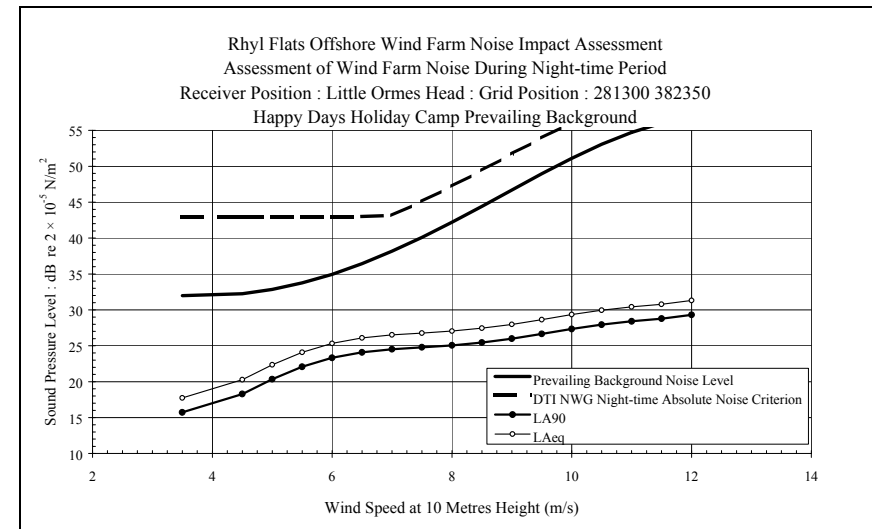
Figure Rhyl Assessment / 7 details the predicted  $L_{A90}$  and  $L_{Aeq}$  noise levels at Little Ormes Head. The predicted levels indicate that the proposed offshore wind farm noise levels will lie below the Lower Quiet Daytime Level Criteria proposed by the DTI NWG.

**Audibility Assessment**

The proposed offshore wind farm is unlikely to be audible at this location when down wind of the proposed site.

**BS 4142 Assessment**

An assessment using the BS 4142 : 1997 rating system would describe the incident rated noise levels as providing a positive indication that complaints are unlikely when downwind of the site.



**Rhyl Assessment / 8**

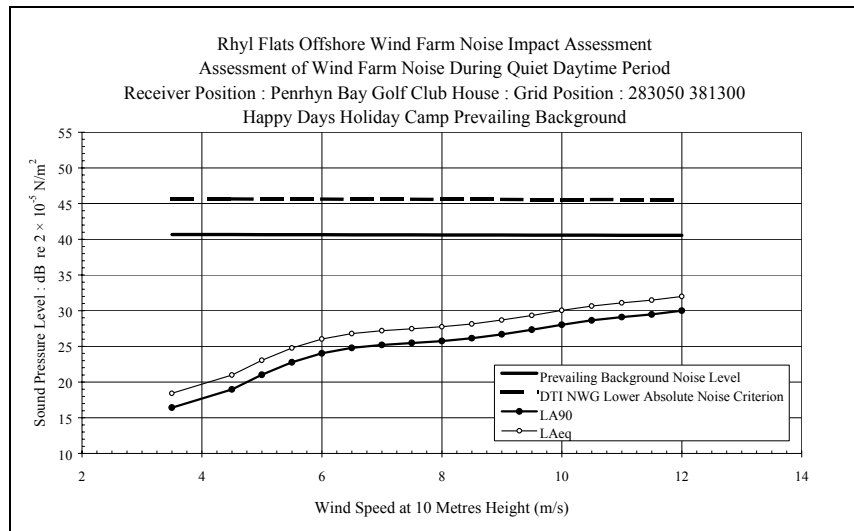
**Night-time Assessment at Little Ormes Head**

Figure Rhyl Assessment / 8 details the predicted  $L_{A90}$  and  $L_{Aeq}$  noise levels at Little Ormes Head. The predicted offshore wind farm noise levels meet the requirements of the DTI NWG Recommendations for Night-time operation to protect the sleep of neighbours.

**Sleep Disturbance Assessment**

Predicted internal noise levels due to turbine operation will range from 8 dB  $L_{Aeq}$  at cut-in wind speeds up to 21 dB  $L_{Aeq}$  at a wind speed of 12 m/ when windows are open for ventilation. With windows closed, internal noise levels due to turbine operation are unlikely to exceed 10 dB  $L_{Aeq}$  at a wind speed of 12 m/s.





**Rhyl Assessment / 9**

**Quiet Daytime Assessment at Penrhyn Bay Golf Club House**

**DTI NWG Recommendations**

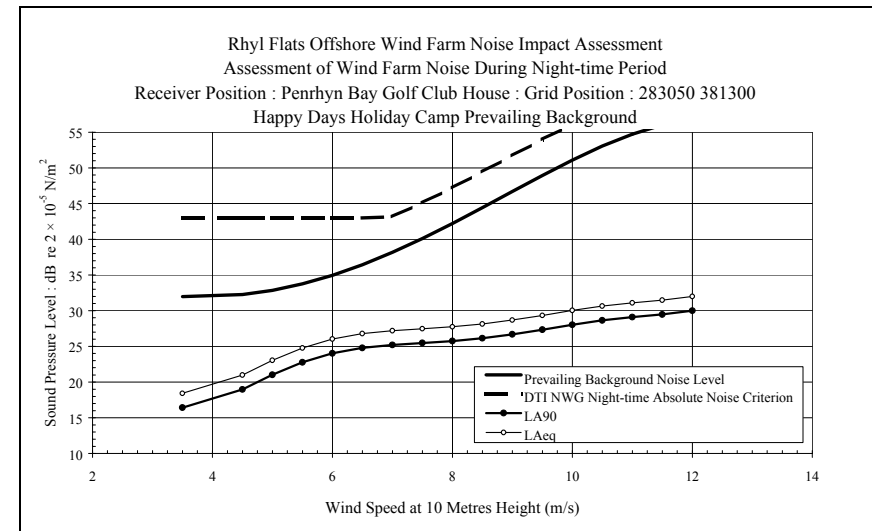
Figure Rhyl Assessment / 9 details the predicted  $L_{A90}$  and  $L_{Aeq}$  noise levels at Penrhyn Bay Golf Club House. The predicted levels indicate that the proposed offshore wind farm noise levels will lie below the Lower Quiet Daytime Level Criteria proposed by the DTI NWG.

**Audibility Assessment**

The proposed offshore wind farm is unlikely to be audible at this location when down wind of the proposed site.

**BS 4142 Assessment**

An assessment using the BS 4142 : 1997 rating system would describe the incident rated noise levels as providing a positive indication that complaints are unlikely when downwind of the site.



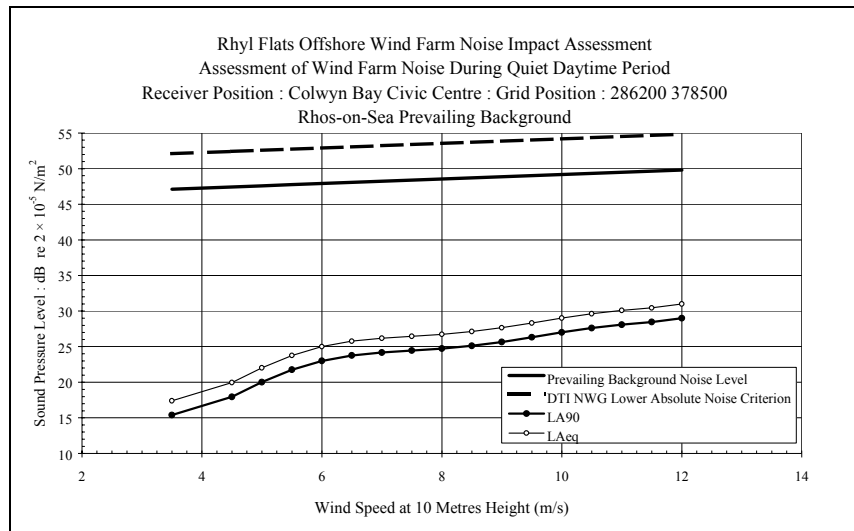
**Rhyl Assessment / 10**

**Night-time Assessment at Penrhyn Bay Golf Club House**

Figure Rhyl Assessment / 10 details the predicted  $L_{A90}$  and  $L_{Aeq}$  noise levels at Penrhyn Bay Golf Club House. The predicted offshore wind farm noise levels meet the requirements of the DTI NWG Recommendations for Night-time operation to protect the sleep of neighbours.

**Sleep Disturbance Assessment**

Predicted internal noise levels due to turbine operation will range from 9 dB  $L_{Aeq}$  at cut-in wind speeds up to 21 dB  $L_{Aeq}$  at a wind speed of 12 m/ when windows are open for ventilation. With windows closed, internal noise levels due to turbine operation are unlikely to exceed 10 dB  $L_{Aeq}$  at a wind speed of 12 m/s.



**Rhyl Assessment / 11**

**Quiet Daytime Assessment at Colwyn Bay Civic Centre**

**DTI NWG Recommendations**

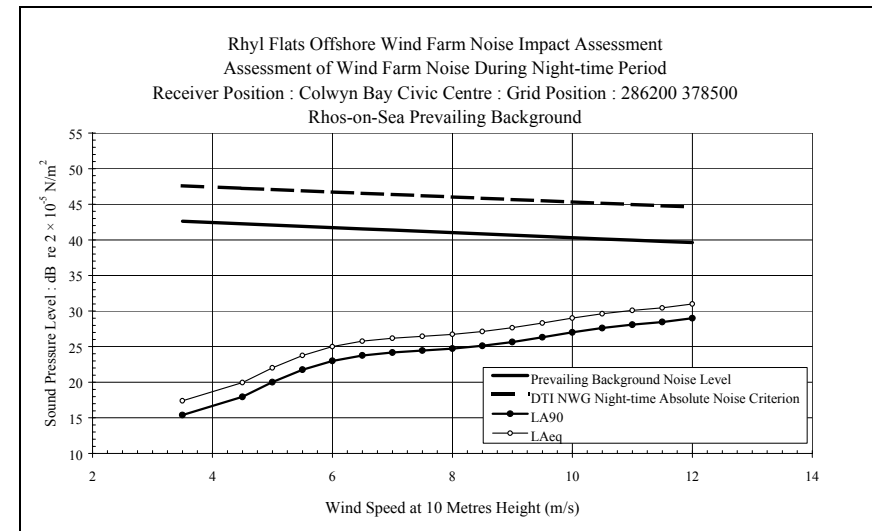
Figure Rhyl Assessment / 11 details the predicted  $L_{A90}$  and  $L_{Aeq}$  noise levels at Colwyn Bay Civic Centre. The predicted levels indicate that the proposed offshore wind farm noise levels will lie below the Lower Quiet Daytime Level Criteria proposed by the DTI NWG.

**Audibility Assessment**

The proposed offshore wind farm is unlikely to be audible at this location when down wind of the proposed site.

**BS 4142 Assessment**

An assessment using the BS 4142 : 1997 rating system would describe the incident rated noise levels as providing a positive indication that complaints are unlikely when downwind of the site.



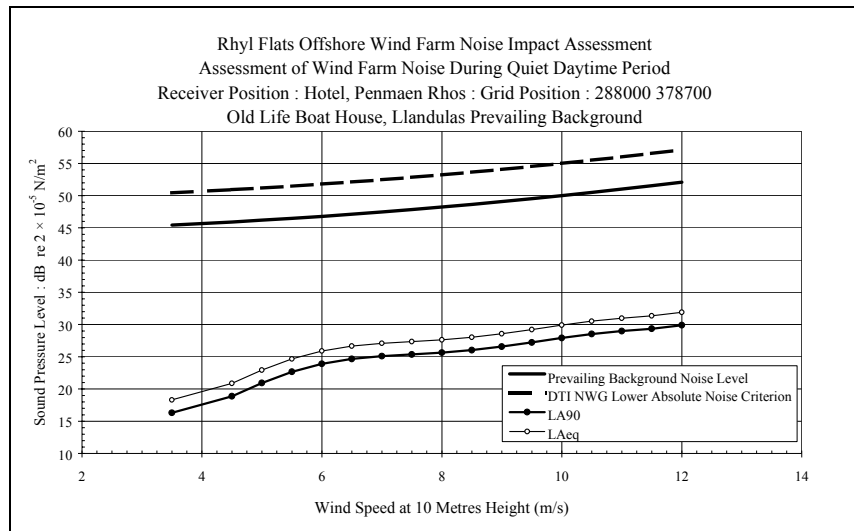
**Rhyl Assessment / 12**

**Night-time Assessment at Colwyn Bay Civic Centre**

Figure Rhyl Assessment / 12 details the predicted  $L_{A90}$  and  $L_{Aeq}$  noise levels at Colwyn Bay Civic Centre. The predicted offshore wind farm noise levels meet the requirements of the DTI NWG Recommendations for Night-time operation to protect the sleep of neighbours.

**Sleep Disturbance Assessment**

Predicted internal noise levels due to turbine operation will range from 7 dB  $L_{Aeq}$  at cut-in wind speeds up to 21 dB  $L_{Aeq}$  at a wind speed of 12 m/ when windows are open for ventilation. With windows closed, internal noise levels due to turbine operation are unlikely to exceed 10 dB  $L_{Aeq}$  at a wind speed of 12 m/s.



**Rhyl Assessment / 13**

**Quiet Daytime Assessment at the Hotel, Penmaen Rhos**

**DTI NWG Recommendations**

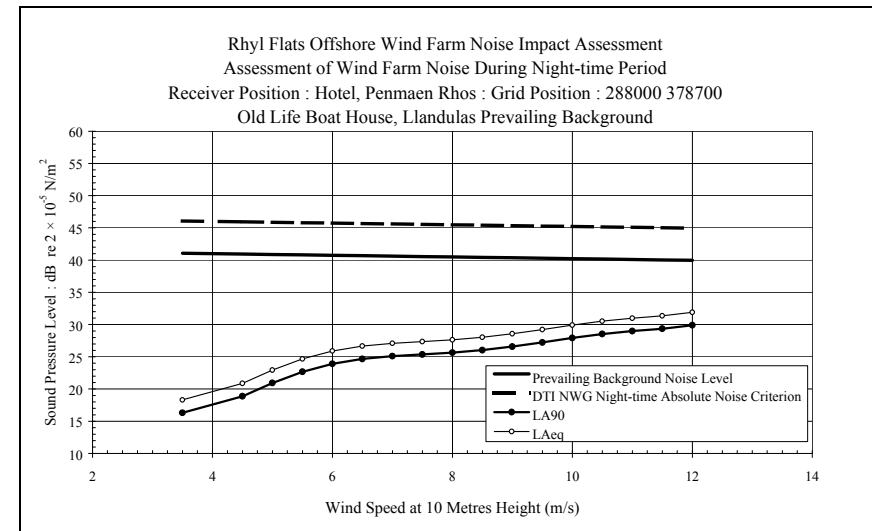
Figure Rhyl Assessment / 13 details the predicted  $L_{A90}$  and  $L_{Aeq}$  noise levels at Hotel at Penmaen Rhos. The predicted levels indicate that the proposed offshore wind farm noise levels will lie below the Lower Quiet Daytime Level Criteria proposed by the DTI NWG.

**Audibility Assessment**

The proposed offshore wind farm is unlikely to be audible at this location when down wind of the proposed site.

**BS 4142 Assessment**

An assessment using the BS 4142 : 1997 rating system would describe the incident rated noise levels as providing a positive indication that complaints are unlikely when downwind of the site.



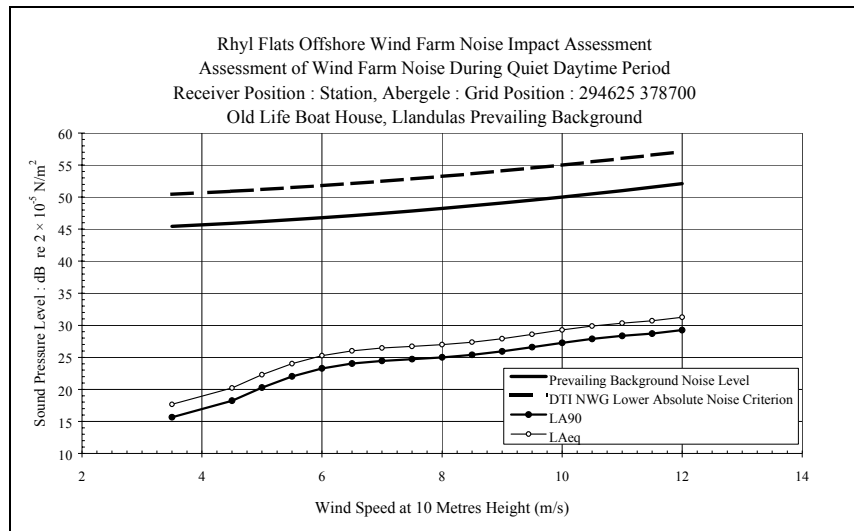
**Rhyl Assessment / 14**

**Night-time Assessment at the Hotel, Penmaen Rhos**

Figure Rhyl Assessment / 12 details the predicted  $L_{A90}$  and  $L_{Aeq}$  noise levels at the Hotel at Penmaen Rhos. The predicted offshore wind farm noise levels meet the requirements of the DTI NWG Recommendations for Night-time operation to protect the sleep of neighbours.

**Sleep Disturbance Assessment**

Predicted internal noise levels due to turbine operation will range from 8 dB  $L_{Aeq}$  at cut-in wind speeds up to 22 dB  $L_{Aeq}$  at a wind speed of 12 m/ when windows are open for ventilation. With windows closed, internal noise levels due to turbine operation are unlikely to exceed 10 dB  $L_{Aeq}$  at a wind speed of 12 m/s.



**Rhyl Assessment / 15**

**Quiet Daytime Assessment at Abergele Station**

**DTI NWG Recommendations**

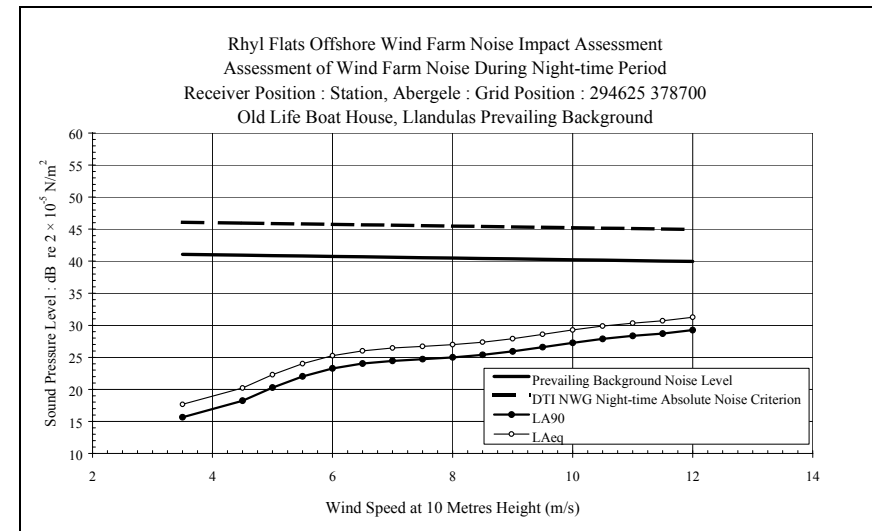
Figure Rhyl Assessment / 15 details the predicted  $L_{A90}$  and  $L_{Aeq}$  noise levels at Abergele Station. The predicted levels indicate that the proposed offshore wind farm noise levels will lie below the Lower Quiet Daytime Level Criteria proposed by the DTI NWG.

**Audibility Assessment**

The proposed offshore wind farm is unlikely to be audible at this location when down wind of the proposed site.

**BS 4142 Assessment**

An assessment using the BS 4142 : 1997 rating system would describe the incident rated noise levels as providing a positive indication that complaints are unlikely when downwind of the site.



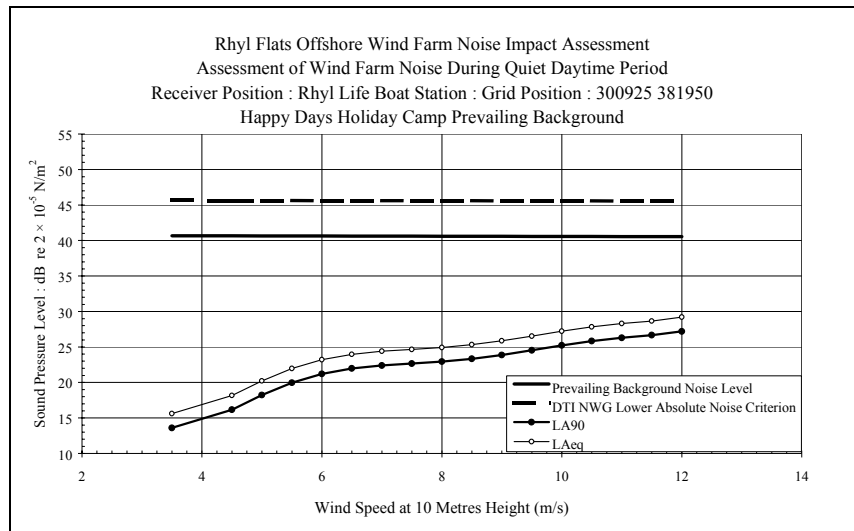
**Rhyl Assessment / 16**

**Night-time Assessment at Abergele Station**

Figure Rhyl Assessment / 16 details the predicted  $L_{A90}$  and  $L_{Aeq}$  noise levels at the Abergele Station. The predicted offshore wind farm noise levels meet the requirements of the DTI NWG Recommendations for Night-time operation to protect the sleep of neighbours.

**Sleep Disturbance Assessment**

Predicted internal noise levels due to turbine operation will range from 8 dB  $L_{Aeq}$  at cut-in wind speeds up to 22 dB  $L_{Aeq}$  at a wind speed of 12 m/ when windows are open for ventilation. With windows closed, internal noise levels due to turbine operation are unlikely to exceed 10 dB  $L_{Aeq}$  at a wind speed of 12 m/s.



**Rhyl Assessment / 17**

**Quiet Daytime Assessment at Rhyl Life Boat Station**

**DTI NWG Recommendations**

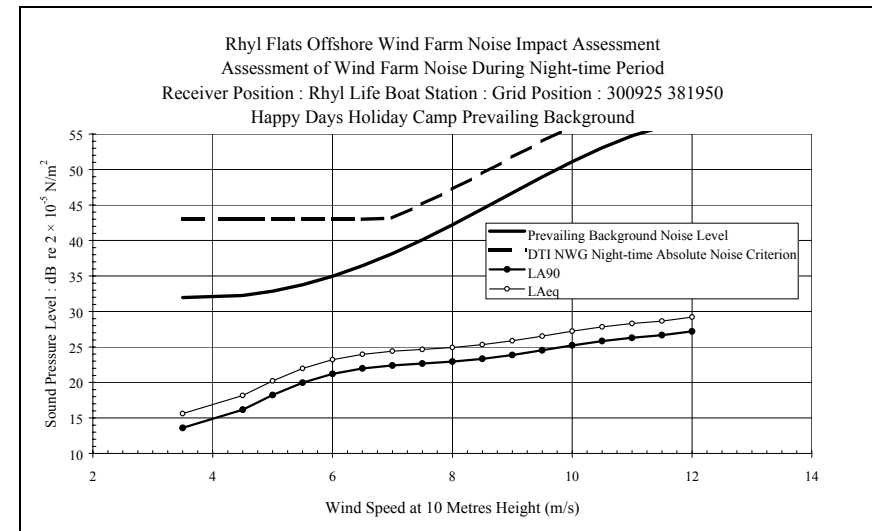
Figure Rhyl Assessment / 17 details the predicted  $L_{A90}$  and  $L_{Aeq}$  noise levels at Rhyl Life Boat Station. The predicted levels indicate that the proposed offshore wind farm noise levels will lie below the Lower Quiet Daytime Level Criteria proposed by the DTI NWG.

**Audibility Assessment**

The proposed offshore wind farm is unlikely to be audible at this location when down wind of the proposed site.

**BS 4142 Assessment**

An assessment using the BS 4142 : 1997 rating system would describe the incident rated noise levels as providing a positive indication that complaints are unlikely when downwind of the site.



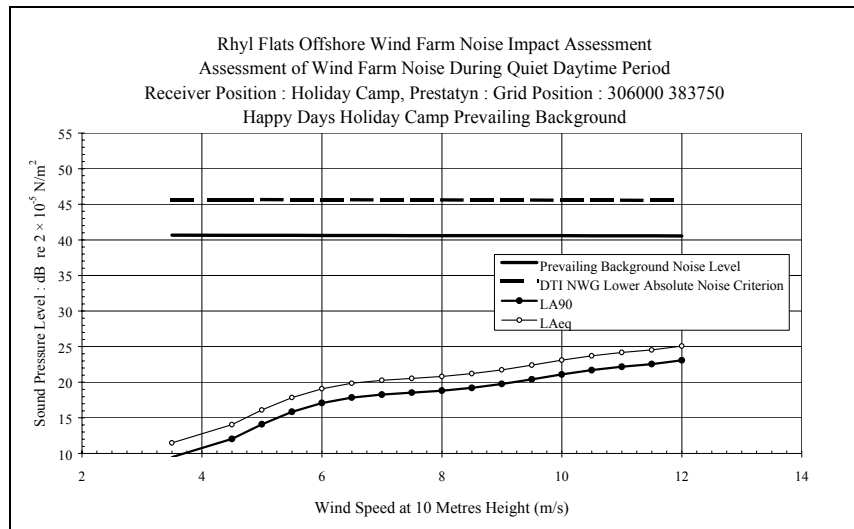
**Rhyl Assessment / 18**

**Night-time Assessment at Rhyl Life Boat Station**

Figure Rhyl Assessment / 18 details the predicted  $L_{A90}$  and  $L_{Aeq}$  noise levels at the Rhyl Life Boat Station. The predicted offshore wind farm noise levels meet the requirements of the DTI NWG Recommendations for Night-time operation to protect the sleep of neighbours.

**Sleep Disturbance Assessment**

Predicted internal noise levels due to turbine operation will range from 6 dB  $L_{Aeq}$  at cut-in wind speeds up to 19 dB  $L_{Aeq}$  at a wind speed of 12 m/ when windows are open for ventilation. With windows closed, internal noise levels due to turbine operation are unlikely to exceed 9 dB  $L_{Aeq}$  at a wind speed of 12 m/s.



**Rhyl Assessment / 19**  
**Quiet Daytime Assessment at Holiday Camp, Prestatyn**

**DTI NWG Recommendations**

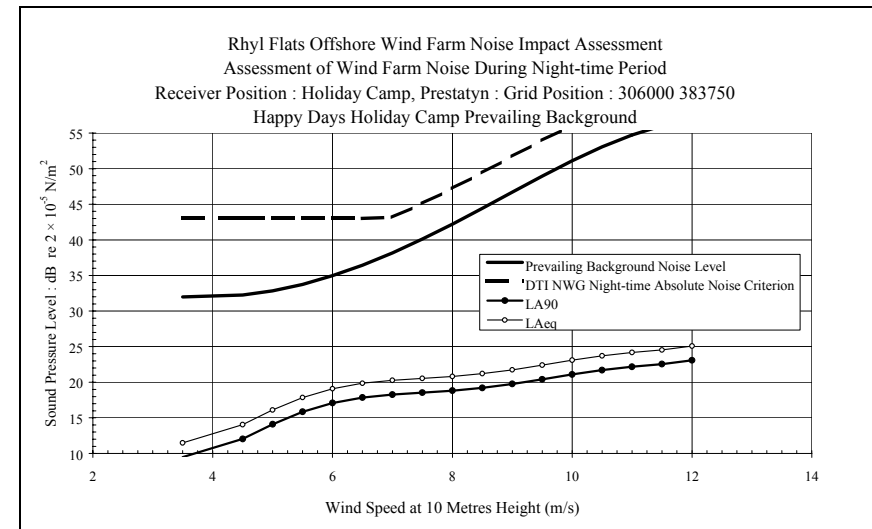
Figure Rhyl Assessment / 19 details the predicted  $L_{A90}$  and  $L_{Aeq}$  noise levels at Holiday Camp, Prestatyn. The predicted levels indicate that the proposed offshore wind farm noise levels will lie below the Lower Quiet Daytime Level Criteria proposed by the DTI NWG.

**Audibility Assessment**

The proposed offshore wind farm is unlikely to be audible at this location when down wind of the proposed site.

**BS 4142 Assessment**

An assessment using the BS 4142 : 1997 rating system would describe the incident rated noise levels as providing a positive indication that complaints are unlikely when downwind of the site.



**Rhyl Assessment / 20**  
**Night-time Assessment at Holiday Camp, Prestatyn**

Figure Rhyl Assessment / 18 details the predicted  $L_{A90}$  and  $L_{Aeq}$  noise levels at the Holiday Camp, Prestatyn. The predicted offshore wind farm noise levels meet the requirements of the DTI NWG Recommendations for Night-time operation to protect the sleep of neighbours.

**Sleep Disturbance Assessment**

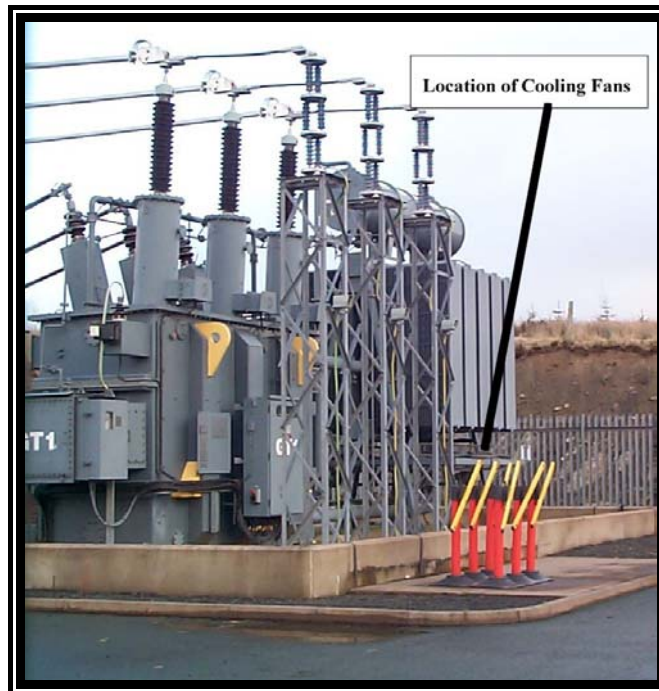
Predicted internal noise levels due to turbine operation will range from 2 dB  $L_{Aeq}$  at cut-in wind speeds up to 15 dB  $L_{Aeq}$  at a wind speed of 12 m/ when windows are open for ventilation. With windows closed, internal noise levels due to turbine operation are unlikely to exceed 5 dB  $L_{Aeq}$  at a wind speed of 12 m/s.

*ANNEX N4*

*SUBSTATION NOISE MEASUREMENT DATA*



Measurement Position for Substation Noise Measurements



Location of Cooling Fans : Not Operating During Measurements

Sound Pressure Level at Measurement Location = 46.7 dB  $L_{Aeq,2 \text{ min}}$  @ 30 metres from Transformer

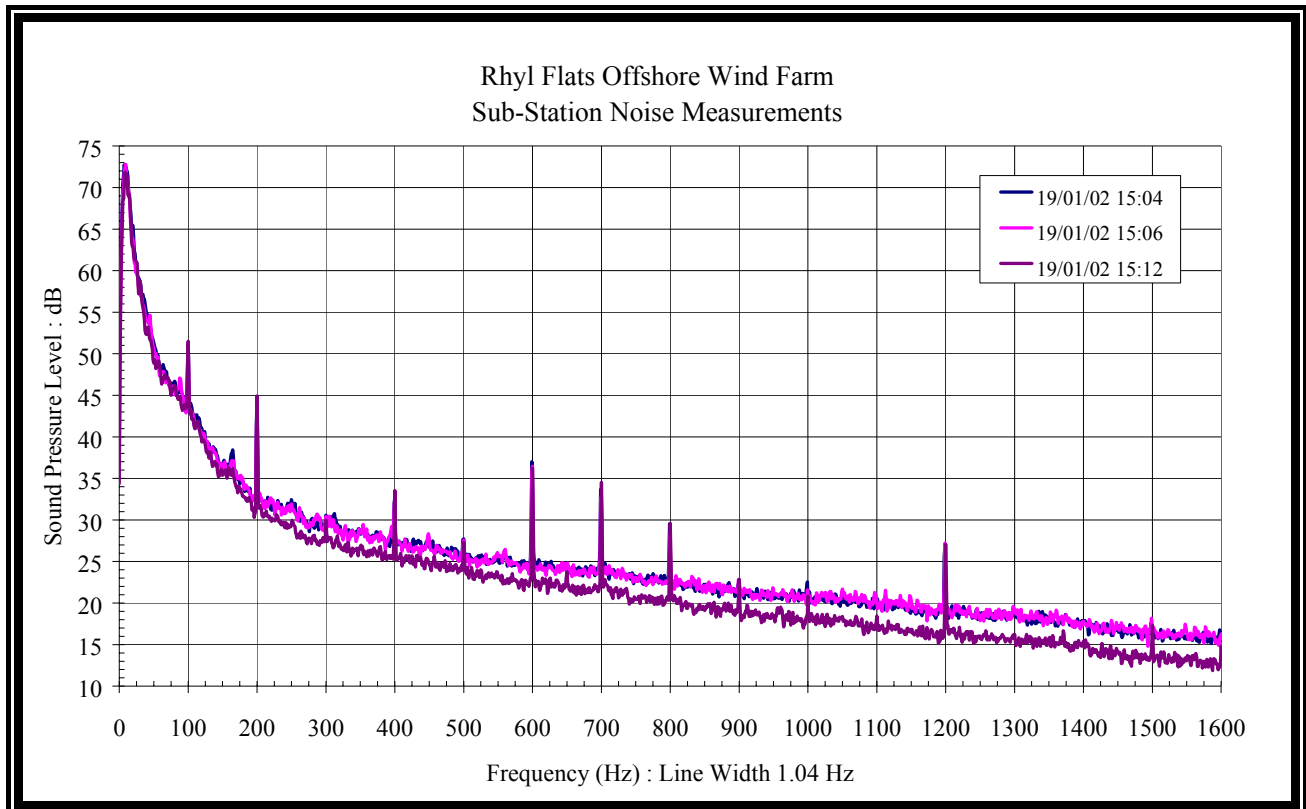
Table Detailing Predicted Noise Levels for Selected Separation Distances

Separation Distance	Predicted Noise Levels at neighbouring Dwellings
@ 150 metres	32.4 dB $L_{Aeq}$
@ 250 metres	27.8 dB $L_{Aeq}$
@ 330 metres	25.2 dB $L_{Aeq}$





## Sound Pressure Level Spectra for Substation Noise



Annex N6 : Figure 1 : Narrowband Analysis of Substation Noise Emissions

An assessment performed of the tonal noise emissions from the Sub-Station, undertaken in accordance with the method described within the DTI NWG Recommendations indicate that tonal noise at 600 Hz and 700 Hz is assessed as being 5.4 dB above the audibility threshold. Based upon this analysis, it is appropriate to apply a 5 dB penalty to the predicted noise levels at neighbouring dwellings to determine the Rated Sound Pressure Level of the new noise source, in accordance with the requirements of BS 4142 : 1997.

## ANNEX N5

### PLANNING POLICY, BRITISH STANDARDS AND OTHER GUIDANCE

*Planning Guidance (Wales): Planning Policy: First Revision*

Planning Guidance (Wales): Planning Policy: First Revision <sup>(1)</sup> considers noise within Section 4.4, paragraphs 4.4.1 to 4.4.3 where the following is stated:

*4.4.1 Noise can affect health and have a direct impact on local amenity. It can therefore be a material consideration, for example in proposals to use or develop land near an existing source of noise or where a proposed new development is likely to generate noise. Local planning authorities should make a careful assessment of likely noise levels before determining such planning applications.*

*4.4.2 Development plan policies should be designed to ensure, as far as is practicable, that noise sensitive developments, such as hospitals, schools and housing, are located away from existing sources of significant noise like road, rail, air transport and some industrial activities or programmed development such as improved or new roads. Policies should also be designed to ensure, as far as possible, that potentially noisy developments are located in areas where noise will not be such an important consideration or where its impact can be minimised. Local planning authorities may adopt policies to prevent potentially noisy developments in areas which have remained relatively undisturbed by noise.*

*4.4.3 Special considerations is required where noisy development is proposed in or near statutorily designated areas. The effect of noise on the enjoyment of other areas of landscape, wildlife and historic value should also be taken into account.*

*Planning Guidance (Wales) Technical Advice Note (Wales) 11 : Noise (TAN 11)*

Detailed guidance concerning noise is given within Planning Guidance (Wales) Technical Advice Note (Wales) 11 : Noise (TAN 11) <sup>(2)</sup>. Specific guidance to the noise issues raised by wind farm developments is given in Annex B Paragraph B19 which states:

*B19. Detailed guidance on noise from wind turbines is contained in Planning Guidance (Wales), Technical Advice Note (Wales) 8, 'Renewable Energy', Welsh Office, 1996, Annex A Paragraphs A28 - A38.*

*Planning Guidance (Wales) Technical Advice Note (Wales) 8 : Renewable Energy (TAN 8)*

Planning Guidance (Wales) Technical Advice Note (Wales) 8 : Renewable Energy (TAN 8) <sup>(3)</sup> advises at Paragraph A28 that:

*A28. Well designed wind turbines are generally quiet in operation.*

(1) Planning Guidance (Wales) : Planning Policy : First Revision : Welsh Office : April 1999

(2) Planning Guidance (Wales) Technical Advice Note (Wales) 11 : Noise : October 1997 : Welsh Office

(3) Planning Guidance (Wales) Technical Advice Note (Wales) 8 : Renewable Energy : November 1996 : Welsh Office

It then goes on to discuss the noise sources found within wind turbines. These may be summarised as follows:

*Mechanical Noise:- generated by the gearbox, generator and other parts of the drive train which can be radiated as noise through the nacelle, gear box and tower supporting structures. Careful design at the development stage of a wind turbine can eradicate this source of noise such that most modern wind turbines do not exhibit tonal noise within the measured/audible noise emissions.*

*Aerodynamic Noise:- generated by the action of the rotating blades of the turbine as they pass through the air. The level of noise from the source is determined by the speed of the blades as they pass through the air. This in turn is determined by the rotor diameter and the rate of rotation. Tip designs for blades have improved resulting in reductions in high frequency noise emissions from this source.*

Wind turbines are quiet when contemplating the amount of energy generated by the turbine compared with the amount of wasted energy radiated by the turbine as noise. As an illustration, if a wind turbine produces 3.3 MW of electricity and radiates 110 dB(A) (re :  $10^{-12}$  Watts) of acoustic energy, then the energy wasted by the turbine as noise is 0.000003 % of that generated energy produced by the turbine. In general, wind turbines may be considered quiet for the energy that is produced through their operation.

Paragraph A28 goes on to indicate that the impact of noise is likely to be greater at low wind speeds. Paragraph A28 also directs the reader to a source of detailed information on wind turbine noise which is contained within the document “ The Assessment and Rating of Noise from Wind Farm” <sup>(1)</sup> .

Paragraph A29 states:

*A29 British Standard BS 4142 : 1990 has been advocated as the standard which comes nearest to dealing with the issues encountered in wind turbine development but BS 4142 is intended to assess noise from industrial premises or fixed installations in mixed residential and industrial areas. BS 4142 does not specify acceptable levels.*

However, TAN 8 advises that BS 4142 <sup>(2)</sup> may be inappropriate for several reasons. These are given as:

- i) wind farms are likely to be developed in rural areas and not in the areas to which the standard is addressed, namely mixed residential and rural (sic) areas;*
- ii) the scope of BS 4142 specifically precludes situations where the background noise levels are below 30 dB(A), which is likely to be the case at some potential wind farm sites; and*

(1) The Assessment and Rating of Noise from Wind Farms : ETSU-R-97 : September 1996 : Energy Technology Support Unit for the Department of Trade and Industry.

(2) BS 4142 : 1997 Method for Rating industrial noise affecting mixed residential and industrial areas : BSI 1997

iii) BS 4142 recommends that noise measurements should not be taken in 'extreme weather conditions such as high wind speeds greater than 5 metres per second average'. This restriction guards against unrepresentative measurements due to wind noise on the microphone. Wind farms are likely to be sited in windy areas where the BS 4142 conditions may not be satisfied. Care should be taken when measuring noise levels in windy conditions.

It should be noted that the actual title of BS 4142 is "Method for rating industrial noise affecting mixed residential and industrial areas." It is assumed that a typographical error has occurred within section a. above.

However, BS 4142 has been reissued with modifications to the guidance concerning weather conditions. BS 4142: 1997 , now states the following at

*Section 5.4 Precautions against interference:*

*Take precautions to minimise the influence on the readings from sources of interference such as the following (and from other sources):*

*- wind, passing over the diaphragm of the microphone of a sound level meter which can generate noise interference;*

*Note. For the purposes of this standard, windshields are generally effective up to wind speeds of 5 m/s.*

*Measured levels shall be considered valid only if they exceed readings on the measuring instrument owing to the above influences by at least 10 dB.*

Therefore, the consequence of this revision is that measurements are not precluded when the average wind speed is greater than 5 m/s as long as these influences are more than 10 dB below the measured noise level. This will be important when measuring the immissions from a noise source that is being assessed to determine the rated level at a receiver location. However, in quiet rural environments, the noise due to wind effects in trees, hedgerows, etc. may be within 10 dB of the self noise of the microphone/wind shield system at higher wind speeds. Therefore, selection of appropriate wind shields when undertaking noise measurements is important when assessing noise from wind turbines. The DTI NWG on Noise from Wind Turbines proposed further investigation of the effects of wind shields which has been reported within ETSU Report W/13/00386/REP Noise Measurements in Windy Conditions<sup>1</sup>.

Paragraph A31 states that :-

*Where any of these factors gives rise to concern about whether BS 4142 is appropriate as a means of determining potential or actual perceived noise nuisance, the combined effect of the wind turbines should be determined with reference to the particular character and sensitivity of the area. This should be assessed by reference to the nature and character of neighbouring developments.*

(1) Noise Measurements in Windy Conditions : ETSU W/13/00386/REP : June 1996

Paragraph A31 continues by highlighting that several agreements have already been reached between local Planning Authorities and developers with respect to noise emissions from wind farms. A number of agreements are given within reference 4 as examples.

Paragraph A32 provides guidance to the statutory tools that may be used to control and abate noise from a source that is perceived as a nuisance under the Environmental Protection Act 1990. It is also stated that:

These provisions are relevant to noise generated by wind turbines, although in particular exceptional cases the community's or the nation's need for renewable energy may override the disadvantage of noise emission.

Paragraph A33 indicates that experience has shown that there is unlikely to be a significant noise problem for any residential property situated further than 350 - 400 metres from the nearest turbine. Lesser separation distances may be acceptable which is dependent upon the type of turbine installed and the specific conditions at a site.

Paragraphs A34 and A35 discuss the need for agreement between parties with respect to the methodology used to determine the predicted noise levels from a wind farm at neighbouring properties. The method of prediction that we have used within the Noise Impact Assessment is detailed below.

Paragraph A36 proposes that to assess the existing background noise levels at potentially sensitive locations neighbouring a proposed development, noise measurements are made for a range of wind speeds as measured at the proposed site. This follows the guidance that is contained within the DTI NWG Report.

Paragraph A37 provides guidance for procedures to be followed to measure and determine the Sound Power Level (SWL) of a wind turbine. The methods described are those used to determine the SWL of the turbine detailed within *Appendix 7 - Annex N* of this report. Since the issue of the TAN 8, a British Standard has now been issued which details noise measurement techniques to determine the sound power level of a wind turbine<sup>(1)</sup>.

Paragraph A38 details information which could usefully accompany a Planning Application for a wind farm. This information is supplied within the ES.

BS 4142 has been identified within TAN 8 as the only existing British Standard which comes closest to the issues encountered when assessing wind farm noise. However, BS 4142 : 1997 states the following within the foreword:

*Response to noise is subjective and affected by many factors (acoustic and non-acoustic). In general, the likelihood of complaint in response to a noise depends on*

(1) BS EN 61400-11:1999 : IEC 61400-11:1998 Wind turbine generator systems- Part 11: Acoustic noise measurement techniques

*factors including the margin by which it exceeds the background noise level, its absolute level, time of day, change in the noise environment, etc., as well as local attitudes to the premises and the nature of the neighbourhood. This standard is only concerned with the rating of noise of an industrial nature, based upon the margin by which it exceeds a background noise level with an appropriate allowance for the acoustic features present in the noise. As this margin increases, so does the likelihood of complaint.*

*The standard is intended to be used for assessing the measured or calculated noise levels from both existing premises and new or modified premises. The standard may be helpful in certain aspects of environmental planning and may be used in conjunction with recommendations on noise levels and methods of measurement published elsewhere.*

*The standard is necessarily general in character and may not cover all situations. The likelihood that an individual will complain depends on individual attitudes and perceptions in addition to the noise levels and acoustic features present. This standard makes no recommendations in respect to the extent to which individual attitudes and perceptions should be taken into account in any particular case.*

*Although, in general, there will be a relationship between incidence of complaints and the level of general community annoyance, quantitative assessment of the latter is beyond the scope of this standard, as is the assessment of nuisance.*

Within the scope of BS 4142 : 1997, it is stated :

*The standard also described a method for assessing whether the noise referred to in (a) is likely to give rise to complaints from people residing in the building. The method is not suitable for assessing the noise measured inside a building or when the background and rating noise levels are both very low.*

*Note. For the purposes of this standard, background noise levels below about 30 dB and rating levels below about 35 dB are considered low.*

In general, wind farms are developed in rural areas where background noise levels are below 30 dB  $L_{A90}$  for some periods of turbine operation. Incident noise levels from wind farms, when turbines are at least 500 - 600 metres from a dwelling, will not normally exceed 35 to 40 dB  $L_{Aeq}$ . Therefore, for a majority of wind farm developments, background and wind turbine noise will fall on the boundaries of suitability defined within the scope of BS 4142. To assess the likelihood of complaints, BS 4142 compares the rated level from the noise source under investigation with the background noise level when the source is not operating. The greater the level difference, the greater the likelihood of complaints. Section 9 of BS 4142 states:

*The greater this difference the greater the likelihood of complaints.*

*A difference of around + 10 dB or more indicates that complaints are likely.*

*A difference of around + 5 dB is of marginal significance.*

*If the rating level is more than 10 dB below the measured background noise level then this is a positive indication that complaints are unlikely.*

However, in low noise environments, potential differences of + 10 dB can occur when the rated level is below 35 dB(A). In these circumstances, the guidance within the foreword becomes more relevant with respect to the likelihood of complaints and the absolute levels which may be acceptable to the general population.

It was specifically for these reasons that the DTI NWG was formed to provide detailed guidance for the assessment and rating of noise from wind turbines.

*The Assessment and Rating of Noise from Wind Farms : ETSU-R-97*

The DTI Working Group on Noise from Wind Turbines (DTI NWG) proposed that when background noise levels were low, i.e. below 30 dB  $L_{A90}$ , that an absolute noise level criterion be adopted. In these circumstances, it is the DTI NWG's opinion that there is no need to restrict noise levels to below an  $L_{A90,10 \text{ min}}$  of 33 dB, equivalent to about 35 dB  $L_{Aeq,10 \text{ min}}$ . The reasoning behind this absolute limit is that if an environment is quiet enough so as not to disturb the process of falling asleep or sleep itself, then it ought to be quiet enough for the peaceful enjoyment of one's patio or garden. This proposed absolute level follows the guidance within CEC EUR Report 5398e <sup>(1)</sup>. The CEC Report discusses the effects of noise upon occupants of buildings and recommends internal and external noise levels which will not effect sleep or relaxation in external and internal environments.

The recommended absolute noise levels proposed by the DTI NWG cover two time periods. The quiet daytime period (defined as between 18:00 and 23:00 hours during the normal working week, between 13:00 and 23:00 hours on a Saturday and all day during Sunday, 07:00 to 23:00 hours) and the night-time period ( defined as between 23:00 and 07:00). When background noise levels are below an  $L_{A90} = 30$  dB, then it is proposed that an absolute limit should be applied.

It is indicated within the report that the DTI NWG considered that setting such a low level as 35 dB  $L_{Aeq}$  ( 33 dB  $L_{A90}$ ) would place a damaging constraint upon wind energy development within the UK. Therefore, the absolute limit proposed by the DTI NWG lies between a level of 35 to 40 dB  $L_{A90,10 \text{ min}}$  when the prevailing background noise level is below 30 dB  $L_{A90}$ . The relaxation of the absolute limit has been justified for the following reasons:

- *Wind farms have global environmental benefits which have to be weighed carefully against the local environmental impact.*

(1) The Commission of the European Communities Report EUR 5398e : Environment and Quality of Life : Damage and Annoyance caused by Noise. : 1975

- *Wind farms do not operate on still days when the more inactive pastimes (eg sunbathing) are likely to take place.*
- *The absolute lower limits will only apply over a limited range of wind speeds. The period of greater exposure to noise will therefore be limited and on some sites will not occur at all.*
- *There is no evidence for or against the assertion that wind farm noise with no audible tones is acceptable up to and including  $L_{A90,10 \text{ min}}$  levels of 40 dB(A) even when background noise levels are 30 dB(A) or less.*
- *Noise levels inside the property will be approximately 10 dB less than those outside assuming an open window. Noise levels could therefore be increased before sleep and relaxation inside the property begin to be affected.*

It is considered by the DTI NWG that daytime limits within the range of 35 to 40 dB  $L_{A90,10 \text{ min}}$  offer a reasonable degree of protection to wind farm neighbours without placing unreasonable restrictions on wind farm development. The levels that are proposed are low when compared to some of the advisory documents reviewed within the DTI NWG Report. This is due to the DTI NWG's concern to protect the external environment. The actual value chosen for the day-time lower limit will depend upon a number of factors which are highlighted as follows:

- *Number of dwellings in the neighbourhood of the wind farm.*

The planning process is trying to balance the benefits arising out of the development of renewable energy sources against the local environmental impact. The more dwellings that are in the vicinity of a wind farm the tighter the limits should be as the total environmental impact will be greater. Conversely, if only a few dwellings are affected, then the environmental impact is less and noise limits towards the upper end of the range may be appropriate. Developers still have to consider the interests of individuals as protected under the Environmental Protection Act 1990. It is our belief however, in accordance with the Welsh Affairs Committee <sup>(1)</sup>, that there have been no cases of complaints of noise at levels similar to those caused by wind farms leading to a successful prosecution as a statutory nuisance. It should be noted however that the Welsh Affairs Committee also report that although the noise may not be a statutory nuisance it can clearly be a cause for distress and disturbance, particularly if residents have been promised inaudibility and the noise has a particular quality leading to complaints.

*The effect of noise limits on the number of kWhs generated.*

*Similar arguments can be made when considering the effect of noise limits on uptake of wind energy. A single wind turbine causing noise levels of 40 dB(A) at several residences would have less planning merit (noise considerations only) than 30 wind turbines causing the same amount of noise at a similar number of properties.*

(1) Wind Energy : Volume I : Second Report : Welsh Affairs Committee : 13th July 1994 : HMSO



- *Duration and level of exposure.*

*The proportion of the time at which background noise levels are low and how low the background noise level gets are both recognised as factors which could affect the setting of an appropriate lower limit. For example, a property which experienced background noise levels below 30 dB L<sub>A90</sub> for a substantial proportion of the time for which the turbines would be operating could be expected to receive tighter noise limits than a property at which the background noise levels soon increased to levels above 35 dB L<sub>A90</sub>. This approach is difficult to formulate precisely and a degree of judgement should be exercised.*

The noise criteria adopted within this Noise Impact Assessment follows the guidance within the DTI NWG with respect to the absolute levels during the quiet daytime period.