9.8.2 Summary of Significant Visual Effects

The significant visual effects of the construction period are generally limited to those receptors situated close to the proposed site. Although the use of cranes to raise the turbines will allow a key construction activity to be seen from further afield, the crucial ground level construction activities will generally only be seen by receptors with close distance views i.e. under 2.0 km. The use of cranes is likely to be restricted to a short period of approximately 1 month. Beyond this distance of 2.0 km the local topography and the screening provided by the large-scale mature, coniferous plantations severely limit the range of available views in which receptors could clearly discern the ground level activities. Consequently potential receptors in settlements such as Abercregan and Glyncorrwg which are both within 2.0 km of the edge of the site are predicted to only have partial views of the crane activities which generates predicted visual effects assessed as only 'minor' significance. The receptor groups who are predicted to sustain 'major' adverse visual effects and the reasons for this assessment are set out below:

- Croeserw - being located above the bottom of the Afan Valley on a north-facing valley side that faces the wind farm site some of its Croeserw's residents will have good views of the operation of the cranes which will intrude prominently above a section of the horizon producing a strong visual contrast.
- The Celtic Trail, St Illtyd's Walk and other public footpaths that cross or bound the site - close distance views with minimal opportunity for screening in open upland landscape hence sweeping views of all ground level construction activities.
- The Coed Morgannwg Way - as above but additional adverse impacts due to its use as access road for 2 km.

Uninterrupted views of the site in which the ground level construction activities are likely to be visible are limited to longer distance views from similarly elevated locations. At the distances involved it is considered unlikely that individual activities will be readily discernible and the clarity of the views will be dependent upon prevalent weather conditions. A good example of this situation is Byrn-Caws Farm which is located 7.5 km to the west at elevation of 210 m and has clear long distance views (see Figure 9.7f) in which the site is an element on the eastern horizon with no intervening screening planting or topographical features. Individual construction activities are unlikely to be discernible, except the cranes. This situation applies to the long distance views available from locations in the southern fringe of the Brecon Beacons National Park where receptors are considered to be particularly sensitive.

During the subsequent operational period there will be an increase in the number of visual receptors and the magnitude of visual impacts generated due to the height and movement of the turbines. Although slimmer than the turbine towers, the introduction of the 31 m diameter blades will increase the overall height of the structures thereby increasing their visual intrusiveness which in turn is compounded by their movement. Whilst masts, pylons and large aerials are existing visual elements in many views in the study area, Ffynnon Oer would be at a larger scale than any other developments on their horizons and as such a key consideration is its intrusiveness. Once again distance, prevailing weather conditions, topography and forestry plantation screening are key determinants and account for the absence of views from many potential middle distance receptor groups, particularly communities and isolated residential receptors located on lower valley sides. The receptor groups who are predicted to sustain 'major' adverse visual effects and the reasons for this assessment are set out below:

- The public footpaths on Werfa - intrusiveness on horizon and lack of any intervening screening elements;
- The bridleway and byway on Foel Trawsnant - intrusiveness on horizon and lack of any intervening screening elements;
- The Celtic Trail - for certain sections there is an absence of screening, compounded by proximity and predicted magnitude of change;
- The Sarn Helen long distance bridleway - intrusiveness on horizon and lack of any intervening screening elements along certain sections with the potential for cumulative and sequential visual impacts;
- The Coed Morgannwg Way - paucity of screening alongside some sections, proximity and magnitude of change;
- St. Illtyd's Walk; - as above;
- Some of the residents on the eastern edge of Cilfrew - visibility of a large number (13-16) of the turbines on the skyline;
- Some of the residents in Cymmer - partial middle distance views of upper parts of turbine and blade movement will form prominent intrusion on large section of northwestern horizon;
- Some of the residents in Abercregan - as above;
- Some of the residents and visitors to Croeserw and the adjacent proposed Afan Valley Holiday Park - as above.

For the remainder of the large number of potential visual receptors with middle or long distance views the assessment considers that the magnitude of visual change that will be generated by the wind farm i.e. the turbine and blades, will not be sufficient to generate effects of 'major' significance.

9.9 Summary

A development of the scale and location of the Ffynnon Oer Wind Farm will almost inevitably generate visual impacts which have consequent effects over a large area. There is an ongoing debate on to whether wind farm turbines in locations such as Ffynnon Oer have adverse, neutral or beneficial effects upon the existing views available to receptors. Research work and public attitude surveys discussed in the previously referenced guidance documents demonstrate that people have widely differing opinions on the types and importance of visual effects caused by wind farms. Opinions are influenced by socio-economic and educational background, recreational interests and the location of the people being polled. However in the Ffynnon Oer visual assessment we have consistently assumed a worst case scenario with the consequence that all visual effects have been classified as being 'adverse'.

The GLVIA guidance makes it clear that one of the key influences upon the magnitude of potential visual impacts is the design of the access to the wind farm. Unsympathetically designed new roads potentially cut across open hillsides to form very incongruous visual elements in their own right as well as leading the eyes of receptors to the turbines. Hence it is

important to point out that this situation will not arise at Ffynnon Oer as the access road will utilise an existing forestry track whose entire length is within the mature forestry plantation. This minimises potential views of the movement of construction and then maintenance vehicles and the potential visual intrusion and landscape impact of the track itself.

Apart from the much shorter length of time that the visual impacts will be generated from the construction period compared with operational period, there are other potentially important differences. There are predicted to be more receptors for the operational period when there are 16 turbines each with a height of 91 m as opposed to the construction period when there will only be one or two elements of a similar height i.e. the cranes. Given that one of the main predicted visual differences relates to views of the ground level activities, it is predicted that receptors sustaining greatest contrasts between the two periods will be the recreational receptors using the relative extensive network of PROWs within and around the site. Nevertheless the magnitude of the visual impacts sustained by the PROW users in both periods is such that the significance of the visual effects for both periods is assessed as being 'major'.

One of the key conclusions drawn from the assessment is the influence of distance upon magnitudes of impact. The photomontages from the Brecon Beacons National Park (Figures 9.9a-c and 9.10a-c) illustrate that at distances of 18.5 km each, the relatively small number of turbines proposed for Ffynnon Oer are not predominant visual elements. Nevertheless it is acknowledged that the movement of the blades will help to draw the eye towards them. Once again the influence of the weather on the turbines visibility must be emphasised, especially the fact that 1 in every 4 days is rainy or cloudy thereby preventing long distance views.

In addition the nature of the wind farm development, with no large new visual masses e.g. buildings, means that the potential for substantially screening or foreshortening existing views does not arise, except for internal views from some PROW sections. Instead the impacts generated by the operational wind farm will be concentrated on the potential of the turbine towers and blades to frame and/or filter close or middle distance views and most importantly to form an intrusive element in sections of existing views and/or form a focal point due to their skyline location.

The elevation of the Ffynnon Oer Wind Farm and the height of the turbines will ensure that there is an extensive Zone of Visual Influence (ZVI) which in turn implies potentially a large number of visual receptors. However the ZVI shown in Figure 9.1, which uses a conservative height estimate of 12 m for all the coniferous plantations, demonstrates that the ZVI only covers approximately fifteen percent of the 1257 km^2 study area. These are overwhelmingly the more elevated areas and as such does include a proportion of areas covered by local landscape designations. Along with forestry cover, topography is the dominant influence upon the extent of the ZVI as well as the regional and road pattern. Hence a very high proportion of the potential visual receptors located in valley bottoms or on lower valley sides, thereby assuring that they are much less likely to be included within the ZVI. The corollary of this baseline situation is that there are relatively few receptors with potential close distance views i.e. views from within 2.0 km of the wind farm in which the turbines would be the dominant visual element.

Wind farm proposals usually generate concerns that they will have adverse effects upon existing landscape character which is one of the primary criteria under which landscapes are designated to provide protection against unsuitable development. The southern part of the site of is covered by a local landscape designation; the unadopted Port Talbot Local Plan Landscape Protection

Area (LPA), whilst there are other landscape designations: Special Landscape Areas (SLAs) and Strategic Coalfield Plateau and Associated Valley Sides within the study area, whilst impacts upon the nationally designated Brecon Beacons National Park has been discussed above. The key landscape designation is the unadopted LPA: whilst the landscape assessment demonstrates that no important landscape elements will be lost to cause any detrimental landscape (or environmental or ecological) effects, it is unlikely to directly enhance existing landscape qualities.

The impacts of the construction and the operation of the wind farm upon landscape elements are very limited. They will concentrate upon the loss of areas of acid grassland and raised blanket bog plus possibly short sections of a dilapidated dry stonewall; all of which are very widespread features in regional upland moorland landscape character areas. It is important to note that by utilising existing forestry roads for access the proposal avoids one of the usual adverse landscape effects associated with wind farm development, namely the requirement to construct a new access road with the associated potential loss of landscape elements and adverse impacts upon landscape characteristics.

The construction and operation impacts and consequent effects upon landscape characteristics generally have a higher level of significance, although for the operational period the assessment considers that the effects are neutral as opposed to adverse during the short-lived construction period. The wind farm's operation would modify some of the more intangible landscape characteristics such as openness, simplicity, harmony and tranquillity, especially during construction activities. The introduction of the 16 turbines would also modify tangible characteristics such as colour, movement and the balance between man-made and apparently naturalistic landscape characteristics. However it is important to bear in mind that the present landscape is itself largely a result of human activities, as witnessed by the evidence of past mining, and that the predicted landscape changes are not permanent.

Overall it is considered that the magnitude of the predicted changes during both construction and operational periods will not be sufficiently large to undermine the upland forest/plateau moorland landscape character area or any of the other defined character areas. There are many precedents within the study area of man-made features in prominent locations such as communication masts and pylons which have not undermined existing landscape character areas. The simple and large-scale character is a robust and can incorporate a development of the type and scale of the proposed wind farm. Wind farms are gradually becoming accepted features in this landscape type in Britain and Europe and their presence and associated movement can highlight many of the components of the landscape character such as exposure and remoteness.

9.10 References

Guidelines for Landscape and Visual Impact Assessment. The Landscape Institute and the Institute of Environmental Assessment. Spon Press, London. 1995.

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Guidelines on the Environmental Impacts of Wind farms and Small Scale Hydroelectric Schemes. Scottish Natural Heritage. SNH Publications, Perth, Scotland. February 2001.

Afan Forest Park leaflet, Forest Enterprise.

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http://www.met-office.gov.uk/climate/uk/averages/sites/48.html Neath (62m AMSL) 1961-90 Station Averages.

10. Public Access

10.1 Introduction

The following section assesses the impact of the development upon existing public rights of way (PROWs) which cross or run close to the proposed wind farm site at Ffynnon Oer. The construction and operation of the wind farm could have direct and indirect impacts and consequent effects upon the users of the range of PROWs:

- Direct impacts are those that would be generated by any temporary or permanent closure or diversion of existing PROWs; whilst;
- Indirect impacts are those environmental impacts and their consequent effects that could potentially be sustained by users of the PROW network and are likely to focus upon visual and acoustic effects. These impacts are assessed in greater detail in the relevant sections (Landscape and visual - Section 9, Noise - Section 12).

Given the importance of the upland areas of South Wales for recreational activities, especially walking and riding, and the consequent presence of a number of designated long distance footpaths it was considered necessary to consider impacts upon public access in a separate section.

10.2 Methodology

Three criteria have been used in evaluating the predicted effects of the proposed development on public rights of way and recreational facilities:

i) The type of effect: direct or indirect with the latter sub-divided into visual and acoustic effects;

ii) The nature of the identified effect (i.e. whether it is adverse, beneficial or neutral);

iii) The policy importance for the evaluation of the sensitivity of the PROWs. The assessment has divided the local PROW resources into four categories based upon their perceived importance to the public and likely levels of usage (although no figures for usage levels are available). In descending order of importance these four categories are:

- National trails or recreational paths e.g. the Coed Morgannwg Way;
- Bridleways, Roads used as public paths (RUPPs) and Byways open to all traffic;
- Public footpaths;
- Other forms of public access including informal access and permitted paths in Forestry Commission plantations which are covered by an open access policy.

The magnitude of the predicted impacts sustained is quantified using a simple scale of high, medium, low or none. In some cases it is not possible to quantify the magnitude of impact and therefore "not quantified" is used in these instances.

The findings in relation to all of these criteria are brought together to give an assessment of significance for each effect, based on professional judgement. Hence significance is a product of sensitivity or policy importance of the individual PROW and the magnitude of the identified impacts. Effects are considered to be "major", "minor" or "no significance". Those effects rated "major" equate to the term "significant effects" in the EIA Regulations 1999.

For all PROWs direct and indirect effects will be considered separately for the construction phase. However as the operation of the wind farm will definitely not require the closure or diversion of any PROWs it is considered that the only effects could be indirect ones.

10.3 Baseline Description

10.3.1 Introduction

Potential direct impacts and consequent effects during the construction period are only considered to apply to PROWs within the defined site or along the proscribed access routes. As demonstrated in the landscape and visual assessment potential views of the wind farm will be available from distances as far away as at least 20 km and the study area was defined in response to this. However it is not considered to be helpful to consider potential indirect effects upon the myriad number of PROWs that are found in a 40 km diameter study area. Hence in defining the PROW study area, and in the absence of specific guidance from CCW, we have had regard to the assertion on page 16 of the most recent SNH guidance on the environmental impacts of wind farms[12] that turbines and blades are usually seen as a dominant focus when viewed from distances of up to 2 km.

Similarly noise assessment guidelines consider that only noise levels above 35 decibels have the potential to generate significant effects for acoustic receptors and a noise contour for this value has been plotted for the proposed wind farm. This demonstrates that by adopting a public access study area of 2.0 km radius the assessment will include all PROW users that could potentially sustain significant acoustic effects.

10.3.2 The Public Rights of Way Network

The PROWs within the study area have been identified using the relevant 1:25 000 Explore OS map and confirmed by Neath and Port Talbot County Borough Council's Definitive Maps. The vast majority have been walked by members of the assessment team. The referenced PROWs are illustrated in Figure 10.1.

In overview the site enjoys a good level of formal and informal public access. PROWs that cross or bound the site and which could therefore sustain direct impacts are listed below:

- St Illtyd's Walk - definitive map ref: 6/6A;

[12] Guidelines on the Environmental Impacts of Wind farms and Small Scale Hydroelectric Schemes. Scottish Natural Heritage. SNH Publications, Perth, Scotland. February 2001.

- Bridleway running south from a cairn near turbine no 1 to the mountain centre near Tonmawr - definitive map ref: 6;
- A short section of public footpath linking the above two PROWs along the western boundary of the site: - definitive map ref: 5.

In addition there are a number of un-surfaced tracks crossing the site allowing access for 4WD vehicles. Also the Coed Morgannwg Way; a national trail, runs northeast to southwest and passes very close to the eastern boundary of the site, although it is crucially this section of the trail is at an elevation that is a minimum of 20 m below that of the site. Sections of the Coed Morgannwg Way and St. Illtyd's Walk have been incorporated into the Celtic Trail High Level Cycle Route that has recently been defined by Sustrans. This runs from Neath to Pontypridd and has been clearly marked with trailmarkers and interpretation boards, including the Millennium Mile Post at the junction of Coed Morgannwg Way and St. Illtyd's Way to the immediate north of the site.

It is important to note that the proposed access route from the A4061 will use approximately 2.6 km of the length of the forestry access track that forms the route of the Coed Morgannwg Way to the immediate north of the site.

Beyond the boundaries of the site up to the edge of the nominal 2.0 km radius study area in addition to the continuation of the PROWs that cross the site , there are sections of the following PROWs as shown on Figure 10.1:

- St Illtyd's Walk/Celtic Way - Definitive Map Reference 6/6A;
- Coed Morgannwg Way/Celtic Way;
- Bridleway - Definitive Map Reference 32;
- Bridleway - Definitive Map Reference 27;
- Bridleway - Definitive Map Reference 14;
- Bridleway - Definitive Map Reference 6;
- Bridleway - Definitive Map Reference 50;
- Bridleway/Public Footpaths - Definitive Map Reference 28/68/73/74/49;
- Bridleway/Public Footpaths - Definitive Map Reference 24/32/33;
- Bridleway - Definitive Map Reference 6B;
- Public Footpath - Definitive Map Reference 55;
- Public Footpath - Definitive Map Reference 15;
- Public Footpath - Definitive Map Reference 16/17;
- Public Footpath - Definitive Map Reference 5;
- Public Footpaths - Definitive Map Reference 33/35/14.

In addition it is noted that the study area contains considerable areas of Forestry Commission plantation to which the open access policy applies.

10.3.3 Predicted Trends

The PROW network around the Ffynnon Oer site is considered unlikely to significantly alter in the near future; only the southern section of the Coed Morgannwg Way has been added since the compilation of the Definitive Map in 1971. The only exception is the possible definition of a companion 'low level cycle route' which could potentially utilise some of the existing forestry and access tracks to the immediate south of the site.

10.3.4 Information Gaps

There are no information gaps with regard to the identification of all PROWs, however Neath and Port Talbot County Borough Council have no available information upon the levels of usage of any of the PROWs. Anecdotal evidence and a weekend site visit indicate that the principal PROWs are relatively popular at weekends for walkers, horse riders and mountain cyclists.

10.4 Mitigation and Enhancement

This section considers the mitigation that will be required to offset the likely impacts of the development upon existing provision both during the six month construction phase and the subsequent operational period.

10.4.1 Temporary Land-Use Change and Construction

None of the PROWs that cross or run close to the site or the access road are proposed to be temporarily closed or diverted and will continue to operate as at present when the users have to accommodate periodic use by forestry vehicles. To reduce the potential negative impacts that would be generated by having construction materials spread across the site it has been agreed that all construction plant and materials will be stored in a secure compound located in a visually unobtrusive area on the east of the site. Also the potential for confusion amongst PROW users due to uncertainty about the purpose and duration of the construction activities will be removed by the introduction of temporary information boards located at appropriate locations on the PROW network.

10.4.2 Permanent Land-Use Change and Operation

Once again none of the PROWs will be diverted or closed, however NWP will erect a series of interpretation boards at key locations on the local PROW network. These will explain the operation of the wind farm in a local and national context as well as providing interpretation information for the wider landscape. The process by which the site was selected and the layout of the turbines determined is set out in Table 10.2.

NWP have contacted Sustrans with regard to the possible improvement of cycle paths within the vicinity of the site.

10.5 Evaluation of Effects

10.5.1 Direct Effects on PROWs - Construction Period

The working plan for the construction period indicates that NWP do not foresee the need to temporarily close or divert any of the PROWs that cross the site. (Hence there are predicted to be no direct effects, however there are likely to be some potential direct effects with regard to the use of the 2.6 km length of the Coed Morgannwg Way as an access route. Based on the fact that the Coed Morgannwg is already jointly used as a PROW and a forestry access track with no apparent problems it is considered that joint usage should be possible with clear signage sited at the main access points. Also widening will take place at key pinch points to reduce risks of conflict between recreational pedestrians and lorries. Hence direct effects are likely to be minor.

10.5.2 Direct Effects on PROWs - Operation Period

The operation of the turbines will not directly impact upon the use of the present PROW network within the site. Experience from other wind farm sites demonstrates that there is generally no problem in retaining existent PROW access within wind farm sites and this would be the case at Ffynnon Oer.

10.5.3 Indirect Effects on PROWs - Construction Period

As previously stated the assessment considers indirect effects on users of the PROW network to primarily consist of visual and acoustic impacts and their subsequent effects. As such, reference should be made to the comprehensive assessments contained in the relevant sections, however the potential for cumulative effects needs to be considered. Visual and acoustic effects with adverse significance levels assessed as both being 'minor' may cumulatively generate an adverse effect of 'major' significance upon the walkers (or cyclists' or riders') enjoyment of the PROWs, especially as it can be assumed that the relative isolation and tranquillity of the area is one of the attractions that draws PROW users to the area. However with Ffynnon Oer it is considered that the likelihood of indirect impacts would be reduced as construction would take place during weekdays rather than at weekends and Bank Holidays when the PROWs will be more heavily used. Furthermore construction will cease during the RAC Rally. The effect is therefore determined to be 'minor'.

10.5.4 Indirect Effects on PROWs - Operation Period

Once again reference should be made to the relevant landscape and visual and noise sections, however where clear views of the turbines and the movement of the blades are available coupled with the ambient sounds of the operation, they could have a detrimental effect upon the levels of enjoyment sustained by the PROW users. The sections of PROWs which pass across open land are considered particularly sensitive as, where they pass through established forestry plantations, views will be severely restricted and noise levels reduced. In particular users of bridleways 6, 11, 32 and 50 and public footpaths 5 and 14/33/35 could sustain indirect negative impacts as they will have good views of at least some of the turbines and access roads and hear the movement of the blades.

The levels of potential disturbance generated by the use of a section of the Coed Morgannwg Way for access by maintenance vehicles will be of a very low magnitude. It is predicted

vehicular movements will be limited to 2 movements per month and as such they will generate no additional impacts and effects upon PROW users compared with the present situation with regard to the occasional use of the Way by forestry vehicles.

10.6 Evaluation of Effects

10.6.1 Criteria

The magnitude of impact is considered to be high when clear views are available and low when views and operational/construction noise are heavily filtered by forestry plantations. Sensitivity criteria areas laid out in 10.1.2 iii). As previously noted no information is available on levels of usage by individual PROWs or season, however the construction of the wind farm will take place during summer months when levels of usage are likely to be at their highest increasing the magnitude of impacts. In order to consistently assess a worse case scenario the assessment consistently evaluates all the effects as being negative, however as stated elsewhere in the ES research indicates that members of the public impacted by wind farms such as PROW users do not necessarily consider them as detrimental.

10.6.2 Evaluation

Table 10.1 summarises the effects of the proposed development upon public rights of way and recreational facilities and assesses the significance of those effects.

Table 10.1 Effects and Evaluation of Significance for Direct Impacts in Construction Period

PROW reference (see Figure 10.1)	Length of PROW impacted (crossing open ground)	Type of Effect	PROW Importance or Sensitivity	Magnitude of Direct Effect	Significance	
					Level	Rationale
6/6A St Illtyd's Walk/Celtic Way	1.8 km (1.8 km)	Adverse	National	Medium	Major	Important PROW and publicised long distance route crossing heart of the site hence potential for disruption
Coed Morgannwg Way/Celtic Way	2.6 km (0 km)	Adverse	National	Medium	Minor	Important PROW which does not cross site, but approx 2.6 km length to be used as access road mitigation should ensure that there is limited disruption from construction vehicles
6	1.5 km (1.5 km)	Adverse	Local	Medium	Minor	All turbines to east therefore unlikely to require closure or temporary diversion
5	1.3 km (1.3 km)	Adverse	Local	Medium	Minor	As above

Key:	Type of Effect	Policy Importance	Magnitude	Significance
	Adverse	National	High	Major
	Neutral	Regional	Medium	Minor
	Beneficial	Local	Low	Not Significant
			None	

Table 10.2 Effects and Evaluation of Significance for Indirect Impacts in Construction Period

PROW Reference (see Figure 10.1)	Length of PROW Impacted (crossing open ground)	Type of Effect	PROW Importance or Sensitivity	Magnitude of Indirect Effect	Significance	
					Level	Rationale
St Illtyd's Walk/Celtic Way 6/6A	3.5 km (2.6 km)	Adverse	National	Medium	Major	Although construction activities only visible and audible for a proportion of path they will be dominant experience for that section of a long distance footpath
Coed Morgannwg Way/Celtic Way	2.6 km (0 km)	Adverse	National	Medium	Minor	No views of construction activities but movement of access vehicles will be feature along relevant section of the long distance footpath
Bridleway 32	2.9 km (1.4 km)	Adverse	Local	Low	Not Significant	Only impacts likely to be some southern views from section across open ground
Bridleway 27	2.2 km (0 km)	Adverse	Local	Low	Not Significant	Only impacts will be aural from elevated site
Bridleway 14	1.6 km (0.7 km)	Adverse	Local	Medium	Minor	Likely to be some views of blades being attached from open section looking northeast
Bridleway 6	3.4 km (1.9 km)	Adverse	Local	Major	Major	Construction activities will dominate open section
Bridleway 50	2.3 km (1.4 km)	Adverse	Local	Medium	Minor	Close enough to site to have good views and hear construction works
Bridleway/Public Footpaths 28/68/73/74/49 in Glyn Corrwg	2.8 km (0.9 km)	Neutral	Local	None	Not Significant	Distance means no noise and valley bottom location means no views due to difference in elevation
Bridleway/Public Footpath 24/32/33	3.7 km (0 km)	Neutral	Local	Low	Not Significant	Possibly some noise from access road

Table 10.2 (continued) Effects and Evaluation of Significance for Indirect Impacts in Construction Period

PROW Reference (see Figure 10.1)	Length of PROW Impacted (crossing open ground)	Type of Effect	PROW Importance or Sensitivity	Magnitude of Indirect Effect	Significance	
					Level	Rationale
Bridleway 6B	2.0 km (2.4 km)	Adverse	Local	Medium	Minor	Proximity to site
Public Footpath 55	2.4 km (0.3 km)	Neutral	Local	None	Not Significant	No views or noise due to differences in elevation and dense forestry
Public Footpath 15	1.2 km (0 km)	Neutral	Local	Low	Not Significant	No views due to dense close by forestry and probably little used
Public Footpath 16/17	2.5 km (0 km)	Neutral	Local	None	Not Significant	No direct relation to site
Public Footpath 5	2.6 km (1.3 km)	Neutral	Local	None	Not Significant	No direct relation to site
Public Footpaths 33/35/14	3.2 km (3.2 km)	Adverse	Local	Medium	Minor	Limited views but impacts from noise

Key:	Type of Effect	Policy Importance	Magnitude	Significance
	Adverse	National	High	Major
	Neutral	Regional	Medium	Minor
	Beneficial	Local	Low	Not Significant
			None	

Table 10.3 Effects and Evaluation of Significance for Indirect Impacts in Operation Period

PROW Reference (see Figure 10.1)	Length of PROW Impacted (crossing open ground)	Type of Effect	PROW Importance or Sensitivity	Magnitude of Indirect Effect	Significance	
					Level	Rationale
St Illtyd's Walk/Celtic Way 6/6A	3.5 km (2.6 km)	Adverse	National	High	Major	Close proximity and no mitigating factors ensure that wind farm will dominate relevant section of long distance footpath
Coed Morgannwg Way/Celtic Way	2.6 km (0 km)	Adverse	National	Low	Minor	Glimpsed views and sound of turbines
Bridleway 32	3.7 km (1.4 km)	Adverse	Local	Medium	Minor	Visually dominant for the 1.4 km section across open ground
Bridleway 27	2.2 km (0 km)	Adverse	Local	Low	Not Significant	Glimpsed views through canopy and some background noise
Bridleway 14	1.6 km (0.7 km)	Adverse	Local	Medium	Minor	Some noise and views of rotating blades from sections crossing open ground
Bridleway 6	3.4 km (1.9 km)	Adverse	Local	High	Major	Turbines will be dominant element in northern section across site
Bridleway 50	2.3 km (1.4 km)	Adverse	Local	High	Minor	Distance and openness mean wind farm will turbines dominant element in all northern views once bridleway attains the top of the ridgeline and open ground
Bridleway/Public Footpaths 28/68/73/74/49 in Glyn Corrwg	2.8 km (0.9 km)	Neutral	Local	None	Not Significant	Distance means no noise and valley bottom location means no views due to difference in elevation

Table 10.3 Effects and Evaluation of Significance for Indirect Impacts in Operation Period

PROW Reference (see Figure 10.1)	Length of PROW Impacted (crossing open ground)	Type of Effect	PROW Importance or Sensitivity	Magnitude of Indirect Effect	Significance	
					Level	Rationale
Bridleway/Public Footpath 24/32/33	3.7 km (0 km)	Adverse	Local	Low	Minor	Only effects sustained will be on 33 due to openness of southwestern views
Bridleway 6B	2.0 km (2.4 km)	Adverse	Local	Medium	Minor	Movement of blades dominant element on ridgeline
Public Footpath 55	2.4 km (0.3 km)	Neutral	Local	None	Not Significant	Distance, change in elevation and forestry screening result in users being unable to discern wind farm's operation
Public Footpath 15	1.2 km (0 km)	Adverse	Local	Low	Minor	Footpath probably little-used (bridleway 14 more direct) and only glimpsed views of blade movement
Public Footpath 16/17	2.5 km (0 km)	Adverse	Local	Low	Minor	Only glimpsed views through dense forestry
Public Footpath 5	2.6 km (1.3 km)	Adverse	Local	Low	Minor	Only glimpsed views through dense forestry
Public Footpaths 33/35/14	3.2 km (3.2 km)	Adverse	Local	High	Major	The turbines and blades will be dominant features for walkers heading in southeastern direction

Key:	Type of Effect	Policy Importance	Magnitude	Significance
	Adverse	National	High	Major
	Neutral	Regional	Medium	Minor
	Beneficial	Local	Low	Not Significant
			None	

10.7 Summary of Key Issues

The site and its immediate environs act as a nodal point for a number of PROWs including two long distance footpaths and a national Saustrans cycle trail. The construction of the Ffynnon Oer wind farm will cause a degree of disruption to the existing recreational provision on the site. However the effects of the short-lived construction period are limited in spatial extent to the PROWs within and immediately around the site and the access road.

During the operational period the noise and visual impacts principally from the rotation of the blades will have effects on a wider extent of PROWS. Indeed the topography and extensive forestry of the surrounding area will result in most views being longer distance views form elevated PROWs on other ridgelines. Many of the PROWs in the 2 km radius area where the wind farm would be the dominant element are at lower elevations crossing or descending the valley sides and therefore allowing very limited views of the wind farm. These views and the noise of the operation are further reduced by the extensive dense forestry cover although it is recognised that over 20 years the distribution of forestry could change with clear felling of some tracts. A good example of the mitigating effects of topographical variation and forestry screening is provided by the Coed Morgannwg Way which runs within 200 m of the southeastern edge of the site. However it is a minimum of 30 m below the level of the wind farm site in mature forestry hence it is predicted that impacts will be restricted to ambient noise and glimpsed views of the rotation of the blades of the eastern-most turbines.

With regard to mitigation, especially during construction there are a number of key issues that come out of this assessment which, if adopted, will ensure that any adverse effects will be reduced:

- parts of the site under construction should be adequately secured from existing areas of open space and footpaths;
- it will be necessary to publicise the construction period to potential users and to ensure that there is adequate supervision of users whilst construction is underway;
- Any unforeseen need to temporarily close a PROW will need to be legally completed before it can be actioned.

Finally note should be taken of the opportunities provided by the wind farm to increase formal access across the site and to provide a limited interpretation facilities for walkers, riders and cyclists.

10.8 References

Guidelines on the Environmental Impacts of Wind Farms and Small Scale Hydroelectric Schemes. Scottish Natural Heritage. SNH Publications, Perth, Scotland. February 2001.

11. Traffic and Transportation

11.1 Introduction

This section details the assessment of traffic and transportation impacts and effects associated with the proposed Ffynnon Oer Wind Farm development. It can be anticipated that the main impacts of traffic generation will occur during the construction period, associated with movements of material to and from the site, with impacts reduced once the site is operational.

Consideration has been given to the proposed access route to the site, the impacts of changes in vehicle numbers and the opportunities for adopting appropriate management principles to vehicle movements to minimise the effects.

11.2 Methodology

11.2.1 Introduction

This assessment of the impacts of traffic has considered the:

- potential impacts on local roads and the users of these roads;
- potential impacts on land uses and environmental resources fronting those roads, including the users and occupiers of these.

Additional traffic on surrounding roads may be generated during the construction and commissioning of the various elements that comprise the scheme, and during future operation of the Wind Farm. The following elements are considered.

- Construction of the Wind Farm. The peak flow of large goods vehicle traffic to and from the development during construction is anticipated to be during the period when access track construction, deliveries of ready mixed concrete, wind turbines and other equipment are required. Roadstone is required for the construction of access tracks between the turbines, and it is intended to source this from an existing open cast site within the forest at grid co-ordinates 287000, 203500 (identified on Figure 11.1) via existing forestry roads. Sourcing from here eliminates the need for bringing this material from other locations thus avoiding a substantial number of lorry movements on the highway. Light vehicle traffic is also likely throughout the construction period and this was included in the assessment in order that the realistic worst case for impacts from traffic during construction was considered.
- Commissioning of the Wind Farm (which will be considered as part of the construction period).
- Operation of the Wind Farm. there will be no permanent staff on site there will be occasional visits from maintenance and repair staff and materials responding to predictable maintenance needs and unpredictable repair needs.

11.2.2 Consultations

The Highways officers of Neath and Port Talbot County Borough Council and Rhondda Cynon Taff County Borough Council, were advised of the scheme, including the type and number of anticipated vehicle movements and the proposed scope of the assessment. They were asked for their comments and for sources of data on traffic movements on the relevant parts of the highway network. Responses have been received from both authorities. Neath and Port Talbot CBC being of the opinion that traffic and transport issues could be scoped out of the assessment. It was the opinion of Rhondda Cynon Taff CBC that existing traffic data collected by Glamorgan Engineering Consultancy for the A4061 north of Tower Colliery in 1997 and 1999 (with a factor applied for 2002) would be acceptable and that the spare capacity and lack of sensitive receptors south of the colliery was such that increases in vehicle movements as a result of the development will be acceptable.

Rhondda Cynon Taff CBC have asked that NWP consider whether there will need to be any physical works required along the existing highway infrastructure to accommodate the abnormal loads required to transport the wind turbines. A survey has been undertaken by the haulage company appointed by NWP to transport the wind turbines. It considers that the access route is capable of accommodating the vehicles.

11.2.3 Methodology

The methodology used in this assessment is based on a comparison between predicted traffic flows on potentially affected roads, with and without the development, for the construction and commissioning stage as well as the operational stage. Criteria are then applied to establish whether significant environmental effects are likely, taking into account the sensitivity of the receptors or the resources likely to be affected; and any changes in the composition of traffic, specifically where a higher proportion of heavy goods vehicles (HGVs are defined as heavy goods vehicles exceeding 7.5 tonnes gross vehicle weight) is anticipated.

The methodology is based on guidance given in *'Guidelines for the Environmental Assessment of Road Traffic'*, published in 1993 by the Institute of Environmental Management and Assessment (IEMA), formerly the Institute of Environmental Assessment. The methodology includes two rules of thumb whereby assessment is undertaken only on:

1. highway links where traffic flows will increase by more than 30% (or the number of large goods vehicles will increase by more than 30%).
2. any specifically sensitive areas (schools etc) where traffic flows have increased by 10% or more.

No specifically sensitive areas have been identified on the road links anticipated to be used to serve the proposed development. The threshold for assessing whether an effect is likely, and assessment is therefore required, is a 30% increase in either total traffic flows or in HGV flows.

Existing traffic flows on the A4061 have been established from traffic counts obtained from Glamorgan Engineering Consultancy. Predictions of future traffic in 2002 have been obtained by applying growth factors to this existing actual count data.

The transportation company appointed to delivery the turbine blades and towers have inspected the proposed access route. They have confirmed that it is possible to access the site without recourse to highway works.

11.2.4 Phasing

Construction
For a development of this type the majority of the changes will occur during the construction period rather than during the operational phase of the development. It is anticipated that the duration of the construction period will be approximately 7 months (though this is weather dependent and could be affected by the ground conditions encountered), and hence any impacts identified will only occur over this relatively short period of time.

Operation
Changes may also occur during the operation of the Wind Farm due to traffic from visits by permanent and maintenance staff. The anticipated numbers and significance are expected to be minor and are discussed in subsequent sections.

11.3 Baseline Description

11.3.1 Existing Situation

Local Highway Network
The local road network relevant to this study is shown on Figure 11.1.

Potential Routes to and From the site
During the construction period there are several potential routes on the local road network which could be used for vehicles to gain access to and from the site. However given the need to avoid sensitive receptors all vehicles will be required to approach the site access from Hirwaun using the A4061.

Routes to be Considered
The main route that the majority of vehicles will use to gain access to and from the site has been identified as:

- the M4 motorway, junction 43;
- then the A465 east to Hirwaun;
- the A4061 south towards Treherbert;
- accessing the forest, south of Mynydd Beili Glas.

It has been assumed, for the purposes of the assessment, that upon reaching the M4 motorway the effects of traffic will be negligible.

The main route has been described travelling into the site, assuming that the access into the site will be located at the existing forestry access located on the A4061 at OS Grid Reference 292500E 202500N. A reversal of this route is anticipated for movements from the site.

The wind turbine components are most likely to be delivered by sea to a port either in Wales or at Bristol. It is not envisaged that there will be any problems associated with the vehicles required to transport the wind turbines in the vicinity of the dock, or of any other docks that

potential turbine suppliers could use, as the only docks of interest to turbine suppliers have road connections that have been specifically designed or upgraded to accommodate loads of this type.

During the operational phase, the traffic accessing the site for maintenance and emergencies will also use the A4061.

Main Route Description

The A465 is a dual carriageway trunk road between the M4 motorway and Hirwaun. East of Hirwaun it becomes single carriageway and links Merthyr Tydfil, Abergavenny and ultimately Hereford. The Hirwaun roundabout provides access to the A4061, this road heads westwards to the Hirwaun Industrial Estate where at a roundabout, it turns south to Treherbert. The stretch of the A4061 from Hirwaun to Tower Colliery in industrial in nature. Beyond Tower Colliery the A4061 is rural in nature passing through forestry plantations.

A survey of the access route has been undertaken by the company appointed by NWP to deliver the turbines. They are of the opinion that all vehicles required for the development will be physically able to use the main route from the M4 to the site entrance. Some loads will be subject to abnormal load restrictions and will require prior police notification and possibly escort.

Existing Traffic Flows

Traffic count data for the locations agreed with the highways authorities is summarised in Table 11.1.

Table 11.1 Existing Two-Way2 Average Weekday 12 hour Traffic Flows (0700-1900 hours)

Count Location	Date of Count	Actual Count - Total Vehicles	Actual count - HGVs[1]	HGVs as a Percent of the Total Vehicles
A4061 immediately to the east of the Hirwaun Industrial Estate roundabout	8th June 1999	6451	1130	17.55%
A4061 immediately to the south of the Hirwaun Industrial Estate roundabout	17th June 1997	2560	412	16.1%

Source: Glamorgan Engineering Consultancy.
Notes:
[1]HGVs are Heavy Goods Vehicles exceeding 7.5 tonnes gross vehicle weight
2 Two-way (sometimes referred to as two-way movements) is defined as the total number of vehicles passing the point from either direction of travel. For example 50 two-way movements could comprise 50 vehicles passing in a single direction, or the same 25 vehicles going past left to right and then right to left.

11.3.2 Predicted Trends

It is accepted practice that traffic survey data should be no more than three years old. However both the Glamorgan Engineering Consultancy and the Highways department of Rhondda Cynon

Taff CBC are of the opinion that the existing traffic data as reproduced above is acceptable for the purposes of this assessment provided a growth factor for the year 2002 is applied.

The growth factors which will be used are those provided by the Glamorgan Engineering Consultancy as agreed with the Highways Department of Rhondda Cynon Taff CBC. The background and predicted traffic flows, after application of growth factors are detailed in Table 11.2.

Table 11.2 Actual Count and Predicted Baseline Count for Assessment of Construction Traffic - Existing Two-Way Average Weekday 12 hour Traffic Flows (0700-1900 hours) year 2002

Count Location (Year of Actual Count)	Actual Count - Total Vehicles	Actual Count - HGVs[1]	HGVs as a Percent of the Total Vehicles	Traffic Growth Factor to 2002	Predicted Total Baseline Traffic 2002	Predicted HGV[1] Baseline Traffic 2002
A4061 immediately to the east of the Hirwaun Industrial Estate roundabout	6451	1130	17.55%	1.0289	6637	1163
A4061 immediately to the south of the Hirwaun Industrial Estate roundabout	2560	412	16.1%	1.0417	2667	429

Source: Glamorgan Engineering Consultancy.
Note: [1]HGVs are Heavy Goods Vehicles exceeding 7.5 tonnes gross vehicle weight.

11.3.3 Information Gaps

Following consultation with both the highway authorities through which traffic generated by the development will pass it is considered that no information gaps now exist. The data can be considered appropriate to provide a robust assessment of impacts and effects of the wind farm development.

11.4 Mitigation and Enhancement

The measures that have been identified to date relate to mitigation, although some mitigation measures also extend into enhancement (see Table 11.3). Further measures, in particular relating to the use of abnormal loads, may be identified following conclusion of the discussions with police and local authorities.

Table 11.3 Mitigation Incorporated into the Proposed Development

Impact	Mitigation Incorporated Into the Proposed Development	Impact Wholly Mitigated?
Construction		
Mud and debris on public roads on the routes used to gain access to and from the site.	The contractor will adopt measures to ensure that public access and roads are kept clear of mud and debris. Wheelwash facilities will be provided if deemed necessary. Note that the majority of vehicles leaving the site will only have travelled on the internal track network, rather than off-road.	Partially
Roadstone, if brought from offsite will generate an estimated 1920 vehicle movements	Roadstone will be sourced from an existing open cast site within the forest using the existing quarry vehicles. This will wholly eliminate the need for the vehicle movements that would otherwise be required -.	Yes
Ready-mix concrete required to be brought to site by road, this will generate 1280 vehicle movements.	Vehicles will be required to use a defined route from the concrete plant avoiding settlements wherever possible	Partially
Effect of abnormal loads delivering plant and components to the site on road traffic flows	Police escorts would be required for all such loads and there is potential for deliveries to be timed for quieter overnight periods 1900hrs to 0700hrs. This is subject to discussions with relevant authorities.	Partially
Effect of abnormal loads delivering plant and components to the site on highway infrastructure.	Any accommodation works necessary to be agreed with local authorities following consent	Partially
Changed traffic flows on surrounding roads	Specified routes for materials to be delivered have been identified and will eliminate effects except on the identified movement routes.	Partially
Site Staff travelling to site in private vehicles	Some site Staff will be transported to site by minibuses	Partially
Operation		
None identified	None identified as necessary.	Yes

11.5 Evaluation of Effects

11.5.1 Construction

It is anticipated that the construction phase will take place over a 7 month period as illustrated within the Construction Programme provided at Section 2.3. The main activities during the construction phase are anticipated to be:

- Construction of hard standing and temporary office facilities;

- Upgrading and construction of access tracks within the Wind Farm site;
- Construction of the tower bases (turbine foundations) and transformer bases;
- Construction of site substation;
- Excavation of trenches and cable laying adjacent to the site tracks;
- Connection of distribution and signal cables;
- Erection of wind turbines;
- Commissioning of site equipment;
- Site restoration.

Pre-Construction

Prior to construction a small number of low-loaders will be required to bring general construction plant and site office accommodation. It is assumed that this would comprise approximately 8 deliveries (16 two-way vehicle movements) over a one week period at the beginning and end of the construction period (total 32 two way movements).

Construction of Access Tracks

An estimated 6.2 km of track will be required to link the turbines and control compound. The existing network of on-site forest tracks will be utilised and the on-site track layout has been designed to minimise the length of track required. It is anticipated that of the total track required, 3.2 km will be new tracks. The design of the tracks is provided in Section 2.

It is intended that the stone for use in the geogrid reinforced tracks will all be sourced from the adjoining forest where suitable rock has been identified within an operational quarry subject to a separate planning permission. This avoids the need for the estimated potential 1920 two-way vehicle movements that would be required if the material had to be brought onto site. The roadstone will be quarried using existing excavators, it will be crushed and graded within an existing crushing plant at the quarry. Transportation between the quarry and wind farm will be via existing quarry vehicles.

The geogrid material that is necessary for the floating tracks is delivered in rolls. It can be assumed that each lorry can transport 50 rolls per delivery. With approximately 840 rolls required for the construction of the track there will be 17 deliveries during the period. Assuming that there are approximately 45 working days for the track construction period (5 day week over anticipated 2.25 months this will equate to around two deliveries every five days (4 two way movements).

During track construction there will be a requirement for approximately 4 excavators, 2 rollers and 2 dumptrucks to move material around the site. This equipment would arrive on site at the start of the track construction process and leave the site at the end of this process. It is assumed that each item will be delivered on a low loader necessitating 6 deliveries (12 two-way movements) at the start and end of track construction (32 two way movements total).

Construction of the Turbine Bases

The proposed wind farm will consist of 16 wind turbines. The materials required for the construction of the turbines and their bases will partly be brought to site by road as well as being

sourced on site. For the purpose of this assessment we have assumed that all of the concrete will be brought to the site by road.

The wind turbine foundations will comprise a reinforced concrete base slab over stone. In total 640 standard cement lorries (1280 vehicles movements) will be required to deliver the material.

Installation of Cabling

Underground cabling will be installed on-site to connect the turbines and the substation and will, in the main, follow the routes of the access tracks. The trenches will require excavation using a JCB backhoe excavator (brought in at the start and included under pre-construction equipment). The cables will be on drums, these would be delivered to site on standard HGV lorries. A maximum of 32 deliveries (64 two-way movements) are assumed to be required.

Construction of the Wind Turbines

Wind turbine towers and nacelles will be transported via low bed trailers. In total 48 deliveries will need to be made for the turbine towers (96 vehicle movements) and a further 16 deliveries for the nacelles (32 vehicle movements). The wind turbine blades will be delivered to site on 35 m long rear steered vehicles (48 vehicle movements). Erection of the towers and blades is undertaken using two cranes of 500 t and 100 t lifting weight respectively. The total vehicle movements expected to be required for the wind turbine construction and commissioning are summarised in Table 11.4.

In addition other facilities to establish will include a substation and transformer compound and a temporary construction compound. General construction materials will also need to be brought to the site. These are estimated to require 10 lorry deliveries over the construction period and the substation to require 5 concrete lorry deliveries, 3 deliveries of electrical components, 5 deliveries of other building materials and 1 delivery of the transformer.

For the purposes of this assessment, it has been assumed that deliveries will take place on-site on 5 days per week for the worst case.

Table 11.4 Vehicles Required to Deliver Materials and Equipment for the Construction of the Wind Turbines and Associated Facilities

Construction Element	Material/ Equipment Required	Total Deliveries Required	Total Deliveries Required for the Construction of 16 Turbines
Turbine Towers, and nacelle		4 deliveries per turbine	64 lorries
Turbine Blades		1.5 per turbine	24 35 m lorries
Turbine Cables and Controllers		2 deliveries per turbine	32 lorries
Blade Hub	1 delivery per turbine	1 flat bed trailer load per turbine	16 lorries
Turbine base rings	1 ring per base	3 base rings can be delivered on 1 flat bed trailer type lorry	6 lorry deliveries
Cranes for erection / general purpose		2 mobile road-going cranes required	2 - assumes that both arrive on-site at the start of turbine erection and leave on completion.
Substation and compounds	Concrete, building materials, electrics	24 deliveries	24 deliveries
Total Deliveries			**168**
Total Movements			**336**

Source: National Wind Power

Construction Site Staff

It is estimated that a maximum of 80 people will be directly employed during the construction of the wind farm at any one time. However, due to the staggered nature of site activities and also the fact that more than one shift may be worked at peak times, taking advantage of appropriate weather and daylight conditions, it is likely that this figure will often be much less. Assuming an average occupancy of 5 people per vehicle (which allows for some arriving by car, but most in minibuses), the maximum number of vehicle arrivals would be 16 or 32 two way movements.

Total Traffic During the Construction Period of the Proposed Development

As discussed previously it is envisaged that during the 7 month construction period there will be a time when many of the above described activities will occur on-site concurrently. Therefore a worst case scenario can be identified for vehicle movements associated with the development.

Table 11.5 provides a summary of the total traffic generated by the wind farm development and identifies the anticipated phasing of activity, based on the indicative programme of operations given in Section 2.3. Average vehicle movements have been rounded up (to the nearest two-way movement)) and the worst case construction period has been defined in a way that ensures that the possibility of overlaps between activities is fully taken into account in defining peak values. This has been defined by assuming that:

- The peak delivery rate of materials (and thus of lorry movements) is derived by assuming the materials arrive over the probable activity period (the shortest realistic timetable anticipated).
- This peak delivery rate could occur at any time over the possible and probable activity periods, but is modified by assuming that materials may start to be delivered in the month prior to the earliest possible activity period, but that deliveries are complete in the month prior to the last probable activity period.
- Equipment for construction will arrive either in the month prior to the earliest possible activity period or (for activities commencing in month 1) in week 1 of month 1. Equipment will leave in the month after the latest possible activity month, or in month 7 for activities running through to the end of the construction period.

Inevitably, therefore, the values given in Table 11.5 and 11.6 overstate the total movements associated with the development. They do, however, provide a realistic assessment of the worst case peak daily movement levels.

Table 11.5 Summary of Vehicle Movements During Construction

Construction Element (all Following Specified Access Route Except Where Stated)	Total Vehicle Movements Required by Type (Two-Way Vehicle Movements) (HGVs Unless Stated)	Worst Case (Construction Period)	Two-Way Vehicle Movements per Month, Week or Day (using 4.5 Weeks per Average Month)
Pre-Construction Preparations			
Delivery and removal of site accommodation etc	32	Months 1 & 7	4 per day, week 1 Month 1 and week 31 7
Construct Access Tracks			
Machinery deliveries to and from site	32	Week 4 Month 1 & Week 31 Month 7	4 per day, week 4 Month 1 and week 31 month 7
Geotechnical Membranes deliveries	34	Months 2 & 3	4 per week Months 2 and 3
Roadstone - from within forest	N/A	N/A	N/A
Prepare Turbine Bases			
Concrete deliveries	1280	Months 3 & 4	30 per day, months 3 and 4
Foundations	64	As above	2 per day, months 3 and 4
Electricity Infrastructure			
Delivery of cables	64	Month 5	14 per week, month 5
Substation			
Substation equipment and transformer, compounds	48	Month 2	Average of 2 per day months 2, 3 and 4

Table 11.5 (continued) Summary of vehicle movements during Construction

Construction Element (all Following Specified Access Route Except Where Stated)	Total Vehicle Movements Required by Type (Two-Way Vehicle Movements) (HGVs Unless Stated)	Worst Case (Construction Period)	Two-Way Vehicle Movements per Month, Week or Day (using 4.5 Weeks per Average Month)
Turbine Erection and Commissioning			
Delivery of towers and nacelles	128	Month 5	6 per day Month 5
Delivery of Blades	48	As Above	4 per day month 5
Delivery of blade hubs, electrics	32	As Above	2 per day month 5
Delivery of turbine base rings	12	As Above	2 per day month 5
Road-going cranes arriving and leaving site	4	As Above	2 in week 1, month 1 and 2 in week 31 month 7
Tools and Generator for erection team, 1 trailer loaded with 40ft container	4		2 in week 1, month 1 and 2 in week 31 month 7
Fuel Deliveries			
Construction plant fuel deliveries (1 per two weeks)	30		2 each alternate week
Site Staff			
Estimated two-way minibus/car movements per day	32 per day		32 per day

To establish the significance of any effect the above total movements are converted to an assessment of the peak levels of traffic activity arising as a result of the development in each period. This is presented in Table 11.6. Note that the vehicle movements have been rounded up to the nearest 2 two-way movements. For example 12 deliveries in a week, representing 24 two-way movements averages out at 4.8 movements per day. For the purposes of the assessment this has been rounded up to 6 two-way movements (or 3 deliveries per day). The only exception is for road-going cranes which arrive on the site and do not leave for several months in which case the value is rounded up to whole numbers only.

Table 11.6 Anticipated HGV Movements During Construction (two-way movements peak daily values)

Month	1	2	3	4	5	6	7
Pre construction equipment and facilities							
Equipment in and out	4						4
Construct Access Tracks							
Machinery	4						4
Road stone	N/A						
Geogrid membrane		2	2				
Prepare Turbine Bases							
Concrete deliveries			30	30			
Foundations			2	2			
Electricity Infrastructure							
Delivery of cables					4		
Substation Construction							
Equipment and material deliveries		2	2	2			
Turbine Erection & commissioning							
Delivery of towers and nacelles					6		
Delivery of Blades					4		
Delivery of Blade Hubs, and electric infrastructure					2		
Turbine Base Rings					2		
Road-going and Crawler cranes arriving and leaving site	1						1
Erection tools and equipment					2		
Fuel deliveries							
Fuel deliveries	2	2	2	2	2	2	2
Expected total peak daily HGV movements in construction month	11	6	38	36	22	2	11

The daily peak HGV traffic generated by the construction activities is expected to be 38 two-way movements per day (month 3 of the 7 month construction programme). This peak level of HGV generation does not occur on each day of construction and is substantially lower for much of the period. The anticipated increase in HGV two-way traffic movements the A4061 is as follows:

A4061 east and west 38 two way movements.

In addition, the construction will also see additional vehicle movements for construction staff, estimated to comprise 32 two-way movements per day at the peak of construction activity. The peak additional total vehicle movements including HGVs and these other vehicles on the key road sections are as follows:

A4061 east and west 70 two way movements.

Table 11.7 Anticipated Changes in Traffic Flows as a Result of Construction Generated Traffic Based on Average Weekday 12 Hour Two-way Traffic Flows (0700-1900 hours)

Count location	Traffic Movements 2002	HGV Movements 2002	Total Daily Generated Traffic Movements	Total Daily Generated HGV Movements	Percentage Increase in Total Traffic Movements	Percentage Increase in HGV Movements
A4061 east	6451	1130	6521	1168	1%	3.4%
A4061 south	2560	412	2630	450	2.7%	9.2%

Source: Glamorgan Engineering Consultancy, Entec UK Ltd and National Wind Power, all percentages rounded to nearest whole number.

The data in Table 11.7 indicates that, no further assessment is required for the sections of road considered. This is because the change in total traffic and HGV traffic on the road links considered is less than the 30% significance threshold in the IEMA guidelines described in Section 11.1. Furthermore it falls below the 10% threshold for sensitive uses, although none have been identified along the route considered. Any effects on users of these roads will therefore be insignificant.

11.5.2 Operation

Normal Wind Farm Operational Activities

During the normal operation of the Wind Farm, routine inspection of the turbines is carried out twice a month. The main service being at 12 monthly intervals and a minor service at 6 months. Routine inspection would be via the route used by construction traffic.

At regular intervals throughout the wind turbine's life, oils and components, such as blades and gear boxes will require extra attention and changes. Routine maintenance such as this will still only require small numbers of workers accessing the site and will extend the duration of service time workers spend on the site, rather than increasing the number of personnel required.

Gearbox oil changes are required approximately every 18 months. Changing the oil and worn components will extend each turbine service by 1 day. Blade inspections will occur as required,

probably between every two and five years, and will utilise a 'cherry picker' or similar, but may sometimes require a 50T crane and man basket. It could take two or three weeks to inspect the blades on the whole site. Repairs to blades would utilise the same equipment but minor damage on every blade (which is not anticipated) would more than double the inspection period. Access would be via the A4061 and forestry track.

Track Maintenance During Wind Farm Operation

Track maintenance may also be required to be carried out during the operation of the Wind Farm. The frequency of this will be dependent on the weather conditions and the volume and nature of traffic requiring access to the site, with heavy plant being particularly wearing. This maintenance will be ongoing during the summer months when weather conditions would be expected to be most favourable.

Snow Clearance

Safe access to the site and especially to the substation is required all year round. It may occasionally be necessary to clear snowdrifts to facilitate site access using a JCB. It is anticipated that this would normally occur between December and March inclusive.

Emergency Operations

In the event of an emergency, and depending upon its nature, the maximum number of vehicles to be involved would be two cranes, one 35 m vehicle and two support vehicles. Ten two way movements.

Total Traffic Generated During Operation of the Proposed Development

Establishing the number of vehicles accessing the site under operation is therefore difficult to predict due to the variety of circumstances that may be encountered. A worst case scenario can be assumed for the assessment based on a scenario that during operation there was a period at which:

- normal servicing was being carried out (2 two way movements per day by fitters in minibus);
- at the same time all the emergency operations were being undertaken (10 two-way movements);

This would result in a total of 12 two way vehicle movements. These movements are below those identified during the construction phase of the development. Consequently when assessed against the IEMA guidelines the effect of operational traffic upon the highway will be insignificant.

11.5.3 Decommissioning

The predicted lifespan of the Wind Farm is 20 years. At the end of this period the Wind Farm could be decommissioned and the land reinstated. Given the changes in transport that are likely to occur over this time period, it is not considered appropriate to consider the traffic implications of wind farm decommissioning in this ES. Alternatively, and subject to planning conditions, a planning application may be submitted to retain the existing turbines or replace them with new ones.

11.5.4 Criteria for Evaluation

The criteria used for the evaluation are subjective but take into account the numbers affected.

Four criteria have been used in evaluating the traffic and transport impacts of the proposed development:

- the type of effect, i.e. whether it is positive, negative, neutral or uncertain;
- the probability of the effect occurring based on the scale of certain, likely or unlikely;
- the policy importance or sensitivity of the resource under consideration, in a geographical context:- international, national (UK), regional (the motorway and trunk road network of Wales), district (the A road network) or local (the road network in the vicinity of the site excluding motorways and trunk roads);
- the magnitude of the effect in relation to the resource that has been evaluated, quantified if possible or, if not, using the scale high, medium, or low.

Professional judgement is used to assess the findings in relation to each of these criteria to give an assessment of significance for each effect. Effects are considered to be of major or minor significance, or not significant.

11.5.5 Evaluation

The evaluation of effects is set out in Table 11.8.

Table 11.8 Effects and Evaluation of Significance - Traffic

Environmental Effect on Receptors	Type of Effect[1]	Policy Importance (or sensitivity)[2]	Magnitude of Effect[3]	Prob-ability of Effect Occurring[4]	Significance	
					Level[5]	Rationale
Construction						
Increased off-site construction traffic on local roads (A4061)	-ve	District	Low	Certain	Not significant	The percentage increase in total traffic and HGVs on the A4061 are both below the 30% threshold stated in the IEMA guidelines for even an extreme worst case scenario.

Table 11.8 (continued) Effects and Evaluation of Significance - Traffic

Environmental Effect on Receptors	Type of Effect[1]	Policy Importance (or sensitivity)[2]	Magnitude of Effect[3]	Prob-ability of Effect Occurring[4]	Significance	
Operation						
Increased operational traffic due to the development, on the A4061	-ve	District	Low,	Certain	Not significant	The percentage increase in total traffic and HGVs on the A4061 are both below the 30% threshold stated in the IEMA guidelines for even an extreme worst case scenario.

Key/footnotes:		
1.Type of effect	2. Policy importance	3. Quantified and/or scaled as high/medium/low
-ve = negative	I = international	
+ ve = positive	N = national (UK)	4. Certain/likely/unlikely
neutral	R = regional	
? = uncertain	D = district	5. Major/minor/not significant
	L = local	

11.6 Summary and Conclusions

The traffic and transportation assessment has involved identifying the environmental effects arising from the vehicle movements that are anticipated during construction and operation of the proposed Wind Farm. A plausible worst case approach has been taken to the analysis, and it is expected that for much of the construction period the level of vehicle movements will be substantially less than the peak value, which is expected to be in month 3.

In consultation with the highway authorities of Neath and Port Talbot and Rhondda Cynon Taff it has been agreed that the possible impact of vehicle movements on the regional network can be scoped out and that it is the impact upon the A4061 only that need be assessed. This would see the highest number of vehicles during month 3 of the construction phase. There are considered to be no sensitive receptors along the stretch of highway over which the construction and operational traffic will pass. Peak movements will be less than 30% of the total vehicle flows and based on the IEMA guidance there will therefore be no significant effect.

12. Noise

12.1 Introduction

This chapter presents an assessment of the noise impact of the proposed Ffynnon Oer Wind Farm on the residents in the vicinity of the proposed site. The proposed wind farm comprises 16 wind turbines each with a maximum capacity of 1.3MW. For the purposes of this noise assessment, noise predictions are based on the noise specifications of one of the candidate machines, namely the Bonus 1.3MW wind turbine.

Noise can have an effect on the environment and on the quality of life enjoyed by individuals and communities. The impact of noise can therefore be a material consideration in the determination of planning applications. The aim of this chapter is to determine the impact of noise at the nearest properties to the proposed wind farm site and to identify how any adverse noise effects can be mitigated. This assessment therefore considers the impact of noise arising from the construction phase of the project as well as from the operation of the wind farm.

Wind turbines may emit two types of noise: firstly aerodynamic noise, which is a natural sounding noise produced by the movement of the rotating blades through the air; and secondly mechanical noise, which may emanate from gearboxes or generators. There has been rapid progress in reducing both aerodynamic and mechanical noise from wind turbines, and new designs are much quieter than those of a few years ago. Mechanical noise in particular is negligible with modern turbine designs. Aerodynamic noise is usually only perceived at a distance when the wind speeds are fairly low. In higher winds, it is generally masked by the normal sound of wind blowing through trees and around buildings. One of the primary objectives of the assessment is to establish this relationship between wind turbine noise and the existing background noise at residential properties surrounding the proposed wind farm.

The assessment of wind farm noise was undertaken in two distinct phases. Initially the sound levels resulting from the operation of the wind farm experienced at the closest residential receptors were calculated using noise propagation software. These predictions showed that noise levels experienced at the closest receptor were slightly above those which governed whether a detailed noise monitoring programme was required. NWP decided that the detailed monitoring should be undertaken in accordance with current best practice in July and August 2002.

12.2 Methodology

12.2.1 Noise Terminology

The ratio between the quietest audible sound and the loudest tolerable sound is a million to one in terms of the change in sound pressure. Because of the wide range a scale based on a logarithmic basis is used in noise level measurement. The scale used is the decibel (dB) scale which extends from 0 to 140 decibels (dB) corresponding to the intensity of the sound pressure level. The ear has the ability to recognise a particular sound depending on the pitch or frequencies found at the source. Microphones cannot differentiate noise in the same way as the

ear, and to counter this weakness the noise measuring instrument applies a correction to correspond more closely to the frequency response of the human ear. The correction factor is called 'A Weighting' and the resulting measurements are written as dB(A). The dB(A) is internationally accepted and has been found to correspond well with people's subjective reaction to noise.

- L_{WA} is the sound power level. It is a measure of the total noise energy radiated by a source of noise, and is used to calculate noise levels at a distant location.
- L_{eq} is the equivalent continuous sound level, and is the sound level of a steady sound with the same energy as a fluctuating sound over the same period. It is possible to consider this level as the ambient noise encompassing all noise at a given time. The L_{Aeq} is the A-weighted.
- L_{A90} index represents the noise level exceeded for 90 percent of the measurement period and is used to indicate quieter times during the measurement period. It is often used to measure the background noise level.

Typical dB(A) noise levels for familiar noises are given in Table 12.1.

Table 12.1 Typical Noise Levels

Approximate Noise Level dB(A)	Example
0	Limit of hearing
30	Rural area at night, no wind or adverse weather conditions
40	Library
50	Quiet office without noisy machinery, such as typewriters
60	Normal conversation
70	In car noise without radio
80	Household vacuum cleaner
100	Pneumatic drill
140	Threshold of pain

Source : Entec

12.2.2 Guidance and Policy

General guidance and policy concerning noise associated with new developments in Wales is presented in the following documents:

- Technical Advice Note 8: Renewable Energy [1].
- Technical Advice Note 11: Noise[2].

Paragraph A28 of TAN 8 states that:

"Well designed wind turbines are generally quiet in operation."

Paragraphs A29 to 31 in the TAN 8 present a discussion of the broad issues surrounding the assessment of noise from wind farms. This discussion concludes that the use of BS4142:1999 [3] (which is traditionally used for the assessment of industrial noise affecting residential areas) is generally inappropriate for wind farms, and that assessments should be undertaken by reference to the nature and character of the area, with the concluding statement:

> *"Experience from mainland Europe 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 depending on the turbines used and the specific conditions at a site."*

Advice about the impact of noise from construction is included in:

- BS5228:1997: Noise and Vibration Control on Construction and Open Sites [4].

As wind farms started to be developed in the UK about ten years ago, it became apparent that existing noise standards did not fully address the issues associated with the unique characteristics of wind farm developments and there was a need for an agreed methodology for assessing the impact of noise emission from wind farms. This methodology was developed for the Department of Trade and Industry (DTI) by the Noise Working Group (NWG).

The NWG comprised a number of interested parties including, amongst others, environmental health officers, wind farm operators, independent acoustic consultants and legal experts who *"...between them have a breadth and depth of experience in assessing and controlling the environmental impact of noise from wind farms"*. In this way it represented the views of all the stakeholders that are involved in this area of wind farm development. The recommendations of the NWG are presented in the DTI Noise Working Group Report – *The Assessment and Rating of Noise from Wind Farms* [5].

The basic aim of the NWG in arriving at the recommendations was the intention to provide:

> *"Indicative noise levels thought to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on wind farm development or adding to the costs and administrative burdens on wind farm developers or local authorities."*

The DTI Noise Working Group report makes it clear from the outset that any noise restrictions placed on a wind farm must balance the environmental impact of the wind farm against the national and global benefits that would arise through the development of renewable energy sources.

> *"The planning system must therefore seek to control the environmental impacts from a wind farm whilst at the same time recognising the national and global benefits that would arise through the development of renewable energy sources and not be so severe that wind farm development is unduly stifled."*

The DTI Noise Working Group recommendations provide a robust basis for assessing the noise implications of a wind farm and have become a well-respected and accepted standard for such developments within the UK. Furthermore, experience has now demonstrated that the implementation of these recommendations has enabled the construction of wind farms without giving rise to operational noise difficulties. This methodology has therefore been adopted for the present assessment.

12.2.3 Overview of Assessment Procedure

The DTI Noise Working Group assessment procedure specifies that wind farm noise limits should be set relative to existing background noise levels at the nearest properties, subject to a fixed minimum limit, and that these limits should reflect the variation in both turbine source noise and background noise with wind speed. The wind speed range that should be considered ranges between the cut-in speed[13] for the turbines and 12 ms^{-1}, with wind speeds being referenced to a 10 metre measurement height.

Separate noise limits apply for daytime and for night-time. Daytime limits are chosen to protect a property's external amenity i.e. the amenity of people in the curtilage of the building, and night-time limits are chosen to prevent sleep disturbance indoors. Absolute lower limits, which are different for daytime and night-time, are applied where very low levels of background noise would be unduly restrictive on such developments.

The daytime noise limit is derived from background noise data measured during so-called 'quiet periods of the day' [5] at residential properties, which comprise:

- All evenings from1800 to 2300; plus
- Saturday afternoons from 1300 to 1800; and
- All day Sunday 0700-2300.

This data is plotted against the concurrent wind speed data measured at the proposed wind farm site and a 'best fit' correlation established. The quiet day-time noise limit, or 'criterion curve', is then based on a level 5 dB(A) above this best fit curve over a 0 - 12 ms^{-1} wind speed range. Where the criterion curve is found to be below a fixed level in the range 35 - 40 dB(A) then the criterion curve is set at that level. The precise choice of criterion within the range 35 – 40dB(A) depends on a number of factors, including the number of noise affected properties and the potential power output of the wind farm.

The night-time noise limit is derived from background noise data measured during the night-time periods, with no differentiation being made between weekdays and weekends [7]. This is plotted against the concurrent wind speed data and a 'best fit' correlation established. The night-time noise limit is again based on a level 5 dB(A) above the best fit curve over a 0 - 12 ms^{-1} wind speed range. Where the criterion curve is found to be below 43 dB(A), it is fixed at 43 dB(A).

To undertake the assessment of noise impact in accordance with the foregoing methodology, the following steps were undertaken:

- measure the background noise levels as a function of site wind speed at the nearest residential receptors;
- determine the quiet day-time and night-time criterion curves from the measured background noise levels at the nearest residential receptors;
- specify the type and noise emission characteristics of the wind turbines;
- specify the number and locations of the wind turbines;

[13] The cut-in speed is the minimum windspeed that needs to be attained before the turbine starts to rotate.

- identify the locations of the nearest, or most noise sensitive, receptors;
- calculate the noise levels due to the operation of the wind turbines as a function of site wind speed at the nearest neighbours;
- compare the calculated wind farm noise levels with the derived criterion curves and assess in the light of planning requirements.

These steps as applied to the Ffynnon Oer Wind farm are now set out in the following sections.

12.3 Baseline Situation

12.3.1 Background Noise Survey Details

In general subjective terms, the existing ambient noise environment around the Ffynnon Oer Wind Farm site is controlled by 'natural' sources such as wind noise, running water and livestock. Human activity noise is also evident in some areas, mainly that associated with local traffic movements particularly those in the village of Abercregan and to a lesser extent those on the A4107 approximately two kilometres to the south of the site.

Two noise monitoring locations at residential properties were agreed with the Local Authority as being representative of the background noise environment around the wind farm site. These are shown in **Figure 12.1** and listed in Table 12.2 below. Elevations have been determined from OS digital terrain data.

Table 12.2 Noise Monitoring Locations

House Name	Easting	Northing	Elevation (m)
Troed y Rhiw Farm	284440	197400	229
No 24 Prossers Terrace	285250	196550	227

The equipment used for the background noise monitoring exercise comprised 2no. RION NL-31 logging sound level meters. These were enclosed in environmental cases with sufficient battery power to enable approximately 7 days continuous logging at the required 10 minute averaging periods. All measurement systems were also fitted with appropriate wind and rain protection for the microphones to maintain Type 1 measurement accuracy. The microphones were all positioned between 1.2 m and 1.5 m above local ground level and were located on the wind farm side of the property in question, and away from obvious local sources of noise, such as running water or boiler flues. The equipment at Troed y Rhiw was located over 10 metres from any building façade and away from trees as prescribed by the methodology. At Prossers Terrace this was not possible as the garden contained a number of trees. At this location the microphone was positioned as far from the building façade and the closest trees as possible.

All measurement systems were calibrated on deployment on 17 July 2002, with recalibrations and battery changes at approximately weekly intervals until the equipment were removed from site on 21 August 2002. No significant (>0.2dB(A)) drifts in calibration were found to have

occurred on any of the meters. The first week of data recorded at Prossers Terrace between 17 and 25 July became corrupted and could not be used for this assessment. This corruption was caused by a fault in the sound level data logger, this problem was rectified by swapping the faulty equipment for another RION NL-31 sound level data logger.

All measurement systems were set to log the $L_{A90,10min}$ and $L_{Aeq,10min}$ noise levels continuously over the deployment period. The internal clocks on the sound level meters were all synchronized with the timer on the 10 m high meteorological mast, from which wind data was simultaneously collected for the analysis of the measured background noise as function of wind speed and direction.

12.3.2 Measured Background Noise Levels

Figure 12.2 shows the range of wind conditions experienced during the noise survey period. The wind speeds were all measured on a 10m high mast located within the boundary of the proposed wind farm site. **Figures 12.3(a)** to **12.4(b)** show the results of the background noise measurements at each of the locations. The results are presented in terms of $L_{A90,10min}$ background noise levels plotted as a function of 10 m height wind speed. Two plots are shown for each location, one for quiet day-time periods and the other for night-time periods. It is apparent from all the plots that the correlation between background noise level and wind speed is very weak and is a result of the sensitive receptors being located in areas relatively sheltered from the wind.

12.4 Mitigation Measures

The agreed mitigation during the construction stages is set out in Table 12.3. This takes the form of generic mitigation measures. The proposed wind farm layout presented in this document has evolved as a result of balancing energy capture against environmental impact considerations, including noise impacts.

Table 12.3 Mitigation Incorporated into the Construction of the Wind Farm

Impact	Mitigation incorporated into the proposed development	Impact wholly mitigated?
Construction and Decommission Noise		
Increased ambient noise levels	• Use of equipment fitted with effective silencers/insulation.	No
	• Appointment of site contact to whom complaints/queries about construction activity can be directed. Any complaints to be investigated and action taken where appropriate.	Yes
	• Restrictions on the proposed hours of operation to avoid sensitive periods and in particular no night time working without prior agreement.	Yes
	• All construction activity to be undertaken in accordance with good practice as described by British Standard 5228:1997 Noise and Vibration Control on Construction and Open Sites. Decommissioning activity to be undertaken with regard to best practice in place at time of decommissioning.	No
Operation Noise		
Increased ambient noise levels	• Turbine noise will be governed by strict limits relating to windspeed and background noise levels	No

12.5 Calculation of Construction Noise Levels

It is anticipated that the overall duration of the construction stage would be approximately seven months as detailed in the construction programme in Section 2.3. During the construction period a range of different activities would take place within the site, for example, there would be delivery of materials to the site, earthmoving within the site, construction and equipment installation activity. The initial phase of works to lay access tracks will take place across the greater part of the proposed wind farm site. Once access roads are completed then the main plant locations will be at the proposed turbine locations shown on Figure 12.1. There will also be construction plant located at the proposed substation during the course of the construction programme. The greatest potential for noise generation is during the track laying stage and excavating and laying the turbine foundations which is programmed to occur simultaneously during Month 3. This worst case has been used for this assessment.

Construction activities will normally be restricted to between 07:00 – 19:00 hours on weekdays and 07:00 – 16:00 on Saturdays. Evening and night-time working is not expected although it is possible that limited 24 hour working may be required to meet specific demands. However, this would be with prior agreement from the Local Planning Authority. Similarly, working on Sundays or Bank Holidays is not expected unless a specific requirement arises, but again, this would require prior agreement.

Construction noise mainly arises through the operation of large items of plant such as excavators, dump trucks and the delivery and handling of materials. Miscellaneous equipment

including compressors, hand tools, generators, etc. would also be required. However, these have a significantly lower noise output than the large items of plant and any potential noise impacts can be effectively controlled by means of siting and screening.

In order to predict the likely site-attributable noise at any point, the contribution of noise from all individual sources must be included. The main items of plant which are likely to be used are detailed in Table 12.4. Noise data for these sources have been obtained from BS5228 Noise and Vibration Control on Construction and Open Sites 1997 [4].

As the actual types of equipment are not known at this stage, typical source noise data for the construction plant have been obtained from information in BS 5228 which gives an indication of noise levels from construction plant taken from measurements at various sites. It should be noted that as the plant noise levels from BS5228 that are used in the assessment are worst case there is scope for mitigation and reduction by use of modern, quieter plant.

Typically, construction equipment are based on diesel engines which have more low frequency (63Hz to 250 Hz) noise content than domestic equipment. Vehicle sound power levels will typically range from L_{wA} 100dB to L_{wA} 120dB depending on type and operation mode.

Delivery vehicles generate noise levels in the order of L_{wA} 108dB when in motion. However, these types of plant usually pass a reception point quite quickly and when stationary will be in idle which significantly lowers the noise output to the environment.

Miscellaneous equipment including hand tools, etc. would also be required. However, these have a significantly lower noise output than the plant in Table 12.4. As such their contribution is unlikely to be significant.

Table 12.4 Expected Plant Inventory during Track Laying and Foundation Laying

Expected Plant	Number	Assumed Sound Power Level dB(A)	Estimated on-time of activity %	Equivalent Continuous Sound Power Level
1. Track Laying				
Mechanical Excavator	4	112	100	115
Dump Truck	2	115	100	115
Roller	2	116	100	116
2. Foundation Laying				
Mechanical Excavator	2	112	100	112
Cement Mixer Truck	1	112	100	112

12.5.1 Choice of Noise Propagation Model

There are many ways available to predict noise propagation in the environment. For construction noise a defined method of prediction is contained in BS5228. This document forms the basis for the majority of construction works assessments throughout the United Kingdom. The prediction method allows for assessment of:

- distance attenuation;
- defined working areas;
- power on-times;
- working average noise levels;
- screening.

The BS5228:1997 calculations have been applied to the stages with the greatest potential for noise during construction of the proposed wind farm, these are the track building and foundation laying. Calculations have been made for the closest residential receptors as detailed in Table 12.2.

12.5.2 Predicted Construction Noise Levels

Day to day activities would vary and not all the equipment listed in Table 12.4 would be operational at all times. However, in order to assess potential construction noise impacts, worst case predictions for noise during the works have been made. As a detailed construction programme has not been made available the calculations have assumed that all plant is operational simultaneously at the closest part of the site to the sensitive receptors. Clearly, in reality this situation would not occur, as plant would operate at different positions around the site. For this assessment the following assumptions have been made:

- Two track laying teams each comprising 1 excavator, 1 roller and 1 dump truck:
  - the first team located between Turbine 16 and Turbine 10;
  - the second team located between Turbines 11 and 6.
- Two foundation teams each comprising 1 excavator and 1 cement mixer truck:
  - the first team laying the foundations at Turbine 16;
  - the second team laying the foundations at Turbine 11.

Predictions for the civils stage have been made for the closest receptors and the results are summarised in Table 12.5.

Table 12.5 Construction Noise Predictions, $L_{Aeq, 1hour}$ dB

Location	Predicted Noise Level
Troed y Rhiw	45.0
No. 24 Prossers Terrace	37.7

Source : Entec

The detailed construction noise calculations are given in Appendix D. Included in the calculations are assumed separation distances for each of the different operations taking place.

The distances are the closest to the sensitive receptors that activities are considered likely to occur during the civils stage.

12.6 Calculation of Operation Noise Levels

12.6.1 Noise Emission Characteristics of the Proposed Wind Turbine Type

The candidate turbine used in this assessment is the Bonus 1.3MW machine with a hub height of 60 metres. A Technical Note [6] on the measurement of noise emission from a similar turbine but with a slightly lower hub height (45m), contains the following information:

- a sound power level, L_{WA}, of 99.0 dB(A), for a 10 m height wind speed (v_{10}) of 8 ms^{-1};
- a gradient increase/decrease of 0.42 dB/m/s;
- an estimated uncertainty on L_{WA} of ± 2 dB;
- octave band spectra in reference conditions as shown in Table 12.6.

Table 12.6 Octave Band Spectrum for Candidate Wind Turbine in reference wind speed conditions (v_{10} = 8 ms^{-1})

Octave Band Hz	Sound Power Level dB(A)
63.5	82.7
125	89.6
250	91.6
500	92.8
1000	91.3
2000	90.7
4000	87.3
8000	78.4
OVERALL dB(A)	**98.8**

12.6.2 Proposed Wind Turbine and Nearest Neighbour Locations

The Ffynnon Oer wind farm is to comprise 16 wind turbines, the locations of which are shown in **Figure 12.1**. Elevations of turbine locations were determined from OS digital terrain data. Table 12.7 shows the distance to the nearest turbine for the selected residential receptors at which background noise levels were measured, as shown in **Figure 12.1** and listed in Table 12.2. As can be seen, the minimum separation distance between any turbine and the nearest residential property is approximately 660 m.

Table 12.7 **Distances to Nearest Turbines (in metres)**

House Name	Nearest Turbine	Distance (m)
Troed y Rhiw Farm	16	660
No. 24 Prossers Terrace	16	1700

12.6.3 Choice of a Noise Propagation Model

Whilst there are several noise propagation models available, here the ISO 9613-2 model has been used [7] to calculate the wind farm noise levels at the selected nearest residential receptors. This model has been identified as most appropriate for use in predicting far-field noise radiation from wind turbines in such rural sites. In this instance, the model took account of:

- geometric divergence;
- air absorption;
- ground reflections.

To make the predictions, it was assumed that:

- the turbines are identical;
- the turbines radiate noise at the power specified in Table 12.6;
- each turbine can be modelled as a point source at hub-height.

Noise levels arising from the operation of the proposed wind farm at Ffynnon Oer have been calculated using the ISO 9613-2 algorithm option in the LIMA commercial noise propagation software. The software package uses as its acoustic input data the octave band sound power output of the turbines and calculates, on an octave band basis, attenuation due to geometric spreading, atmospheric absorption, and ground effects. It was decided to set the inputs to the model to give the worst case scenario and as such the highest levels of predicted noise. In order to do this it was necessary to exclude ground cover (ie vegetation) from the predictions as it is non permanent and may be subject to change during the life of the wind farm. In reality, the wind passing through trees and other forms of vegetation will help mask the noise generated by the wind farm by increasing the background noise levels. Similarly, the model assumed hard ground between the turbines and the receptors, as hard surfaces appear to have virtually no absorption properties whereas maximum attenuation occurs over grassland. Topography can also have a significant effect on noise propagation but the effects can be quite unpredictable and as such has been omitted from the model. By excluding topographic features the model illustrated how the wind farm noise would propagate over flat ground which in reality is unrealistic but adds to the worst case scenario. The noise model predicts noise levels in terms of L_{Aeq}, in order to convert these levels to L_{A90} levels, which are recommended by the NWG report, a simple subtraction of 2 dB has been made to all levels.

The ISO 9613-2 algorithm has been chosen as being the most robust prediction method, based on the findings of a recent joint European Commission research project into wind farm noise propagation over large distances. The title of the research project was 'Development of a Wind Farm Noise Prediction Model', JOULE project JOR3-CT95-0051. The final report is given as reference [8].

Whilst it is impossible to specify exact error bands on noise predictions, the ISO 9613-2 model was found to be the best available, both in flat and complex terrain. This model, like all the others, tends to over-estimate the noise at nearby dwellings, rather than under-estimate it. The overriding conclusion of the work undertaken as part of the EC research study was that the ISO 9613-2 algorithm tended to predict noise levels that would generally occur under downwind propagation conditions. The probability of non-exceedence of the levels predicted by the ISO 9613-2 algorithm was around 85%. The other important outcome of the research was to clearly demonstrate that under upwind propagation conditions between a given receiver and the wind farm, the wind farm noise level at that receiver will be as much as 10dB(A) to 15dB(A) lower than the level predicted using the ISO 9613-2 algorithm.

All noise level predictions, both day and night, are undertaken using a receiver height of 2.0 m above local ground level.

12.6.4 Predicted Wind Farm Noise Immission Levels

Table 12.8 shows the predicted wind farm noise levels, L_{A90}, likely to be experienced at the residential receptors for each 10m height wind speed from 4 ms^{-1} to 12 ms^{-1} inclusive. These levels were predicted using no topographical features and can therefore be taken to be worst case. All wind farm noise levels in this report are presented in terms of the L_{A90} noise indicator, in accordance with the recommendations of the NWG Report [5].

Under the recommended reference wind speed, i.e. v_{10} equal to 8 ms^{-1}, predicted wind farm noise levels at 2.0 m height are 38.2 dB(A) at Troed y Rhiw Farm and 29.9 dB(A) at No. 24 Prossers Terrace.

Figure 12.5 shows the L_{A90} isobel (ie noise contour) plots for the site at the reference wind speed of v_{10} equal to 8 ms^{-1}. Such plots are useful for evaluating the noise 'foot print' of a given development.

Table 12.8 Predicted Wind Farm Noise Levels ($L_{A90,T}$ dB) at 2.0m height at Receptor

House Name	Reference Wind Speed (v_{10})/ms^{-1}								
	4	5	6	7	8	9	10	11	12
Troed y Rhiw Farm	34.5	34.9	35.4	35.8	36.2	36.6	37.2	37.6	38.2
No. 24 Prossers Terrace	26.2	26.6	27.1	27.5	27.9	28.3	28.7	29.2	29.6

12.7 Evaluation of Noise Impact

12.7.1 Construction Noise

The predicted construction noise levels have been compared to the daytime background noise levels at the receptors. The comparison is given in Table 12.9 below.

Table 12.9 Comparison of Measured Background Noise Levels and Predicted Construction Noise Levels

Receptor	Predicted Construction Noise $L_{Aeq\ 10\ hour}$ dB	Background Noise	
		$L_{Aeq\ 10mins}$ dB	$L_{A90\ 10\ Mins}$ dB
Troed y Rhiw	45.0	32.3 - 61.4	30.9 - 53.7
No 24 Prossers Terrace	37.7	35.7 - 64.6	33.9 - 46.5

Comparison of the day-time ambient noise levels in terms of the L_{Aeq} dB index indicates that the predicted construction noise levels are similar to, or lower than, the prevailing levels. Comparison of the predicted construction noise levels with the prevailing L_{A90} dB background noise levels (the underlying noise level at quiet day-time periods) indicates that for some periods of the programme the difference could be up to approximately +15 dB(A).

Given the foregoing observation, construction noise can be expected to be distinctly audible at quiet times during the working day at periods when works are close to each receiver location. However, the ambient noise climate, including natural sources such as running water and the wind blowing through vegetation, and local vehicles will provide some masking noise reducing the subjective audibility.

DOE advisory leaflet AL72 [9] provides current information regarding the potential impacts of construction site noise. It gives advice as to the maximum levels of construction site noise at adjacent occupied buildings during daytime hours (07:00 to 19:00 hours).

The area around the site is rural and as such, the relevant criteria from AL72 are as follows:

Daytime (07:00 - 19:00) facade[14] $L_{Aeq\ 12\ hour}$	70 dB(A) – for rural, suburban and urban areas
Evening (19:00 - 22:00) facade $L_{Aeq\ 12\ hour}$	60 dB(A) – no construction anticipated
Night-time (22:00 - 07:00)	no construction.

The predicted construction noise levels during the worst-case track laying and foundation stage relate to free field conditions. Predicted values are within the criterion for daytime construction noise levels. Noise generating activities are not anticipated to occur during the evening or night-time periods. Although construction noise is likely to be audible at the closest properties, particularly during working in the closest areas of the site, it would be well below generally accepted criteria for maximum levels of construction noise.

[14] Note – façade noise levels are those within 1 m of the affected building where the effects of noise reflections occur.

12.7.2 Operation Noise

Figures 12.6(a) to **12.7(b)** show the predicted wind farm noise levels received at the receptors overlaid on the criterion curves derived from the background noise measurements (**Figures 12.3(a)** to **Figure 12.4(b)** inclusive) in accordance with the NWG recommendations.

It can be seen from **Figures 12.6(a)** to **12.7(b)** that the quiet day-time criterion is met at both properties and for all wind speeds and, like the quiet daytime situation, the night-time criterion is again satisfied at both properties for all windspeeds.

12.7.3 Evaluation of Noise Impacts

Table 12.10 below summarises the noise effects of the proposed development and assesses their significance.

Four criteria have been used in evaluating the noise effects of the proposed development:

- the type of effect, i.e. whether it is positive, negative, neutral or uncertain;
- the probability of the effect occurring based on the scale of certain, likely or unlikely;
- the policy context for the evaluation based on the following:
  - international (trans-national boundaries);
  - national (Wales wide);
  - regional (South Wales);
  - district (greater than 2 km beyond the site, but less than 20km);
  - local (within a 2 km radius of the site boundary);
- the magnitude of the effect in relation to the resource that has been evaluated, i.e. high, medium, low or no effect.

The findings in relation to all of these criteria are brought together to give an assessment of significance for each effect. Effects are considered to be of major, minor or no significance. This assessment relies on professional judgement rather than any scoring of the criteria.

Table 12.10 Effects and Evaluation of Significance

	Type Of Effect	Probability Of Effect Occurring	Policy Importance or Sensitivity	Magnitude of Effect	Significance Level	Rationale
Construction Phase						
Noise at properties and recreational receptors due to construction activity	-	Likely	Local	Mostly - Minor, however, could be short periods of Some effect during specific works	Low	High noise levels would be short-term and would generally vary over the construction phase. Mitigation measures would be used to reduce effects and noisy activities would be restricted to day-time periods
Operation Phase						
Operational Noise	-	Unlikely	Local	Minor	Low	Mitigation to meet agreed design criteria levels will ensure no effect at closest properties

Key:	Type	Probability	Policy Importance	Magnitude	Significance
	-ve = Negative	Certain	International	Major	High
	+ve = Positive	Likely	National (UK)	Some	Low
	? = Unknown	Unlikely	Regional	Medium	Not Significant
	0 = Neutral		District Local	Minor	
				None	

12.8 Summary of Key Findings and Conclusions

12.8.1 Construction Noise

The potential impact of noise generated through the construction of the wind farm has also been addressed. This noise impact has been assessed in accordance with guidance given in:

- Technical Advice Note 11: Noise [1];
- BS5228:1997: Noise and Vibration Control on Construction and Open Sites [4].

12.8.2 Wind farm Noise

The acoustic impact of the operation of the proposed Ffynnon Oer wind farm on the local environment has been assessed in accordance with the accepted guidance on wind farm noise assessment as issued in the DTI publication 'The Assessment and Rating of Noise from Wind Farms' [5]. The assessment has also accounted for other appropriate relevant standards and guidelines, including:

- Technical Advice Note 8: Noise [1];
- Technical Advice Note 11: Renewable Energy [2].

The assessment has been undertaken of the noise impact at two properties, Troed Y Rhiw which is the closest property to the site and therefore subject to the greatest potential noise impacts and Prossers Terrace whose location was agreed as being representative of other potential receptors in the area. These properties are listed in **Table 12.2** and shown on **Figure 12.1.**

The proposed wind farm comprises 16 wind turbines with a minimum separation distance of approximately 675m between any residential property and the nearest turbine.

Calculations have been undertaken for the candidate Bonus 1.3MW turbine. Predicted noise levels under reference wind speed conditions ($8ms^{-1}$ measured at 10 m height) are 36.2dB(A) at Troed y Rhiw and 27.9dB(A) at Prossers Terrace. The DTI NWG Guidelines recommend that during the day-time periods the allowable wind farm noise limit be set to 5dB(A) above the measured background noise level with a minimum level set in the range of 35 to 40dB(A), (minimum level not used in these cases as the background noise is above 35dB(A)at all wind speeds at which the turbines would be operational). However, during night-time periods, when most people would be expected to be indoors, a higher noise level is permissible than during day-time. In this instance, if the background noise level falls below 38dB(A) then the night-time absolute fixed noise limit is set to 43dB(A).

Applying the foregoing noise limits to the Ffynnon Oer Wind farm at the agreed assessment locations results in compliance at all properties for all wind speeds.

12.9 References

1 Technical Advice Note 8: Renewable Energy, Welsh Office, 1996.

2 Technical Advice Note 11: Noise, Welsh Office, 1997.

3 BS4142:1997: Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas, British Standards Institute, HMSO, 1997.

4 BS5228:1997: Noise and Vibration Control on Construction and Open Sites, HMSO, 1997.

5 The Working Group on Noise from Wind Turbines: 'The Assessment and Rating of Noise from Wind farms', ETSU Report ETSU-R-97, 1996.

6 'Measurement of Noise Emission from a Bonus 1.3MW Wind Turbine Situated Kassøvej 26, DK-6230 Rødekro', Delta Noise and Vibration, 2000.

7 'Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation', International Standards Organisation, ISO 9613-2, 1996.

8 'Development of a Wind farm Noise Propagation Prediction Model', Bass J H, Bullmore A J, Sloth E, Final Report for EU Contract JOR3-CT95-0051, 1998.

9 Advisory Leaflet 72 Noise Control on Building Sites, Department of the Environment, 1976.

13. Hydrology and Hydrogeology

13.1 Introduction

This section describes the existing site hydrology, the local surface water environment and groundwater conditions at the site and surroundings. It also describes an approach for managing surface water during the construction and operation of the proposed development. Based on the sensitivity of the local water environment a strategy for managing and protecting water resources is described.

13.2 Methodology

The methodology is based on the collection of a wide range of data and published material, plus consultations with statutory bodies, relating to the site and surrounding water environment. The data collected and other sources of information reviewed are listed in Table 13.1. Consultations and data collection were undertaken with the Environment Agency (EA) and the Neath Port Talbot County Borough Council. These consultations focused on the use of the local water environment for water supplies. Additional EA data was collected from their website (www.environment-agency.gov.uk).

The assessment has been undertaken primarily using a qualitative assessment based on professional judgement and statutory and general guidance. Such guidance includes the following:

- PPG 25 Development and Flood Risk;
- Groundwater Regulations 1988;
- Environment Act 1990;
- EA Pollution Prevention Guidance Notes (PPG);
- EC Fisheries Directive (78/659/EEC);
- EC Dangerous Substances Directive (76/464/EEC);
- Private Water Supply Regulations 1991;
- Forestry Commission 'Forests and Water Guidelines' 2000.

Table 13.1 Sources of Information: Hydrology and Surface Water Quality

Topic	Source of Information
Climate	
Rainfall	Centre for Ecology and Hydrology (CEH) national river flow archive (website www.nwl.ac.uk/ih/nrfa)
Surface waters	
Water quality and pollution incidences	Environment Agency website (www.environment-agency.gov.uk)
River flows	Centre for Ecology and Hydrology (CEH) national river flow archive (website www.nwl.ac.uk/ih/nrfa)
Water abstractions	Environment Agency and Neath Port Talbot County Borough Council
Groundwater	
Groundwater vulnerability	Groundwater Vulnerability Map of West Glamorgan, Sheet 35
Abstractions and Discharges	
Licensed abstractions	Environment Agency Consultation
Private Water Supplies	Neath Port Talbot County Borough Council Consultation
Consented Discharges	Environment Agency Consultation
Soils Environment	
Soil type	Soils of England and Wales, Sheet 5, Southwest England

13.3 Baseline Information

13.3.1 Site Description and Topography

The site is located in an elevated position with a high point of 464 mAOD which forms part of a larger ridge referred to as Cefnmawr. Since this is a high point a number of drainage catchment areas are located within the site. The site itself is situated on gently sloping ground, whereas beyond the site slopes become steeper. To the north and beyond the site the flat plateau gives way to a narrow valley leading to the Vale of Neath. This is a wide flat bottom valley which is glacial in origin. To the south and west of the site small valleys give way to Cwm Afan.

13.3.2 Climatic Conditions

Rainfall data for the general area is available for the river flow gauging station at Resolven (SN 815017) sourced from the National River Flow Archive (www.nwl.ac.uk/ih/nrfa). Annual average rainfall for the period 1961-1990 is 1949 mm. This reflects the rainfall at the gauge which is located at an elevation of 15.1 m AOD, compared to an average level of 440 m AOD within the site. Therefore since the effect of altitude can increase rainfall a higher annual average rainfall value is expected within the site. The National River Flow Archive also quotes losses from the gauge to equal 652 mm, and this is an approximate of evaporative losses at the gauge. Deducting rainfall from evaporative losses gives an indication of net rainfall, which is

defined as the quantity of rainfall that becomes available for runoff. Net rainfall for the site equates to ~1300 mm, though the effects of altitude within the site boundary would tend to result in a slightly higher value. However, this value of net rainfall illustrates how the site will be subjected to heavy rainfall and significant potential will exist for the derivation of runoff from the site throughout the year.

13.3.3 Surface Water Environment

Existing Surface Drainage

Due to the elevated location of the site runoff flows to three separate catchments (Figure 13.1). Approximately 0.36 km^2 drains northwards to a tributary of the Melin Court Brook. This tributary flows within the site and is sourced from a spring and a well called 'Ffynnon Oer' which are both located within the proposed site (Figure 13.1). Still within the site the stream flows into a small pond feature, which reflects an area of flatter topography. Just beyond the proposed site boundary the stream enters an area of overgrown vegetation and marshy ground. The stream is less well defined in this area. Further tributaries enter the Melin Court Brook though these are located outside the proposed site boundary, and some of these are fed by springs. The Melin Court Brook follows a relatively straight course and passes over a number of waterfalls. The Melin Court Brook eventually flows into the River Neath.

Drainage to the west flows towards an area of forestry and drains approximately 0.45 km^2 of the proposed site. A small drainage channel carries some drainage and water from the 'Ffynnon Oer' spring, and is perhaps a relic of previous water management within the area. A number of drainage channels are present within the forest and these ultimately drain to the Nant Twynpumerw and the Nant Y Cywion and subsequently into the Nant Blaenpelenna (Figure 13.1).

The remaining catchment area drains southwards and is the largest area draining the site at approximately 0.79 km^2. This area is wetter than the remainder of the site, with areas of wet grassland in the southern section of the site. Drainage from this area is sourced from springs along with the wet grassland areas. A number of small channels drain this area and feed the Nant Cregan. There is a change in land use at the site boundary where upland grassland gives way to forestry. The Nant Cregan drains a predominantly forested catchment. The Nant Cregan flows within an incised valley and outflows into the River Avan (Figure 13.1).

Surface Water Quality

The EA have not carried out any specific water quality monitoring within any of the surface watercourses of the site. In general surface water within the site will consist primarily of rainfall and any spring discharges, the quality of which are expected to be generally good and unpolluted.

Water quality data is available for a number of surface watercourses near the site, based on the EA General Quality Assessment (GQA) classification scheme. To the southwest of the site the EA monitor a minewater discharge at Twyn Pumerw, which enters the Nant Bleaenpelenna (Figure 13.1). Agency data, sourced from their website, indicate a 'good' chemical and biological quality of water with low nitrates and phosphates. Data is also available for the Neath Canal Weir, and as with the Twyn Pumerw discharge, water quality is classified as 'good'. Water quality that has been classified as 'good' under the GQA scheme is classified as water that would be suitable for abstraction and for both salmonid and cyprinid fisheries.

13.3.4 Groundwater Environment

Groundwater Flow

Geological mapping shows the site to be underlain by Carboniferous Upper Coal Measures strata. The conjectured outcrop of the Mountain coal seam is shown in the north and south of the site - essentially following the hilltop relief. In the west of the site the Graigola seam is also brought to outcrop by the north - south trending Pen-y-Castell fault. Superficial deposits are not shown at the site. However in the west and north of the site, on the slopes to the higher ground, landslipped ground is shown.

Based on the Groundwater Vulnerability Map of West Glamorgan and following consultation with the EA the site overlies strata that is classified as 'minor' aquifer. Minor aquifer is defined as having variable permeability due to fractures within low primary permeability rocks. They tend not to produce large quantities of groundwater for abstraction, though they can be locally important for local supplies and in supplying base flow to rivers. The Groundwater Vulnerability Map of West Glamorgan also classifies the soil overlying geological strata, in terms of its ability to convey water and contaminants into groundwater from the surface. The soils at the site are classified as having a low potential to convey water and contaminants into groundwater.

A number of groundwater features are present within the site, with the Melin Court Brook being fed by the Ffynnon Oer spring. In addition a number of issues result across the site and these will probably reflect the drainage of rainfall over Cefn Mawr through soils and near surface strata.

Groundwater movement and flow in the area is likely to have been effected by historical mining. The effects of mining will have been to create preferential flow paths, and to alter water levels particularly during mining. Most of the mining is historical and it is expected that water levels would have recovered to normal levels. It is not expected that any future springs will occur over the site from recovering minewater levels.

Groundwater Quality

No groundwater quality information is available for sources within the site. However, some of the surface watercourses within the site are fed by groundwater springs, and these surface watercourses do not appear to suffer from any particular water quality problems. Since the area local to the site has historically been subject to coal mining the potential exists for discharges of groundwater from mines. Such discharges could be contaminated with typical minewater pollutants, such as iron pyrite which oxidises at the surface to form ferric iron. Ferric iron or iron ochre can become deposited on the bed of watercourses and lead to environmental problems, such as reduced oxygen content and smothering of channel beds.

Such minewater discharges do occur within the locality of the site, with minewater treatment projects implemented in the River Neath catchment at Ynysarwed and on the River Pelenna, which is a tributary of the River Afan. Following consultation with the EA it is not believe that there are any minewater discharges within or close to the site that result in water quality problems. The minewater discharge at Twyn Pumerw, which enters the Nant Bleaenpelenna, is defined by the Agency as being of 'good' quality. However, the potential exists for such minewater discharges to occur from the old mineworkings located within the locality of the site, though the risks of such discharges are small particularly as no discharges have occurred to date.

13.3.5 Soils Environment

Soils information for the site is based on the Soils Map of England and Wales, Sheet 5, Southwest England. Information on the soils environment provides useful data for interpreting the hydrological regime of a site.

The major soil type underlying the site is the Gelligaer Association (654c) which consist predominantly of loamy permeable soils with a wet peaty surface. They can often have deposits of iron forming 'ironpans' which form an impermeable barrier to water movement. To the northwest of the site the soils belong to the Wilcocks 1 Association (721c). These are classified as slowly permeable loamy soils over clayey soils with peat surface horizons. Soils also differ to the southwest of the site. Soils here are more peaty and belong to the Crowdy 2 Association (1013b).

13.3.6 Abstractions and Discharges

There are three EA licensed abstractions within a 2 km radius beyond the site. These licences are located approximately 1.75 km from the boundary of the site and are used for lake top up and through flow. In addition to EA licensed abstractions, additional abstractions for private water supplies can be found. These abstractions are typically less than 20 m^3/day and are generally for the supply of drinking water to individual dwellings. Consultation with Neath Port Talbot County Borough Council has identified that there are three private water supplies located close to the site, with the closest approximately 1.2 km from the site boundary. The location of these private water abstractions are illustrated on Figure 13.1. Whilst these abstractions are located relatively close to the site, none are located within catchment areas that are drained by the site. Water quality data provided by Neath Port Talbot County Borough Council indicate that the quality of each of these sources meets the Private Water Supply Regulations 1991.

The EA has also provided details relating to licensed discharges. The EA is aware of two groundwater discharges, one of which is located within the site, and the remaining one located approximately 1.25 km from the site. These discharges are for the disposal of sheep dip direct to ground. The authorisation for the sheep dip disposal on the site allows a maximum discharge rate of spent sheep dip of 0.5 m^3/day and a maximum of 1.5 m^3/annum. The location of both licences are illustrated on Figure 13.1.

13.3.7 Hydrological Regime

The site is located within a relatively wet climate since annual net rainfall is over 1000 mm. This wet climate is reflected in the development of peat soils at the site, since these need to remain perennially wet to develop. Peat soils have a relatively high water storage capacity and therefore the site and surrounding will remain wet underfoot for the majority of the year. Excess rainfall not taken into soil storage will result in runoff from the site. This is directed into a number of small streams which radiate from the site. In addition areas of ponded water develop creating areas of wet grassland. Areas adjacent to the site have been forested and it is apparent that these areas have been artificially drained since there are a number of drainage channels within these areas.

Groundwater is present beneath the site, most probably in small quantities, and supports a number of the small streams radiating from the site. The majority of groundwater most probably represents rainfall over Cefn Mawr draining through soils and near surface strata. In places groundwater will have been effected by historical mining. Mining will most probably

have created preferential flow paths, though the extent of mining is limited beneath the site to shafts and small scale near surface adits. These features will not particularly have effected groundwater flow paths beneath the site.

13.4 Mitigation Incorporated into the Proposed Development

13.4.1 Introduction

Table 13.2 sets out the proposed mitigation measures to limit adverse impacts on the water environment. Mitigation proposals are divided into those relating to the construction and operational phase.

13.4.2 Construction Phase

Access Roads

Access roads within the site will be constructed using a standard floating road design. The access roads will also avoid areas of deeper peat to ensure that there will be no damage in these areas.

Drainage from roads will also be directed into adjacent areas to directly replenish soils. Limited lateral drains will be provided for surface water runoff which may collect on the uphill side of roads running parallel to contours. Access roads will be cambered to ensure that drainage is quickly shed off the roads onto surrounding land. This is designed to minimise the flow of water along roads causing erosion of road surfaces. The design of the access roads and drainage will be such that sediment erosion and transportation is minimised to ensure that the input of sediments into any watercourse is minimised. In particular it will be necessary to ensure that the private water supply located on the Nant Cregan is protected. Water quality leaving the site and entering the Nant Cregan will be monitored throughout the construction phase to ensure that there is no deterioration in stream quality.

Access roads will need to cross a number of streams within the site. Stream crossings will use a standard approach most likely to be sulphate resistant concrete culverts. Limited bank stabilisation works, using geotextile or other natural and sustainable materials, will be required either side of the stream crossings to ensure that stream erosion does not occur in these areas, particularly if any disturbance to banks has occurred during construction. Stream crossings will consist of culverts of sufficient size to convey maximum likely flows, to ensure that there is no risk of water backing up behind the culverts which could place pressure on the roads and lead to bankside erosion of peat in the vicinity of the crossing.

Electric Cables

The laying of electric cables, to connect the wind turbines with the on site substation, will be in small trenches, to minimise damage to the properties of soils. Trenches would be dug during drier periods, if possible, and any spoil material will be placed on the uphill slope to reduce the likelihood of runoff entering the excavations. The electric cables will be quickly placed within the trenches and soils replaced to minimise the ingress of water into the trenches.

Wind Turbines and Crane Pads

The installation of the wind turbines and crane pads will require the excavation of soils to provide a firm structural footing.

The wind turbines will be constructed on concrete support plinths, which will be placed on a solid footing i.e., solid strata or mineral soils. The support foundations will be formed by pouring concrete into the excavations. Sulphate resistant concrete will be used so that acid rich waters do not have a corrosive effect on the turbine bases.

Wind turbines will be positioned far enough away from watercourses to ensure that any accidental spillage of concrete during concrete pouring will not pose a risk to surface water. The consistency of the concrete will also be such that there is no potential for the concrete to enter the soil water environment and be transported through the soils either to groundwater or surface water sources. Spill response measures will be put in place to ensure that any accidental spillages at the surface can be contained and quickly removed from the site.

Excavated soils for the turbine foundations will in general be replaced on the turbine footing or used to restore other parts of the site. However, it may be necessary to excavate and remove from site any soils excavated within the area where sheep dip disposal currently occurs. Such soils would be removed from site and disposed of within an appropriately engineered disposal site.

Source of Roadstone

The construction of the access roads will require the sourcing of roadstone from an opencast located within the adjacent areas of forestry. The roadstone will need to be crushed and sorted within that site. This will avoid erosion of sediments entering nearby watercourses at Ffynnon Oer.

Site Working Practices

As with similar construction operations there will be heavy plant and machinery on site, and this results in the need to store oils and diesel. With such storage and during refilling and maintenance operations there is the potential for accidental spillages. As a result the storage of oils and diesel will be within either the temporary put down compound or close to the roadstone processing plant. Storage will be within impervious storage bunds with 110% capacity, so that any spillages will be contained. Refuelling of machinery will also be undertaken within designated areas, so that any spillages can be easily contained.

Throughout the construction phase best working practices will be adopted and measures to protect the water environment will be made by adopting recommendations set out in the following EA Pollution Prevention Guidance Notes (EAPPG):

- EA PPG 1 General Guide to the Prevention of Water Pollution;
- EA PPG 2 Above Ground Oil Storage Tanks;
- EA PPG 5 Works in, near or liable to affect watercourses;
- EA PPG 6 Working at Construction and Demolition Sites.

A risk assessment of activities will be undertaken to ensure that nearby private water supplies are protected throughout the scheme, as stated earlier.

13.4.3 Operation Phase

Apart from the operation of the wind turbines and general maintenance of the turbines, there will be few on-site activities during the operational phase. However, the developed site has the potential to affect the water environment beyond the construction phase resulting in the need to develop a longer term sustainable mitigation strategy.

Access Roads

The proposed mitigation for the potential impacts of the access roads on hydrology and soils was described under the construction phase, and will continue to function throughout the operational phase of the site. Methods incorporated into the scheme are designed to be sustainable and to cope with storm events. Therefore only routine maintenance is envisaged to be necessary for the road network within the site during the operational phase.

Site Working Practices

As stated earlier, there will be very little in the way of on-site activities during the operation of the wind farm. However, there will still be the need to carry out regular maintenance of the wind turbines and this will require regular access by maintenance crews. During such activities there may be the need to bring oils, greases and other substances, bringing with it the potential for accidental spillages. Such spillages are likely to be very small and since site drainage will be limited the risk to downstream watercourses from such spillages would be very low.

However, throughout the site operation best working practices will be adopted and measures to protect the water environment will be made by adopting recommendations set out in the following EA Pollution Prevention Guidance Notes (SEPPG):

- EA PPG 1 General guide to the prevention of water pollution;
- EA PPG 5 Works in, near or liable to affect watercourses.

To reduce the risk of pollution by sheep dip, via new pathways created by the wind farm development, NWP will arrange for the disposal of the spent sheep dip off site at an appropriate disposal site.