

Consortium of South
Wales Valleys Authorities

**TAN 8 Annex D study of
Strategic Search Areas
E and F: South Wales
Valleys**

Final report

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Wales Valleys Authorities

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December 2006

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Executive Summary

Introduction and context

In July 2005 the Welsh Assembly Government (WAG) published the Ministerial Interim Planning Policy Statement (MIPPS) 01/2005: Planning for Renewable Energy¹ and *Technical Advice Note (TAN) 8: Planning for Renewable Energy*. This TAN indicates that there are only a few relatively unconstrained areas in Wales that are capable of accommodating large scale (>25MW+) wind power developments; these areas comprise 7 Strategic Search Areas (SSA). The availability of existing or planned electrical grid infrastructure was a significant factor in the identification of these unconstrained areas.

Two of these 7 areas are Area E “Pontardawe” and Area F “Coed Morgannwg” which the TAN suggests have an “indicative generating capacity” of 100 MW and 290MW respectively (approximately 50 and 150 modern wind turbines of 100m in height).

An extract from TAN 8 showing the extent of the published SSAs is included within the main report.

Paragraph 2.3 of TAN 8 indicates that “Local Planning Authorities are best placed to assess detailed locational requirements within and outside SSAs in the light of local circumstances” and that (Para 2.10) “Local Planning Authorities should take an active approach to developing local policy for SSAs in order to secure the best outcomes. Further advice is contained within Annex D [of TAN 8]”. A consortium of South Wales Valley Planning Authorities² have therefore jointly commissioned consultants (Arup (with sub-consultants)) to undertake such a refinement exercise of SSA E and F which a view to providing an evidence base for subsequent planning policy formation and decision-making.

This Arup study is primarily a landscape and visual assessment exercise which seeks to identify a ‘Preferred Area or Areas’ for large-scale wind farms broadly within the boundaries of the Strategic Search Area(s), working within the context of the indicative capacity targets for the SSAs (identified in TAN 8 in Table 1 Page 5). The study however also uses a range of technical and other environmental data to inform its work.

No formal consultation has been undertaken with statutory bodies as part of the study; the only discussions that have taken place have been with the Planning Authorities that commissioned the study.

Approach

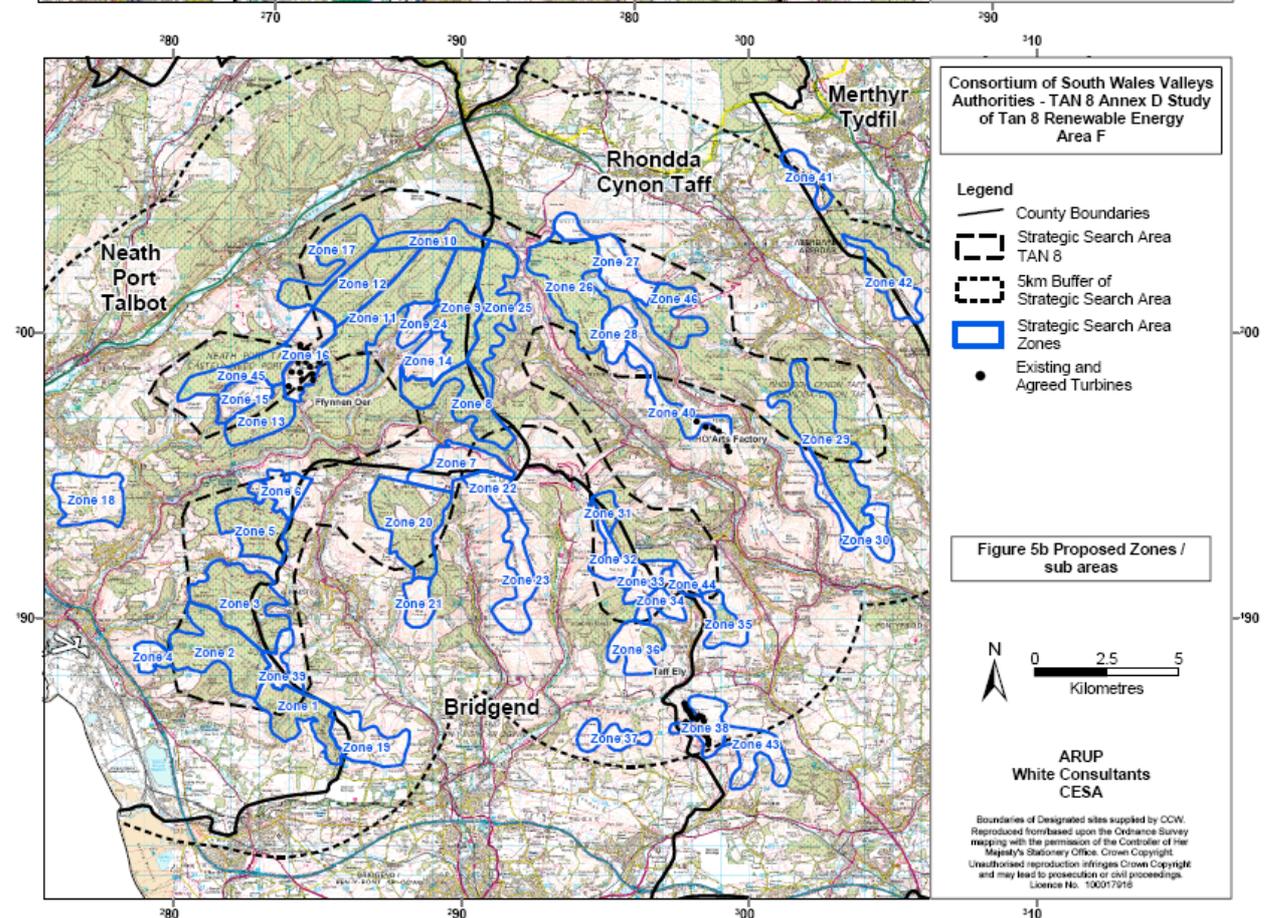
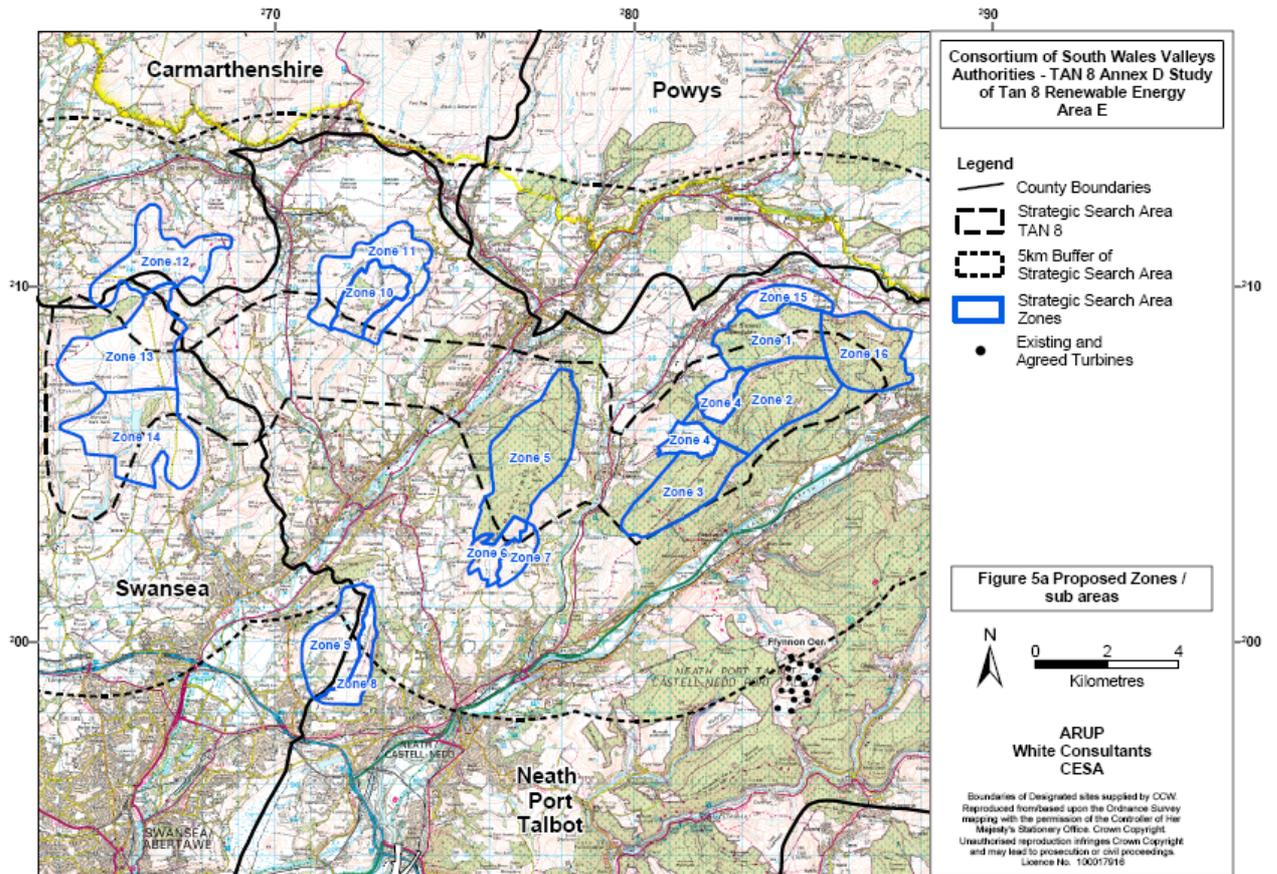
In order to assist in the discrimination of the environmental performance of the SSA as defined, the technically feasible parts of the SSA and its margins up to 5km were sub-divided into smaller spatial units, termed *zones*. The zones were derived so that they can enable discrimination between parts of the SSAs in landscape and visual terms. It follows therefore that each zone should have similar landscape and visual characteristics (i.e. they are homogeneous landscape units where possible) and are therefore based upon the units published in existing landscape assessment studies such as LANDMAP. By virtue of an initial constraint analysis, the zones coincide with areas considered both “technically feasible” for the development for larger scale wind farms and largely free of other environmental constraints. The range of constraints considered included wind speed, slopes, residential properties, Sites of Special Scientific Interest and Scheduled Ancient Monuments; the presence or absence of settlement and/or suitable wind resource has been shown to have the greatest influence on the available areas for further study.

Some 62 zones were derived, and these are shown on **Figure A** below.

¹ The MIPPS amends Sections 12.8 to 12.10 of Planning Policy Wales (PPW) (2002).

² Led by Neath Port Talbot County Borough Council, the consortium also comprises the City and County of Swansea, Carmarthenshire County Council, Bridgend County Borough Council and Rhondda Cynon Taff County Borough Council.

Figure A - SSA Zones derived for the study, SSAs E and F



The study first reviews the defined zones as to whether they are broadly acceptable in accordance with the following TAN 8 criteria (Para 2.9 p 6):

- Comprise an extensive area with a good wind resource
- Be an upland area (typically over 300m above ordnance datum) which contains a dominant landform that is flat (plateau) rather than a series of ridges.
- Be generally sparsely populated.
- Be dominated by conifer plantation and/or improved/impoverished moorland.
- have a general absence of nature conservation or historic landscape designations.
- Be of sufficient area to accommodate developments over 25MW, or at least in combination with other contiguous SSA parts be able to accommodate developments over 25MW

TAN 8 Annex D Para 8.6 indicates that at the local level, accepted thresholds of change, having regard to nationally developed capacity targets, can be established by more detailed assessments.

Therefore, in addition, the defined zones have been reviewed for broad acceptability in accordance with the following criteria (developed specifically for this study):-

- To have a LANDMAP visual and sensory Value aspect rating of less than 'Outstanding'
- To have a landscape sensitivity that is less than 'High'
- To have visual impacts upon residential dwellings that would not cause 'dominance'
- Not to cause cumulative landscape or visual impact upon settlements within the SSA

These criteria and their explanation/justification are set out within Chapter 4 of this report : Landscape and visual analysis.

The study then ascertains the *relative* environmental and landscape performance of the SSA zones which pass the above tests (those which are "environmentally acceptable ") with respect to the following criteria:

- **LANDMAP Visual and sensory value.** This is derived largely from desk study based upon published landscape assessments. The Visual & Sensory aspect of LANDMAP identifies those landscape qualities within the zone that are perceived through the senses. It deals with the individual physical attributes of landform and land cover, as well as their visual patterns of distribution and sensory characteristics, and the relationships between them in a particular area
- **Landscape "capacity"** to large scale wind farms i.e. a physical property relating to the zone which considers whether the landform/landcover is of scale/character and thus of low enough landscape sensitivity to could accommodate large wind turbines i.e. it has a higher landscape capacity than other areas within the SSA. This factor has been derived specifically for this study following fieldwork and desk study in accordance with published landscape best practice techniques for the assessment of wind farms in the UK and a methodology developed specifically for this study
- **The potential for additional visual impact** i.e. the wider visual effects that developing a zone might have, and the degree to which sensitive receptors such as settlement, roads, National Parks, National Trails (where appropriate) and AONBs are influenced by any additional visual effects. The additional visual effects have been determined from 3-D computer modelling. The results are presented in terms of the theoretical visual effects (ZTV) of hypothetical wind turbines (located on a uniform layout within each zone) in the strategic search area when compared to any visual effects arising from existing large wind farms in and around the SSA. The results have been broadly validated by fieldwork. The detailed methodology has also been developed specifically for this study.
- **Presence/absence of designated Historic Landscape** (as defined by Cadw) and thus degree of the total historic landscape resource potentially affected within any given zone.
- **The likelihood of major effects upon visual amenity and setting, particularly cumulative effects upon valley communities.** i.e. the visual effects that developing a zone might have upon adjacent villages and settlement in terms of dominance and sense of enclosure. These visual effects (as above) have been determined from 3-D computer modelling.

The results of the *relative* environmental and landscape performance of the zones or sub-areas of SSA are then brought together in the report within a summary matrix which includes the approximate estimated capacities³ (in MW) for the respective zones.

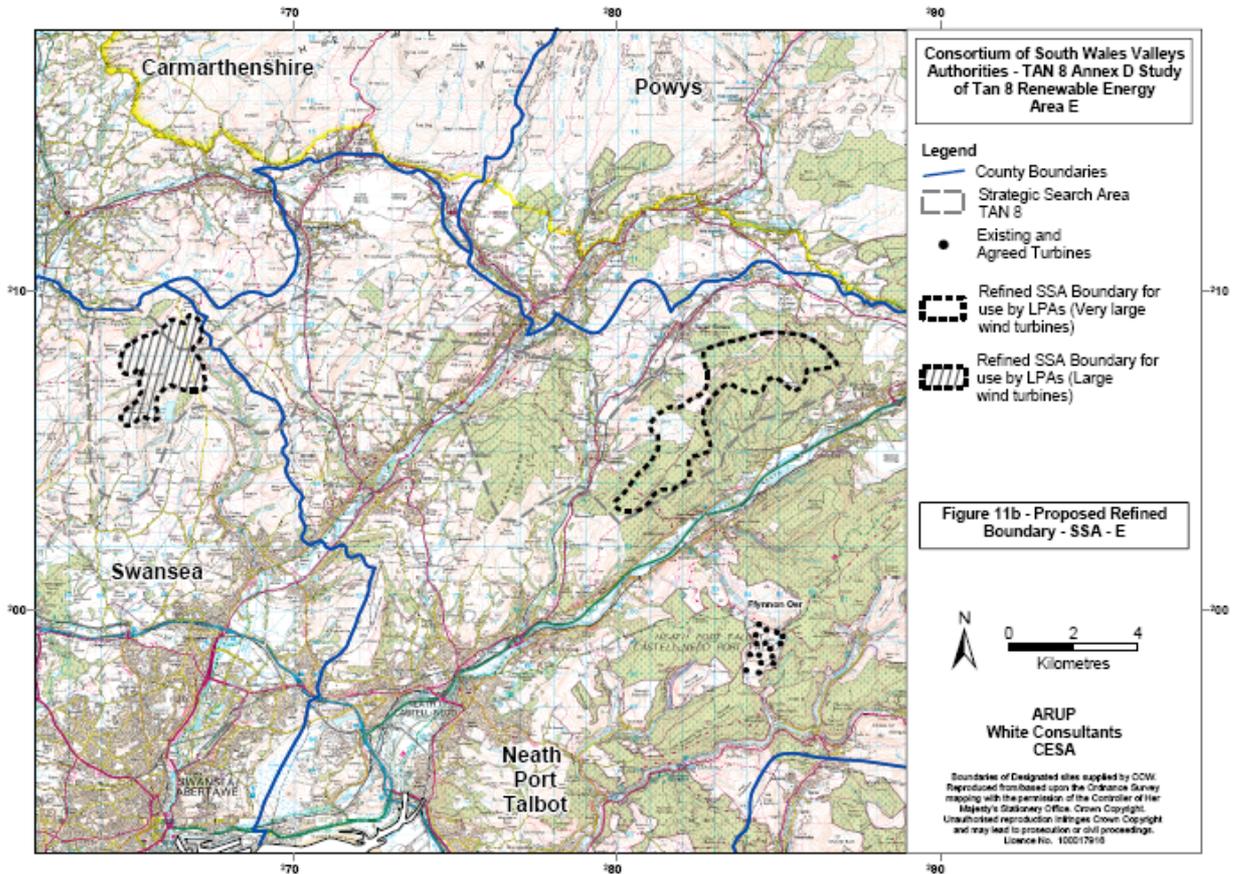
The study then goes on to consider how many "environmentally acceptable" zones are required to deliver the TAN 8 indicative targets for each strategic search area. It then develops a refined SSA boundary that encompasses these zones, making recourse in the derivation of this boundary to the constrain data prepared previously.

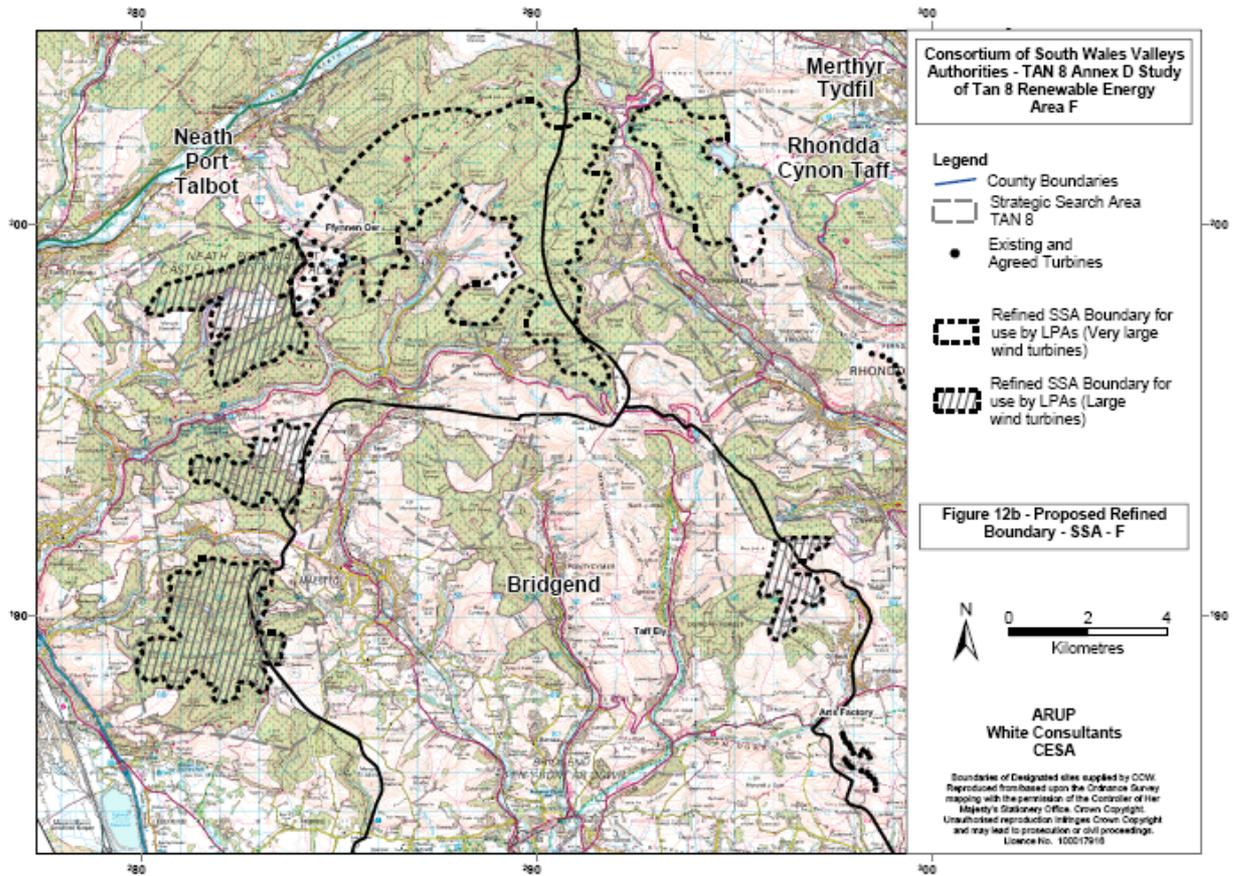
³ The study has considered the "developable capacity" of the defined zones in terms of the amount of Megawatts (MW) of wind energy that may be possible in each, based upon a average yield of 7.5MW per sq. km (typically around 3-5 modern wind turbines) where the areas are not constrained.

Results for the SSAs

It is recommended that the TAN 8 SSA boundaries are therefore refined to remove the environmentally worst performing areas and any additional land not needed to deliver the TAN 8 indicative capacities. The recommended refined boundaries are shown on **Figure B** overleaf. The recommended refined boundaries do not accord fully with the full extent of the earlier recommended zones. This is because the opportunity has been taken, following further desk study and field work, to draw the boundaries back slightly from the zone boundaries in some cases. This is to better reflect local topography and the inherent landscape and visual benefits that this offers. This has been possible without undermining the estimated developable capacities of the zones used in the first stage of the analysis as the changes are small and at the margins of the zones.

Figure B - Refined SSA Boundaries, SSAs E and F





The refined boundaries are for subsequent transposition into the appropriate Local Development Plan(s) or any interim Supplementary Planning Guidance. They may also be used in the interim to inform development control decisions with respect to large scale wind farms in the area.

Glossary

| | |
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| ALV | Area of Landscape Value- a designation by a local authority for an area of landscape. |
| Aspect Area (LANDMAP) | A discrete geographic area of relatively homogenous character identified within a particular aspect. In GIS it will be represented as a single polygon. An [evaluated] aspect can be either <i>visual and sensory, geological landscapes, landscape habitats, historical landscape or cultural landscape</i> . |
| Character Area (LANDMAP) | A discrete geographic area of relatively homogenous character identified from the structured analysis of the five evaluated LANDMAP aspects. |
| LANDMAP | A national landscape information system in Wales. Information about the landscape is gathered, mapped, organised and evaluated through the application of a nationally consistent method. |
| Landscape Assessments | A structured approach to identifying the characteristics of a landscape. It provides a description of an area, defines key characteristics and in Wales is carried out using LANDMAP. |
| Landscape Capacity | The ability of the landscape to accommodate development of a specific type or different amounts of change. |
| Landscape Character | The distinct and recognisable pattern of elements, features and qualities that occur consistently within a particular landscape area. |
| Landscape Designations | Assignations of value to areas of landscape by national or local authorities with associated planning controls. |
| Landscape Sensitivity | The intrinsic sensitivity of the landscape to change including its character as a whole and individual elements and features which contribute to that character. |
| Landscape Effect | Change in the elements, characteristics, character and qualities of the landscape as a result of development. This can be positive or negative. |
| Large-scale wind farm | As per TAN 8 para 2.2, over 25MW |
| MW | Megawatts- a measure of electrical power output. Modern turbines are rated between 1.5 and 3MW. |
| ms⁻¹ | Metres per second, a measure of average wind speed |
| Sensitive Receptor | viewer group (clarify) . A sensitive receptor is one who may be more sensitive than others because of the likely duration of the effect [eg a resident] or may be sensitised to landscape or visual quality [eg a walker]. |
| SLA | Special Landscape Area- a designation by a local authority for an area of landscape. |
| SSA | Strategic Search Area (as established via TAN 8) |
| Strategic scale wind farm | As per TAN 8 para 2.2 and 2.9, over 25MW, but also forming part of an area which could accommodate up to 70MW |
| TAN | Technical Advice Note |
| Value | The relative value or importance of landscape through a structured assessment taking into consideration specific criteria sometimes expressing consensus, and defining whether an area is of international/national, regional/county, local or of low value. |
| Visual effect / influence | Change in the appearance of the landscape perceived by receptors as a result of development. This can be positive or negative. |
| Visual and Sensory | An evaluated aspect of LANDMAP. This is derived largely from desk study based upon published landscape assessments. The Visual & Sensory aspect of LANDMAP identifies those landscape qualities that are perceived through the senses. It deals with the individual physical attributes of landform and land cover, as well as their visual patterns of distribution and sensory characteristics, and the relationships between them in a particular area. |
| ZTV | Zone of Theoretical Visibility- an area in which a proposed development may be visible [based on the contours of landform only] and where there may be an effect. The term 'Zone of Theoretical Visibility' (ZTV) is used to describe the area over |

| | |
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| | <p>which a development can theoretically be seen, and is based on a Digital Terrain Model (DTM) and overlaid on a map base. This is also known as a Zone of Visual Influence (ZVI), Visual Envelope Map (VEM) and Viewshed. However the term ZTV is preferred for its emphasis of two key factors that are often misunderstood:</p> <ul style="list-style-type: none">• visibility maps represent where a development may be seen theoretically – that is, it may not actually be visible in reality, for example due to localised screening which is not represented by the Digital Terrain Model (DTM); and• the maps indicate potential visibility only, that is, the areas within which there may be a line of sight. They do not convey the nature or magnitude of visual impacts, for example whether visibility will result in positive or negative effects and whether these will be significant or not. <p>Most ZTV produced are in conjunction with individual wind farm applications and are calculated by computer.</p> |
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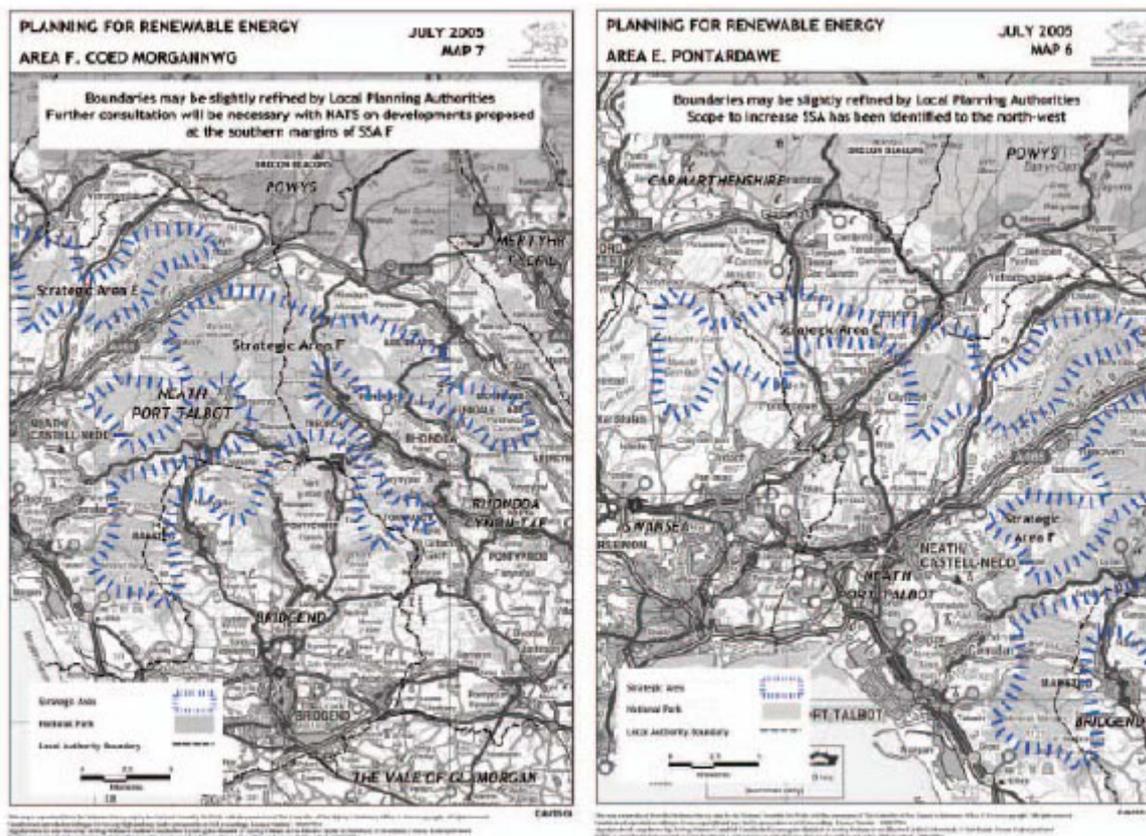
1 Introduction/Brief

1.1 Scope of Study

In July 2005 the Welsh Assembly Government (WAG) published the Ministerial Interim Planning Policy Statement (MIPPS) 01/2005: Planning for Renewable Energy⁴ and *Technical Advice Note (TAN) 8: Planning for Renewable Energy*. This TAN indicates that there are only a few relatively unconstrained areas in Wales that are capable of accommodating large wind power developments. These areas make up the 7 Strategic Search Areas (SSA) capable of accommodating large (>25MW+) wind power developments.

Two of these 7 areas are Area E “Pontardawe” and Area F “Coed Morgannwg” which the TAN suggests have an “indicative generating capacity” of 100MW and 290MW respectively (approximately 50 and 150 modern wind turbines of 100m in height).– See **Figure 1**).

Figure 1 TAN 8 Strategic Search Areas E and F



Paragraph 2.10 of the TAN (and Annex D) encourages local authorities to undertake more detailed mapping and landscape assessments in order to formulate policies for on-shore wind power. This report is the output from such an exercise of SSAs E and F with the primary aim of informing the development plan through designating a ‘search area’ within the emerging Local Development Plan(s) (LDP) and also for informing development control purposes.

⁴ The MIPPS amends Sections 12.8 to 12.10 of Planning Policy Wales (PPW) (2002).

1.2 Brief

The study was jointly funded by five local planning authorities that together comprise the “Consortium of South Wales Valleys local authorities”; Neath Port Talbot County Borough Council, Rhondda Cynon Taff County Borough Council, Bridgend County Borough Council, The City and County of Swansea and Carmarthenshire County Council. The brief follows.

The consultants will be expected to undertake a detailed assessment of the South Wales Valleys Strategic Search Area (E and F) and map the best locations for wind farm development within the SSAs in accordance with the principles of Annex D of TAN 8, having regard to landscape, environmental and technical factors. The consultants should consider the ability of the areas to deliver the TAN 8 indicative capacities and recommend refined boundaries that deliver only the indicative capacities, on the basis that these capacities are targets.

The recent experience in undertaking the equivalent studies for Denbighshire/Conwy and Powys suggests that the following small changes are needed to the approach as set out in the TAN 8 Annex. The changes are:

- Rather than identifying potential wind farm sites *per se*, the study considers hypothetical wind turbines distributed evenly across each the SSA ‘sub-areas or zones’ on a random grid basis of 4 turbines per km²
- More than 5-10 SSA ‘sub-areas’ may be needed to aid decision making per SSA
- The study area for considering which wind farms are relevant to the visual analysis would be 30km from the TAN 8 SSA boundary
- Existing small wind farms (<5MW) will not be considered within the visual analysis as contributing to the “existing visual impact”
- An assumed turbine height of 125m to blade tip is used within the study
- Cultural heritage and nature conservation data is most likely to inform the relative ability to develop fully SSA sub-areas (and thus their likely capacity in MW for wind turbines), rather than to influence which zones should be prioritised in the overall summary matrix.

Although consideration of grid connectivity was stipulated in the study brief, this was not considered to be of critical importance to warrant extensive coverage in this report given that this has already been covered in sufficient depth within TAN 8 and the concurrent Arup supporting data (see <http://www.wales.gov.uk/subiplanning/content/research/arup/index-e.htm>). Grid availability and supply are essentially an economic issue and this study should establish the most suitable areas for wind development on the basis of land-use planning factors.

In addition the consideration of issues such as potential highways constraints /access, and hydrology were agreed to be beyond the scope of this exercise, given that these issues will only become a material consideration once developers begin to apply for planning permission in respect of a ‘developable’ area. It is not until this time that these location-specific issues can be dealt with. While land ownership is not normally a material consideration in planning matters, the potential for land ownership rights to delay implementation (ownership, leasehold, mineral rights) were recognised. Notwithstanding this, it is considered that the range of sites should broadly achieve WAG’s target even if some sites take a little longer to clear these issues.

An informal consultation has been held with Forestry Commission Wales (FCW) with respect to determining those parts of its estate within South Wales that are only leasehold.

FCW have begun a National Forest Estate Wind Farm Programme⁵ to allow its land to be developed for wind turbines in accordance with the strategy outlined within TAN 8. One area (Mynydd Marchywel in SSA E) is not in FCW freehold and will not be released for development under the National Forest Estate Wind Farm Programme. The landowner is also unwilling to see the area developed due to existing mineral rights. Nevertheless, this area has been considered in the analysis for this study (to provide data if this situation should change in the future).

1.3 Study Team

This study has been undertaken by Arup, with assistance from White Consultants (Landscape and Visual issues) and the University of Northumbria, Centre for Environmental and Spatial Analysis (GIS support).

1.4 Report Structure

This report is divided into the following sections

- Chapter 2 describes the methodology
- Chapter 3 covers the review of technical and environmental (i.e. non-landscape) factors which have the potential to affect the capacity of the SSA and establishes the zones of the SSA to be used in subsequent analysis
- Chapters 4 covers the landscape and visual analysis of the zones in terms of landscape value, landscape sensitivity/capacity and visual impact, respectively
- Chapter 5 contains the overall analysis and makes recommendations on the ranking of the SSA zones in terms of environmental performance.
- Chapter 6 considers the conclusions and recommendations

All mapping has been undertaken at 1:50000 scale but is reproduced at smaller scale within this report. Colour A3 Figures are contained to the end of this report.

1.5 Bibliography

The following documents have been used throughout this study in the generation of the methodology and in support of the analysis undertaken:

- Arup, June 2005, Facilitating Planning for Renewable Energy in Wales: Meeting the target. July 2004
- Arup, June 2005, Facilitating Planning for Renewable Energy in Wales: Meeting the target. Review of Final Arup Report June 2005
- Carys Swanwick, January 2004, Topic Paper 6 Techniques and Criteria for judging Capacity and Sensitivity. Countryside Agency.
- Cadw, 2001, Register of Landscapes of Special Historic Interest in Wales
- Cadw, 2001, Register of Landscapes of Outstanding Historic Interest in Wales
- Cadw, 2004, Guide to Good Practice on using the Register of Landscapes of Historic Interest in Wales in the Planning and Development Process
- Garrad Hassan, June 2005, Energy Assessment of TAN 8 Wind Energy Strategic Search Areas and Update Report dated Oct 2005.
- Landscape Institute & Institute of Environmental Management & Assessment (LI- IEMA). 2002. Guidelines for Landscape and Visual Impact Assessment. 2nd edition. Spon Press, London.

⁵ <http://www.forestry.gov.uk/forestry/infd-6hyjdu>

- SNH Advisory Service Landscape Group, 4th Draft May 2004, Guidance for Assessment of Cumulative Landscape and Visual Impacts arising from wind farm developments, for Scottish Natural Heritage.
- SNH et al, Visual Analysis of Wind farms: Good Practice Guidance, Consultation Draft 22.7.05.
- University of Newcastle 2002 Visual Assessment of Wind farms Best Practice. Scottish Natural Heritage commissioned report F01AA303A.
- University of Newcastle and CESA May 2003, Landscape Capacity Study for Onshore Wind Energy Development in Western Isles, [Method]. For Western Isles Council.

In addition this study has acknowledged existing planning applications for wind farms within and around the SSAs, including the data prepared by developers in support of Environmental Impact Assessments.

2 Methodology

2.1 Introduction

The aim of the study is to determine the best locations for wind development in accordance with the principles Annex D of TAN 8, having a regard to landscape, environmental and technical factors.

The best locations for wind farms are those that are (amongst other factors), likely not to cause unacceptable landscape and visual impacts. However determining acceptability for a form of built development is difficult as it raises the concepts of thresholds, and who should set such thresholds.

This study is informed in its consideration of environmental acceptability by the following (broadly in order of priority):-

1. The TAN 8 characteristics of what constitutes a strategic search area for larger wind farms (Para 2.9 p6)
2. Existing Structure, Local and Unitary development plan policies for the authorities concerned relating to the protection of landscape and visual amenity (not withstanding the fact that most pre-date TAN 8 and its acknowledgement of landscape change within the SSAs).
3. UK best practice in the siting and assessment of wind farms
4. The expert view of the consultant team

This study aims to minimise the potential for substantial changes in landscape character by focusing development onto those parts of an SSA(s) most able to accommodate large scale wind farms by virtue of their topography, landscape capacity and value. It also aims to minimise the potential for additional visual impact by focusing development, where possible, onto those parts of an SSA in which large scale wind farms would be least visible from the overall surrounding area, residents and vehicle users and users of Nationally designated landscapes/National Trails, where applicable.

The starting premise to the study is that the refined TAN 8 Strategic Search area boundaries will be a material consideration and inform the plan process and to a lesser extent, inform development control decisions.

2.2 Overview

The methodology adopted generally accords with the TAN 8 Annex D "Potential Methodology for Local Planning Authorities with Strategic Search Areas" and is generally supported by Countryside Council for Wales (CCW), RSPB and other stakeholders. The study initially followed the method used in studies of the other SSAs but this was modified and enhanced as the complexity of the area's landform and settlement pattern emerged.

The methodology for the study is primarily an *objective* landscape and visual assessment exercise which seeks both to identify a 'Preferred Area or Areas' for siting wind farms broadly within the Strategic Search Area boundary(s) identified in TAN 8. In so doing it also provides a broad *relative* ranking of the environmental performance of the environmentally acceptable parts of the SSA and its margins. The study also uses a range of technical and other environmental data to inform and modify the landscape work. However the study also has two other outputs, a review of the indicative generating capacity for the SSA as published in the TAN, and the determination of the likely generating capacity of the SSA

zones or sub-areas when derived⁶. Together these various components of the study are brought together to provide the local planning authority(s) affected by the SSA(s) with a refined SSA boundary which has been verified (as a minimum) still able to achieve the indicative generating capacity(s) required by TAN 8.

2.3 Qualification of methodology

It is important to stress from the outset that the methodology adopted is new, and represents a compromise between a strategic and a local approach to the planning for wind energy. It fits the aspirations of all parties for the timely and cost effective next stage refinement of an SSA, as initially defined in TAN 8, in order to inform considerable development pressures following the publication of TAN 8 in July 2005. It is *not* a comprehensive visual and landscape assessment of all parts of the SSAs similar to that which would be prepared as part of an Environmental Impact Assessment (EIA) for an individual development⁷, nor does the study consider biodiversity issues in great detail as this again is best addressed at the EIA stage when site-specific data can be gathered.

The methodology relies extensively on existing published data (eg. LANDMAP landscape assessments) and quantitative visual data generated via a GIS analysis. Fieldwork is undertaken to develop key datasets to inform the GIS analysis and then to verify the results and overall findings/recommendations arising out of such an analysis. It has been possible to visit the key viewpoints within and surrounding each zone within an SSA, and to assess in the field the views in and out of each part of an SSA. No formal consultation has been undertaken with statutory bodies as part of the study; the only discussions that have taken place have been with officers of the Planning Authorities that commissioned the study and various bodies to gather factual data including RSPB Cymru and Forestry Commission Wales (FCW).

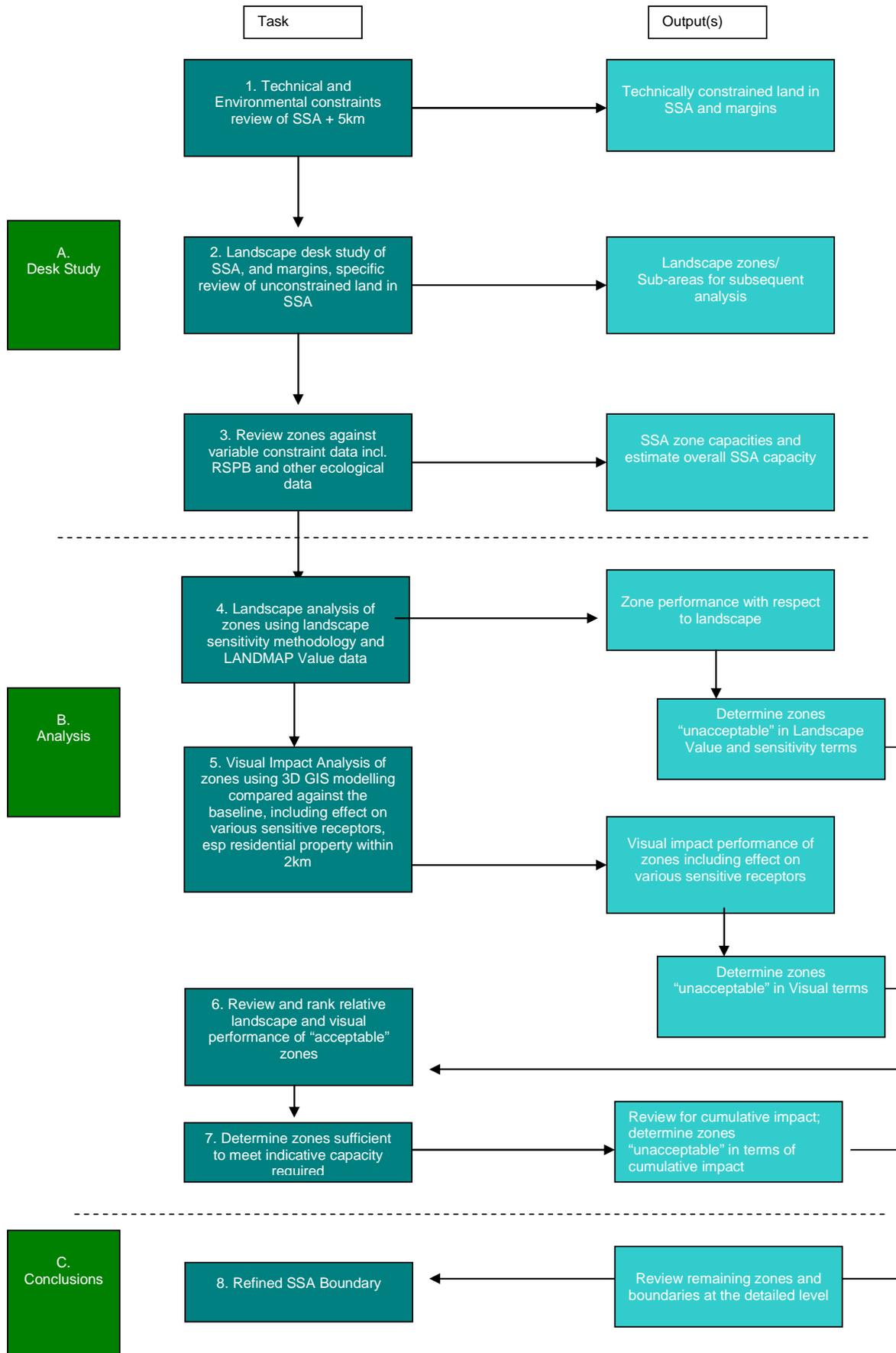
2.4 Methodological stages

The overall methodology for the study is set out in the flow chart in **Figure 2** overleaf.

⁶ The likely generating capacities of the SSA zones or sub-areas are only intended to inform the study and may not reflect what development propose within the zones.

⁷ All wind farms greater than 2 turbines of greater than 15m height are considered "Schedule 2 Development" under the EIA Regulations 1999 and thus must be screened for EIA. In practice all large scale (>25MW) wind farms will require an EIA.

Figure 2 – Summary methodology



The study ascertains the *relative* and *absolute* environmental and landscape performance of the zones or sub-areas of the SSA with respect to the following criteria:

- **LANDMAP Visual and sensory value.** This is derived largely from desk study based upon published landscape assessments and is independent of the type of development proposed. The Visual & Sensory aspect of LANDMAP identifies those landscape qualities that are perceived through the senses. It deals with the individual physical attributes of landform and land cover, as well as their visual patterns of distribution and sensory characteristics, and the relationships between them in a particular area.
- **Landscape “sensitivity/capacity”** to large scale wind farms i.e. a physical property relating to a zone which considers whether the landform/landcover is of scale/character that could accommodate wind turbines. This has been derived specifically for this study following fieldwork and desk study in accordance with published landscape best practice techniques for the assessment of wind farms in the UK.
- **The potential for additional visual impact** i.e. the wider visual effects developing a zone might have, and the degree to which sensitive receptors such as settlement, roads, the National Parks and AONBs are influenced by any additional visual impact. The additional visual impact has been determined from 3-D computer modelling of the maximum likely visual effects of hypothetical wind turbines located on a uniform layout within each zone in the strategic search area; the results have been validated by fieldwork.
- **the likelihood of major effects upon visual amenity and setting, particularly cumulative effects upon valley communities.** i.e. the visual effects that developing a zone might have upon adjacent villages and settlement in terms of dominance and sense of enclosure. These visual effects (as above) have been determined from 3-D computer modelling.

The results of the *relative* environmental and landscape performance of acceptable zones or sub-areas of SSA are brought together in the report within a summary matrix which includes the approximate estimated capacities (in MW) for the respective zones.

In bringing together the various landscape and visual data in arriving at the overall environmental performance of a zone, the TAN 8 Annex D studies, including this study, give slightly greater weight to the potential additional visual impacts out with the SSA upon sensitive receptors, than to the direct effects upon landscape factors *per se* within the SSA. This is for the following reasons:

- TAN 8 acknowledges (Para 2.9) that generally the SSAs have certain physical characteristics that support their development with large-scale wind farms and that within the SSAs (Para 8.4), an implicit objective of the development of SSAs is to accept a degree of change in landscape character.
- Local planning authorities throughout Wales have raised the potential for additional visual impact and its potential effects upon settlement and other sensitive receptors (on the margins of, and outside the SSA) as their major concern in the refinement exercises on the SSAs.

However SSAs E and F are materially different to other SSAs in Wales, in that close to half a million people live in and around the SSAs in areas of complex topography. Therefore this particular study has given additional weight to the effects upon the visual amenity and setting for the many valley communities that will be affected to varying degrees by the future development of the SSAs.

2.5 Acceptability Criteria

TAN 8 sets out the following criteria (Para 2.9 p 6):

- Comprise an extensive area with a good wind resource

- Be an upland area (typically over 300m above ordnance datum) which contains a dominant landform that is flat (plateau) rather than a series of ridges.
- Be generally sparsely populated.
- Be dominated by conifer plantation and/or improved/impooverished moorland.
- have a general absence of nature conservation or historic landscape designations.
- Be of sufficient area to accommodate developments over 25MW, or at least in combination with other contiguous SSA parts be able to accommodate developments over 25MW

TAN 8 Annex D Para 8.6 indicates that at the local level, accepted thresholds of change, having regard to nationally developed capacity targets, can be established by more detailed assessments.

Therefore, in addition, any part of the refined/modified strategic search area boundary has to be acceptable in accordance with the following criteria:-

- To have a LANDMAP visual and sensory Value aspect rating of less than 'Outstanding'
- To have a landscape sensitivity that is less than is considered 'High'
- To have visual impacts upon residential dwellings which would not cause 'dominance'
- Not to cause cumulative landscape or visual impact upon settlements

These criteria and their explanation/justification are set out within Chapter 4 of this report: - Landscape and visual analysis.

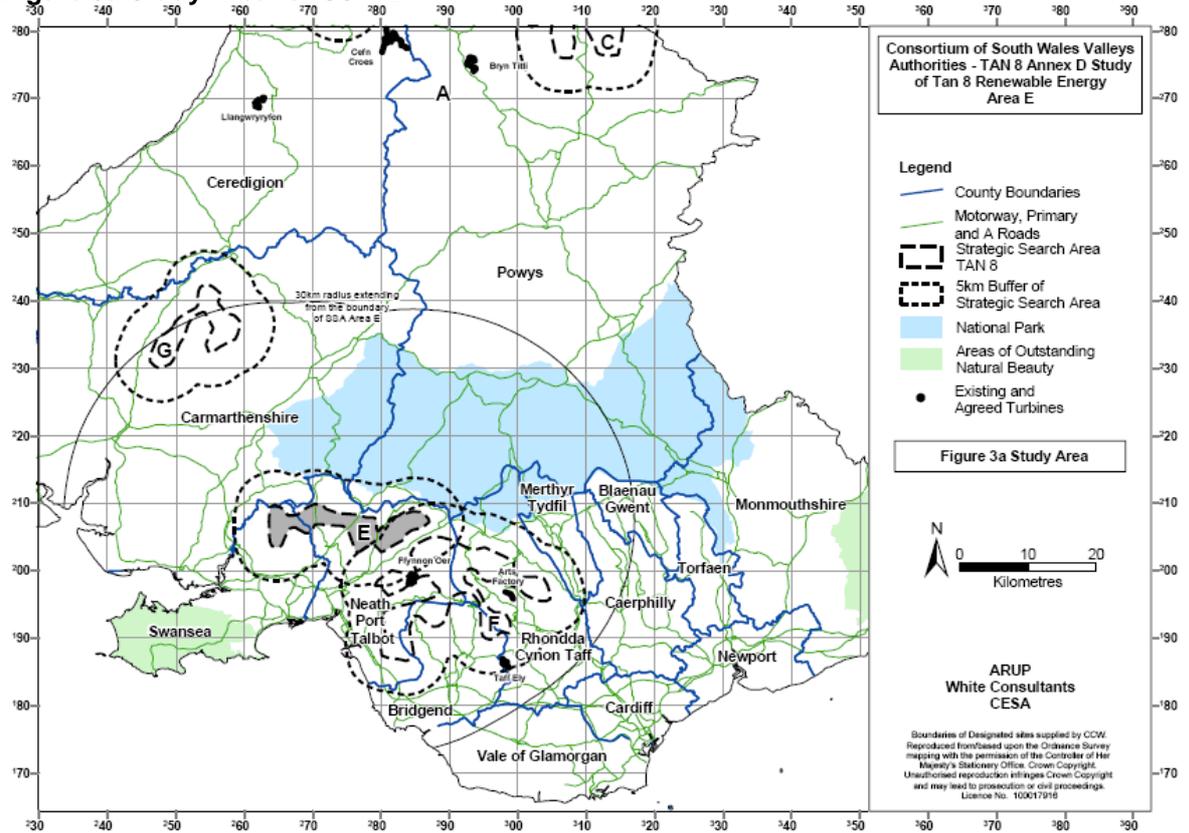
2.6 Study Area

The wider study area for the exercise is indicated in Figure 3a and 3b below. It relates to an area sufficient to encompass the potential visual effects of all existing and consented wind farms within and around the SSA(s) >5MW and to set the context. This is considered to be an area within an approximately 30km radius from the outer TAN 8 SSA boundary as published. National Parks and Areas of Outstanding Natural Beauty (AONB) are also illustrated on Figure 3a and 3b.

The SSA boundary⁸ as published in TAN 8 has been buffered by 5km in all directions to allow for a review of its margins (in accordance with the guidance in TAN 8 Annex D) and is also shown on Figure 3a and 3b and subsequent figures. Other SSAs in Wales plus their 5km buffered margins are shown for context.

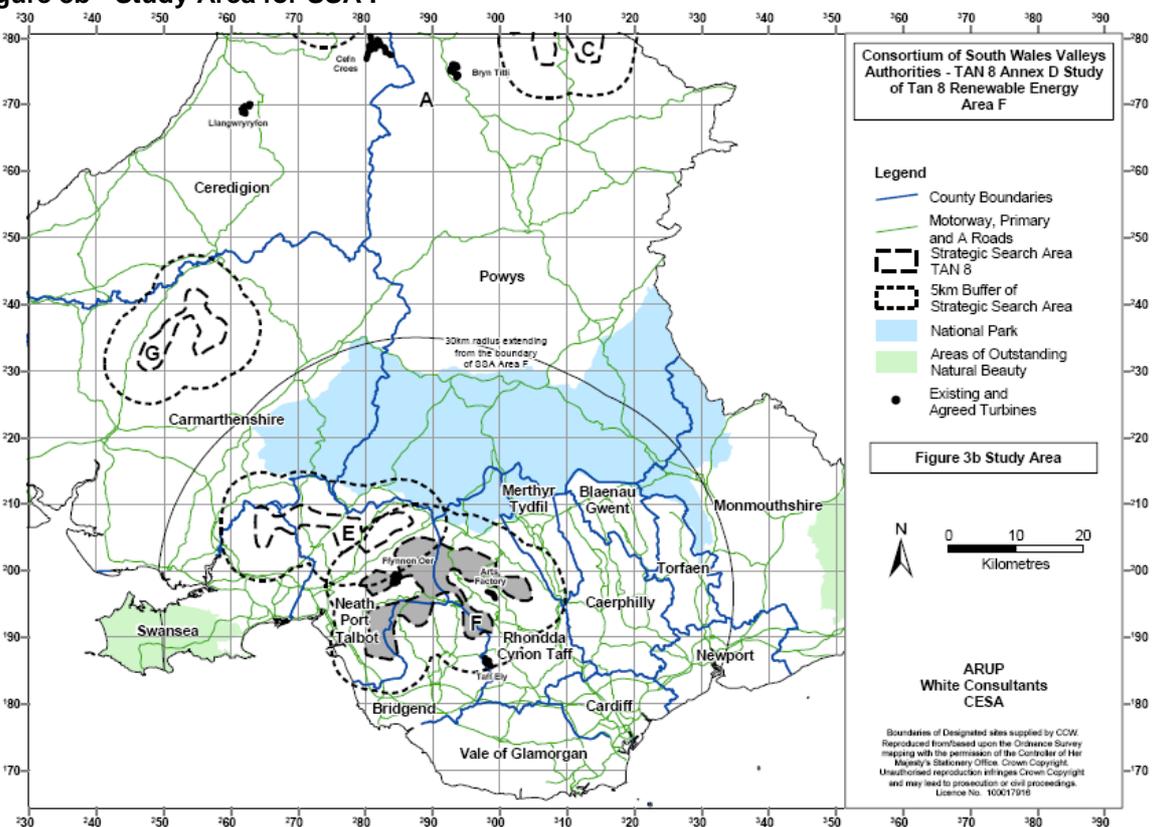
⁸ All figures in this report utilise a dashed line representing the centre line of the 800m wide boundary shown in TAN 8.

Figure 3a Study Area for SSA E



Note "Existing/Agreed turbines" refers to wind farms >5MW in accordance with Appendix A.

Figure 3b - Study Area for SSA F



Please note in subsequent Figures in this report, SSAs E and F are both shown on drawings of the same size, are drawn at different scales, to aid presentation. However SSA F is approximately twice the size of SSA E

2.7 Existing/Agreed wind farms

The study adopts a baseline for landscape and visual analysis which comprises the following:-

- All wind farms which have been constructed, or are under construction or have a valid planning consent as of June 2005, but which have an output greater than 5MW i.e. they are not "small" as defined by TAN 8, para. 2.12.

The rationale is that small wind farms may be considered acceptable at locations outside the SSA(s) where those developments are considered to be in accordance with development plan policies and are materially acceptable in line with the guidance contained in TAN 8. Therefore, neither the existing or potential presence of small wind farms nor their absence should unduly influence the strategic planning of the SSAs as this addresses larger scale (over 25MW) onshore wind developments as defined in TAN 8 para.2.2. However any cumulative impact of a mixture of large and/or small developments will need to be assessed and the relevant policies of development plans and TAN 8 revisited (as appropriate) when they are reviewed. The details of the existing/agreed wind farms used in this report are included in **Appendix A**.

3 Technical and environmental constraints review

3.1 Overview

Whilst the whole SSA (s) and 5km buffered margin could be subjected to a landscape and visual analysis, this would be a resource intensive and largely academic exercise. Practically much of the land within and in the immediate surrounds of the SSA(s) lacks the features which would render it suitable for hosting large-scale (>25MW) onshore wind farms.

The first stage of the study is therefore (having eliminated land which could not be developed) to determine the least constrained/unconstrained wind resource areas within and around the SSA(s). These are then subsequently examined for their variable performance with respect to landscape, visual, ecological and other data.

This initial constraints review also permits an understanding of the likely total area of least constrained/unconstrained wind resource areas within and around the SSA.

In relation to spatial planning for onshore wind at the national level within the development of TAN 8, the decision was taken for simplicity of analysis to treat the relevant factors in just three categories. For consistency, the same approach has been adopted for the local authority-led TAN 8 Annex D studies. These were:

- Absolute constraints
- Variable constraints
- Electrical connection issues

Each of these are described and discussed in the sections below.

3.2 Absolute constraints

Absolute constraints are defined as those which would be likely to prevent large-scale wind energy developments. These constraint datasets have been used for the purposes of *eliminating land* as the initial input to the derivation of the SSA zones which then undergo further landscape and visual assessment.

Table 1 below sets out those factors considered absolute constraints for the purposes of the TAN 8 Annex D studies and gives the reasons for their inclusion within this category.

Table 1. Absolute constraints to large-scale wind energy development in Wales

| Criteria / constraint | Source | Details/justification/decision |
|--|-----------------------|---|
| Visual / aural amenity on sensitive receptors (Settlements, isolated properties, farms etc) (+500 m radius buffer of all postal addresses) | OS Address point data | There is an emerging best practice approach within the onshore wind industry of siting development a minimum of 500m from residential properties (for noise/amenity and safety reasons). It is acknowledged that acoustic separation distances closer to 700m are now the norm for the very largest rated turbines (2-3MW turbines) and the refined boundaries (when developed) generally respond to this sort of separation distance from residential areas. |
| Wind speed < 6.9 ms ⁻¹ On 1km square | DTI/NOABL Model | Developers of large (i.e. ≥ 25MW) wind farms would typically seek sites with a minimum mean annual wind speed of 7 m/s (defined at 45m above |

| | | |
|---|---------------------|--|
| basis | | ground level). Generally areas subject to wind speeds below this figure are not considered economically viable and this has been the case to date in Wales. With the very highest turbines some flexibility is now available on the margins of the areas of higher wind speeds. |
| Slope (>15 degrees) | OS Panorama Dataset | Wind farms are unlikely to be located on slopes greater than 15 degrees due to constraints of access track construction etc. |
| Sites of Special Scientific Interest | CCW | Wind farms generally have a very small physical footprint compared to the total area occupied by the development, since only the turbine footings and access / maintenance tracks require the disturbance of the ground surface. Nonetheless, because of the ecological importance of sites under designation such areas are now considered as absolute constraints to large-scale wind farm developments. |
| National Parks, Areas of Outstanding Natural Beauty (AONB), Special Protection Areas, RAMSAR, pSAC, SAC, National Nature Reserves, | CCW | Because of the landscape, cultural and ecological importance of sites under designation such areas are considered as absolute constraints to large-scale wind farm developments. The defined SSAs should exclude these (with the exception of some small spot sites) but 5km buffer may touch on some sites. |
| Scheduled Ancient Monuments (300m buffer around point source) | Cadw | Scheduled Ancient Monuments (SAMs) are designated by Cadw and are statutorily protected and the study has made an allowance in the density assumptions. |

3.3 Variable constraints

Variable constraints are defined as those which, in general, are likely to inhibit the development of large wind energy developments but for which there is the possibility to develop within the area concerned to a reduced extent but with appropriate mitigation. Variable constraints are therefore considered mainly an influence on the capacity (in MW) of the part of the SSA concerned.

Table 2 below sets out those factors considered to be variable constraints for the purpose of the TAN 8 Annex D studies and gives the reasons for inclusion within this category.

Table 2. Variable constraints to large-scale wind energy development in Wales

| Criteria / constraint | Source | Details/justification/decision |
|---|--------|--|
| Ministry of Wales (MoD) Mid Wales Tactical Training Area / MoD Low Flying Area 7T | MOD | The MoD is a statutory consultee in any wind farm application. It is common for potential developers to contact the MoD before submitting their planning application. In the Tactical Training Area over much of Mid Wales (LFA7T) the MoD has stated with respect to |

| | | |
|---|--|---|
| | | <p>wind development “Our area in Wales, LFA7T, in particular, appears to be approaching what we deem to be saturation point, and we are likely to resist any future proposals for development there.” However, the published guidance states that “a wind farm on the edge of a [Tactical Training Area] may well be approved of as it presents little danger to training within the TTA, and several have been developed in the past” (paragraph 4.1.7.2).</p> <p>The MoD TTA is considered a variable constraint around its edges, where overlapped by the 5km buffer of existing SSAs.</p> |
| <p>Safeguarded Aerodromes</p> <p>(A line of sight <i>viewshed</i> 30km from Cardiff Airport has been used to show the interaction between the radar and local topography)</p> | <p>National Air Traffic Services Website</p> | <p>Cardiff is an officially safeguarded aerodrome. Each safeguarded aerodrome is issued with two safeguarding maps centred on the aerodrome. One map extends out to a radius of 15km and indicates the height above ground level for which proposed development is subject to consultation. The second map extends to a radius of 30km; the local planning authority is required to consult the relevant aerodrome regarding any wind turbine proposal within the radius.</p> |
| <p>Major TV Transmitter Masts (10km radius)</p> | <p>Website</p> | <p>Turbines within the proximity of major TV masts have the potential to cause interference to signals</p> |
| <p>National Trails, Cadw Historic Landscapes, Cadw Historic Parks and Gardens. RSPB Reserves <i>County wildlife sites/county wildlife trust sites/ Local Nature Reserves</i>⁹</p> <p>(National Trails have been buffered by 250m either side, where appropriate)</p> | <p>CCW, RSPB, Cadw, Local Authorities and County Wildlife Trusts</p> | <p>Because of the landscape, cultural and ecological importance of sites under designation such areas are considered as constraints on the scale and spatial extent of development of large-scale wind farm developments.</p> |
| <p>RSPB Bird data</p> <p>(1 km square basis)</p> | <p>RSPB</p> | <p>Data regarding a nationally important population of a bird species of acknowledged conservation importance¹⁰. If, within this 1km square, a development is proposed which is located within the relevant disturbance radius for the species, the developer will need to modify the design of the proposed development, after discussions with the RSPB. If no acceptable design modification takes place, or can take place, the RSPB has indicated that they will lodge and maintain a formal objection</p> |

3.3.1 Treatment of Biodiversity issues

In this study, a range of biodiversity sites/features have been treated as ‘absolute’ and ‘variable’ constraints as set out in **Table 1** and **Table 2** above. These sites/features are

⁹ These have been considered where suitable data is available in a consistent manner across an SSA, and where not already covered by other higher level designations such as SSSI –See **Appendix K**.

¹⁰ (Annex 1 of the EU Birds Directive, Section 74 of the Countryside and Rights of Way Act 2000, or red-listed in Wales, in "The Population Status of Birds in Wales : An analysis of Conservation Concern, 2002 - 2007" Thorpe, R and Young, A. 2002,)

those for which the appropriate datasets are available generally at an all-Wales level. They are also those for which it is considered that the nature conservation interest present and the development of wind turbines are likely to be broadly incompatible, either through:

- Policy conflict/effects with habitats of national/international ecological interest (Special Protection Areas (SPA), RAMSAR, Special Areas of Conservation (SAC and , pSAC), National Nature Reserves and Sites of Special Scientific Interest SSSI)
- tenancy agreements/ effects upon ecological interest (in the case of Local Wildlife Trust/RSPB sites),
- bird habitat disruption (in the case of RSPB data relating to Nationally important species)

With ecological habitat data of lower statutory status (Phase 1 Habitat data, County wildlife sites etc.) it may or may not present a real constraint to the development of wind turbines, depending upon the basis for the designation for the site(s) and the conservation status of the ecological resource present. Whilst guidance on this topic has historically been produced¹¹ it relates to the development control process and precedes the strategic approach as advocated in TAN 8, the guidance therefore offers no specific advice on the treatment of biodiversity data within a TAN 8 Annex D study.

In addition to the designated and potential sites identified on the basis of habitat quality, there are also a number of species, for which the area is important which have been listed in one or more of the following:

- The Conservation (Natural Habitats) Regulations 1994, Wildlife and Countryside Act 1981, UK Biodiversity Action Plan (UKBAP) and Local Biodiversity Action Plans (LBAPs).

It is considered that these species issues (and potential effects upon habitats identified as of potential via the Phase 1 Habitat data/effects upon county wildlife sites) can only sensibly be addressed as constraints at the EIA stage. This is when more site-specific data is available and the developer's proposals for habitat improvement/management are known; an appropriate response in a strategic/county level study where subsequent detailed studies will inevitably follow of the local biodiversity interests¹².

3.4 Electrical Connection Issues

Electrical connection issues are a key strategic constraint to the development of larger scale (>25MW) wind farms. The strategic nature of this issue means it was given extensive coverage with the research underpinning TAN 8 via the Arup supporting data (see <http://www.wales.gov.uk/subiplanning/content/research/arup/index-e.htm>). In particular a specialist study of the electrical supply system for Wales was previously undertaken¹³ which indicated that provision to the SSAs was possible and that suitable grid capacity could be provided broadly within the 2010-2012 time period with various existing and planned reinforcement proposals to the network.

Ultimately grid connection is an economic issue to be dealt with by developers and to a certain extent its provision is linked to the successful achievement of planning permission for key large scale projects.

¹¹ BWEA et al (2001) Wind farm development and nature conservation

¹² All wind farms of a scale likely to contribute to the SSA indicative capacities will require an EIA under either the planning process or the Section 36 Electricity Act consenting route.

¹³ Future Energy Solutions (2004), Connection Areas for Wind Energy in Wales – Grid Considerations.

3.5 Cumulative constraints review

A cumulative assessment of the land-take impact of individual absolute technical and environmental constraints within the SSA and its 5km buffer has been undertaken using a GIS. The blue colour and transparency used to indicate areas with a single absolute constraint remains consistent throughout; hence darker blue shading indicates a greater number of constraints are acting on a specific area of land. Conversely, lighter blue shading signifies the presence of fewer absolute constraints. Variable constraints are shown with a blue cross-hatch symbol overlying the absolute constraint data. White areas are those that remain completely unconstrained with respect to the constraints defined for the purposes of this exercise.

All unconstrained land under the 5km buffer to the SSA (whether masked by variable constraints such as the Cardiff Airport safeguarding zone, or whether contiguous with the SSA unconstrained land or not) will be taken forward for further landscape and visual analysis, provided:

- a significant proportion (typically upwards of 25%) of the unconstrained area lies within the 5km buffer
- the unconstrained land is generally of sufficient size to make a meaningful contribution to the original SSA.

3.5.1 Results for SSA E and F

The results for SSA E and F and the 5km buffer(s) are shown in **Figure 4a and 4b** and this represents the first completed stage of the assessment methodology.

Figure 4a - Technical and Environmental Constraints for SSA E

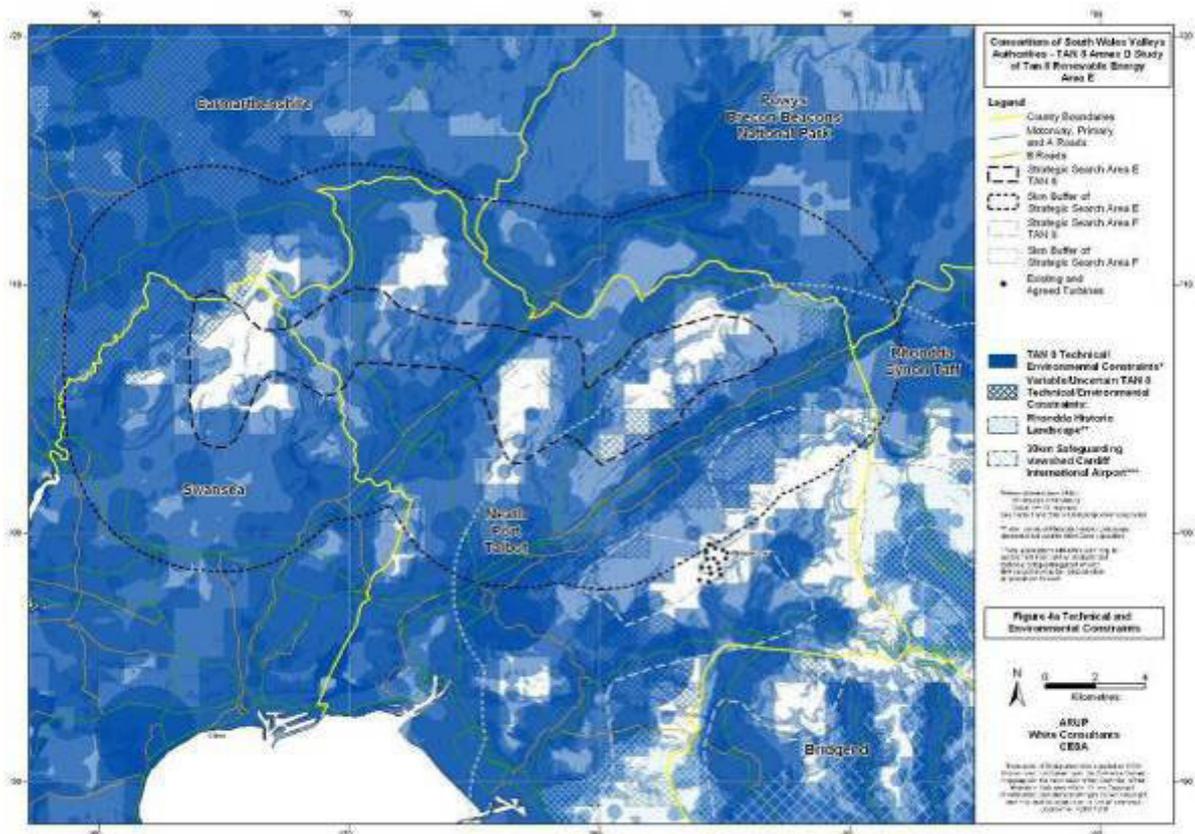
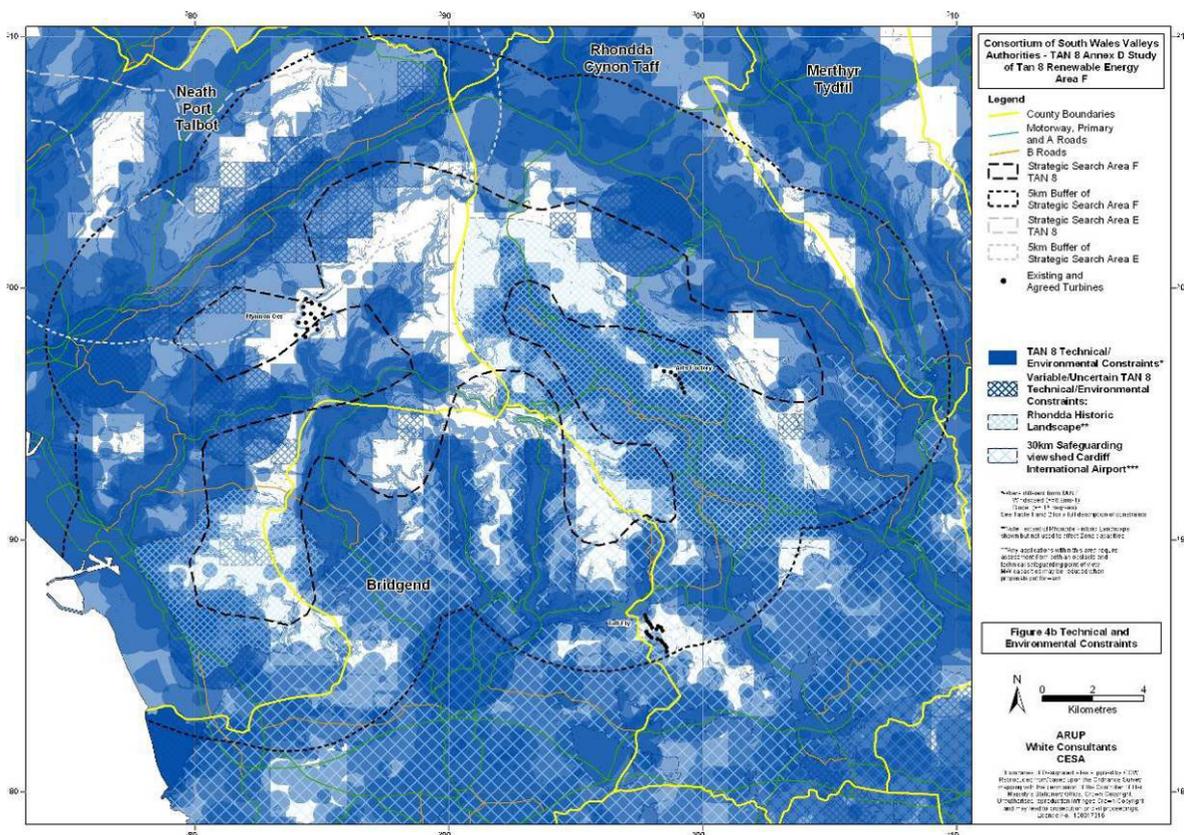


Figure 4b - Technical and Environmental Constraints for SSA F



The analysis confirms that the TAN 8 SSA boundary for SSA E includes the main areas of unconstrained resource in the area. However there are three possible additional areas identified beyond the TAN 8 SSA boundary but within the 5km buffer, as well as one area positioned on the fringe of the 5km buffer line, these are shown on **Figure 4a** and these are:

- Mynydd y Bettws (to the far north-west)
- Mynydd Uchaf – (the Aman Awel Tawe proposal site) -(to the north/north-west)
- The area north-east of Glyn-neath.
- Mynydd Drumau – which lies on the fringe of the 5km buffer line

All of the above areas have therefore been taken forward for further landscape and visual analysis, to test if the refined SSA boundary should be extended to include these potentially unconstrained areas.

The analysis confirms that in relation to area F the TAN 8 SSA boundary includes the main areas of unconstrained resource in the area. There are some possible small additional areas identified beyond the TAN 8 SSA boundary but within/on the 5km buffer, these are shown on **Figure 4b** and these are:

- A 6km long, elongated strip of land to the north east of the SSA, between the Aberdare and Merthyr valleys
- A relatively sizeable tranche of land lying to the south of the south-eastern limb of the SSA, forming an extension of the Taff Ely wind farm
- A finger of land sited a short distance to the west of the Taff Ely wind farm
- Small areas to the immediate south of the SSA boundary in the vicinity of Gilfach Goch/Tonyrefail
- Mynydd Llangeinwr

- The southern part of the St Gwynno Forest
- Mynydd Baeden near the Llynfi Valley

All of the above areas have therefore been taken forward for further landscape and visual analysis, to test if the refined SSA boundary should include these areas.

3.6 Identification of zones for further analysis

Zones or sub-areas of the SSA are necessary so that they can be used to enable discrimination between parts of the SSA and its margins in landscape and visual terms. This is in accordance with the methodology outlined within TAN 8 Annex D and also Chapter 2/**Figure 2** of this report. It follows therefore that each zone should have similar landscape and visual characteristics i.e. they are homogeneous landscape units where possible.

In addition the zones need to be:

- of similar visibility (and hence topographic) characteristics, and
- be generally unconstrained¹⁴ with respect to absolute constraints considered above and,
- Ideally be of a size comparable with large scale wind farms (>25MW)¹⁵. In some cases (especially in the South Wales Valleys) however zones are smaller than this criterion, on the basis that several small zones may be aggregated together to arrive at an area comparable with a developers site of interest.

It is considered that the most logical and available data to inform the derivation of zones within the SSA and its margins is published LANDMAP assessments of the local authorities encompassing the SSA. Further explanation of LANDMAP is included in **Appendix C** and from the CCW website.

In particular it is the Visual and Sensory Aspect evaluated aspect layer which is the most applicable for this sort of study. The *visual and sensory aspect* is a process of mapping what is perceived through the senses, primarily visually, from the physical attributes of landform and land cover to their visible patterns of distribution and their consistent relationships in particular areas. The senses of hearing, smell and touch are also considered as part of the perceived characteristics of the landscape. Partly based on aesthetic and perceptual criteria, this aspect uses many descriptive terms that are similar to the Landscape Character Approach (used in England and Scotland) to ensure familiarity and consistency of application.

The LANDMAP visual and sensory aspect layer is also the only LANDMAP aspect layer available throughout Wales and which has been subject to independent quality assurance.

Where scoping studies are available for proposed wind farm developments in the SSAs, then their spatial extent is also referred to when developing zones for subsequent analysis, to ensure the coverage and choice of appropriate aspect layers matches the spatial extent of the developer proposals where possible/practical.

In all cases the LANDMAP visual and sensory aspect layer data is reviewed in the field prior to the derivation of SSA zones.

¹⁴ The general principle has been that where the only constraint is modelled wind speed, the zones have been drawn slightly larger than the data suggests recognising the potential for errors etc. in the wind data. The wind model used considers speeds at 45m AOD. Very large turbines are able to operate successfully in some cases in some areas beyond the wind model used. The locations of these areas have been determined by recourse to the Garrad Hassan validation study of the SSAs. If land is constrained by 'absolute constraints' (including settlement data), the principle is to eliminate that land from further analysis.

¹⁵ As a wide rule of thumb applications for wind farm developments are likely to range in capacity from between 25-50MW

The zones derived for this study are not intended as a development control tool *per se*; they are only a means to arrive at the final recommended refined boundary.

3.6.1 Results for SSA E and F

A desk study has been carried out. Data has been collected on the SSA's and surrounding areas. This includes:

- LANDMAP data for Neath Port Talbot, Bridgend Rhondda Cynon Taff, Merthyr Tydfil (Visual and Sensory, Landscape Habitats, Historical Landscape, Cultural Landscape and Geological Landscape)
- LANDMAP draft data for Swansea, (visual and Sensory, Landscape Habitats, Historical Landscape and Geological Landscape) and Carmarthenshire (visual and Sensory)
- Ffynnon Oer Windfarm Environmental Statement (Entec October 2002)
- Local authority planning policies in relation to landscape designations and policies.

The definitions of landscape character, elements and characteristics are all as per the GLVIA¹⁶ 2002.

Extensive site visits to the areas have been carried out to verify the desk study work and to experience the character of the SSA and surrounding areas. A number of viewpoints were identified to represent a range of receptors. These included:

- Settlements eg Swansea, Neath, Port Talbot, Glyncorrwg, Croeserw, Maesteg, Treorchy, Aberdare, Hirwaun, Merthyr Tydfil and Gilfach Coch.
- Roads eg M4, A465, A4059, A4061.
- Brecon Beacons National Park
- Visitor attractions such as Margam Country Park and Afan Forest Park.
- Viewpoints eg Craig Ogwr, Mynydd Belli Glas

The zones proposed for analysis are based on these existing assessments and fieldwork and they are shown in blue on the **Figure 5a and 5b** below.

¹⁶ Landscape Institute & Institute of Environmental Management & Assessment (LI-IEMA). 2002. Guidelines for Landscape and Visual Impact Assessment. 2nd edition. Spon Press, London

Figure 5a - Proposed Zones/Sub-areas for SSA E

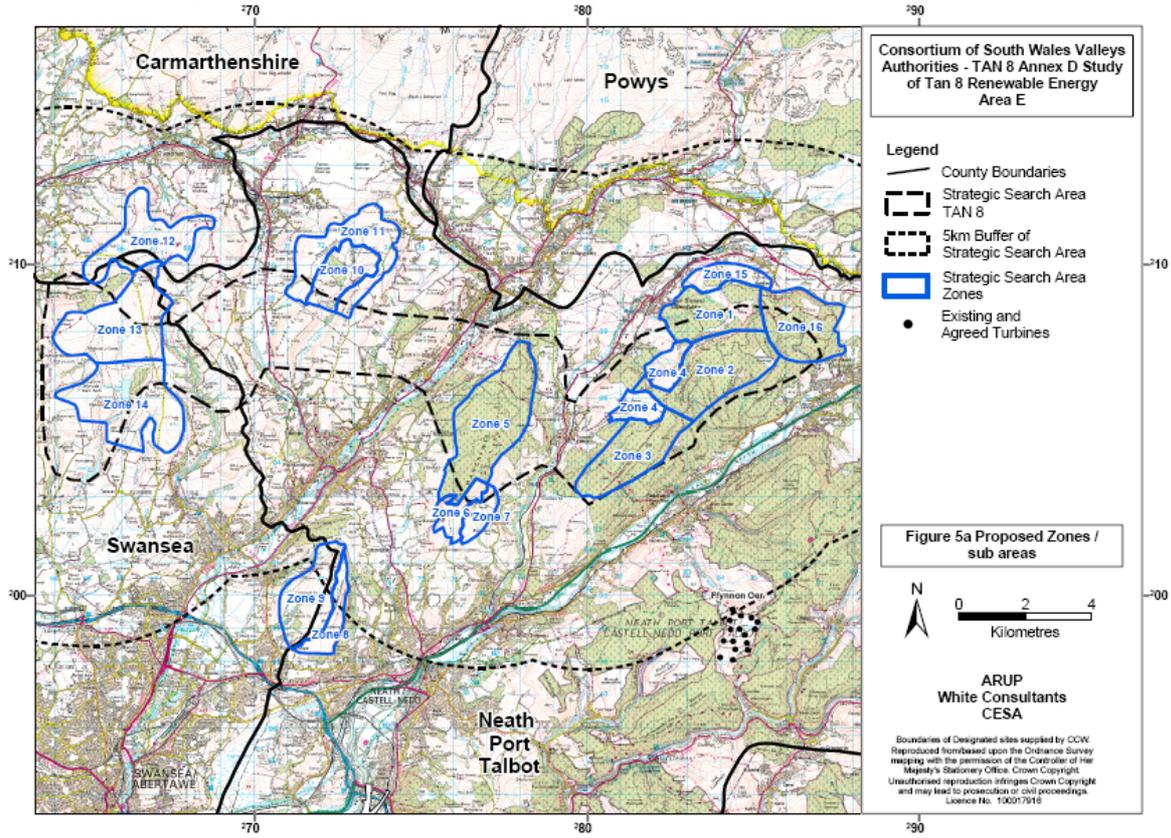
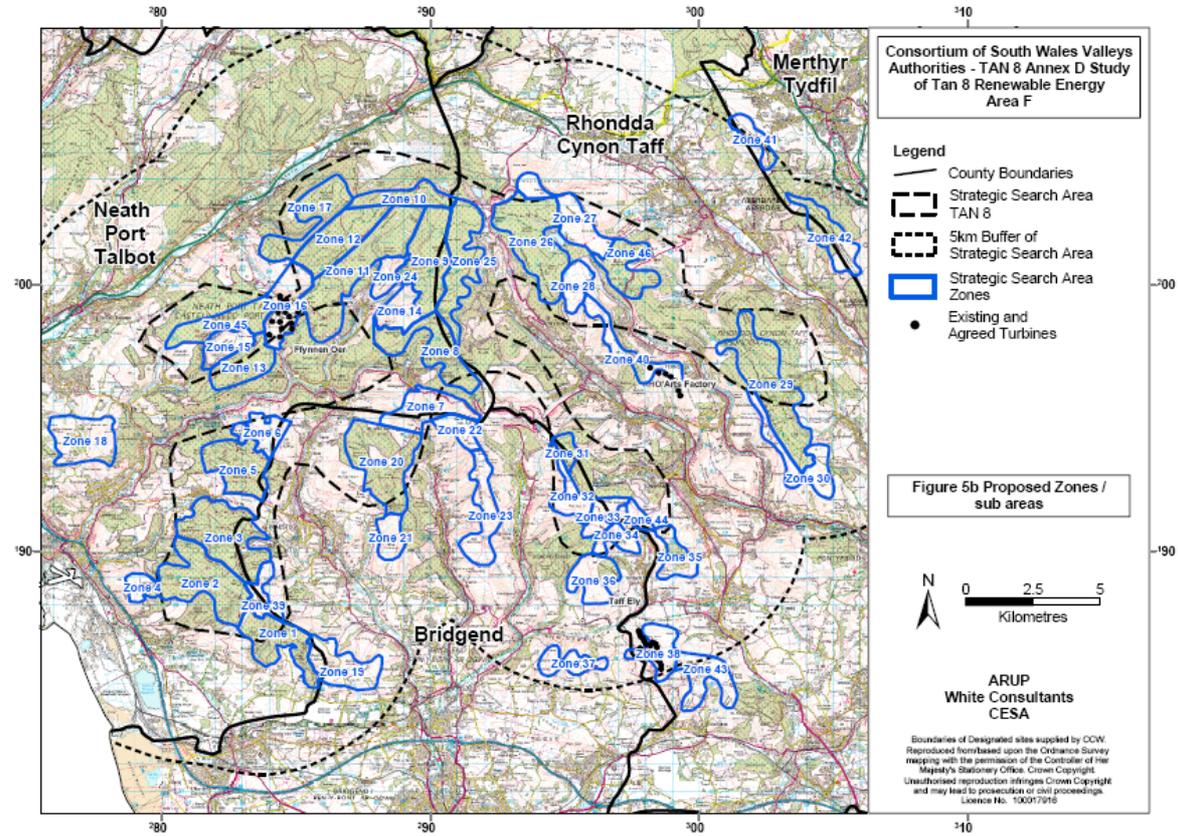


Figure 5b - Proposed Zones/Sub-areas for SSA F



3.7 Review of indicative capacity for the SSA(s)

Indicative capacities for the SSAs (and zones within the SSAs) are necessary to assist in determining the spatial extent of the refined SSA boundary. Sufficient land is sought within the refined boundary to allow delivery of the TAN 8 indicative capacities for the SSAs as set out in Table 1 of TAN 8 p5.

The indicative capacities determined as part of this study *for each zone* are not intended to set limits on the scale of development which may or may not be possible within each zone. A method for the determination of the potentially developable capacity (MW) of an SSA for wind farms follows¹⁷.

3.7.1 Capacity determination

The capacity of an SSA can be broadly established by totalling up the number of “white” unconstrained 1km grid squares present within the SSA as shown on the cumulative constraints mapping (**Figure 4a and 4b**) and applying a representative energy yield. (White grid squares are defined as being unconstrained by the various national technical and environmental criteria and, as a result “drop out” of the sieving exercise.) This data can be combined with a lower allowance for the number of grid squares which are only overlain by variable constraints (eg.certain historic landscapes or RSPB data) and an overall total arrived at.

Grid squares occupied by existing wind turbines are assumed to have a negligible capacity for the purposes of this study (both by virtue of their physical presence and their noise effects). Re-powering of existing wind farms within the SSAs has not been taken account in the achievement of the appropriate indicative capacity for an SSA.

As a conservative rule of thumb the potential capacity of each unconstrained 1km grid square is taken as being an *average* of 8.5MW. Further justification for this figure is included in **Appendix B**.

It is acknowledged that with larger turbines (2-3MW+) higher energy yields of up to 9-12MW may be possible for individual 1km grid squares (particularly if these are within a large wind farm). It is however considered unlikely that such an intensity of development would be possible across a widespread area (such as a whole SSA) due to a range of site specific constraints (particularly noise). It also assists the planning outputs to this study to also work with a capacity estimate at the lower end of the possible range, as this ultimately encourages the inclusion of slightly more land in the refined SSA boundary and thus permits greater spatial flexibility for both developers and the local planning authority.¹⁸

Grid squares occupied by just variable constraints¹⁹ are considered to have an *average* minimum capacity of 4MW.

It is acknowledged that for the Cardiff Wales Airport Safeguarding (which affects part of SSA F) this would be a crude measure, since if a site is cleared by the Cardiff Wales Airport then most likely it would be developable to a capacity of at least 8.5MW/sq. km. A decision

¹⁷ It is recognised that developers will have more accurate capacity models based upon industry specific computer programs such as GH WindFarmer. These are able to take greater account of site-specific factors such as the noise generated by existing and proposed turbines.

¹⁸ In deriving the capacity totals for SSA zones the assumption is made that all potential areas are developed and that each area duly accommodates the maximum number of turbines achievable, an unlikely scenario in reality. The analysis is unable to take further account of issues such as landowners who would be unwilling to offer their land up for turbine development and/or site access to these zones for turbines. The capacity figures derived from these exercises are therefore indicative only and in most cases might not all be achieved. This issue is explored further in Chapter 5 of this report in the context of the recommendations.

¹⁹ With the exception of some Historic landscapes – see Appendix D.

has been taken therefore not to reduce the average minimum capacity beneath areas affected by the Cardiff Airport Safeguarding “surface” but just to indicate the extent of this “surface” on **Figures 6a and 6b**. The legend to these figures indicates that any applications in this area require assessment from both an obstacle and technical safeguarding point of view and that capacities (in MW) may be reduced when proposals are put forward.

3.8 Identification of zone capacities

The derived zones/sub-areas within the SSA based upon the existing LANDMAP landscape assessments are compared with the cumulative constraint analysis undertaken previously. This allows for an approximate determination of the capacities of the individual SSA zones. The zones are also given names for ease of future reference.

3.8.1 Results for SSA E and F

The overlay of the derived zones and the cumulative constraint data is shown graphically on **Figure 6a and 6b** below.

Figure 6a - Technical and Environmental Constraints with Zones and 500m grid for SSA E

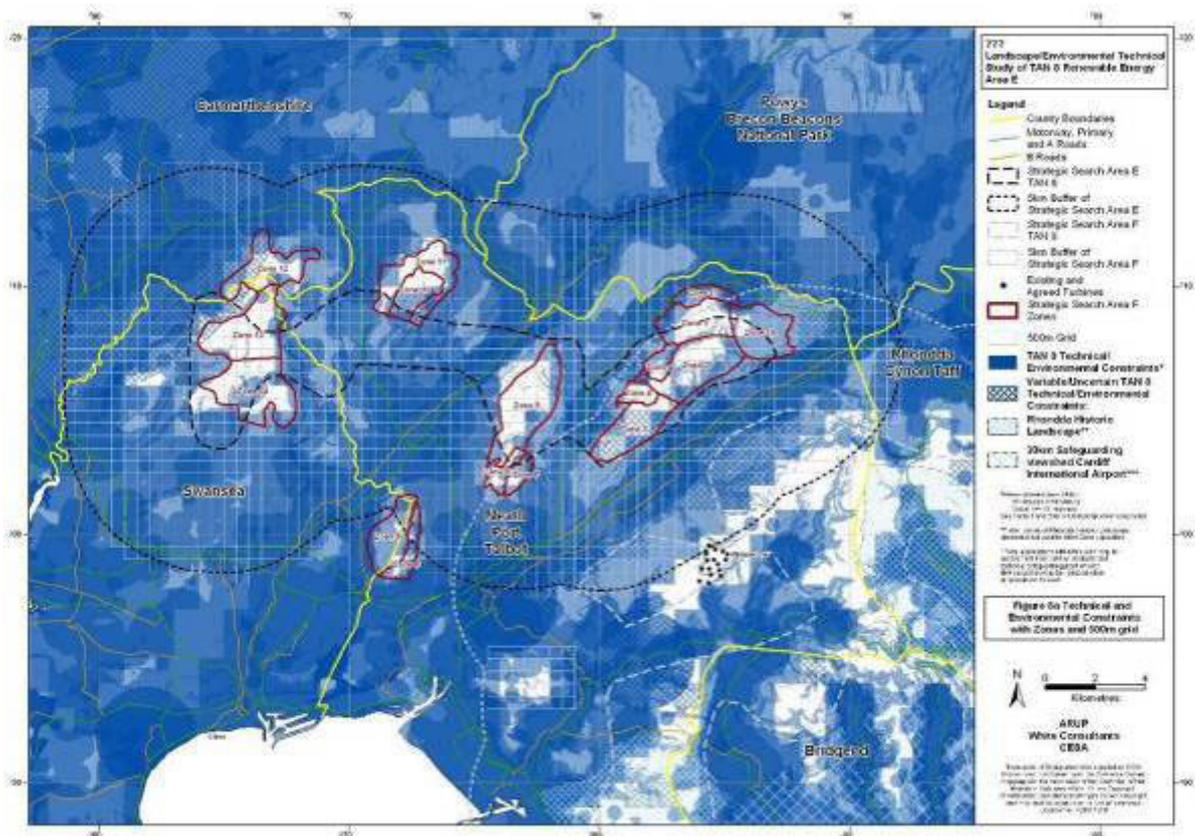
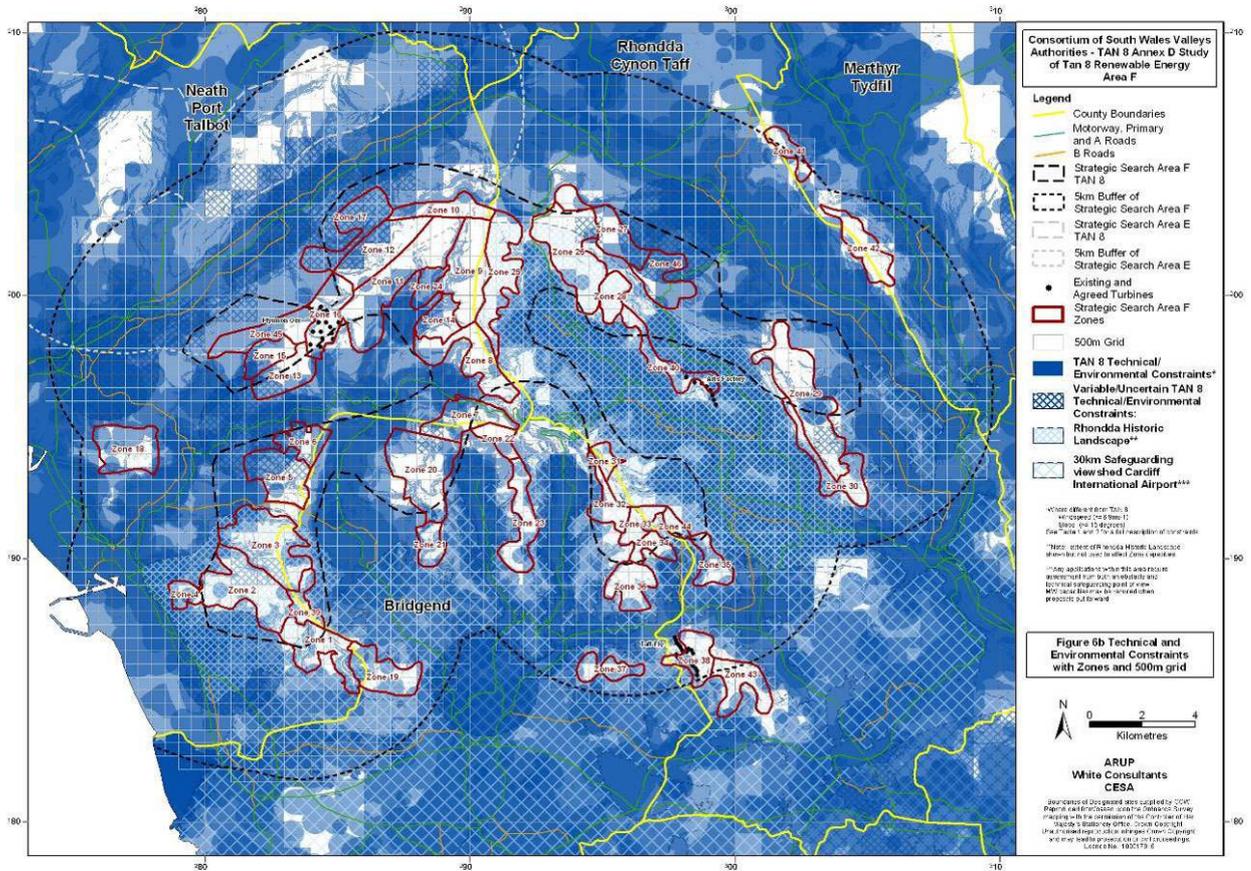


Figure 6b - Technical and Environmental Constraints with Zones and 500m grid for SSA F



The results are displayed in **Tables 3a and 3b** below.

Table 3a - Estimated Capacities (MW) of each zone in SSA E

SSA Zone E - Pontardawe

| Zone names | No of unconstrained 500m sq. grid squares (approx.) | No of variable constrained 500m sq. grid squares (approx.) | Approx. Estimated Capacity - unconstrained areas(MW) | Approx. Estimated Capacity- Variable constrained areas (MW) | Total Zone capacity (MW) |
|---|---|--|--|---|----------------------------|
| 1 Seven Sisters (East) | 11 | 0 | 23 | 0 | 23 |
| 2 Hirfynydd (Sarn Helen) | 8 | 0 | 17 | 0 | 17 |
| 3 Hirfynydd (Sarn Helen) - South West | 3 | 8 | 6 | 8 | 14 |
| 4 Hirfynydd (Sarn Helen) - West | 4.5 | 0 | 10 | 0 | 10 |
| 5 Mynydd Marchywel | 15 | 0 | 32 | 0 | 32 |
| 6 Mynydd Marchywel South West | 1 | 0 | 2 | 0 | 2 |
| 7 Mynydd Marchywel South East | 1 | 0 | 2 | 0 | 2 |
| 8 Mynydd Drumau (east) | 0.5 | 0 | 1 | 0 | 1 |
| 9 Mynydd Drumau (west) | 0.25 | 0 | 1 | 0 | 1 |
| 10 River Egel Valley | 3.25 | 0 | 7 | 0 | 7 |
| 11 Mynydd Uchaf (AAT site) | 7.5 | 0 | 16 | 0 | 16 |
| 12 Mynydd y Bettws | 4.25 | 8.5 | 9 | 9 | 18 |
| 13 Mynydd y Gwair | 18.5 | 1 | 39 | 1 | 40 |
| 14 Upper Lliw Reservoir | 13 | 0 | 28 | 0 | 28 |
| 15 Onllwyn South | 0 | 0 | 0 | 0 | 0 |
| 16 Glyn Neath North | 6 | 0 | 13 | 0 | 13 |

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Table 3a - Estimated Capacities (MW) of each zone in SSA F

SSA Zone F - Coed Morgannwg

| Zone names | No of unconstrained 500m sq grid squares (approx.) | No of variable constrained 500m sq. grid squares (approx.) | Approx. Estimated Capacity - unconstrained areas(MW) | Approx. Estimated Capacity- Variable constrained areas (MW) | Total Zone capacity (MW) |
|---|--|--|--|---|----------------------------|
| 1 Moel ton-mawr | 3 | 3 | 6 | 3 | 9 |
| 2 Mynydd Margam | 0 | 12 | 0 | 12 | 12 |
| 3 Mynydd Bach | 0 | 11 | 0 | 11 | 11 |
| 4 Ergyd Isaf (Mynydd Margam West) | 0 | 1 | 0 | 1 | 1 |
| 5 Afan Argoed South East | 3 | 3 | 6 | 3 | 9 |
| 6 Foel Trawsant | 2 | 0 | 4 | 0 | 4 |
| 7 Mynydd y Gelli | 3 | 0.5 | 6 | 1 | 7 |
| 8 Mynydd Blaengwynfi | 12.5 | 0 | 27 | 0 | 27 |
| 9 Mynydd Blaenrhondda (West) | 14.5 | 0 | 31 | 0 | 31 |
| 10 Mynydd Pen-y-Cae - Llyn Fach | 5.5 | 0 | 12 | 0 | 12 |
| 11 Glyncoed West | 19.5 | 0 | 41 | 0 | 41 |
| 12 Coed Morgannwg Way | 9.5 | 0 | 20 | 0 | 20 |
| 13 Mynydd Nant-y-bar | 7.5 | 0 | 16 | 0 | 16 |
| 14 Glyncoed East | 3 | 0 | 6 | 0 | 6 |
| 15 Mynydd Fforch dwm | 3.5 | 0 | 7 | 0 | 7 |
| 16 Ffynnon Oer (wind farm) | 3 | 0 | 6 | 0 | 6 |
| 17 Mynydd Resolven | 0 | 7 | 0 | 7 | 7 |
| 18 Mynydd-y-Gaer and Foel Fynyddau | 5 | 0 | 11 | 0 | 11 |
| 19 Mynydd Baedan | 3.5 | 0 | 7 | 0 | 7 |
| 20 Mynydd Caerau | 8 | 2 | 17 | 2 | 19 |
| 21 Moel Cynhordy | 2 | 0 | 4 | 0 | 4 |
| 22 Werfa | 3.5 | 0 | 7 | 0 | 7 |
| 23 Mynydd Llangeinwyr | 7.5 | 0 | 16 | 0 | 16 |
| 24 Mynydd Corrwg Fechan | 0 | 0 | 0 | 0 | 0 |
| 25 Mynydd Blaenrhondda | 15.5 | 0 | 33 | 0 | 33 |
| 26 Mynydd Tynewydd | 19 | 3 | 40 | 3 | 43 |
| 27 Mynydd Bwllfa | 3 | 0 | 6 | 0 | 6 |
| 28 Cefn y Rhondda (north) | 5.5 | 0 | 12 | 0 | 12 |
| 29 St Gwynno Forest | 16.5 | 4 | 35 | 4 | 39 |
| 30 St Gwynno Forest (South) | 4 | 0 | 9 | 0 | 9 |
| 31 Mynydd William Meyrick (NE) | 1.5 | 0 | 3 | 0 | 3 |
| 32 Mynydd William Meyrick (SW) | 4 | 0 | 9 | 0 | 9 |
| 33 Mynydd Maesteg (North) | 5.5 | 0 | 12 | 0 | 12 |
| 34 Mynydd Maesteg (South) | 3.5 | 0 | 7 | 0 | 7 |
| 35 Mynydd y Glifach (Trane) | 3 | 0 | 6 | 0 | 6 |
| 36 Mynydd Maendy Gifach Goch | 7.5 | 0 | 16 | 0 | 16 |
| 37 Mynydd y Gaer | 2.5 | 0 | 5 | 0 | 5 |
| 38 Mynydd Maendy (Taff Ely wind farm) | 4 | 0 | 9 | 0 | 9 |
| 39 Mynydd Margam (East) | 2 | 0 | 4 | 0 | 4 |
| 40 Cefn y Rhondda | 1.5 | 0 | 3 | 0 | 3 |
| 41 Mynydd Merthyr (North -East) | 2.5 | 0 | 5 | 0 | 5 |
| 42 Mynydd Merthyr | 9 | 0 | 19 | 0 | 19 |
| 43 Mynydd Portref (Taff Ely wind farm east) | 9 | 0 | 19 | 0 | 19 |
| 44 Mynydd Pwllyrhebog | 2 | 0 | 4 | 0 | 4 |
| 45 Ffynnon Oer (west) | 2.5 | 0 | 5 | 0 | 5 |
| 46 Mynydd Bwllfa (south east) | 1.25 | 0 | 3 | 0 | 3 |

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The analysis reveals an estimated total capacity for SSA E (plus appropriate land in the 5km buffer) of 223 MW approx. The TAN 8 indicative capacity for SSA E (100MW) is therefore seen as robust and suggests that around 50 % (approximately) of the technically suitable (i.e. largely unconstrained) sites within the SSA plus 5km margin may need to be developed to meet the TAN 8 indicative capacity.

The analysis reveals an estimated total capacity for SSA F (plus appropriate land in the 5km buffer) of 564 MW approx. The TAN 8 indicative capacity for SSA F (290MW) is therefore seen as robust and suggests that around 57 % (approximately) of the technically suitable (i.e. largely unconstrained) sites within the SSA plus 5km margin may need to be developed to meet the TAN 8 indicative capacity.

As a comparison, Garrad Hassan²⁰ in its independent review of the draft TAN 8 study considered the capacity of SSA E and F to be approximately 152 MW and 430 MW respectively²¹. These capacities are only for the area *within* the SSA boundary(s) as published i.e. excluding the possible unconstrained resource in the 5km buffer to the SSA boundary. The Garrad Hassan study does however raise some concerns regarding the ability to achieve the full capacity indicated due to the constraints posed by the presence of large areas of coniferous forestry (which is acknowledged). The Garrad Hassan work also considers a more conservative noise approach including a buffer around residential properties of 700m and a 40dB(A) absolute limit. These issues are returned to at the end of this report.

The next chapter consider the landscape and visual performance of the defined zones.

²⁰ Garrad Hassan, June 2005, Energy Assessment of TAN 8 Wind Energy Strategic Search Areas

²¹ Garrad Hassan Table 3.2, "Noise Constraint case scenario"

4 Landscape and Visual Analysis

4.1 Introduction: Landscape and Visual Analysis

This chapter considers the landscape and visual performance of the zones identified within the previous chapter. It establishes the terminology used in the assessment, the method and the results. As discussed previously the approach is to use nationally recognised techniques/criteria where possible, linked to existing policy documentation, to determine the relative and absolute landscape and visual performance of the different parts of the Strategic Search Areas (SSAs). This can then inform the justification for any proposed modifications to the TAN 8 SSA boundaries (as published).

Guidance on the assessment on the landscape and visual effects of individual wind farm proposals is well established via the Guidelines for Landscape and Visual Impact Assessment (GLVIA)²² and more recent specific guidance on the visual analysis aspects.²³ There is also emerging guidance on the cumulative landscape and visual assessment of a series of wind farm proposals.²⁴ The cumulative landscape and visual assessment guidance is however based on the premise of a dispersal approach to the planning of wind farm developments, not the concentration approach advocated within TAN 8. TAN 8 Annex D para. 8.4 indicates that “*within and immediately adjacent to the Strategic Search Areas, the implicit [landscape and visual] objective is to accept landscape change i.e. a significant change in landscape character from wind turbine development*”. However, in seeking the best location and minimising other harmful effects, the potential for direct and cumulative impacts is still taken into account.

The GLVIA states that the area of study should address the site itself and its wider landscape context i.e. those areas within which the development may influence character. The areas within the SSA and the adjacent areas have been looked at in some detail but also the effects on nationally designated landscapes at a greater distance have been considered.

The TAN 8 Annex D studies therefore require a modified approach to addressing the landscape and visual impacts, including the introduction of thresholds of acceptability.

The approach adopted is to firstly determine the *intrinsic* landscape and visual performance of the various zones/sub-areas within and adjacent to the SSA using criteria outlined in the sections which follow.

The next stage is then to determine the *relative* landscape and visual performance of the various zones/sub-areas within and adjacent to the SSA, and the potential for cumulative landscape and visual impact. This is generally in relation to any existing wind farms, such that the presence of an existing wind farm within or on the margins of an SSA should not prejudice the further development of that SSA. Indeed, the parts of the SSA that should perform well in visual terms (in particular) are those which are already heavily influenced by existing wind farms, otherwise the concentration approach advocated by TAN 8 could be undermined. This is with the acknowledgement that existing wind farms in Wales were not necessarily sited in accordance with the principles that would be used today.

This chapter considers the landscape analysis first, then the visual assessment, then presents the overall findings.

²² Landscape Institute & Institute of Environmental Management & Assessment (LI-IEMA). 2002. Guidelines for Landscape and Visual Impact Assessment. 2nd edition. Spon Press, London

²³ SNH et al, Visual Analysis of Wind farms: Good Practice Guidance, Consultation Draft 22.7.05

²⁴ SNH Advisory Service Landscape Group, 4th Draft May 2004, Guidance for Assessment of Cumulative Landscape and Visual Impacts arising from wind farm developments, for Scottish Natural Heritage.

4.2 Landscape terminology/Method

UK best practice guidance suggests that there are two separate, but interrelated components to landscape assessment when assessing the ability or otherwise for an area to accommodate large-scale wind farms. These are:

- a) **Landscape value** - the relative value or importance of landscape through a structured assessment taking into consideration specific criteria. This data is available through the LANDMAP visual and sensory aspect layer evaluation contained within published landscape assessments. It is independent of development type. Visual and sensory aspect value is derived from four criteria- scenic quality, integrity, character and rarity. These are measured on a four point scale, *low>moderate>high> outstanding and are justified*. These equate to low, local, county/regional and national/international importance. More detail on the method is available in Appendix C and CCW LANDMAP guidance. Value is regarded as an important element in defining where wind turbines are located as it is an indication of perceived value of a landscape resource to the area. If this is affected by wind turbine development then its value will be decreased. It is one of the factors defined by Countryside Agency Topic Paper 6 on landscape sensitivity and capacity.
- b) **Landscape sensitivity/capacity** - The intrinsic sensitivity of the landscape to change including its character as a whole and individual elements and features which contribute to that character, and in particular the ability/*landscape capacity* of the landscape to accommodate in this case large-scale wind farms²⁵. The landscape capacity of a particular landscape has to be specifically assessed on a case-by-case basis using appropriate criteria. The method used for the TAN 8 Annex D studies is set out in **Appendix E** and completed worksheets for each SSA zone are included in **Appendix F**. Landscape capacity is measured on a five-point scale, *low>medium/low>medium>medium/high>high*. Where a zone exhibits more than one landscape capacity (due typically to higher sensitivity/lower capacity land on its margins) the lower landscape capacity attributable to the zone is used in the analysis. This is generally reflects typically the core areas of upland plateaux which are the most likely parts of zones to be developed.

It is important to note that *high* or *outstanding* value does not necessarily mean that a sub-area/zone has higher sensitivity to, and lower capacity for, wind farm development. For example, a large scale rolling but simple landscape may be highly valued by virtue of its landscape qualities, cultural and biodiversity associations, yet its very scale and simplicity may render it able to accommodate (in landscape capacity terms), a series of large structures such as 125m high wind turbines.

4.3 Landscape Value/Sensitivity and visual thresholds

4.3.1 TAN 8 criteria

TAN 8 indicates that any part of the refined/modified strategic search area has to be acceptable in accordance with the following TAN 8 criteria (Para 2.9 p 6):

- Comprise an “*extensive area with a good wind resource*”

²⁵ In determining the landscape capacity of any given area for wind turbine development we have taken into consideration the Countryside Agency 2004 Topic Paper 6: Techniques and Criteria for judging Capacity and Sensitivity. In this publication, landscape character sensitivity, visual sensitivity and landscape value are combined to define landscape capacity (Figure 1B, p6). The method devised for this study builds on this guidance (which it is acknowledged relates to England) and uses LANDMAP information to provide value and inform landscape sensitivity, and combines this with visibility in a structured and reasoned way.

- Be an “*upland area (typically over 300m above ordnance datum) which contains a dominant landform that is flat (plateau) rather than a series of ridges*”.
- Be “*generally sparsely populated.*”
- Be “*dominated by conifer plantation and/or improved/impooverished moorland*”.
- have “*a general absence of nature conservation or historic landscape designations*”.
- Be of “*sufficient area to accommodate developments over 25MW*” to achieve at least 70MW installed capacity”, or it is considered at least in combination with other contiguous SSA parts be able to accommodate developments over 25MW

TAN 8 Annex D Para 8.6 indicates that at the local level, accepted thresholds of change, having regard to nationally developed capacity targets, can be established by more detailed assessments.

Therefore, in addition, any part of the refined/modified strategic search area boundary has also be acceptable at least in accordance with the following criteria:-

- To have a LANDMAP visual and sensory Value aspect rating of less than ‘Outstanding’
- To have a landscape sensitivity that is less than is considered ‘High’
- To have visual impacts upon residential dwellings which would not cause ‘dominance’
- Not to cause cumulative landscape or visual impact upon settlements

4.3.2 Landscape thresholds

Landscape thresholds relate both to the TAN 8 definitions, the general aspirations for the protection of the best areas of landscape and the wish to direct large-scale wind farms to the landscapes most able to accommodate the large structures, so minimising the degree of landscape change within and around the SSAs.

The most highly valued landscapes [of national importance] are National Parks and Areas of Outstanding Natural Beauty. These areas are substantially equivalent to ‘outstanding’ value in LANDMAP. There may be aspect areas outside these designations which are also ‘outstanding’ in terms of LANDMAP visual and sensory value. Development of large scale wind farms in these areas is considered unacceptable.

In directing large-scale wind farms to the landscapes most able to accommodate the large structures, reference has to be made to the landscape sensitivity and thus landscape capacity of an area.

An area will be generally unacceptable for large scale wind turbines if it has a high landscape sensitivity/low capacity for development. These are generally areas which intrinsically have some, or all, of the following characteristics:

- Fine grain landscapes of small scale with a relatively complex landcover, where large structures (>100m in height) would dominate or even overwhelm the features present (eg. pastures of small to medium size, farmsteads, areas with deciduous trees in hedgerows, boundary walls and valley side/fridd landscapes).
- Edge landscapes, where there is a sharp change in level and again, the structures would be over dominant.
- Outlier hills or small scale narrow single ridges
- Rock outcrops/cliffs/cwm, whose sense of scale and dramatic nature would be affected by large man-made structures
- Have a complex skyline

- Have some or all of the above and have a very sensitive relationship to other areas within the SSA with similar sensitive characteristics.

4.3.3 Visual Impact Thresholds

There have been many studies relating to the potential visual effect of windfarm development, the methodologies for which are brought together in the publication ‘Visual assessment of windfarms: Best practice’²⁶. Many of these studies have been carried out in Scotland to inform policymaking. Though not applicable in policy terms in Wales, the principles are still relevant as the development types and the landscapes (particularly within the Southern Uplands) have many similarities with Wales. ‘PAN 45: Renewable Energy Technologies’²⁷ suggest the following perception for a windfarm²⁸ in an open landscape (**Table 4a**):

Table 4a –Perceptual distances for Windfarms

| <i>Distance</i> | <i>Perception</i> |
|-----------------|---|
| 0-2km | Likely to be a prominent feature |
| 2-5km | Relatively prominent |
| 5-15km | Only prominent in clear visibility -- seen as part of a wider landscape |
| 15-30km | Only seen in very clear visibility -- a minor element in the landscape |

The ‘Visual assessment of windfarms: Best practice’²⁹ suggests, based on this and other research that the size classes, names and descriptions of visual effect should be modified. This study does not come to a view on significance which is related to the sensitivity of the receptor. In **Table 4b** below the University of Newcastle data is taken and a view is developed on distance and significance of effect for 125m to blade tip turbines depending on sensitivity of receptor as the basis of the calibration of effects for visual impact assessment.

²⁶ produced for Scottish Natural Heritage by the University of Newcastle 2002

²⁷ produced by the Scottish Executive in 2002

²⁸ [without relating this to tower height, but having earlier referred to turbines of tower height >70m and rotor diameters of >80m ie height to blade tip of up to 110 m]

²⁹ produced for Scottish Natural Heritage by the University of Newcastle 2002

Table 4b – Calibration of significance of visual effects with distance for windfarms

| University of Newcastle criteria | | | | This study calibration | | | | |
|----------------------------------|---------------|---|--|-----------------------------|----------------|---|---|-------------------|
| Size class <i>[Magnitude]</i> | Name | Descriptors - appearance in central vision field | Modifying factors | Magnitude of Effects | Distance range | Sensitivity of Receptor | | |
| | | | | | | High Sensitivity | Moderate sensitivity | Low sensitivity |
| | | | | | | Likely significance of effect | | |
| Very large | Dominant | Commanding, controlling the view | Few | Substantial adverse | Up to 2 km | <i>Severe</i> | <i>Major</i> | <i>Moderate</i> |
| Large | Prominent | Standing out, striking, sharp, unmistakable, easily seen | Few | Substantial/Moderate | 2 to 5 km | <i>Severe. Major in some situations</i> | <i>Major. Moderate in some situations</i> | <i>Moderate</i> |
| Medium | Conspicuous | Noticeable, distinct, catching the eye or attention, clearly visible, well-defined | Many: Limit of potential visual significance | Moderate | 4- 10 km | <i>Major</i> | <i>Moderate</i> | <i>Minor</i> |
| Very small | Inconspicuous | Lacking sharpness of definition, not obvious, indistinct, not clear, obscure, blurred, indefinite | Many: Limit of ZVI | Minor | 9-20km | <i>Moderate</i> | <i>Minor</i> | <i>Minor</i> |
| Negligible | Faint | Weak, not legible, near limit of acuity of human eye | Few | Negligible | 15km-30km | <i>Negligible</i> | <i>Negligible</i> | <i>Negligible</i> |

The sensitivity of receptors is based on commonly accepted standards derived from the Guidelines for Landscape and Visual Assessment [GLVIA 2002].

The total angle of view where turbines are visible due to intervening landform or vegetation will also have an important influence on magnitude of effect. It is therefore also considered in the cumulative impact assessment (next chapter refers).

The most significant i.e. “severe to moderate significance of effects” are shown highlighted in **Table 4b** namely:-

- All sensitive receptors within 20km eg Open Access land, public footpaths, other outdoor recreational users, residential.
- Settlements – effects within 2km, 5km and 10km (acknowledged double counting – distance band tends to highlight most significant effects where potential for inter-visibility screening would be less)
- National Park/National Trails – effects within 20km to give appropriate emphasis to outdoor sensitive receptors
- Roads within 5km (lower sensitivity users)

The data for the effects within these distance bands for each of the zones with the study area has therefore been generated and is discussed in the sections which follow.

It is considered that substantial adverse effects upon high sensitivity receptors should be avoided i.e. are unacceptable. It is at this distance that large wind turbines will become dominant. Zones that perform the worst with respect to these criteria are not therefore taken forward for analysis.

4.3.4 Cumulative Impact thresholds

Cumulative landscape and visual impact between wind farm proposals within and around the SSAs is generally given less weight under TAN 8 as the strategy adopted (TAN 8 Annex D Para 8.5) *“is a means of concentrating the impact of wind turbines in a relatively small proportion of the country in areas that are, on balance, technically, practically and environmentally better able to accommodate such impacts than other parts of Wales”*.

The MIPPS (para 12.8.13) indicates that local planning authorities should ensure that any potential detrimental effects on local communities are minimised [in facilitating the development of all forms of renewable energy] . Zones/parts of an SSA which give rise to unacceptable cumulative landscape and visual effects, particularly on residential properties, are those which, if developed, would surround communities. This could be defined as affecting over 180 degrees of the field of view from a settlement to major to severe significance of effects (as established in Table 4 above).

4.4 Landscape Value Analysis

4.4.1 Landscape value results for SSA E and F

Landscape assessments

The existing Development Plans identify special landscape areas, or landscape policies that identify significant landscape types.

The most recent assessments have been carried out as part of the LANDMAP process and have been quality assessed. This has been carried out for all aspects in Neath Port Talbot, Rhondda Cynon Taff, Bridgend, Swansea, Merthyr Tydfil although the Cultural aspect was not available for Swansea during the study period. Quality Assurance for RCT is underway but not completed. . Carmarthenshire has also recently carried out a LANDMAP assessment for the visual and sensory aspect although this is not quality assured.

Overall, the assessments are considered of fine enough grain with enough information to be helpful in defining character and sensitivity and to have a degree of consistency. Brecon Beacons National Park has been assessed as part of the Brecknockshire LANDMAP study.

A qualitative description of the landscape sensitivity of the SSA zones, together with the completed landscape sensitivity worksheet for each zone, is included in **Appendix F**, together with the support for their landscape value assessment.

It is considered (as previously discussed) that the LANDMAP Visual and Sensory assessment offers the best potential comparison of landscape value. The LANDMAP Visual and Sensory values for the various zones in SSA E and F are shown in **Table 4c and 4d** below and on **Figure 7a and 7b**.

Table 4c Landscape Value of the SSA E zones from LANDMAP Visual and Sensory data

| Zone | Zone Name | Visual and Sensory value | Visual and Sensory as numerical Value | Ranking : LANDMAP Visual and Sensory |
|------|---------------------------------------|--------------------------|---------------------------------------|--------------------------------------|
| 1 | Seven Sisters (East) | Moderate | 2 | 2 |
| 2 | Hirfynydd (Sarn Helen) | Moderate | 2 | 2 |
| 3 | Hirfynydd (Sarn Helen) - South West | Moderate | 2 | 2 |
| 4 | Hirfynydd (Sarn Helen) - West | Moderate | 2 | 2 |
| 5 | Mynydd Marchywel | Moderate | 2 | 2 |
| 6 | Mynydd Marchywel South West | Moderate | 2 | 2 |
| 7 | Mynydd Marchywel South East | Moderate | 2 | 2 |
| 8 | Mynydd Drumau (east) | High | 3 | 11 |
| 9 | Mynydd Drumau (west) | Moderate | 2 | 2 |
| 10 | River Egel Valley | High | 3 | 11 |
| 11 | Mynydd Uchaf (AAT site) | High | 3 | 11 |
| 12 | Mynydd y Bettws | High | 3 | 11 |
| 13 | Mynydd y Gwair | High | 3 | 11 |
| 14 | Upper Lliw Reservoir | High | 3 | 11 |
| 15 | Onllwyn South | Low | 1 | 1 |
| 16 | Glyn Neath North | Moderate | 2 | 2 |

Table 4d Landscape Value of the SSA F zones from LANDMAP Visual and Sensory data

| Zone | Zone Name | Visual and Sensory value | Visual and Sensory as numerical Value | Ranking : LANDMAP Visual and Sensory |
|---------|---|--------------------------|---------------------------------------|--------------------------------------|
| Zone 1 | Moel ton-mawr | Moderate | 2 | 1 |
| Zone 2 | Mynydd Margam | Moderate | 2 | 1 |
| Zone 3 | Mynydd Bach | Moderate | 2 | 1 |
| Zone 4 | Ergyd Isaf (Mynydd Margam West) | Moderate | 2 | 1 |
| Zone 5 | Afan Argoed South East | Moderate | 2 | 1 |
| Zone 6 | Foel Trawsnant | Moderate | 2 | 1 |
| Zone 7 | Mynydd y Gelli | High | 3 | 34 |
| Zone 8 | Mynydd Blaengwynfi | Moderate | 2 | 1 |
| Zone 9 | Mynydd Blaenrhondda (West) | Moderate | 2 | 1 |
| Zone 10 | Mynydd Pen-y-Cae - Llyn Fach | Moderate | 2 | 1 |
| Zone 11 | Glyncorwg West | Moderate | 2 | 1 |
| Zone 12 | Coed Morgannwg Way | Moderate | 2 | 1 |
| Zone 13 | Mynydd Nant-y-bar | Moderate | 2 | 1 |
| Zone 14 | Glyncorwg East | Moderate | 2 | 1 |
| Zone 15 | Mynydd Fforch dwm | Moderate | 2 | 1 |
| Zone 16 | Ffynnon Oer (wind farm) | Moderate | 2 | 1 |
| Zone 17 | Mynydd Resolven | Moderate | 2 | 1 |
| Zone 18 | Mynydd-y-Gaer and Foel Fynyddau | Moderate | 2 | 1 |
| Zone 19 | Mynydd Baedan | High | 3 | 34 |
| Zone 20 | Mynydd Caerau | Moderate | 2 | 1 |
| Zone 21 | Moel Cynhordy | Moderate | 2 | 1 |
| Zone 22 | Werfa | High | 3 | 34 |
| Zone 23 | Mynydd Llangeinwyr | High | 3 | 34 |
| Zone 24 | Mynydd Corrwg Fechan | Moderate | 2 | 1 |
| Zone 25 | Mynydd Blaenrhondda | Moderate | 2 | 1 |
| Zone 26 | Mynydd Tynewydd | Moderate | 2 | 1 |
| Zone 27 | Mynydd Bwlfa | High | 3 | 34 |
| Zone 28 | Cefn y Rhondda (north) | Moderate | 2 | 1 |
| Zone 29 | St Gwynno Forest | Moderate | 2 | 1 |
| Zone 30 | St Gwynno Forest (South) | Moderate | 2 | 1 |
| Zone 31 | Mynydd William Meyrick (NE) | Moderate | 2 | 1 |
| Zone 32 | Mynydd William Meyrick (SW) | High | 3 | 34 |
| Zone 33 | Mynydd Maesteg (North) | High | 3 | 34 |
| Zone 34 | Mynydd Maesteg (South) | High | 3 | 34 |
| Zone 35 | Mynydd y Glifach (Trane) | Moderate | 2 | 1 |
| Zone 36 | Mynydd Maendy Glfach Goch | Moderate | 2 | 1 |
| Zone 37 | Mynydd y Gaer | High | 3 | 34 |
| Zone 38 | Mynydd Maendy (Taff Ely wind farm) | High | 3 | 34 |
| Zone 39 | Mynydd Margam (East) | High | 3 | 34 |
| Zone 40 | Cefn y Rhondda | Moderate | 2 | 1 |
| Zone 41 | Mynydd Merthyr (North -East) | Moderate | 2 | 1 |
| Zone 42 | Mynydd Merthyr | Moderate | 2 | 1 |
| Zone 43 | Mynydd Portref (Taff Ely wind farm eas | High | 3 | 34 |
| Zone 44 | Mynydd Pwllyrhebog | High | 3 | 34 |
| Zone 45 | Ffynnon Oer (west) | Moderate | 2 | 1 |
| Zone 46 | Mynydd Bwlfa (south east) | Moderate | 2 | 1 |

Figure 7a - LANDMAP Visual and Sensory value of zones in SSA E

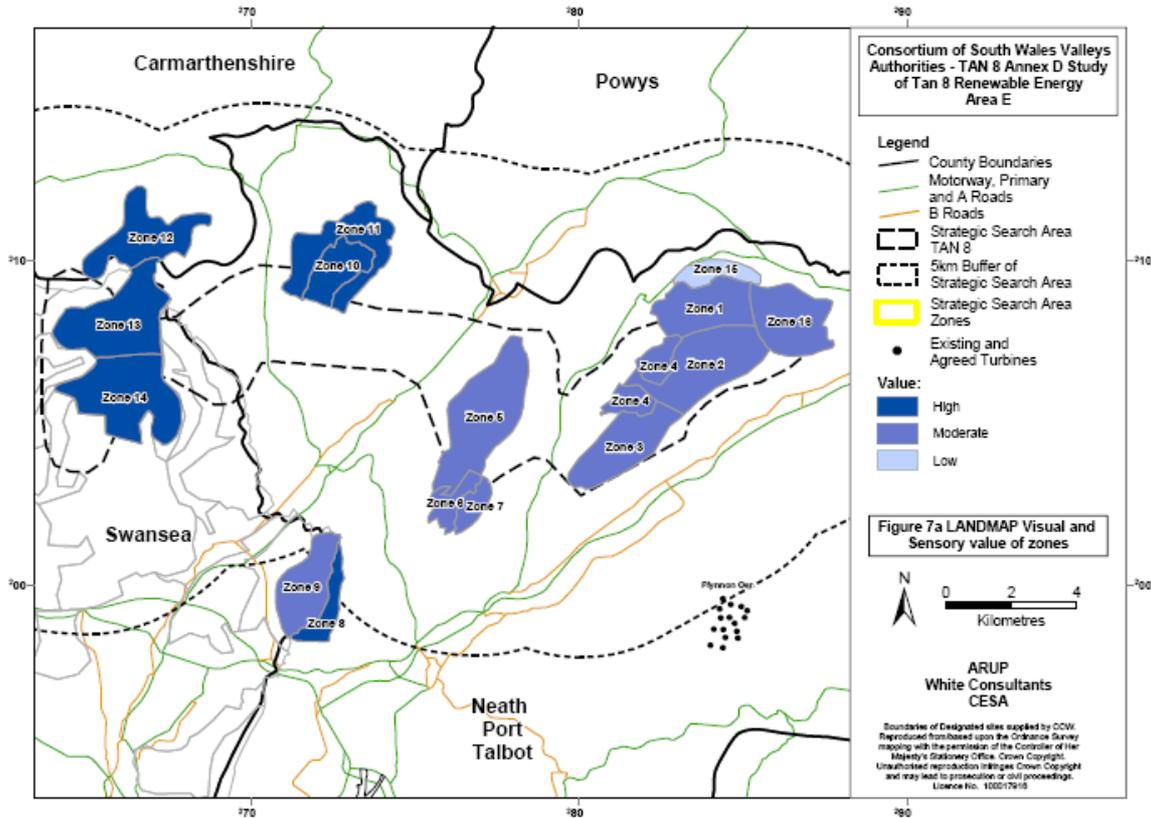
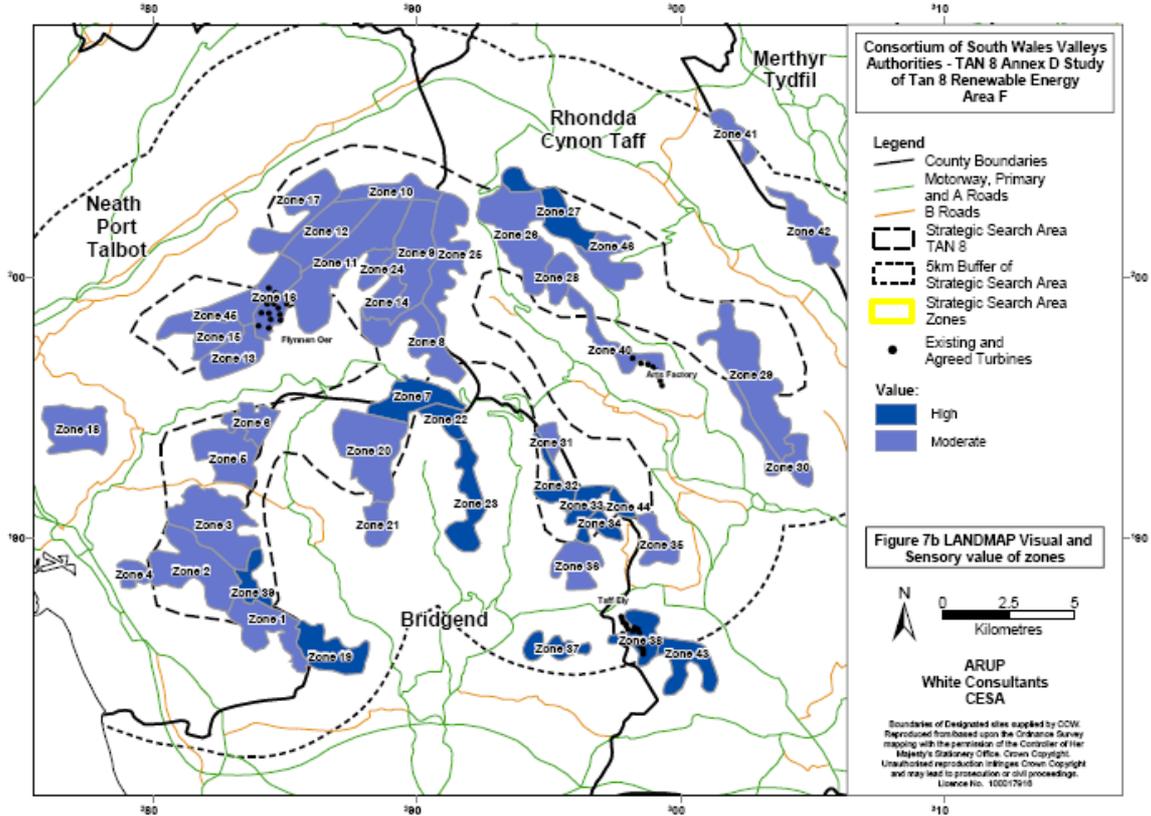


Figure 7b - LANDMAP Visual and Sensory value of zones in SSA F



In accordance with the criteria outlined within Section 4.3 of this report (landscape value/sensitivity and visual thresholds), none of the zones in SSAs E or F are unacceptable as parts of a strategic wind farm zone on the basis of their landscape value alone.

4.5 Landscape Capacity Analysis

4.5.1 Landscape capacity results for SSA E and F

The resulting zone performance is summarised in **Table 5a and 5b** below and on **Figure 8a and 8b**.

Table 5a Summary landscape sensitivity of the SSA zones in SSA E

| Zone | Zone Name | Lowest Landscape Sensitivity | Landscape Sensitivity as numerical value | Ranking: Landscape sensitivity |
|------|---------------------------------------|------------------------------|--|--------------------------------|
| 1 | Seven Sisters (East) | Medium High | 4 | 2 |
| 2 | Hirfynydd (Sarn Helen) | Medium High | 4 | 2 |
| 3 | Hirfynydd (Sarn Helen) - South West | Medium High | 4 | 2 |
| 4 | Hirfynydd (Sarn Helen) - West | Medium High | 4 | 2 |
| 5 | Mynydd Marchywel | Medium High | 4 | 2 |
| 6 | Mynydd Marchywel South West | Medium High | 4 | 2 |
| 7 | Mynydd Marchywel South East | High | 5 | 13 |
| 8 | Mynydd Drumau (east) | High | 5 | 13 |
| 9 | Mynydd Drumau (west) | High | 5 | 13 |
| 10 | River Egel Valley | High | 5 | 13 |
| 11 | Mynydd Uchaf (AAT site) | Medium-high | 4 | 2 |
| 12 | Mynydd y Bettws | Medium-high | 4 | 2 |
| 13 | Mynydd y Gwair | Medium | 3 | 1 |
| 14 | Upper Lliw Reservoir | Medium-high | 4 | 2 |
| 15 | Onllwyn South | Medium-high | 4 | 2 |
| 16 | Glyn Neath North | Medium High | 4 | 2 |

Table 5b Summary Landscape Sensitivity of the zones in SSA F

| Zone | Zone Name | Landscape Sensitivity | landscape Sensitivity as numerical value | Ranking : landscape sensitivity |
|---------|---|-----------------------|--|---------------------------------|
| Zone 1 | Moel ton-mawr | High | 5 | 40 |
| Zone 2 | Mynydd Margam | Medium-high | 4 | 26 |
| Zone 3 | Mynydd Bach | Medium | 3 | 13 |
| Zone 4 | Ergyd Isaf (Mynydd Margam West) | High | 5 | 40 |
| Zone 5 | Afan Argoed South East | Medium | 3 | 13 |
| Zone 6 | Foel Trawsnant | Medium | 3 | 13 |
| Zone 7 | Mynydd y Gelli | Medium | 3 | 13 |
| Zone 8 | Mynydd Blaengwynfi | Medium-low | 2 | 3 |
| Zone 9 | Mynydd Blaenrhondda (West) | Low | 1 | 1 |
| Zone 10 | Mynydd Pen-y-Cae - Llyn Fach | Medium-high | 4 | 26 |
| Zone 11 | Glyncorrwg West | Medium-Low | 2 | 3 |
| Zone 12 | Coed Morgannwg Way | Medium-Low | 2 | 3 |
| Zone 13 | Mynydd Nant-y-bar | Medium-Low | 2 | 3 |
| Zone 14 | Glyncorrwg East | Medium | 3 | 13 |
| Zone 15 | Mynydd Fforch dwm | Medium-Low | 2 | 3 |
| Zone 16 | Ffynnon Oer (wind farm) | Low | 1 | 1 |
| Zone 17 | Mynydd Resolven | Medium-high | 4 | 26 |
| Zone 18 | Mynydd-y-Gaer and Foel Fynyddau | High | 5 | 40 |
| Zone 19 | Mynydd Baedan | High | 5 | 40 |
| Zone 20 | Mynydd Caerau | Medium | 3 | 13 |
| Zone 21 | Moel Cynhordy | Medium-high | 4 | 26 |
| Zone 22 | Werfa | Medium-high | 4 | 26 |
| Zone 23 | Mynydd Llangeinwyr | Medium-high | 4 | 26 |
| Zone 24 | Mynydd Corrwg Fechan | Medium-high | 4 | 26 |
| Zone 25 | Mynydd Blaenrhondda | Medium-low | 2 | 3 |
| Zone 26 | Mynydd Tynewydd | Medium-low | 2 | 3 |
| Zone 27 | Mynydd Bwlfa | Medium | 3 | 13 |
| Zone 28 | Cefn y Rhondda (north) | Medium-low | 2 | 3 |
| Zone 29 | St Gwynno Forest | Medium | 3 | 13 |
| Zone 30 | St Gwynno Forest (South) | Medium-high | 4 | 26 |
| Zone 31 | Mynydd William Meyrick (NE) | Medium | 3 | 13 |
| Zone 32 | Mynydd William Meyrick (SW) | Medium | 3 | 13 |
| Zone 33 | Mynydd Maesteg (North) | Medium | 3 | 13 |
| Zone 34 | Mynydd Maesteg (South) | Medium | 3 | 13 |
| Zone 35 | Mynydd y Glifach (Trane) | Medium-high | 4 | 26 |
| Zone 36 | Mynydd Maendy Glfach Goch | Medium-high | 4 | 26 |
| Zone 37 | Mynydd y Gaer | High | 5 | 40 |
| Zone 38 | Mynydd Maendy (Taff Ely wind farm) | High | 5 | 40 |
| Zone 39 | Mynydd Margam (East) | Medium-high | 4 | 26 |
| Zone 40 | Cefn y Rhondda | Medium-high | 4 | 26 |
| Zone 41 | Mynydd Merthyr (North -East) | Medium-high | 4 | 26 |
| Zone 42 | Mynydd Merthyr | Medium-high | 4 | 26 |
| Zone 43 | Mynydd Portref (Taff Ely wind farm eas | High | 5 | 40 |
| Zone 44 | Mynydd Pwllyrhebog | Medium | 3 | 13 |
| Zone 45 | Ffynnon Oer (west) | Medium-low | 2 | 3 |
| Zone 46 | Mynydd Bwlfa (south east) | Medium-low | 2 | 3 |

Figure 8a Landscape sensitivity Data for the zones in SSA E

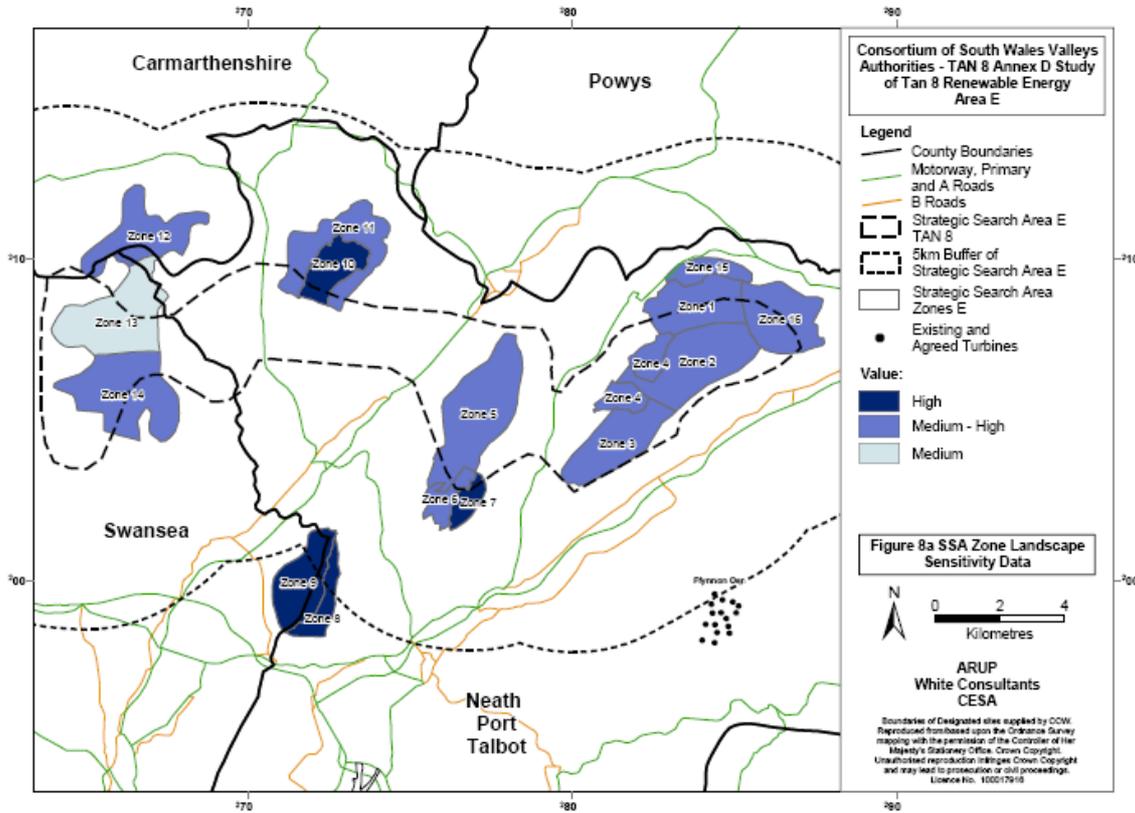
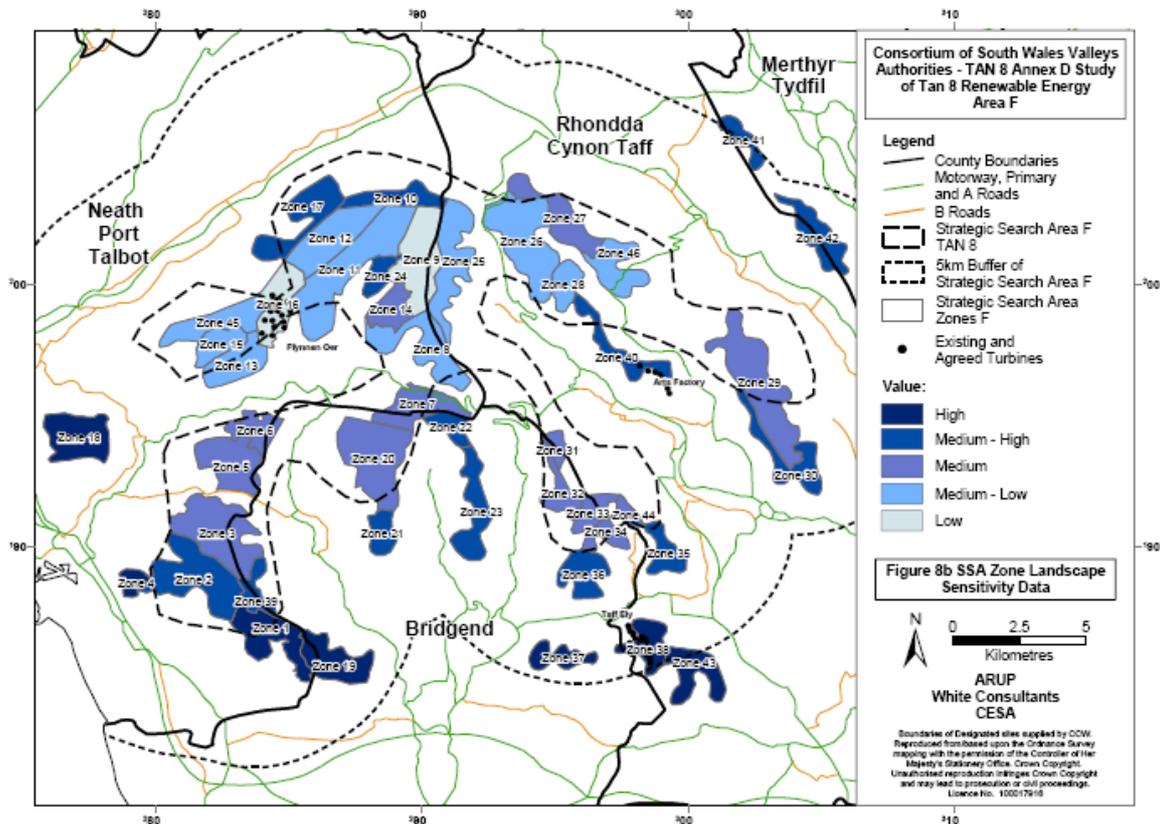


Figure 8b Landscape sensitivity Data for the zones in SSA F



4.5.2 Landscape sensitivity analysis: implications for wind farm type

The data presented within **Figures 8a and 8b** above has two functions. It assists in the relative ranking of zones in terms of “environmental performance” and in determining those zones which are intrinsically unsuitable by virtue of their landscape sensitivity. However importantly within the South Wales Valleys the landscape sensitivity concept also assists in the broad determination of the likely acceptable wind farm typologies per landscape zone/zones.

In accordance with the criteria outlined within Section 4.3 of this report (landscape value/sensitivity and visual thresholds), those areas classified as high sensitivity are intrinsically not suitable for strategic scale wind farm development and include:

Within SSA E, Zones 7, 8, 9 and 10.

Within SSA F, Zones 1,4, 18, 19, 37, 38, 43.

These are therefore excluded from the final analysis in Section 5.0.

Though those zones which are of medium-high landscape sensitivity are less desirable they have been taken forward. They may be able to accommodate a limited number of wind turbines in limited parts of their area with very careful site design as part of a larger wind farm site.

Landscape sensitivity analysis for wind farms suggests that generally the less sensitive the landscape unit, the more able it is to accommodate large-scale structures such as wind turbines. There is some correlation between the five point sensitivity scale adopted for this study and wind turbine size, such that generally:

- a low sensitivity³⁰ landscape could best accommodate the largest types of wind turbines
- a highly sensitive landscape might only be able to accommodate the smaller types of wind turbines (or none at all) There is clearly a continuum between these two extremes.

Within the South Wales Valleys the distribution of landform and topography is such that the more robust, lower sensitivity landscapes are located:-

- Within the uplands to the north of Glyncoirwg in SSA F, Zones 8, 9, 11, 12, 13,15, 16, 25, 26, 28,45, and 46). (Medium-low and some low)
- Within the western part of SSA E - Zone E13 (medium) – Mynydd-y-Gwair

The landscape sensitivities generally in SSA E are higher (i.e. more sensitive) that those in SSA F.

It should be noted that generally the landscape sensitivities are generally lowest within the northern parts of SSA F where the landform is between 400-500mAOD and where the plateau width is such that wind turbines do not need to be located close to the valley edge or scarp slope. The conclusion is that the very largest types of wind farms could best be accommodated only within these areas. Such large structures would otherwise start to dominate the landforms to the south-west, south and south-east of both SSA's with their heights significantly in excess of one third of the height of the landform onto which they would be placed.

4.6 Visual Impact Analysis

4.6.1 Visual Terminology/Method

Visual Impact Assessment forms the second part of the landscape and visual assessment of a development proposal. A visual analysis in turn forms part of the visual impact

³⁰ when this judgement is based upon a specific assessment for wind farm developments

assessment and this uses the 'Zone of Theoretical Visibility' (ZTV) for each part of the SSA zone³¹.

The purpose of the TAN 8 Annex D studies is to determine the *relative* visual impact between parts of the SSA (Para 6.4 first bullet). It is therefore necessary to develop a ZTV for turbines placed in each of the SSA zones/sub-areas, review the data in the field and then compare the results. However in order to further inform the relative visual impacts of each part of the SSA it is considered not only necessary to look at the relative ZTVs for each zone, but to also consider what sensitive receptors are affected by the various ZTVs. This gives a greater appreciation of the likely magnitude and significance of the visual impact associated with developing different parts of the SSA.

This study is not able to formally consider the influence of inter-visibility within the ZTV work but the team consider this aspect during fieldwork and when arriving at the conclusions of the study.

The approach adopted is to not only determine the relative visual performance of the various zones/sub-areas within and adjacent to the SSA, but to do this as a *comparison* to the existing situation. It is therefore also necessary to generate a cumulative ZTV for all of the existing/agreed wind farms³² within and surrounding the SSA (as shown in the examples -**Figure 9a and 9b** below).

In addition to existing/agreed wind farms, SSA E and F have the potential to be affected by the development of the consented offshore wind farm at Scarweather Sands, near Porthcawl. The ZTV of this development has therefore been added to **Figures 9a and 9b**. However the ZTV for Scarweather has not been used in the quantitative analysis as to do so would favour development in the SSA F zones which are affected by the offshore development (since these zones would perform well with respect to the 'existing/agreed wind farms indicators'). It is considered that the seascape and landscape impacts are quite distinct from onshore windfarms and should not be aggregated. The Scarweather data has therefore been used qualitatively to comment on the likelihood of cumulative visual impact between on and offshore wind proposals for visual receptors

³¹ The term 'Zone of Theoretical Visibility' (ZTV) is used to describe the area over which a development can theoretically be seen, and is based on a Digital Terrain Model (DTM) and overlaid on a map base. This is also known as a Zone of Visual Influence (ZVI), Visual Envelope Map (VEM) and Viewshed. However the term ZTV is preferred for its emphasis of two key factors that are often misunderstood:

- visibility maps represent where a development may be seen theoretically – that is, it may not actually be visible in reality, for example due to localised screening which is not represented by the Digital Terrain Model (DTM); and
- the maps indicate potential visibility only, that is, the areas within which there may be a line of sight. They do not convey the nature or magnitude of visual impacts, for example whether visibility will result in positive or negative effects and whether these will be significant or not.

Most ZTV produced are in conjunction with individual wind farm applications and are calculated by computer.

³² Existing/Agreed wind farms as detailed in Appendix A.

Figure 9a Visual Impact - Existing Wind Farms – SSA E

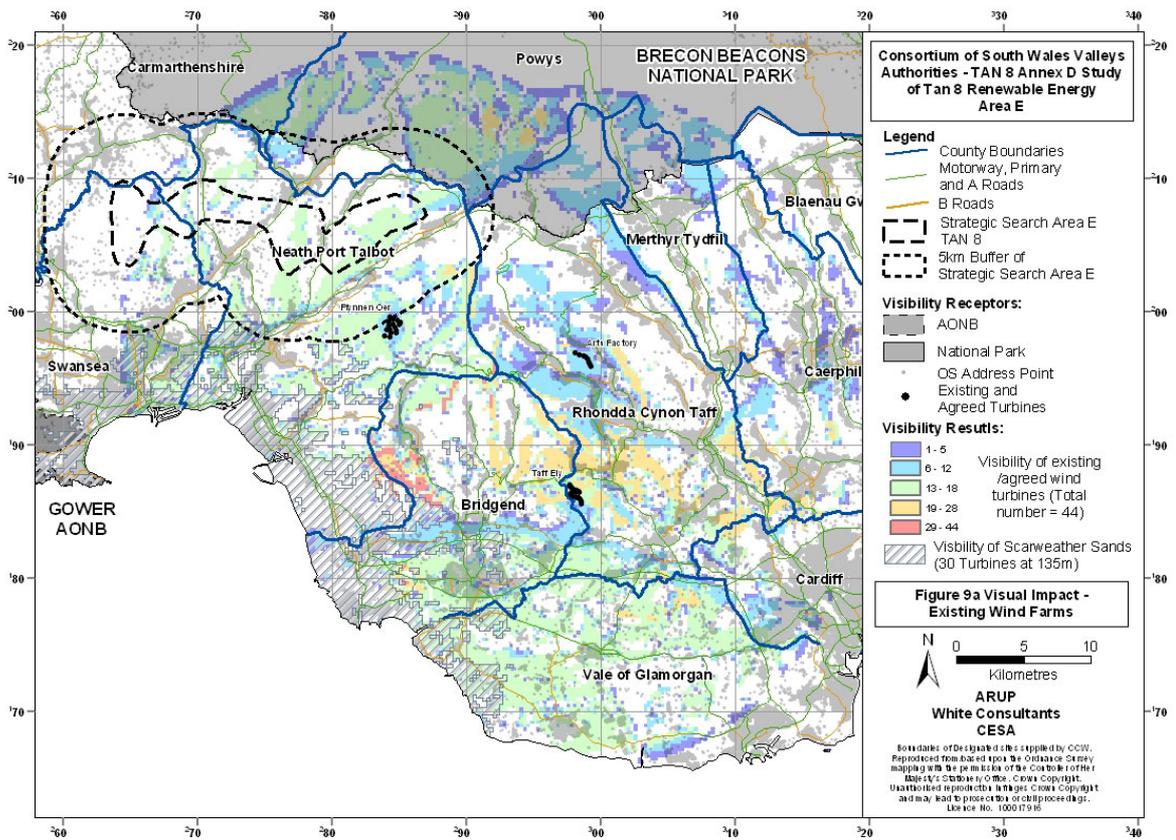
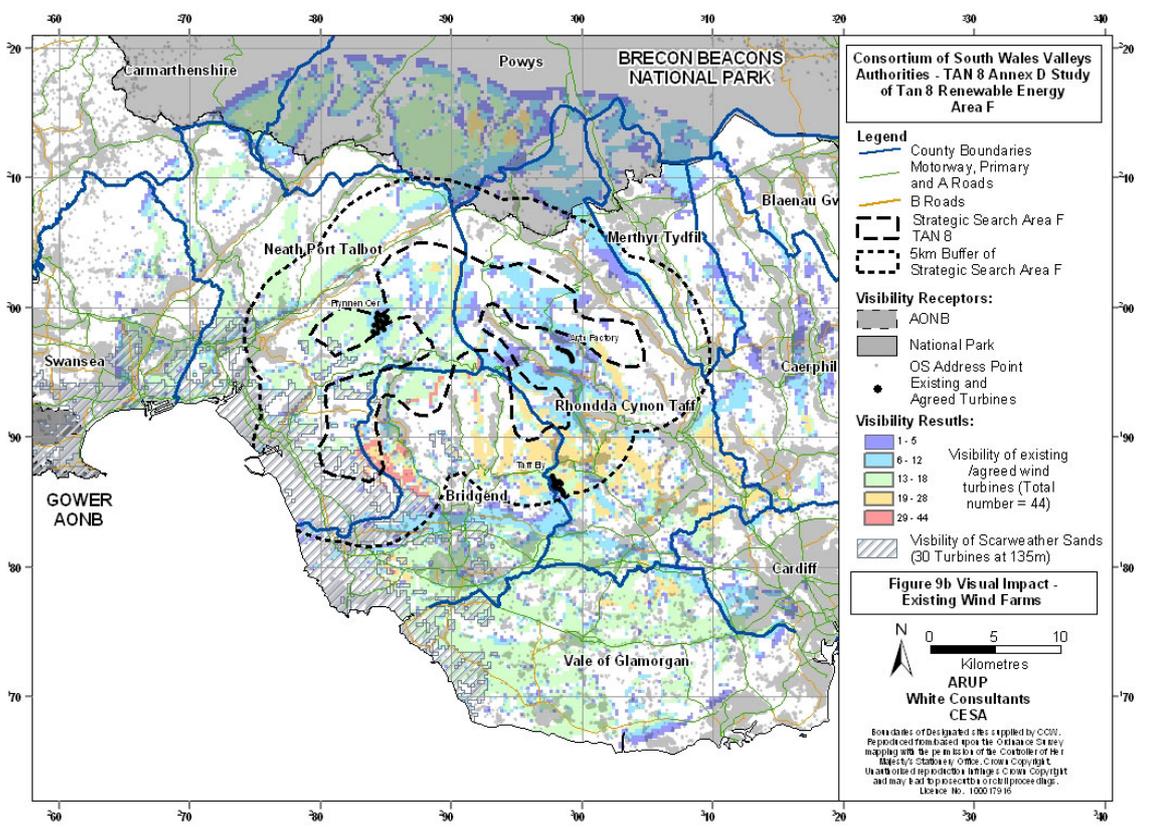


Figure 9b Visual Impact - Existing Wind Farms – SSA F



The ZTV results for each zone are therefore compared to the cumulative ZTV of the existing wind farms and the difference noted. It is this difference data that is used to rank the performance of the SSA zones in visual impact terms. This is shown graphically in **Figure 10a and 10b** below.

Figure 10a- Example ZTV for Zone 1 in SSA E compared to existing situation - spatial extent of additional visibility

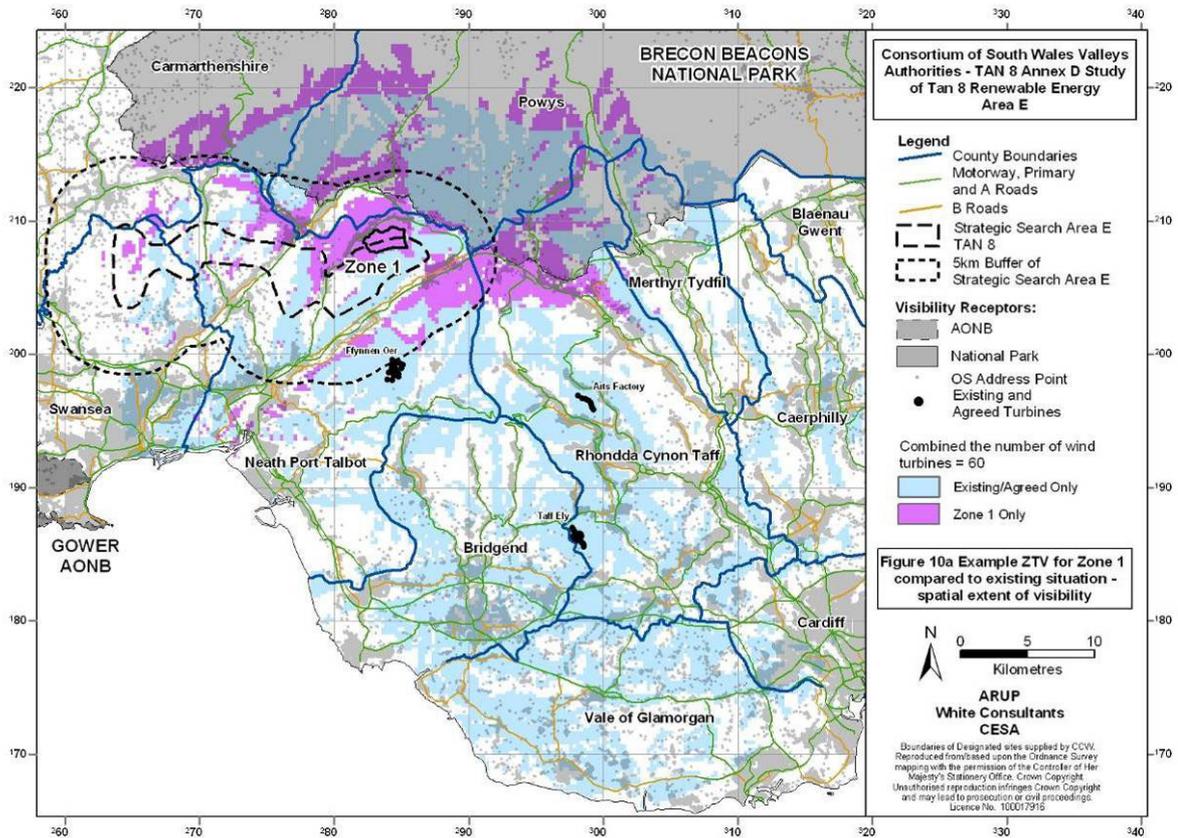
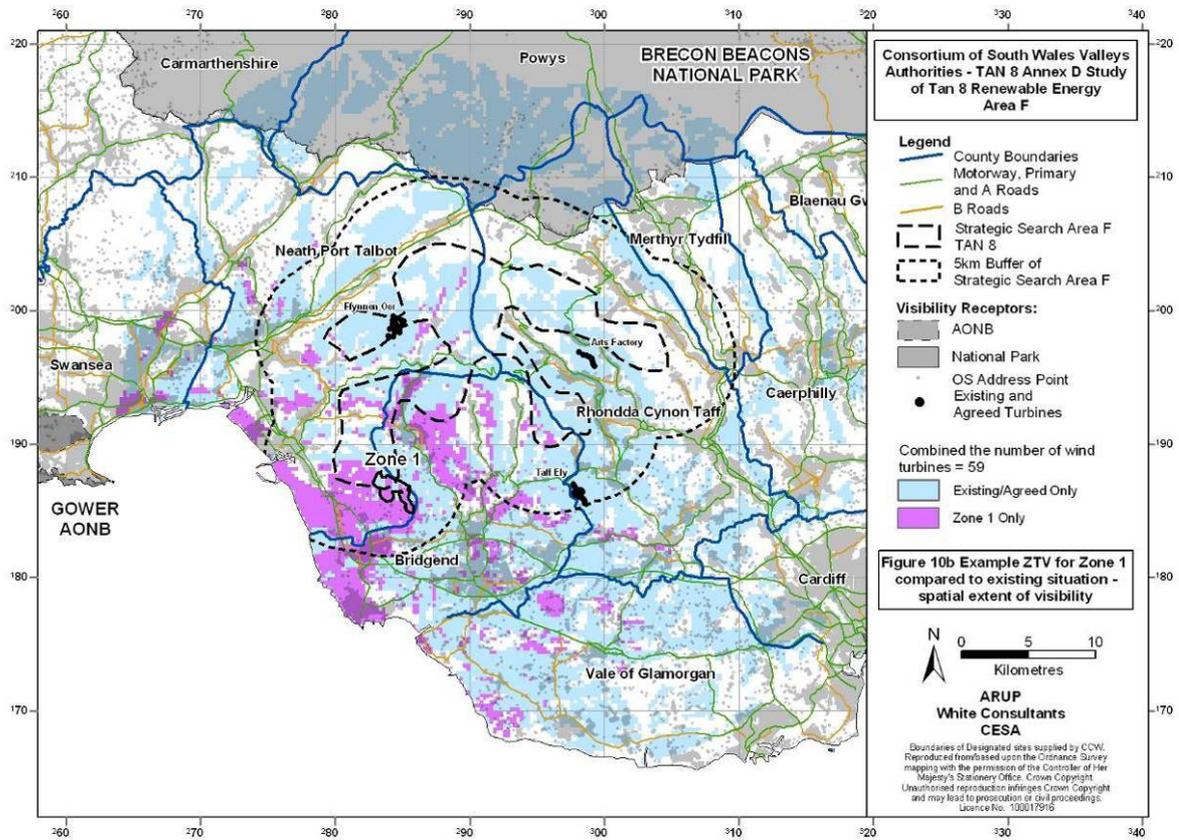


Figure 10b- Example ZTV for Zone 1 in SSA F compared to existing situation - spatial extent of additional visibility



Full details of the Methodology used for the GIS and Visual Analysis is included in **Appendix G**, however key parameters are outlined below in **Table 6**.

Table 6 – Key parameters used in the generation of the relative visual analysis

| | |
|----------------------------|--|
| Turbine height | 125m to blade tip (an average between 130m in forested areas and 110/120m in open moorland). It should be stressed that using height to blade-tip in the ZTV presents a conservative approach to the analysis; many individual EIA ZTV studies for wind farms consider height to hub as well as to blade tip. |
| Turbine density in zones | 4 No. placed within each OS grid square within the zone on a grid basis. Note this turbine distribution does not relate to the likely developable capacity (MW) available per zone as no constraints are taken into account. |
| Grid size used in ZTV | 250m square |
| Extent of ZTV | 20km from edge turbines in the zone. Whilst it is acknowledged that 30-35km represents the ZTV in many cases, the study is concerned with <i>moderate adverse</i> visual impacts and greater only (reference Table 4). For 100-130m turbines these impacts are considered to occur within 20km of the SSA zone. |
| Existing/agreed wind farms | All wind farms which have been constructed, or are under construction or have a valid planning consent as of June 2005, but which have an |

| | |
|--|---|
| | output greater than 5MW (i.e. they are not “small” as defined by TAN 8, para. 2.12.) and they are within 30km of the boundary of the TAN 8 SSAs. See Appendix A for details. 30km is justified as it places an existing wind farm on average 40km from a wind farm in the centre of an SSA, such that each wind farm is within the moderate adverse visual impact distance (20km) of each other. |
|--|---|

The visual impact data represented by the total ZTV for each zone (over and above that related to the existing situation) is then disaggregated by the following sensitive receptors:

- The **overall visual effects** (to determine likely effects to general users of the study area utilising access land, footpaths, bridleways, minor roads etc.). A distance of 20km is used to cover the range of sensitivity of receptors.
- **People day to day** - Specific visual effects upon residents and vehicle users (incl. users of A and B-roads). Distances of 5 and 10km respectively are used.
- **Landscape/sensitive outdoor recreation receptors** - Specific visual effects upon users of Nationally designated landscapes/National Trails (National Parks and Areas of Outstanding Natural Beauty (AONB) and any appropriate National Trails. A distance of 20km is used.
- The likelihood of **severe effects upon visual amenity and setting, particularly cumulative effects upon valley communities**. i.e. the visual effects that developing a zone might have upon adjacent villages and settlement in terms of dominance and sense of enclosure. The number of residents able to theoretically see turbines within a zone within a distance of 2km is used.

In arriving at an overall summary of the *visual* performance of an SSA zone/sub-area, the disaggregated visual impact data is brought together as follows:

- Overall visual effects data (ranked) + effects upon people day to day data (ranked)+ landscape/sensitive outdoor receptors data (ranked)+effects on settlements within 2km data (ranked).

This process ensures that each of the above factors is given equal weight. The visual data is then supplemented by a qualitative analysis undertaken following fieldwork.

Within the complex incised plateau nature of the South Wales Valleys Coalfield it was felt necessary to further modify the way the above data were combined. The effects on settlements within 2km were increased by 100%. The justification for this was that unlike other SSAs, over 0.5 million people live within or close to SSAs E and F and up to 10,000 people live within 2km of some of the zones (and would potentially be able to see turbines located within those zones). Regardless of whether turbines are viewed as positive or negative elements in the landscape, the potential for significant visual dominance over valley settlements given the scale of the proposed structures (125m+ to blade tip) is very high.

Further justification for the ZTV parameters and the way they are grouped together is set out in **Appendix H**.

The results of the qualitative visual assessment of each SSA zone are included within **Appendix I – Visual Effects Commentary**.

4.6.2 Visibility analysis for SSA E and F

There are two national landscape designations which are potentially affected by development of the SSA's. These are the Brecon Beacons National Park (BBNP) and

Gower Area of Outstanding Natural Beauty (AONB). Planning Policy Wales states that these areas are of equal status in terms of landscape and scenic beauty and both designations shall be afforded the highest status for protection from inappropriate developments. There is a duty to have regards to activities affecting these areas, whether those activities lie within or outside the designated areas.

The BBNP is located outside the SSAs to the north, running as close as 1km, and due to its elevation, parts look down onto and across to the SSAs. The Gower AONB is however around 15-20km to the south west of SSA E with very long distance views taking in Swansea's western outskirts including Gorseinon, Penllergaer and Fforestfach in the middle ground. See **Figure 3a**. For this reason the Gower AONB is not explicitly brought into the quantitative analysis as effects within this distance range (given the intermediate presence of Swansea) are not considered sufficiently significant. This issue however should be returned to and carefully examined in the subsequent development of SSA E.

In addition, Margam Mountain and the Rhondda Historic Landscapes are potentially affected by the development of the SSA(s) as discussed in the next section.

The detailed results analysing the various ZTV data for potential turbines in each zone are included in **Appendix H**. A summary is presented in **Table 7a and 7b** below.

Table 7a- Visibility Analysis for the zones in SSA E

| Zone | Zone Name | Ranking: Overall visual effects | Ranking : Landscape/Sensitive outdoor receptors visual effects | Ranking: People day by day sensitive receptors | Ranking: Visual Dominance on settlement X2 | Total Visibility Score | Ranking of total visibility |
|------|--------------------------------------|---------------------------------|--|--|--|------------------------|-----------------------------|
| 1 | Seven Sisters (East) | 2 | 15 | 2 | 8 | 27 | 1 |
| 2 | Hirfynydd (Sam Helen) | 4 | 16 | 8 | 10 | 38 | 7 |
| 3 | Hirfynydd (Sam Helen) - South West | 2 | 12 | 6 | 14 | 34 | 5 |
| 4 | Hirfynydd (Sam Helen) - West | 9 | 14 | 2 | 24 | 49 | 12 |
| 5 | Mynydd Marchywel | 4 | 10 | 11 | 16 | 41 | 9 |
| 6 | Mynydd Marchywel South West | 12 | 8 | 9 | 26 | 55 | 13 |
| 7 | Mynydd Marchywel South East | 7 | 3 | 5 | 12 | 27 | 1 |
| 8 | Mynydd Drumau (east) | 15 | 1 | 15 | 32 | 63 | 16 |
| 9 | Mynydd Drumau (west) | 12 | 2 | 16 | 30 | 60 | 15 |
| 10 | River Egel Valley | 8 | 7 | 7 | 6 | 28 | 3 |
| 11 | Mynydd Uchaf (AAT site) | 9 | 9 | 9 | 18 | 45 | 10 |
| 12 | Mynydd y Bettws | 15 | 6 | 13 | 22 | 56 | 14 |
| 13 | Mynydd y Gwair | 14 | 5 | 14 | 2 | 35 | 6 |
| 14 | Upper Lliw Reservoir | 11 | 4 | 12 | 4 | 31 | 4 |
| 15 | Onllwyn South | 6 | 11 | 1 | 28 | 46 | 11 |
| 16 | Glyn Neath North | 1 | 13 | 4 | 20 | 38 | 7 |

Table 7b- Visibility Analysis for the zones in SSA F

| Zone | Zone Name | Ranking: Overall visual effects | Ranking : Landscape/Sensitive outdoor receptors visual effects | Ranking: People day by day sensitive receptors | Ranking: Visual Dominance on settlement X2 | Total Visibility Score | Ranking of total visibility |
|---------|--|---------------------------------|--|--|--|------------------------|-----------------------------|
| Zone 1 | Moel ton-mawr | 24 | 1 | 38 | 12 | 75 | 10 |
| Zone 2 | Mynydd Margam | 27 | 1 | 41 | 26 | 95 | 17 |
| Zone 3 | Mynydd Bach | 19 | 1 | 36 | 40 | 96 | 19 |
| Zone 4 | Ergyd Isaf (Mynydd Margam West) | 42 | 1 | 34 | 86 | 163 | 40 |
| Zone 5 | Afan Argoed South East | 10 | 1 | 22 | 48 | 81 | 12 |
| Zone 6 | Foel Trawsnant | 11 | 1 | 13 | 70 | 95 | 17 |
| Zone 7 | Mynydd y Gelli | 11 | 25 | 18 | 44 | 98 | 20 |
| Zone 8 | Mynydd Blaengwynfi | 7 | 31 | 10 | 22 | 70 | 9 |
| Zone 9 | Mynydd Blaenrhondda (West) | 27 | 42 | 25 | 10 | 104 | 22 |
| Zone 10 | Mynydd Pen-y-Cae - Llyn Fach | 43 | 46 | 33 | 14 | 136 | 35 |
| Zone 11 | Glyncorwg West | 15 | 38 | 21 | 16 | 90 | 14 |
| Zone 12 | Coed Morgannwg Way | 23 | 39 | 16 | 6 | 84 | 13 |
| Zone 13 | Mynydd Nant-y-bar | 6 | 22 | 6 | 18 | 52 | 5 |
| Zone 14 | Glyncorwg East | 3 | 27 | 3 | 28 | 61 | 8 |
| Zone 15 | Mynydd Fforch dwm | 2 | 21 | 2 | 2 | 27 | 1 |
| Zone 16 | Ffynnon Oer (wind farm) | 3 | 32 | 4 | 4 | 43 | 3 |
| Zone 17 | Mynydd Resolven | 30 | 37 | 26 | 38 | 131 | 33 |
| Zone 18 | Mynydd-y-Gaer and Foel Fynyddau | 44 | 28 | 43 | 84 | 199 | 45 |
| Zone 19 | Mynydd Baedan | 22 | 1 | 40 | 36 | 99 | 21 |
| Zone 20 | Mynydd Caerau | 9 | 18 | 31 | 50 | 108 | 23 |
| Zone 21 | Moel Cynhordy | 14 | 1 | 24 | 74 | 113 | 24 |
| Zone 22 | Werfa | 35 | 23 | 12 | 60 | 130 | 32 |
| Zone 23 | Mynydd Llangeinwyr | 16 | 20 | 29 | 62 | 127 | 30 |
| Zone 24 | Mynydd Corrwg Fechan | 1 | 18 | 1 | 32 | 52 | 5 |
| Zone 25 | Mynydd Blaenrhondda | 31 | 41 | 26 | 20 | 118 | 27 |
| Zone 26 | Mynydd Tynewydd | 34 | 44 | 39 | 34 | 151 | 38 |
| Zone 27 | Mynydd Bwlfa | 41 | 45 | 36 | 24 | 146 | 37 |
| Zone 28 | Cefn y Rhondda (north) | 31 | 35 | 14 | 52 | 132 | 34 |
| Zone 29 | St Gwynno Forest | 36 | 34 | 45 | 66 | 181 | 43 |
| Zone 30 | St Gwynno Forest (South) | 39 | 29 | 41 | 78 | 187 | 44 |
| Zone 31 | Mynydd William Meyrick (NE) | 36 | 26 | 19 | 82 | 163 | 40 |
| Zone 32 | Mynydd William Meyrick (SW) | 38 | 24 | 23 | 54 | 139 | 36 |
| Zone 33 | Mynydd Maesteg (North) | 21 | 17 | 15 | 64 | 117 | 26 |
| Zone 34 | Mynydd Maesteg (South) | 17 | 1 | 8 | 68 | 94 | 15 |
| Zone 35 | Mynydd y Glifach (Trane) | 17 | 1 | 19 | 90 | 127 | 30 |
| Zone 36 | Mynydd Maendy Glifach Goch | 7 | 1 | 10 | 42 | 60 | 7 |
| Zone 37 | Mynydd y Gaer | 19 | 1 | 28 | 30 | 78 | 11 |
| Zone 38 | Mynydd Maendy (Taff Ely wind farm) | 13 | 1 | 8 | 72 | 94 | 15 |
| Zone 39 | Mynydd Margam (East) | 40 | 1 | 35 | 46 | 122 | 28 |
| Zone 40 | Cefn y Rhondda | 26 | 33 | 17 | 88 | 164 | 42 |
| Zone 41 | Mynydd Merthyr (North -East) | 45 | 40 | 44 | 76 | 205 | 46 |
| Zone 42 | Mynydd Merthyr | 45 | 43 | 46 | 80 | 214 | 47 |
| Zone 43 | Mynydd Portref (Taff Ely wind farm east) | 27 | 1 | 30 | 58 | 116 | 25 |
| Zone 44 | Mynydd Pwllyrhebog | 24 | 1 | 7 | 92 | 124 | 29 |
| Zone 45 | Ffynnon Oer (west) | 5 | 30 | 5 | 8 | 48 | 4 |
| Zone 46 | Mynydd Bwlfa (south east) | 33 | 36 | 32 | 56 | 157 | 39 |

Most zones in SSA E have a mixed performance but by considering the overall visual performance some trends start to emerge (such as the generally poor performance of E6 and 12 – Mynydd Marchywel south west and Mynydd y Bettws). Zone 15, Onllwyn South performs particularly poorly in relation to effects on settlement within 2km. In accordance with the criteria outlined within Section 4.3 of this report (landscape value/sensitivity and visual thresholds), it is proposed that this zone is not suitable for strategic windfarm development and should not be taken forward in the final analysis in Section 5.0.

Zone 1 Seven Sisters appears to perform relatively well because it is not visible over a wide area but parts are very close to Seven Sisters so any SSA refined boundary should be kept well away from this settlement. Zone 13 and 14 Mynydd y Gwaer appears to perform relatively well as does the southern extent of the Hirfynydd Ridge.

None of the zones in SSA E are affected by a 20km ZTV from Scarweather Sands.

For SSA F, there is again a wide spread in visual performance, ranging from the relatively good performance of F15 and some of the other zones around Glyncorwg (which are very visually contained) to poor performance in the outliers located to the North-East of the SSA (such as zones F41 and F42 above Aberdare).

Generally, zones to the north perform less well in relation to effects on sensitive receptors being visible from the Brecon Beacons National Park (eg Zone 10). Those to the south or on narrow ridges tend to have more effects on settlements (eg Zone 40). Some have effects on both.

Zones 30, 31, 35, 40, 41, 42 and 44 perform particularly poorly in relation to effects on settlement within 2km. In accordance with the criteria outlined within Section 4.3 of this report (landscape value/sensitivity and visual thresholds), it is proposed that these zones are not suitable for strategic windfarm development and should not be taken forward in the final analysis in Section 5.0.

Zones 2,3,5 and 6 (Mynydd Margam and margins) are also affected by the ZTV for Scarweather Sands offshore wind farm, which, whilst not directly affecting this analysis, is a factor that should be considered for any detailed proposals within these zones.

4.7 Historic landscape analysis

In addition to Landscape Value and Landscape Capacity, in some parts of Wales the SSA's coincide with landscapes designated by Cadw/CCW/COMOS as being of Special or Outstanding Historic Interest i.e. they are "**historic landscape**".

Historic landscape was not considered a constraint in the National TAN 8 analysis, it was considered more appropriate that each historic landscape was considered on its merits and its effects considered at a more local level. Cadw stresses in the introduction to the published register(s)³³ that the historic landscapes are advisory and non-statutory, yet also indicates that historic landscapes will have to be given 'due consideration' alongside all other development issues.

The rationale for the treatment of historic landscape in the TAN 8 Annex D studies is set out in **Appendix D**. In summary the decision has been made to use historic landscape to a degree in the analysis, but not to treat all historic landscapes in the same way. Some have features which are more sensitive to large-scale wind energy developments than others. The issues are therefore two fold, the magnitude of the effect on the particular historic landscape resource (i.e. how much of it is affected by the SSA/SSA zone) and the impact, i.e. how sensitive to this particular development type is the historic landscape in question.

It is acknowledged that more detailed consideration will be necessary when any specific proposals are considered.

4.7.1 Results for SSA E and F

SSA E is not affected by any historic landscape(s).

The central/south-eastern part of SSA F is affected by The Rhondda Historic Landscape, whilst the Mynydd Margam area in the south-west of SSA F is affected (as the name suggests) by Margam Mountain historic landscape.

The Merthyr Mawr Kenfig and Margam Burrows Outstanding Historic Landscape is located some 5km from the south-western margins of SSA F and therefore has not be considered further in the analysis/assessment.

³³ Cadw, 2001, Register of Landscapes of Special Historic Interest in Wales and Cadw, 2001, Register of Landscapes of Outstanding Historic Interest in Wales

The Rhondda historic landscape potentially affects zones 25,26,28,40, 30, 31, 33 and 44. Based upon the criteria used as the basis of its designation, outlined in **Appendix D**, the Rhondda historic landscape³⁴ is considered to have an only limited influence on the strategic planning of wind farms and has not affected significantly the analysis. It should however be borne in mind when considering applications for development in these zones and reference should be made to the current Cadw guidance on the topic referenced in **Appendix D**.

The Margam Mountain³⁵ historic landscape potentially affects zones 2, 3, 4, 39 and 1 (in part). This designation reflects criteria which are more sensitive to wind farm developments and thus assumptions on the potential capacities (in MW) that might be developed in these zones have been moderated accordingly (to 4MW/km²) (See Chapter 3 and **Figure 4b**). This allows for considerable micro-siting to respect specific features in the historic landscape and the setting of Margam Park, if any zones in this area are included within the final refined boundary. Again this should however be borne in mind when considering potential applications for development in these zones and reference should be made to the current Cadw guidance on the topic referenced in **Appendix D**.

4.8 Overall landscape and visual performance

The summary visibility performance data is brought together with the landscape character data to arrive at an overall performance rating for the SSA zone/sub-area in landscape and visual terms.

4.8.1 Overall landscape and visibility analysis for SSA E and F

The full results based upon individual criteria are included in **Appendix H**. A summary of the grouped data per each of the six assessment criteria categories is presented below in **Table 9a and 9b**. These six factors are (as previously indicated) :-

- LANDMAP Visual and Sensory value
- Landscape sensitivity to wind farm development
- The overall visual effects
- People day to day.
- Landscape/sensitive outdoor recreation receptors
- The likelihood of severe effects upon visual amenity and setting, particularly cumulative effects upon valley communities.

³⁴ **The Rhondda**, comprising the valleys of the Rhondda Fawr and Rhondda Fach in the Glamorgan uplands, contains one of the largest and best known mining conurbations and coalfield communities in Britain. Although devoid of its former mining and industrial base, the area retains intact its supporting infrastructure, and is the most important industrial and cultural landscape of its kind in Wales. The area includes: communities of distinctive terraced housing, public and municipal buildings, Anglican churches, Nonconformist chapels, cemeteries, breweries, public houses, shops and schools, most retaining their original architectural characteristics; important and significant historic and continuing social, political, spiritual, educational and cultural associations.

³⁵ **Margam Mountain** is a discrete block of the South Wales uplands situated at the south west fringe of the historical Glamorgan Blaenau, displaying continuity, density and diversity of human occupation from the prehistoric period to the recent past. The area includes: Bronze Age ritual and funerary monuments; large Iron Age hillforts, settlements, enclosures and trackways; a Roman road, a large and important group of Early Christian Inscribed Stone monuments and associations; medieval defensive works; Margam Abbey, later a site for gentry residences, a landscaped park, pleasure gardens and a magnificent Georgian orangery; Second World War defensive installations.

Table 9a Summary Visual and Landscape ranking for SSA E

| Zone | Ranking: LANDMAP visual and sensory value | Ranking: Landscape sensitivity | ranking: Overall visual effects | Ranking : Landscape/Sensitive outdoor receptors visual effects | Ranking: People day by day sensitive receptors | Ranking: Visual Dominance on settlement X2 | Sum of Ranks | Summary rank | Capacity (MW) |
|------|---|--------------------------------|---------------------------------|--|--|--|--------------|--------------|----------------|
| 1 | 2 | 2 | 2 | 15 | 2 | 8 | 31 | 1 | 23 |
| 2 | 2 | 2 | 4 | 16 | 8 | 10 | 42 | 3 | 17 |
| 3 | 2 | 2 | 2 | 12 | 6 | 14 | 38 | 2 | 14 |
| 4 | 2 | 2 | 9 | 14 | 2 | 24 | 53 | 11 | 10 |
| 5 | 2 | 2 | 4 | 10 | 11 | 16 | 45 | 7 | 32 |
| 6 | 2 | 2 | 12 | 8 | 9 | 26 | 59 | 13 | 2 |
| 7 | 2 | 13 | 7 | 3 | 5 | 12 | 42 | 3 | 2 |
| 8 | 11 | 13 | 15 | 1 | 15 | 32 | 87 | 16 | 1 |
| 9 | 2 | 13 | 12 | 2 | 16 | 30 | 75 | 15 | 1 |
| 10 | 11 | 13 | 8 | 7 | 7 | 6 | 52 | 10 | 7 |
| 11 | 11 | 2 | 9 | 9 | 9 | 18 | 58 | 12 | 16 |
| 12 | 11 | 2 | 15 | 6 | 13 | 22 | 69 | 14 | 18 |
| 13 | 11 | 1 | 14 | 5 | 14 | 2 | 47 | 8 | 40 |
| 14 | 11 | 2 | 11 | 4 | 12 | 4 | 44 | 6 | 28 |
| 15 | 1 | 2 | 6 | 11 | 1 | 28 | 49 | 9 | 0 |
| 16 | 2 | 2 | 1 | 13 | 4 | 20 | 42 | 3 | 13 |

Table 9b - Summary Visual and Landscape ranking for SSA F

| Zone | LANDMAP visual and sensory value | Landscape sensitivity | ranking: Overall visual effects | Ranking : Landscape/Sensitive outdoor receptors visual effects | Ranking: People day by day sensitive receptors | Ranking: Visual Dominance on settlement | Sum of Ranks | Summary rank | Capacity (MW) |
|---------|----------------------------------|-----------------------|---------------------------------|--|--|---|--------------|--------------|-----------------|
| Zone 1 | 1 | 40 | 24 | 1 | 38 | 12 | 116 | 15 | 9 |
| Zone 2 | 1 | 26 | 27 | 1 | 41 | 26 | 122 | 16 | 12 |
| Zone 3 | 1 | 13 | 19 | 1 | 36 | 40 | 110 | 14 | 11 |
| Zone 4 | 31 | 40 | 42 | 1 | 34 | 86 | 234 | 44 | 1 |
| Zone 5 | 1 | 13 | 10 | 1 | 22 | 48 | 95 | 10 | 9 |
| Zone 6 | 1 | 13 | 11 | 1 | 13 | 70 | 109 | 13 | 4 |
| Zone 7 | 31 | 13 | 11 | 25 | 18 | 44 | 142 | 22 | 7 |
| Zone 8 | 31 | 3 | 7 | 31 | 10 | 22 | 104 | 11 | 27 |
| Zone 9 | 1 | 1 | 27 | 42 | 25 | 10 | 106 | 12 | 31 |
| Zone 10 | 31 | 26 | 43 | 46 | 33 | 14 | 193 | 40 | 12 |
| Zone 11 | 1 | 3 | 15 | 38 | 21 | 16 | 94 | 9 | 41 |
| Zone 12 | 1 | 3 | 23 | 39 | 16 | 6 | 88 | 8 | 20 |
| Zone 13 | 1 | 3 | 6 | 22 | 6 | 18 | 56 | 4 | 16 |
| Zone 14 | 1 | 13 | 3 | 27 | 3 | 28 | 75 | 5 | 6 |
| Zone 15 | 1 | 3 | 2 | 21 | 2 | 2 | 31 | 1 | 7 |
| Zone 16 | 1 | 1 | 3 | 32 | 4 | 4 | 45 | 2 | 6 |
| Zone 17 | 1 | 26 | 30 | 37 | 26 | 38 | 158 | 26 | 7 |
| Zone 18 | 1 | 40 | 44 | 28 | 43 | 84 | 240 | 45 | 11 |
| Zone 19 | 31 | 40 | 22 | 1 | 40 | 36 | 170 | 31 | 7 |
| Zone 20 | 1 | 13 | 9 | 18 | 31 | 50 | 122 | 16 | 19 |
| Zone 21 | 1 | 26 | 14 | 1 | 24 | 74 | 140 | 21 | 4 |
| Zone 22 | 31 | 26 | 35 | 23 | 12 | 60 | 187 | 36 | 7 |
| Zone 23 | 31 | 26 | 16 | 20 | 29 | 62 | 184 | 35 | 16 |
| Zone 24 | 1 | 26 | 1 | 18 | 1 | 32 | 79 | 6 | 0 |
| Zone 25 | 1 | 3 | 31 | 41 | 26 | 20 | 122 | 16 | 33 |
| Zone 26 | 1 | 3 | 34 | 44 | 39 | 34 | 155 | 25 | 43 |
| Zone 27 | 31 | 13 | 41 | 45 | 36 | 24 | 190 | 38 | 6 |
| Zone 28 | 1 | 3 | 31 | 35 | 14 | 52 | 136 | 19 | 12 |
| Zone 29 | 1 | 13 | 36 | 34 | 45 | 66 | 195 | 41 | 39 |
| Zone 30 | 1 | 26 | 39 | 29 | 41 | 78 | 214 | 42 | 9 |
| Zone 31 | 1 | 13 | 36 | 26 | 19 | 82 | 177 | 32 | 3 |
| Zone 32 | 31 | 13 | 38 | 24 | 23 | 54 | 183 | 34 | 9 |
| Zone 33 | 31 | 13 | 21 | 17 | 15 | 64 | 161 | 27 | 12 |
| Zone 34 | 31 | 13 | 17 | 1 | 8 | 68 | 138 | 20 | 7 |
| Zone 35 | 1 | 26 | 17 | 1 | 19 | 90 | 154 | 24 | 6 |
| Zone 36 | 1 | 26 | 7 | 1 | 10 | 42 | 87 | 7 | 16 |
| Zone 37 | 31 | 40 | 19 | 1 | 28 | 30 | 149 | 23 | 5 |
| Zone 38 | 31 | 40 | 13 | 1 | 8 | 72 | 165 | 29 | 9 |
| Zone 39 | 31 | 26 | 40 | 1 | 35 | 46 | 179 | 33 | 4 |
| Zone 40 | 1 | 26 | 26 | 33 | 17 | 88 | 191 | 39 | 3 |
| Zone 41 | 1 | 26 | 45 | 40 | 44 | 76 | 232 | 43 | 5 |
| Zone 42 | 1 | 26 | 45 | 43 | 46 | 80 | 241 | 46 | 19 |
| Zone 43 | 31 | 40 | 27 | 1 | 30 | 58 | 187 | 36 | 19 |
| Zone 44 | 31 | 13 | 24 | 1 | 7 | 92 | 168 | 30 | 4 |
| Zone 45 | 1 | 3 | 5 | 30 | 5 | 8 | 52 | 3 | 5 |
| Zone 46 | 1 | 3 | 33 | 36 | 32 | 56 | 161 | 27 | 3 |

On the basis of the data presented above, plus the detailed justifications included in **Appendices F and I**, the following zones are considered unacceptable in *landscape* terms in accordance with the criteria outlined within Section 4.3 of this report (landscape value/sensitivity and visual thresholds),:

Zones E7,E8, E9,E10, F1,F4, F18, F19, F37, F38, F43

On the same basis the following zones are considered unacceptable in *visual* terms:

Zones E15, F30, F31, F35, F40, F41, F42, F44.

The remaining zones are taken forward to be assessed alongside further issues of cumulative effects and contribution to a rational approach to concentration of the SSA in the next chapter.

5 Overall Analysis

5.1 Introduction

This chapter brings together the results of the landscape and visual assessment outlined in the previous chapter and the technical capacity data for each zone (i.e. how much each can potentially deliver in terms of MW output) to arrive at a recommended refined boundary for each Strategic Search Area.

5.2 Context/other factors

TAN 8 (Table 1) establishes indicative capacities for the SSAs in order to assist in delivering an established target of 800MW of installed onshore wind capacity by 2010. In line with the approach in TAN 8, the areas could contribute to an indicative 1120 MW capacity (Table 1). Part of the study brief and the philosophy behind the TAN 8 Annex D studies is to identify sufficient land to allow the delivery of the TAN 8 indicative capacity targets³⁶. The key question is how much land is required?

This study has used moderate to low wind energy capacity estimates (in terms of MW/km²) when determining the extent of developable land within the various SSA zones which encourages slighter larger areas of land to be included in any refined SSA boundaries. Set against these two factors, a number of constraints may affect deliverability. They include:

- Noise impacts (this study has used a minimum 500m buffer around residential properties, in practice with 100m+ high, 2MW+ output turbines, separation distances greater than these may be needed (eg. 700m). Existing or planned wind farms in the area may also raise the ambient noise level, effectively restricting the scope available for new developments.)
- Lack of site access (this study has not considered the feasibility of getting wind turbines to the various zones)
- Forestry constraints (some of the land within the zones lie within the areas of coniferous forest and therefore developers will have to work with the forest owners in the implementation of any proposals)
- Land ownership (this study presumes that all landowners³⁷ are accepting of the need to site turbines on their land, this is unlikely to always be the case)
- Site specific ecological, hydrological and archaeological constraints, unsuitable ground conditions etc. which will only be known about when Environmental Impact Assessments of proposals in the zones are undertaken.
- Developers may not come forward for some or all of the land within a zone within the time period required by the TAN (2010) or that not all planning permissions granted will be implemented within the same time period
- There is a need for micro-siting/design flexibility to minimise further landscape and visual impacts which will become apparent only when Environmental Impact Assessments of proposals in the zones are undertaken.
- Many developers may also favour the DTI Section 36 application route³⁸, by proposing sites larger than 50MW; as a result of this developers may choose larger

³⁶ TAN 8 Annex D Para 1.2 – “*The purpose of the local planning exercise is to achieve a finer grain of development allocation within the SSA, taking into account landscape, visual and cumulative impacts. It is not intended for use in the negotiation of the SSA capacities indicated in the Final TAN 8.*”

³⁷ With the exception of Mynydd Marchwyd in SSA F.

sites that the zones comprise or combine zones together when submitting proposals. Some parts of zones may not therefore be developed when this occurs.

TAN 8 para 2.5 indicates that “there may be practical, technical and/or environmental reasons why the capacity may be more or less than that indicated” and para 8.6 “At the local level, accepted thresholds of change, having regard to nationally developed energy capacity targets, can be established by more detailed assessments”.

The recommendations of this study are therefore reflect this position.

5.3 Zones required in SSA E

The final ranking of the zones developed for the study, and the indicative capacities for each of the zones is presented in **Table 10a** below. The zones are presented in descending order, with the highest ranked (and thus best performing) zones shown first³⁹. The tables also contain a cumulative capacity (MW) column.

Table 10a - SSA E - Ranked Zones with cumulative estimated zone capacities (MW)

| Zone | | Summary rank | Approx. Capacity (MW) | Cumulative Capacity (MW) |
|------|---------------------------------------|--------------|------------------------|---------------------------|
| 1 | Seven Sisters (East) | 1 | 23.4 | 23 |
| 3 | Hirfynydd (Sarn Helen) - South West | 2 | 14.4 | 38 |
| 2 | Hirfynydd (Sarn Helen) | 3 | 17.0 | 55 |
| 16 | Glyn Neath North | 3 | 12.8 | 68 |
| 14 | Upper Lliw Reservoir | 6 | 27.6 | 95 |
| 5 | Mynydd Marchywel | 7 | 0.0 | 95 |
| 13 | Mynydd y Gwair | 8 | 40.3 | 135 |
| 4 | Hirfynydd (Sarn Helen) - West | 11 | 9.6 | 145 |
| 11 | Mynydd Uchaf (AAT site) | 12 | 15.9 | 161 |
| 6 | Mynydd Marchywel South West | 13 | 2.1 | 163 |
| 12 | Mynydd y Bettws | 14 | 17.5 | 181 |

TAN 8 contains an indicative target of installed capacity of 100MW for SSA E, *Pontardawe*. The implications of the data presented in **Table 10a** are that an area **comprising** the 4 lowest ranked zones need not be developed, and these are highlighted.

Development of these lowest ranked zones would not be necessary to meet the TAN 8 indicative capacities (and thus the National target), and if developed would give rise to greater environmental harm in landscape and visual terms than the zones above. However it is acknowledged that there is a continuum in environmental performance between the zones in the table and that the distinction between zones above and below the line is subtle; they all pass both sets of acceptability criteria outlined in Section 4.3.1.

5.4 Development of the refined boundary for SSA E

Within the required zones in SSA E which contribute to the SSA indicative capacity, there are parts of many zones which are likely to be unacceptable for development. These mainly

³⁸ Applications for power generation of greater than 50MW are determined at present by the DTI, with the local planning authority reduced to the role of a consultee to the application. This process is established via the Electricity Act 1989.

³⁹ This ranking order *does not imply a sequential approach to the release of land within any refined SSA boundary* (that would be impractical to implement); it is a tool to broadly ascertain which are the preferred areas to include within the minor refinement of the TAN 8 SSA boundary in accordance with the TAN 8 Annex D Methodology.

comprise the edges, close to changes in level such as near to the rock cliffs in Zone E2, or close to settlement such as Zone E1. This means that the capacity of the refined SSA could be less than the overall figure of 135MW in **Table 10a** above.

The area recommended for inclusion within the refined boundary comprises the most environmentally acceptable parts of zones E1, E2, E3, and E16 (the Hirfynydd ridge above the Neath Valley), E13 (Mynydd y Gwair) and the northern part of zone E14. It should be noted that biodiversity issues may influence the capacity on and around the Hirfynydd ridge.

5.4.1 Cumulative impacts and effect on zones

Mynydd Marchywel is a single ridge with medium-high landscape sensitivity located to the west of the Dulais valley. If wind turbine development was permitted in this zone, there would be a likelihood of significant cumulative effects on settlement in the valley at Crynant as turbines would need to be located on the relatively narrow ridgetops on both sides [in Zone E3]. This would be likely to be unacceptable. In accordance with the criteria outlined within Section 4.3 of this report (landscape value/sensitivity and visual thresholds) it is therefore recommended that this zone is not taken forward as part of the refined SSA.

Because of this reduced capacity it is necessary to include Zone 4 in the revised SSA boundary keeping development back from the ridge edge to avoid effects on Crynant and the Dulais valley.

5.4.2 Overall classification of SSA Zones

In accordance with the above analysis, each part of an SSA by definition now falls into one of the following categories, as set out in **Table 10b** below. There is a continuum between the “GREEN” and “YELLOW” categories which reflects a general decrease in environmental performance.

Table 10b – Classification of SSA constituent parts

| Category | Description |
|--|---|
| Comprises a zone but acceptable (2010) (GREEN) | Zone (or part of a zone) is part of the best environmentally performing group of zones in terms of either intrinsic landscape sensitivity, value or visual characteristics as per criteria outlined in Section 4.3 & 4.5 of this report. This zone is needed to contribute to the 2010 indicative capacity for the SSA as established by TAN 8. |
| Comprises a zone (YELLOW) | Zone (or part of a zone) is part of the less environmentally performing group of zones in terms of either intrinsic landscape sensitivity, value or visual characteristics as per criteria outlined in Section 4.3 & 4.5 of this report. This zone is not needed to contribute to the 2010 indicative capacity for the SSA as established by TAN 8. |
| Comprises a zone but unacceptable (ORANGE) | Zone unacceptable due to cumulative landscape and visual impact as per criteria outlined in Section 4.3 & 4.5 of this report. |
| Comprises a zone but unacceptable (RED) | Zone unacceptable due to intrinsic landscape sensitivity, value or visual characteristics as per criteria outlined in Section 4.3 & 4.5 of this report. |

The summary of the environmental performance of the SSA zones for SSA E is shown on **Figure 11a** below, whilst the recommended refined boundary for SSA E, derived from this data is therefore shown on **Figure 11b** below.

Figure 11a - Summary of Zone Environmental Performance

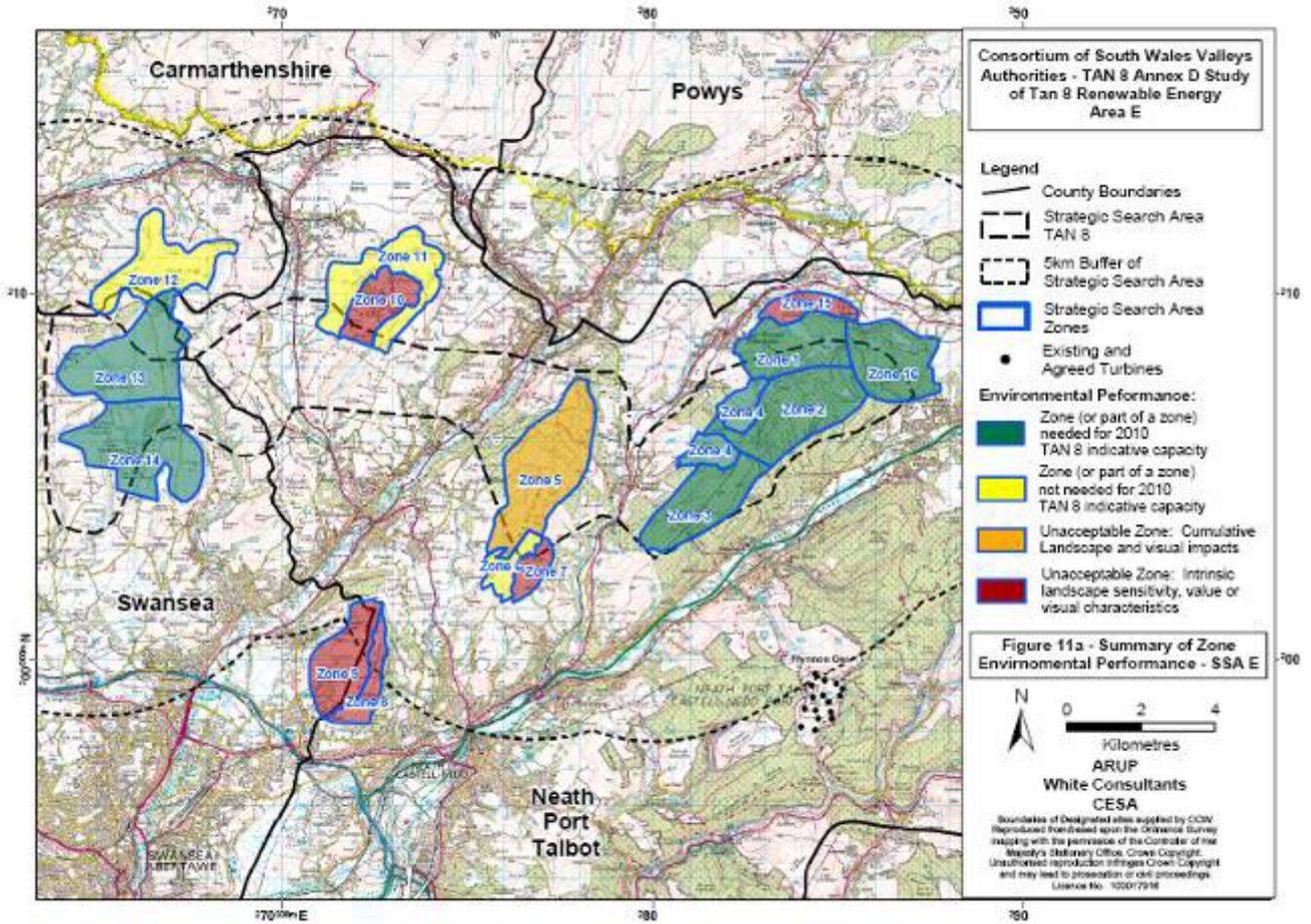
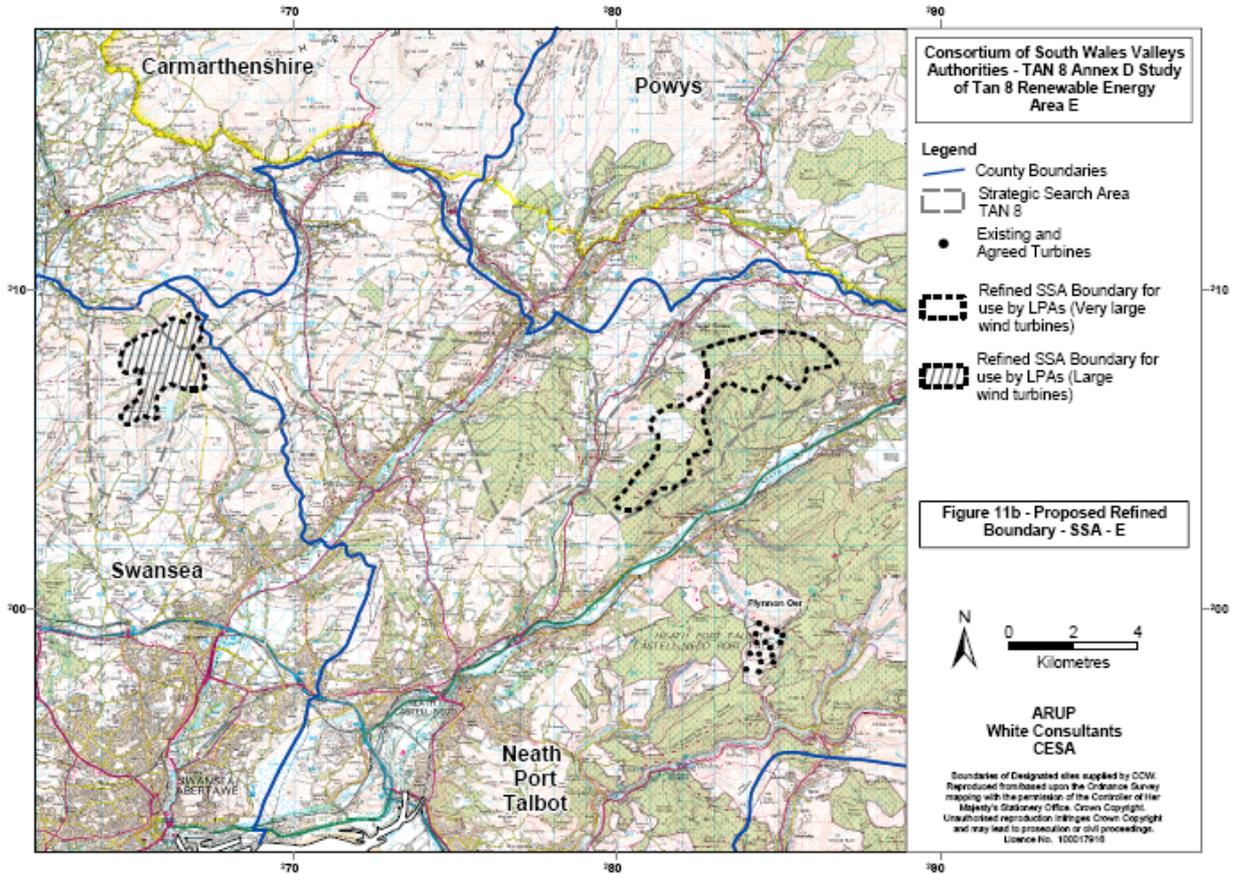


Figure 11b - Proposed Refined SSA boundary



The refined boundary comprises two areas with the following estimated capacities for development;

- Mynydd y Gwair (and environs) – 35-40 MW
- Hirfynydd ridge (and environs) – 60-65 MW

5.4.3 Other comments

With reference to Section 4.3 of this report (landscape sensitivity and typology), it is considered that whilst it has been demonstrated that a refined SSA boundary for E can support around 100MW of wind turbines, the scale and type of landform within the refined SSA boundary is not ideal for large scale wind farms. This is as demonstrated by most landscape sensitivity ratings being high or medium-high. Zone E13/E14 [with medium sensitivity] is best able to accommodate larger turbines as it comprises plateaux rather than ridge and is a very simple landform, although it is of relatively small extent/scale. The Hirfynydd Ridge (Zones E1,2,3,4 and 16 in part) is a single ridge with complex topography to the east, only partially masked by the presence of the coniferous forestry. Nevertheless, it is the largest landform within SSA E and of a height (400m+AOD) and scale (7km in length) that could accommodate some of the largest turbines, although the ridge makes the landform far from ideal.

This differentiation is reflected on **Figure 11b**.

Particular attention should also be given in any EIA for development in Zone E14 to ensure that the setting of the Upper Lliw Reservoir is protected as far as is possible. It is for this reason that only part of Zone E14 is shown as encompassing the refined boundary.

5.5 Zones required in SSA F

The final ranking of the zones developed for the study, and the indicative capacities for each of the zones is presented in Table 10b below. The zones are presented in descending order, with the highest ranked (and thus best performing) zones shown first⁴⁰. The tables also contain a cumulative capacity (MW) column.

Table 10b - SSA F - Ranked Zones with cumulative estimated zone capacities (MW)

| Zone | | Summary rank | Approx. Capacity (MW) | Cum Cap |
|---------|-------------------------------|--------------|------------------------|---------|
| Zone 15 | Mynydd Fforch dwm | 1 | 7 | 7 |
| Zone 16 | Ffynnon Oer (wind farm) | 2 | 6 | 14 |
| Zone 45 | Ffynnon Oer (west) | 3 | 5 | 19 |
| Zone 13 | Mynydd Nant-y-bar | 4 | 16 | 35 |
| Zone 14 | Glyncorwg East | 5 | 6 | 41 |
| Zone 24 | Mynydd Corrwg Fechan | 6 | 0 | 41 |
| Zone 36 | Mynydd Maendy Gifach Goch | 7 | 16 | 57 |
| Zone 12 | Coed Morgannwg Way | 8 | 20 | 78 |
| Zone 11 | Glyncorwg West | 9 | 41 | 119 |
| Zone 5 | Afan Argoed South East | 10 | 9 | 128 |
| Zone 8 | Mynydd Blaengwynfi | 11 | 27 | 155 |
| Zone 9 | Mynydd Blaenrhondda (West) | 12 | 31 | 186 |
| Zone 6 | Foel Trawsant | 13 | 4 | 190 |
| Zone 3 | Mynydd Bach | 14 | 11 | 201 |
| Zone 2 | Mynydd Margam | 16 | 12 | 213 |
| Zone 20 | Mynydd Caerau | 16 | 19 | 232 |
| Zone 25 | Mynydd Blaenrhondda | 16 | 33 | 265 |
| Zone 28 | Cefn y Rhondda (north) | 19 | 12 | 277 |
| Zone 34 | Mynydd Maesteg (South) | 20 | 7 | 284 |
| Zone 21 | Moel Cynhordy | 21 | 4 | 288 |
| Zone 7 | Mynydd y Gelli | 22 | 7 | 295 |
| Zone 26 | Mynydd Tynewydd | 25 | 43 | 339 |
| Zone 17 | Mynydd Resolven | 26 | 7 | 346 |
| Zone 33 | Mynydd Maesteg (North) | 27 | 12 | 357 |
| Zone 46 | Mynydd Bwlfa (south east) | 27 | 3 | 360 |
| Zone 39 | Mynydd Margam (East) | 33 | 4 | 364 |
| Zone 32 | Mynydd William Meyrick (SW) | 34 | 9 | 373 |
| Zone 23 | Mynydd Llangeinwyr | 35 | 16 | 389 |
| Zone 22 | Werfa | 36 | 7 | 396 |
| Zone 27 | Mynydd Bwlfa | 38 | 6 | 402 |
| Zone 10 | Mynydd Pen-y-Cae - Llyn Fach | 40 | 12 | 414 |
| Zone 29 | St Gwynno Forest | 41 | 39 | 453 |

TAN 8 contains an indicative target of installed capacity of 290MW for SSA F, *Coed Morgannwg*. The implications of the data presented in **Table 10b** are that an area **comprising** the 12 lowest ranked zones need not be developed, and these are highlighted.

As per SSA E, development of these lowest ranked zones would not be necessary to meet the TAN 8 indicative capacities (and thus the National target), and if developed would give rise to greater environmental harm in landscape and visual terms than the zones above.

⁴⁰ This ranking order *does not imply a sequential approach to the release of land within any refined SSA boundary* (that would be impractical to implement); it is a tool to broadly ascertain which are the preferred areas to include within the minor refinement of the TAN 8 SSA boundary in accordance with the TAN 8 Annex D Methodology. The zones in themselves are also not intended as a development control tool, they are a means to an end to help justify any boundary refinements.

However it is acknowledged that there is a continuum in environmental performance between the zones in the table and that the distinction between zones above and below the line is subtle; they all pass both of the acceptability criteria outlined in Section 4.3.1.

5.6 Development of the refined boundary for SSA F

5.6.1 Cumulative Impacts and effect on zones

Within the necessary zones implied by the analysis presented in Table 10b above, there are still issues of cumulative landscape and visual impact. In accordance with the criteria outlined within Section 4.3 of this report (landscape value/sensitivity and visual thresholds) issues affect the following zones:

Zones 3 and 5: *Mynydd Bach and Afan Argoed South East: These two zones when developed have the potential to cause cumulative visual effects upon the settlement of Bryn, located on the B4282. It is therefore recommended that the north-western part of Zone 3 is not developed and that the potential for cumulative visual effects are carefully examined in any EIA prepared for proposals either north or south of the settlement. Within these two zones keeping development above the 250m-275m contour should help minimise the potential for dominance of the settlement by wind turbines.*

Zone 14: *Glyncorwg East consists of large scale open convex slopes which fall towards Glyncorwg. The area is well contained and only affects the one village which is why it scores well in the ranking. However, potential visual effects of development on the settlement could be severe, dominating the settlement and whilst the upper slopes to the extreme east /south east of the area may be suitable dependent on visibility from the village, the majority of the area is unlikely to be acceptable. This reduces the probable capacity significantly.*

Zone 24: *Mynydd Corrwg Fechan is a small hill at the head of the valley overlooking the settlement of Glyncorwg. As it is surrounded by higher ground visual effects are limited to the village and to the valley to the south. This means that the area performs well in the rankings despite its landscape sensitivity. However, wind turbine development on the southern/middle of the area would dominate the village and would be likely to cause severe adverse visual effects. Therefore any development would need to be limited to the northern part of the area and designed to minimise effects on the settlement. This will reduce the area's capacity.*

Zone 36: *Zone 36 differs in character from other plateau/ridge top areas inasmuch as it gently slopes down from 390mAOD to around 250mAOD rather than having a relatively level top and steep valley sides. Indeed, the area is outside the SSA boundary. Windfarm development on these slopes would be highly prominent to the south from Glynogwr and beyond. Whilst the valley is relatively sparsely populated views would be open and uninterrupted and the effects significantly adverse. It is therefore recommended that development is located only on the northern quarter of the zone if acceptable in terms of a detailed EIA.*

Zones 20 and 21: *The cumulative effects of the remaining zones need to be considered carefully. Zones 2, 3, 5 and 6 form a major block which will deliver upto 46MW. They lie on the western side of the Llynfi valley. To the east of the Llynfi valley are Zones 20 and 21. They are ranked lower than zones 2, 3, 5 and 6 and would deliver upto 23MW. Developing both sides of the valley would be likely to result in unacceptable cumulative visual impact on Maesteg and other settlements in the valley bottom and sides. It is therefore recommended that Zone 20 and 21 are not taken forward. The conical nature of the Mynydd Caerau to the north of Zone 20 and the prominence of the ridge in Zone 21 make them sensitive to windfarm development (see Landscape Sensitivity assessment sheets).*

Zone 34: *Wind turbines on Mynydd Maesteg (South) may have an adverse effect on Evanstown/Gilfach Goch. The eastern part of the zone is outside the SSA boundary in any case. This would reduce the overall capacity of the area with turbines limited to the western part of the area. It is therefore recommended that development is located only on the north-western quarter of the zone if acceptable in terms of a detailed EIA.*

5.6.2 The need for further zones

When the above zones are partially or totally removed from the refined boundary they reduce the potential developable capacity by some 40-50MW approximately. The above recommendations therefore mean that less environmentally acceptable zones require consideration from “below the line” in **Table 10b** in order to demonstrate delivery the target capacity. These are considered below. The comments form a summary of landscape sensitivity and visual effects comments found in the Appendices.

Zone 7: *Mynydd y Gelli forms an open upland landscape sloping north and west from Werfa. There is potential for significant adverse effects on the settlement of Blaengwnfi within 2km which, with Abergwnfi, may suffer unacceptable cumulative effects with the development of Zone 8 to the north. To the west, the zone forms the northern slopes of the conical Mynydd Caerau which is sensitive to windfarm development. To the east the area impinges on the setting of the highpoint at Werfa and is outside the SSA boundary. Therefore this zone should not be developed.*

Zone 26: *This area extends the core plateau area to the east linking it to Zone 28 on large scale forested landform and is acceptable provided turbines are kept away from the northern scarp edge.*

Zone 17: *This hill has medium-high landscape sensitivity and is highly visible to the north as a separate hill from the main plateau mass to the east. Effects on settlements in the Neath valley at Resolven and Glyneath are likely to be significantly adverse. Therefore this zone should not be developed.*

Zone 33: *This zone would extend the relatively small outlying area formed by Zones 34 and 36 further onto the relatively simple dissected plateau ridge further away from the settlement of Gilfach Goch. On this basis, it is recommended as being included in the revised SSA area.*

Thus from the next four zones “below the line” zones F26 and F33 are recommended for taking forward as part of the refined SSA boundary for SSA F. With the two additional zones a further 50MW approximately is added to the refined boundary, bringing the total back to the 290MW indicative capacity.

In accordance with the above analysis, each part of an SSA by definition now falls into one of the categories as set out in **Table 10c** above.

The summary of the environmental performance of the SSA zones for SSA E is shown on **Figure 12a** below, whilst the recommended refined boundary for SSA E, derived from this data is therefore shown on **Figure 12b** below.

Figure 12a - Summary of Zone Environmental Performance

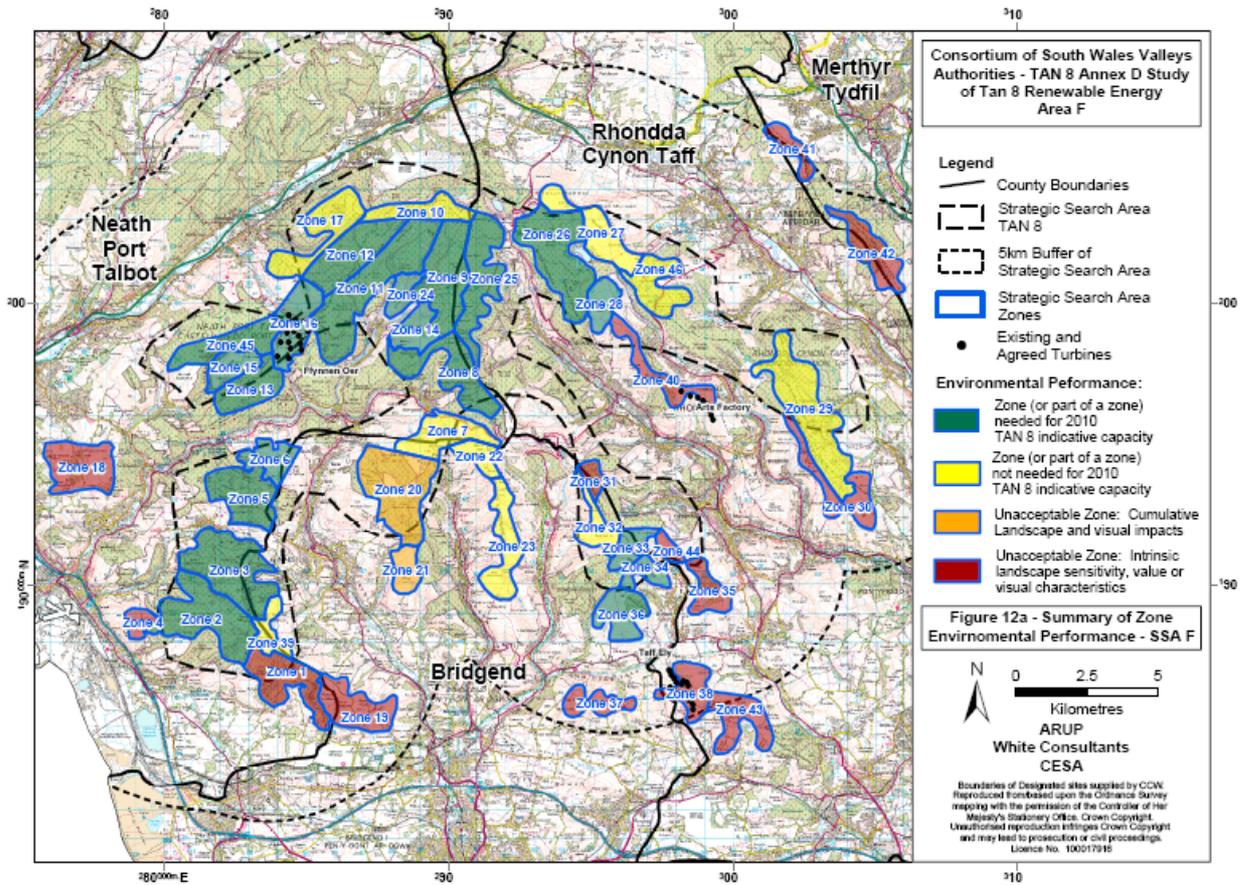
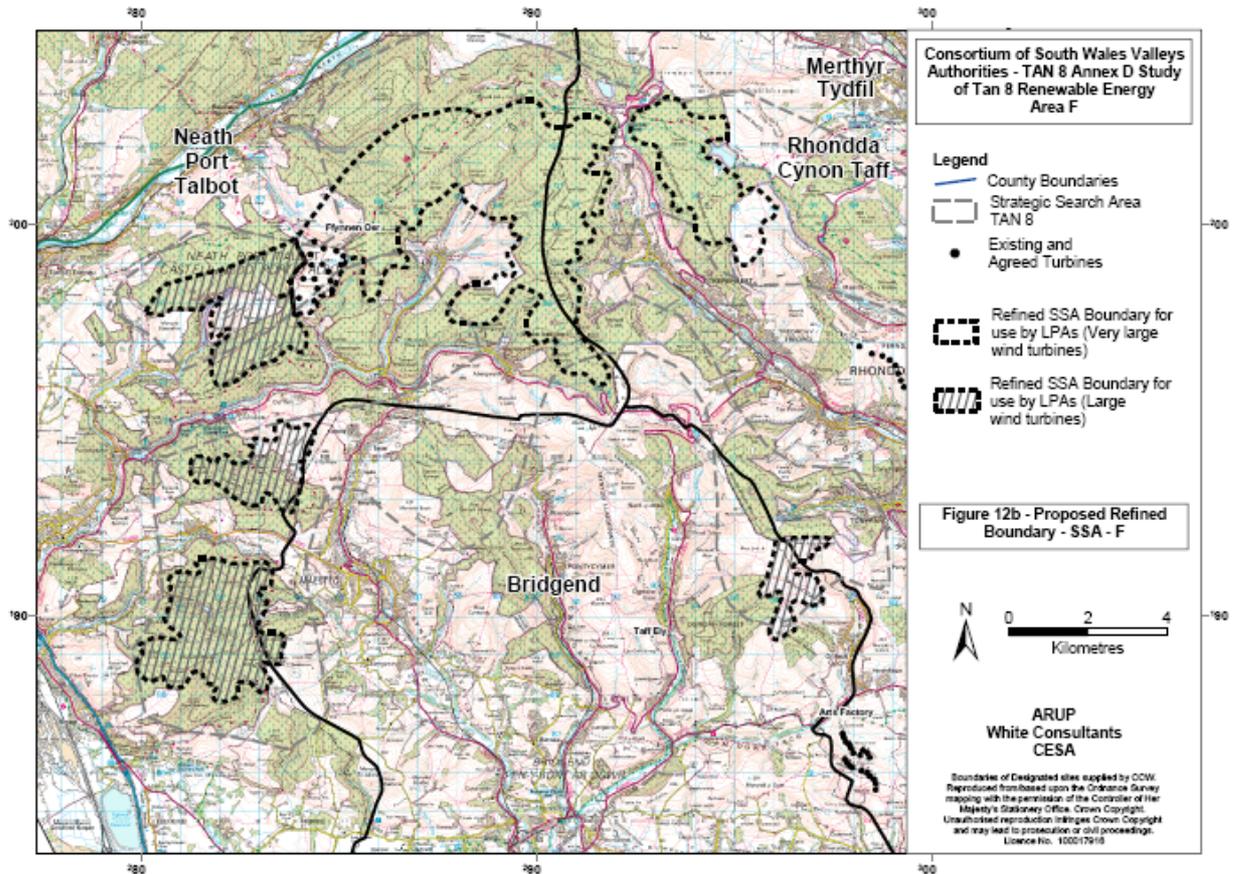


Figure 12 b - Proposed Refined Boundary



The refined boundary comprises six areas with the following estimated capacities for development;

- Mynydd Margam (and environs) – 25-30 MW
- Afan Forest Park South (and environs) – 15-20 MW
- Mynydd Fforch-dwm (and environs) –40-45MW
- Coed Morgannwg – 140-150MW
- Mynydd Ystradfermol (and environs)- 50-55 MW
- Mynydd Maes-teg (and environs)- 15-20 MW

5.6.3 Other comments

Zones F2,F3,F5 and F6 (Mynydd Margam and margins) are slightly affected by the ZTV for Scarweather Sands offshore wind farm, and the Margam Mountain historic landscape also potentially affects zones F2 and F3 (in part). Thus whilst Mynydd Margam and its margins are included in the refined SSA boundary for F (with a recommended lower turbine density) development proposals in these areas should still be subject to very careful examination with regard to both a) their effects upon the historic landscape resource, and b) cumulative landscape and visual impact with the offshore wind farm at key sensitive receptors.

Zones F5 and F13 coincide with the most heavily used part of the Afan Forest Park (closest to the main visitor centre) and it is likely that development proposals in these zones will have to carefully work with the requirements of the local authority and the Forestry Commission to ensure that effects upon recreational users are rendered negligible. Other parts of the Forest Park potentially affect zones F8, F9 and F11, but these are used mostly

by mountain bikers and it is highly likely that the two land uses could co-exist without conflict.

5.7 Wind Turbine height within the refined SSA boundaries

The size of wind turbines is a key issue and one that is of significant concern to stakeholder groups. Where at all possible, best practice suggests that wind turbine size should relate to the scale of the landform. Guidance prepared by Arup supporting TAN 8⁴¹ indicates that ideally turbines should be no higher than a third of the height of the landform if there is a pronounced change in level such as on scarp edge or valley side. The reason for this is to minimise the effect of reducing the scale of the landform (which would be a significant adverse landscape effect); the role of upland ridges as a large scale landscape backcloth to the settlements of the valleys is important.

Wind turbines are increasing in size in order to optimise the energy output reaching over 125m in height and up to 140m in forested areas. The TAN 8 'rule of thumb' guidance is therefore not achievable across all the SSA areas. However, whilst it might be reasonable in the light of TAN 8 to accept turbines of around 130m in the larger scale core SSA areas, turbine height should be limited where possible in the fringe areas of lower landform to the south of SSA F and the west of SSA E. It is recommended that a cap of approximately 100m is placed on turbines in these areas; it is realised this has implications for the size of blades that can be used and thus may affect the rated output (in MW) of turbines in these areas.

Thus this brings a further level of planning guidance below the proposed refined SSA boundaries, whereby the zones within the refined SSA(s) are split into two key types namely:-

- Large scale, high relief landscapes capable of accommodating very large scale wind turbines⁴² (SSA E - Hirfynydd ridge, SSA F – Coed Morgannwg)
- Medium to large scale landscapes but with a greater potential for effects on scale of landscape (SSA F – Afan Forest Park North, SSA E – Mynydd y Gwair and environs, SSA F – Afan Forest Park South, SSA F – Mynydd Margam and environs, SSA F – Mynydd Maesteg (nr Tonypany), SSA F –Maerdy North). In these large scale wind turbines (up to 100m maximum) would be appropriate but number and density to be controlled where possible such that they appear as separate wind farms with appropriate, or at least as a transition to the strategic developments located to the centre of the SSAs. Despite the acknowledgement in TAN 8 that within the SSAs the implicit objective is to accept landscape change⁴³, within these areas, the sub-objective to avoid the worst cumulative visual effects.

As a result of this the recommended zones for SSA F are set out in **Table 11a and 11b** below, including an indication of the wind turbine heights acceptable. Generally SSA F is more suited to the very large wind farm type.

⁴¹ See Arup (2004) – Facilitating Planning for Renewable Energy in Wales: Meeting the Target – Report on Research Contracts 105/2002 and 269/2003.

⁴² number and density broadly suitable subject to EIA and appropriate micro-siting

⁴³ TAN 8 Annex D para 8.4

Table 11a SSA E Proposed refined SSA Zones with cumulative estimated capacities (MW)

| Zone | | Summary rank | Approx. Capacity (MW) | Cumulative Capacity | Wind turbine size |
|------|---------------------------------------|--------------|------------------------|---------------------|-------------------|
| 1 | Seven Sisters (East) | 1 | 12 | 12 | Very large |
| 3 | Hirfynydd (Sarn Helen) - South West | 2 | 12 | 24 | Very large |
| 2 | Hirfynydd (Sarn Helen) | 3 | 14 | 38 | Very large |
| 16 | Glyn Neath North | 3 | 10 | 48 | Very large |
| 14 | Upper Lliw Reservoir | 6 | 12 | 60 | Large |
| 13 | Mynydd y Gwair | 8 | 32 | 92 | Large |
| 4 | Hirfynydd (Sarn Helen) - West | 11 | 8 | 100 | Very large |

Table 11b SSA F Proposed refined SSA Zones with cumulative estimated capacities (MW)

| Zone | | Summary rank | Approx. Capacity (MW) | Cumulative Capacity | Wind turbine size |
|---------|------------------------------|--------------|------------------------|---------------------|-------------------|
| Zone 15 | Mynydd Fforch dwm | 1 | 7 | 7 | Large |
| Zone 16 | Ffynnon Oer (wind farm) | 2 | 6 | 14 | Very large |
| Zone 45 | Ffynnon Oer (west) | 3 | 5 | 19 | Large |
| Zone 13 | Mynydd Nant-y-bar | 4 | 16 | 35 | Large |
| Zone 14 | Glyncorwg East | 5 | 2 | 37 | Very large |
| Zone 24 | Mynydd Corrwg Fechan | 6 | 0 | 37 | Very large |
| Zone 36 | Mynydd Maendy Gilfach Goch | 7 | 4 | 41 | Large |
| Zone 12 | Coed Morgannwg Way | 8 | 20 | 61 | Very large |
| Zone 11 | Glyncorwg West | 9 | 41 | 102 | Very large |
| Zone 5 | Afan Argoed South East | 10 | 9 | 111 | Large |
| Zone 8 | Mynydd Blaengwynfi | 11 | 27 | 138 | Very large |
| Zone 9 | Mynydd Blaenrhondda (West) | 12 | 31 | 169 | Very large |
| Zone 6 | Foel Trawsant | 13 | 4 | 173 | Large |
| Zone 3 | Mynydd Bach | 14 | 11 | 184 | Large |
| Zone 2 | Mynydd Margam | 16 | 12 | 196 | Large |
| Zone 25 | Mynydd Blaenrhondda | 16 | 33 | 229 | Very large |
| Zone 28 | Cefn y Rhondda (north) | 19 | 12 | 241 | Very large |
| Zone 34 | Mynydd Maesteg (South) | 20 | 7 | 245 | Large |
| Zone 26 | Mynydd Tynewydd | 25 | 43 | 288 | Very large |
| Zone 33 | Mynydd Maesteg (North) | 27 | 12 | 300 | Large |

6 Conclusions and Recommendations

6.1 Conclusions

This study has considered the potential refinement of the boundaries of SSAs E and F as published in TAN 8. Using an extensive analysis involving fieldwork and computer modelling, it has reviewed the nationally published boundaries in the light of data not available to the original consultants at the time of their derivation, principally landscape and visual information.

It concludes that there is no need to extend either TAN 8 boundary outwards by any significant degree i.e. there is no "*robust evidence that land outside (but close to) the SSA is suitably unconstrained*" (TAN 8 para 2.4). The land outside the published SSA boundaries has been demonstrated either to be:-

- a) unacceptable in landscape and visual terms for the development of large scale wind farms forming part of a strategic search area, or
- b) not to be needed to contribute to the 2010 indicative capacity, by virtue of sufficient currently available resource located within the better environmentally performing parts of the SSAs.

Although still a strategic study, the work has identified the extent of the complexity of landscapes within the SSAs and the need to consider the impacts on the very many communities that either lie adjacent to or within the SSAs.

In identifying the refined SSA boundaries it is accepted that significant change in the landscape will impact on many communities. The refined areas contain the preferred areas and while it is considered that these will have significant effects, the other parts of the SSA s performed worse or would have greater adverse effects upon the communities.

6.2 Recommendations

6.2.1 Development within the SSAs

It is recommended that the local planning authorities consider the principles, criteria and refined boundaries outlined within this report as soon as possible. Such an approach should still ensure that the TAN 8 indicative capacities are achieved (or exceeded given the lower end energy yield/km² estimates used) whilst protecting as far as is possible the landscape, ecological and visual environment of the Study Area.

Wind farm developers still need to demonstrate that proposals within the refined SSAs respond to the existing/agreed wind farms, communities as well as to the landscape as a whole. To this end, initial guidelines to minimise the landscape and visual impacts of wind farms in the Strategic Areas is included in **Appendix J**. These should be further developed and updated as development within the SSAs proceeds.

6.2.2 Development outside the SSAs

This report does not explicitly consider the scope for onshore wind outside the refined SSAs. TAN 8 para. 2.12 indicates local planning authorities could define a set of local criteria that would determine the acceptability of smaller community based wind schemes and define in more detail what is "smaller" and "community based". This exercise would logically follow the endorsement of the work within this study.

6.2.3 Biodiversity and landscape strategy for the SSAs

This study has only been able to address the potential adverse effects on the development of the SSAs on landscape and biodiversity. However the technical potential/feasibility for achieving biodiversity/landscape improvements in and around the SSAs (through management improvements linked to development of the SSAs) should be considered. Broad principles for each SSA should be developed. Individual applications for wind farms could then be seen within this strategic context and appropriate site specific biodiversity/landscape management plans developed to fit within this wider context. Put simply, there should be an agreed regional view, supported by stakeholders, as to what the SSAs should look like in 20-25 years and what habitats and species should be dominant in and around the wind turbines.

Emphasis could be given to the list of Species and Habitats of Principal Importance for Conservation of Biological Diversity. This list⁴⁴ has been prepared under section 74 of the Countryside and Rights of Way Act 2000. It identifies the living organisms (species) and habitat types that the National Assembly for Wales considers to be of principal importance for the purpose of conserving biological diversity in accordance with the 1992 United Nations Convention on Biological Diversity. In addition, where possible, any regional view of the SSAs should also consider the species and habitats contained within local authorities Biodiversity Action Plans.

⁴⁴ Going Wild in Wales(2003) - <http://www.wales.gov.uk/subienvironment/content/guidance/list-of-species-e.pdf>

FIGURES

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