Technical note: Appraisal of NOx Emissions on Ancient Woodland, Waunarlwydd.

1. Introduction

1.1 Technical Note Purpose

This technical relates to the potential effects caused by oxides of nitrogen (NOx) emissions to air and nitrogen deposition to the ecological value of the surrounding ancient semi-natural woodland and restored ancient woodland from the proposed operation of the gas fired power plant off Titanium Road, Waunarlwydd.

1.2 Background Information

The proposal from Viridis 178 Ltd relates to the operation of twenty-seven gas fired spark ignition engines on the site off Titanium Road, Waunarlwydd, SA5 4SF (grid reference SS 60652 96386). With the stated maximum operating time of ~2000 hours per annum the power plant will be used to provide additional supply to the electrical grid during periods of high demand or as required.

A number of pollutants have a negative effect on air quality with one of the most significant and relevant to habitats and species (particularly plant species) being NOx which can be are deposited as wet or dry deposits. NOx pollutants affect habitats and species mainly through two resulting effects; acidification and eutrophication. Acidification increases the acidity of soils, which can directly affect some organisms but which also promotes leaching of some important base chemicals (e.g. calcium), and mobilisation and uptake by plants of toxins (especially metals such as aluminium). Air pollution contributes to eutrophication within ecosystems by increasing the amounts of available nitrogen (N)[1]. This is a particular problem in low-nutrient habitats, where available nitrogen is frequently the limiting factor on plant growth, and results in slow-growing low-nutrient specialists being out-competed by faster growing species that can take advantage of the increased amounts of available N.

Overall in the UK, there has been a significant decline in NOx emissions in recent years and a consequent decrease in acid deposition; in England and Wales, NO_x has declined by 65% since 1990 (NAEI, 2014). The emissions are generally expected to decline further in future years and the effect of NO_x decreases on ecosystems has been marked, particularly in respect of acidification. The key contributor to acidification is now thought to be deposited nitrogen, for which the major source (ammonia emissions) has not decreased significantly. Indeed, although it was estimated that the proportion of UK semi-natural ecosystems that exceeding the critical loads for eutrophication would decline from 40% to 32% by 2010 (NEGTAP, 2001)[2], eutrophication from N-deposition (again, primarily from ammonia) is now considered the most significant air quality issue for many habitats.

The Environment Agency's Risk Assessment Methodology (formerly Horizontal Guidance Note H1) requires detailed dispersion modelling to be carried out based on local receptors, including; "*ancient woodland within 2 km of the location*". Within a ~500m radius of the proposed installation are a number of patches designated

[1] Nitrogen that is in a form that can be absorbed and used by plants.
[2] NEGTAP (2001). Transboundary Air Pollution: Acidification, Eutrophication and Ground-level Ozone in the UK. Report of the National Expert Group on Transboundary Air Pollution (D Fowler Chair). UK Department of the Environment, Food and Rural Affairs.

as Ancient semi-natural woodland or Restored Ancient Woodland (Forestry Commission, 2016)[3]. These are defined by Natural Resource Wales (2016)[4] as; "*Ancient semi-natural woodland (ASNW) – broadleaf woodlands comprising mainly native tree and shrub species which are believed to have been in existence for over 400 years*" and "*Restored Ancient Woodland Sites (RAWS) – woodlands which are predominately broadleaves now and are believed to have been continually wooded for over 400 years. These woodlands will have gone through a phase when canopy cover was more than 50% non-native conifer tree species and now have a canopy cover of more than 50 percent broadleaf*".

The survey was undertaken to provide ecological baseline data relating to the ancient woodland within the ~500m radius of the proposed installation location. This information was further used to investigate the potential effects that NOx emissions may have upon the woodlands to provide information for the permitting for the power plant.

1.3 Scope of Proposed Works

The scope of the works involves the running of the proposed power plant installation up to a maximum of ~2000 hours per annum.

1.4 Site Context

The proposed installation site is located within an agricultural pasture field ~250m north of Titanium Road, Waunarlwydd and ~5.75km north-west of Swansea city centre. To the south and west of the proposed installation site is pasture, to the north a small area of grassland and scattered immature trees and to the east a currently operational power generation site containing diesel fired generators operated by Green Frog 214 for the short term operating reserve (STOR).

Further afield to the south and west are large industrial factory units and beyond that the residential area of Waunarlwydd. While to the north and east the habitats are dominated by agricultural fields with those in the immediate surrounding of the site being predominantly marshy grass and soft rush dominated pastures. Aerial imagery shows fields further away also to be of pastoral use, bound by hedgerows and interspersed with woodland copses and a number of waterbodies.

2. Methodology

Desk Study

Prior to the survey visit a data gathering exercise using internet sources (MAGIC: Multi Agency Geographic Information for the Countryside, Google Earth Pro and OS mapping.) was conducted to obtain any information relating to the proposed installation site in addition to any information relating to features of particular ecological interest within the immediate surrounding. Additional information was obtained from the Forestry Commission (2016) inventory showing the extent of ancient semi-natural woodland or restored ancient woodland.

The contextual information obtained as a result of the desk study is important as it may indicate the presence of, or the potential for, protected and notable species that could occur on the site itself, and indicate potential off-site factors that may influence constraints to development at the site.

Ecology Walkover Survey

The survey, based on the Joint Nature Conservation Committee (JNCC) Phase 1 Habitat survey[5] methodology was undertaken by appropriately qualified Amec Foster Wheeler assistant consultant ecologist Sam Barnes BSc MSc on 4th November 2016. The survey included all woodland patches designated as

[3] Forestry Commission Inventory Map (2016). http://maps.forestry.gov.uk/imf/imf.jsp?site=fcwales_ext&. Retrieved; 1st November 2016.
[4] Natural Resource Wales (2016). https://naturalresources.wales/forestry/woodlands-and-the-environment/ancient-woodland-inventory/?lang=en. Retrieved; 11th November 2016.
[5] JNCC (2010). Handbook for Phase 1 habitat survey, a technique for environmental audit. JNCC, Peterborough, UK.

Ancient semi-natural woodland or Restored Ancient Woodland (Forestry Commission, 2016) within a ~500m buffer zone around the proposed installation location.

The walkover survey aimed to record habitats within the woodlands and assess their relative nature conservation importance, in particular it aimed to identify the presence or potential presence of habitats and species. Habitats and species recorded considered to be of conservation importance were photographed and location recorded with GPS where possible. The survey assessed the status/extent of habitats/species within the woodlands and their capacity to withstand the NOx levels that are predicted by dispersion modelling data, as well identifying any potential requirement for mitigation. Where botanical species were recorded the DAFOR scale was used if applicable denoting the following; (D) dominant, (A) abundant, (F) frequent, (O) occasional and (R) rare. Finally, any areas of particular ecological interest such as Ancient Woodland Indicator species were given a target note with a description and their location recorded. The list of species deemed Ancient Woodland Indicators (AWI) was taken in accordance with Woodland Trust (2007)[6].

Post Analysis

Upon competition of the survey visit, the website Air Pollution Information System (APIS- http://www.apis.ac.uk) was used to determine the critical level (CLE) and critical load (CLO) of the habitats and species recorded on site where such data was available. Utilising this information, in conjunction with the modelled emission data provided within the Air Quality Report (Amec, 2016)[7], allowed the impacts upon the habitats and species found within any of the ancient semi-natural woodland or restored ancient woodland sites to be predicted.

Constraints

- The botanical survey has been undertaken at a sub-optimal period during early November. The optimal period for botanical surveys is between April and August when the majority of species are in flower to allow for the maximum number of species to be identified. Although considered outwith the optimal survey season for botanical identification, a range of species were recorded (likely due to relatively warm Autumnal period) and it is therefore considered unlikely that the time of year greatly affected the results and assessment; and
- One area designated as Ancient semi-natural woodland could not be surveyed due to access restrictions. This was at the edge of the buffer zone, ~485m north-west of the proposed installation site at its closest point. This woodland is unlikely to be subject to a large effects due to the distance from the proposed installation.

3. Results

Desk Study

The desk study identified six patches of woodland designated as Ancient semi-natural woodland or Restored Ancient Woodland on the Forestry Commission (2016) inventory map as follows;

Table 3.1: Location of ASNW and RAW within ~500m of the proposed installation

Woodland Patch	Location [Central Grid Reference]	Designation [Forestry Commission, 2016]	Distance From Proposed Installation
WP1	SS 60762 96393	ASNW	~150m east
WP2	SS 60730 96530	ASNW and RAW	~160m north-east

[6] Woodland Trust (2016). Ancient Woodland Species List. http://www.backonthemap.org.uk/theproject/analysis/species Retrieved; 14th November 2016.
[7] Amec Foster Wheeler (2016). Air Quality Impact Assessment of Emissions to Atmosphere from Viridis Swansea Capacity Mechanism Power Plant. Amec Foster Wheeler, Knutsford, UK.

Woodland Patch	Location [Central Grid Reference]	Designation [Forestry Commission, 2016]	Distance From Proposed Installation
WP3	SS 61010 96566	RAW	~415m east-north-east
WP4	SS 60443 96741	RAW	~435m north-west
WP5	SS 60190 96634	ASNW	~510m north-west
WP6	SS 61270 96618	ASNW and RAW	~675m north-east

Note: ASNW = Ancient semi-natural woodland and RAW = Restored Ancient Woodland

Ecology Walkover Survey

Latin names are found in Appendix A, site photographs are found in Appendix B. The habitat survey recorded the following;

Woodland Patch One

Designated as ancient semi-natural woodland, the copse is ~0.29ha in size and located ~150m east of the proposed installation site. To the north of the woodland is an area of poor semi-improved grassland with scattered broad leaved trees, to the east pasture fields separated by an access road, to the south an area of marshy grassland and forming the western boundary is the currently operational diesel gas fired electricity generating plant, Green Frog 214 STOR.

The woodland comprises of broad leaved trees including alder (F), sycamore (O), ash (R), hazel (O), oak (F) and willow (O). A relatively open canopy is present with an agricultural unpaved road running through the southern part of the wood. There is also a spoil pile devoid of trees within the western area of the wood and a low amount of trees within the centre of the wood where instead dense scrub is dominant. Mature trees noted include approximately ten mature alders towards the centre, five mature oaks on the southern edge, two mature beech and a small dead tree on the eastern boundary and a mature sycamore on the western boundary with the majority of these having a diameter at breast height (DBH) of ~0.6m and none above ~1.2m DBH. Evidence of cattle grazing was recorded with cattle trodden paths of poached ground throughout the woodland.

The ground flora within the woodland centre is dominated in patches by dense bramble which also contains bracken (O), nettle (O), Himalayan balsam (R) and broad leaved dock (O). Where this scrub vegetation is sparser towards the edges of the woodland, on the cattle paths and covering the spoil pile within the western portion of the woodland, more botanical diversity is present and the habitat is closer to poor semi-improved grassland. Species recorded include Yorkshire fog (A), geranium sp. (R), cuckoo-flower (O), soft rush (O), creeping buttercup (O), field bindweed (R), harts-tongue fern (O), cleavers (R), willowherb sp. (O), dandelion sp. (O), clover (A) and broad leaved dock (O).

In addition, the survey recorded three AWI species within the ground flora. These were herb robert, ivy, and common dog violet. The ivy was recorded throughout the woodland in small localised areas while the common dog-violet and herb robert were found on the eastern woodland edge where the ruderal vegetation was less dense.

Woodland Patch Two

Using the Forestry Commission map, the desk study showed this woodland patch comprising of two adjoining woodland sections; a western section of ancient semi-natural woodland, ~0.68ha in size, and an eastern section designated as restored ancient woodland site, ~0.54ha in size. The central point is located ~160m north-east of the proposed installation site. The Forestry Commission map showed the woodland surrounded on all sides by agricultural land with the watercourse, Afon Lian forming the southern boundary. During the walkover survey however the woodland extents were noted to be considerably smaller than those recorded during the desk study.

The restored ancient woodland site that forms the eastern half has mostly been felled. In its place was a pasture field dominated by perennial rye grass with the only a single mature tree, a sycamore located on an

earth bank (SS 60832 96552). Additional vegetation present included approximately ten young/semi-mature birch trees with DBH of ~0.25m along with a number of scattered gorse shrubs and bramble patches (SS 60780 96541) on an earth bank. Evidence of grazing is present here with the short sward containing limited botanical diversity with only perennial rye grass, buttercup and clover noted.

Similarly, nearly all the ancient semi-natural woodland western portion has been removed and pasture field currently in its place. Of the former ancient semi-natural woodland site, three areas of vegetation remain; the first a row of trees along the watercourse Afon Lian creating the southern edge of the former ancient semi-natural woodland site, secondly, a single mature dead tree (SS 60717 96514) and lastly, an area of bramble dominated scrub ~0.26ha in size where the desk study showed the north-west historical extent of the ancient semi-natural woodland.

The trees along the Afon Lian watercourse are semi-mature and mature with oak, alder, birch and sycamore recorded. This strip of trees is thin with only a single row of trees on both sides of the watercourse present. The ground flora is in sections a continuation of the grazed pasture field whereas in other sections bramble and gorse are abundant forming a shrub layer.

The last remaining portion of the ancient semi-natural woodland is in the north-west corner of its former extent, in a field separate to the grazing pasture. The vegetation is predominately young and semi-mature willow, birch and hazel with the ancient semi-natural woodland potentially felled previously to allow the installation of the three 11kv power lines that oversail the scrub. Only two mature trees are present within the section, both oak, with the rest of the trees creating of dense continuous scrub with young and semi-mature trees. The ground flora within the more open areas of scrub are covered with large expanses of Japanese knotweed along with bramble and Himalayan balsam. At the edges species noted include soft rush, gorse and hogweed along with foxglove, an AWI species.

Woodland Patch Three

Located upstream along the Afon Lian to the east of woodland patch two, woodland patch three is ~415m east-north-east of the proposed installation site. Designated as restored ancient woodland the woodland patch is ~1.01ha in size with an agricultural pasture field to the north, the Afon Lian watercourse running along the southern and western extent and the eastern edge formed by an agricultural trackway.

The woodland ground conditions vary throughout with wetter, waterlogged areas and drier sections present. Drier sections are predominately on the southern and eastern parts of the woodland where cattle paths and evidence of shooting with game feeding stations and footpaths were noted. The trees within these areas are birch, oak, lime and ash, a number of which were mature, covered in ivy and had sections of deadwood within the canopy. The ground flora in these areas comprises brambles, hogweed, dandelion, himalayan balsam, dead nettle sp., cranesbill sp., greater plantain and creeping buttercup and on the eastern edge of the woodland a small number of young rhododendron were recorded.

In the wetter areas towards the northern and western parts of the woodland the ground is waterlogged and crossed with a drain. A few small pools of shallow water are also present on the ground surface. The dominant tree species is alder with willow sp. (F), ash (O) and birch (R) also present. The ground flora supports buttercup (A), flag iris (O), water dropwort (F), cleavers (R), hogweed (O), bramble (O), Himalayan balsam (O), cuckoo flower (O), willowherb sp. (R), soft rush (O), Yorkshire fog (O), gypsywort (R), (O) and a sedge sp (F). Additionally the AWI species of herb robert (O), wood avens (O), opposite leaved golden saxifrage (A), common dog violet (A) and ivy (O) were present within the ground flora.

The trees within the woodland ranged from young saplings to mature specimens although only three mature trees were noted, two oaks and a single dead tree, all on the eastern edge of the woodland.

Woodland Patch Four

Designated as restored ancient woodland, ~0.57ha in size, and surrounded by agricultural land on all sides, the woodland is located ~435m north-west of the proposed installation. Shown as a single area of woodland during the desk study, the southern third is separated from the northern two thirds by an area of scrub due where an 11kv OHL passes through the woodland in a west-east orientation.

Numerous trees within the woodland are mature with alder (A), oak (O) and birch (F) present along with a potential hornbeam. Throughout the woodland regrowth of the tree species along with hazel, holly, elder, hawthorn and bramble creates a dense shrub layer. This covering of shrubs, along with the dense tree canopy, has created heavy shading of the ground and it is covered with a layer of leaf litter with little ground flora present. Ground flora that is present within the woodland is dominated by ivy with bracken and Himalayan balsam present along with dense stands of bramble, willowherb and Japanese knotweed at the woodland edges. A single red campion flower, an AWI species, was noted within the centre of the woodland.

At the northern end of the woodland a damp area is present where the ground flora changes to become dominated by soft rush and the tree composition changes to be predominately dense willow scrub. This however is a small portion of the woodland with the vast majority of the woodland comprising of the drier habitat described previously.

Woodland Patch Five

The centre of this patch of a semi-natural woodland is ~510m north-west of the proposed installation site. Due to access restrictions however it was not possible to survey.

Woodland Patch Six

While the centre of this woodland patch is ~675m north-east of the proposed installation, at its closest point is only ~470m so falls within the survey buffer zone. It is located on the Afon Lian watercourse to the east of woodland patch three where it is separated by a clearing for an agricultural track ~30m wide.

The desk study showed the woodland patch comprises of two areas. The first is designated as restored ancient woodland and it covers ~1.18ha and is roughly rectangular in shape. The second section is an area of ancient semi-natural woodland. This area of ancient semi-natural woodland is ~0.48ha in size and extends from the first section in a north-east direction with marshy grassland forming its immediate surroundings.

The walkover survey noted however that both of the woodland sections were less extensive than recorded during the desk study.

The area of restored ancient woodland, the eastern third had been removed reducing the size from ~1.18ha to ~0.61ha in size. At this eastern end where the vast majority of this loss has occurred, the woodland has been replaced with pasture which at the time of the survey was predominately bare, heavily poached showing evidence of grazing with small tussocks of soft rush interspersed throughout. An additional smaller part of the woodland has been lost at the south-west tip where an electricity pylon is present and instead of woodland the ground is dominated by a mix of tall ruderal and improved grassland habitat.

The remaining area of this restored ancient woodland is similar in composition to that of woodland patch three however less botanical diversity was noted along with evidence of heavier grazing with cattle poached tracks throughout the wood. Ground conditions were mixed with wetter areas predominately in the eastern part of the woodland where alder dominated with birch, hazel, oak and birch also present although in greater frequency on the drier areas. The ground flora was dominated by bramble with creeping buttercup, cuckoo flower, nettle, bracken, soft rush and ivy, an AWI species, along with areas of dense leaf litter where the canopy was denser.

The ancient semi-natural woodland area forming the north-eastern section had also been replaced with pasture grazing land on its western end resulting in the woodland being ~0.21ha in size, a reduction of ~0.27ha. This woodland removal has had the resulting effect that the two sections of woodland patch six are now no longer connected and instead separated by an area of grazing pasture ~70m at its closest point.

The ancient semi-natural woodland section covers ground on a range of levels. At its southern and western extent the ground is lower than the surrounding with alder and willow abundant and damp soils. The ground flora here contains species including water drop hemlock, bramble, mint sp., willow herb, Himalayan balsam, soft rush, hogweed and a single individual foxglove, an AWI species. On the woodlands northern boundary, where the woodland borders a damp pasture field, the ground is higher and therefore drier and less waterlogged. Here a number of mature oak trees are present with DBH ~0.8m and a ground flora dominated by brambles.

Post Analysis

Using habitat data gathered during the walkover survey in conjunction with APIS it was attempted to determine the critical level (CLE) and critical load (CLO) of the woodland present on site.

The APIS website provided the critical level annual mean NOx and critical level daily mean NOx, 30µg m^{-3} and 75µg m^{-3} respectively. These levels are set for all receptors types as "*values are not habitat specific, as in critical loads, but have been set to cover broad vegetation types*" (APIS, 2016[8]).

Critical load values are specific for each habitat type with APIS providing data on a number of specific habitat types. The APIS category of Broadleaved, Mixed and Yew Woodland was deemed applicable which has a critical load range of 10 - 20 kg N ha^{-1} y^{-1}. In order to take a conservative approach the lower end of the range was taken due to the potentially sensitive nature of ancient woodland to the effects of nitrogen deposition and air emissions.

From the Air Quality report (Amec, 2016), the baseline amount of NOx within the immediate surroundings of the proposed installation and additional NOx produced by the operation of the proposed installation data was reviewed with the following receptor locations deemed the most relevant. These locations were selected due to their location adjacent to the woodland patches and proximity to the proposed installation.

Table 3.2: Data Receptor Locations

Monitor	Location (Grid Reference)	Relevant Woodland Patch	Woodland Section
AW 7	SS 60662 96428	Woodland Patch 1	ASNW
AW 5	SS 60635 96594	Woodland Patch 2	ASNW
AW 6	SS 60641 96543	Woodland Patch 2	RAW
AW 8	SS 60822 96624	Woodland Patch 3	RAW
AW 4	SS 60385 96725	Woodland Patch 4	RAW
AW 3	SS 60136 96717	Woodland Patch 5	ASNW
AW 9	SS 60980 96630	Woodland Patch 6	RAW
AW 10	SS 61071 96698	Woodland Patch 6	ASNW

Note: ASNW = ancient semi-natural woodland, RAW = restored ancient woodland

Data from the predicted receptor locations is shown below, based on the assumptions within the Air Dispersion Modelling report.

Table 3.3: Critical Levels of both daily and annual mean NOx and Critical Loads of nitrogen deposition

		AW 7 [WP1]	AW 5 [WP2]	AW 6 [WP2]	AW 8 [WP3]	AW 4 [WP4]	AW 3 [WP5]	AW 9 [WP6]	AW 10 [WP6]
Annual Mean NOx Level (µg m^{-3})	PC	27.26	4.48	7.01	4.42	1.13	0.78	3.38	2.20
	PEC	44.38	18.67	22.39	18.66	12.73	12.24	17.56	13.73
Daily Mean NOx Level (µg m^{-3})	PC	262.86	72.87	99.83	58.20	30.56	26.36	35.81	31.92
	PEC	3416.76	883.77	1267.23	1069.10	491.44	439.58	677.17	555.95

[8] APIS (2016). http://www.apis.ac.uk/overview/issues/overview_Cloadslevels.htm. Retrieved: 9th November 2016.

Nitrogen Deposition Load (kg N ha^{-1} y^{-1})	PC	5.50	0.90	1.41	0.89	0.23	0.16	0.68	0.44
	PEC	21.04	16.44	16.95	16.43	15.77	15.70	16.22	15.98

Note: PC = Process Contribution, PEC = Predicted Environmental Concentration. All data obtained from Amec (2016).

4. Conclusions

Using the data within Amec (2016) the following points were noted;

- The annual mean critical level was exceeded at the monitoring location AW 7, the closest to the proposed installation and corresponding with woodland patch one. The remaining seven monitoring locations have predicted annual mean NOx levels below the annual mean critical level;
- The daily critical level was exceeded at all eight monitoring locations considered with the largest exceedance predicted to occur at the location of the monitor AW 7 (woodland patch 1); and
- The critical load upper range is exceeded by the PEC only at one location, AW 7. At the remaining seven monitoring locations the lower end of the critical load range is exceeded with the lower end of the range chosen to provide a worst case scenario prediction.

The reasons for the daily critical level being exceeded were stated within Amec (2016) as "*primarily influenced by emissions from the adjacent Green Frog 214 STOR power plant*" and "*the calculations of daily mean NOx are based on the pessimistic assumption that both the application plant and the adjacent Green Frog 214 STOR power plant are operating during all those hours that give the highest concentrations, so the numbers are overestimated*". The reasons for the exceedance of annual critical level and critical load at AW 7 are due to the presence of existing modelled background levels from the currently operational diesel plant and factories within the immediate surroundings of the proposed installation factored in to the emission model.

The data from Amec (2016) showed the greatest amount of NOx and N deposition is predicated to be at monitor AW 7 which corresponds with woodland patch one, located ~150m east of the proposed installation site. At this location all three predicted values, both the daily and annual NOx critical level, and the annual N deposition load are above their respective critical values.

The walkover survey recorded woodland in a variety of conditions with woodland patch one considered to be declining ancient semi-natural woodland of limited ecological value. AWI species recorded within the woodland patch were common dog violet, ivy and herb robert however these alone do not confirm the quality of the ancient semi-natural woodland as ancient woodland indicator species alone should not be used to make a determination (Glaves et al, 2007)[9]. The presence of the Schedule 9 listed invasive species[10] Himalayan balsam was also recorded within the ground flora of the woodland. While the walkover recorded this species in relatively small abundance, it is likely that left unchecked and untreated, the prevalence of this species will increase potentially outcompeting native species currently within the woodland, including the AWIs. Finally the walkover survey noted the woodland was open with some areas more accurately described as dense scrub with scattered trees which in conjunction with the small size of ~0.29ha lead to a sparse woodland.

Woodland patch two, located ~160m north-east of the proposed installation is of poor declining quality with the majority removed entirely. The remaining habitat from the historical extent is limited to a single row of trees adjacent to the watercourse Afon Lian, a large dead tree and an area of scrub at the former north-west edge. The trees adjacent to the watercourse are mature with an understorey mix of grazing pasture and shrubs such as bramble and gorse while the scrub to the north-west is nearly all young trees with an understorey including abundant Japanese knotweed and Himalayan balsam, both listed on Schedule 9 as

[9] Glaves.P, Rotheram.I, Wright.B, Handley.C and J.Birbeck (2007). A Report to the Woodland Trust: Field Surveys for Ancient Woodlands: Issues and Approaches. Sheffield, UK

[10] Schedule 9 of Wildlife and Countryside Act 1981 (as amended)

invasive species. These factors lead to woodland patch two being classed as being in a poor declining condition.

With all sections of woodland within ~250m of the proposed installation site being in a declining condition, or missing entirely, it is unlikely that the increased emissions caused by the proposed installation will have a detrimental effect. This is due to the pre-existing woodland conditions which are predicted to decline further should no active woodland management be introduced.

The woodland patches further afield, outside a ~250m radius of the proposed installation site are of better quality and larger in scale. These however are subject to agricultural encroachment, cattle grazing and/or have Himalayan balsam, Japanese knotweed and rhodendendron (all listed on schedule 9 as invasive species) within the ground flora with all factors potentially impacting upon the woodlands over time. The modelled PEC levels and PEC load for these are below the critical level and load given for the habitat although the pre-existing load is above the more conservative lower limit, potentially more applicable to sensitive ancient woodland. However, due to the purpose of the proposed installation; to supplement the electricity supply during periods of high demand, it is likely that the vast majority of the operational time will be during the winter period. This winter operational period is outside the main growth periods for all botanical species within the woodland which is likely to further reduce any impact from the proposed development.

5. Recommendations

It is recommended that monitoring be undertaken in the future to record any potential effects to the any of the surrounding woodland patches caused by the operation of the proposed installation. Any potential effects are to be determined by a walkover survey to be undertaken during the optimal survey period and conducted one, three and five years after the beginning of the proposed installations operation.

Should any adverse effects to the woodlands be noted either by a decrease in botanical diversity, changes in botanical species assemblage to reflect impacts from nitrogen deposition or airborne NOx, etc. compensatory or additional mitigation measures, such as woodland management, may need to be implemented to offset any effects of the operation of the proposed installation.

Appendix A Latin Names

Common Name	Latin Name
Alder	*Alnus glutinosa*
Sycamore	*Acer pseudoplatanus*
Hazel	*Corylus avellana*
Oak	*Quercus sp.*
Willow	*Salix sp.*
Bracken	*Pteridium sp.*
Common nettle	*Urtica dioica*
Himalayan Balsam	*Impatiens glandulifera*
Japanese Knotweed	*Fallopia japonica*
Broadleaved dock	*Rumex obtusifolius*
Perennial ryegrass	*Lolium perenne*
Yorkshire fog	*Holcus lanatus*
Cranesbill	*Geranium sp.*
Cuckoo flower	*Cardamine pratensis*
Soft rush	*Juncus effusus*
Creeping buttercup	*Ranunculus repens*
Field bindweed	*Convolvulus arvensis*
Harts-tongue fern	*Asplenium scolopendrium*
Cleavers	*Galium aparine*
Willowherb	*Epilobium sp.*
Dandelion	*Taraxacum spp.*
Clover	*Trifolium sp.*
Common dog violet	*Viola riviniana*
Herb Robert	*Geranium robertianum*
Ivy	*Hedera helix*
Foxglove	*Digitalis purpurea*
Common hogweed	*Heracleum sphondylium*
Gorse	*Ulex europaeus*
Rhododendron	*Rhododendron sp.*
Bramble	*Rubus fruticosus*

Greater plantain	*Plantago major*
Ash	*Fraxinus excelsior*
Flag iris	*Iris pseudacorus*
Water dropwort	*Oenanthe sp.*
Gypsywort	*Lycopus europaeus*
Wood avens	*Geum urbanum*
Opposite leaved golden saxifrage	*Chrysosplenium oppositifolium*
Hornbeam	*Carpinus betulus*
Red campion	*Silene dioica*
Holly	*Ilex aquifolium*
Elder	*Sambucus nigra*
Hawthorn	*Crataegus monogyna*

Appendix B Site Photographs

Woodland Patch 1 – South West Corner showing access track and dense scrub

Woodland Patch 2 – Showing cleared areas

Woodland Patch 3 – Eastern end

Woodland Patch 6 – Showing mature oak with adjacent strip of scrub and pasture field

B5

Author

Sam Barnes

Reviewer

Sian Jones

Copyright and non-disclosure notice

Third party disclaimer

Management systems

This document has been produced by Amec Foster Wheeler Environment & Infrastructure UK Limited in full compliance with the management systems, which have been certified to ISO 9001, ISO 14001 and OHSAS 18001 by LRQA.