PEEL ENVIRONMENTAL MANAGEMENT LTD AND BILSTHORPE WASTE LTD

PUBLIC INQUIRY UNDER SECTION 77 OF THE TOWN AND COUNTRY PLANNING ACT 1990 (AS AMENDED) INTO THE PROPOSED DEVELOPMENT OF AN ENERGY FROM WASTE FACILITY ON LAND AT BILSTHORPE BUSINESS PARK, BILSTHORPE, NOTTINGHAMSHIRE

PINS REFERENCE: APP/L3055/V/14/3007886
LPA REFERENCE: ES/2950

ENVIRONMENTAL STATEMENT

THIRD REGULATION 22 SUBMISSION

SEPTEMBER 2015

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V3

September 2015

This report is submitted in support of a detailed planning application for the above project. The application has been co-ordinated by AXIS with technical inputs from:

- AXIS – Project Management / Co-ordination, Planning Policy & Need, Traffic & Transportation, Landscape & Visual Effects, Cultural Heritage, Cumulative Effects and Grid Connection;
- UMC ARCHITECTS – Architecture & Design;
- TERRACONSULT – Geology, Hydrogeology and Ground Conditions;
- ARGUS ECOLOGY – Ecology & Nature Conservation;
- FICHTNER – Air Quality and Human Health;
- NVC – Noise
- TIER / WEETWOOD – Surface Water and Flood Risk
- REGENERIS – Socio-Economics
- COTSWOLD ARCHAEOLOGY – Heritage

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FOREWORD

This Environmental Statement (ES) is submitted in support of a detailed planning application made jointly by Peel Environmental Management (UK) Ltd. and Bilsthorpe Waste Ltd. for the development of Bilsthorpe Energy Centre, a combined Materials Recovery Facility and Plasma Gasification Facility, on land at Bilsthorpe Business Park (formerly part of Bilsthorpe Colliery), Eakring Road, Bilsthorpe, Nottinghamshire. The ES comprises the following documents.

- The Environmental Statement (ES) Main Report (Volume 1), which contains the detailed project description; an evaluation of the current environment in the area of the proposed development; the predicted environmental impacts of the scheme; and details of the proposed mitigation measures which would alleviate, compensate for, or remove those impacts identified in the study. Volume 1 also includes a summary of the overall environmental impacts of the proposed development and all relevant schematics, diagrams and illustrative figures;

- Technical Appendices (Volume 2), which include details of the methodology and information used in the assessment, detailed technical schedules and, where appropriate, raw data;

- Non-Technical Summary (Volume 3), containing a brief description of the proposed development and a summary of the ES, expressed in non-technical language;

- An update to the ES by way of a series of Regulation 22 submissions of further and other information, comprising:
    - Regulation 22 submission of further and other information (July 2014);
    - Second Regulation 22 submission of further and other information (August 2014); and
    - Third Regulation 22 submission of further and other information (September 2015).

Paper copies of the third ES Regulation 22 submission are availiable as a single volume, for £25.00. Copies of the original ES documentation, as a three volume set are available at a cost of £250.00. The first and second Regulation 22 submissions, both as

single volumes, are available at a combined cost of £50.00. Alternatively, the ES Non-Technical Summaries (the original ES and ES Regulation 22 submissions) can be purchased for £25.00 per four document set. The entire ES documentation is available on a CD at a cost of £10.00. All requests to purchase any ES documentation should be made in writing to Peel Environmental Management (UK) Ltd, Bilsthorpe Energy Centre, FREEPOST RSKS SBBE LHHZ, c/o PPS Group, Hanover House, 30 – 32 Charlotte Street, Manchester, M1 4FD. An electronic copy of the Non-Technical Summary documents is also available via email bilsthorpe@peel.co.uk, free of charge. In addition, all of the planning application documentation, including the ES can be downloaded from www.peel.co.uk/bilsthorpe.

1.0 INTRODUCTION

1.1 Introduction

1.1.1 In November 2013 Peel Environmental Management (UK) Ltd and Bilsthorpe Waste Ltd (the applicants) submitted a planning application, reference 3/13/01767/CMW, to Nottinghamshire County Council (NCC) for the development of Bilsthorpe Energy Centre, a combined Materials Recovery Facility and Plasma Gasification Facility, on land at Bilsthorpe Business Park (formerly part of Bilsthorpe Colliery), Eakring Road, Bilsthorpe, Nottinghamshire. The application was accompanied by an Environmental Statement (ES) that describes the proposal and provides an assessment of the likely significant environmental effects that may arise from the construction and operation of the facility.

1.1.2 In July 2014 Peel Environmental Management (UK) Ltd and Bilsthorpe Waste Ltd provided a "Regulation 22 Submission" to NCC in response to a request for "further information" pursuant to Regulation 22(1) of the Town and County Planning (Environmental Impact Assessment) Regulations 2011, hereafter referred to as the 2011 EIA Regulations. These documents were subsequently advertised for consultation under Regulation 22(3) of the 2011 EIA Regulations.

1.1.3 In August 2014 Peel Environmental Management (UK) Ltd and Bilsthorpe Waste Ltd provided a "Second Regulation 22 Submission" to NCC in response to an additional request for "further information" pursuant to Regulation 22(1) of the 2011 EIA Regulations. These documents were also subsequently advertised for consultation under Regulation 22(3) of the 2011 EIA Regulations.

1.1.4 The planning application was duly considered by the NCC Planning and Regulatory Committee on the 18th November 2014. The Committee resolved to approve the application. The decision was referred to the Secretary of State who, on 19th December 2014, under Section 77 of the Town and Country Planning Act 1990 (as amended), called-in the application for his own determination. A Public Inquiry into the proposed development will commence on the 3rd November 2015.

1.1.5 An ecological assessment of the proposed BEC development was included within the Environmental Statement which accompanied the planning application. The original assessment was supplemented by further information contained within both the first (July 2014) and second (August 2014) Regulation 22 submissions. The original ecological assessment was based upon ecological survey data which was gathered in 2012 / 2013 (up to 3 years ago). As a consequence, the ecological surveys have been updated to provide the inspector and SoS with an adequate evidence base to consider the ecological impacts of the proposed development.

1.1.6 In the first Regulation 22 submission NCC requested that the applicants contact the Environment Agency pursuant to applying for and obtaining an R1 design specification (which would confirm the BEC's status as a recovery facility). At the time there was no clear application route for the type of power generation proposed at the BEC (gas engine rather than steam cycle to generate power). Furthermore, an application to the EA would need to be supported by detailed design information, some of which was not available at the time. In light of this, the applicants proposed, and the waste planning authority accepted, that a planning condition could be imposed to require the Applicant to obtain provisional R1 status prior to starting operations.

1.1.7 The EA has subsequently produced new guidance[1] which removed some of the obstacles to an application and detailed design information is now availiable. This has allowed for a design stage R1 application to be prepared and submitted to the EA. The detailed design information that underpins the R1 application updates some of the information presented within the original ES (and subsequent Regulation 22 submissions), and it is important to consider the implications of this.

1.1.8 The Environmental Statement (ES) Main Report states in a number of locations that the percentage of renewable energy that would be generated by the BEC is 60%. However, this figure was provided in error and it is the actual percentage of energy generated that can be classed as renewable is 50.62% (a more detailed explanation is provided in paragraph 4.1 below).

[1] *"Guidelines on the Interpretation of the R1 Energy Efficiency Formula for Incineration Facilities Dedicated to the Processing of Municipal Solid Waste According to Annex II of Directive 2008/98/EC on Waste"*

1.1.9 In light of the foregoing, the applicants have submitted this supplement to the ES in order to fully evaluate these matters.

1.2 This Document

1.2.1 This document is the third supplement to the original ES. It has been submitted under Regulation 22 of The Town and Country Planning (Environmental Impact Assessment) Regulations 2011 (as amended) as *"Further information and evidence respecting environmental statements"*. In this instance the information contained within this report is provided voluntarily by the applicant as *Other Information* specifically for the purposes of an Inquiry held under the Town and Country Planning Act 1990. The response has been provided under the following headings, each of which forms a separate section of this report:

Section 2.0 – Ecology and Nature Conservation

Section 3.0 – R1 Recovery Status

Section 4.0 – Conclusions

2.0 ECOLOGY AND NATURE CONSERVATION

2.1 Introduction / Background

2.1.1 A number of studies were carried out to inform the preparation of the ecological impact assessment contained within the original Environmental Statement, and subsequent Regulation 22 submissions, they comprised.

Environmental Statement

2.1.2 An Extended Phase 1 Habitat Survey and a great crested newt (GCN) survey were undertaken by SLR Consulting in 2012 for Peel Environmental Management (UK) Ltd. and Bilsthorpe Waste Ltd. This included a habitat survey of the former Bilsthorpe Colliery area, and a survey of ponds within 500m of the proposed BEC site.

2.1.3 The scope of further ecological surveys to support the EIA was informed by a formal Scoping Opinion obtained from Nottinghamshire County Council (NCC) under Regulation 13 of the EIA Regulations.

2.1.4 Based upon the outcome of the scoping exercise, survey work carried out by Argus Ecology in the 2013 survey season included:

- A verification of the 2012 extended Phase 1 Habitat survey;
- A breeding bird survey of the proposed BEC site and surrounding Bilsthorpe Colliery area, extending to a wider area than that predicted to be affected by noise effects; and
- An assessment of current habitat quality for nightjar in two local woodlands, Eakring Brail Wood and Cutts Wood, together with a single evening nightjar survey during the active season.

2.1.5 In addition, the Air Quality Assessment (AQA) carried out by Fichtner Consulting Engineers allowed for consideration of the effects of nitrogen deposition on Birklands and Bilhaugh SAC, while the noise assessment carried out by NVC established the extent of potential noise impacts on birds.

2.1.6 The ecological impact assessment included full consideration of potential effects on the Sherwood ppSPA, including assessment of air quality, noise, and human disturbance on bird populations within and outside the ppSPA.

2.1.7 A Biodiversity Offsetting Metric was calculated in accordance with the requirements of NCC.

First Regulation 22 Submission

2.1.8 A Regulation 22 Request was made by NCC on 19 March 2014 and resulted in the provision of the following additional ecological information:

- A Wader Mitigation Plan, to address cumulative impacts of the BEC with other planned developments at Bilsthorpe Colliery (Including a proposal for 4.8ha of mitigation land for waders and dingy skipper, located within 100m of the Site);
- Re-calculation of the Biodiversity Offsetting Metric to include the wader mitigation area;
- Confirmation that a noise contour plan in Appendix 11-2 of the ES referred to LAeq levels;
- Clarification of water quality, water permanence and the capacity for habitat creation in the proposed water attenuation feature on Site;
- Consideration of potential air quality impacts on sensitive lichens in Birklands and Bilhaugh SAC;
- A woodlark survey in Bilsthorpe Colliery and Cutt's Wood, and assessment of habitat quality in Bilsthorpe Colliery, carried out from early March 2014 by an ornithologist with particular experience of this species;
- A dusk – dawn nightjar survey carried out during optimum conditions in Cutt's Wood in June 2014, combined with an assessment of the potential effects on nightjar of nitrogen deposition, increased traffic noise and disturbance, cumulative effects, lighting and operational noise; and
- An assessment of the effects of noise and lighting on bats, with consideration of whether the predicted noise and lighting levels around the proposed BEC Site could affect foraging habitat used by bats.

Second Regulation 22 Submission

2.1.9 Following submission of the first Regulation 22 submission in July 2014, NCC made a second Regulation 22 request on 21 August 2014, resulting in the provision of the following additional ecological information:

- further updating of the Wader Mitigation Plan, including more detail on the design of habitats for little ringed plover; and
- an ecological assessment of nitrogen deposition impacts on Redgate Woods and Mansey Common SSSI, and on Local Wildlife Sites within 2km of the proposed BEC.

2.1.10 Some of the ecological information that has informed the environmental assessment was collected in 2012 / 2013. Furthermore, since these surveys were carried out other developments have come forward within the survey area that could influence the baseline for the ecological assessment. As a consequence, the ecological surveys have been updated to provide the inspector and SoS with an adequate evidence base to consider the ecological impacts of the proposed development. The updated surveys comprise:

- An updated habitat survey of the proposed BEC site and mitigation area, to take into account natural vegetation succession and any other changes since 2013 (Appendix 2-1);
- A bat activity survey across the proposed BEC site and surrounding habitats, again to reflect habitat changes and data age (2012 surveys) (Appendix 2-2);
- An assessment of great crested newt presence / absence, because of data age (2012 survey), habitat changes, and the recent availability of improved detection techniques (Appendix 2-3);
- An updated breeding bird survey of the Colliery site, to take into account habitat changes, including the implementation of the Solar Farm development to the south of the application site (Appendix 2-4); and
- A dingy skipper butterfly survey of the proposed BEC site and land to the north, to take account of changes in habitat suitability on site since 2013 (Appendix 2-5).

2.1.11 Based on the results of these surveys, the conclusions of the ecological impact assessment have been updated to take account of any changes to the ecological baseline, and the proposed mitigation measures have been revised, leading to an updated Wader Mitigation Plan (Appendix 2-6) and consequent changes to the Biodiversity Offsetting Metric (contained within the Wader Mitigation Plan report).

2.2 Summary of the Findings

Habitat Survey

2.2.1 The habitat survey found significant changes in vegetation on the BEC site between 2013 – 2015 due primarily to natural successional processes. Over 55% of the site's area supported neutral grassland vegetation, forming a mosaic with short ephemeral vegetation and bare, periodically inundated areas.

2.2.2 The current disposition of habitats on site is consistent with Open Mosaic on Previously Developed Land priority habitat ('brownfield' habitat), which is listed in Section 41 of the Natural Environment and Rural Communities Act 2006 as a habitat of principal importance for the conservation of biodiversity in England.

2.2.3 The rapidity of natural succession suggests that plant communities will continue to develop, and the site is likely to decline in value due to the establishment of tall, species-poor grassland. This process may be slower in areas where newly exposed colliery spoil appears to have a high chloride content, which is currently restricting vegetation to salt-tolerant species. However, leaching of soluble salts from the surface will tend to remove this constraint in the coming years.

2.2.4 While acknowledging the likely temporary nature of the brownfield priority habitat, the value of the site has been re-assessed in terms of Biodiversity Units to reflect its current higher status.

Bat Activity Survey

2.2.5 The bat activity survey broadly confirmed the inferences made about usage of the site and surrounding habitats by bats. Although a higher level of bat activity was recorded compared to a 2012 survey of the former Colliery site by AESL Ltd, this was largely confined to higher quality foraging habitats such as the two waterbodies to the south and east of the BEC site.

2.2.6 Species recorded included common pipistrelle, soprano pipistrelle, noctule and Daubenton's bat.

2.2.7 Very little bat activity was recorded over the BEC site itself, although common pipistrelle were seen on one occasion foraging around lights on the Council depot site, adjacent to the western boundary of the BEC site. Common pipistrelle are relatively tolerant of higher light intensities, such as occur within the County Council Highways Depot site.

2.2.8 An emergence survey was also undertaken on a brick structure located a short distance to the east of the BEC site boundary. There was no evidence of use as a bat roost.

2.2.9 The bat survey did not indicate any changes were necessary to the Environmental Statement, or the assessment of effects of noise and lighting on bats submitted as part of the first Regulation 22 submission.

Great Crested Newt Survey

2.2.10 The survey included all ponds within 500m of the site boundary, and involved calculation of a Habitat Suitability Index for each pond, together with sampling and subsequent laboratory analysis of great crested newt environmental DNA (e-DNA). Ponds sampled included three which had been recently created for amphibians as part of the Solar Farm ecological mitigation works.

2.2.11 Field sampling for eDNA was undertaken by licensed ecologists in accordance with published methodology, using kits supplied by Fera, a Natural England – approved laboratory based in York. All samples were

negative, with the exception of one from a pond in the north-east of the site which was classed as 'inconclusive'. This was most likely due to contamination by leachate arising from the adjoining colliery spoil tip.

2.2.12 The results of the great crested newt survey did not indicate any changes were necessary to the conclusions of the Environmental Statement.

Breeding Bird Survey

2.2.13 The breeding bird survey revealed some significant changes to the bird fauna of the wider Bilsthorpe Business Park site, with some changes also apparent within the BEC site.

2.2.14 Lapwing, one of the interest features of the Local Wildlife Site, were not recorded during the updated survey, whereas the surveys in 2013 identified that an estimated five pairs were present. This is most likely due to construction of the Solar Farm in the south-eastern part of the colliery area.

2.2.15 Little ringed plover, which had been confirmed breeding on the BEC site in 2013, were recorded as a 'possible' breeding species in 2015, with only one individual recorded on one of the survey occasions. This may be due to the reduction in bare and sparsely vegetated habitats by natural succession. A pair of oystercatchers were present in both 2013 and 2015; in 2013 successful breeding was confirmed on the BEC site, while in 2015 they were recorded as 'probable' breeders, but with a territory extending to the south-east of the BEC site.

2.2.16 Increasing vegetation cover had allowed a pair of skylarks to colonise the BEC site and grey partridge were also recorded on one occasion in better established grassland near the southern site boundary. Over the whole of the Business Park site, a number of species had increased, including skylark, four species of warbler and song thrush.

2.2.17 As little ringed plover were present (although probably not breeding) on the BEC site, a precautionary approach would be to maintain the conservation evaluation in the Environmental Statement, and consequently retain the

requirement for mitigation. Oystercatcher should also still remain as a secondary target for mitigation measures.

2.2.18 The loss of breeding lapwing from the wider Business Park site decreases the likelihood that the wader mitigation area will be used, while supporting the suggestion in the Environmental Statement that the largest magnitude impact on this species would occur as a consequence of construction of the Solar Farm. This downgrades the significance of the cumulative impact assessment within the ES with respect to lapwing.

2.2.19 The mitigation area should still be managed to create suitable habitat for breeding lapwing, but successful re-colonisation would represent enhancement over the current baseline, rather than mitigation for cumulative impacts of the BEC and other developments

2.3 Updates to the Wader Mitigation Plan

2.3.1 The Wader Mitigation Plan has been updated to reflect the findings of the habitat survey and breeding bird survey.

2.3.2 The greater value attached to the brownfield habitat present on the BEC site compared to the previous bare ground requires greater emphasis to be given to creation of more diverse, semi-improved neutral grassland habitat. The previous plan considered habitat structure over much of the site, compared to a greater emphasis on grassland species diversity in the updated plan.

2.3.3 The updated plan increases the mitigation area to 8.35ha, extending into areas within 200m of the nearest wind turbine which would not have been considered suitable for lapwing-focussed mitigation measures. This also provides an improved field boundary configuration compared to the earlier proposal, which will facilitate grazing management of the site.

2.3.4 Mitigation measures for little ringed plover and oystercatcher remain unchanged.

2.4 Revisions to the Biodiversity Off-setting Metric

2.4.1 A revised Biodiversity Offsetting Metric has been calculated to take into account both the increased value of the BEC site, and the increased value of the proposed mitigation measures. Calculation methods and underlying assumptions remain unchanged. This is set out in Appendix 1 of the Wader Mitigation Plan.

2.4.2 The resulting metric provides a net benefit of +42.58 biodiversity units which is +32.43 units more than the benefits delivered by the previous mitigation scheme (+8.35 biodiversity units units). Over twice the area of the BEC site has now been allocated for ecological mitigation measures.

2.5 Changes to the Conclusions of the Ecological Impact Assessment

2.5.1 Most of the conclusions of the Ecological Impact Assessment (Chapter 8 of the ES Main Report) remain unchanged as a consequence of updated survey work.

2.5.2 The BEC site itself now has a higher value, and its loss would be considered to have local scale significance. However, this is offset by mitigation measures to give a net positive residual impact with respect to habitats.

2.5.3 Cumulative impacts on lapwing as a consequence of the BEC development are demonstrably not significant, as the population has been lost from the wider Business Park site in the absence of the BEC development.

2.5.4 There is a potentially greater risk of impacts on dingy skipper, although this has been addressed by additional survey work and found not to be likely to occur.

2.5.5 Attention will be required to the timing of site clearance works and measures to prevent breeding of little ringed plover during the construction phase. Such matters can be addressed and enforced through a suitably worded planning condition and / or the Construction Management Plan.

3.0 R1 RECOVERY STATUS AND CLIMATE CHANGE BENEFITS

3.1 Introduction

3.1.1 On 21 August 2015, the Applicants submitted an application to the Environment Agency for classification of the BEC as an R1 Recovery Facility on the basis of design information. The application is included as Appendix 3-1. This section of the submission explains the background to the R1 application and any implications for, or changes to, the Environmental Assessment.

3.2 R1 Application

3.2.1 As explained in Section 3.0 of the first Regulation 22 submission in July 2014, it was not possible at that time to make an R1 application. This was because there was insufficient detailed design information available. It was also because the application process, at that time, was not suitable for a gasification plant without a steam cycle. The Environment Agency changed the application process in September 2014, in order that it might be possible for an application to be made, but it was not possible to do this before the planning application was determined in November 2014 and, in any event, the detailed design information was not available at that time. Therefore, the Applicant proposed, and the Council agreed, that a planning condition should be imposed to require the plant to achieve R1 design status.

3.2.2 Following the calling-in of the application, the Applicant has been provided with the necessary detailed design information to make the R1 application. The detailed design process has led to a number of changes in the technical details of the scheme, although it is important to note that there are no changes to the external appearance of the plant, nor to the direct environmental impacts.

- A design stage application for R1 status must be based on a single design point. The selected design point is waste with a net calorific value of 12.581 MJ/kg, as the design is based on test runs with a waste with this net calorific value. The waste feed rate to the gasifier remains at 95,000 tonnes per year.

- The supplier of the gas engine has now been selected and the supplier has been able to guarantee a higher efficiency than had been anticipated originally. Hence, the plant is expected to generate 13.77 MW of power, giving a gross efficiency (based on power generated) of 28.8%, and export 9.77 NW, giving a net efficiency (based on power exported after allowing for on-site use) of 20.44%. This is an increase in the efficiency mentioned in paragraph 7.1.2 of the July 2014 Regulation 22 submission, which was 18.48%.

3.2.3 The R1 value in the application is 0.6756, which is higher than the threshold value of 0.65 and confirms that the BEC would be classified as a Recovery facility.

3.3 Climate Change Benefits

3.3.1 The increase in efficiency means that the carbon assessment presented in the second Regulation 22 submission needs to be updated. For completeness, the carbon assessment has also been carried out based on the design waste composition used for the R1 application. Since there is now more design information availiable, it has been possible to refine the carbon assessment in two ways.

- It takes into account the calculated calorific value of the different wastes and it assumes that the thermal input is constant in all cases. This means that the mass balance changes somewhat, because the calorific value of the waste is different in each case. If the net calorific value is lower than the design value, then more waste would be processed through the gasifier, and vice versa.
- On reviewing the carbon assessment in the Regulation 22 submissions, it was clear that the waste compositions from the SLR and ERM studies, after removal of recyclates, had been further adjusted by reducing the ash and moisture content before the waste was fed to the gasifer, to keep this consistent with the original carbon assessment. This had the effect, in the calculation only, of increasing the carbon content of the waste, increasing the carbon dioxide emissions and reducing the overall benefit of the proposals. We considered that this was a conservative approach in the absence of design information. However, we note that

the carbon content (% as received) in table 10.2 in the Regulation 22 submissions did not allow for this factor.

3.3.2 It has been confirmed that the gasifier will be able to operate without removing ash or water. As such the assessment has reverted to the original compositions. This means that the total carbon in the waste processed through the gasifier is lower. The figure shown as "carbon content (as received)" is now the carbon content of the waste processed through the gasifier.

3.3.3 Since the waste composition for the R1 calculation was not derived from a specific waste analysis, the original assumption that 55% of the carbon in the waste is derived from biodegradable sources has been used. The detailed analysis of the other three waste compositions continues to show that this is a reasonable assumption.

Summary of Mass Balance					
Waste Composition	SLR, Low	SLR, High	ERM	R1	Average
MRF Input, after source segregation (tpa)	106,831	110,084	114,360	117,310	112,146
Material recovered (tpa)	14,180	23,097	18,206	22,310	19,448
Gasifier throughput (tpa)	92,651	86,876	96,154	95,000	92,670
Net calorific value (MJ/kg)	12.9	13.74	12.43	12.581	12.913
Biodegradable Content by mass	62.46%	59.24%	60.72%		60.81%
Biodegradable carbon content	56.74%	54.57%	57.39%	55%	56.23%
Biodegradable energy content (NCV)	50.62%	49.67%	51.57%		50.62%
Carbon content (%as received)	34.33%	37.04%	33.03%	35.49%	34.45%
Carbon content (%dry, ash-free)	55.52%	56.10%	54.83%	51.43%	54.47%

Summary of Carbon Assessment					
Waste Composition	SLR, Low	SLR, High	ERM	R1	Average
Landfill gas releases	41,210	40,308	41,767	42,492	41,444
Transport – waste and PG outputs	141	145	150	154	147.5
Electricity offset – landfill gas	-6,273	-6,136	-6,358	-6,468	-6,309
Total Landfill Emissions	35,078	34,317	35,560	36,178	35,283
Transport – waste and PG outputs	947	1,008	1,015	1,052	1,006
Emissions offset by recycling	-6,207	-6,265	-6,814	-7,344	-6,658
Electricity offset – gasifier	-28,543	-28,543	-28,543	-28,543	-28,543
Emissions from PG	48,317	52,275	46,781	55,263	50,659
Total Facility Emissions	14,514	18,475	12,438	20,428	16,464
Net Benefit of facility	20,564	15,842	23,122	15,750	18,820

3.3.4 It can be seen that the plant is now predicted to displace between 15,800 and 23,100 tonnes of CO_2 equivalent, compared to the figures in the second Regulation 22 submission of 5,800 to 7,900 tonnes of CO_2 equivalent.

4.0 RENEWABLE ENERGY

4.1 In preparing evidence for this Inquiry, the Applicant has also noted an error in the scheme description with regard to the stated percentage of renewable energy that would be generated by the BEC. Environmental Statement (ES) Main Report paragraph 4.1.5 states that the biodegradable or biomass content of the waste *"is recognised as a renewable source of energy and as such, around 60% of the energy produced by the proposed BEC development would be classed as renewable"*. However, reference to the ES Second Regulation 22 Submission Appendix 4-1 page 3, Table 10.2, indicates that this is not correct. Table 10.2 does identify that the average biodegradable content by mass in the target waste is indeed 60.81%. However, the same table also identifies that the average biodegradable energy content is actually 50.62%. It is the actual energy content of the waste that dictates the percentage of energy generated that can be classed as renewable. Accordingly, this is 50.62% and not 60% as stated in the ES.

5.0 CONTRIBUTION TO LOCAL RENEWABLE ENERGY NEED

5.1 Introduction

5.1.1 As noted previously in this submission the Application Proposal has, since the submission of the planning application, been subject to on-going design work which largely relates to the specification and performance evaluation of the process equipment. As a result of this work it has been established that:

1) the gross electrical output from the gas engines has increased from 13.6MW to 13.77MW and the net power available for export to the electricity grid has increased from 9.6MW to 9.77MW.
2) the percentage of energy generated that can be classed as renewable is 50.62% and not 60% as stated in the ES

5.1.2 Section 3.5 of the Planning Statement submitted in support of the planning application considers the contribution that the facility would make to local renewable energy needs (assessed at a regional level). This concludes that the development of the facility would increase the currently installed capacity in the region by circa 3.67%. The assessment relies upon both the electrical output of the facility and the percentage of renewable energy generated. Furthermore, the assessment also relies upon statistical data produced by the Department of Energy and Climate Change (DECC).

5.2 Contribution to Local Renewable Energy Need

5.2.1 The figures for the electrical output of the facility and the percentage of renewable energy generated have changed and more recent statistical data has been published by DECC since the original assessment was carried out. As such, the assessment needs to be updated.

5.2.2 Electricity data for the East Midlands Region published by DECC in March 2013[2] shows the most recent total electricity consumption figures. This shows that total electricity consumption in the East Midlands was 21,113GWh.

[2] https://www.gov.uk/government/statistical-data-sets/regional-and-local-authority-electricity-consumption-statistics-2005-to-2011

5.2.3 DECC's most recent regional ReSTATs data (for the calendar year of 2013[3]) shows that the total renewables electricity generation in the East Midlands in 2013 was 2,435.0 GWh. This equates to **11.5%** of the region's consumption.

5.2.4 Looking at the ReSTATS data other facts can be established:

i) Renewables generation in the East Midlands is the fifth lowest of the nine English regions.

ii) Renewables generation in the East Midlands steadily increased from has seen a significant rise in generation between 2011 and 2013 from 1,653.3 GWh to 2,435.0 GWh. The increase appears to be almost exclusively as a result of additional generation from wind, which has almost doubled in that time.

iii) Renewables generation in the East Midlands is heavily reliant on waste (ReSTATS Data Table 2013). In 2013 the position on generation by technology type was:

- Landfill gas: 13.1% of generation;
- Sewage gas: 2.9% of generation;
- Other bioenergy (an undefined part of which is waste based): 11.9% of generation;
- Hydro: 0.51%;
- Wind: 63.7%; and
- Solar: 7.9%.

5.2.5 With regard to the figures provided above, circa 71.6% of all renewables generation in the Region is from wind and solar energy. However, all of these sources of renewable energy are intermittent in terms of the level of peak load and base load electricity demand they can provide. The role that energy from waste / biomass can play in supporting these more intermittent renewable electricity technologies is explicitly recognised in both National Policy Statement (NPS) EN-1 and in the DEFRA publication Energy from Waste: A Guide to the Debate.

- NPS EN-1 recognises that EfW can be used to generate 'dispatchable' power, providing peak load and base load electricity on demand. As

[3] *DECC ReSTATS 2013 Data table - see: https://www.gov.uk/government/statistics/regional-renewable-statistics*

more intermittent renewable electricity comes onto the UK grid, the ability of biomass and EfW to deliver predictable, controllable electricity is increasingly important in ensuring the security of UK supplies.

- The Guide to the Debate recognises that the energy EfW produces has the added advantage that it is non-intermittent and as such, it can complement other renewable energy sources such as wind or solar that is intermittent.

5.2.6 In addition to the above, it must also be recognised that whilst landfill gas current provides a further 13.1% of renewable generation, as the region's landfills age and as more waste is diverted from landfill, the levels of landfill gas that are available will decline.

5.2.7 In light of the aforementioned points, it is clear that energy from waste and biomass will play an increasingly important role as part of the renewable energy mix within the Region.

5.2.8 Based on the available DECC data, the East Midlands Region is failing in the deployment of renewables and meeting its obligations to contribute to the national renewables target of 15% by 2020. Furthermore when considered in light of the government's 'lead scenario' to achieve the 2020 target, the poor contribution of the region towards 30% of electricity from renewables is even more apparent.

5.2.9 In light of the above, any development that assists the East Midlands Region to meet its share of the national renewable energy target (which is being missed), should be afforded significant weight in terms of the benefit it brings.

5.2.10 As stated previously, the proposed BEC development would generate 13.77MW of electricity. Of the electricity generated, it has been assumed that 50.62% would be classed as renewable. This would equate to 6.97MW of the electricity generated by the BEC. Based upon 7,600 hours of generation per annum, the facility would generate 52,972MWh/yr (52.97GWh/yr) 'net' of renewable electricity. This would increase the current installed capacity in the region by circa **2.18%.**

5.2.11 Whilst the contribution that the proposed BEC development would make to increasing renewable electricity production in the region is less than the original assessment, it is still a considerable benefit of the scheme and will contribute towards local (and national) renewable energy targets.

6.0 SUMMARY AND CONCLUSIONS

6.1 Summary

6.1.1 In November 2013 Peel Environmental Management (UK) Ltd and Bilsthorpe Waste Ltd (the applicants) submitted a planning application, reference 3/13/01767/CMW, to Nottinghamshire County Council (NCC) for the development of Bilsthorpe Energy Centre, a combined Materials Recovery Facility and Plasma Gasification Facility, on land at Bilsthorpe Business Park, Eakring Road, Bilsthorpe, Nottinghamshire.

6.1.2 In July 2014 and August 2014 the applicants provided submissions under Regulation 22 of The Town and Country Planning (Environmental Impact Assessment) Regulations 2011 to NCC that contained additional information on the potential environmental effects of the proposed BEC development.

6.1.3 This 'third' Regulation 22 Submission has been made voluntarily by the Applicants (Peel Environmental management UK Ltd – PEMUKL and Bilsthorpe Waste Ltd – BWL), in respect of the above application. It specifically seeks to provide further and other information in relation to updated ecology surveys and revised technical / facility design information which informed an application to the Environment Agency for classification of the BEC as an R1 Recovery Facility.

6.1.4 The further / other information does not identify any additional environmental impacts and does not alter the conclusions presented within the ES.

6.2 Conclusion

6.2.1 It remains the case and the view of the applicants that the proposed BEC development would provide a sustainable waste management solution for the management of residual Commercial and Industrial waste arising in Nottinghamshire and the surrounding area. The project would also assist in diverting the waste from landfill, provide a source of renewable energy (and potentially heat) and create local job opportunities.

Appendix 2-1

Bilsthorpe Energy Centre Habitat Survey – 2015 Update (September 2015)

Bilsthorpe Energy Centre

Habitat survey – 2015 update

Submission under Regulation 22
Town and Country Planning (Environmental Impact Assessment) Regulations 2011

Prepared for Axis PED

Kevin Honour MSc MCIEEM

Version 1.2 / Ref. 14-019

09/09/2015

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Bilsthorpe Energy Centre

Habitat survey – 2015 update

Report Reference	Ref. 14-019
Date	09/09/2015
Date of survey/s	

Issue	Prepared by	Checked by	Approved by	Status	Date
V1	Kevin Honour MSc MCIEEM	Dr Caroline Hiller MCIEEM	Paul Lupton MSc	Choose an item.	09/09/2015

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This report has been prepared in accordance with CIEEM's Guidelines for Ecological Report Writing.

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Contents

1 Introduction

This document provides an update to the Extended Phase 1 Habitat Survey of the Bilsthorpe Energy Centre (BEC) site and proposed wader mitigation area, previously undertaken in 2013 to inform the Environmental Impact Assessment of the proposed BEC facility. It has been prepared to form part of a voluntary submission under Regulation 22 of the Town and Country Planning (Environmental Impact Assessment) Regulations 2011; it is designed to inform the Secretary of State's decision under Section 77 of the Town and Country Planning Act 1990 (as amended).

The update is necessary to properly account for natural successional changes to the Energy Centre site, which had been cleared of vegetation in 2013 as a consequence of recent coal recovery operations and storage of red shale. It was noted by early 2015 that much of the site had been re-colonised by vegetation, with potential implications for evaluation of the site's ecological interest, and calculation of the Biodiversity Offsetting Metric. Any changes to the latter had further implications for the area of mitigation required to achieve no net loss of biodiversity interest; the area of habitat survey was therefore extended to the proposed mitigation area to the north of the proposed BEC facility.

In addition, a survey of land to the east of the site in 2014 to inform a proposed coal recovery operation (AESL Ltd., 2014) located lesser centaury (*Centaurium pulchellum*), a plant species which is rare in Nottinghamshire, being more common further south. The survey checked for presence on site, as well as in the area where it was reported in 2014.

This report describes survey scope and methodology; provides a summary description, survey plan, and detailed 'target notes' of vegetation; and provides a revised evaluation of ecological interest, including a re-calculated biodiversity value to apply to the Biodiversity Offsetting Metric. The metric value has been re-calculated in the revised Wader Mitigation Plan, which also forms part of the Regulation 22 submission.

2 Scope and methodology

2.1 Scope of survey

The geographic scope of survey included the proposed BEC site, and adjacent areas to the east which had previously been mapped as bare ground, following disturbance from coal recovery works. The proposed mitigation area was also surveyed.

The ecological scope was limited to mapping of Phase 1 habitats and component species, with incidental recording of fauna such as birds and butterflies. An assessment was made of the continued suitability of the mitigation area to support the mitigation aims, and its capacity to support a greater level of ecological enhancement which may be necessary to achieve offsetting targets.

2.2 Methodology

The habitat survey followed Phase 1 methodology (JNCC, 1993) for classification of habitats. Locations of habitat boundaries were mapped using a Topcon GMS Pro differential GPS / Glonass receiver, providing sub-metre positional accuracy.

The site was visited on 7th August 2015, within the optimum May – August period for recording the maximum number of vascular plant species in a vegetation survey. A further checking survey was carried out following a site visit on 25th August 2015, in order to provide a further field check of the draft habitat map, and search for presence of lesser centaury (*Centaurium pulchellum*) on site.

Weather conditions during the surveys are summarised below:

Table 2.1: Weather conditions

Date	Times	Temperature	Weather
07/08/15	0945 - 1607	22 – 25^{0}C	Sunny and dry, CC 3/8; light E wind, F1-2.
25/08/15	1600 - 1700	17^{0}C	Cloudy with sunny intervals, rain towards end of survey; CC 6/8 – 8/8, wind SW F3-4.

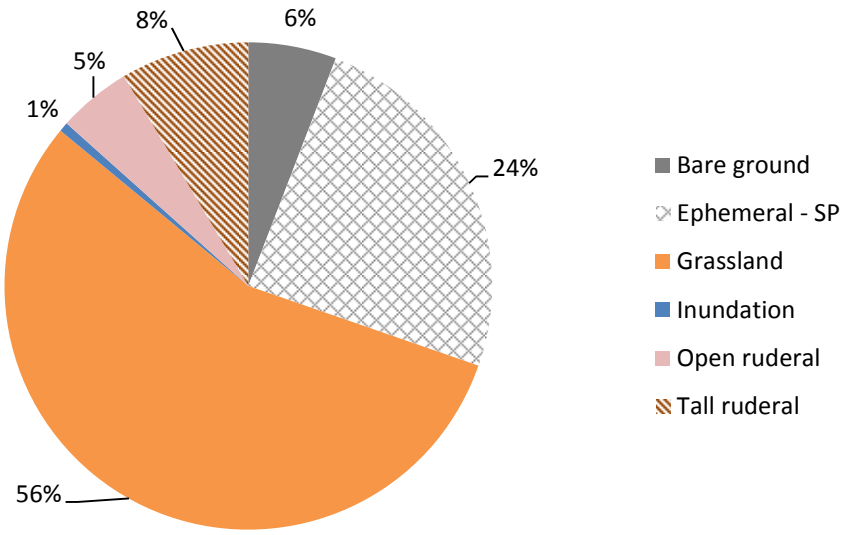
3 Habitats and vegetation

3.1 Proposed BEC facility

Habitats present on site

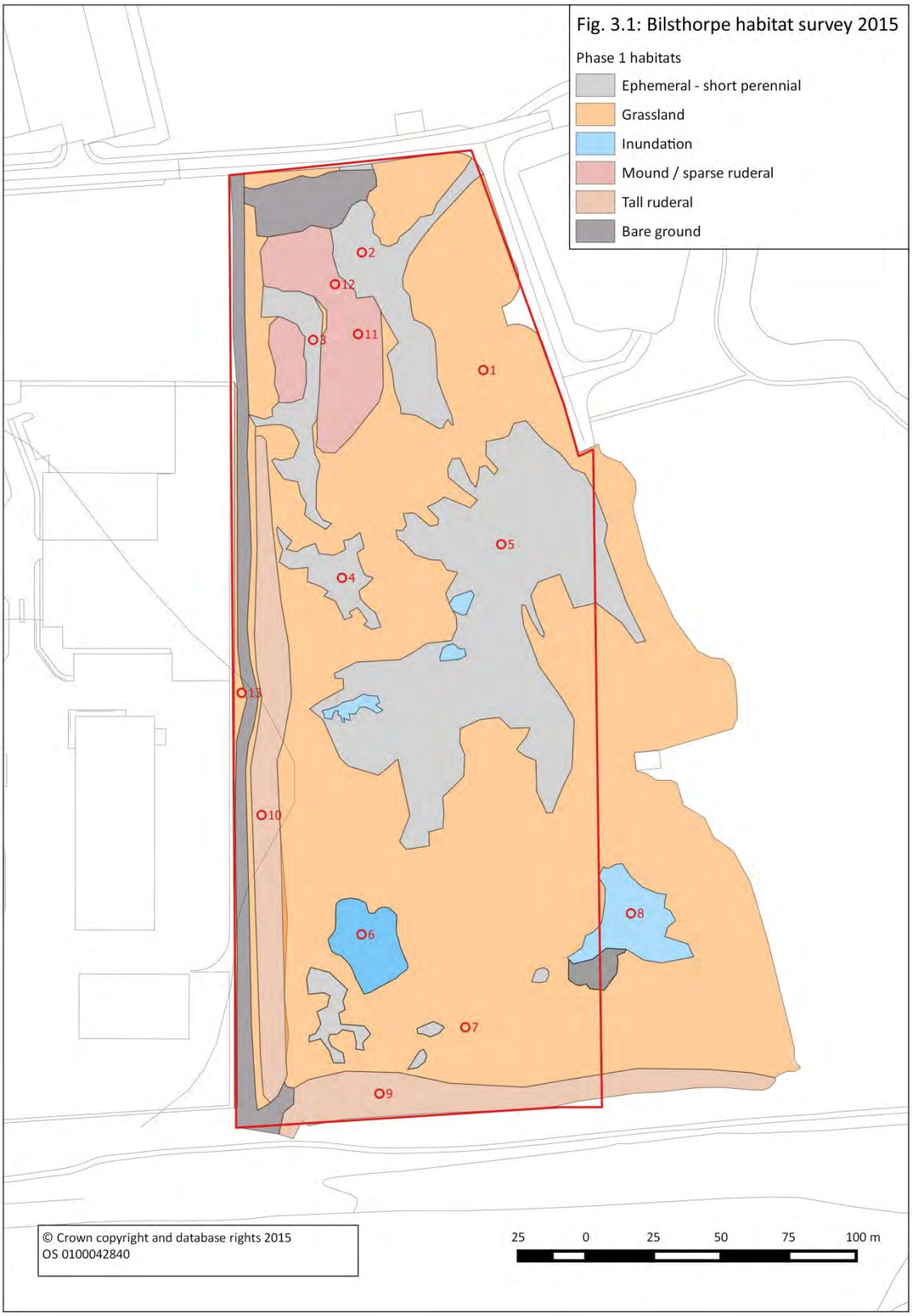
The following chart summarises the area of different component habitats present within the proposed BEC site. The spatial disposition of habitats is shown on Figure 3.2 overleaf; further details of species composition and relative abundance are given in the target notes in Appendix 1.

Chart 3.1: Habitats present within site



This shows that grassland has established over the majority of the site over a period of not much more than two years since it was cleared. Much of this still retains a relatively open structure (e.g. target note 1) with creeping bent (*Agrostis stolonifera*) the most abundant grass species, and associated species including legumes (including bird's-foot trefoil, *Lotus corniculatus*) and ruderal (disturbed-ground) species such as bristly ox-tongue (*Helminthotheca echioides*). The south-western part of the site (note 7) supports a taller and better established sward composed of Yorkshire fog (*Holcus lanatus*) and tufted hair-grass (*Deschampsia cespitosa*) overtopped by tall umbellifers such as hemlock (*Conium maculatum*).

There are several more sparsely-vegetated areas of varying size within the site, which support ephemeral – short perennial vegetation. Species include abundant annual beard-grass (*Polypogon monspelianus*), with a lower cover of a similar suite of species found in the more established grassland areas.



The persistence of areas of shorter, sparser vegetative cover appears to correlate with areas where the surface substrate comprises patches of exposed colliery spoil and red shale. Some of the exposed colliery spoil areas are dominated by salt-tolerant species such as annual beard-grass, lesser sea-spurrey (*Spergularia marina*)

and spear-leaved orache (*Atriplex prostrata*). High soluble salts contents are frequently encountered in colliery spoils; areas of elevated chloride levels were previously found in a study of spoil at Bilsthorpe (Billings, 1987).

Smaller patches of bare ground within the site are associated with periodically inundated areas, where there are localised areas of compacted or otherwise poorly permeable surface soils. These held water earlier in the year, but by the August survey all were dry apart from a very small (<1m^2) area, leaving cracked mud. There were very limited areas of marginal vegetation, including species such as jointed rush (*Juncus articulatus*).

Other areas which remain bare include an unsurfaced track running down the western boundary of the site, and an area in the north-west is being regularly disturbed for access to the northern toe of the red shale tips. It is understood this material is being used for cycle track construction on the dismantled rail line. These are also consequently sparsely vegetated in places, although the sides are becoming colonised with a sparse cover of tall ruderal vegetation, and part of the top now supports a dense cover of tall ruderal species such as false oat-grass (*Arrhenatherum elatius*) and spear thistle (*Cirsium vulgare*).

In contrast to the above, low linear bunds located on the southern periphery adjacent to the former rail line, and near the western periphery of the site support a dense cover of tall ruderal species. This includes a large population of bastard cabbage (*Rapistrum rugosum*) on the western bund, and hemlock (*Conium maculatum*) on the southern bund. This is indicative of high nutrient supply, most likely due to the use of topsoil to form the bunds.

Habitats outside site

Pond to south

Water levels in the linear pond to the south of the site were relatively low in August 2015, producing a drawdown area of exposed mud. This had been extensively colonised by New Zealand swamp stonecrop (*Crassula helmsii*), an invasive species listed on Schedule 9 of the Wildlife and Countryside Act 1981.

Grassland to east – lesser centaury area

A small and scattered population of lesser centaury (*Centaurium pulchellum*) was located in an area of established grassland to the east of the site, around 75m east of

the site boundary. This appears to be the location referred to in the ecological appraisal of the proposed coal recovery operation (AESL Ltd., 2015).

3.2 Proposed mitigation area

The proposed mitigation area to the north of the site still supports improved grassland vegetation, as reported in previous habitat surveys. Species composition varies between flat ground in the south of the area and the adjacent slope which were previously disturbed by coal recovery operations, and more elevated areas to the north which were undisturbed and previously grazed.

The southernmost areas still only support a ca. 80-90% cover, with a high percentage of the sward composed of creeping bent, which is likely to have arisen by natural colonisation rather than sowing of agricultural species. Bird's-foot trefoil is present with white clover (*Trifolium repens*) in the understorey, and there are also small populations of species of open habitats such as common centaury.

The slope to the north is better established with a closed sward, and has a higher proportion of species indicative of agricultural improvement (or deliberate sowing at restoration) such as ryegrass, while retaining species of open habitats such as bristly ox-tongue.

The open, elevated area at the top of the slope supported ungrazed agricultural grassland at the time of survey, with common bent, with cattle grazing confined to the north-facing slope following the re-location of the former boundary fence northwards. The area described above now forms part of a single field unit 8.35ha in area, with a stone cattle trough located at the south-eastern corner.

The location of target notes (13-15) from the proposed mitigation area, and extent of the single grassland enclosure are shown in Figure 3.2 overleaf.

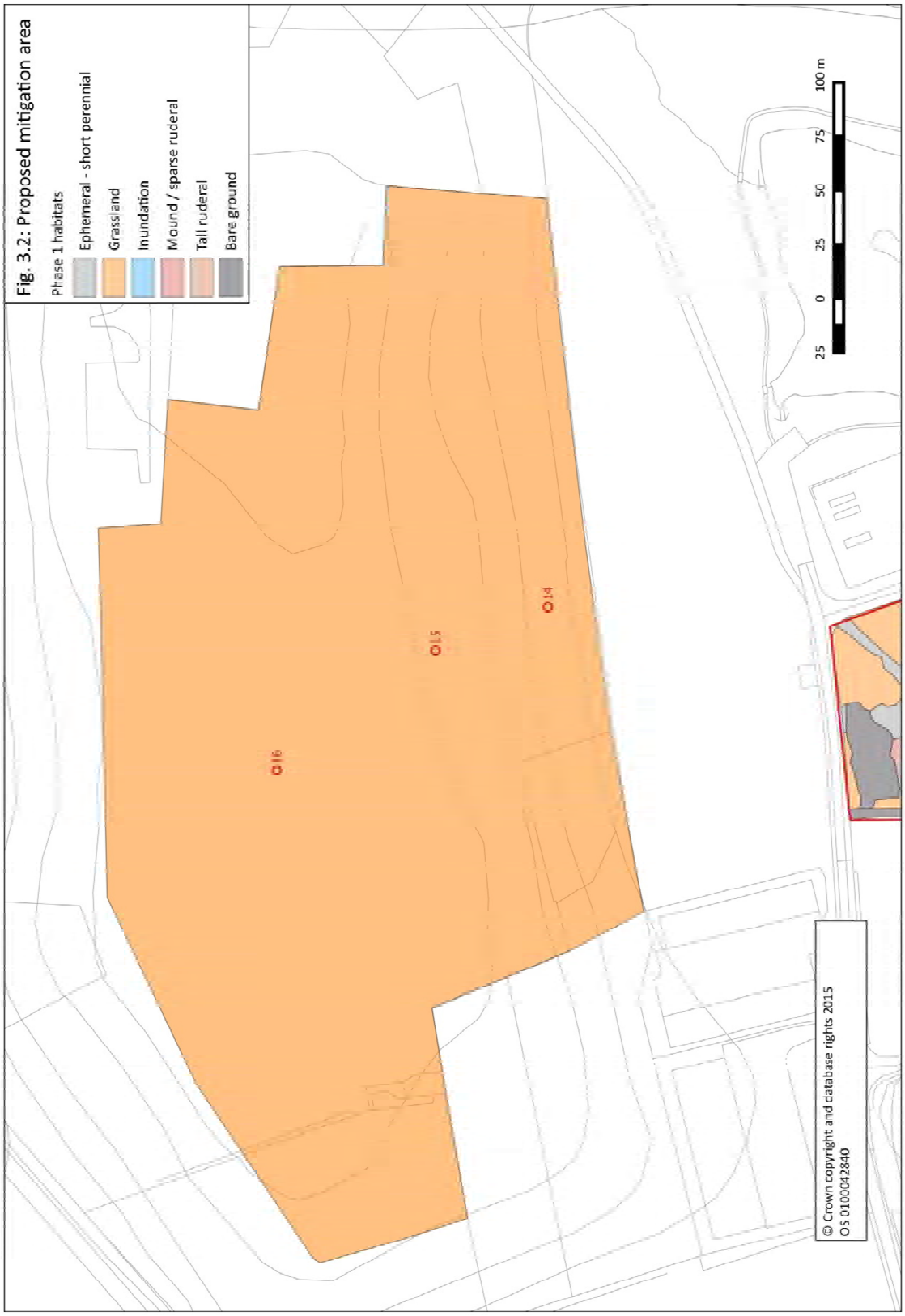


Fig. 3.2: Proposed mitigation area
Phase 1 habitats
Ephemeral - short perennial
Grassland
Inundation
Mound / sparse ruderal
Tall ruderal
Bare ground
100 m
75
50
25
0
25
I4
I5
I6
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OS 0100042840

4 Revised evaluation of ecological interest

4.1 BEC facility

Open mosaic (brownfield) priority habitat

The combination of grassland, ephemeral – short perennial vegetation and periodically inundated areas could now be classified as 'open mosaic habitat on previously developed land' Priority Habitat, the brownfield site priority habitat, listed on Section 41 of the Natural Environment and Rural Communities Act 2006.

Criteria for identification of open mosaic habitat have been defined in a 2010 revision of *UK Priority Habitat Descriptions* (BRIG, 2010). To qualify as open mosaic habitat all of the following features must be present:

Table 4.1: Criteria for definition of open mosaic habitat

	Criterion
1	The area of open mosaic habitat is at least 0.25 ha in size.
2	Known history of disturbance at the site or evidence that soil has been removed or severely modified by previous use(s) of the site. Extraneous materials/substrates such as industrial spoil may have been added.
3	The site contains some vegetation. This will comprise early successional communities consisting mainly of stress-tolerant species (e.g. indicative of low nutrient status or drought). Early successional communities are composed of (a) annuals, or (b) mosses/liverworts, or (c) lichens, or (d) ruderals, or (e) inundation species, or (f) open grassland, or (g) flower-rich grassland, or (h) heathland.
4	The site contains unvegetated, loose bare substrate and pools may be present.
5	The site shows spatial variation, forming a mosaic of one or more of the early successional communities (a)–(h) above (criterion 3) plus bare substrate, within 0.25 ha.

The site includes all of these features at present, and therefore qualifies as the priority habitat. However, most of the site is lacking in a key feature of this habitat, which is the presence of edaphic (soil) conditions which limit natural successional processes. The habitat description states:

"*These are generally primary successions, and as such unusual in the British landscape, especially the lowlands. The vegetation can have similarities to early/pioneer communities (particularly grasslands) on more 'natural' substrates but, due to the edaphic conditions, the habitat can often persist (remaining relatively*

stable) for decades without active management (intervention). Stands of vegetation commonly comprise small patches and may vary over relatively small areas, reflecting small-scale variation in substrate and topography."

Over 55% of the site's area now supports grassland habitat, representing a rapid change over two years. In the absence of further disturbance, there would therefore be few constraints on natural succession continuing, and most of the site becoming vegetated with a relatively species-poor tall grassland habitat. There are edaphic constraints in the form of ephemeral areas with an inferred high soil chloride content, and compacted areas with periodically inundated bare ground.

The areas supporting salt-tolerant vegetation may continue to support a sparser vegetation cover in the short term, but leaching of soluble salts is likely, allowing denser grassland vegetation to establish. The elevated salt levels will have arisen by fresh exposure of previously buried spoil which now occupies a flat landform; this contrasts with situations where leaching out of salts from the sides of colliery spoil mounds causes localised accumulations of high levels and restricts plant growth over a much longer timescale.

Priority species

The potential of the site to support dingy skipper butterfly has increased since 2013 due to the establishment of bird's-foot trefoil in a relatively open matrix of associated vegetation. The potential presence of dingy skipper was investigated in the Dingy Skipper Survey report.

Habitat quality for little ringed plover has declined since 2013, due to the reduction in the area of bare loose substrates; although the main patch of ephemeral – short perennial vegetation is of sufficient size at 0.72ha in area, the cover of annual beard-grass, creeping bent and lesser sea-spurrey is mostly >50%. Even this area represents sub-optimal habitat, as investigated in the Breeding Bird Survey report.

4.2 Proposed mitigation area

The proposed mitigation area is currently of low value for nature conservation, with limited species diversity in the grassland habitat. Agricultural improvement is more limited in the southern part of the site where the site has been restored, which has a significant potential for creating a more diverse sward, as well as habitat for little ringed plover and dingy skipper. Findings are consistent with the 2013 survey, with

the main difference relating to the lack of summer grazing on top of the slope and change in field boundaries.

4.3 Biodiversity Offsetting Metric

Revised calculation of Biodiversity Units

It is necessary to revise the valuation of the site in terms of Biodiversity Units which was previously provided in Table 8.9 of the Environmental Statement. This previously valued the site at 8.7 biodiversity units (8.35 net value after taking into account on-site habitat creation). In particular, if it accepted that at the time of assessment the site has characteristics of open mosaic habitat, then the 'habitat distinctiveness' category rises to 'high', in accordance with DEFRA criteria (DEFRA, 2012, Appendix 1). However, the 'habitat condition' category remains 'poor', as the majority of the site is clearly reverting to what is likely to become rank and species-poor grassland over a relatively short timescale.

The incorporation of an improved value for the baseline condition of the site in accordance with DEFRA (2012) guidance produces the following table:

Table 4.2: Calculation of revised site biodiversity value

Factor	Assessment	Value or weighting
Habitat distinctiveness	High	3
Habitat condition	Poor	1
Biodiversity units / ha	(Matrix in Figure 4 of DEFRA (2012) guidance)	6
Area of site	-	4.35ha
Total Biodiversity Units	(units/ha) x (area of site)	**26.1**

Note that the future baseline in the absence of development of the site much of this is likely to decline through natural succession to a tall grassland community typical of ungrazed sites. This would be allocated to a 'medium' distinctiveness value according to the criteria in Appendix 1 of DEFRA (2012), giving a value of 4 units / hectare, and a site value of **17.4**.

5 Conclusions

The updated habitat survey has shown a relatively rapid successional change, with grassland becoming established over the majority of the site, and a dense cover of tall herbs colonising more fertile soils of peripheral bunds.

Based on the known ecological affinities of species present on site, the main brake on continued rapid change is in the inferred high soluble salt content of some areas of exposed surface spoil material. In the absence of further intervention, even these areas are likely to re-vegetate over the next few years, as edaphic constraints are due to recent exposure of previously buried spoil, and surface concentrations of chloride and other salts can be expected to reduce through leaching processes.

Despite the above caveats, the site does currently support open mosaic habitat, which endows it with a higher overall biodiversity value than it had in 2013 (although habitat quality for a key species, little ringed plover, has declined). A precautionary approach has been taken to calculation of the Biodiversity Offsetting Metric, and the higher 'open mosaic habitat' value derived here is used in developing enhanced mitigation measures in the revised Wader Mitigation Plan.

6 References

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Appendix 1 Habitat survey target notes

(a) Proposed BEC site

1 Neutral grassland

Main area of relatively sparse grassland, cover ca. 80% with bare patches and a limited understorey.

Grasses include dominant creeping bent (*Agrostis stolonifera*), occasional tufted hair-grass (*Deschampsia cespitosa*) and Yorkshire fog (*Holcus lanatus*), with rare annual beard-grass (*Polypogon monspelianus*) and rough meadow-grass (*Poa trivialis*).

Herbs include abundant black medick (*Medicago lupulina*); locally abundant tall melilot (*Melilotus altissimus*); frequent bristly ox-tongue (*Helminthotheca echioides*), lesser trefoil (*Trifolium dubium*), bird's-foot trefoil (*Lotus corniculatus*) and scentless mayweed (*Tripleurospermum inodorum*); locally frequent ribwort plantain (*Plantago lanceolata*); occasional curled dock (*Rumex crispus*), colt's-foot (*Tussilago farfara*), spear thistle (*Cirsium vulgare*), hoary willowherb (*Epilobium parvifolium*) and red clover (*Trifolium pratense*); rare creeping thistle (*Cirsium arvense*), ragwort (*Senecio jacobaea*), great willowherb (*Epilobium hirsutum*), and great mullein (*Verbascum thapsus*).

Eastern margins adjacent to road support a few low goat willow (*Salix caprea*) and grey sallow (*Salix cinerea*) saplings.

Butterflies included frequent common blue (*Polyommatus icarus*) and painted lady (*Vanessa cardui*). Two skylark (*Alauda arvensis*) were recorded within this part of the site.

2 Ephemeral – short perennial

Very sparsely vegetated area with ca. 20% cover.

Grasses include frequent annual beard-grass and creeping bent. Herbs include frequent bristly ox-tongue; locally frequent black medick, lesser trefoil and great plantain (*Plantago major*); occasional scentless mayweed, bird's-foot trefoil, and common orache (*Atriplex patula*); rare bastard cabbage (*Rapistrum rugosum*) and weld (*Reseda luteola*).

3 Ephemeral – short perennial

Relatively sparsely vegetated area with ca. 50% cover on the west of the site, bounded by red shale mounds.

Grasses include abundant annual beard-grass, frequent creeping bent, and rare Yorkshire fog.

Herbs include frequent bristly ox-tongue and lesser trefoil; occasional scentless mayweed; rare curled dock, broad-leaved dock (*Rumex obtusifolius*) and rare procumbent pearlwort (*Sagina procumbens*).

4 Ephemeral – short perennial

Area of sparse vegetation with ca. 20% cover, locally denser, elsewhere patches of bare ground on colliery spoil, red shale and subsoil substrates.

Similar species to other parts of the site, with grasses including abundant annual beard-grass. Herbs include locally abundant lesser sea-spurrey (*Spergularia marina*), occasional spear-leaved orache (*Atriplex prostrata*) and bristly ox-tongue.

Abundant sea-spurrey is indicative of possible high soluble salts levels in soil.

5 Ephemeral – short perennial

Extensive area of ephemeral – short perennial to south-east of main grassland area, generally vegetation cover >50% with bare areas. Not very species-rich, mostly dominated by a canopy of creeping bent with an understorey of abundant lesser sea-spurrey. Other species include abundant annual beard-grass; frequent bristly ox-tongue and scentless mayweed; locally frequent spear-leaved orache; and occasional tall melilot.

6 Inundation community

Seasonally flooded area, dry at the time of survey. Largely bare, cracked ground with margins dominated by creeping bent, with frequent jointed rush (*Juncus articulatus*) and annual beard-grass; locally frequent creeping buttercup (*Ranunculus repens*) and rare hard rush (*Juncus inflexus*).

7 Neutral grassland

Taller grassland to 1m height, with a few sparser patches of ephemeral – short perennial vegetation a few square metres in area. Generally closed sward with plant litter and bryophytes (*Brachythecium rutabulum*) in ground layer.

A grass canopy of frequent tufted hair-grass and abundant Yorkshire fog is overtopped by taller hemlock (*Conium maculatum*), and has an understorey of bird's-foot trefoil, tall melilot and red bartsia (*Odontites verna*). There is a transition to shorter grassland further east, with increasing cover of creeping bent, red bartsia and common centaury (*Centaurium erythraea*).

Additional species include frequent rough meadow-grass and bristly ox-tongue; occasional white clover (*Trifolium repens*), lesser trefoil, scentless mayweed and

ribwort plantain; rare mugwort (*Artemisia vulgaris*), meadow vetchling (*Lathyrus pratensis*), red clover and spear thistle.

8 Inundation community

Largely bare, cracked mud with abundant annual beard-grass and creeping bent around the margins; rare tall fescue (*Schedonorus arundinaceus*) and bulrush (*Typha latifolia*).

9 Tall ruderal vegetation

Bund along southern periphery of site, dominated by tall herbs including umbellifers and thistles, with grasses subordinate in cover; there is one small grey sallow (*Salix cinerea*) bush.

Herbs include dominant hemlock; locally abundant creeping thistle; frequent spiny sow-thistle (*Sonchus asper*) and great willowherb; locally frequent stinging nettle (*Urtica dioica*) and welted thistle (*Carduus acanthoides*); occasional scentless mayweed, bristly ox-tongue, lesser burdock (*Arctium minus*), hoary willowherb, square-stalked willowherb (*Epilobium tetragonum*) and ragwort; rare tufted vetch (*Vicia cracca*) and weld.

Grasses include frequent common couch (*Elytrigia repens*) and tufted hair-grass; locally frequent common reed (*Phragmites australis*) and rough meadow-grass; occasional cock's-foot (*Dactylis glomerata*); rare timothy (*Phleum pratense*) and false oat-grass (*Arrhenatherum elatius*).

Butterflies recorded include gatekeeper (*Pyronia tithonus*).

10 Tall ruderal vegetation

Bund parallel with western periphery of site, supporting tall herb-dominated vegetation.

Herbs include abundant bastard cabbage, bristly ox-tongue, creeping thistle, spear thistle, and hemlock; frequent ragwort, welted thistle, and curled dock; occasional mugwort, square-stalked willowherb, scentless mayweed and weld; rare yarrow (*Achillea millefolium*), tufted vetch and teasel (*Dipsacus fullonum*).

11 Tall ruderal vegetation / bare ground(red shale mounds)

Smaller, western mound largely bare, with scattered buddleia (*Buddleia davidii*) and weld starting to colonise. The larger eastern mound supports tall ruderal vegetation on top, with sparser ruderals colonising the sides; the northern face is bare due to recent removal of red shale.

Grasses include abundant false oat-grass; frequent Yorkshire fog; occasional creeping bent and colt's-foot.

Herbs include dominant spear thistle; abundant ragwort and creeping thistle; frequent bristly ox-tongue, hairy tare (*Vicia hirsuta*), smooth sow-thistle (*Sonchus oleraceus*) and bastard cabbage; occasional scentless mayweed; and rare great lettuce (*Lactuca virosa*).

12 Ephemeral / tall ruderal / bare ground

More sparsely vegetated northern part of shale mound.

Grasses include occasional creeping bent; occasional rough meadow-grass; rare tufted hair-grass and common bent (*Agrostis capillaris*).

Herbs include frequent bristly ox-tongue, smooth sow-thistle, black medick and lesser trefoil; occasional broad-leaved dock, weld, scentless mayweed, common mouse-ear (*Cerastium fontanum*) and great mullein; rare stinging nettle, welted thistle and smooth hawk's-beard (*Crepis capillaris*).

13 Neutral grassland

Narrow fringe of grassland along western fenceline adjacent to Council depot, 1-2m wide, supporting moderately diverse grassland with associated herbs.

Grasses include abundant creeping bent; frequent Yorkshire fog, cock's-foot and couch.

Herbs include frequent bristly ox-tongue, creeping thistle, spear thistle, tall melilot, great willowherb, and bird's-foot trefoil; occasional upright hedge-parsley (*Torilis japonica*), red bartsia, curled dock, bush vetch, ribwort plantain, common cat's-ear (*Hypochaeris radicata*) and great lettuce.

(b) <u>Proposed mitigation area</u>

14 Semi-improved neutral grassland

Southern part of field unit on flat ground at base of slope, area previously restored after coal recovery. Still only 80-90% vegetative cover, grasses comprise creeping bent, tufted hair-grass and ryegrass (*Lolium perenne*), with an understorey of bird's-foot trefoil, white clover (*Trifolium repens*) and occasional / rare common centaury.

15 Improved grassland

The slope supports a largely closed sward with much more abundant ryegrass over a white clover understorey, characteristic of improved grassland. The area retains vegetation characteristic of more disturbed parts of the site, with abundant creeping bent, locally abundant rough meadow-grass and frequent Yorkshire fog. Scattered herbs include rare tall melilot, common mouse-ear, ribwort plantain, common centaury, bristly ox-tongue and ribwort plantain.

16 Improved grassland

Area at top of slope ungrazed at the time of survey, supporting a herb-poor sward with abundant common bent, frequent Yorkshire fog and ryegrass.

Appendix 2-2

Bilsthorpe Energy Centre Bat Activity Survey – 2015 Update (September 2015)

Bilsthorpe Energy Centre

Bat survey – 2015 update

Submission under Regulation 22
Town and Country Planning (Environmental Impact Assessment) Regulations 2011

Prepared for Axis PED

Paul Lupton MSc
Version 1 / Ref. 14-019
01/09/2015

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Bilsthorpe Energy Centre

Bat survey – 2015 update

Report Reference	Ref. 14-019
Date	01/09/2015
Date of survey/s	May – August 2015

Issue	Prepared by	Checked by	Approved by	Status	Date
V1	Paul Lupton MSc	Dr Caroline Hiller MCIEEM	Kevin Honour MSc MCIEEM	FINAL	01/09/2015

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This report has been prepared in accordance with CIEEM's Guidelines for Ecological Report Writing.

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Summary

This document provides an update to a bat survey carried in 2012 on the Bilsthorpe Business Park site, and provides additional information focussed on the area around the proposed Bilsthorpe Energy Centre (BEC) facility. It describes survey scope and methodology, provides a summary description and survey plans, and provides a revised evaluation of ecological interest with respect to use by bats.

Several methods were used to update the information regarding bats on the proposed BEC site. These were emergence surveys of the brick structure close to the site, transect surveys, and a fixed point automated survey of the waterbody close to the southern site boundary.

A number of bat species were found to be utilising habitats close to the site, the majority of which were common pipistrelle *(Pipistrellus pipistrellus).* Much smaller numbers of soprano pipistrelle *(Pipistrellus pygmaeus)*, Daubenton's bat *(Myotis daubentonii)* and noctule *(Nyctalus noctula)* were detected, though none of these were observed foraging or roosting on the proposed site footprint. The single structure to the east of the site that has any roosting potential was observed on each survey occasion; no bats were seen to emerge from the building.

The surveys verified that the assessment of bat status within the ES still applies with bat species using peripheral habitats for foraging but with no bat activity in or around the site itself. Surveys confirm the proposed development would have a negligible impact on bats, and the mitigation measures within the ES remain adequate in addressing potential lighting and noise impacts.

Contents

1 Introduction

This document provides a bat activity and emergence survey of the proposed Bilsthorpe Energy Centre (BEC) site and surrounding habitats. It has been prepared to form part of a voluntary submission under Regulation 22 of the Town and Country Planning (Environmental Impact Assessment) Regulations 2011; it is designed to inform the Secretary of State's decision under Section 77 of the Town and Country Planning Act 1990 (as amended).

A bat activity survey was previously undertaken in 2012 of Bilsthorpe Business Park and former colliery tip. It had been undertaken by AESL Ltd. to assess potential impacts of the recently constructed Solar Farm, but provided adequate baseline data to inform the Environmental Impact Assessment of the proposed BEC facility in 2013. Given the age of the baseline data, it was thought necessary to update this survey, and focus more on the area around the proposed BEC site, including habitats which the EIA had predicted would have a higher level of bat activity such as wetlands.

The report describes survey scope and methodology, provides a summary description, survey plan, and provides a revised evaluation of ecological interest with respect of the use of the site by bats.

2 Scope and methodology

2.1 Scope

The surveys were intended to update and review the assessment of the value of the site for bats. The main aims were;

- To assess the status of the site with regard to its ability to support a bat roost.
- To assess levels of bat activity around and across the development site with regard to the relative importance of the site for foraging and commuting bats.
- To assess the impact of the proposed development on the observed bat populations.
- To assess the water bodies close to the site as to their importance for foraging bats.

2.2 Methodology

Data search

A request was made to Nottinghamshire Biological and Geological Records Centre (NBGRC) in August 2015 for updated bat records in a study area of 2km around the site.

Site surveys

An initial walkover survey of the site was undertaken in order to investigate the potential of the site and surrounding area to support bats. A single brick pump house building was inspected to identify potential access points for bats; this building is about 15m to the east of the development plot boundary.

A programme of evening emergence surveys and transect surveys were carried out at the site in accordance with current guidelines (Hundt, 2012). The development footprint must be regarded as being a low risk site lacking any roosting structures and with foraging opportunities likely to be limited by the large areas of sparse vegetation.

For the evening survey from 15 minutes prior to sunset a surveyor equipped with a bat detector, watched the pump house building so that any emerging bats could be detected. Any bats observed were to be counted and the species, time and location of detected bats were to be noted, as was their direction of flight.

Transect surveys were carried out on three occasions. A Pettersson D240X linked to an Edirol recorder was used by the lead surveyor. Output is recorded as a single two-channel WAV file, with heterodyne signals recorded on one channel and time-expanded signals on the other. This was checked and bat calls were isolated and split, using Audacity v.1.2.6 digital audio

editor, into smaller segments containing time expanded recordings for analysis using BatSound to produce sonograms and frequency spectra.

Automated detection was carried out using an ecoObs Batcorder 2.0. This is a real-time recorder with a 16-150kHz sensitivity, writing 500kHz, 16-bit RAW files to an SDHC card. Factory default settings were used for quality, threshold (-27dB), posttrigger (400ms interval between calls) and critical frequency (16kHz lowest frequency). The standard threshold value gives a recording range of at least 10m from the device. The Batcorder was placed on an Opticron tripod set just over 2m above ground level, and set to record from sunset to sunrise.

The RAW files recorded by the Batcorder were analysed using the programs bcAdmin, batIdent and bcAnalyze. BcAdmin identifies the number of bat calls in each RAW file; batIdent carries out a statistical analysis of the calls to identify species, using Random Forest and support vector machine algorithms to classify the calls and estimate the probability of correct identification. Calls are compared to a reference database of European bat calls; this can lead to misidentification, with previous Batcorder surveys erroneously suggesting presence of non-UK species such as pond bat (*Myotis dasyphyllus*) at lower probability levels. Application of ecological judgement is therefore required in the interpretation of results, while the decision tree produced by the program can be helpful. A threshold of 90% or 95% probability can also be applied before accepting an additional species record.

BcAdmin also produces nocturnal activity graphs, ID graphs showing the identity of species recorded through the night with probability levels, and summary tables of species ranked by total length of recorded calls. Sonograms and frequency spectra were produced to check and verify individual calls using bcAnalyze.

2.3 Personnel

Bat activity surveys were led by Paul Lupton and Dr Caroline Hillier, Paul is a director with Argus Ecology Ltd; he holds Natural England roost survey license (CLS 01672) and has many years' of experience in carrying out bat surveys and licensing. Dr Caroline Hillier is senior ecologist at Argus Ecology Ltd. and is a Natural England licensed bat worker (CLS 02396) with over 6 years' experience in carrying out bat surveys and bat risk assessments. David Thornborrow and Elizabeth Thompson functioned as field assistants and surveyors. David holds Natural England survey and bat roost visitor's licences. Elizabeth is an experienced bat worker and has undertaken bat surveys for Argus Ecology for several years.

2.4 Survey dates and conditions

Table 2.1: Survey dates and times

Date	Sunset	Start Time	Finish Time	Surveyors
27/05/15	21.13	21.00	23.20	CH & PL
09/06/15	21.34	21.16	23.30	CH & DT
12/08/15	20.38	20.05	22.40	CH & ET

Table 2.2: Weather conditions

Date	Start Temp (^{o}C)	Finish Temp (^{o}C)	Wind speed / Direction	Cloud Cover (%)	Precipitation (mm)
27/05/15	13	12	B3-westerly	40	0
09/06/15	10	9	B1 – north easterly	50	0
12/08/15	22	15	B1 - easterly	5	0

3 Results

3.1 Data search

Three species of bats were provided by the NBGRC desk study, as being recorded within 2km of the Site. These were:

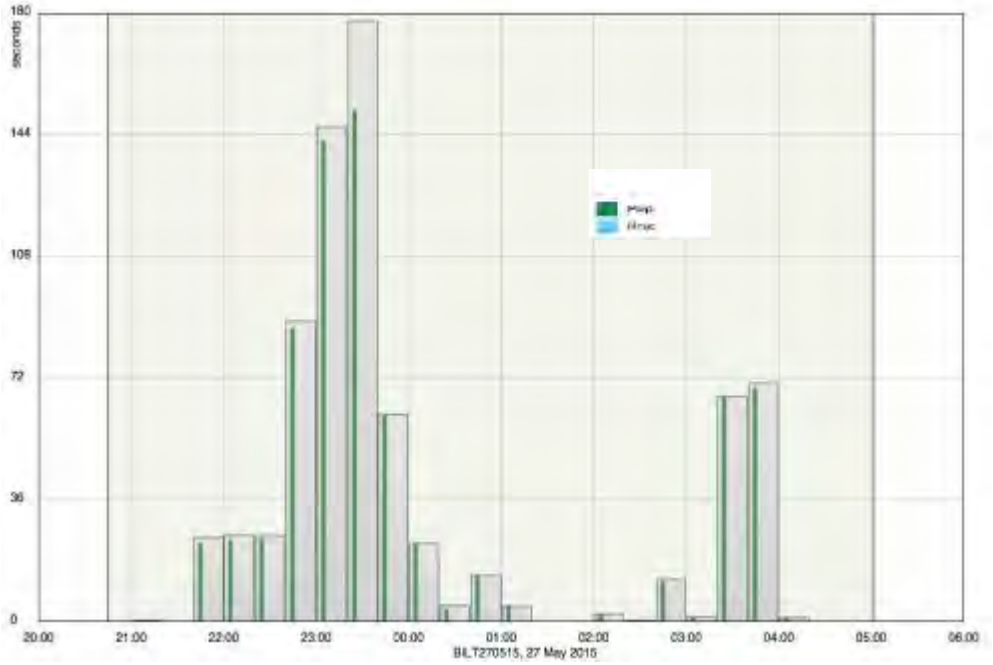
- Brown long-eared (*Plecotus auritus*): 2km to the west of the Site in 2004; 1.6km to the north in 2004; 1.9km to the north-east in 2009.
- Common pipistrelle (*Pipistrellus pipistrellus*): 2km to the west of the Site in 2005; 1.5km to the north in 2009; 1.8km to the south-east in 2010
- Noctule (*Nyctalus noctula*): 1800m to the south-east of the Site in 2010.

In addition, bat surveys undertaken in 2012 by AESL Ltd. to inform the Solar Farm development indicated that common pipistrelle were recorded foraging over plantation woodland around 0.4km to the south of the development site.

3.2 Automated detector results

The batcorder was employed on the first survey occasion with the specific objective of monitoring the level of bat activity across the southern pond (pond D). Its position is shown in Drawing 4. The detector was set to run from 20.00 until 05.30. The first bat detected was a common pipistrelle at 20.41 and the last bat was at 04.02, also a common pipistrelle. In total there were 721 registrations, which is a relatively high number for this type of survey. The higher than average number within this survey was not surprising given the large numbers of insects coming off the pond and the relatively sheltered position of the area being sampled. Night-time activity is shown in Figure 3.1 overleaf.

Fig 3.1: Night-time bat activity 27th – 28th May 2015



The majority of registrations were common pipistrelle (721) with much smaller numbers (4) of soprano pipistrelles (*Pipistrellus pygmaeus*) and noctules (2). It must be noted that 721 pipistrelle registrations on the detector will not translate into 721 bats. Each registration represents a bat 'pass'. Single foraging bats can therefore produce multiple registrations. The figure therefore should be interpreted as significant foraging activity by a number of common pipistrelle bats with confirmation of the presence across the eastern end of the pond of the other two species.

Sample sonograms of common pipistrelle and noctule are given below.

Fig. 3.2: Common pipistrelle sonogram - Batcorder

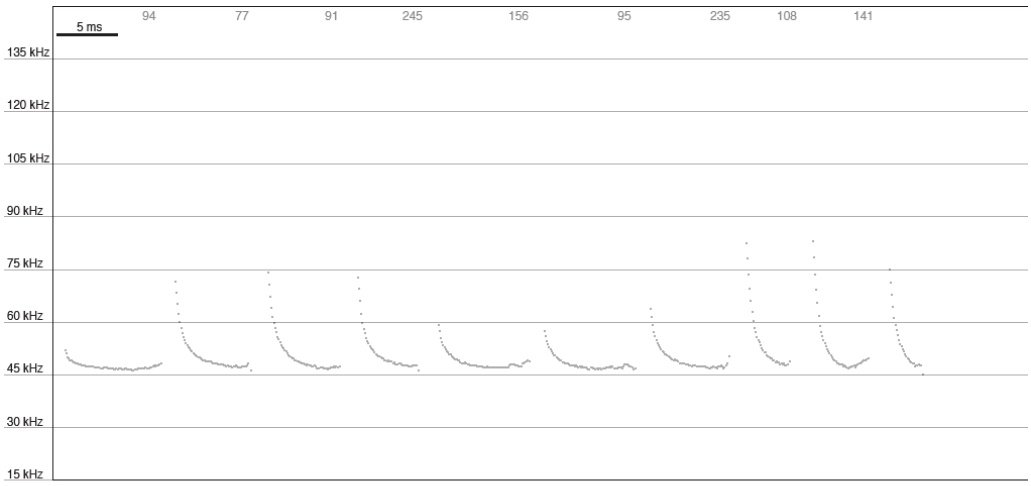
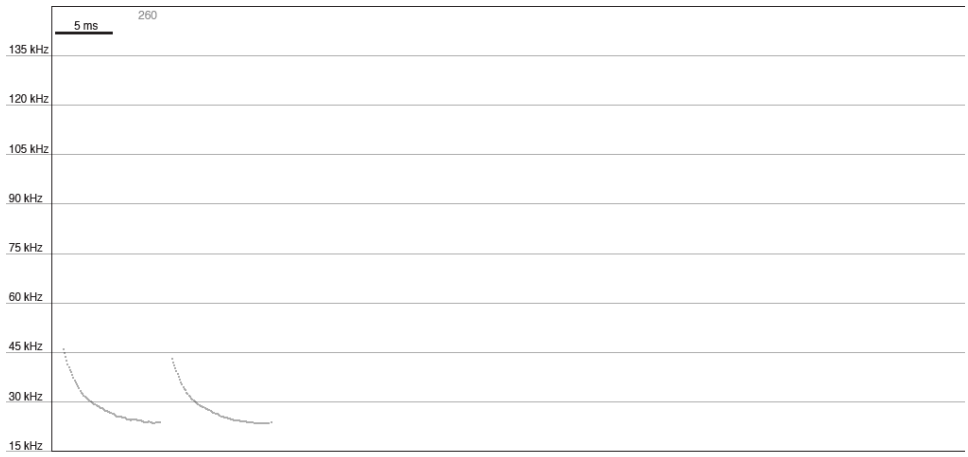


Fig. 3.3: Noctule sonogram - Batcorder



3.3 Transect results

Transect 1 – May 2015

The first bat detected was a commuting common pipistrelle at 21.36, 23 minutes after sunset. It should be noted that this was the only bat in any of the transects that was seen flying directly over the site from west to east. From 21.55 a minimum of five common pipistrelles were seen to be foraging over pond A and in the scrubby woodland surrounding it. At 21.55 pipistrelles were detected flying over the woodland along the eastern boundary of the site and between 22.09 and 22.11 multiple common pipistrelles were observed feeding over pond D along its length. The bats appeared to be entering the study area from the west. As well as feeding activity, social calls and movement of bats were detected which appeared to be along the whole length of pond D. This is consistent with static detector data from the Batcorder.

Both ponds continued to be the focus of bat activity throughout the survey and at 22.38 *Myotis* species (later identified through sonogram analysis as Daubenton's bats *(Myotis daubenonii)*) were seen feeding over pond D. Common pipistrelle activity continued until the end of the survey at 23.20. The results are summarised for this transect in Drawing 1.

Fig. 3.4: Common pipistrelle sonogram (transect recording)

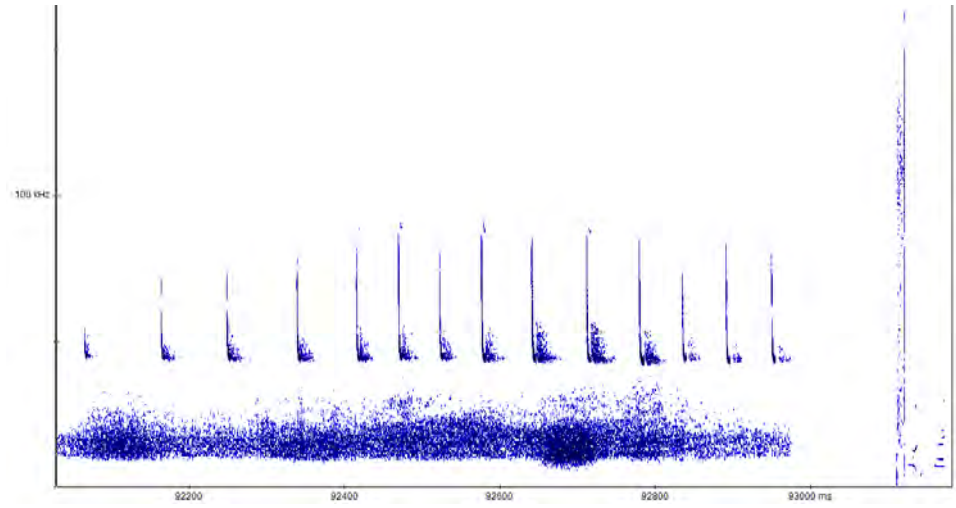


Fig. 3.5: Daubenton's bat sonogram (transect recording)

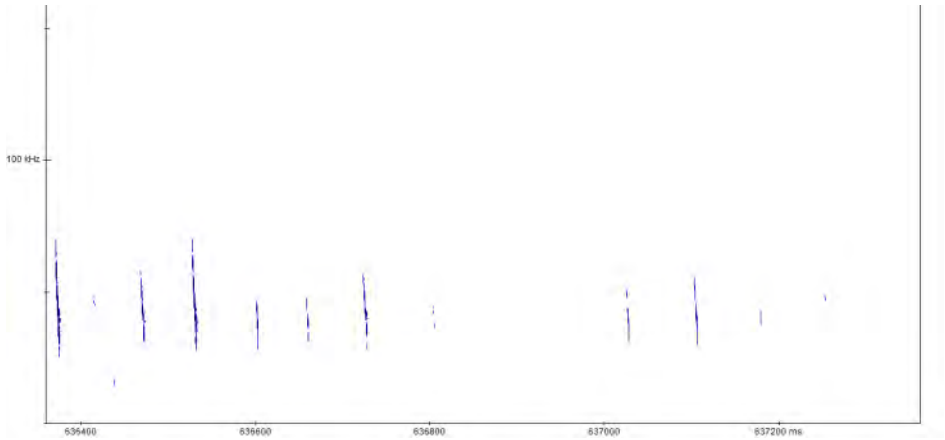
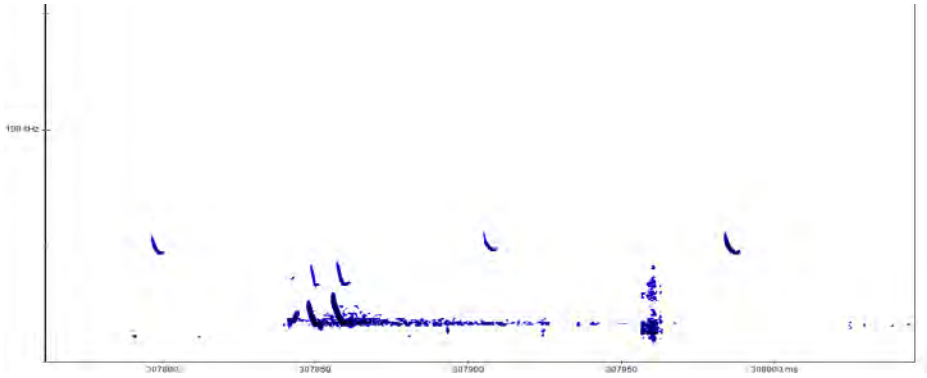


Fig. 3.6: Common pipistrelle social calls



Transect 2 – June 2015

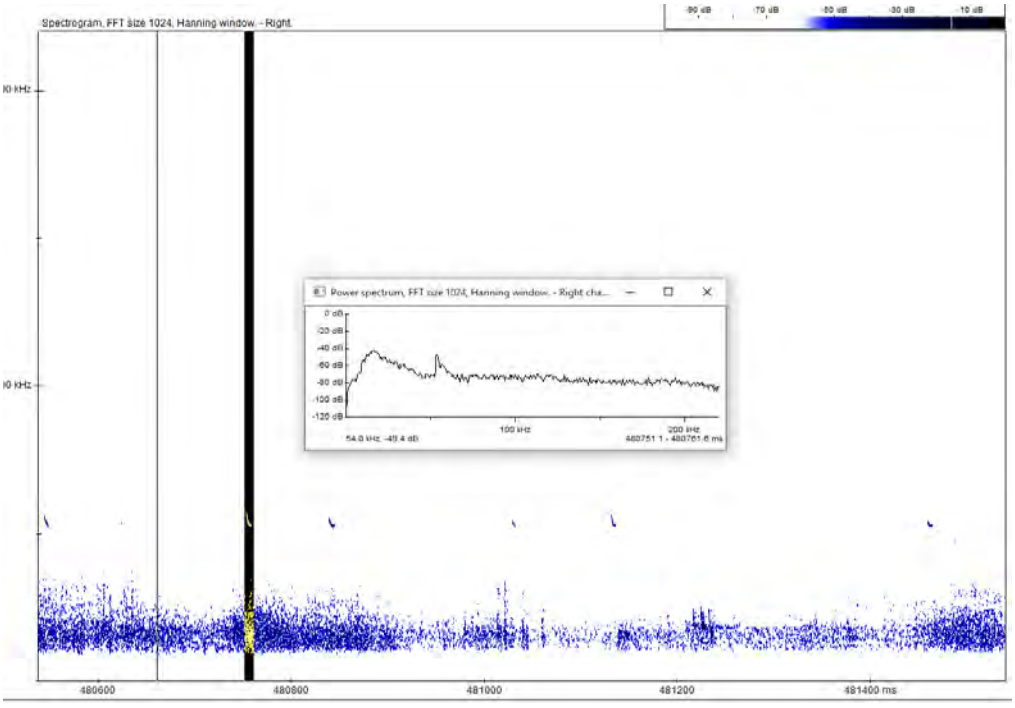
The transect commenced at the western side of pond A and the first bats were detected close to the pond at 22.01, 27 minutes after sunset. Within the next five minutes they were joined by several more pipistrelles and at 22.05 a noctule was detected though not seen. Common

pipistrelles were feeding over pond D and there were social calls and feeding 'buzzes' detected over the pond on each circuit of the transect. At 23.17 Daubenton's bats were detected over pond D and intense pipistrelle feeding activity continued over both water bodies until the end of the survey at 23.30. Other than over the two ponds there was no evidence of bat activity elsewhere on the transect route. Drawing 2 summarises the results of the survey.

Transect 3 – August 2015

The August survey followed the same pattern as the earlier surveys with ponds A and D showing the greatest degrees of bat activity. There were two significant differences on this survey occasion. Firstly, soprano pipistrelles were detected around the site around pond A at 21.42 then again at 21.48. The second significant change was a number of common pipistrelle were seen feeding close to the lights of the Council depot (along the western site boundary). Neither of the previous transect surveys had found any bat activity in this part of the site. Drawing 3 summarises the results of the surveys.

Fig. 3.7: Soprano pipistrelle sonogram and frequency spectrum



3.4 Emergence survey

There is only one structure close to the site that has some potential for roosting bats. This is an isolated, brick pump-house in the middle of an area of sparsely vegetated ground around 15m east of the development footprint. The building has a concrete roof and would be impervious to bats had had it not been for deliberate damage to the brickwork forming large holes in the structure.

One surveyor watched this structure from sunset until 40mins after sunset (on each survey occasion) to identify any bats that were exiting the building. No bats were seen using the building in any of the surveys.

4 Ecological impact assessment and mitigation strategy

The Ecology chapter in the Environmental Statement identified the likely use of water-bodies and woodland edges by foraging bats, while noting the proposed BEC site itself provided few opportunities. The ES stated *"They (bats) should be considered as interest features for purposes of impact assessment (i.e. control of light spillage) and potential enhancement (i.e. creation of new foraging habitat)".* An earlier Regulation 22 submission (Argus Ecology, 2014) considered potential impacts on bats of noise and lighting both in the construction phase of the development and the operational phase.

The surveys carried out in 2015 have confirmed bat usage associated with woodland edge and wetland habitat features, while also confirming that the proposed BEC site does not have any potential for roosting bats and limited potential for foraging bats.

The 2015 surveys therefore confirmed the key premises of the ES and assessment of noise / lighting impacts, and as such confirms the impact assessment and mitigation strategy can be regarded as being current to the status of bats in and around the site.

5 Conclusions

Most of the bat activity (drawing 4) detected during the survey programme was common pipistrelle activity associated with the fishing pond to the north of the site (pond A) and the linear pond to the south (pond D). The Batcorder registered a large number of bat passes and these were mostly common pipistrelles with a small number of noctule and soprano pipistrelles also being recorded. Placement of this remote device was at the eastern end of the southern pond with the microphone pointing out over the water body. Based on cross-referencing of transect observations with automated recordings, it can be concluded that the large number of registrations include multiple passes by single bats feeding across the pond. The presence of high common pipistrelle activity on the southern pond was confirmed in subsequent transect surveys, which also found *Myotis* species feeding at the western extent of the pond. Through sonogram analysis these were identified as Daubenton's bats. Bats were seen to be approaching this pond to feed from the west of the site along the disused railway corridor; there was no observations or recordings of bats crossing the proposed development site to access the pond.

The fishing pond to the north east of the site (pond A) also had a large number of common pipistrelles feeding across the water body and in the woodland and scrub that surrounds the pond. It was not possible to discover the precise direction of movement in order to access the pond though it is likely that it was from the south east through the young plantation.

In the course of the transects one observer watched the brick structure close to the development site boundary. No bats were seen to emerge from any of the holes that had been punched into the brickwork or indeed any other cracks and crevices in the structure. There are no other possible roosts on site and although vegetation has become more complex since the early surveys on the site, it still offers limited foraging opportunities.

Large parts of the site appeared to be largely bat free with little bat activity along the eastern boundary or indeed along the northern boundary and the main body of the development footprint. In the course of the final transect survey a small number of common pipistrelle bats were seen feeding around the lighting columns on the council depot site; this demonstrates that for this species, the development is not likely to create significant negative lighting impacts.

The surveys confirmed that the assessment of bat status within the ES still applies with bat species using peripheral habitats for foraging but with no bat activity in or around the site itself. It can therefore be anticipated that the development will create a negligible impact on bats, and the proposed mitigation strategy is adequate.

6 References

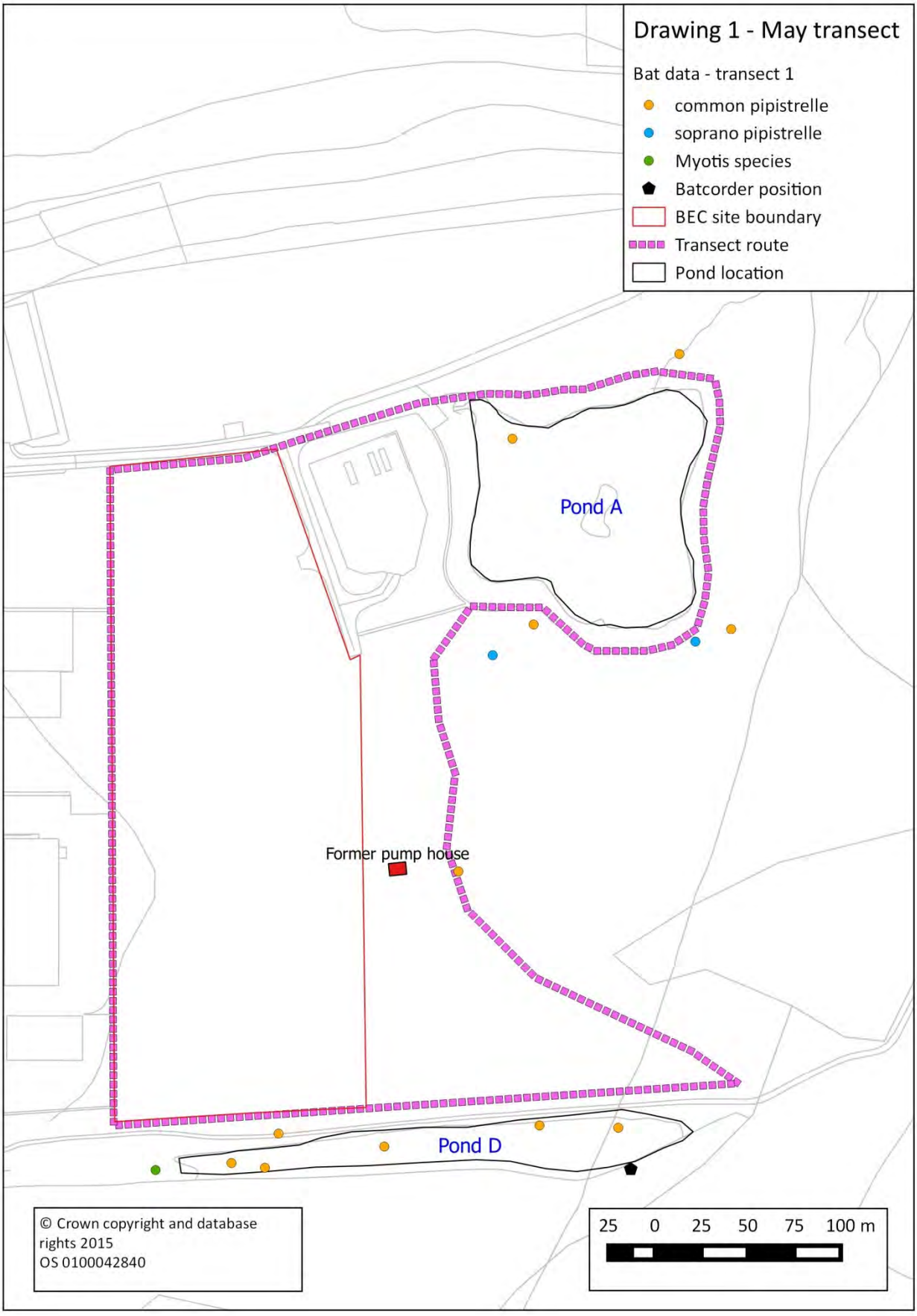
Argus Ecology (2014) *Proposed Energy Centre Bilsthorpe Business Park, Nottinghamshire Addendum report: impacts of noise and light on bat foraging.* Report prepared for Peel Environmental Management UK Ltd.

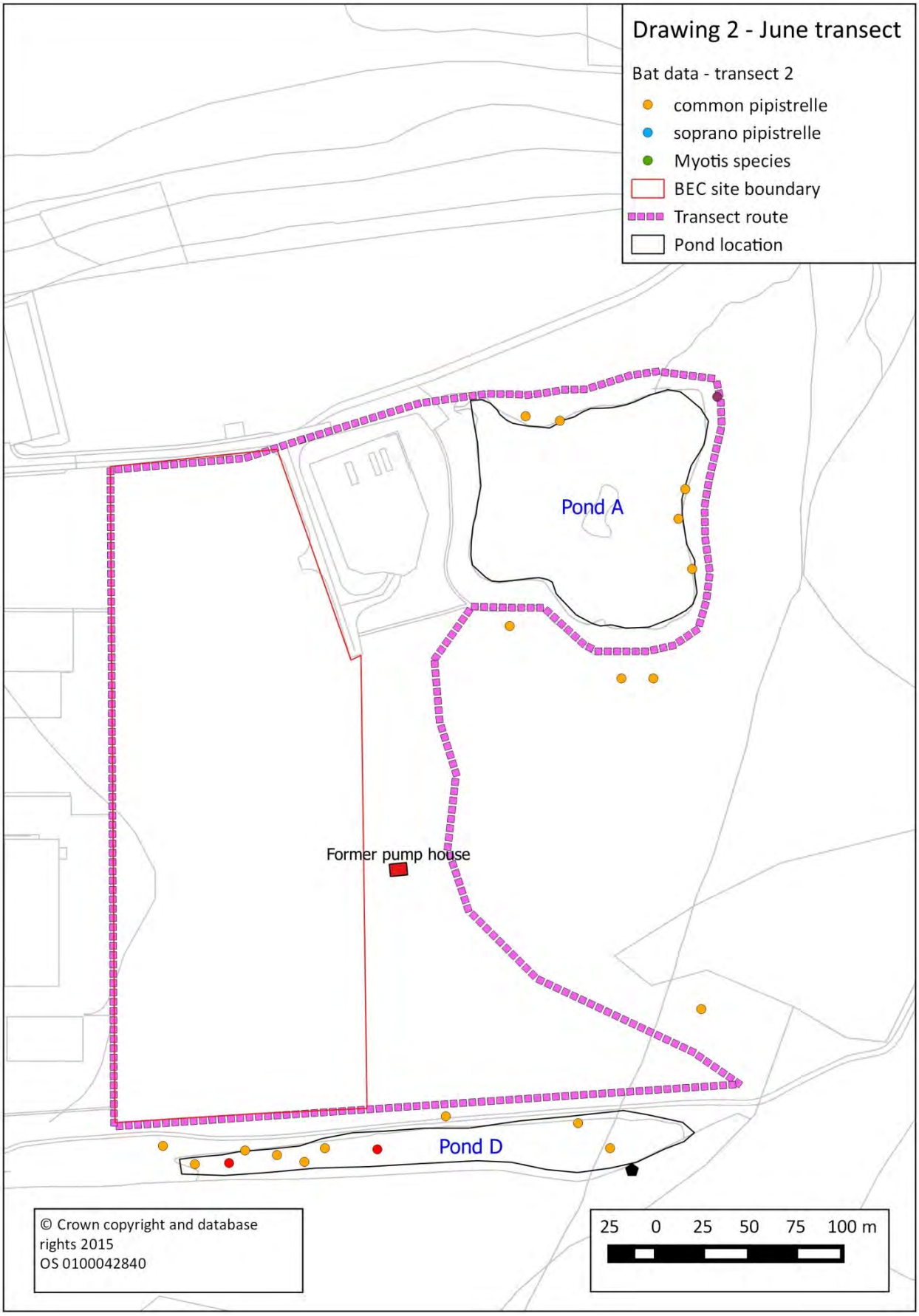
AESL Ltd. (2012) *Bilsthorpe Extended Phase 1 Habitat Survey (Proposed Solar Farm)*. On behalf of Re-Fin Solar (Bilsthorpe) Limited.

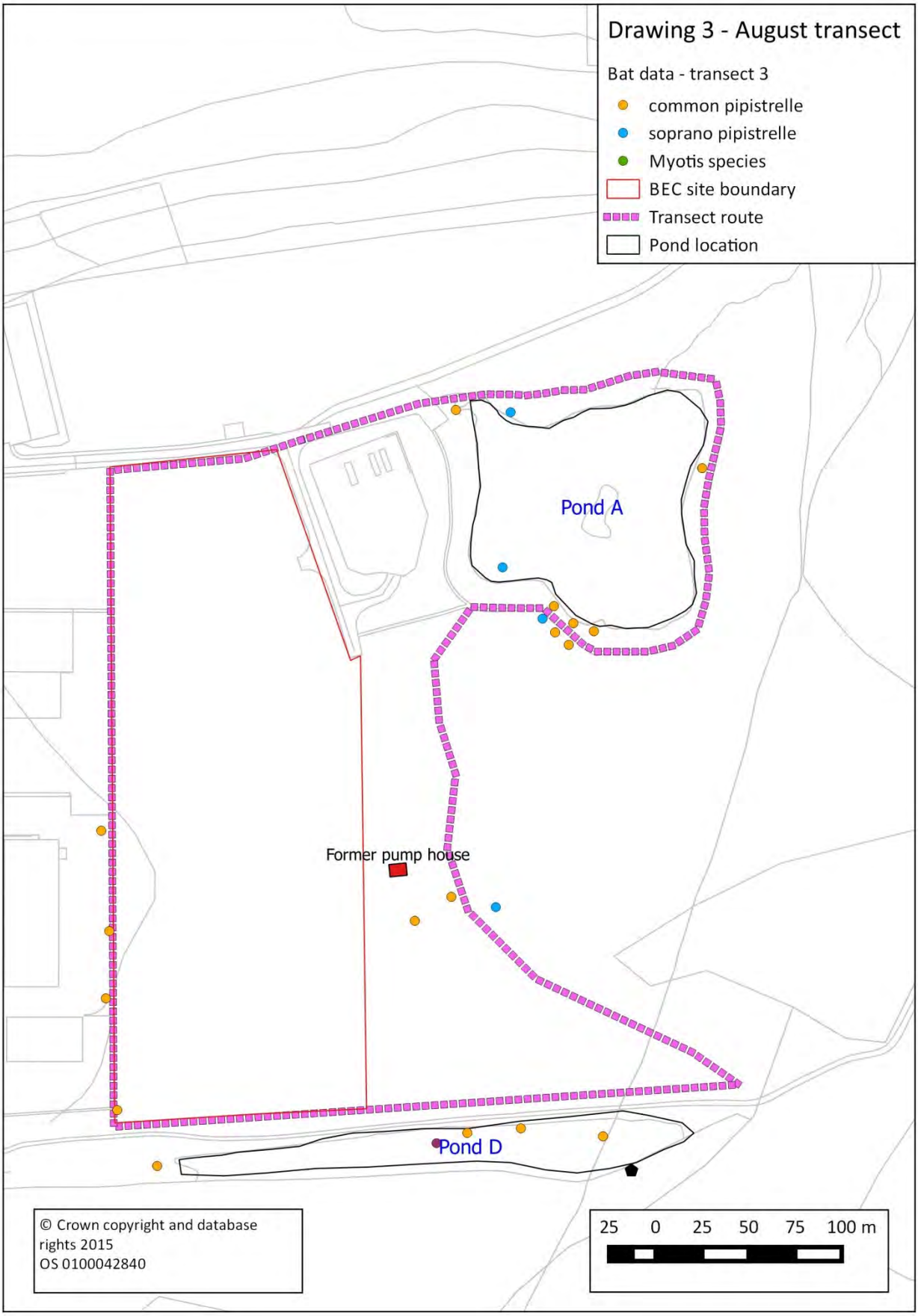
Hundt, L. (2012) *Bat Surveys: Good Practice Guidelines*, 2nd edition, Bat Conservation Trust

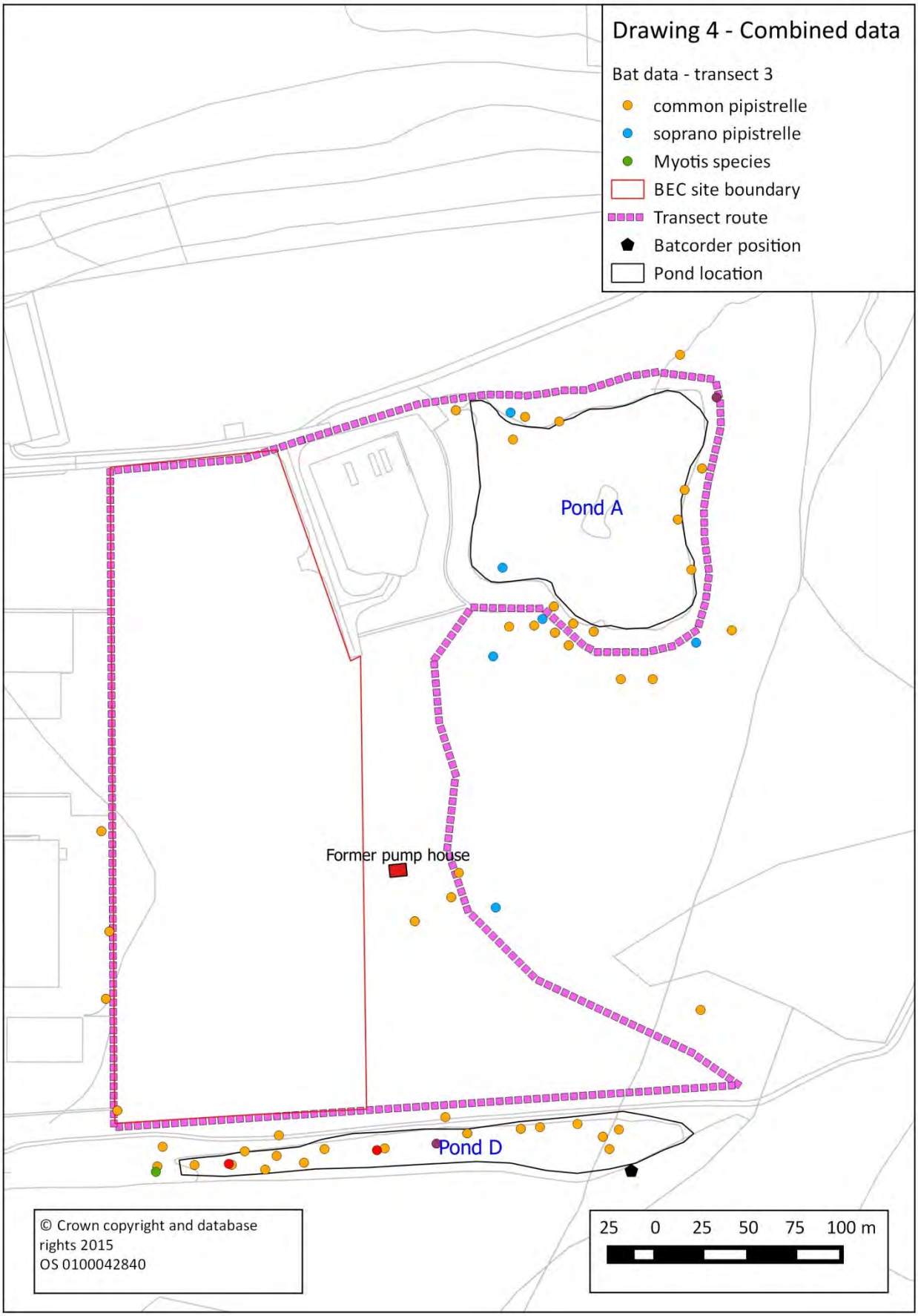
Mitchell-Jones, A.J. (2004). *Bat Mitigation Guidelines*, English Nature

Appendix 1 Site drawings




Drawing 2 - June transect
Bat data - transect 2
common pipistrelle
soprano pipistrelle
Myotis species
BEC site boundary
Transect route
Pond location
Pond A
Former pump house
Pond D
© Crown copyright and database rights 2015
OS 0100042840
25 0 25 50 75 100 m


Drawing 3 - August transect
Bat data - transect 3
common pipistrelle
soprano pipistrelle
Myotis species
BEC site boundary
Transect route
Pond location
Pond A
Former pump house
Pond D
© Crown copyright and database rights 2015
OS 0100042840
25 0 25 50 75 100 m


Drawing 4 - Combined data
Bat data - transect 3
common pipistrelle
soprano pipistrelle
Myotis species
BEC site boundary
Transect route
Batcorder position
Pond location
Pond A
Former pump house
Pond D
© Crown copyright and database rights 2015
OS 0100042840
25 0 25 50 75 100 m

Appendix 2-3

Bilsthorpe Energy Centre Great Crested Newt Risk Assessment (July 2015)

Bilsthorpe Energy Centre
Great Crested Newt Risk Assessment

Submission under Regulation 22
Town and Country Planning (Environmental Impact Assessment) Regulations 2011

Prepared for AXIS PED

Paul Lupton MSc
v1 / 14-019
13/07/2015

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Report Reference	14-019
Date	13/07/2015
Date of survey/s	April-May 2015

Issue	Prepared by	Checked by	Approved by	Status	Date
V1	Paul Lupton DATA PROTECTION	Claire Gilchrist MSc	Paul Lupton MSc	DRAFT	16/06/2015

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Summary

This document provides an update to the Great Crested Newt (GCN) survey of the Bilsthorpe Business Park site previously undertaken by SLR in 2012 to inform the Environmental Impact Assessment of the proposed BEC facility.

Two techniques were used to carry out risk assessments of the ponds within 500m of the proposed BEC site. Habitat suitability indices were calculated and eDNA analysis were used to verify the earlier survey work. Six ponds were investigated. These included a pond very close to the development site (within 15m), a large fishing pond to the east, and three newly created mitigation ponds that had been produced as part of the solar farm project.

Habitat suitability scores were low for three of the six ponds including the pond closest to the site boundary. The other three ponds had an average score but these were the newly created mitigation ponds which lacked any aquatic vegetation, had widely variable water levels and had a poor invertebrate community. All of these ponds plus the two ponds closest to the development site proved negative for great crested newt DNA, with a single pond returning an inconclusive result due to poor water quality.

The survey has verified the 2012 conclusion that this species is not present within 500m of the development site.

Contents

1 Introduction

1.1 Introduction

This document provides an update to the Great Crested Newt (GCN) survey of the Bilsthorpe Business Park site previously undertaken by SLR in 2012 to inform the Environmental Impact Assessment of the proposed Bilsthorpe Energy Centre (BEC) facility. It has been prepared to form part of a voluntary submission under Regulation 22 of the Town and Country Planning (Environmental Impact Assessment) Regulations 2011; it is designed to inform the Secretary of State's decision under Section 77 of the Town and Country Planning Act 1990 (as amended).

This report describes survey scope and methodology and provides a summary evaluation of the status of the site with respect to great crested newt occupancy.

1.2 Habitat description

The BEC site itself supports no suitable breeding habitat for amphibians, with ephemeral pools all dry or holding very shallow water at the time of survey. There are areas of rough grassland which may provide suitable terrestrial refuges for great crested newts and other amphibians. Other parts of the site remain sparsely vegetated and as such are of limited value to all amphibian species.

1.3 Legislative background

Great crested newt are protected under the Conservation of Habitats and Species Regulations 2010 (Schedule 2, Regulation 40(1)) and Schedule 5 of the Wildlife and Countryside Act 1981.

Where there is a risk of a development impacting upon GCN adequate survey work must be carried out and implementation of the development proposals may be subject to obtaining a Natural England European Protected Species Development Licence (issued under Regulation 53(2)(e) of the Conservation of Habitats and Species Regulations 2010).

Article 16 contains derogations from Article 12. This is transposed by Regulation 53 which allows licences to be issued under certain circumstances. The effect of these licences is to make an activity that would otherwise be an offence, lawful if carried out in accordance with the provisions of the licence.

A European Protected Species (EPS) Licence may be required for any activity which:

- Is likely to result in the deliberate capture, injury or killing of a great crested newt;
- Will result in the deliberate disturbance of newts. Disturbance of animals includes in particular any disturbance which is likely to:
  (a) Impair their ability to:
    (i) Survive, breed, reproduce, or rear or nurture their young; or
    (ii) In the case of animals of hibernating or migratory species, to hibernate or migrate; or
  (b) Affect significantly the local distribution or abundance of the species to which they belong.
- Will damage or destroy a breeding site or resting place used by great crested newts.

A licence can only be granted if the following tests can be met:

- The consented operation must be for 'preserving public health or public safety or other imperative reasons of overriding public interest including those of a social or economic nature and beneficial consequences of primary importance for the environment';
- There must be 'no satisfactory alternative'; and
- The action authorised 'will not be detrimental to the maintenance of the population of the species concerned at a favourable conservation status in their range.

2 Survey and assessment methodology

2.1 Pre-existing information of great crested newt in the area

As part of the original application, species records were received from NBGRC. The nearest great crested newt records were 0.6km SSE from the site.

Amphibian surveys were undertaken by SLR on 10 water bodies close to the site in May 2012, the closest of which (pond D) is only 15m from the site boundary. No great crested newts were recorded within any of the ponds within 500m of the site. They found small numbers of great crested newt in a mitigation pond 620m to the south of the development site. This pond and the other ponds to the south of the solar farm were not considered as part of this study as they were more than 500m away from the development site with significant barriers to movement.

2.2 Field survey methodology

Great crested newt habitat suitability index

The areas of standing water and surrounding habitats were surveyed in order to calculate their Habitat Suitability Index (HSI) score at the present time.

The HSI was developed by Oldham *et al*. (2000) and is used by Natural England as part of the evaluation system for the European protected species (EPS) licensing process. It is a scoring system based on an assessment of habitat quality. In general, ponds with a high HSI are more likely to support a great crested newt population than those with a low HSI score.

eDNA sampling

Field sampling was undertaken by licensed great crested newt surveyors with methods following those detailed in Biggs *et al* (2014).

The method detects pond occupancy from great crested newt using traces of DNA shed into the pond environment (eDNA). A single visit is made to each pond between April 15th and June 15th under suitable weather conditions (avoiding heavy rain) and water samples taken and preserved in Ethanol for later analysis in the laboratory. The detection of GCN eDNA is carried out using real time PCR to amplify part of the cytochrome 1 gene found in mitochondrial DNA.

Timing

The survey work was carried out on 28th May 2015. eDNA samples were taken first from each pond before assessing habitat suitability, in order to maintain appropriate biosecurity measures to avoid cross-contamination. Samples were kept chilled, and delivered to FERA Science Ltd. in York on 30th May 2013.

Personnel

The survey work was carried out by Paul Lupton (GCN level 1 survey licence WML CL08 number 2015-7150-CLS-CLS) and Dr Caroline Hillier (GCN level 1 survey licence WML CL08 number 2014-6607-CLS-CLS). Paul Lupton is Director and Caroline Hillier is senior ecologist at Argus Ecology Ltd. Both are very experienced amphibian surveyors holding the relevant Natural England licence. The report was compiled by Paul Lupton.

3 Results

3.1 Pond descriptions

Pond photographs are provided in Appendix 1 and position of ponds is shown on Figure 1. Ponds are named as in the SLR report though within this survey there were three newly created mitigation ponds that have been given the names K, L and M.

Pond A (Plate 1)

This is a large fishing pond approximately 77m from the development site. It appears well stocked with fish and also supports a waterfowl population. Vegetation cover is approximately 15% and there is less than 5% cover along the shoreline. Water quality appears moderate and it is a permanent water body that never dries. Terrestrial habitat around the pond is good consisting of seeded grassland with scattered trees and shrubs and there is some aquatic vegetation which includes common reed *(Phragmites*), *Potamogeton* spp., compact rush *(Juncus conglomeratus)*, greater pond sedge *(Carex riparia)*, water lily *(Nymphaeaceae spp.)* and yellow flag (*Iris pseudacorus)*. The aquatic invertebrate community appears to lack diversity though there were several species of water beetle (Coleoptera) present and a high mollusc biomass. The large pond area of around 10000 m^2 is sub optimal for GCN.

Pond D (Plate 2)

A linear pond with a very large fish population around 10-15m from the development site boundary. It has about 30% aquatic vegetation cover which includes the invasive New Zealand pygmyweed (*Crassula helmsii*). At the margins are common reed, common spike-rush *(Eleocharis palustris*) and bulrush (*Typha latifolia*) and there is a large area dominated by water crowfoot *(Ranunculus sp.)*. Marginal vegetation is well established and terrestrial habitat is good. Water quality was only moderate with large amounts of suspended solids being present in the water column due to the activity of the carp in the water. There are a small number of water fowl using the pond and there were moderate numbers and diversity of freshwater invertebrates. At the eastern and western ends of the ponds are bulrush beds and common reed (*Phragmites australis*).

Pond K (Plate 3)

This is a mitigation pond for the Solar Farm that was not present during the earlier surveys. It is of relatively recent construction, has no aquatic or marginal vegetation and is likely to be seasonally dry. No fish or fowl present and terrestrial habitat

consists of reseeded grassland and sheep grazed improved grassland with few refuge opportunities. At the time of survey the water had an area of around 500m^2. Canada geese were grazing the grassland and using the water body. There were a small number of frog tadpoles in the water.

Pond L (Plate 4)

This is a mitigation pond for the Solar Farm that was not present during the earlier surveys. Of a similar size and form as pond K it is of relatively recent construction, has no aquatic or marginal vegetation and it is shallow and consequently is likely to be seasonally dry. No fish or fowl present and terrestrial habitat consists of reseeded grassland and sheep grazed improved grassland with few refuge opportunities. At the time of survey the water had an area of around 450m^2. Canada geese were grazing the grassland and using the water body. There were a small number of frog tadpoles in the water.

Pond M (Plate 5)

The third Solar Farm mitigation pond was also not present during the earlier surveys. Larger than ponds H & I it is also of relatively recent construction, has no aquatic or marginal vegetation and it is shallow and consequently is likely to be seasonally dry. No fish or fowl present and terrestrial habitat consists of reseeded grassland and sheep grazed improved grassland with few refuge opportunities. At the time of survey the water had an area of around 1000m^2. Canada geese were grazing the grassland and using the water body.

Pond B (Plate 6)

This is a settling lagoon for water coming off the site, located 456m away from the nearest boundary of the proposed BEC site. It is an artificial feature with bank-sides consisting of cobbles. At the time of survey there was a significant leachate input from the mine waste. Within the pond there are stands of common reed and filamentous algae. There was a good invertebrate biomass, although the water quality appeared poor with probable minewater contamination. Surrounding terrestrial habitat is good and there were no signs of fish or waterfowl around the pond. Pond B is very close to a much larger water body (pond C in the SLR report) which has a very high waterfowl population and is over 514m from the development plot.

It was determined at the time of survey that pond B would be DNA tested due to its suitable size and invertebrate and aquatic vegetation content.


Fig. 1: Pond locations
BEC site boundary
Pond location
Pond A
Pond B
Pond C
Pond D
Pond K
Pond M
Pond F
Pond I
Pond 1 (GCN)
© Crown copyright and database rights 2015
OS 0100042840
50 0 50 100 150 200 m

3.2 Habitat suitability index results

Six waterbodies were assessed in the course of the current survey, the scores for each index and the resulting HSI scores are given in Table 3.1. Photographs of each pond can be found at Appendix 1.

Table 3.1: HSI calculations

	Pond reference					
Parameter	**A**	**B**	**D**	**K**	**L**	**M**
1 - Location	1	1	1	1	1	1
2 - Pond area	-	0.9	-	1	1	1
3 - Pond drying	0.9	0.9	0.9	0.5	0.5	0.5
4 - Water quality	1	0.01	0.67	0.33	0.33	0.33
5 - Shade	1	1	1	1	1	1
6 - Fowl	0.67	1	0.67	0.67	0.67	0.67
7 - Fish	0.01	0.67	0.01	1	1	1
8 – Ponds / 1km radius	0.8	0.8	0.8	0.8	0.8	0.8
9 - Terrestrial habitat	0.67	0.67	1	0.33	0.33	0.33
10 - Macrophytes	0.3	0.4	0.5	0.3	0.3	0.3
HSI	**0.46**	**0.51**	**0.49**	**0.62**	**0.62**	**0.62**

Habitat suitability scores are interpreted on a categorical scale which is given below.

Table 3.2: Categorisation of HSI scores

HSI	<0.5	0.5 – 0.59	0.6 – 0.69	0.7 – 0.79	>0.8
Pond suitability	Poor	Below average	Average	Good	Excellent
Proportion of ponds occupied	0.03	0.20	0.55	0.79	0.93

3.3 eDNA results

The laboratory results from FERA are provided in full in Appendix 2.

None of the ponds had a positive result for great crested newt DNA. One pond had an inconclusive result (pond B). The FERA notes in Appendix 2 explain this is likely to be as a result of DNA degradation due to materials in the water body. As illustrated in

photograph 6 in Appendix 1, and noted above in section 3.1, leachate from the colliery waste tip flows into this pond; this is likely to be responsible for the sample degradation reported by the laboratory.

4 Interpretation and evaluation

Habitat suitability assessment

The HSI result indicated that only ponds K, L and M provided *average* habitat suitability for great crested newt. These three ponds were newly created, and although scoring highly for size, absence of fish and lack of shade, they also lacked any aquatic vegetation (for cover and egg laying). At the time of survey they also had poor connectivity with more mature habitats.

Ponds A and D were assessed as *poor*, their size, populations of fish and waterfowl all representing significant contra-indicators to the likelihood of supporting great crested newt. Pond B was assessed as borderline between 'poor' and 'below average', with the major contra-indicator being water quality. Other factors such as vegetation cover and size were generally positive, but the leachate ingress, resulting in higher conductivity levels, is likely to be a more important factor in predicting absence. Great crested newt are generally not found in ponds with elevated conductivity levels (Williams & Biggs, 2012).

eDNA results

All ponds on site (except the 'inconclusive' pond B) were negative for the presence of eDNA. This provides a greater level of certainty than conventional methods that great crested newt are not present, while confirming that there have been no changes since the 2012 SLR survey.

Pond B is located 456m from the nearest boundary of the BEC site, and is 990m north of the landfill site mitigation pond ('Pond 1' in SLR (2012)) where one great crested newt male was recorded on a single occasion during the 2012 surveys. In the unlikely event that a population had established in this pond since 2012, the distance from the BEC site would make any impact on either individual newts or the local population unlikely. Furthermore, the reason for the 'inconclusive' result is the same reason why presence of great crested newt in this pond is unlikely, namely poor water quality.

5 Conclusions

The results of this study support the conclusions of the Environmental Statement that great crested newt are not a constraint for the development of the site. They are not present in any of the ponds present within 500m of the proposed BEC facility and most of the habitats on site offer few opportunities for foraging or hibernating amphibians.

6 References

Biggs, J., Ewald, N., Valentini, A., Gaboriaud, C., Griffiths, R.A., Foster, J., Wilkinson, J., Arnett, A., Williams, P. and Dunn, F. (2014b). *Analytical and methodological development for improved surveillance of the Great Crested Newt. Appendix 5. Technical advice note for field and laboratory sampling of great crested newt (Triturus cristatus) environmental DNA*. Freshwater Habitats Trust, Oxford.

Gent, A. H. & Gibson, S.D. (Eds.) (1998, 2003). *The Herpetofauna Workers' Manual*. Joint Nature Conservation Committee, Peterborough.

Langton, T.E.S., Beckett, C.L. & Foster, J.P. (2001).*Great Crested Newt Conservation Handbook*. Froglife. Halesworth.

SLR (2012). *Bilsthorpe Colliery Bilsthorpe, Nottinghamshire; Great Crested Newt Survey Report.*

Whitehurst, J. (2001) *Great Crested Newt Mitigation Guidelines: Version August 2001*. English Nature.

Williams, P. & Biggs, J. (2012). *Change in great crested newt Habitat Suitability Index between 1996 and 2007 assessed using lowland Countryside Survey data*. JNCC Report, No.467.

Appendix 1 Photographs

Pl 1 – Pond A; fishing lake

Pl. 2 – Pond D; linear fishing pond

Pl. 3 – Pond H; newly created water body

Pl. 4 – Pond I; newly created water body

Pl. 5 – Pond J; Newly created water body

Pl. 6 – Pond B showing leachate input

Appendix 2 FERA report

DNA ANALYSIS REPORT Commercial in Confidence

Customer:	Argus Ecology Ltd
Address:	Unit 14 The Greenhouse Greencroft Industrial Park Annfield Plain Co. Durham DH9 7XN
Contact:	**Paul Lupton**
Email:	paul@argusecology.co.uk
Tel:	07967374189
Report date:	15 June 2015
Order Number:	GCN118
Samples:	Pond Water
Analysis Requested:	Detection of Great Crested Newt eDNA from pond water.

Thank you for submitting your samples for analysis with the Fera eDNA testing service. The details of the analysis are as follows:

Method:
The method detects pond occupancy from great crested newts (GCN) using traces of DNA shed into the pond environment (eDNA). The detection of GCN eDNA is carried out using real time PCR to amplify part of the cytochrome 1 gene found in mitochondrial DNA. The method followed is detailed in Biggs J., *et al*, (2014). Analytical and methodological development for improved surveillance of the Great Crested Newt. Appendix 5. Technical advice note for field and laboratory sampling of great crested newt (*Triturus cristatus*) environmental DNA. Freshwater Habitats Trust, Oxford.

The limits of this method are as follows: 1) the results are based on analyses of the samples supplied by the client and as received by the laboratory, 2) any variation between the characteristics of this sample and a batch will depend on the sampling procedure used. 3) the method is qualitative and therefore the levels given in the score are for information only, they do not constitute the quantification of GCN DNA against a calibration curve, 4) a 'not detected' result does not exclude presence at levels below the limit of detection.

The results are defined as follows:
Positive: DNA from the species was detected.
eDNA Score: Number of positive replicates from a series of twelve.
Negative: DNA from the species was not detected; in the case of negative samples the DNA extract is further tested for PCR inhibitors and degradation of the sample.
Inconclusive: Controls indicate degradation or inhibition of the sample, therefore the lack of detection of GCN DNA is not conclusive evidence for determining the absence of the species in the sample provided.

DNA ANALYSIS REPORT
Commercial in Confidence

Results:

Customer Reference	Fera Sample Ref.	GCN Detection	GCN Score	Inhibition	Degradation
[redacted]					
BIL-06	S15-050549	Inconclusive	0	No	YES
BIL-04	S15-050550	Negative	0	No	No
BIL-05	S15-050551	Negative	0	No	No
BIL-01	S15-050552	Negative	0	No	No
BIL-03	S15-050553	Negative	0	No	No
[redacted]					
BIL-02	S15-050555	Inconclusive	0	No	YES

The results indicate that eDNA for great crested newts was not detected in any of the ten samples analysed. However, with two samples (S15-050549 and S15-050555) we detected degradation of the internal control. Therefore, due to the risk of any eDNA also being degraded resulting in a false negative, we have issued an inconclusive results. We did note that both these samples contained a high level of white clay like material which possibly contributed to the result. Analysis was conducted in the presence of the following controls: 1) Extraction blank, 2) appropriate positive and negative PCR controls for each of the TaqMan assays (GCN, Inhibition, and Degradation). All controls performed as expected.

Appendix 2-4

Bilsthorpe Energy Centre Breeding Bird Survey – 2015 Update (September 2015)

Bilsthorpe Energy Centre

Breeding bird survey – 2015 update

Submission under Regulation 22
Town and Country Planning (Environmental Impact Assessment) Regulations 2011

Prepared for Axis PED

Frank Daly MSc MCIEEM

Version 1.0 / Ref. 14-019/2

14/09/2015

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Bilsthorpe Energy Centre

Breeding bird survey – 2015 update

Report Reference	Ref. 14-019/2
Date	14/09/2015
Date of survey/s	April – June 2015

Issue	Prepared by	Checked by	Approved by	Status	Date
V1	Frank Daly MSc MCIEEM	Kevin Honour MSc MCIEEM	Paul Lupton MSc	DRAFT	14/09/2015

All Argus Ecology Ltd. staff subscribe to the Chartered Institute of Ecology and Environmental Managements (CIEEM) code of professional conduct in their work.

This report has been prepared in accordance with CIEEM's Guidelines for Ecological Report Writing.

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Summary

This report provides details of a breeding bird survey carried out on the proposed Bilsthorpe Energy Centre (BEC) site and wider Bilsthorpe Business Park in 2015. It is designed to provide an update of a similar survey carried out across the same area in 2013, employing the same observers and methodology as the previous survey.

The survey found significant differences between the 2013 and 2015, which could be explained by changes in vegetation and development of a Solar Farm on part of the former Colliery site.

The most significant change is the loss of lapwing as a breeding species in the wider survey area; this is most likely to be due to the change in habitat structure brought about by the Solar Farm, but the influence of wider-scale regional population changes may also be important.

Within the proposed BEC site, a single little ringed plover was recorded on one survey occasion, and the species has been downgraded from 'confirmed' to 'possible' breeding status. A pair of oystercatchers were present in both years, with a territory in 2015 which extended onto grassland to the east of the site. An increased area of grassland led to the establishment of a skylark territory on site, and a pair of grey partridge were recorded on one occasion. This natural succession has reduced habitat quality for little ringed plover and oystercatcher.

Within the wider survey area an increased number of territories of a number of species were recorded; these included species of conservation concern including skylark, song thrush, willow warbler and whitethroat, as well as 'green list' species such as blackcap and robin. All of these are relatively common and widespread species, and do not offset reductions in breeding waders.

In terms of conservation interest, the breeding wader assemblage of Bilsthorpe Colliery Local Wildlife Site has declined in value since 2013, due to the loss of lapwings from the surrounding area, and reduced habitat quality for little ringed plover and oystercatcher.

In terms of the proposed Wader Mitigation Area, it is still thought worthwhile to provide higher quality habitat for breeding waders, particularly little ringed plover and oystercatcher, but other priorities such as establishing more diverse grassland vegetation should be given higher priority than before.

Contents

1 Introduction

This document provides an update to the Breeding Bird Survey of the proposed Bilsthorpe Energy Centre (BEC) site and wider Bilsthorpe Business Park, previously undertaken in 2013 to inform the Environmental Impact Assessment of the proposed BEC facility. It has been prepared to form part of a voluntary submission under Regulation 22 of the Town and Country Planning (Environmental Impact Assessment) Regulations 2011; it is designed to inform the Secretary of State's decision under Section 77 of the Town and Country Planning Act 1990 (as amended).

The update survey was necessary in order to:

- assess any changes in the breeding bird assemblage within the Energy Centre site, particularly as a consequence of increasing vegetation cover;
- to check any changes in the wider former Colliery site, subsequent to the implementation of the Solar Farm development; and
- to check the current status of breeding birds on the proposed wader mitigation area.

The report provides an estimate of the numbers and species of breeding birds present, and compares these to the 2013 data. The ornithological interest of the BEC site and wider area is evaluated, with particular reference to breeding waders, one of the key qualifying features of Bilsthorpe Colliery Local Wildlife Site.

2 Scope and methodology

2.1 Scope of survey

The geographic scope of survey included the proposed BEC site, and the wider area of Bilsthorpe Business Park and former Colliery site. Any birds on adjacent habitats (e.g. on adjoining arable fields) visible from the survey area were also noted.

2.2 Methodology

The same survey methods were used as in the 2013 survey, employing a modified Common Bird Census (CBC) methodology to monitor the populations of common breeding birds on site (Bibby *et al*., 2000; Gilbert *et al*., 1998; Marchant, 1983). This involves the production of bird species maps that can be used to indicate the density and distribution of territorial breeding birds. Non-breeding species (e.g. overflying species, species foraging on site) were noted and where appropriate described below, but are not shown on the territory map. The probability of breeding is assessed and tabulated for each species with respect to standard BTO breeding evidence codes.

Three visits were made within the breeding season, each commencing within one hour of sunrise. The survey area was walked at a slow pace with frequent pauses to identify species and record behaviour; the route was organised to cover the whole of the site within 50m of the surveyor.

Dates, times and weather conditions of surveys are tabulated below:

Table 2.1: Survey dates and weather conditions

Visit	Date	Times	Sunrise	Weather conditions
1	29/04/15	05:26 – 10:35	05:33	8 – 10^{0}C; light showers, cloud 6/8 (wind S, F4)
2	22/05/15	05:08 - 09:55	04:56	4-8^{0}C; dry and overcast (SW: 2-3)
3	26/06/15	04:42 - 08:21	04:39	5-10^{0}C; dry and overcast (no wind)

.

3 Results

3.1 Summary of results

A total of 42 species were recorded within the wider survey area. Locations of species assessed as being of at least 'possible' breeding status are shown in Figures 1 and 2; Appendix 1 gives an explanation of the breeding evidence codes used below.

The tables below list bird species recorded within the BEC site, with an assessment of their likely breeding status and the estimated number of breeding pairs.

Table 3.1: Species recorded within proposed BEC site

Bird species	BTO species code	Breeding status	No. of pairs	BTO breeding code
Mallard	MA	Non-breeding	0	U
Grey partridge	P.	Possible	0	H
Oystercatcher	OC	Probable	1	T
Little ringed plover	LP	Possible	1	H
Stock dove	SD	Non-breeding	0	U
Woodpigeon	WP	Non-breeding	0	U
Skylark	C.	Probable	1	T
Meadow pipit	LI	Possible	1	H

The table below lists species with at least **possible** breeding status within the wider survey area, including those listed above.

Table 3.2: Breeding species recorded within wider survey area

Bird species	BTO species code	Breeding status	No. of pairs	BTO breeding code
Greylag goose	GJ	confirmed	1	FL
Canada Goose	CG	confirmed	1	FL
Mallard	MA	possible	2	H
	MA	confirmed	2	FL
Tufted duck	TU	possible	8	H
Grey partridge	P.	possible	1	H
Pheasant	PH	possible	3	H
Buzzard	BZ	possible	1	H
Moorhen	MH	confirmed	3	FL
Coot	CO	possible	4	H
Oystercatcher	OC	probable	1	T
Little ringed plover	LP	possible	1	H
Woodpigeon	WP	possible	12	H
	WP	possible	3	S
Kestrel	K.	possible	1	H
Magpie	MG	possible	1	H
Jay	J.	possible	1	H
Rook	RO	confirmed	50	ON
Blue tit	BT	possible	4	H
	BT	possible	1	S

Bird species	BTO species code	Breeding status	No. of pairs	BTO breeding code
Great tit	GT	possible	4	H
Coal tit	CT	possible	1	H
Skylark	S.	possible	8	S
	S.	probable	7	T
Long-tailed tit	LT	possible	1	H
Chiffchaff	CC	possible	5	S
	CC	probable	1	T
Willow warbler	WW	possible	14	S
	WW	probable	7	T
Blackcap	BC	possible	5	S
	BC	probable	6	T
Whitethroat	WH	possible	6	S
	WH	probable	3	T
Wren	WR	possible	11	S
	WR	probable	8	T
Blackbird	B.	possible	7	H
	B.	possible	4	S
Song thrush	ST	possible	1	S
	ST	probable	1	T
Robin	R.	possible	14	S
	R.	probable	3	T
Dunnock	D.	possible	5	S
House sparrow	HS	possible	1	H
Meadow pipit	MP	possible	1	H
Chaffinch	CH	possible	1	H
	CH	possible	9	S
	CH	probable	8	T
Bullfinch	BF	possible	1	H
	BF	probable	1	P
Linnet	LI	possible	2	H
Goldfinch	GO	possible	5	H
	GO	probable	1	T
Yellowhammer	Y.	possible	3	S
Reed bunting	RB	possible	2	S
	RB	probable	1	T

Non-breeding species recorded included:

- Single shelduck recorded in the north-eastern pond;
- Foraging grey herons in site, with up to 4 (including fledged juveniles) recorded in one pond, and two birds noted roosting on solar panels;
- Overflights by herring gull;
- A stock dove foraging on the northern part of the proposed BEC site;
- Overflying swifts, and swallows foraging over water-bodies; and
- Pied wagtail foraging on the dismantled railway to the south of the BEC site.

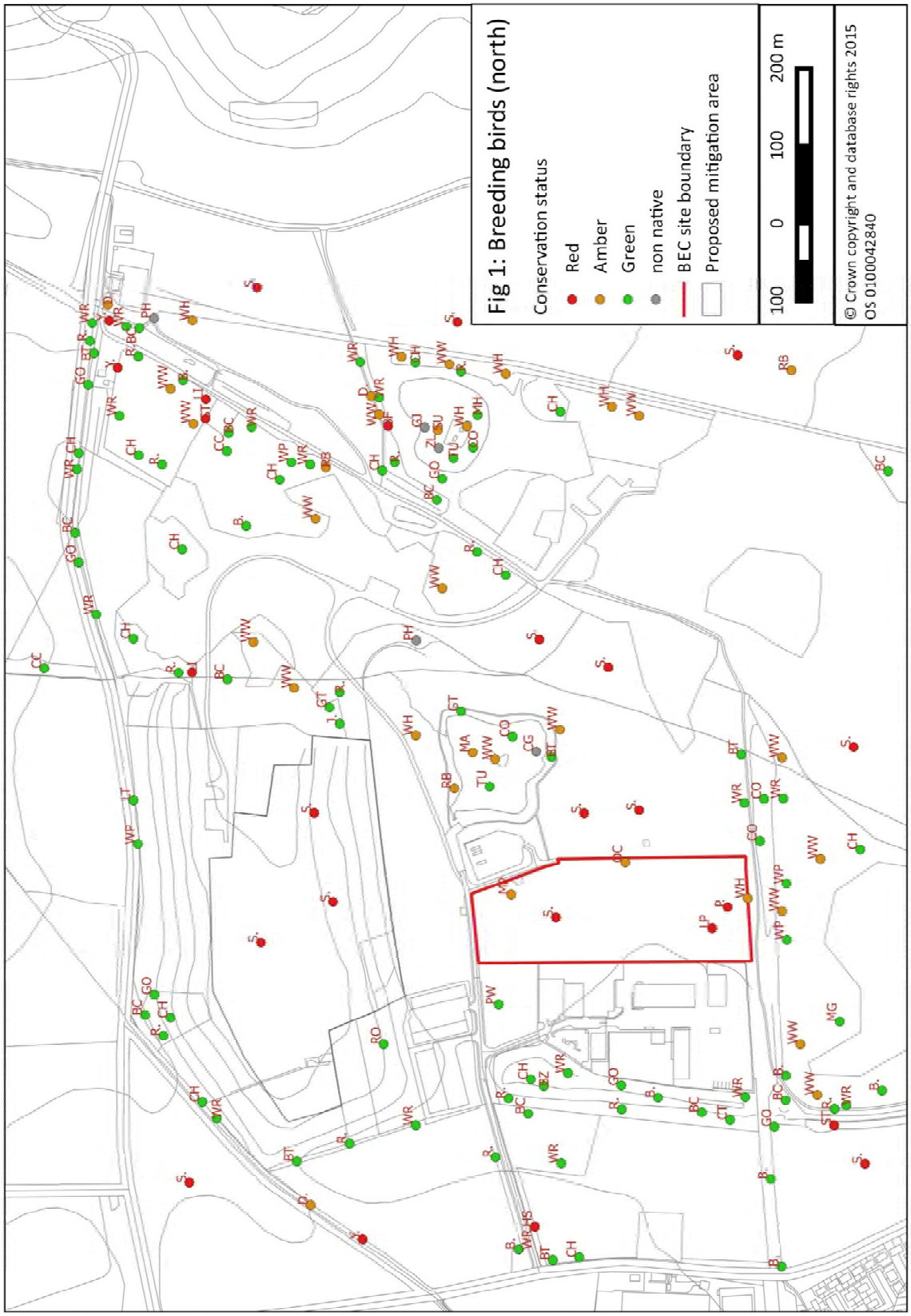
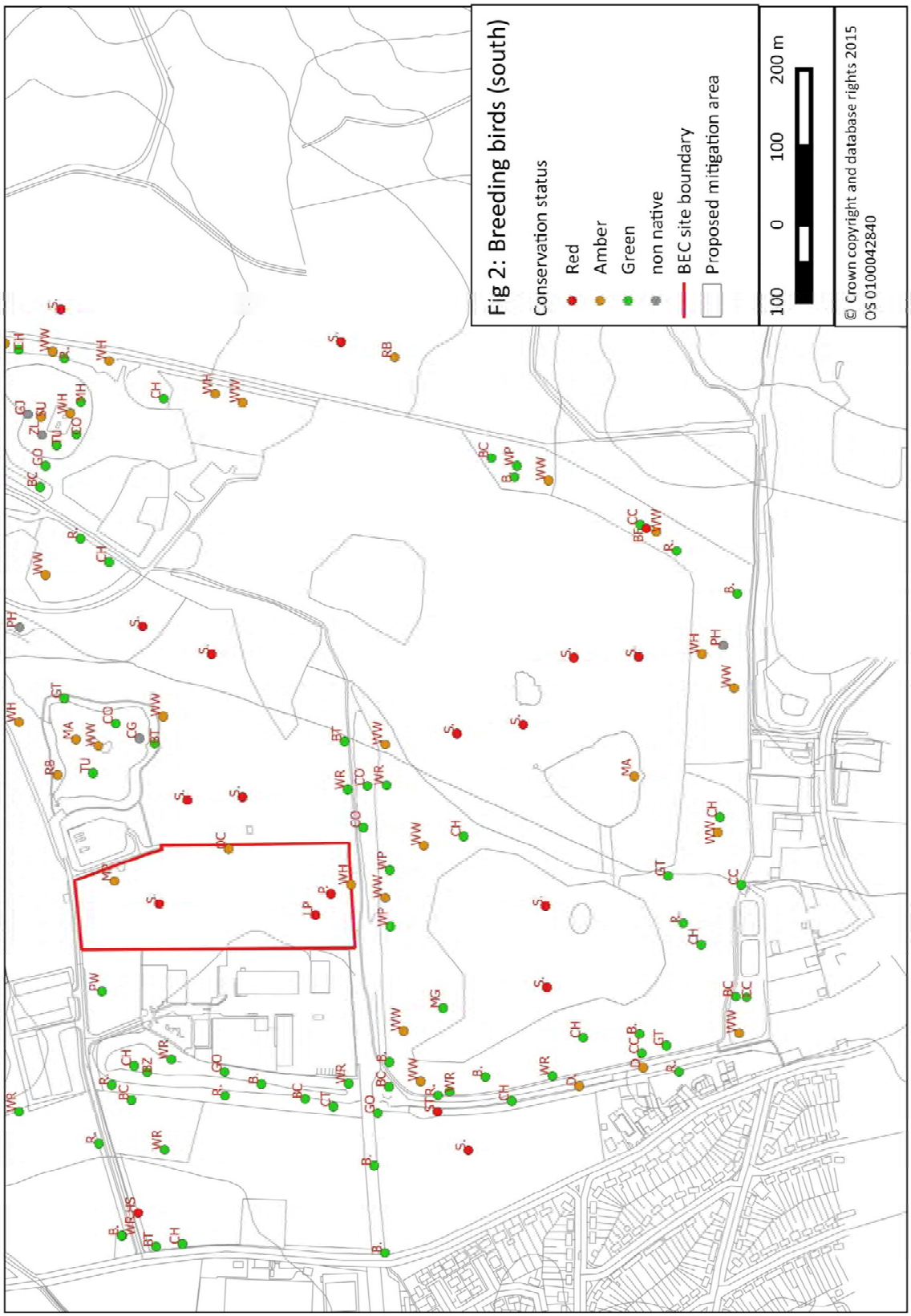


Fig 1: Breeding birds (north)
Conservation status
Red
Amber
Green
non native
BEC site boundary
Proposed mitigation area
100 0 100 200 m
© Crown copyright and database rights 2015
OS 0100042840



See Table 3.2 above for interpretation of species codes.

4 Evaluation

4.1 Changes in proposed BEC site avifauna since 2013

Status of little ringed plover

In contrast to the confirmed breeding attempt in 2013 (evidenced by a distraction display), there was only one record of a single little ringed plover in June 2015 from the more sparsely vegetated southern part of the site, and no records on the other survey occasions. This has to be recorded as a 'possible' breeding bird as it was recorded in suitable breeding habitat, but it is relatively weak evidence.

The area of suitable breeding habitat has reduced since 2013 due to establishment of grassland and tall ruderal vegetation, which may account for the lack of breeding evidence.

Status of oystercatcher

Oystercatcher were confirmed as successfully breeding within the proposed BEC site in 2013. In 2015 a pair was observed on each survey visit, either on site (on one occasion) or on grassland to the east (on two visits); the location of the record in Figures 1 and 2 is the centroid of these three observations. This is a 'probable' breeding record, and indicates status probably hasn't changed since 2013, although it is unclear whether breeding was attempted on site or on the area to the east.

Establishment of skylark and meadow pipit

A pair of skylarks were holding territory on all three survey occasions, and can be regarded as 'probable' breeders on site. A meadow pipit was recorded on one occasion only in suitable breeding habitat, and can be regarded as a 'possible' breeder. Neither of these species bred on site in 2013, and will have benefitted from the re-establishment of grassland habitat since then.

Grey partridge

Two grey partridge flushed from grassland in the southern part of the site represent the first record of this species within the bird surveys; red-legged partridge, an introduced game species, were recorded in 2013. With a record on only one occasion, this is a 'possible' breeding record due to presence in suitable habitat.

4.2 Changes in wider site avifauna since 2013

Waders of grassland / shallow marginal habitats

Five lapwing territories were present in 2013, with confirmed breeding (fledged young). Distribution of lapwings was centred on the large open area of pasture on the south-eastern part of the restored colliery tip, where there were shallow pools providing good quality habitat for fledged chicks.

In 2015 the Solar Farm had been constructed over much of this part of the site. No lapwings were recorded on any part of the survey area. The inference is that lapwings have been displaced from the site by the presence of the solar panels, which has reduced the openness of the habitat and rendered it unsuitable for this species. It should be stressed that this is an inference, as absence may (for example) be due to wider scale population decline or changes, but this interpretation is consistent with the known habitat preferences of lapwings.

Aside from the little ringed plover and oystercatcher referred to above, there were no other records of waders from the site in 2015. This contrasts with the records of dunlin and green sandpiper from the shallow standing water within the Solar Farm in 2013. Although these migratory species are likely to be recorded much more irregularly on site in any event, it is unlikely that they would find the Solar Farm site attractive as a stop-over, due to the presence of the panels.

Other grassland species

Skylark increased the numbers of 'possible' breeding birds holding territory by eight across the whole site in 2015 compared to 2013, interestingly maintaining a very similar population density within and around the Solar Farm, with 2 -3 pairs holding territory. Persistence in this habitat is likely to depend on management, in particular the timing of mowing if there is no grazing within the panels, but the panels themselves do not appear to have prevented birds holding territories and performing song flights over the site. Areas of the site with increased skylark density included the proposed mitigation area to the north of the BEC site, grassland to the east of the BEC site, and the grassland to the west of the Solar Farm.

Species of woodland and scrub habitats

A song thrush territory was located in the same area of woodland in the north-east of the survey area in both 2013 and 2015, with an additional territory recorded in woodland in the south-western part of the site in 2015.

All four species of warbler recorded in 2013 – chiffchaff, willow warbler, blackcap and whitethroat – increased their estimated breeding population in 2015. This may be a consequence of increasing maturity of plantations providing improved habitat quality, although this does not explain the increase in whitethroat territories (associated with lower scrub and hedgerow habitats). Other resident woodland species such as robin, wren, dunnock and chaffinch also increased their estimated number of territories.

Species of wetland habitats

Aside from the incorporation of shallow scrape habitats in the Solar Farm, the deeper ponds and associated habitats on site maintained a similar bird fauna to 2013. Three species – mute swan, little grebe, and great crested grebe – were not recorded in the 2015 survey.

Reed bunting were not recorded breeding in 2013, but there were up to three pairs in 2015, one associated with the fishing pond, and one in an arable field just east of the survey area.

4.3 Revised conservation evaluation

Local Wildlife Site qualifying features

The breeding wader assemblage has declined significantly from 2013 – 2015, with lapwing no longer recorded on site and the status of little ringed plover reduced to 'possible' breeding, leaving one pair of probable breeding oystercatchers as the only unchanged species.

Comparative conservation status

The conservation status of species recorded in 2013 is compared below to 2015. Species marked with an asterisk (*) are not thought to breed in the survey area.

Table 4.1: Comparative conservation status

Status	2013	2015
Annex I - EU Birds Directive	dunlin*	none
Schedule 1.1 - Wildlife & Countryside Act, 1981	little ringed plover, green sandpiper*	little ringed plover
Section 41 - Natural Environment & Rural Communities Act, 2006	lapwing, skylark, song thrush, dunnock, linnet, yellowhammer	skylark, song thrush, dunnock, house sparrow, linnet, bullfinch, yellowhammer, reed bunting

Status	2013	2015
BTO 'Red List' species	lapwing, dunlin, green sandpiper*, skylark, song thrush, linnet, yellowhammer	skylark, song thrush, house sparrow, linnet, yellowhammer
BTO 'Amber List' species	shelduck*, mallard, tufted duck, oystercatcher, green woodpecker*, swallow*, house martin*, willow warbler, whitethroat, mistle thrush, dunnock	shelduck*, mallard, tufted duck, oystercatcher, stock dove*, swift*, swallow*, willow warbler, whitethroat, dunnock, meadow pipit, bullfinch, reed bunting

The key difference in conservation value is the loss of Section 41 / Red list lapwing, and possible loss of Schedule 1 little ringed plover as a breeding species, contrasting with an increase in Section 41 / Red list skylark population together with song thrush and the Amber-listed reed bunting. Other Amber list species such as willow warbler and whitethroat have also increased.

5 Conclusions

Changes in the avifauna of the site from 2013 to 2015 can be explained in terms of habitat and land-use changes in the intervening period – construction of the Solar Farm, establishment of vegetation on the proposed BEC site, and greater maturity of the plantations. Other wider-scale population changes may have influenced the observed changes; for example, the unfavourable conservation status of lapwing in the East Midlands region may have made abandonment of the site more likely following construction of the Solar Farm.

Observed changes are not all negative, with populations of many songbirds, including skylark, song thrush, willow warbler and whitethroat all increasing on the wider former Colliery site. However, these are all common and widespread species nationally and in the region; their increasing population does not offset the decline in the value of the site for breeding waders, especially given the fact that this was one of the qualifying features of Bilsthorpe Colliery Local Wildlife Site.

The loss of lapwing from the site and possible reduction in the status of little ringed plover has implications for conservation priorities within the proposed wader mitigation area. There is still value in creating alternative habitat for little ringed plover, especially as they are still visiting the site. Optimal management of the open grassland may attract lapwing back to the mitigation area, but the chances of success must be assessed as lower. It is better that this should be combined with measures to create a more diverse grass sward, in order to fulfil wider biodiversity offsetting objectives.

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Appendix 1 BTO breeding evidence codes

Non-breeding

F Flying over

M Species observed but suspected to be still on **M**igration

U Species observed but suspected to be s**U**mmering non-breeder

Possible breeder

H Species observed in breeding season in suitable nesting **H**abitat

S Singing male present (or breeding calls heard) in breeding season in suitable breeding habitat

Probable breeding

P Pair observed in suitable nesting habitat in breeding season

T Permanent **T**erritory presumed through registration of territorial behaviour (song etc.) on at least two different days a week or more part at the same place or many individuals on one day

D Courtship and **D**isplay (judged to be in or near potential breeding habitat; be cautious with wildfowl)

N Visiting probable **N**est site

A Agitated behaviour or anxiety calls from adults, suggesting probable presence of nest or young nearby

I Brood patch on adult examined in the hand, suggesting **I**ncubation

B Nest **B**uilding or excavating nest-hole

Confirmed breeding

DD Distraction-**D**isplay or injury feigning

UN Used **N**est or eggshells found (occupied or laid within period of survey)

FL Recently **FL**edged young (nidicolous species) or downy young (nidifugous species). Careful consideration should be given to the likely provenance of any fledged juvenile capable of significant geographical movement. Evidence of dependency on adults (e.g. feeding) is helpful. Be cautious, even if the record comes from suitable habitat.

ON Adults entering or leaving nest-site in circumstances indicating **O**ccupied **N**est (including high nests or nest holes, the contents of which cannot be seem) or adults seen incubating

FF Adult carrying **Fa**ecal sac or **F**ood for young

NE Nest containing **E**ggs

NY Nest with **Y**oung see or heard

Appendix 2-5

A dingy skipper butterfly survey of the proposed BEC site, to take account of changes in habitat suitability on site since 2013 (September 2015)

Bilsthorpe Energy Centre, Bilsthorpe, Nottinghamshire

Dingy Skipper Transect Survey 2015

Submission under Regulation 22
Town and Country Planning (Environmental Impact Assessment) Regulations 2011

Prepared for Axis PED

Frank Daly MSc MCIEEM

Version 1.0

9th September 2015

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Contents

1 Introduction

This document sets out the results of a dingy skipper (*Erynnis tages*) transect survey undertaken in 2015 at the site of the proposed Bilsthorpe Energy Centre (BEC) development at Bilsthorpe Business Park, Bilsthorpe, Nottinghamshire. It has been prepared to form part of a voluntary submission under Regulation 22 of the Town and Country Planning (Environmental Impact Assessment) Regulations 2011; it is designed to inform the Secretary of State's decision under Section 77 of the Town and Country Planning Act 1990 (as amended).

The survey site lies within the Bilsthorpe Colliery Local Wildlife Site (LWS), which is designated for breeding waders and dingy skipper butterfly. Dingy skipper are a priority species, listed under Section 41 of the Natural Environment and Rural Communities Act 2006. In addition, dingy skipper is a priority species in Butterfly Conservation's Regional Action Plan for the East Midlands (including Nottinghamshire, Leicestershire & Rutland and South Derbyshire).

Vegetation development since the earlier surveys carried out in 2013 to inform the BEC planning application has made it necessary to check for the presence of dingy skipper on site. Of particular relevance is the establishment of a population of bird's-foot trefoil (*Lotus corniculatus*) growing in a fairly open sward; this is the butterfly's food plant, and preferred habitat association of early successional brownfield land.

Transect routes were therefore walked within the dingy skipper flight period, both within the BEC site and on other potentially suitable habitat to the north, in order to determine whether the species was present on site. Other species of butterfly were also recorded in the course of surveys.

2 Ecology of dingy skipper

Dingy skipper occurs in a wide range of open, sunny habitats including chalk downland, woodland rides and clearings, coastal habitats such as dunes and undercliffs, old quarries, railway lines and waste ground. Suitable conditions occur where the larval food plant, common bird's-foot-trefoil (*Lotus corniculatus*), grow in a sparse sward, often with patches of bare ground in a sunny, sheltered situation. Taller vegetation is also required for shelter and roosting (Asher *et al.*, 2001).

The main adult flight period is from early May to the end of June (Bourn *et al*., 2000).

Dingy skipper occurs in discrete colonies, many of which are very small, containing fewer than 50 individuals at the peak of the flight period. It has been regarded as a sedentary species and unlikely to colonise new areas of habitat unless they are close to existing populations, although individual movements of several kilometres have been recorded (Bourn *et al*., 2000). This longer-distance dispersal may be important in colonising ephemeral habitats, which are likely to be of patchy and relatively short-lived occurrence; however, population persistence may be greater when there are more closely linked habitat patches which are individually larger in area, forming a larger meta-population (Gutiérrez *et al*., 1999).

3 Methodology

3.1 Site survey

The transect survey was divided into two sections (Transect 1 & Transect 2) where suitable habitat for dingy skipper was available (Figure 1). These comprised areas of sparse vegetation with flowering common bird's-foot-trefoil, and patches of bare ground, and included the BEC site (Transect 2) and land to the north within the Business Park (Transect 1).

Transects were walked at a slow, steady pace counting all butterflies seen within a fixed distance - 2.5m either side of the transect line and 5m ahead. The transect walks were carried out under suitable weather conditions and within the flight period of the dingy skipper. Suitable conditions are warm, dry and bright weather with only moderate winds. Minimum requirements are 13-17^{0}C with at least 60% sunshine, or over 17^{0}C and not raining. Wind speed must be less than Beaufort scale 5. (Butterfly Conservation[1]).

The site was surveyed on three separate occasions: 22nd & 27th May and 26th June 2015, during the flight period of the dingy skipper.

3.2 Personnel

Paul Lupton and Frank Daly of Argus Ecology carried out the site survey. Both have extensive experience in surveying Lepidoptera, and both in particular are familiar with the identification of dingy skipper.

4 Results

4.1 Transect surveys

No dingy skippers were recorded on site during the transect surveys.

Five other butterfly species were recorded during the transect surveys: small white (*Pieris rapae*), common blue (*Polyommatus icarus*), small tortoiseshell (*Aglais urticae*), meadow brown (*Maniola jurtina*), and small heath (*Coenonympha pamphilus*).

Survey 1

Survey date: 22/05/15 Times: 10:00 - 10:45

Weather: 18^{0}C; dry and overcast (CC: 8/8) with a gentle breeze (wind SW: force 2-3)

Butterfly species recorded:

No butterflies were recorded during the transect surveys.

Survey 2

Survey date: 27/05/15 Times: 13:00 - 13:45

Weather: 19^{0}C; dry and partially sunny (CC: 4/8) with a gentle breeze (wind SW: 3)

Butterfly species recorded:

Butterfly species	Transect 1	Transect 2	**Total**
Small white *Pieris rapae*	0	2	**2**
Common blue *Polyommatus icarus*	0	5	**5**
Small tortoiseshell *Aglais urticae*	0	2	**2**
Small heath *Coenonympha pamphilus*	0	8	**8**

Survey 3

Survey date: 26/06/15 Times: 10:00 - 10:45

Weather: 18^{0}C; dry and overcast (CC: 8/8) - no wind

Butterfly species recorded:

Butterfly species	Transect 1	Transect 2	**Total**
Meadow brown *Maniola jurtina*	1		**1**

4.2 Additional records

A relatively large population of common blue butterfly was noted in the habitat survey in August 2015. This is within the second brood flight period of this species (late May records would be first brood), when they are typically more numerous (source: http://www.ukbutterflies.co.uk/species.php?species=icarus). Common blue are a common and widespread species; a number of larval food-plants are present on the BEC site, including bird's-foot trefoil, lesser trefoil (*Trifolium dubium*) and black medick (*Medicago lupulina*).

Other species recorded included painted lady (*Vanessa cardui*) and gatekeeper (*Pyronia tithonus*).

5 Discussion

In 2013, both transect areas mostly comprised bare ground. Since that time both areas have begun to vegetate over and assumed the character of ephemeral grassland which provides good quality habitat for dingy skipper. However, none were recorded during transects within its flight period.

Due to the disturbed nature of the site until very recently, it is likely that dingy skipper have not yet colonised. It is not known if they currently persist in other parts of the Business Park; the main remaining suitable areas are in the planned coal extraction area to the east of the BEC site, and on the dismantled rail line to the south and west.

One butterfly species of conservation importance, small heath, was recorded during the transect surveys. Small heath is listed as a 'Section 41' priority species of principal importance under the Natural Environment and Rural Communities Act 2006 in England. It was recorded in the south-eastern part of Transect 2, in relatively sparsely vegetated grassland to the north of the bund. This is to the south-east of the proposed BEC site.

The majority of butterfly species were recorded in Transect 2 on a grassy bund between the southern edge of the former application site boundary and the northern edge of the linear pond. This supports an area of relatively floriferous tall ruderal (disturbed-ground) vegetation with abundant nectar sources.

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Appendix 1

Photo 1 Transect 1 - Common bird's-foot-trefoil in flower (looking westwards)

Photo 2 Transect 2 - Common bird's-foot-trefoil in flower (looking north eastwards)

Bilsthorpe Energy Centre
Bilsthorpe
Nottinghamshire

Legend

Site boundary

Butterfly transect route

argus ecology

Unit 14 The Greenhouse, Greencroft Ind Park, Annfield Plain, Co Durham. DH9 7XN

Figure 1 - Dingy Skipper Survey

Version 1.0: 8 September 2015

Appendix 2-6

Bilsthorpe Energy Centre Updated Wader Mitigation Plan (September 2015)

Proposed Energy Centre Bilsthorpe Business Park, Nottinghamshire

Wader mitigation plan

Prepared for Peel Environmental Management (UK) Ltd. and Bilsthorpe Waste Ltd.

Ref: 14-019/01-3
Kevin Honour MSc MCIEEM
Revised Version 3.0
14th September 2015

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Contents

1 Introduction

This document provides a Wader Mitigation Plan to address likely adverse effects on ground-nesting waders as a consequence of the development of the Bilsthorpe Energy Centre, Bilsthorpe Business Park, Nottinghamshire.

The Mitigation Plan has been produced as part of a submission of additional information under Regulation 22 of the Town and Country Planning (Environmental Impact Assessment) Regulations 2011.

The Environmental Impact Assessment (EIA) of the Energy Centre predicted the displacement of one pair of little ringed plover (*Charadrius dubius*) and partial loss of foraging habitat for lapwing (*Vanellus vanellus*), up to five pairs of which will be displaced from the former colliery tip by a Solar Farm development.

The plan is designed to provide suitable near-site breeding habitat for little ringed plover and lapwing, in order to offset predicted impacts and help to achieve no net loss of biodiversity interest as a consequence of the Energy Centre development.

The total area proposed for inclusion in the mitigation is over 4.5ha of potentially suitable breeding wader habitat (*increased to 8.35ha of grassland habitat mitigation*).

As a consequence of this additional mitigation proposal, the Biodiversity Offsetting Metric included in the EIA has been re-calculated, and is appended to this document.

Revised version – second Regulation 22 request

This revised version has been produced in response to a further Regulation 22 Request of 21st August 2014, and includes the following additional information:

- a plan to indicate those parts of the site where habitat incorporating areas of standing water would be created;
- an explanation of why the mitigation area is largely limited to an area outside a 200m zone around the nearest wind turbine;
- an indicative plan showing additional wet scrape areas;
- proposals to enhance the existing sward with a small number of nectar-rich species to increase invertebrate abundance and diversity (e.g. red clover, bird's-foot trefoil);
- additional coppicing along the eastern side of the plantation;

- a commitment to carry out annual breeding wader surveys, listed in the schedule of maintenance works in section 8.2; and
- consideration of how future development of land immediately to the south would affect the functioning of the area.

Revised version – third Regulation 22 submission

Following additional ecological survey work in 2015, it is necessary to revise the proposed Wader Mitigation Plan; it has also been revised to ensure better implementation of appropriate agricultural management of the mitigation area.

Breeding bird surveys in 2015 following implementation of the Solar Farm development found that lapwing had been displaced from the wider former colliery site, with no records during the breeding season. Habitat quality within the proposed BEC site for little ringed plover had also declined due to increased vegetation cover, and there was only a single record of a possible breeding species.

The reduction in habitat quality for waders was accompanied by an increase in botanical diversity within the BEC site, as vegetation developed with characteristics of Open Mosaic Habitat on Previously Developed Land priority habitat. Based on the rapidity of natural succession, it was thought unlikely that this habitat would persist for long in the absence of any further disturbance of the BEC site. Nevertheless, it required a re-calculation of the Biodiversity Offsetting Metric, which is reported in a Habitat Survey provided within this third Regulation 22 submission.

The proposed mitigation area has recently been re-fenced by the tenant, with the aim of providing a large enough area that can be managed as a single grazing unit, and improves the openness of the landscape, an important factor for breeding lapwing. A single field of 8.35ha has now been created, and is supplied with a stock watering trough in the south-east corner. This provides opportunities for enhancement of the grassland habitat to create a more diverse sward, including areas within a 200m displacement distance of the wind turbines, while excluding areas on the northern and western slopes which had previously not been considered suitable for breeding waders. Management will still aim to provide suitable management which may attract breeding lapwing in the future; while it would be very welcome, the establishment of breeding lapwing cannot be considered a realistic target in the present circumstances. Little ringed plover and oystercatcher breeding habitats remain as management plan targets.

2 Scope and methodology

2.1 Plan format

The Mitigation Plan format follows guidelines in BS42020:2013 (*Biodiversity — Code of practice for planning and development*) for post-development management of habitats and species, and is structured as follows:

a) Description and evaluation of features to be managed.

b) Ecological trends and constraints on site that could influence management.

c) Aims and objectives of management.

d) Appropriate management options for achieving aims and objectives.

e) Prescriptions for management actions.

f) Preparation of a work schedule (including an annual work plan capable of being rolled forward over a five year period).

g) Body or organization personnel responsible for implementation of the plan.

h) Monitoring and remedial measures.

i) Funding resources and mechanisms to ensure sustainable long-term delivery of the proposed management.

The Plan is focussed on the habitat requirements of two wader species: little ringed plover and oystercatcher, although the needs of lapwing, a species which it is hoped will occur on site in future years are also a priority. The Plan also considers grassland biodiversity, and the needs of dingy skipper butterflies.

2.2 Methodology

A search for potential mitigation sites was undertaken for areas within the wider land ownership of Haworth Estates at the former Bilsthorpe Colliery. Known constraints were overlain on a site plan, including an existing wind farm, and areas of future development (e.g. a consented Solar Farm site). A distance of 200m from each turbine was taken as a possible displacement distance, within which lapwing and little ringed plover would be less likely to breed; the rationale for this is explained in more detail in Section 4 below.

The initial site search suggested that an area of pasture land in the north-west of the site could be suitable for enhancement for breeding waders. Separate, independent breeding bird surveys carried out by Argus Ecology and SLR Consulting in 2013 had

not recorded breeding waders on this part of the site, so the key issue to determine was whether the site could be enhanced to be suitable for waders, rather than whether its carrying capacity (i.e. breeding density) could be improved.

A site visit was carried out on 24th February 2014 to assess the opportunities and constraints presented the potential mitigation site. Current habitat quality was assessed and constraints identified which might explain the lack of current usage by waders. Potential improvements were identified, and the location of any proposed additional features was plotted in the field using a mapping-grade Topcon GMS-2 Pro GNSS receiver. Other parts of the site were also visited for comparison, including the planned Solar Farm site which held breeding lapwings in 2013, and the proposed Energy Centre site which had supported a pair of little ringed plover in 2013.

In order to inform the revised plan, a further visit was carried out on 7th August 2015, in order to record sward species composition and confirm the position of the new fence.

3 Description and evaluation of features

3.1 Habitats and vegetation

Habitats present in proposed mitigation area

The proposed mitigation area is located just over 100m north of the proposed development site, and incorporates the top and south-facing slopes of a mound which runs along the northern part of the former colliery site. The location is shown on Figure 1, and illustrated on the oblique aerial photograph below, with most of the site visible (shaded blue); the proposed Energy Centre boundary is shown edged red.

Photo 3.1: Mitigation area location

Note that this is a more recent aerial than currently available on Google Earth or Bing Maps, and shows changes following coal recovery operations.

The northern part of the mitigation area comprises part of a large field of improved grassland, previously managed as sheep-grazed permanent pasture. This has now been integrated with an area of less well-established open grassland occupying a south-facing slope, and separated from cattle-grazed pasture on the north and west-facing slopes of the mound. The flat ground at the base of the slope was damp during the February 2014 survey, with some standing water in wheel-ruts, and evidence of occasional standing water during wetter periods (see Photo 3.2 below). The boundaries of this flat area were plotted with the GNSS in order to define the maximum possible extent of wetland (shingle & scrape) habitat creation.

Photo 3.2: Flat ground – south part of mitigation area

The agricultural grassland was partly divided by a small area of scrub and a post-and-rail fence running north-south, although this was not stock-proof, and the field was managed as a single unit, as illustrated by the photograph below:

Photo 3.3: Scrub and fence – looking north

The landscaped mound has a broad, relatively level top offering an open aspect, which is illustrated by the photograph below, taken looking west from the fenced boundary with the established permanent pasture and more recently-established sward. The fence line has now been moved northwards to the right-hand side of the picture, creating a large open area on the flat topped mound.

Photo 3.4: Elevated grassland within proposed mitigation area (Feb 2014)

To the west of the mitigation area land slopes down steeply to a row of tall poplars just over the site boundary, while the northern edge slopes down to a hedgerow adjacent to a minor road. There is also a small plantation on the northern slope, with young ash trees in the upper, southern part of the enclosure. These areas are not suitable for breeding waders, because of the slope and proximity of taller trees; they were previously to have been managed as part of the same grazing unit, but would not have been considered part of the mitigation area. The gradient also makes this area difficult to crop for hay or silage, and they are currently (summer 2015) managed as a single field unit of cattle-grazed permanent pasture.

Habitats previously and currently utilised by waders

There are two areas previously and currently utilised by breeding waders which have been or would be displaced by recently implemented schemes and proposed developments at Bilsthorpe Business Park and the former Bilsthorpe Colliery tip.

Proposed BEC site

The proposed Energy Centre site supported a pair of little ringed plover in the 2013 breeding season, which were also observed adjacent to areas of shallow standing water on the planned Solar Farm site to the south.

The suitability of the Energy Centre site for little ringed plover was a consequence of the loss of vegetation and creation of areas of bare ground due to the coal recovery operations which had been carried out. Parts of the site had been colonised by tall ruderals later in 2013, rendering it less open and less suitable for little ringed plover, as illustrated by the photograph below:

Photo 3.5: Proposed Energy Centre site in February 2014

Occurrence of little ringed plover on this site in the absence of development was predicted to be ephemeral in nature, as habitat quality declines due to natural succession. This was found to be the case in summer 2015, when grassland cover was mapped at 55% of total site area, with just 24% of the site including ephemeral – short perennial vegetation which retained some value for little ringed plover. Only one little ringed plover was recorded on site on one occasion, and could not be regarded as more than a 'possible' breeder.

A pair of oystercatchers were recorded in the vicinity of the proposed BEC site in both 2013 and 2015. In 2013 successful breeding was confirmed; in 2015 breeding was

assessed as 'probable', although the oystercatcher territory extended onto adjoining land to the east.

Solar Farm site

The Solar Farm site supported an estimated five pairs of lapwing in 2013, occupying an area of elevated improved grassland on the former colliery tip. In February 2014 this area maintained its suitability for breeding lapwing, with a number of areas of shallow standing water present within an area of open grassland, as illustrated overleaf. Loss of this site will also affect little ringed plover breeding on the Energy Centre site, as they will lose aquatic marginal habitats for foraging.

Photo 3.6: Grassland and shallow standing water – Solar Farm site

By April 2015 construction of the Solar Farm was complete, and this area was covered in ground-mounted solar panels and enclosed by a tall security fence. Shallow standing water remained under the panels, and the area continued to be used by territorial skylarks and even roosting grey heron, but lapwing had been displaced from the Bilsthorpe Colliery tip.

3.2 Evaluation of habitat quality for breeding waders

Habitat requirements for breeding little ringed plover

Little ringed plover require bare or sparsely vegetated habitats for breeding; their natural habitat includes areas such as shingle islands on braided streams within rivers. They colonised Britain in the second half of the 20th century after first breeding in 1938, taking advantage of the availability of similar habitat in sand & gravel quarries. They will also breed on recently cleared industrial sites and colliery spoil heaps.

Key habitat requirements include:

- Bare, preferably coarse-textured shingle substrate (if set in grassland, at least 0.2ha in area);
- Availability of shallow water margin habitats; and
- Limited opportunities for predators (e.g. maintaining open aspect with limited cover around nest sites.

Habitat requirements for breeding oystercatcher

Oystercatcher prefer to nest in bare areas with a loose substrate (Heppleston, 1972), and would benefit from habitat creation targeted at little ringed plover.

They also require short grassland vegetation with penetrable ground for foraging; unlike lapwing and little ringed plover, oystercatcher feed by probing. Unlike most other waders, oystercatcher feed young chicks, so the availability of suitable foraging habitat in close proximity to the chicks is not so critical as in other species which have to forage for themselves.

Habitat requirements for breeding lapwing

The management needs of lapwing on agricultural land are now reasonably well-established, with recently published guidance from Natural England (TIN090: Natural England, 2011), and RSPB (Farming For Birds – Lapwing advice sheet: http://www.rspb.org.uk/Images/lapwing_england_tcm9-207562.pdf).

For permanent grassland habitats, key management principles include:

- Maintaining a short sward in spring (grass height in March 3cm or less over 80% of the field);
- Maintaining taller patches and tussocks for shelter (10-15cm height in March, covering no more than 20% of the field);

- Reducing the risk of trampling nests by keeping stocking levels low between mid-March and mid-June;
- Grazing the field more intensively in late summer and autumn to produce the short sward height needed in spring;
- Creating or maintaining damp areas within each field, either by creating shallow scrapes or linear footdrains (Smart *et al*, 2006); and
- Avoiding areas with trees or other vantage points, which could be used by predators.

Habitat quality for breeding waders

The proposed mitigation area did not support any breeding waders in 2013 or 2015, so it is important to understand the potential constraints which are likely to be restricting current habitat quality. These include:

- Lack of standing water during the breeding season;
- Grazing by sheep in 2013, giving an even sward without longer vegetation to provide cover for chicks;
- Grazing by sheep during the breeding season, increasing the risk of nest losses through trampling;
- Absence of winter grazing, leading to a longer, less suitable sward for nesting at the start of the breeding season;
- Proximity of hedgerows and plantation, increasing predation risk, and subdividing fields into smaller, more enclosed units;
- Lack of bare shingle habitat for little ringed plover;
- Proximity of wind turbines; and
- Presence of steeper slopes with trees and hedgerows around the northern and western margins.

With respect to wind turbines, although a buffer distance of 200m was chosen to aid mitigation site selection, evidence suggests that this is conservative with respect to lapwing. A study of breeding bird displacement distances around turbines (Pearce-Higgins *et al*, 2009) did not find a significant effect on proximity to turbines for lapwing, although there was a (non-significant) reduction in probability of occurrence within 200m of the turbine.

The mitigation plan previously excluded areas most areas within 200m of the nearest turbine from habitat improvements. As the emphasis has shifted towards little ringed plover, dingy skipper and grassland biodiversity and away from lapwing, it is legitimate to include these areas in grassland diversification measures. This will also allow for a net benefit in terms of the Biodiversity Offsetting Metric to be achieved.

The mitigation area is designed to be large enough to provide mitigation for waders and grassland habitats greater than the predicted impacts of the Energy Centre, while allowing for agricultural management in conjunction with the other parts of the Bilsthorpe Colliery site; in particular, it is important to retain sufficient area for grazing stock in other parts of the site to allow for reduction in grazing levels during the breeding season. This has been achieved in the revised plan by retaining cattle grazing on permanent pasture to the north and west of the mitigation area.

Implications of future developments

The area of land most likely to be utilised by nesting lapwings is on top of the hill, around 170m north of the nearest current or planned development area. It will retain an open aspect in the future, and continue to provide suitable lapwing habitat if other parts of the colliery site are developed. Future developments will not therefore impose any constraints on utilisation of the site by lapwing.

The scrape and shingle area designed for little ringed plover is adjacent to a potential future industrial plot, with the boundary a minimum distance of 25m from the edge of the shingle. In the author's experience little ringed plover are less affected by the proximity of built structures when choosing suitable breeding sites. Examples include:

- a site in South Yorkshire adjacent to a large commercial vehicle factory building where an open area supporting breeding little ringed plover was located as close as 25m to the factory unit, with patches of scrub in places;
- a site in Gloucestershire where little ringed plover were breeding on a small area of suitable habitat on a vacant industrial plot, adjacent to a road with shrubs and trees, with tall lamp standards; and
- the Bilsthorpe Energy Centre site itself, where little ringed plover occupied the site although it was adjacent to buildings, noise and human activity associated with the Council Highways depot site.

The Energy Centre boundary is just over 100m from the southern edge of the mitigation area, and very unlikely to disturb little ringed plover utilising shingle habitats or the adjacent scrape. Predictions of noise levels and light spillage from the site in the ES do not indicate any impact at this distance.

4 Ecological trends and constraints on site

4.1 Ecological trends

In the absence of any additional intervention, the agricultural grassland in the northern part of the site is likely to continue to support improved grassland with limited species diversity.

The more recently established grassland in the southern part of the site will establish a closed grass sward, having close to 100% cover when surveyed in summer 2015. Its ability to support grazing stock may be limited without further intervention (e.g. oversowing and fertilising), making it more suitable for conservation grazing with limitations on stocking density or on the number of weeks the site is grazed. Poor drainage at the foot of the slope may also limit its value for agriculture.

Surrounding plantation woodland will become more established, with immature trees on the northern boundary of the plantation, and the area of scrub between the two former field units increasing in height.

4.2 Constraints

The same constraints which are currently discouraging use of the site by breeding waders will continue to operate in the absence of changes in management.

The edge effect of plantations and scrub will increase with greater tree and shrub height, and will further reduce habitat quality for waders.

5 Aims and objectives of management

5.1 Aims

One primary aim of management is to establish and maintain conditions suitable for the successful breeding of ground-nesting waders, including little ringed plover, oystercatcher, and (if possible) lapwing.

A second important aim is to establish a more diverse grassland community which will offset habitat loss within the BEC site.

5.2 Objectives and vision for site

Grassland habitats

The grass sward will be short in the early spring over 80% of the field, with some tussocks of taller vegetation remaining, providing suitable conditions for nesting lapwing. Grazing pressure will reduce between mid-March and mid-June, reducing the risk of trampling nests and chicks. A small scrape will provide cover and a foraging area for chicks.

Around 2.8ha of grassland on the elevated part of the site would be suitable for breeding lapwing. As lapwing territories can be as small as 0.5ha when nesting, this could support up to 5 pairs; however, a more realistic target based on previous densities on the Solar Farm site would be 2 pairs, while current loss of the species from the wider site suggests this should be an aspiration rather than a defined target.

The grassland area would also be suitable for foraging oystercatcher, the scrape providing areas of greater penetrability compared to other areas of grassland.

Scrape and shingle habitats

The flat ground at the base of the slope will support an area of shingle large enough for one pair of nesting little ringed plover. A scrape, holding water well into the breeding season will provide suitable foraging habitat for adult birds, with ready access for chicks. This shingle area will also be suitable for a pair of nesting oystercatcher.

The scrape will have a variable depth, so that as it dries through the season it will develop as a number of separate pools, coalescing into a single waterbody in wet conditions.

The sloping grassland to the north of the scrape which currently supports poorly-established grassland will be improved to increase its resilience for grazing stock and value for wildlife by appropriate amendments and sowing a grass / legume mix, incorporating native cultivars of red clover (*Trifolium pratense*) and bird's-foot trefoil (*Lotus corniculatus*). This faces south, and will provide a suitably sheltered habitat for foraging butterflies and other invertebrates. The better established grassland on the top of the slope will be diversified by over-sowing with yellow rattle (*Rhinanthus minor*), which is known to increase grassland diversity by reducing grass vigour.

Woodland and scrub

The young plantation on the northern and north-eastern edges of the woodland will be maintained as coppice, restricting height growth to less than 3-4 metres and limiting vantage points for avian predators.

Unnecessary fencing and areas of defunct hedgerow and scrub patches will be removed to maximise openness and limit habitats for ground-based predators.

The mature woodland edge will not be coppiced, as this is further from likely areas to be used by breeding lapwing, and the mature trees themselves have an ecological and wider landscape value.

6 Appropriate management options for achieving objectives

6.1 Boundary features and adjacent habitats

Changes to field boundaries

Field boundaries have already been rationalised in order to manage the mitigation area as a single agricultural unit of 8.35ha and control grazing levels. The boundary of the revised mitigation area is shown in Figure 2.

By including areas further east than previously planned, access is possible to a water supply in the south-east corner of the new unit, allowing the field to be grazed without the need to retain access to troughs on the northern edge of the Business Park site.

Scrub and plantation management

The small area of scrub and defunct hedgerow in the western part of the site should be removed, along with any remaining fencing. A 15m strip on the northern and eastern edge of the plantation to the west (0.26ha in area). A 0.12ha area of young ash trees in the plantation to the north is now within the new permanent pasture field unit, and does not require further management.

6.2 Grassland management

Grazing management

The necessary changes in attractiveness of the established grassland for breeding waders can be accomplished by changes in the grazing regime, in terms of timing, type of stock and stocking density, in accordance with the following management principles:

- Maintaining a short sward in spring (grass height in March 3cm or less over 80% of the field);
- Maintaining taller patches and tussocks for shelter (10-15cm height in March, covering no more than 20% of the field);
- Reducing the risk of trampling nests by keeping stocking levels low between mid-March and mid-June;
- Grazing the field more intensively in late summer and autumn to produce the short sward height needed in spring;

- Creating or maintaining damp areas within the field by creating shallow scrapes; and
- Maintaining an open aspect to fields, avoiding trees or other vantage points which could be used by avian predators.

All species will benefit from a reduction or temporary cessation in grazing pressure during the breeding season, in order to reduce the risk of livestock trampling eggs.

Grazing by cattle is preferable on fields managed for breeding waders, both to reduce the risk of nest trampling in spring (cattle and horses are less likely to trample than sheep), and to create a more varied sward through more intensive grazing in autumn.

Levels of 1 cow / hectare between mid-March and mid-June have been recommended in the past by the RSPB. This is equivalent to a very light grazing pressure (in terms of forage intake, a 550kg dairy cow is equivalent to 1 Livestock Unit (LU); a smaller 400kg beef cow is equivalent to only 0.56LU (Crofts & Jefferson, 1994). A grazing intensity of 0.56LU / ha is probably too low in itself to prevent the development of a rank, tussocky sward as the breeding season progresses, which will not be suitable for lapwing. If cattle grazing is employed, a balance may have to be reached between preventing development of rank vegetation during the breeding season and the risk of nest trampling.

Diversification of grass sward

The south-facing grass sward was not very well-established in early 2014, and may break down under grazing management, particularly on the steeper parts of the slope. This was assessed in 2015, which found that the sward had become better established, but was still quite open, and dominated in many places by non-agricultural species such as creeping bent grass (*Agrostis stolonifera*). It is still thought to be open enough to enable establishment by re-sowing; the area on the top of the slope would need cutting and a short period of heavy cattle grazing to break up the sward, in accordance with recommendations in TIN064 (Natural England, 2010), so this method should be confined to the slopes. The seed mix used should include a high proportion of native legume species in the sward, including red clover and bird's-foot trefoil.

The better established grassland at the top of the slope can be mown to a low level and oversown with yellow rattle (*Rhinanthus minor*) in accordance with recommendations in TIN060 (Natural England, 2009).

An appropriate target for a more diverse sward would be a threshold in the range of 10-15 species per $4m^2$ sample area.

6.3 Scrape management

Construction of scrape and shingle area

A shallow scrape should be excavated on flat ground in the southern part of the slope of around 0.1ha in area; this encompasses an area of naturally wet ground. Material from the scrape should be spread evenly around, so as to avoid creating steep slopes or bunds close to the water. The base of the scrape should be compacted by the excavator bucket in order to reduce permeability.

To the north of the scrape, an area of 0.3m deep shingle (gravel) should be spread over the remainder of the flat area at the foot of the slope, which should provide an area of around 0.2ha. The total area of 0.3ha of shingle and scrape encompass all of the area with potential to create such a habitat, as adjacent areas are gently sloping.

Another smaller scrape should be excavated in an area of existing damp grassland within the improved grassland area on the top of the slope.

Locations of proposed scrapes and shingle areas are shown on Figure 2.

After-care requirements

The main after-care requirements are for control of encroaching vegetation on the shingle habitat. Periodic application of a non-selective, systemic herbicide should be undertaken after the end of the breeding season. This should not encroach on adjacent grassland areas sown with bird's-foot trefoil, although selective control of noxious weeds may be necessary.

7 Prescriptions for management actions

7.1 Establishment works (year 1)

The appropriate management options set out above can be translated into the following actions:

Table 7.1: Establishment work prescriptions

Habitat / feature	Operation	Details	Timing
Scrub	Removal	Grub out small area of scrub (ca. 100m^2) on old field boundary, together with any shrubs in defunct hedgerow / fence to north.	Aug. – Feb.
Fencing	Removal	Remove any remaining remnants of fencing along former field boundaries.	Aug. – Feb.
Fencing	*Installation*	*Construct stock-proof post-and-wire fencing with gate.*	*Complete*
Scrub	Coppicing	Coppice 15m strip (0.26ha) along northern and eastern edge of SW plantation, and 0.12ha area of young ash trees in northern plantation.	Winter
Scrapes	Construction	Shallow excavation of scrape to <0.5m maximum depth over 0.1ha area, with spoil spread over flat area of field.	Aug. – Feb.
Shingle bed	Construction	Spread 0.2ha area of gravel in a 0.3m thick layer, compact with excavator bucket.	Aug. – Feb.
Grassland	Improve diversity: Introduction of legumes / other wildflowers and yellow rattle	Harrow and over-sow or slot-seed with red clover, bird's-foot trefoil and other species on sloping areas of sward in accordance with TIN064, and with yellow-rattle at top of slope in accordance with TIN060.	Autumn

7.2 Maintenance prescriptions

Habitat	Operation	Details	Timing
Grassland	Monitor sward height	Check <30mm over 80% of field area to monitor effectiveness of earlier management	Early March
Grassland	Grazing	Graze with cattle at 0.56LU/ha (1 head beef cattle / ha) or less	mid-March – mid-June
Grassland	Grazing	Graze with cattle or cattle / sheep at levels sufficient to reduce sward height to 20mm across 80% of field by end of season	Late June – autumn
Grassland	Mowing	Optional operation to take late-season hay or silage crop if stock not available for grazing in this period.	Late summer / autumn
Shingle bed	Herbicide treatment	Assess requirement for treatment of tall weed species; spot-treatment with appropriate systemic herbicide if necessary. Specification and use should be in accordance with Plant Protection Products (Sustainable Use) Regulations 2012 and relevant Codes of Practice	August
Plantations	Coppicing	Coppice same areas as year 1 when regrowth reaches 3m, or on a 3-year cycle, whichever is sooner	Winter (triennial)

8 Work schedule

8.1 Establishment works (year 1-2)

Action	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Boundary works											
Fence removal								year 1				
New fencing								complete				
Scrub removal								year 1				
Coppicing	year 2									year 1		
	Scrape and shingle bed											
Excavate scrape								year 1				
Form shingle bed								year 1				
	Grassland management											
Assess pasture quality								complete				
Over-sowing									year 1			
Manure spreading			year 2									

8.2 Maintenance works

Action	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Plantations											
Coppicing	year 4, 7, 10 etc.									year 3, 6, 9 etc.		
	Scrape and shingle bed											
Herbicide treatment								As required				
	Grassland management											
Monitor sward height			annual									
Breeding season grazing			annual									
Post-breeding season grazing						annual						
Mowing									as required			
Manuring			as required									
	Bird monitoring											
Wader survey				annual	annual							

9 Implementation

The Wader Mitigation Plan will be implemented and funded by the site operator, by agreement with Haworth Estates as landowner and their tenant.

10 Monitoring and remedial measures

Monitoring provisions

Measures have been built into the management prescriptions and work schedule set out above to monitor the success of the Wader Mitigation Plan in achieving its habitat quality targets. These include:

- Annual checks on sward structure and height to assess achievement of suitable quality standards;
- Annual checks on shingle bed area to determine requirements for weed control;
- Annual checks on grassland diversity quality and resilience, to assess need for further remedial treatment;
- Monitoring of habitat utilisation by birds - the appropriate methodology for assessing utilisation of enclosed fields by breeding waders is O'Brien & Smith (1992), which requires two visits during the breeding season..

Remedial measures

Remedial measures to address lack of attainment of habitat targets have been built into the management prescriptions and work programme above. Additional measures may be required to address issues which may arise (e.g. invasive species such as Australian swamp stonecrop (*Crassula helmsii*) colonising the scrape), and to address any lack of attainment of breeding wader targets.

The results of monitoring may also suggest changes to the management prescriptions – for example, if tree growth is more vigorous than anticipated, coppicing frequency may need to be increased. Implementation of the plan should be flexible enough to make these adjustments.

Examples of anticipated and potential remedial measures are summarised in the table overleaf.

Table 10.1: Potential remedial measures

Feature	Trigger	Action
Breeding waders	No breeding little ringed plover or oystercatcher	Assess whether any further habitat quality improvements can be made.
Breeding waders	Failure to breed successfully	Assess whether improvements in habitat quality, predator control or exclusion, or changes to stocking levels would improve likely breeding success.
Grassland	Decline in quality of sward on poorer quality soils on southern slope	Assess whether temporary stock exclusion using electric fencing would allow recovery, or whether further remediation needed
Grassland	Failure to achieve gains in grassland diversity	Changes to management regime / further sowing or introduction of plants into sward
Scrape (and other habitats)	Presence of invasive species listed on Schedule 9 Wildlife and Countryside Act 1981 (as amended)	Eradication with appropriate bio-security measures in accordance with species-specific guidance.

11 References

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Natural England (2009). *The use of yellow rattle to facilitate grassland diversification*. Technical Information Note TIN060, first edition, 12th November 2009.

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O'Brien, M. and Smith, K. W. (1992). Changes in the status of waders breeding on wet lowland grassland in England and Wales between 1982 and 1989. *Bird Study* **39**: 165-176.

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Smart, J., Gill, J.A., Sutherland, W.J., and Watkinson, A.R. (2006). Grassland-breeding waders: identifying key habitat requirements for management. *Journal of Applied Ecology*, **43**, 454-463.

Appendix 1 Further modification of biodiversity offsetting metric

1 Introduction

The Energy Centre ES included a calculation using the DEFRA Biodiversity Offsetting Metric of the value of proposed on-site habitat creation, set against the existing value of the site. This was carried out using DEFRA guidance (DEFRA, 2012), including the published 'distinctiveness' scores for valuing habitats.

Modification in second Regulation 22 submission

Consultation responses to the ES from the County Council and Wildlife Trust pointed out that this approach did not take into account the full ecological interest of the site, as it did not account for birds. In fact this limitation of the metric was acknowledged in the ES, which highlighted the predicted impact on birds, including the cumulative impact of currently consented developments which had not been adequately mitigated. The Wader Mitigation Plan is essentially a response to this deficiency in the biodiversity offsetting methodology.

As the Mitigation Plan proposes a significant addition to the area of land managed for nature conservation, it is pertinent to re-calculate the offsetting metric to take this into account. Since completion of the ES, further work on the surface water drainage and flood attenuation system has confirmed that the attenuation feature is unlikely to hold permanent standing water; this requires a further minor revision of the offsetting metric calculation. Standing water and wet grassland have been taken out of the calculation, and replaced with species-rich grassland habitat; this is a conservative assumption, since it could be reasonably anticipated that wet grassland (a higher-value habitat) would develop in the base of the attenuation lagoon.

In re-calculating the metric, it should be recognised that deficiencies in the methodology will continue to skew the results. The target habitat over much of the mitigation area is improved or semi-improved grassland, which have a low 'distinctiveness' score of 1. The ecological value of the mitigation arises from changes in habitat structure, leading to greater probability of utilisation by target species and a reduced risk of nest predation or chick mortality. This is not adequately accounted

for in the offsetting metric, resulting in a neutral result for most of the mitigation area.

The value of the area of shingle could also be assessed as 'low' if it is assigned to the 'other artificial rock exposure and waste' category, which is clearly an inadequate representation of a feature designed to support a Schedule 1 breeding bird. However, application of DEFRA guidance (Appendix 1) suggests that it should be included as a secondary habitat category of a single habitat parcel, in this case 'other standing open water and canals', which has a 'medium' score of 2. These caveats should be borne in mind when assessing the true value of the mitigation area.

Further re-calculation in 2015

Further re-calculation of value has been carried out to reflect the greater value of the BEC site due to natural successional processes, as reported in the 2015 Habitat Survey, the intended increase in emphasis in the management plan on grassland diversification, and the larger mitigation area which is now proposed.

2 Re-calculation of value

Valuation of habitat creation

The following table provides a re-calculation of Table 8.12 in the ES, and Table A1.1 in the second version of the Wader Mitigation Plan.

Table A1.1: Re-calculation of net value of proposed habitat creation

(a): proposed habitat creation area ('gross' value)

Habitat	Equivalent in DEFRA guidance	Distinctiveness	Multiplier	Area (ha)	Value
					(biodiversity units)
Species-rich grassland	Other neutral grassland	Medium	4	0.671	2.684
Semi-improved grassland	Other neutral grassland	Medium	4	7.9898	31.9592
Scrape and shingle area	Other standing waters	Medium	4	0.361	1.444
Sub-total			sub-total	9.0218	36.0872
	-	Condition multiplier – 'medium'	4	TOTAL	**144.3488**

(b): value of existing habitat within mitigation area

Habitat	Equivalent in DEFRA guidance	Distinctiveness	Multiplier	Area (ha)	Value
Open mosaic habitat	Open mosaic habitat on previously developed land	High	6	0.671	4.026
Improved grassland	Improved grassland	Low	2	7.9898	15.9796
Improved grassland	Improved grassland	Low	2	0.361	0.722
		Condition multiplier	1	TOTAL	***20.7276***
Net-total				(144.35--20.73)	**123.6212**

Application of risk and time multipliers

The next stage is to account for the risk of successful creation and time taken to achieve target habitats. In the ES a 'low risk' multiplier was used for the on-site mitigation; here a more conservative 'medium risk' multiplier is used for all of the components of the mitigation, both on-site and off-site. The same <5 year 'time multiplier' of 1.2 is used, as the additional habitats do not take a long time to create. This gives the following figures, after disaggregating the different habitat components values set out above.

Table A1.2: Application of risk and time multipliers

Component area	Total units	Risk multiplier	Time multiplier	TOTAL
Species-rich grassland	6.71	1.5	1.2	**3.73**
Semi-improved grassland	111.8572	1.5	1.2	**62.14**
Scrape and shingle	5.054	1.5	1.2	**2.808**
				68.68
			Value of Energy Centre site	***-26.1***
			Net increase in biodiversity units	**+42.58**

This significantly increases the net positive value of habitat creation from +8.35 units in the previous version. This is because of the greater size of the mitigation area, and greater attention paid to improving grassland diversity.

Bilsthorpe, Nottinghamshire

ENERGY CENTRE

WADER MITIGATION PLAN

Drain

67.1m

Ward Bdy

Def

Cattle-grazed permanent pasture

Small scrape (damp area)

TURBINE 4 LOCATION

Cattle-grazed permanent pasture

New fence

Proposed new mitigation field - 4.6ha excluding steeper slopes to north-west

Grassland diversity enhancement - yellow rattle oversowing (top of slope)

Remove small area of scrub

Grassland diversity enhancement - oversowing grass / legume / wildflower mix

Coppice 15m strip to create scrub area

Plantation

Shingle area (min. 0.2ha)

200m radius

New scrape

Existing mature woodland

Mitigation field water trough

El Sub Sta

ESS

Pond

KEY

- Mitigation area
- BEC boundary
- Inundated scrape
- Deeper areas of scrape

argus ecology

The Greenhouse, Greencroft Industrial Park, Annfield Plain, Co. Durham, DH9 7XN

Figure.1: Mitigation proposals

Version 3.0, 15/09/2015

Appendix 3-1

Application to the Environment Agency for classification of the Bilsthorpe Energy Centre as an R1 Recovery Facility on the basis of design information

Application for an environmental permit Part A – About you

You will need to fill in this part A if you are applying for a new permit, applying to change an existing permit or surrender your permit, or want to transfer an existing permit to yourself. Please check that this is the latest version of the form available from our website.

Please read through this form and the guidance notes that came with it. Please write clearly in the answer spaces.

Note: if you believe including information on a public register would not be in the interests of national security you must tick the box in section 5 of F1 or F2 and enclose a letter telling us that you have told the Secretary of State. We will not include the information in the public register unless directed otherwise.

It will take less than one hour to fill in this part of the application form.

Where you see the term 'document reference' on the form, give the document references and send the documents with the application form when you've completed it.

Contents

1 About you

Are you applying as an individual, an organisation of individuals (for example, a partnership), a company (this includes Limited Liability Partnerships) or a public body?

An individual	☐ Now go to section 2
An organisation of individuals (for example, a partnership)	☐ Now go to section 3
A public body	☐ Now go to section 4
A registered company or other corporate body	☐ Now go to section 5

2 Applications from an individual

2a Please give us the following details

Name

Title (Mr, Mrs, Miss and so on)

First name

Last name

Date of birth (DD/MM/YYYY)

Now go to section 6

3 Applications from an organisation of individuals

3a Type of organisation

For example, a charity, a partnership, a group of individuals or a club

3b Details of the organisation

If you are an organisation of individuals, please give the details of the main representative below. If relevant, provide details of other members (please include their title Mr, Mrs and so on) on a separate sheet and tell us the document reference you have given this sheet.

Contact name

Title (Mr, Mrs, Miss and so on)

First name

3 Applications from an organisation of individuals, continued

Last name

Date of birth (DD/MM/YYYY)

Now go to section 6

4 Applications from public bodies

4a Type of public body

For example, NHS trust, local authority, English county council

4b Name of the public body

4c Please give us the following details of the executive

An officer of the public body authorised to sign on your behalf

Name

Title (Mr, Mrs, Miss and so on)

First name

Last name

Position

Now go to section 6

5 Applications from companies or corporate bodies

5a Name of the company

Peel Environmental Management UK Limited

5b Company registration number

07580930

Date of registration (DD/MM/YYYY)

28/03/2011

If you are applying as a corporate organisation that is not a limited company, please provide evidence of your status and tell us below the reference you have given the document containing this evidence.

Document reference

Now go to section 6

6 Your address

6a Your main (registered office) address

For companies this is the address on record at Companies House.

Contact name

Title (Mr, Mrs, Miss and so on)

Mr

First name

Richard

Last name

Barker

Address

Peel Dome

The Trafford Centre

Manchester

Postcode

M17 8PL

Contact numbers, including the area code

Phone

0161 629 8200

Fax

0161 629 8335

Mobile

07425 629675

Email

rbarker@peel.co.uk

6 Your address, continued

For an organisation of individuals every partner needs to give us their details, including their title Mr, Mrs and so on. So, if necessary, continue on a separate sheet and tell us below the reference you have given the sheet.

Document reference for the extra sheet

6b Main UK business address (if different from above)

Contact name

Title (Mr, Mrs, Miss and so on)

First name

Last name

Address

Postcode

Contact numbers, including the area code

Phone

Fax

Mobile

Email

Now go to section 7

7 Contact details

7a Who can we contact about your application?

This can be someone acting as a consultant or an 'agent' for you.

Contact name

Title (Mr, Mrs, Miss and so on) Mr

First name Stephen

Last name Othen

Address Fichtner Consulting Engineers Ltd
Kingsgate House
Wellington Road North
Stockport

Postcode SK4 1LW

Contact numbers, including the area code

Phone 0161 4760032

Fax 01614740618

Mobile

Email stephenothen@fichtner.co.uk

7 Contact details, continued

7b Who can we contact about your operation (if different from question 7a)?

Contact name

Title (Mr, Mrs, Miss and so on)

First name

Last name

Address

Postcode

Contact numbers, including the area code

Phone

Fax

Mobile

Email

7c Who can we contact about your billing or invoice?

As in question 7a ☐

As in question 7b ☐

Please give details below if different from question 7a or 7b.

Contact name

Title (Mr, Mrs, Miss and so on) Mr

First name Richard

Last name Barker

Address Peel Dome

The Trafford Centre

Manchester

Postcode M17 8PL

Contact numbers, including the area code

Phone 0161 629 8200

Fax 0161 629 8335

Mobile 07425 629675

Email Rbarker@peel.co.uk

8 How to contact us

If you need help filling in this form, please contact the person who sent it to you or contact us as shown below.

General enquiries: 03708 506 506 (Monday to Friday, 8am to 6pm)

Textphone: 03702 422 549 (Monday to Friday, 8am to 6pm)

Email: enquiries@environment-agency.gov.uk

Website: www.environment-agency.gov.uk

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Please tell us if you need information in a different language or format (for example, in large print) so we can keep in touch with you more easily.

Feedback

(You don't have to answer this part of the form, but it will help us improve our forms if you do.)

We want to make our forms easy to fill in and our guidance notes easy to understand. Please use the space below to give us any comments you may have about this form or the guidance notes that came with it.

How long did it take you to fill in this form?

We will use your feedback to improve our forms and guidance notes, and to tell the Government how regulations could be made simpler.

Would you like a reply to your feedback?

Yes please ☐

No thank you ☐

Crystal Mark 19101 Clarity approved by Plain English Campaign

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Date received (DD/MM/YYYY)

Our reference number

Payment received?

No ☐

Yes ☐ Amount received

£

FICHTNER
Consulting Engineers Limited

PEEL ENVIRONMENTAL

BILSTHORPE RENEWABLE ENERGY CENTRE

R1 APPLICATION

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Stockport, Cheshire, SK4 1LW, United Kingdom
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PEEL ENVIRONMENTAL
BILSTHORPE RENEWABLE ENERGY CENTRE
R1 APPLICATION

Document Production & Approval Record				
ISSUE NO. 2	**NAME**	**SIGNATURE**	**POSITION**	**DATE**
Prepared by:	Stephen Othen		Technical Director	21/8/15
Checked by:	James Sturman		Consultant	21/8/15

Document Revision Record				
ISSUE NO.	**DATE**	**DETAILS OF REVISIONS**	**PREPARED BY**	**CHECKED BY**
1	18/8/15	Draft for client review	SMO	JRS
2	21/8/15	Final for submission	SMO	JRS
3				
4				
5				
6				
7				

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Background

Peel Environmental Management UK Ltd ("Peel") is developing a Energy Centre at Bilsthorpe Business Park near Newark. The project is known as the Bilsthorpe Energy Centre and will include a plasma gasification plant which will generate electricity from waste fuel derived from commercial, industrial and potentially municipal waste sources.

Peel wishes to apply for the plasma gasification plant to be classified as a R1 Recovery operation, based on design data. Since the plasma gasification technology cannot be assessed using the standard R1 spreadsheet, the calculations to demonstrate that it qualifies are set out in this document.

1.2 Process Summary

Before being transferred into the gasifier the prepared waste is blended in a feed hopper with met coke and limestone. The blended feedstock is then transferred into the gasifier.

Inside the gasification chamber the coke forms a bed at the bottom, while the feedstock is heated to a high temperature (1200°C) in a controlled amount of oxygen to form a synthesis gas (synas). A molten slag will flow through the coke bed and from the bottom of the gasifier while the syngas will flow through the top of the gasifier prior to cleaning and processing.

The syngas is passed through various clean-up processes including a quench/scrubber, direct contact cooler, syngas blower, wet electrostatic precipitator, syngas compressor, COS hydrolysis, mercury removal and sulphur removal. The cleaned syngas is then combusted in a gas engine to generate electricity.

The process is illustrated below. A set of process flow diagrams and a heat and mass balance for the design point is included in Appendix A.

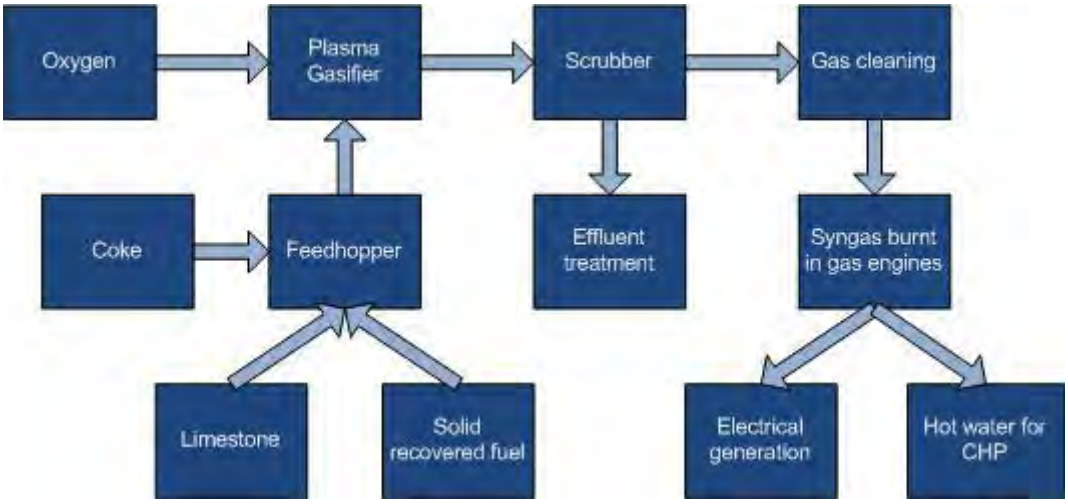


Figure 1 – Simplified process flow diagram

2 R1 CALCULATION

2.1 R1 Formula

The R1 formula is set out in a footnote to Annex II of the Waste Framework Directive as:

$$\textit{Energy efficiency} = \frac{E_p - (E_f + E_i)}{0.97 \times (E_w + E_f)}$$

In which:

E_p means annual energy produced as heat or electricity. It is calculated with energy in the form of electricity being multiplied by 2.6 and heat produced for commercial use multiplied by 1.1 (GJ/year)

E_f means annual energy input to the system from fuels contributing to the production of steam (GJ/year)

E_w means annual energy contained in the treated waste calculated using the net calorific value of the waste (GJ/year)

E_i means annual energy imported excluding Ew and Ef (GJ/year)

0.97 is a factor accounting for energy losses due to bottom ash and radiation.

The derivation of the four quantities in this formula is set out below. Where values in the calculation are taken from the heat and mass balance data in Appendix A, a stream number has been shown.

2.2 Energy in Waste, E_w

The plant is designed to process 12.5 tonnes per hour of prepared waste (stream 20-001 on sheet 4) with a net calorific value (NCV) of 12.581 MJ/kg. The plant is assumed to operate for 7,600 hours per year. Hence:

E_w = 12,500 kg/h x 12.581 MJ/kg x 7,600 h/y = 1,195,195 GJ/y

2.3 Energy in Fuel, E_f

There are two types of fuel used in the plasma gasification process.

- While the main purpose of the coke is to form a bed for the gasification process, the energy in the coke contributes to the energy in the syngas. Therefore, the coke is considered to be a fuel for the purpose of the R1 calculation.
- Natural gas is used as a start-up fuel, to warm the bed before waste is added and to support the establishment of stable syngas. However, the gas burners are not used when the gas engines are running and so the natural gas does not contribute to the production of energy. Natural gas can also be used as a fuel in the gas engines, but this is not expected to be required. For this reason, in the design case calculation, natural gas is not included in E_f.

The plant is designed to use 0.500 tonnes of coke per hour (stream 20-003 on sheet 4). The net calorific value of coke is 29.8 MJ/kg. Hence,

E_f = 500 kg/h x 29.834 MJ/kg x 7,600 h/y = 113,369 GJ/y

2.4 Energy Imported, E_i

The energy imported into the process comes in two forms.

- Natural gas is used for start-up, as explained above. As stated in Appendix C, the designers expect that a full start-up of the plant would use 9,000 Nm^3 of natural gas, with a NCV of 34.2 MJ/Nm^3. The designers expect two to four start-ups a year, but we have assumed six start-ups in a year in order to be conservative.

  Hence, E_i (gas) = 6 x 9,000 Nm^3 x 34.2 MJ/Nm^3 = 1,847 GJ
- Electricity is imported when the plant is offline. The designers expect electricity consumption when the plant is offline to be low. We have taken a figure of 670 kW, which is around 5% of the generation capacity, and assumed that this is consumed for each hour that the plant is offline. Again, this is considered to be conservative. The total electricity imported is multiplied by the factor of 2.6 for electricity.

  Hence, E_i (electricity) = 670 kW x (8760 − 7600) x 3.6 MJ/kWh x 2.6 = 7,275 GJ

Hence:

E_i (total) = 1,847 GJ + 7,275 GJ = 9,122 GJ.

2.5 Energy Produced, E_p

Although the plant will be designed to export heat as well as power, this application is based on power generation only. If heat is exported, the R1 value would improve.

The heat and mass balances in Appendix B show that the plant will produce 14,949 kg/h of clean syngas, or 14,544 m^3/h at a reference temperature of 15°C (stream 30-030 on sheet 3). The indicative composition of the syngas is shown below and this gives a gross calorific value (GCV) of 9.244 MJ/m^3 and a NCV of 8.633 MJ/m^3, both at a reference temperature of 15°C.

Hence, the total energy available in the syngas will be:

14,544 m^3/h x 7,600 h/y x 8.633 = 954,243 GJ/y

Substance	Molar Fraction
Carbon monoxide	0.4507
Carbon dioxide	0.1732
Nitrogen	0.0669
Argon	0.0144
Hydrogen	0.2303
Methane (CH4)	0.0204
Ethane (C2H6)	0.0026
Ethene (C2H4)	0.0005
Hydrogen sulphide (H2S)	<0.0001
Hydrogen cynanide (HCN)	0.0001
Water	0.0410

According to the letter from the gas engine supplier, Finning, reproduced as Appendix B, the efficiency of the gas engines when running with this syngas will be 39.5%. Hence, the power generated will be 954,243 x 0.395 = 376,926 GJ, which is equivalent to 13.77 MW. Hence,

E_p = 376,926 x 2.6 = 980,007 GJ

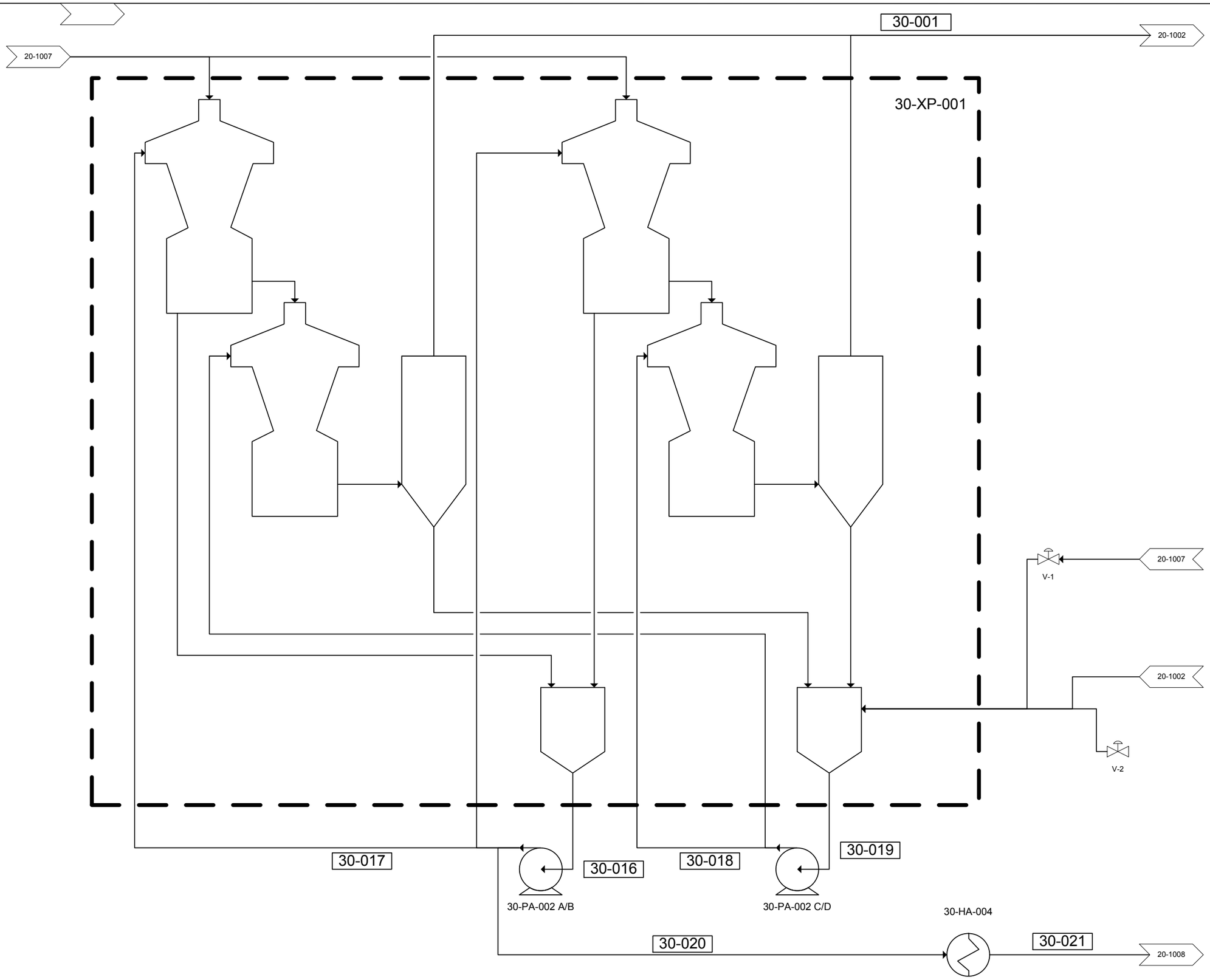
2.6 Calculation of R1 value

From the figures above, we can calculate the R1 efficiency.

$$\textit{Energy efficiency} = \frac{E_p - (E_f + E_i)}{0.97 \times (E_w + E_f)} = \frac{980007 - (113369 + 9122)}{0.97 \times (1195195 + 113369)} = 0.6756$$

Hence, the R1 efficiency is greater than 0.65.

Appendix A - Heat and Mass Balances



General:

1. For Heat & Material Balance Data refer to 33139-8110-21-1001

Notes:

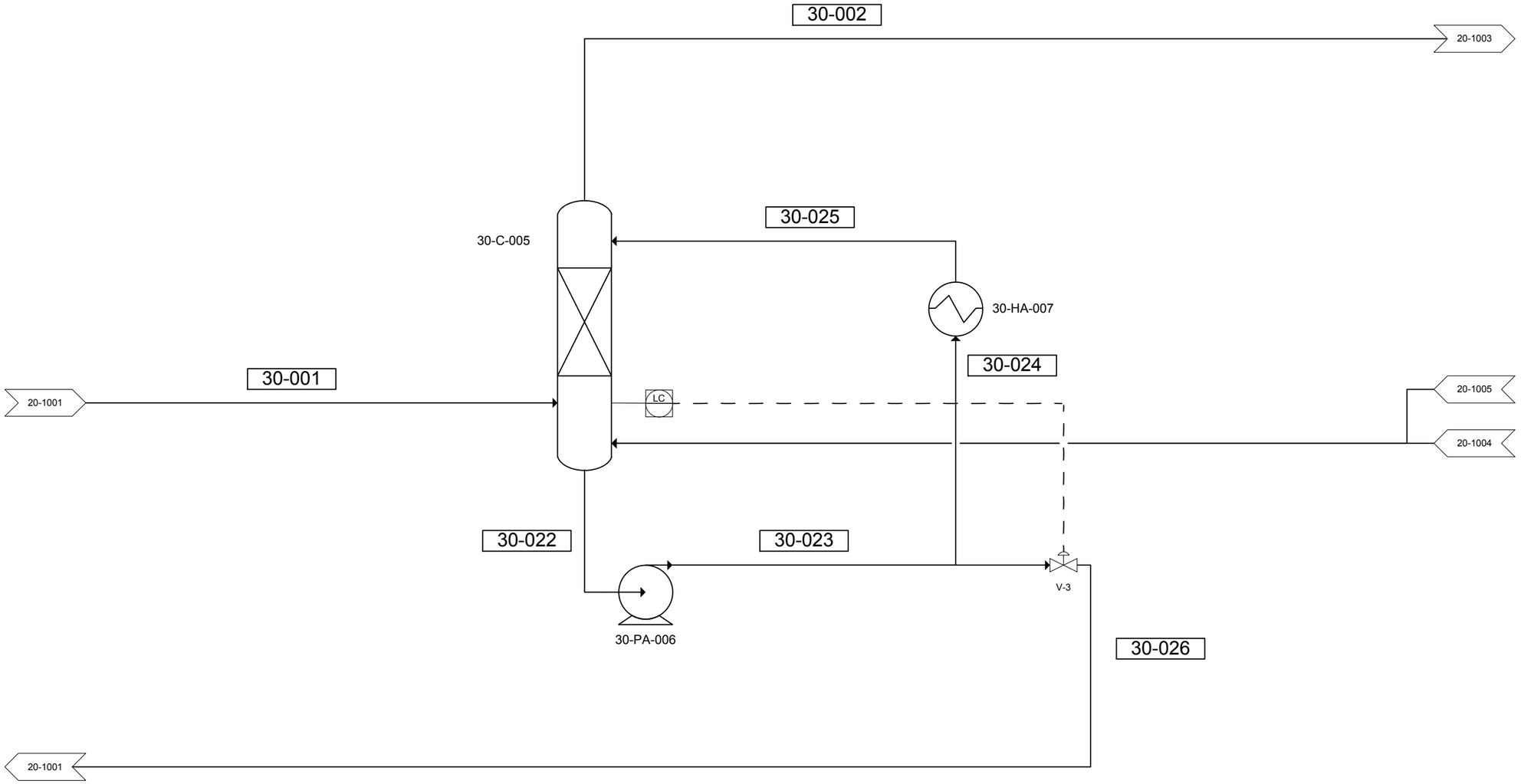
REV	DATE	DESCRIPTION	BY	CHCK	APPR
O1	01/05/13	ISSUED FOR PROPOSAL	LG	MC	MC

FOSTER WHEELER

PROCESS FLOW DIAGRAM
Venturi Scrubber

FW-CONTRACT NO: 33139

FW DRG NO:	DSN:	REV:
33139-8110-20-1001	0001	O1



General:

1. For Heat & Material Balance Data refer to 33139-8110-21-1001

Notes:

REV	DATE	DESCRIPTION	BY	CHCK	APPR
O1	01/05/13	ISSUED FOR PROPOSAL	LG	MC	MC

FOSTER WHEELER

PROCESS FLOW DIAGRAM
Direct Contact Cooler

FW-CONTRACT NO: 33139

FW DRG NO:	DSN:	REV:
33139-8110-20-1002	0001	O1

General:

1. For Heat & Material Balance Data refer to 33139-8110-21-1001

Notes:

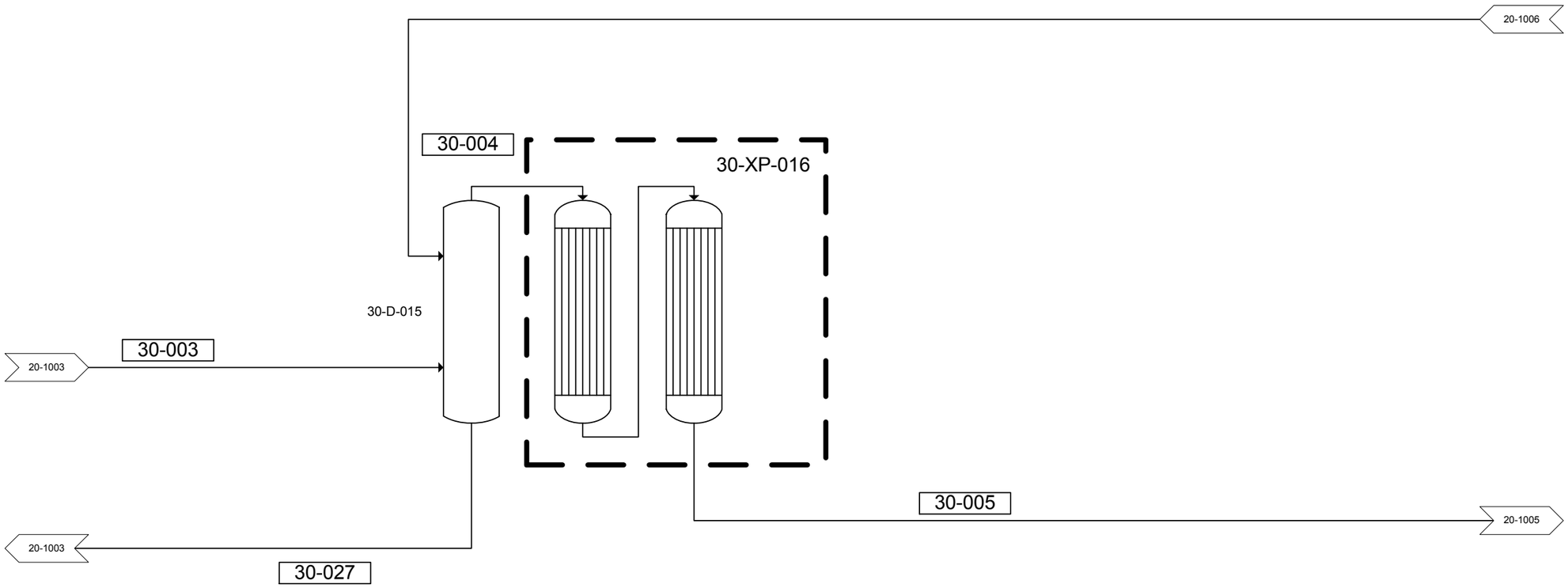
REV	DATE	DESCRIPTION	BY	CHCK	APPR
O1	01/05/13	ISSUED FOR PROPOSAL	LG	MC	MC

FOSTER WHEELER

PROCESS FLOW DIAGRAM
Syngas Blower

FW-CONTRACT NO: 33139

FW DRG NO:	DSN:	REV:
33139-8110-20-1003	0001	O1



General:

1. For Heat & Material Balance Data refer to 33139-8110-21-1001

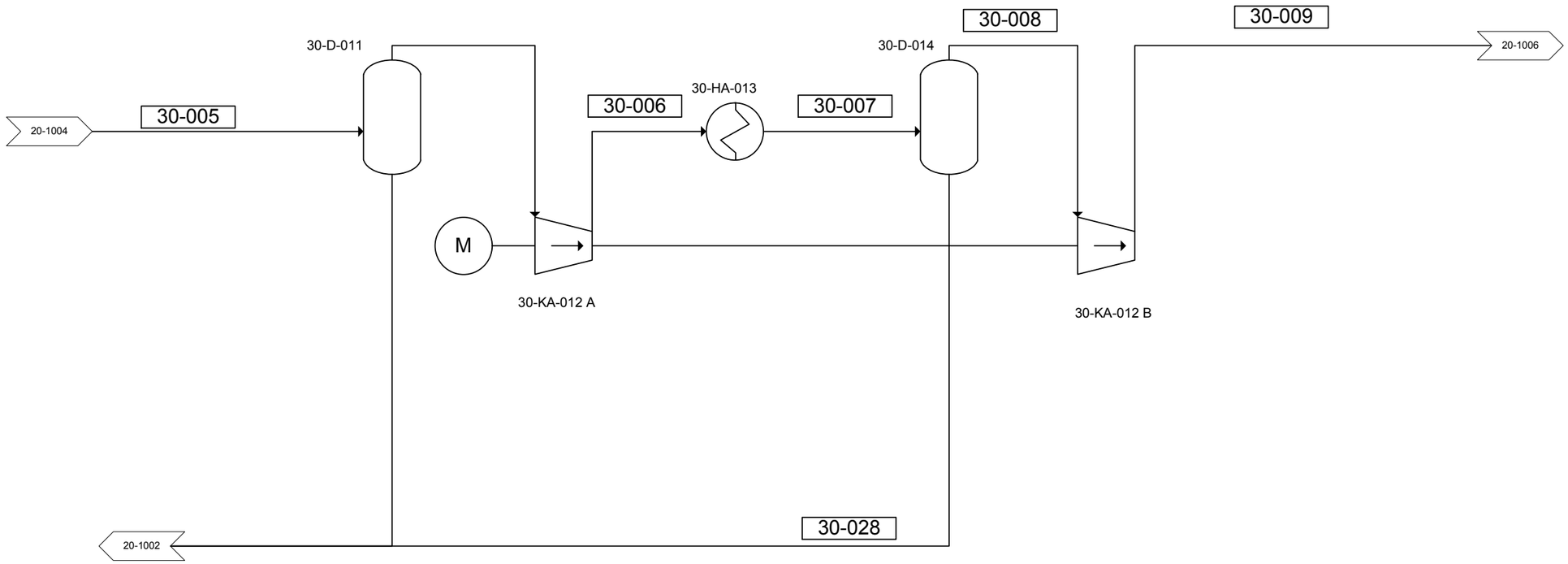
Notes:

REV	DATE	DESCRIPTION	BY	CHCK	APPR
O1	01/05/13	ISSUED FOR PROPOSAL	LG	MC	MC

PROCESS FLOW DIAGRAM
Wet Electrostatic Precipitator

FW-CONTRACT NO: 33139

FW DRG NO:	DSN:	REV:
33139-8110-20-1004	0001	O1



General:

1. For Heat & Material Balance Data refer to 33139-8110-21-1001

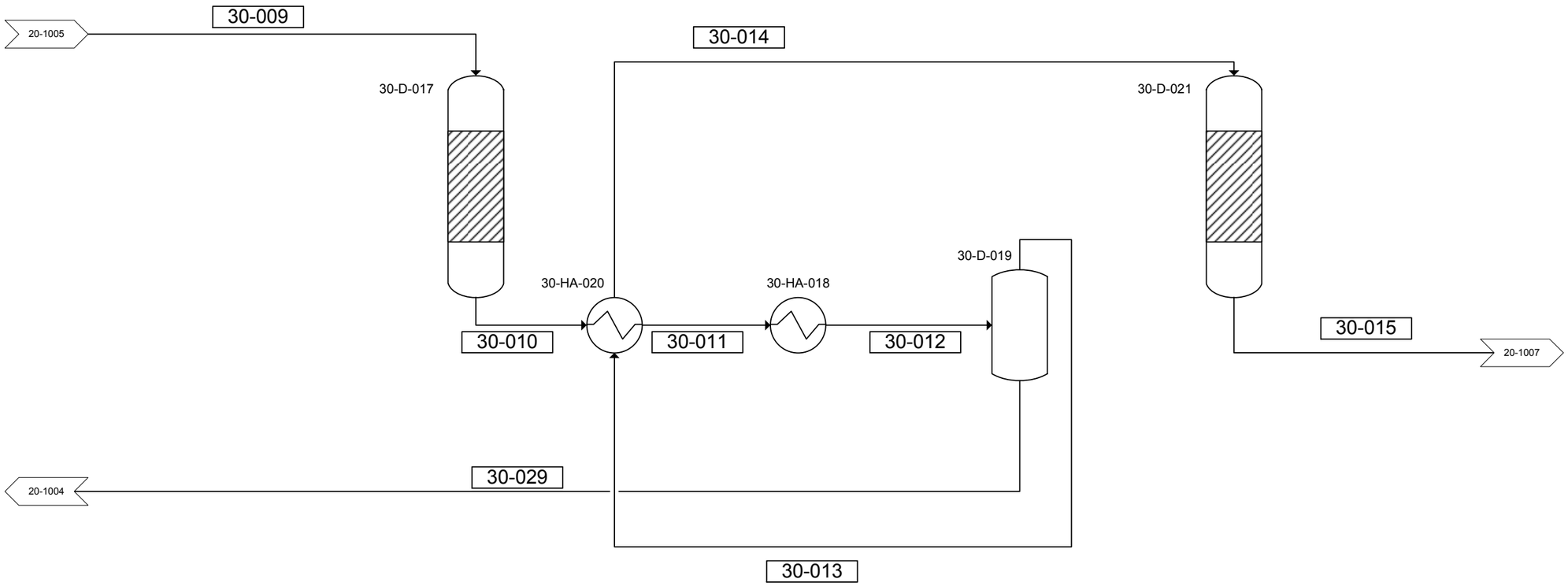
Notes:

REV	DATE	DESCRIPTION	BY	CHCK	APPR
O1	01/05/13	ISSUED FOR PROPOSAL	LG	MC	MC

PROCESS FLOW DIAGRAM
Syngas Compressor

FW-CONTRACT NO: 33139

FW DRG NO:	DSN:	REV:
33139-8110-20-1005	0001	O1



General:

1. For Heat & Material Balance Data refer to 33139-8110-21-1001

Notes:

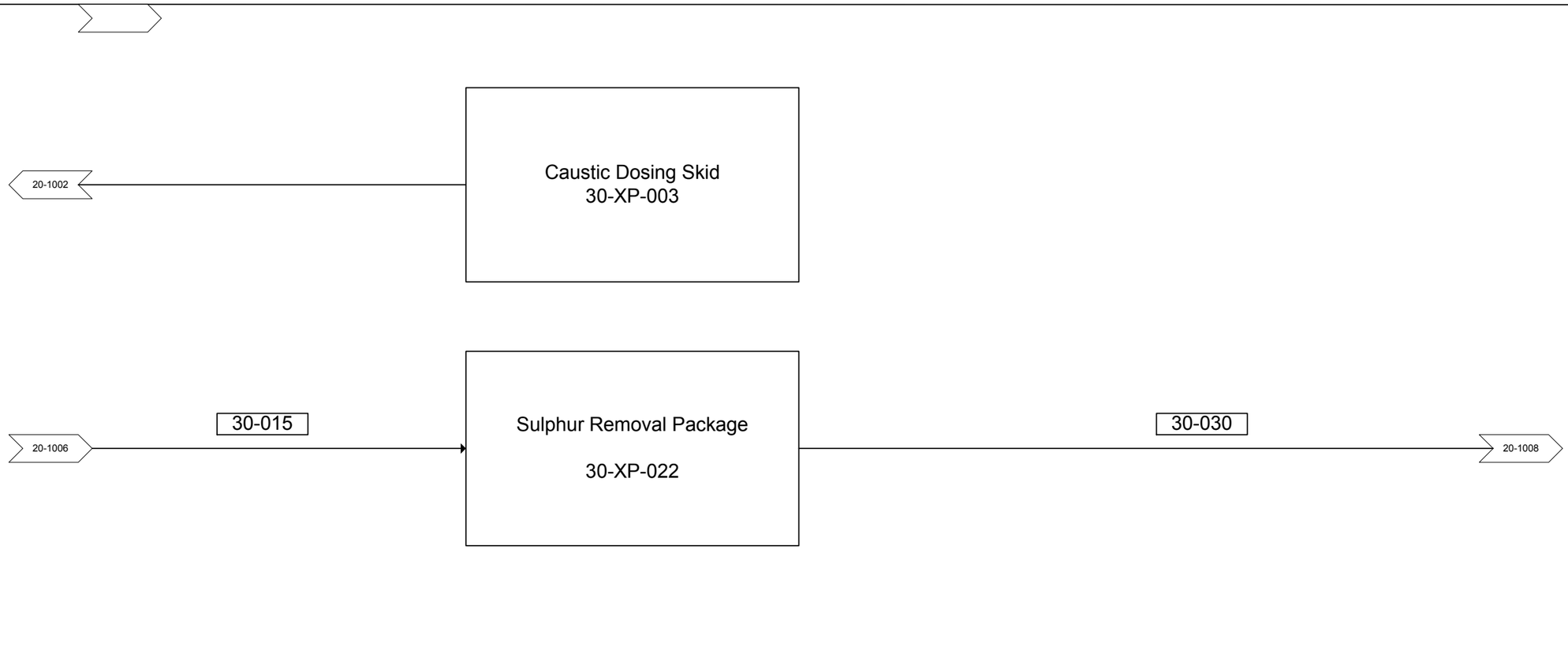
REV	DATE	DESCRIPTION	BY	CHCK	APPR
O1	01/05/13	ISSUED FOR PROPOSAL	LG	MC	MC

FOSTER WHEELER

PROCESS FLOW DIAGRAM
COS and Hg Removal

FW-CONTRACT NO: 33139

FW DRG NO:	DSN:	REV:
33139-8110-20-1006	0001	O1



General:

1. For Heat & Material Balance Data refer to 33139-8110-21-1001

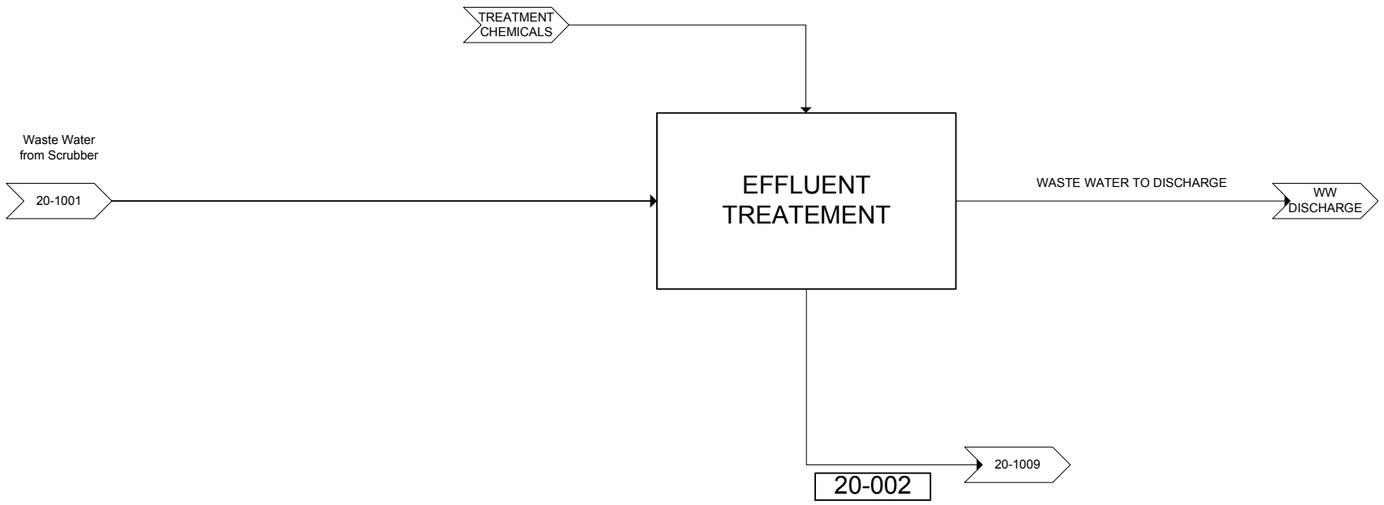
Notes:

REV	DATE	DESCRIPTION	BY	CHCK	APPR
O1	01/05/13	ISSUED FOR PROPOSAL	LG	MC	MC

PROCESS FLOW DIAGRAM
Vendor Packages

FW-CONTRACT NO: 33139

FW DRG NO:	DSN:	REV:
33139-8110-20-1007	0001	O1



General:

1. For Heat & Material Balance Data refer to 33139-8110-21-1001

Notes:

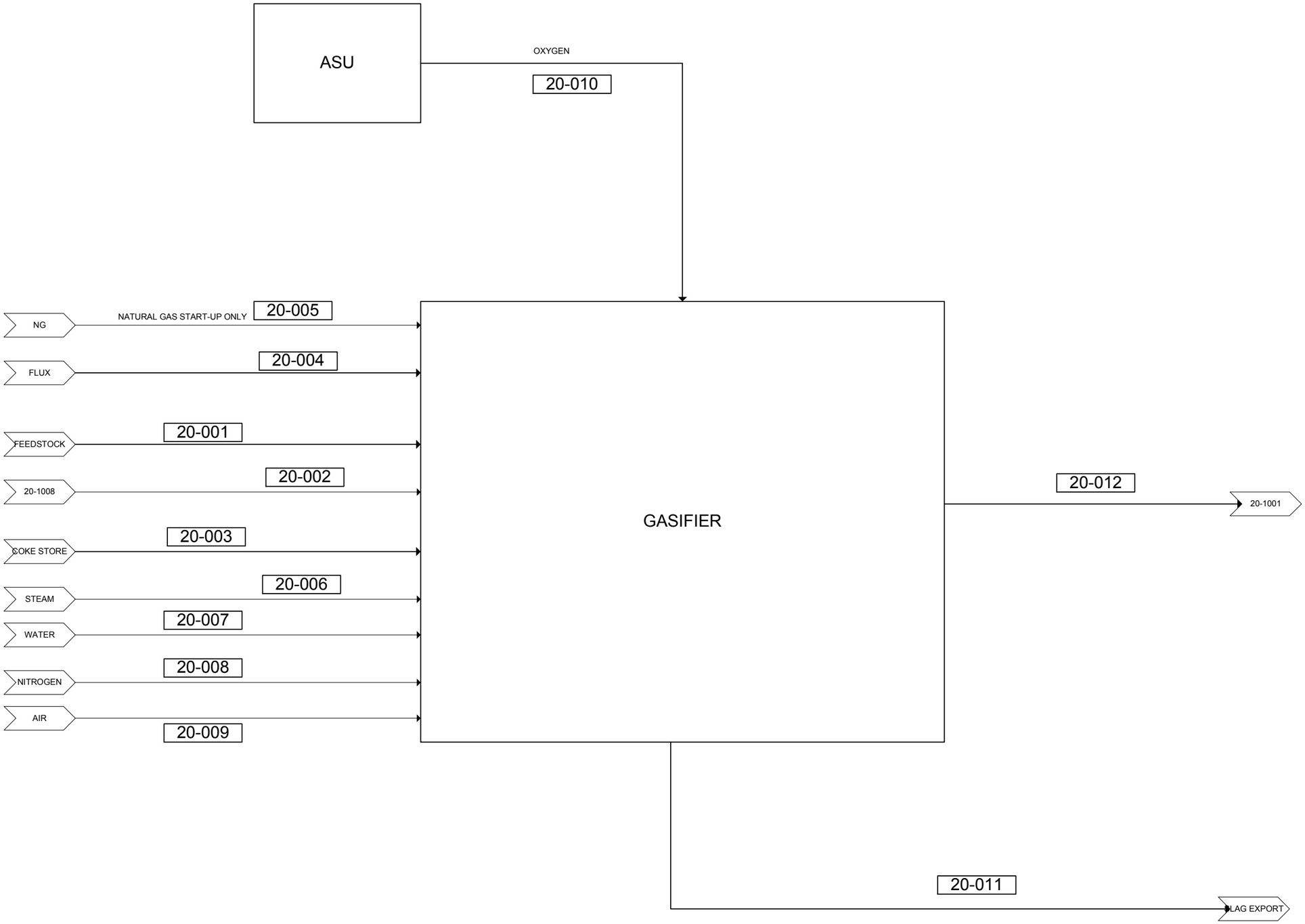
REV	DATE	DESCRIPTION	BY	CHCK	APPR
O1	01/05/13	ISSUED FOR PROPOSAL	LG	MC	MC

FOSTER WHEELER

PROCESS FLOW DIAGRAM
Interconnects

FW-CONTRACT NO: 33139

FW DRG NO:	DSN:	REV:
33139-8110-20-1008	0001	O1



General:

1. For Heat & Material Balance Data refer to 33139-8110-21-1001

Notes:

REV	DATE	DESCRIPTION	BY	CHCK	APPR
O1	01/05/13	ISSUED FOR PROPOSAL	LG	MC	MC

FOSTER WHEELER

PROCESS FLOW DIAGRAM
Gasifier by Alter

FW-CONTRACT NO: 33139

FW DRG NO:	DSN:	REV:
33139-8110-20-1009	0001	O1

FW Contract:	33139
Client's Name:	Waste2tricity
Project Title:	Bilsthorpe Waste to Energy
Project Location:	Bilsthorpe , UK

REVISION	O1	Signature	O2		O3	
DATE	02/07/2013		08/07/2013		05/08/2015	
ORIG. BY	L. Grim		L. Grim		J. Watt	
APP. BY	M. Cook		M. Cook		M. Cook	

FOSTER WHEELER ENERGY LTD.

Heat & Material Balance

										Rev.	O1	O2	O3				
		Client: Waste2tricity						Contract:	33139	Date	02/07/2013	08/07/2013	31/07/2015	SHEET	2	of	4
		Description: Bilsthorpe Waste to Energy								Orig. By	L. Grim	L. Grim	J Watt				
		Unit: 30 - Syngas Cleanup								App. By	M. Cook	M. Cook	M. Cook				
										Doc Number:	33139-8110-21-1001						

Stream (Summary)	UOM	30-0	30-001	30-002	30-003	30-004	30-005	30-006	30-007	30-008	30-009	30-010	30-011	30-012	30-013	30-014	30-015
Description		30-0	Quenched SynGas	Cooled Gas to Blower	Syngas from Blower	Saturated Syngas to WESP	Syngas from WESP	Hot IP syngas	Cooled IP Syngas	Cool Dry IP Syngas	Hot HP SynGas	Syngas DS of COS Hydrolysis	Cold Wet HP sngas	Syngas D/S of COS aftercooler	Cold Dry HP Syngas	Superheated HP syngas to Hg Removal	Superheated Clean Syngas to H2S removal
Phase		Liquid	Vapor	Vapor	Vapor	Vapor	Vapor	Vapor	Mixed	Vapor	Vapor	Vapor	Vapor	Mixed	Vapor	Vapor	Vapor
Total Molar Rate	kg-mol / hr	2729	1648	623	623	640	640	640	640	605	605	605	605	605	597	597	597
Total Mass Rate	kg / hr	49568	34297	15816	15816	16120	16120	16120	16120	15486	15486	15486	15486	15486	15338	15337	15337
Temperature	C	88.3	87.9	30.3	90.5	47.2	47.2	93.1	30.0	30.0	108.0	108.0	93.5	25.0	25.0	40.0	39.9
Pressure	kPa	101	101	83	140	140	135	200	180	180	350	330	320	310	310	300	280
Total Molecular Weight		18.2	20.8	25.4	25.4	25.2	25.2	25.2	25.2	25.6	25.6	25.6	25.6	25.6	25.7	25.7	25.7
Total Specific Enthalpy	kcal / kg	-3689	-2316	-1328	78	-1359	-1359	89	-1387	-1288	71	-1266	-1270	-1296	-1271	-1267	-1267
Total Cp	kcal/kg-C	0.98	0.38	0.29	0.30	O3	0.30	0.30	0.32	0.29	0.30	0.30	0.30	0.30	0.29	0.29	0.29
Vapor Mole Fraction	fraction	0.000000	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.99	1.00	1.00	1.00
Higher Heating value	MJ/Nm3	-	4.655	8.856	8.856	8.676	8.676	8.676	8.676	9.061	9.061	9.061	9.061	9.061	9.158	9.159	9.159
Higher Heating value	kJ/kg																
Total Molar Component Fractions	fraction																
CO		0.0000	0.1682	0.4448	0.4448	0.4331	0.4331	0.4331	0.4331	0.4583	0.4583	0.4583	0.4583	0.4583	0.4646	0.4646	0.4646
CO2		0.0000	0.0750	0.1974	0.1974	0.1922	0.1922	0.1922	0.1922	0.2033	0.2033	0.2033	0.2033	0.2033	0.2061	0.2061	0.2061
O2		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N2		0.0000	0.0249	0.0659	0.0659	0.0642	0.0642	0.0642	0.0642	0.0679	0.0679	0.0679	0.0679	0.0679	0.0689	0.0689	0.0689
AR		0.0000	0.0054	0.0143	0.0143	0.0139	0.0139	0.0139	0.0139	0.0147	0.0147	0.0147	0.0147	0.0147	0.0149	0.0149	0.0149
H2		0.0000	0.0759	0.2006	0.2006	0.1953	0.1953	0.1953	0.1953	0.2066	0.2066	0.2066	0.2066	0.2066	0.2095	0.2095	0.2095
CH4		0.0000	0.0076	0.0201	0.0201	0.0196	0.0196	0.0196	0.0196	0.0207	0.0207	0.0207	0.0207	0.0207	0.0210	0.0210	0.0210
C2H6		0.0000	0.0010	0.0026	0.0026	0.0025	0.0025	0.0025	0.0025	0.0026	0.0026	0.0026	0.0026	0.0026	0.0027	0.0027	0.0027
C2H4		0.0000	0.0002	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
C3H8		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
C4H10		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
HCL		0.0055	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
H2S		0.0000	0.0005	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0013	0.0013	0.0013
COS		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SO2		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NH3		0.0032	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
HCN		0.0000	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
H2O		0.9890	0.6409	0.0525	0.0525	0.0776	0.0776	0.0776	0.0776	0.0240	0.0240	0.0240	0.0240	0.0240	0.0105	0.0105	0.0105
NAOH		0.0023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Solids composition/Assay																	
Solids																	
Coke	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Flux (Limestone)	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gasifier carry-over	kg/h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dry, Ash Free Solids Assay																	
Carbon	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydrogen	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
oxygen	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitorgen	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulphur	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlorine	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
As Received																	
Moisture Content	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ash	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Notes																	

FOSTER WHEELER ENERGY LTD.

Heat & Material Balance

Client: Waste2tricity **Contract:** 33139

Description: Bilsthorpe Waste to Energy

Unit: 30 - Syngas Cleanup

Rev.	O1	O2	O3
Date	02/07/2013	08/07/2013	31/07/2015
Orig. By	L. Grim	L. Grim	J Watt
App. By	M. Cook	M. Cook	M. Cook
Doc Number:	33139-8110-21-1001		

Stream (Summary)	UOM	30-017	30-018	30-019	30-020	30-021	30-022	30-023	30-024	30-025	30-026	30-029	30-030	CAUSTIC			
Description		Quench Water to the 1st stage venturi	Quench Water to the 2nd stage venturi	Water from 2nd stage venturi	Hot Blowdown from Venturi	Cold Blowdown from Venturi	DCC hot water	Hot water from DCC circulation pump	Hot water to DCC cooler	Cold water to DCC	Hot DCC water to Quench	HP syngas Liquids	Sweet Syngas to Gas Engines	CAUSTIC	Total Water to Saturator		
Phase		Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Vapor	Liquid	Liquid		
Total Molar Rate	kg-mol / hr	3400	3400	3420	454	454	14625	14702	13600	13600	1102	8	614.67	4	78.16		
Total Mass Rate	kg / hr	61640	61408	61783	8235	8235	263557	264925	245075	245075	19850	149	14949	100	1408		
Temperature	C	87.2	84.7	87.9	87.2	30.0	73.7	73.6	73.6	30.0	73.6	25.0	39.9	30.0	29.6		
Pressure	kPa	250	325	101	250	230	88	350	350	300	350	310	180	200	180		
Total Molecular Weight		18.1	18.1	18.1	18.1	18.1	18.0	18.0	18.0	18.0	18.0	18.0	24.32	24.8	18.02		
Total Specific Enthalpy	kcal / kg	-3700	-3725	-3721	-3700	-3756	-3740	-3740	-3740	-3783	-3740	-3787	-	-3209	-3784		
Total Cp	kcal/kg-C	0.99	1.00	1.00	0.99	0.98	1.00	1.00	1.00	0.99	1.00	0.99	0.29	0.64	0.99		
Vapor Mole Fraction	fraction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00		
Higher Heating value	MJ/Nm3	-	-	-	-	-	-	-	-	-	-	-	9.244	-	-		
Higher Heating value	kJ/kg																
Total Molar Component Fractions	fraction																
CO		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.4507	0.0000	0.0000		
CO2		0.0003	0.0008	0.0011	0.0003	0.0003	0.0002	0.0002	0.0002	0.0002	0.0002	0.0004	0.1732	0.0000	0.0002		
O2		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
N2		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0669	0.0000	0.0000		
AR		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0145	0.0000	0.0000		
H2		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2303	0.0000	0.0000		
CH4		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0204	0.0000	0.0000		
C2H6		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0026	0.0000	0.0000		
C2H4		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0005	0.0000	0.0000		
C3H8		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
C4H10		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
HCL		0.0038	0.0000	0.0000	0.0038	0.0038	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
H2S		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
COS		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
SO2		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
NH3		0.0023	0.0001	0.0001	0.0023	0.0023	0.0002	0.0002	0.0002	0.0002	0.0002	0.0000	0.0000	0.0000	0.0001		
HCN		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0000	0.0000		
H2O		0.9918	0.9980	0.9978	0.9918	0.9918	0.9995	0.9996	0.9996	0.9996	0.9996	0.9995	0.0410	0.6897	0.9997		
NAOH		0.0018	0.0011	0.0011	0.0018	0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3103	0.0000		
Solids composition/Assay																	
Solids																	
Coke	%	-	-	-	-	-	-	-	-	-	-	-	-	-			
Flux (Limestone)	%	-	-	-	-	-	-	-	-	-	-	-	-	-			
Gasifier carry-over	kg/h	-	-	-	-	-	-	-	-	-	-	-	-	-			
Dry, Ash Free Solids Assay																	
Carbon	%	-	-	-	-	-	-	-	-	-	-	-	-	-			
Hydrogen	%	-	-	-	-	-	-	-	-	-	-	-	-	-			
oxygen	%	-	-	-	-	-	-	-	-	-	-	-	-	-			
Nitorgen	%	-	-	-	-	-	-	-	-	-	-	-	-	-			
Sulphur	%	-	-	-	-	-	-	-	-	-	-	-	-	-			
Chlorine	%	-	-	-	-	-	-	-	-	-	-	-	-	-			
As Received																	
Moisture Content	%	-	-	-	-	-	-	-	-	-	-	-	-	-			
Ash	%	-	-	-	-	-	-	-	-	-	-	-	-	-			
Notes																	

FOSTER WHEELER ENERGY LTD.

Heat & Material Balance

Client: Waste2tricity **Contract:** 33139
Description: Bilsthorpe Waste to Energy
Unit: 20-Gasifier

Rev.	O1	O2	O3
Date	02/07/2013	08/07/2013	31/07/2015
Orig. By	L. Grim	L. Grim	J Watt
App. By	M. Cook	M. Cook	M. Cook
Doc Number:	33139-8110-21-1001		

Stream (Summary)	UOM	20-001	20-002	20-003	20-004	20-005	20-006	20-007	20-008	20-009	20-010	20-011	20-012				
Description		Feedstock to Gasifier	Solids return from WWT	Coke Bed Material to Gasifier	Flux to Gasifier	Natural gas to Gasifier	Steam to Partial Quench	Water to Partial Quench	Nitrogen to Sight Glasses	Air to gasifier unit	Oxygen to Gasifier	Slag from Gasifier	Paritally Quenched Syngas to Quench/Scrubbing				
Phase		Solid	Solid	Solid	Solid	Gas	Vapour	Liquid	Gas	Gas	Gas	Solid	Vapour				
Total Molar Rate	kg-mol / hr	-	-	-													
Total Mass Rate	kg / hr	12500	1232	500	1001	NNF	213	1296	203	925	6927	1815	22593				
Temperature	C	AMB	AMB	AMB	AMB	-	148	AMB	22	25	25	1650	850				
Pressure	kPa	101	101	101	101	-	446	401	136	1136	136	101	101				
Total Molecular Weight		-	-	-	-	-	18	18	28	28	32	-	-				
Total Specific Enthalpy	kcal / kg	-	-	-	-	-	-	-	-	-	-	-	-				
Total Cp	kcal/kg-C	-	-	-	-	-	-	-	-	-	-	-	-				
Vapor Mole Fraction	fraction	0	0	0	0	1	1	0	1	1	1	0	1				
Higher Heating value	MJ/Nm3	-	-	-	-	-	-	-	-	-	-	-	9.7				
Higher Heating value	kJ/kg	13588	1035	29834	n/a		n/a	n/a	n/a	n/a	n/a	n/a					
Total Molar Component Fractions	fraction																
CO		-	-	-	-	-	-	-	-	trace	-	-	0.2784				
CO2		-	-	-	-	-	-	-	-	0.0004	-	-	0.1241				
O2		-	-	-	-	-	-	-	-	0.2100	0.9200	-	0.0000				
N2		-	-	-	-	-	-	-	-	0.7800	0.0800	-	0.0413				
AR		-	-	-	-	-	-	-	-	0.0090	trace	-	0.0089				
H2		-	-	-	-	-	-	-	-	-	-	-	0.1246				
CH4		-	-	-	-	-	-	-	-	trace	-	-	0.0126				
C2H6		-	-	-	-	-	-	-	-	-	-	-	0.0016				
C2H4		-	-	-	-	-	-	-	-	-	-	-	0.0003				
C3H8		-	-	-	-	-	-	-	-	-	-	-	0.0000				
C4H10		-	-	-	-	-	-	-	-	-	-	-	0.0000				
HCL		-	-	-	-	-	-	-	-	-	-	-	0.0022				
H2S		-	-	-	-	-	-	-	-	-	-	-	0.0008				
COS													0.0001				
SO2		-	-	-	-	-	-	-	-	trace	-	-	0.0000				
NH3		-	-	-	-	-	-	-	-	-	-	-	0.0017				
HCN		-	-	-	-	-	-	-	-	-	-	-	0.0001				
H2O		-	-	-	-	-	1.0000	1.0000	-	-	-	-	0.4035				
NAOH		-	-	-	-	-	-	-	-	-	-	-					
Solids composition/Assay																	
Solids																	
Coke	%	-	-	100	-	-	-	-	-	-	-	-	-				
Flux (Limestone)	%	-	-	-	100	-	-	-	-	-	-	-	-				
Gasifier carry-over	kg/h	-	-	-	-	-	-	-	-	-	-	-	389				
Dry, Ash Free Solids Assay																	
Carbon	%	51.43	100	99.13	-	-	-	-	-	-	-	-	-				
Hydrogen	%	6.69	-	-	-	-	-	-	-	-	-	-	-				
oxygen	%	40.06	-	-	-	-	-	-	-	-	-	-	-				
Nitorgen	%	1.07	-	-	-	-	-	-	-	-	-	-	-				
Sulphur	%	0.15	-	0.87	-	-	-	-	-	-	-	-	-				
Chlorine	%	0.6	-	-	-	-	-	-	-	-	-	-	-				
As Received																	
Moisture Content	%	21	65	1.18	-	-	-	-	-	-	-	-	-				
Ash	%	10	31.84	7.03	-	-	-	-	-	-	-	-	-				
Notes								1		2	3	4					

1. Assume 3 bar delivery pressure
2. Plasma Torch requires 125kg/h at 1136 kPa, shroud air 800 kg/h at 136 kPa
3. Oxygen required as oxidant 6737 kg/h, 92% w/w, 136 kPa, 25°C, shroud oxygen 190 kg/h, 136 kPa
4. Slag and mixed metals. No composition details available.

Appendix B - Letter from Finning

FINNING (UK) LTD.
Power Systems
688-689 Stirling Road,
Slough SL1 4ST
Telephone: 01753497300
Fax: 01753 497398

Mr. John Hall,
Waste 2 Tricity Ltd,

26th February 2015,

Ref: Caterpillar G3520C Engine / generator set electrical conversion efficiency.

Dear John,

Further to our recent discussion I can confirm that the nominal electrical conversion efficiency of our Caterpillar G3520C 1950kWe biogas generating sets is 39.53% based on the Lower Calorific Value (LCV) of the input gas.

The LCV of the gas from your process is such that modelling predicts that the engine fuel system would not be able to flow enough gas to achieve full load and our software model (attached) shows that you should expect a full load figure of around 94% of plate rating, with associated reduction in fuel usage, which equates to a maximum output of 1833 kWe. The expected loss of efficiency due to this small reduction in output would in our opinion be very marginal, so we are comfortable that a figure of 39.5% could be achieved at this output. On the basis of 8 machines running this would provide a total output of 14.6 MWe, assuming there was no limitation on gas supply volumes.

This “nominal” efficiency figure quoted is a conservative real life figure based on long term operation of these pieces of equipment and takes into account not only the efficiency of the engine itself, but also the efficiency of the coupled alternator, and variability from machine to machine. This is a slightly lower efficiency than the often quoted ISO 3046/1 figure which is a best efficiency figure. In our experience the actual achieved efficiency is somewhere between the nominal figure and the best efficiency figure.

In addition to the losses within the machine itself there are a small number of electrical ancillaries which consume power such as control panels ventilation fans etc. These consume around 10 – 15 kWe dependant on ambient conditions, but we have put much effort into reducing this load as much as possible by careful and precise control so that only the minimum run at any time. They do not use a simple all on / all off logic, but start in

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688-689 Stirling Road,
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sequence based on monitoring of the engine jacket temperature and combustion air temperature.

In addition to the above there are well developed technologies available which enable some of the engine waste heat to be converted directly into electricity, and an example of this would be the Organic Rankine Cycle (ORC) turbine. These can be fitted to engines to produce electricity and work completely independently of the engine. A typical machine of this type could generate an additional 150 kWe of electricity per generator set and requires no fuel input. These could be connected independently on a turbine per engine basis or as a common group. If connected on a turbine per engine basis this would increase the output to 2100 kWe for no increase in fuel consumption which would give an electrical conversion efficiency of around 42.6% and a total combined output of a potential 16.8 MWe.

There are of course other technologies available such as steam, but these are not sold on the basis of being a “bolt on” engine ancillary so would need a more thorough assessment, but on the basis of the way the question was framed, yes, it is possible to provide additional output for no increase in fuel consumption, and marginal change in plant size.

I trust this answers the question you raised, but if you require any further clarification please do not hesitate to contact me.

Yours sincerely.

DATA PROTECTION

David Hatherill BEng PhD CEng FIMechE
Head of Technologies.
Finning (UK) Ltd.

Appendix C – Letter from Waste2tricity

Waste2Tricity

Mr. R. Barker,
Peel Environmental Ltd.,
Peel Dome,
The Trafford Centre,
Manchester,
M17 8PL

10th August 2015

Dear Richard,

Please see enclosed the HMB and the block diagram for the Bilsthorpe project.

So far as the consumption/import of NG and electricity are concerned; we advise that we estimate that for a cold start of the gasifier 9,000 cu.m of natural gas would be consumed for gasifier heating + flare. A typical year may have 2-4 cold starts. When the plant is offline the electrical consumption is minimal. The main loads are the security lighting, surface water sump pump (if raining), transformer losses and the office/ gatehouse / welfare facilities which would be heating/ cooling if needed, lights, control room & computer systems.

Yours sincerely,

John Hall
Managing Director

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