Gravity, Puriton, Bridgwater Somerset

Heritage Technical Note

Document Ref.: 218374.02
February 2022

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Document Information

Document title	Gravity, Puriton, Bridgwater, Somerset
Document subtitle	Heritage Technical Note
Document reference	218374.02
Client name	This is Gravity Limited
Address	c/o Salamanca Group 3 Burlington Gardens London WS1 3EP
Site location	Gravity, Puriton, Bridgwater
County	Somerset
National grid reference	333250, 141631 (ST 33250 41631) to 334642, 142041 (ST 34642 42041)
WA project code	218374
Project management by	Sarah Generalski-Sparling and Lucy Marston
Document compiled by	Sarah Generalski-Sparling

Quality Assurance

Issue	Date	Version	Author	Approved by
1	17/01/2022	Internal Draft	SGS	L.E.Marston LEM
2	18/01/2022	First External Draft	SGS	L.E.Marston LEM
3	21/01/2022	Second External Draft	SGS	L.E.Marston LEM
4	10/02/2022	Final	SGS	L.E.Marston LEM

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Wessex Archaeology was commissioned by This is Gravity Ltd to prepare a Heritage Technical Note in relation to the proposed development at Gravity, Puriton, Bridgwater, Somerset, approximately located between National Grid Reference 333250, 141631 (ST 33250 41631) to 334642, 142041 (ST 34642 42041).

Acknowledgements

This project was commissioned by This is Gravity Ltd and Wessex Archaeology is grateful to them in this regard.

Gravity, Puriton, Bridgwater
Somerset

Historic Environment Technical Note

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology (WA) has been commissioned by This is Gravity Ltd (hereafter 'the Client') to prepare a Historic Environment Technical Note in relation to the proposed development at Gravity, Puriton, Bridgwater, Somerset (hereafter 'the Site'), located approximately between National Grid Reference 333250, 141631 (ST 33250 41631) to 334642, 142041 (ST 34642 42041).

1.2 Aims and purpose of the technical note

1.2.1 This technical note has been prepared in response to Historic England's consultation letter (received 8th December 2021, the '2021 Response') in regard to the submitted Local Development Order (LDO) for the Site.

2 THE DEVELOPMENT IN CONTEXT

2.1 Introduction

2.1.1 The Site comprises the land of a former Royal Ordnance Factory (ROF) which has been subject to a previous planning permission under the name of 'Huntspill Energy Park' (HEP; the 'Consented Scheme' ref. 42/13/00010). This consent is now extant as it has been implemented through delivery of the Gravity Link Road, and is therefore capable of implementation in its entirety and forms part of the environmental baseline for assessment of the Gravity LDO.

2.1.2 Previous archaeological works undertaken as part of the HEP Consented Scheme are discussed in **Section 2.2**, while more information on the HEP application and the technical assessments from a heritage perspective are discussed in **Section 2.4**.

2.2 Previous archaeological works

2.2.1 A series of archaeological works have been undertaken within and immediately adjacent to the Site, including, in chronological order, a desk-based assessment (WA 2011), building recording of the former ROF buildings (WA 2012a), investigations along the route of the Proposed Access Road (PAR) (now the constructed Gravity Link Road) which included geophysical survey (WA 2019a), trial trench evaluation and associated small scale excavation (WA 2019b), an archaeological strip, map and record excavation within the former BAE Systems site (WA 2020), a further geophysical survey over much of the current investigation area (WA 2021a) and a revised and updated Historic Environment Desk-based Assessment (WA 2021b) which informed the most recent Historic Environment Environmental Statement (ES) Chapter supporting the Environmental Impact Assessment (EIA) for the LDO.

2.2.2 Brief accounts of each of the fieldwork stages are provided below. However, the corresponding reports should be consulted in full for further, more detailed information (these can be provided if required).

2012a Historic building recording

2.2.3 A programme of historic building recording of the former ROF site was carried out in 2012. This was undertaken in accordance with an English Heritage Level 2 survey relevant at the time and comprised 42 buildings which reflected the majority of the former processes, services and support functions which took place on the ROF site. The purpose of the recording was to provide a record of the buildings prior to their demolition.

2019a Geophysical survey

2.2.4 This survey comprised a series of pasture and arable fields totalling c. 5 hectares (ha) to the south and east of Puriton as part of the access road to the HEP (now the constructed Gravity Link Road).

2.2.5 The survey detected anomalies of definite, probable, and possible archaeological interest along the linear route. Few of these were identified within the wetter, lower lying northern part of the route. Those anomalies interpreted to be of archaeological origin were thought to represent ploughing trends and land drainage methods.

2012b Field evaluation

2.2.6 The evaluation represented a limited sample of the area evaluated within the ROF boundary. Only one of the 14 trenches (Trench 5 'TR6') encountered archaeological features, although in TR12, a thin layer of peat deposit was also identified. The trenches were positioned in relatively open areas to provide a general overview of the archaeological potential.

2.2.7 Two parallel ditches, both of which were found to cut the very upper surface of the alluvial clays, were identified within TR6. Within the ditches, a complete horse skull, Roman pottery and burnt or fired clay and six iron objects were recovered.

2.2.8 Due to the limited scope of the works, the full potential of the Roman features could not be entirely determined.

2020 Archaeological mitigation works

2.2.9 Archaeological mitigation works at the former ROF site were undertaken between September to October 2020 as a condition of planning permission (ref: 43/13/00010). Although the excavations were relatively small scale (focused on a small area within the south-western extent of the Site), recovered later Iron Age to Romano-British remains were considered to be of interest.

2021a Geophysical survey

2.2.10 The survey comprised land to the east and south of the former ROF including 27 grazing fields to the north of Woolavington Road covering an area of c. 50 ha. The survey area was split over 36 land parcels to target areas not previously subject to geophysical survey.

2.2.11 Three distinct groups of anomalies were identified and indicated ditched enclosures on the western edge, the centre and the north-east of the survey area. The ditches in the north-east suggest a ladder settlement or field system. Given the proximity of prehistoric and Romano-British settlements in the surrounding area an archaeological interpretation cannot be ruled out for these anomalies, however, they could equally be evidence of modern agricultural activity.

2.2.12 The results of the geophysical survey were discussed in detail with the South West Heritage Trust (SWHT) used to produce the scope of archaeological works discussed further below (**Section 2.3**).

2.3 Forthcoming works

2.3.1 A Written Scheme of Investigations (WSI) for Archaeological Evaluation within the Site was produced by Wessex Archaeology in November 2021 (2021c). This includes additional land to the south of the Consented Scheme along Woolavington Road which is now included in the LDO. The scope of the evaluation was based on the results of the 2021 geophysical survey, areas of known modern disturbance and existing constraints (such as, for example, land boundaries and services).

2.3.2 Following consultations with SWHT, it has been agreed that the evaluation, which comprises 44 trial trenches, is sufficient to characterise the area. Subsequent mitigation may be required depending on the results of the evaluation. This will be presented in an updated WSI once the results are known.

2.4 Previous LVIA and noise assessment

2.4.1 In the 2021 Response, further information on the Landscape and Visual Assessment (LVIA) (especially in regard to assessment made of Brent Knoll and listed churches at Woolavington and Puriton and the scope of the assessment) and the noise assessments (especially in regard to noise impacts) produced for the ES was requested by Historic England. While the Client’s response was captured in a subsequent letter issued to Historic England on 17th December 2021 (ref: Project / File: Gravity/ 49102), the responses have also been included here for clarity and to ensure that the technical note comprehensively closes out any points previously raised as part of the 2021 Response.

LVIA

2.4.2 The LVIA recognised the national importance of Brent Knoll (see Para 14.6.156, LVIA) and identified visual receptors on it being of Very High Sensitivity and the LCA Lowland Hills being of High Sensitivity (see Para 14.6.47 & 48, LVIA). The role of the Churches of St Michael and All Angels (Puriton) and Church of St Mary (Woolavington) are also specifically considered within the LVIA (Para 14.6.77 & 81, LVIA).

2.4.3 With regard photography and visualisations, the photographs were taken in accordance with the Landscape Institute ‘Technical Guidance Note 06/19 (dated September 2019).

2.4.4 This appropriate LVIA assessment has been used to inform the heritage assessment, assisting in identifying potential visual changes as a result of the development upon the identified significance of heritage assets, and the contribution made by any mitigation.

Noise assessment

2.4.5 Operational impacts associated with the proposed development considered the change in road traffic noise as the likely most significant impact from a noise perspective during operation. The results of the assessment concluded that change in noise levels at all receptors, including the Listed Buildings and heritage assets within the two villages, is likely to be a negligible change and therefore not significant.

2.4.6 During the construction phase, an assessment of on-site plant and off-site construction traffic has also been undertaken. Based on the distance and intervening screening due to existing buildings the likely impact from on-site construction plant to the listed buildings and heritage assets is likely to be a minor/negligible impact of a temporary nature and is therefore not significant. Notwithstanding this conclusion, best practice measures are to be included in the Framework Demolition and Construction Environmental Management Plan (FDCEMP) to further reduce noise emissions during the construction phase. This will further reduce any construction impacts upon the significance of heritage assets.

2.4.7 With regards to construction traffic, calculations indicate that the impact on the identified construction routes is likely to be negligible which is not significant. Again, the location of the heritage assets away from these construction routes indicates that the impacts upon their significance from construction traffic noise would also be negligible.

2.4.8 As the noise assessment concluded that there would be no adverse permanent impacts/noise increases across the study area which includes the heritage assets within the villages, this conclusion informed the ES Cultural Heritage Chapter inasmuch as these impacts would not lead to harm to the significance of the heritage assets.

2.5 Huntspill Energy Park

2.5.1 The HEP consent comprises an outline extant permission for an energy related employment park with all reserved matters (apart from the PAR). This application was supported by an Environmental Statement and was consented in 2017 (planning ref.: 42/13/00010) by Sedgemoor District Council.

2.5.2 The year 2032 has been identified as the assessment year for operational effects for the majority of the technical assessments included in the ES (including Cultural Heritage). This year has been identified as it is the end of the current Local Plan period and a date by which it is reasonable to assume that the development approved by the LDO will have been delivered.

2.5.3 The current conditions at the Site and in the surrounding area have been factored forward to predict likely conditions at the Site in 2032 to enable the effects of the LDO to be considered against a ‘do nothing’ scenario.

2.5.4 The following elements are therefore included in the 2032 Baseline:

- The implemented 2017 Planning Consent. The safeguarded land uses are not included in the 2032 baseline as they have not been granted consent (i.e., they were safeguarded only and would require a new planning permission or consent to progress).

- The approved village enhancement scheme was identified as mitigation for the 2017 Planning Consent and will be implemented one year from the opening of the Gravity Link

- Road, i.e., by autumn 2022. Therefore, this is factored into the 2032 baseline.

- Landscaping associated with the Gravity Link Road, which is due to be implemented from October 2021.

- Other existing and approved development in the surrounding area. This includes development that has been allocated in the Local Plan 2011-2032.

- Likely changes to the natural environment between now and 2032. This includes natural changes such as growth in vegetation and establishment of habitats, especially of landscaping implemented as part of the 2017 Planning Consent. It also includes anthropogenic changes such as changes to climate, air quality and human behaviours where there can be a high degree of confidence that such changes will occur (for example the transition towards electric vehicles on the basis of clear Government policy on the phasing out of internal combustion engines and the increase in bus services to avoid private vehicle usage as promoted in the recently published national bus strategy).

2.5.5 Each chapter outlines as appropriate how these changes have been considered in establishing the 2032 baseline.

2.5.6 For the assessment of effects during operation, the EIA assumes that the Proposed Development will be constructed in accordance with the maximum build out of the mix, quantum and parameters detailed in Chapter 3 of the ES.

2.5.7 As such, the Cultural Heritage impacts have been assessed against this baseline, including the changes in the site context described above and including the consented development through 42/13/00010.

2013 and 2017 Historic Environment Assessments and Scope of 2021 HEDBA

2.5.8 The original 2013 Environmental Statement (ES) included a Cultural Heritage Chapter (Chapter 10) which was supported by an Archaeological Desk-based Assessment. The assessments predated Historic England's (previously English Heritage) guidance on setting first published in 2015, and as such only archaeology was considered. Furthermore, an assessment of harm to the significance of heritage assets based on a change in their setting was not requested as part of the scope of the ES in 2013.

2.5.9 The 2017 assessments provided an update in the form of an addendum to the 2013 assessments only and therefore largely included archaeological considerations only. **Appendix 1** presents the results of the Chapter 10 impact assessment outlined in the 2017 Chapter Addendum (based on the 2013 assessments), however, it must be noted that this covers archaeological considerations only.

2.5.10 Due to a change in guidance requiring setting assessment since the 2013 ES, consideration of heritage assets which could experience harm to their significance by way of a change in their setting was covered in the 2021 HEDBA. As such, the HEDBA presents the complete historic environment baseline, that is, it does not only cover archaeological considerations and therefore presents a holistic historic environment assessment. This means that there are no gaps in terms of setting assessment.

2.5.11 A gazetteer of the designated heritage assets considered in the 2021 HEDBA is included in **Appendix 2**. Although the known historic environment within a 1 km Study Area informed the baseline of the HEDBA, further factors, such as a bare earth Zone of Theoretical Visibility (ZTV) covering an approximate 5 km radius from the Site, and the results of a site walkover survey covering the Site and the wider surrounding landscape also influenced which heritage assets were identified for further assessment as part of the setting assessment presented in Section 6 of the HEDBA and the 2021 ES. This assessment was undertaken in line with the Historic England GPA3 guidance (2017).

Summary

2.5.12 Based on the above, in terms of setting assessment, there are no identified heritage assets that have not been considered by either this technical note or the 2021 HEDBA and corresponding ES Chapter.

3 ADDITIONAL ASSESSMENT FOLLOWING RESPONSE

3.1 Introduction

3.1.1 The 2021 Historic England Response highlighted areas where further clarification and/or assessment would be required. Subsequently, additional consultation was carried out on 20th December 2021 which resulted in the production of this technical note to address any outstanding queries.

3.1.2 Further clarification in regard to the assessment of harm to the significance of two designated heritage assets, a Scheduled Monument and a Grade I listed building, scoped out of further assessment as part of the 2021 HEDBA was requested in advance of the meeting on 20th December 2021. While this was previously provided for further discussion, this is also included in **Appendix 3**. The assets in question included the Scheduled Motte with two baileys immediately east of Bristol at Down End (NHLE 1019291) and the Grade I listed Church of St Mary at Woolavington (NHLE 1060144).

3.1.3 At the meeting on 20th December 2021 additional clarification, especially in regard to potential impacts to the significance of two Grade I listed churches within the Study Area was required. These include the listed Church of St Mary (NHLE 1060144) in Woolavington (to the east of the Site) and the Church of St Michael and All Angels (NHLE 1344664) in Puriton (to the west of the Site) (discussed in **Section 3.2**).

3.1.4 In addition to this, further visualisations in relation to views from Brent Knoll and Glastonbury Tor were also requested (discussed in **Section 3.3**).

3.2 Listed Buildings

3.2.1 The following sections provide, firstly, a general overview of the results of the WA 2021 HEDBA and the 2021 ES Chapter in regard to the listed churches, and secondly, further information in regard to their visual and/or spiritual landscape relationship.

Church of St Michael and All Angels (NHLE 1344664), Puriton

- The site walkover survey supporting the HEDBA confirmed that limited glimpses of the wider agricultural landscape within which the Site is currently experienced (following the demolition of the ROF buildings) are possible from the churchyard (see **Plate 1**), albeit, these would likely be seasonal only due to the nature of screening afforded by existing mature trees and vegetation.

- While the Church is situated at the centre of the historic village and lies on a plateau of slight topographic prominence, this is best appreciated from Rye (i.e., the road to the east of the Church) where glimpses of the church tower can be appreciated.

- The ES Chapter considered that the immediate setting of the churchyard makes an important contribution to its significance allowing the architectural and historic interests, from which its significance is predominantly derived, to be best appreciated. The wider village centre also makes an important contribution to its significance allowing it to be appreciated as one of the settlement's focal points. Beyond the

Church's immediate and village setting, the ability to experience, the church is diminished, although there are glimpsed views out to the wider landscape.

- When details of the proposed development become available as the scheme progresses through the detailed design process, this would be reassessed as part of the mitigation checklist (see **Section 3.5**).

Church of St Mary (NHLE 1060144), Woolavington

- The site walkover survey supporting the HEDBA confirmed that there is no visual connection with the agricultural landscape within which the Site is currently experienced (following the demolition of the ROF buildings) and the Church.
- The built environment within the settlement centre forms a relatively coherent centre of historic buildings which are best appreciated in close proximity and in combination with each other. Within that centre, the Church forms the focal point and, with its tower, is a prominent feature of the settlement visible in views from the Causeway to the east of the Site (this is further discussed in 'Relationship between the churches and Woolavington church tower' below).
- When further details of the proposed development become available as the scheme progresses through the detailed design process, this would be reassessed as part of the mitigation checklist (see **Section 3.5**).

Relationship between the churches and Woolavington church tower

3.2.2 The churches are sited within their respective village settlements and historic parishes of Woolavington (to the south-east of the Site) and Puriton (to the south-west of the Site). While the majority of the Site sits within the parish of Puriton, its most eastern part does extend into Woolavington parish.

3.2.3 Church towers are reflection of the spiritual role and dominance of the church within the community. They are an expression of the wealth and status that these religious building to the wider environment.

3.2.4 The church tower at Puriton is a less distinctive local landmark outside of the village itself, primarily due to its height and the intervening built character of the surrounding village. It is described as a "*squat unbuttressed tower of 4 receding stages*" in its listing description, with the earliest parts being of 13th century date with later 14th and 15th century additions.

3.2.5 The church tower of Woolavington is more prominent than that at Puriton, and can be viewed from outside its village context, and is experienced as part of the wider built form of the village. the Church is best appreciated from within the village, especially from Church Street, looking north, which will not be affected by the proposed development given a complete lack of visibility. While views of the church tower can be achieved from the east and south of the village), it can also be seen when approaching the village travelling southwards along the Causeway.

3.2.6 The Causeway is a historic route connecting with Woolavington, set on slightly higher ground due to the susceptibility of the wider area to flooding. Here the church tower is seen as forming part of the wider settlement, with open rural landscape to either side of the Causeway along the route.

3.2.7 The experience of travelling and moving along the Causeway is transient. At the intersection of Stoningpound Rhyne, Reeds Rhyne and the Causeway (c. 715 m north-west of the

Church), in the context of the wider Woolavington built environment, with an awareness of the proposed development to the west. The tower will be seen and this impact will require further assessment.

3.2.8 As stated above, when the detailed design becomes available, this would be reassessed as part of the compliance process and through the mitigation checklist (see **Section 3.5**).

3.2.9 The views taken from Brent Knoll as part of the Landscape and Visual Assessment (LVIA) (further discussed in **Section 3.3**) show that only Woolavington is noticeable in southern views from the scheduled hillfort when looking south, indicating that there is also no appreciable visual link between the churches from promontories to the north of the Site. Similarly, from Glastonbury Tor (further discussed in **Section 3.3**), neither village is distinguishable, even though areas which are further away, such as Hinkley Point Power Station, are visible.

3.2.10 It is also important to note that changes within views of the landscape, and overall visibility of the development, from these two locations (i.e., Brent Knoll and Glastonbury Tor) will be mitigated through the required Environmental Colour Assessment (Mitigation Checklist item 14) which must be undertaken for the whole site as part of the first compliance submission and referenced in each subsequent compliance application.

3.2.11 When traversing along the accessible paths on the northern side of the Polden Ridge (to the south of the Site and villages), both church towers are visible this will need to be assessed at the Compliance stage.

Summary

3.2.12 The extent of these potential changes, and any subsequent impact to the significance of the Church based on them, can be appropriately and proportionately assessed and mitigated through the LDO compliance processes. A summary of measures which have been put into place is provided in **Section 3.4**.

3.3 Landscape and wider views

3.3.1 This technical note includes views from both Brent Knoll and Glastonbury Tor to show the likely parameters, including the assumed heights of the flues which could potentially be dispersed across the Site. These are further discussed below and included as **Appendix 4**.

Brent Knoll

3.3.2 The scheduled hillfort and associated field system of Brent Knoll (NHLE 1008248) was scoped in for assessment as part of the Setting Assessment in the HEDBA and for further assessment in the ES.

3.3.3 The asset derives its significance primarily from its archaeological interest and through the information the archaeological remains could yield relating to the occupation and use of the fort from the Iron Age through to the Romano-British period. There is also an archaeological potential for later activities from the medieval period through to the 20th century.

3.3.4 the proposed development would likely prevent visibility towards the hillfort from limited locations. It would continue to be visible from other vantage points within the surrounding landscape.

3.3.5 As such, the ES concluded that the hillfort is an asset of high heritage significance with the magnitude of impact from the proposed development assessed. The scheme would result in harm but through the mitigation measure the impact could be brought down to negligible, resulting in a negligible or no effect, which is not significant.

Glastonbury Tor

3.3.6 Since the production of the ES, Glastonbury Tor, which is both scheduled (NHLE 1019390) and listed (NHLE 1345475), has been identified by Historic England as requiring inclusion for further consideration based on the potential for impacts to its significance due to a change in its wider setting. As such, this asset has been included for consideration in this technical note. The following sections will provide an overview of the asset's significance, its setting and the contribution setting makes to its significance.

3.3.7 Glastonbury Tor primarily derives its significance from its archaeological (especially in terms of its scheduled aspect) and architectural (especially in terms of its listed aspects) interests. The tower with the upper storey remains extant which forms a dominant feature of the Somerset landscape.

3.3.8 The setting of Glastonbury Tor is defined by its prominent landscape position on top of a natural hill which offers views to and from the surrounding landscape and as such is far ranging, with views as far as Hinkley point and the seascape beyond

3.3.9 The fact that Glastonbury Tor is a prominent landscape feature is important when considering views towards it, while the fact that long distance views can be achieved from the monument is also important. As such, the setting of the asset makes a positive contribution to its significance, and it is assumed that its topographical prominence was likely a contributing factor as to why this site was selected for occupation and monastic activity in the first place.

Additional assessment of wider views in regard to Brent Knoll and Glastonbury Tor

3.3.10 When displaying the extent of the Site in white and adding the flue limits as a dashed line, the view from Brent Knoll shows that the development (including the flues) would not block views towards the Polden Ridge from Brent Knoll.

3.3.11 Similarly, this is also the case for views from Glastonbury Tor, where the view shows that, even with the addition of the parameter heights of the flues, the height of the development would not break the skyline.

3.3.12 It is acknowledged that this was a former brownfield site. However, this assessment is considering the worst-case scenario and the development has the potential to form a conspicuous structure within the landscape, which could be considered to be harmful. However, we are of the view that this can be mitigated through the compliance process to be reduced the impact to negligible or no harm.

3.4 Assessment Summary and Action Steps

3.4.1 The ES identified that there is potential for harm to the significance of the Grade II listed Manor Farmhouse (NHLE 1060137) as a result of a change in its setting due to the proposed development leading to the loss of associated rural land. This is based on the account of the rural landscape contributing to the asset's significance and the fact that rural landscape views from the building would likely be impacted, thereby harming our understanding of its connection with the agricultural landscape.

3.4.2 Additionally, although no detailed design is currently available, this technical note acknowledges that, depending on the final design of the proposed development, the potential for harm to the assets captured in this note, being the two churches, Brent Knoll and Glastonbury Tor, would need to be re-evaluated to confirm any potential harm to their significance.

3.4.3 This is based on the fact that, in a worst-case scenario, these assets have been identified as having the potential for experiencing harm which, based on the information currently available, cannot be fully ascribed. Where such an impact could originate from that might lead to harm to the significance of heritage assets cannot currently be specified. However, this would need to result in such a substantial change within the setting of a heritage asset which would in turn directly harm the significance of the asset. This is in line with Historic England's GPA3 guidance on The Setting of Heritage Assets (2017) which notes that, while setting is not itself a heritage asset, "*its importance lies in what it contributes to the significance of the heritage asset or the ability to appreciate that significance*". Therefore, the importance of setting is in what it contributes to the significance of an asset, simple intervisibility or proximity to a proposed development is not considered to constitute harm in itself, and 'setting' is not a designation.

3.4.4 Based on the above, the following measures have been put into place to ensure that such a review process is undertaken as soon as the final design becomes available:

- Design principles *BH2: Design to mitigate where possible the landscape and visual impacts as identified in the ES; and BH5 An innovative approach to design and materials which considers the landscape and visual impact of the building(s)* (in regard to building heights), as well as *SL1: Create strong strategic landscape at the edges of the site* will be updated to make greater reference to the historic environment and its landscape and cross reference back to this technical note added.

- A mitigation checklist, which accompanies the compliance form of the application, has been produced with specific reference to the aforementioned heritage assets as part of mitigation checklist item 16 (see **Section 3.5**).

- A Heritage Impact Assessment (HIA) will be added to the Application for Compliance Form as a supporting document which will need to be provided in support of a valid application for compliance with the LDO. This will ensure that an assessment of harm to the significance of the historic environment, in particular those assets included in checklist item 16, is provided at each application for compliance stage.

3.4.5 The above action steps ensure that an assessment of potential harm to the significance of (in particular the above named) heritage assets will be undertaken based upon the final scheme once known.

3.5 Mitigation Checklist item 16

3.5.1 To further support the LDO application, and to ensure that mitigation is being considered at an early stage, a mitigation checklist accompanies the compliance form of the application. Draft mitigation checklist item 16 (MC16) currently considers designated heritage assets, their setting and landscape views and it is proposed that the wording of the draft item could be amended as follows to address the key findings of this note and additional assessment herein:

"*Each compliance application must consider impacts upon the significance of designated heritage assets based on a change in their setting by way of a proportionate assessment which identifies the level of harm in accordance with the NPPF. This should include an* *assessment of the following designated heritage assets in particular, views to and from the asset and their landscape setting, itemised as follows:*

Item 1) views to and from the asset, including the Grade I listed Church of St Michael and All Angels (NHLE 1344664), Grade I listed Church of St Mary (NHLE 1060144) and Grade II listed Manor Farmhouse (NHLE 1060137).

Item 2) landscape settings, including from Brent Knoll Scheduled Monument (NHLE 1008248) and from Glastonbury Tor Scheduled Monument and Grade I Listed Building (NHLE 1019390, 1345475).

Any mitigation should seek to ensure that there is no or minimal conflict between the heritage asset's conservation or any aspect of the proposal. Proposed mitigation should be set out in the form of design measures to accommodate the built structures in a way that will positively respond to the setting of the designated heritage assets."

BIBLIOGRAPHY

The Richards Partnership, 2017. Chapter 6 Landscape and Visual Impact Assessment '*Huntspill Energy Park: Environmental Statement*'

Wessex Archaeology, 2011. *BAE Royal Ordnance Factory, Puriton, Bridgwater – Archaeological Desk-Based Assessment* (Report ref.: 68791.01)

Wessex Archaeology, 2012a. *Royal Ordnance Factory, Puriton, Bridgwater, Somerset – Historic Building Record, Volume 1 and 2* (Report ref.: 84300.02)

Wessex Archaeology, 2012b. *Royal Ordnance Factory, Puriton, Somerset: Archaeological Evaluation Report* (Report ref.: 84300.03)

Wessex Archaeology, 2017. Chapter 10 Cultural Heritage '*Huntspill Energy Park: Environmental Statement*'

Wessex Archaeology, 2019a. *Gravity, Woolavington, Puriton, Bridgwater: Detailed Gradiometer Survey Report* (Report ref.: 218371)

Wessex Archaeology, 2019b. *Gravity Energy Park Access Road, Puriton, Somerset: Archaeological Investigations* (Report ref.: 218370)

Wessex Archaeology, 2020. *Gravity, Cowslip Meadow, Puriton, Somerset, Archaeological Mitigation Interim Summary of Results* (Report ref: 218372)

Wessex Archaeology, 2021a. *Gravity, Puriton, Cowslip Meadow: Detailed Gradiometer Survey Report* (Report ref.: 218373)

Wessex Archaeology, 2021b. *Gravity: Historic Environment Desk-based Assessment* (Report ref.: 218374.01)

Wessex Archaeology, 2021c. *Gravity, Puriton, Bridgwater, Somerset, Written Scheme of Investigation for Archaeological Evaluation* (Report ref.: 218375.01)

Online resources

ADS: http://archaeologydataservice.ac.uk/

Historic England: http://www.historicengland.org.uk/listing/the-list/

All URLs Accessed on 10/01/2022

PLATES

Plate 1: View from the Grade I listed Church of St Michael and All Angels churchyard towards the Site, looking east

APPENDICES

Appendix 1: Impact Assessment Table as per 2017 ES Addendum Chapter 10 Cultural Heritage (based on 2013 results)

HUNTSPILL ENERGY PARK: ENVIRONMENTAL STATEMENT
Cultural Heritage

Table 10.4 Cultural Heritage Impact Table

Development Activity	*Potential Impact Identified*	*Magnitude of impact*	*Positive /adverse*	*Direct/ Indirect/ Secondary*	*Short / Medium / Long - Term*	*Temp/ perm*	*Significance*	*Mitigation Measures*	*Significance of Residual Impact*
CONSTRUCTION PHASE									
Groundworks associated with Energy Park	Loss of Romano- British buried remains (low value)	High	Adverse	Direct	Long term	Perm	Moderate	Known archaeological remains located within green spaces within site. Phased archaeological investigation to record buried remains	Minor Adverse
	Loss of previously unknown archaeological remains in previously developed areas (very low value)	High	Adverse	Direct	Long term	Perm	Minor	Phased archaeological investigation to record buried remains	Minor Adverse
	Loss of peat deposits and palaeo-environmental data (low value)	High	Adverse	Direct	Long term	Perm	Moderate	Limited development in northern part of Site. Phased archaeological investigation to record buried remains.	Minor Adverse
Groundworks associated with Access Road	Loss of Romano- British buried remains (medium value)	High	Adverse	Direct	Long term	Perm	Substantial	Phased archaeological investigation/ excavation to record buried remains	Minor Adverse
	Loss of windmill site (low value)	High	Adverse	Direct	Long term	Perm	Moderate	Phased archaeological investigation to record buried remains	Minor Adverse
	Partial loss of tramway route (low value)	Low	Adverse	Direct	Long term	Perm	Minor	Phased archaeological investigation to record buried remains	Negligible Adverse
OPERATION PHASE									
Operation of Access Road	Loss of context of the historic landscape	Medium	Adverse	Direct	Long term	Perm	Minor	Appropriate screening	Minor Adverse

Appendix 2: Gazetteer of Designated Heritage Assets considered in the 2021 HEDBA with an additional column showing which assets are specifically being covered under MC16 following the submission of the ES

NHLE No.	Grade	Name	Level of Harm as per HEDBA (to be reviewed in the Heritage Impact Assessment as part of the Application for Compliance)	Covered under MC16 following ES submission? Y/N
1008248	N/A	Brent Knoll	Likely harm – to be taken forward for further assessment in ES Chapter	**Yes**
1019291	N/A	Motte with two baileys immediately east of Bristol Road, Down End	No harm identified	No
1060144	I	CHURCH OF ST MARY	Likely harm – to be taken forward for further assessment in ES Chapter	**Yes**
1344664	I	CHURCH OF ST MICHAEL AND ALL ANGELS	No harm identified	**Yes**
1060102	II	UNIDENTIFIED MONUMENT IN CHURCHYARD, ABOUT 10 METRES SOUTH OF CHANCEL, CHURCH OF ST MARY	No harm identified	No
1060103	II	GOLDCLEEVE	No harm identified	No
1060104	II	POOL HOUSE	No harm identified	No
1060105	II	GRANGE COTTAGE	No harm identified	No
1060106	II	EAST GRANGE THE GRANGE	No harm identified	No
1060107	II	COCKPIT IN GROUNDS OF THE GRANGE	No harm identified	No
1060137	II	MANOR FARMHOUSE	Likely harm – to be taken forward for further assessment in ES Chapter	**Yes**
1173477	II	UNIDENTIFIED MONUMENT CHURCHYARD, ABOUT 10 METRES SOUTH EAST OF CHANCEL, CHURCH OF ST MICHAEL AND ALL ANGELS	No harm identified	No
1296223	II	GATEWAY TO PURITON MANOR	No harm identified	No
1344686	II	UNIDENTIFIED MONUMENT IN CHURCHYARD, ABOUT 15 METRES SOUTH EAST OF EAST END OF CHURCH OF ST MARY	No harm identified	No
1344687	II	CAUSEWAY FARMHOUSE	No harm identified	No
1344688	II	HALLACOTT	No harm identified	No

Appendix 3: Additional Assessment of Reason for Scoping Out at 2021 HEDBA Stage

Asset Name	Location to Site	Reason for Scoping Out of further assessment following site visit
Motte with two baileys immediately east of Bristol, Down End (NHLE 1019291)	900 m to the west of the Site	The remains of the castle comprise part of a mound and three broadly concentric mounds which form the earthwork of a motte with two baileys. The asset is located outside of Puriton's main core (to the west of the Site) and is separated from it by the M5 and the small residential area of Down End (part of Puriton). The significance of the monument mainly consists of its archaeological and historic interests. Its archaeological interest is best appreciated from close inspection of its remains, while its historic interest links to, firstly, the local history and development of Puriton, and, secondly, to the history of the wider medieval fortifications introduced by the Normans in Somerset. The immediate topography surrounding the Scheduled Monument is relatively flat, and this, combined with the fact that it is largely surrounded by tees, limits views from the top of the surviving mounds which do not extend beyond Down End, the Bridgewater Centre industrial estate and the Bridgewater Business Centre (located to the west and south of the monument respectively). Based on this, the existing setting of the monument comprises a settlement edge character which borders on to an industrial/business park area. It is considered that the existing immediate setting of the monument contributes little to the appreciation of its interests, but that it does somewhat contribute to the understanding of its historic interest. The historic setting of the motte and bailey castle would have likely afforded it good views across the wider landscape due to its position at the northern end of the Polden Hills. The Site is located outside the immediate setting of the monument and forms part of the wider backdrop of the area which includes a mainly agricultural landscape with interspersed settlements and areas of scattered modern developments. This wider setting would have historically been important in understanding the monument and its placement within the wider Norman fortifications and along the Somerset Levels, however, this has now been lost. Therefore, the Site is not considered to form part of the setting of the monument that still contributes to its significance (i.e., its immediate setting). As such, this Scheduled Monument is scoped out of further assessment.
Church of St Mary, Woolavington (NHLE 1060144)	800 m south-east of the Site	The Grade I listed Church of St Mary is located within the core of Woolavington. The Church is of 11th century date, although it was altered from then onwards and extensively restored in the 1880s. From its location within the village core, views towards its surrounding rural landscape are limited. The significance of the church consists of its archaeological, architectural and historic interests. Broadly, the archaeological interest includes the church and the churchyard and focuses on what information it could yield about the church's construction, use and origin. The architectural interest lies in the design and decorative features of the church. Elements as part of any changes and restorations from the 11th century onwards are themselves of interest. The historic interest of the church is linked to the development of Woolavington. This interest is strengthened by its location within the historic core of the settlement and its position within the cluster of other surviving Listed Buildings which also contribute to the understanding of the village (further discussed below). The church is set within a small cluster of other Listed Buildings located within the settlement core. This cluster forms a relatively coherent centre of historic buildings which are best appreciated from close proximity and in

		combination with each other which also helps to understand the historic development of the village. Within this cluster, the listed church provides a focal point and is sited within its own churchyard. As such, the village setting which forms the church's immediate setting is considered to greatly contribute to the historic interest of the asset. The church tower forms a prominent feature of the settlement and is visible from approaches to the settlement, for example, from Causeway/the B3141 to the north (to the east of the Site), Eight Acre Drove to the east of the church, and Combe Lane to the south-east of the church. While the Site may be visible in the same views towards the tower from the Causeway (when approaching Woolavington from the north), it is anticipated that the Site would not detract from or harm the significnace of the Church through a change within a view of the church tower. The surrounding agricultural landscape forms the wider backdrop setting of the village, however, this setting is not considered to meaningfully contribute to the significance of the church. The Site is therefore not considered to form part of the setting of the church that actively contributes to its significance (i.e., its immediate village setting). As such, this Listed Building is scoped out of further assessment.

Appendix 4: Figures 1 and 2 showing views from Brent Knoll and Glastonbury Tor towards the Site

		Date:	20/01/2022	Revision Number:	0
		Scale:	N/A	Illustrator:	a.gray
		Path:	X:\PROJECTS\218374		

View looking south-south-west from Brent Knoll towards the Site (marked with dotted line)

Figure 1

Date:	20/01/2022	Revision Number:	0
Scale:	N/A	Illustrator:	a.gray
Path:	X:PROJECTS\218374		

View looking west-north-west from Glastonbury Tor towards the Site (marked with dotted lines)

Figure 2

Appendix 5: Huntspill Energy Park Technical Report on Potential Energy Generation

Environment

BAE Systems

April 2012

Huntspill Energy Park Technical Report on Potential Energy Generation

Prepared by: .... Catherine Mackay
Principal Environmental Consultant

Checked by: .... Simon Wheeler
Regional Director

Approved by: .... Simon Wheeler
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Rev No	Comments	Checked by	Approved by	Date
0	Draft issued to client for comment	CM		
1	Final issued to client	CM	SW	24/04/2012

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Table of Contents

1. Introduction

1.1 Report Context

BAE Systems have instructed AECOM to produce a technical report to support the outline application for redevelopment of the former BAE Systems facility to a mixed use commercial/industrial estate which also encompasses an energy park. Outline planning permission is sought for the employment uses on this redeveloped site and that Plots E, J and K are safeguarded for future development for energy generation.

It is understood that further planning permissions will be required for these energy generation plots, and that "reasonable assumptions" must be made in order for the competent authority (Sedgemoor Council) to adequately assess cumulative impacts. This will be outlined in the accompanying Environmental Impact Assessment (EIA). Therefore we have identified the potential types of energy generation within the Huntspill Energy Park, and have provided "reasonable assumptions" based upon consented schemes across the UK.

It is recognised that the individual energy facilities in these plots will be subject to different planning regimes dependent upon their generating capacity. For example, any energy generation over 50MW will require planning permission from the Planning Inspectorate under the *Planning Act 2008* (formerly under the Infrastructure Planning Committee (IPC)).

Each section of this report will outline the "reasonable assumptions" for each individual Plot using an example scheme which has either been granted (or has an intention to grant) planning permission. The main environmental elements of consideration associated with the energy generation facilities are air quality and odour, noise and traffic, and these are all highlighted within each section. Other details regarding average duration of construction phase, appearance, employment benefits, general operations and specifications are outlined where available.

1.2 Site Description & Infrastructure

The former BAE Systems facility had no previous form of energy generation onsite. However there are several overhead grid connections surrounding the site. In addition, the EDF Withy End windfarm is proposed to the north of the site (ref 54/11/00004) and National Grid propose to upgrade the current 132kV line which crosses the site in a north-south direction to a 400kV transmission line to support the proposed Hinkley Point C nuclear power station.

1.3 Report Structure

The following sections outline the structure of this technical report:

Section 2 outlines the "reasonable assumptions" used for the outline EIA for Plot E

Section 3 outlines the "reasonable assumptions" used for the outline EIA for Plot J

Section 4 outlines the "reasonable assumptions" used for the outline EIA for Plot K1

Section 5 outlines the "reasonable assumptions" used for the outline EIA for Plot K2

Section 6 outlines the commercial viability for the proposed energy uses.

In order to provide example "reasonable assumptions", information contained within these sections is solely derived from the Environmental Statement and supporting technical documentation which has been submitted in support of planning permission for the individual projects. AECOM is not responsible for determining the quality of this information, but as the schemes are granted, or have an intention to grant, it must be assumed that it was sufficient for the competent authority and statutory consultees.

1.4 General Assumptions

The following general assumptions will apply to all plots:

- The finished floor levels for each of the plots proposed for energy uses will be identified through the Flood Risk Assessment, which will be submitted with the planning application;
- There is no restriction on planting or landscaping within the appropriate areas of the energy use plots unless specified;
- To calculate man years, the assumption of 20 man days in a month and 11 months in a year (to account for illness and leave) has been used (with the exception of Rookery South where the figure was provided in the Environmental Statement);
- Under Article 219 of UK Air Navigation Order (ANO) 2009, there is a mandatory lighting requirement for structures of 150m or more in height, however structures of lesser height may need to be lit if they constitute a hazard to air navigation. The Article 219 specification requires that medium intensity (2000 candela) steady red lights be mounted as close as possible to the top of the structure and at intermediate levels not exceeding 52 metres. Such lighting should be displayed at night and be visible from all directions. In addition, the location of a tall structure may also be a potential hazard to aviation. Comment should be sought from the Directorate of Airspace Policy (DAP) of the CAA for all proposals over 90m in height; and
- There will be no requirement for any abstraction from the Huntspill River. Any water required for the energy uses will be taken from the mains supply.

2. Plot E – Energy from Waste

2.1 Type of Energy Generation

The size of Plot E and its proximity to a railway suggests that a medium scale thermal plant such as energy from waste would be suitable for this plot. The rail head does also provide opportunities for a biomass plant but for a 50MW facility would require a significantly larger fuel source as opposed to energy from waste.

2.1 Technology

Energy from Waste (EfW) is the process of creating energy in the form of electricity or heat using incineration, gasification or pyrolysis technology to combust a waste source and is a form of energy recovery. Older EfW processes produce electricity directly through combustion of the waste. More modern facilities produce a combustible fuel commodity, such as methane, methanol, ethanol or synthetic fuel. Modern incinerators reduce the volume of the original waste by 95-96 percent, depending upon composition and degree of recovery of materials such as metals for recycling and the ash for the construction industry.

There are a number of other new and emerging technologies that are able to produce energy from waste and other fuels without direct combustion. Many of these technologies have the potential to produce more electric power from the same amount of fuel than would be possible by direct combustion. This is mainly due to the separation of corrosive components (ash) from the converted fuel, thereby allowing higher combustion temperature, efficiently converting the fuel into a liquid or gaseous fuel.

An example of an EfW plant, operated by Veolia in Sheffield where 62% of waste collected from the surrounding area is taken to the Energy Recovery Facility (ERF) where it is burnt at temperatures of over 850°C in a specially controlled environment. The heat created from the process is converted to steam and used to generate heat and electricity. The ERF is designed to handle 225,000 tonnes of municipal solid waste a year. Up to 60MW of heat is supplied to over 140 buildings connected to the District Energy Network. The plant also generates up to 19MW of electricity for the National Grid; enough to power up to 19,000 homes.

2.2 Introduction to Scheme

2.2.1 Reasonable Assumption

Should the proposed energy generation capacity be over 50MW, this will require determination under the *Planning Act 2008* by the Planning Inspectorate. Therefore in order to provide reasonable assumptions, we are using the Covanta Rookery South Resource Recovery Facility, which has recently been Development Consent Order (DCO) by the Secretary of State under the *Planning Act 2008*.

2.2.2 Site Description

The RRF is located at a former brick clay pit near Stewartby in Bedfordshire, and comprises an Energy from Waste facility with an average gross/net electrical output of approximately 65/55 MW and a dedicated post-treatment Materials Recovery Facility (MRF). The total pit area is approximately 210ha and is subject to a Low Level Restoration Scheme (LLRS), although the application boundary for this project is 130ha. Therefore a large amount of ground works are required prior to construction commencing.

The EfW facility will be fuelled by 585,000 tonnes per annum of residual waste and will also act as a Combined Heat and Power (CHP) facility. The facility will generate sufficient electricity to supply approximately 82,000 homes. The post-treatment MRF is dedicated to the management of the Incinerator Bottom Ash (IBA) produced by the EfW facility and aims to recover approximately 90% of this material to a secondary aggregate for use in construction projects and ferrous/non-ferrous metals for recycling. Numbers in brackets denote buildings within the scheme.

2.2.3 Scheme Specifics

The overall Rookery South scheme encompassed a larger site and therefore for the purposes of this reasonable assumption, only the EfW facility will be tested. It is recognised that there may be by-products although this will depend upon the technology and type of waste used. Therefore the MRF will be removed from the description of this reasonable assumption.

In addition, the Rookery South facility also included a rail head, although it was concluded that this would not be used for the scheme. However due to the close proximity to the rail head at Huntspill, it is assumed that the rail head may be utilised for delivery of waste and also potential removal of by-products such as ash and metals. However it is likely that the waste material for fuel will be brought in by road.

No water is expected to be extracted from the Huntspill River for the steam turbine. Steam and water is contained as a closed loop system within thermal generation. Water required for commissioning will be taken via the main supply.

2.2.4 Orientation

The assumption is that the proposed scheme will use the railhead. They the plant will be orientated with storage and hoppers towards the rail head with the remainder of the facility including the air cooled condensers and stack will be located away from the rail head. Administration buildings and car parking will be located appropriately with no limitations on landscaping.

2.3 Project Description

2.3.1 Key Components

Principal plant buildings and their dimensions are as follows.

- the provision of a drainage channel on a realignment in substitution for a drainage channel that would otherwise be provided in Rookery South Pit;
- the extension of an attenuation pond similarly to be constructed in Rookery South Pit;
- an underground connection to the electricity grid allowing the export and import of electrical power;
- works for the creation of an upgraded site access and new junction on Green Lane, Stewartby and an improved entrance to the Marston Vale Millennium Park;
- improvements to Green Lane between its junction with footpath 4 and Stewartby Lake including footway improvements; and
- improvements to Green Lane level crossing including the installation of full automatic barriers.

Ancillary structures would include:

- weighbridges and security gatehouses;
- internal site roads and parking facilities;
- workshops and stores;
- landscaping, earth bunds and boundary treatments;
- pipes for steam pass outs and for hot water pass outs within the Application Site;

- habitat creation;
- the provision of footpaths and cycleways and footpath linkages; and
- foul drainage provision, surface water management systems and water supply works.

Key dimensions of the overall facility area as follows:

Table 2.1 – Key Dimensions.

EfW Facility Element	Max Height (from FFL)*	Max Height (AOD)
Tipping Hall (FFL +41.0m AOD)	15.0m	56.0
Boiler House	43.0m	74.0
Turbine Hall and Air Cooled Condensers	20.0m	51.0
Stack	105m	136

*Note: * Finished Floor Level (FFL) assumed as +31m AOD unless otherwise stated*

Building widths and heights have been scaled from the planning figures submitted to the Infrastructure Planning Commission (IPC). The local dimensions of the facility are outlined here:

Table 2.2 – Building Dimensions

Building Number	Description	Height (m)	Length (m)	Width (m)
6	Tipping Hall	20	19	44.5
7	Refuse Bunker	36	10	38
8	Boiler House	38	33	34
9	FGT Area	32	20	32
13	Turbine Hall	15	19	22.5
19	Silos	23	10	31

2.3.2 Materials and Appearance

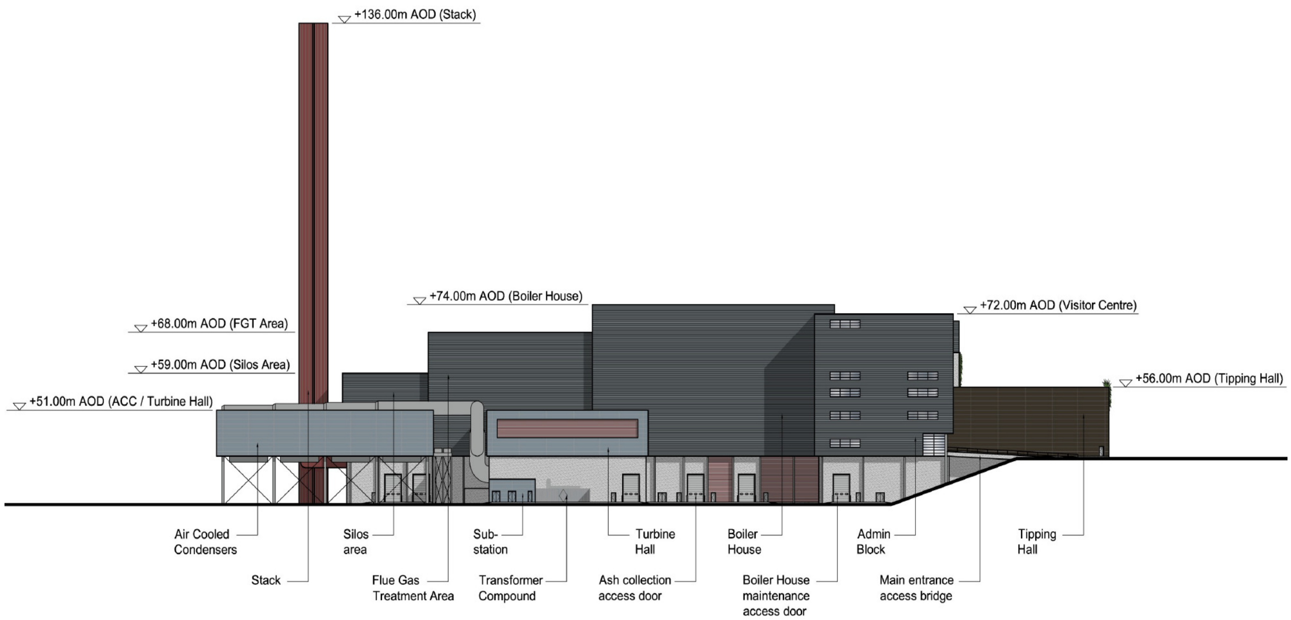
Below the datum the EfW facility will be clad in concrete, which provides a natural grey colour. Any entry or loading doors will be a mid-grey tone in keeping with the concrete. Above the datum, the main elements of the EfW building including the refuse bunker (7), boiler house (8), FGT area (9) and silos (19) are clad in profiled metal cladding, which will be dark grey in colour.

The stack will be clad in a terracotta coloured metal cladding, which will be consistent with the localised brick chimneys in Stewartby.

The administration area (15) will be clad in anthracite grey coloured profile cladding, whilst the other operational areas will be clad slightly differently as follows:

- tipping hall (6) will be clad in grey brown colour – expressing the raw nature of incoming waste;
- turbine hall (13) and air cooled condensers (14) are to be clad at high level in composite panels in height grey and the lower part in pre-cast concrete – expressing the "processed" output of electricity and heat; and
- workshops and stores (10) to be clad entirely in light grey composite panels

Figure 2.1 – Visualisation of Rookery South RRF



2.3.2 Employment Benefits

The proposed scheme would also be directly responsible for the creation of up to 80 permanent jobs (comprising 61 EfW operators site workers, 11 HGV drivers and one manager).

2.4 Construction Phase

2.4.1 Duration

The construction phases of this project were scheduled to last 39 months, and were limited to daylight hours of 07:00 to 19:00, Monday to Friday and 07:00 to 13:00 on Saturday. There is no timing breakdown of construction phases and therefore this includes the LLRS of the Rookery clay pit and reinstatement for a development platform.

2.4.2 Workforce

The 39 month construction phase includes a workforce of approximately 320 persons which is the equivalent of 1,040-1,300 person years of employment (variation in figures found within ES).

The highest volume of traffic occurs between months 20-28 and therefore the assumption is that this is the peak employment period.

2.4.3 Delivery of Process Plant

Details regarding the delivery of turbines and/or abnormal loads were not included within the Rookery South RRF Environmental Statement as these areas are subject to construction contracts, and therefore were to be agreed at the appropriate time. The traffic surveys undertaken as part of the Transport Assessment (Appendix 18.2) considered abnormal loads no larger than the maximum legal articulated vehicle size.

Preference is given to off-site fabrication and modular construction to minimise the requirement for abnormal loads. For example, boiler membrane walls are to be brought to site in large panels and welded *in situ*, although their installation will require heavy duty mobile cranes. Other process plant such as boiler sections, steam drums, steam turbine, process fans and compressors are to be delivered on loader and craned into position.

Large scale construction plant such as cranes and generation equipment are commonly modular and the likely nature of their transport will be infrequent through construction as they will be required at set times. This is often after enabling works.

For Huntspill it can be assumed that generation equipment can be delivered by road or rail head to site from Avonmouth Dock.

2.4.4 Construction Traffic

The following table outlines the predicted two-way construction vehicle movements per day (the LLRS movements have been excluded but these may incorporate the MRF):

Table 2.3 – Predicted two way traffic movements during construction

	Month	HGVs	Cars / LGVs
RRF Construction Movements (39 month period)	1	10	58
	2	6	94
	3	26	96
	4	68	130
	5	316	138
	6	308	178
	7-12	Average = 100 Min = 8 Max = 308	Average = 434 Min = 236 Max = 566
	12-19	Average = 100	Average = 434

	Month	HGVs	Cars / LGVs
		Min = 8 Max = 308	Min = 236 Max = 566
	20-28	Average = 126 Min = 124 Max = 308	Average = 578 Min = 568 Max = 584
	29-39	Average = 4 Min = 2 Max = 6	Average = 298 Min = 58 Max = 528

2.4.5 Construction Value

The overall Rookery South RRF was valued at a construction cost of £45 million.

2.5 Operational Phase

2.5.1 Operation

The EfW facility will be operational 24 hours a day, 365 days a year. Deliveries of fuel are restricted to between 05:00 and 23:00, Monday to Saturday, excluding Christmas Day, New Years Day and Easter.

The MRF has operational hours of Monday to Friday 07:00 to 18:00 and Saturday 07:00 to 14:00.

The assumed plant availability is 89% (the allowance for planned and unplanned maintenance shutdowns).

2.5.2 Vehicle Movements

The following table outlines the type and number of predicted vehicle movements associated with the project based on the nominal capacity of 585,000tpa being delivered as per the operational hours above.

Table 2.4 – Predicted two way vehicle movements during operation

Summary of Total Vehicle Movements per day	In	Out	Total (2-way)
Vehicle collection vehicles	33	33	66
RCV / Roll on / Skip	50	50	100
Bulk loaders	59	59	108
Fuel in (HGVs)	8	8	16
Products exiting (HGVs)*	28	28	56
Sub Total HGV	178	178	356

Summary of Total Vehicle Movements per day	In	Out	Total (2-way)
Staff	67	67	134
Visitors	11	11	22
Maintenance	9	9	18
Total Movement	265	265	530

* products exiting include IBA, fly ash and metals

Further information including extracts from the ES and technical appendices can be found in Appendix A

2.6 Decommissioning

It is anticipated that the Rookery South RRF has an operational life span of 35 years. When decommissioned, the steel structure would be removed and recycled and pre-cast concrete broken and crushed for reuse.

It was anticipated that the decommissioning process would generate a similar level of operations associated with the construction phase.

2.7 Air Quality

The main EfW building has been included in the Rookery dispersion modelling. The stack is designed to ensure that the treated combustion gases are dispersed at a height and a velocity such that they have no significant impact on the surrounding area. The treated emissions are monitored by emissions monitoring equipment (26). The emissions which will be monitored continuously include the particulates SO_2 and NO_x, This provides readings of emissions to demonstrate that they do not exceed the Waste Incineration Directive (WID) limits and if there is adverse trending in the levels of emissions. The Rookery modelling has broken the building down into a number of elements to reflect the stepped nature of the building design, however, the heights of the individual sections has not been provided in the ES or Technical Appendix.

The engineering drawings provide a number of building layouts, which include the elevation of various building sections in mAOD.

The following processes were identified as being the main contributors to air quality:

Construction Phase

- emissions of dust associated with on site construction activities;
- emissions associated with traffic accessing the site during construction; and
- emissions associated with the removal of asbestos from the conveyor.

Operational Phase

- emissions arising from the combustion process in the EfW facility;
- emissions from the diffuse sources connected with the IBA handling and
- emissions associated with traffic accessing the site during the operation of the RRF.

2.7.1 Stack Parameters

The stack height assumed in the air quality assessment is 100 metres and the stack height given on the plans as 136 mAOD. As such, a base elevation for the site of 36 mAOD has been assumed to allow the calculation of the building heights. Building widths and heights have been scaled from the planning figures submitted to the Infrastructure Planning Commission (IPC).

Table 2.5 – Emissions

Parameter	Units	Value
Number of stacks		1
Number of flues		3
Flue diameter	m	1.8
Stack height (from base)	m	100
Gas temperature	Celsius	137
Volume flow rate	Nm^3/s	39.1
Volume flow rate	Am^3/s	48.3
Moisture content	%	18.88
Oxygen content	%	6.06

Table 2.6 – Parameter Concentrations & Mass

Parameter	Emission Concentration Limits (WID) (mg/Nm^3)		Mass Emissions (g/s)	
	Long-term	Short-term	Long-term	Short-term
$PM_{10}/PM_{2.5}$	5	10	0.196	0.391
NO_x	200	200	7.83	7.83
SO_2	15	50	0.587	1.96
CO	25	50	0.978	1.96
VOC	3	10	0.117	0.391
HCl	7.5	10	0.294	0.391
HF	0.5	1.0	0.0196	0.0391
Dioxins	7.0×10^{-8}	1×10^{-7}	2.74×10^{-9}	3.91×10^{-9}
Ammonia	3	10	0.117	0.391
Sum of Group 1 metals (Cd and Tl)	0.005	0.05	1.96×10^{-4}	1.96×10^{-3}
Sum of Group 2 metals (Hg)	0.01	0.05	3.91×10^{-4}	1.96×10^{-3}
Sum of Group 3 metals (Sb, AS, Pb, Cr, Co, Cu, Mn, Ni, V)	0.05	0.5	1.96×10^{-3}	0.0196
Arsenic	0.025	0.25	9.78×10^{-4}	0.0096
PAH (as Benzo[a]pyrene)	0.000088	n/a	3.44×10^{-6}	n/a
Chromium (VI)	0.00015	n/a	5.87×10^{-6}	n/a

Notes: Normalised /actual emissions are described in terms of the actual conditions at emission from the stack or in terms of normalised conditions.
Pollutant emissions rates are presented per stack
Emission of arsenic were separated out from the rest of the Group 3 metals as the project was subject to site specific emission limits

2.7.3 Vapour & Plume Visibility

Vapour or venting of steam from the stacks commonly occurs and is normally visible during the start-up procedure., This is necessary to protect the steam turbine and takes place for a relatively short period of time. Sometimes it can occur during emergency venting of steam, which is expected to occur infrequently. A release of steam will also be required upon commissioning.

The water vapour content of any plume from an EfW is dependent on the following:

- the fuel type to be used, i.e. black bag waste or processed waste (Refuse Derived Fuel (RDF)); and
- the level of pre-processing, i.e. sorting, recycling, composting etc undertaken to boost materials recovery or the fuels calorific value (CV).

The type of abatement plant to be used will also affect he moisture content of any resultant plume.

The Rockery facility comprised of both an EfW and Materials Recovery Facility (MRF). The MRF will process both household and business waste by recycling and composting where possible with the residue from the recovery process used in the EfW. The Rockery facility also utilised a dry flue gas abatement system. Both the pre-processing of the waste and use of a dry abatement system will affect the moisture content of the plume. Typically moisture vapour concentrations for EfW's are of the region of 13 – 19%.

The proposed Rookery facility has an anticipated moisture content of 18.88% H_2O (20.4% if a semi-wet flue gas abatement was used) so this may be considered a conservative assessment for the majority of facilities. Based on the use of dry abatement system the mass of water emitted from the facility will be approximately 0.1199 kg per kg, while for a semi-dry process the mass emission would be 0.1296 kg per kg.

Based on the use of dry flue gas abatement the Rookery ES provided the following frequencies of visible plumes and plume lengths.

Table 3.6 – Plume Length & Frequency

Plume Length	Frequency (% of the year)
0m (no visible plume)	48%
0-50m	33%
50-100m	14%
100-150m	4.1%
150-200m	0.87%
200-250m	0.19%
250-300m	0.06%
Maximum	278m

Plume visibility analysis was undertaken which outlined that that for over 98% of the time the plume would be less then 150m long. It should be noted that local conditions will affect the number and length of visible plumes from the facility dependent on local meteorological conditions including wind speed, temperature and relative humidity.

2.7.4 Abatement Methods

Generally thermal power stations in the UK use Selective Non-Catalytic Reduction (SNCR) for the control of nitrogen oxides and therefore emissions are kept with EU set limits. Other emissions can be controlled via careful control of combustion conditions along with the use of ammonia/urea injection (acid gas control), activated carbon injection to control the emission of metals and bag filters to reduce particulate/metal emissions.

No water is expected to be extracted from the Huntspill River for the steam turbine. Steam and water is contained as a closed loop system within thermal generation. Water required for commissioning will be taken via the main supply.

2.7.5 Emissions from Traffic

Peak construction traffic ranges between 114 – 546 LDVs and 546 to 248 HGVs over the life of the construction phase with higher HGV peak movements at the start of the construction process and a higher peak LDV flow towards the end of the construction period.

Operational traffic for the proposed facility consists of 154 LDVs and 366 HGVs.

2.7.6 Odour

EfW facilities may produce some odour from dustcarts delivering waste and storage of waste. Odour should be destroyed in the furnace assuming all combustion air is extracted from the tipping hall and waste bunker. Use of fast opening/closing doors/an airlock system and negative pressure within the tipping hall will minimise the potential for fugitive odour and dust effects. All waste should be delivered in sealed containers, or appropriate vehicles for the material being transported and should only be allowed to discharge their loads once within the tipping hall and the doors closed. In addition, the tipping hall should be kept under negative pressure. Secondary mitigation can be the use of water or deodorant sprays.

For Rookery South EfW this was actually scoped out of the Environmental Statement as the above operations were implemented, without the need for secondary mitigation.

2.7.7 Assessment of Significance and Mitigation Measures

Although there was an increase in traffic numbers during construction and operation, the impacts were not significant as concentrations of NO_2 and PM10 were predicted to be well below the air quality standards and therefore unlikely to result in any unacceptable impacts to air quality.

In relation to the combustion process, impacts on human health were assessed in the immediate vicinity of the facility whereas the study area for ecological receptors was 10km of the site. The results of the dispersion modelling demonstrated that emissions from the EfW facility for all substances would not be significant and it was considered highly unlikely that any air quality standards would be exceeded.

Other studies were undertaken in relation to impacts upon human health, i.e occurrence of ill health, cardiovascular hospital admissions and development of cancer, which concluded that the likelihood of these ailments occurring would be very small. Therefore it was concluded that the EfW facility did not pose a significant impact to human health.

In relation to ecological features, dispersion modelling was undertaken considering impacts of acid deposition, nutrient nitrogen deposition, NO_x and SO_2 on the nine SSSIs which were within 10km of the site. It was predicted that there would be a marginal significant impact related to nutrient nitrogen deposition. However this was based upon modelling a stack height of 100m, and it was noted that an extension to 105m is likely to reduce these impacts to below 1% for the upper limit. Impacts upon the seven SSSIs were considered to be not significant whereas two SSSIs would have minor adverse impacts.

It was recognised that mitigation measures would have to be implemented to the storage and movement of the IBA to ensure that dust emissions do not result in nuisance of human and ecological receptors.

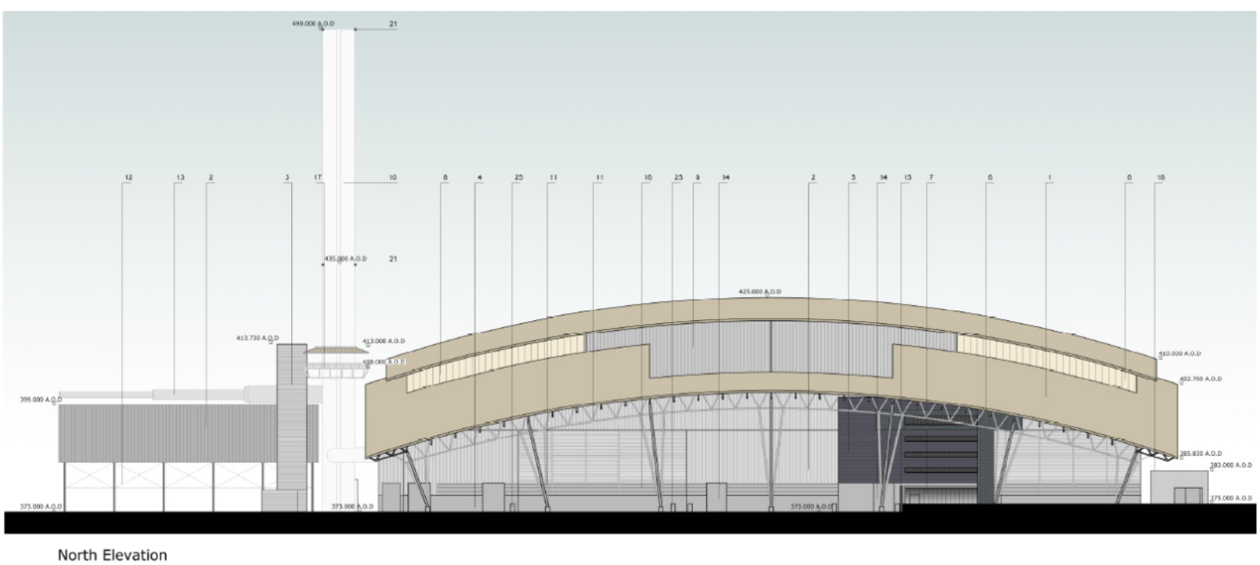
Other mitigation measures included a Construction Environmental Management Plan, wheel washing facilities, traffic management and ongoing air quality monitoring, which would be undertaken as part of the Environmental Permit.

2.8 Noise

2.8.1 Construction Phase

Limited information was provided with the Rookery South EfW Environmental Statement, therefore the Covanta Brig Y Cwm 65MW Municipal Solid Waste Resource Recovery Facility, which is a similar facility, has been used to provide reasonable assumptions.

Figure 2.2 – Visualisation of Brig Y Cwm RRF (north elevation)



Here, the construction noise assessment in the ES was separated into three phases; Ground Works, Piling and Pipeline Construction. Noise data used for noise predictions in each construction phase is summarised in the Table 2.7 below.

Table 2.7 – Construction Noise

Ground Works	
Plant	**LAeq @ 10m taken from BS 5228 site prep**
Excavator - 71t	77
Dozer - 40t	80
Piling	
Plant	**LAeq @ 10m taken from BS 5228 site prep**
Precast Driven Piles	101
Pipeline Construction	
Plant	**Laeq @ 10m taken from BS 5228 site prep**
Excavator - 71t	77
Dozer - 40t	80
Pneumatic Breaker	83
Road Lorry (full)	80

2.8.2 Traffic

Construction traffic for the proposed facility is summarised in the table below.

Table 2.8 – Construction Traffic

Number of 2-way HGV movements	LWA (dB)
490	106

Operational traffic for the proposed facility is summarised in the table below.

Table 2.9 – Operational Traffic

AAWT	HGV %
808	68

2.8.3 Operational Noise

A combination of Covanta and RPS noise source data was used in the ES to establish the likely levels of operational noise from the production of both electrical and heat energy. Noise sources used in the ES predictions along with the sound transmission loss performance of the building envelope is summarised in the tables below.

Table 2.9 – Main Equipment Noise

Main Equipment	SWL (dB(A))	Location	Comments
Unloading Waste into Bunker	88	inside	
Unloading Hoppers	81	inside	

Main Equipment	SWL (dB(A))	Location	Comments
Combustion Fan	75-85	inside	
Conveyors	90	inside	
Residue and Ash Conveyor	78-80	inside	
Feed Water Pumps	85	inside	
Condensate Pumps	80	inside	
Vacuum Ejector	80	inside	
Air Compressors	90-95	inside	
Turbine	85 SPL	inside	Presume 1m outside acoustic enclosure
Chimney	93	inside	
Conveyor Drive Units	93	inside	
Shredder	93	outside	
Conveyor Drive Units	75	outside	
Stack Transformers	82	outside	Full load

Table 2.10 – Noise from ACCs

Air Condenser Unit - No. 15 fans	
Spectrum, octave band frequency	**Std heat exchange area and 15 std fans**
31.5 Hz	119 dB
63 Hz	117 dB
125 Hz	115 dB
250 Hz	110 dB
500 Hz	107 dB
1000 Hz	105 dB
2000 Hz	102 dB
4000 Hz	95 dB
8000 Hz	92 dB
A weighted sound power total	110 dB(A)

Table 2.11 – Building Envelope Noise

Building Envelope	
Building Facade	Rw 38 dB
Roof & Personnel Doors	Rw 25 dB
Separate Housing for Turbine	Rw 45 dB
Louvers etc.	Rw 0 dB
Fast Closing Doors	Rw 23-25 dB

2.8.4 Assessment of Significance

It was predicted that the highest level of noise would occur during construction, and principally from piling phases of the project, and also during construction of the access road, although this would be more localised. Worst case scenarios were tested such as the use of generators as opposed to mains electricity, and also the construction plant used. Predicted noise levels during construction would be below the significant effects thresholds for the nearest sensitive noise receptors (dwellings) and therefore considered to be not significant.

Operational noise will be constant throughout the day and night due to the 24 hour operation of the EfW although the MMF will only work during daylight hours. Due to the distance to dwellings it would be expected that the received noise would be broadband in nature and not have a distinct tonal quality. Further to assessment of the baseline and predicted impacts, it was considered that the impact during daytime operations would result in a 0.3 dB increase against the baseline and a 0.5 dB increase at night, and therefore this is considered not significant.

Impacts from vehicle noise on the access road were also predicted to be not significant due to an increase of less than 1dB during the day and 0.3dB in the night. More specific analysis was undertaken as set times of the day and the results still predicted a non significant impact. Impacts on the wider traffic network were considered negligible due to a predicted 3% increase in predicted traffic growth.

2.8.5 Mitigation Measures

Mitigation during construction required compliance with BS 5228:2009 and selection of quieter machinery, localised screening, controlled working hours and restricted delivery times and access routes.

Operational mitigation measures included implementation of the optimised design and layout of the plant to minimise acoustic disturbance to human health and ecology. Significant reductions can be achieved by design by using quieter equipment and screening/attenuation of noisy plant. This is especially evident through reduction by design of the Air Cooled Condensers (ACCs) and it is stated within the ES that discussions with the manufacturers resulted in the ACCs being modified.

Consideration was given to the benefits of a 2m high bund surrounding the RRF, which is part of landscaping strategy for the site.

2.9 Lighting

With respect to the Rookery South application, a Lighting Strategy was developed to provide the required level of illumination for safe operation of the RRF, whilst respecting the location of the Application Site. The strategy comprises an external lighting layout and consideration of the control of internal lighting in views from the surrounding area.

In accordance with the Institute of Lighting Engineers’ Guidance Note for the reduction of obtrusive lighting GN01 (2005), the lighting and illumination impacts of the Project are designed to comply with Environment Zone E2 (low district brightness within rural/small village locations). Whilst providing adequate luminance for the various tasks which occur on the development, the Lighting Strategy is proposed to minimise the effects to local receptors, whether human or ecological.

2.9.1 Railway sidings

In terms of guidance there are various documents including railway standards, British Standards, CIBSE standards, etc. Railway and British Standards would usually have a higher priority that CIBSE but there is a lot of cross reference between these documents. There are a number of different standards for railways e.g. Network Rail has their own standards.

The CIE standard for *Lighting of Outdoor Work Places* makes reference to lighting requirements based on different areas, task and activities (section 5.2).

2.9.2 Stack Aviation Lighting

With respect to the Rookery South project, the stack will be lit with three medium intensity red obstruction lights in compliance with regulations and in agreement with Cranfield Airport, which will include one high level light positioned within 1m of the top of the stack and two mid-level lights facing west.

3. Plot J - Combined Cycle Gas Turbine

3.1 Type of Energy Generation

Given the size of Plot J and proximity to the high voltage overhead transmission line, it has been suggested that a larger scale thermal plant would be appropriate in this location. Technology such as Combined Cycle Gas Turbine or CCGT would be suitable for this plot.

3.1.1 Technology

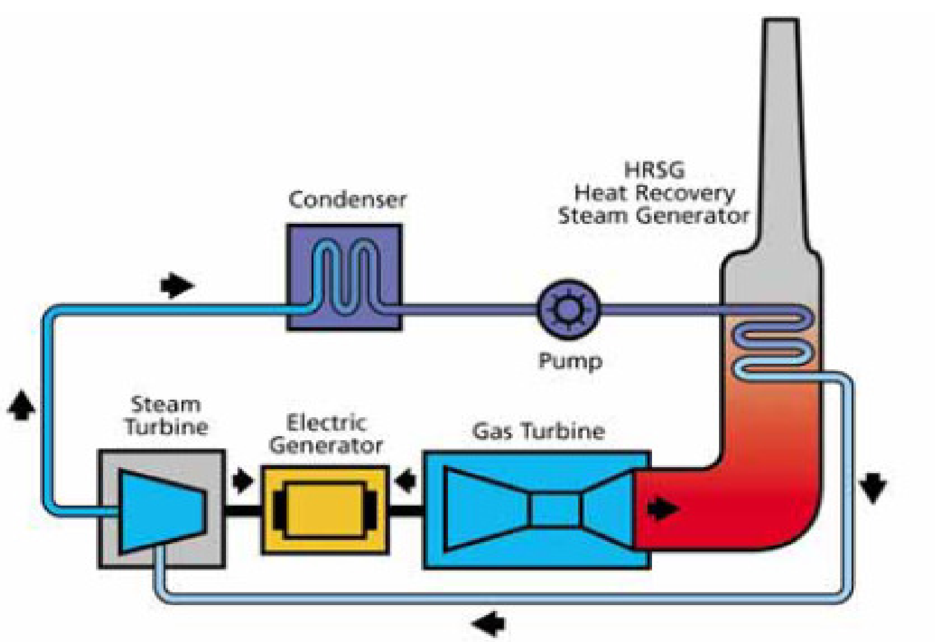
The term 'combined cycle' refers to the use of two processes to produce electricity. The burning of natural gas is the first. The recovery of heat from the waste gases to produce steam to drive a steam turbine is the second. Together, these processes capture much more of the energy in the gas. Combined-cycle plants can achieve efficiencies of 60% whilst producing limited emissions.

Gas is mixed with filtered, compressed air and burned. The hot combustion gases expand, driving the gas turbines. This in turn drives generators to produce electricity. The hot exhaust gases from this process contain significant amounts of recoverable energy. The gases are passed through the heat recovery boiler to produce steam. The high pressure steam is then used to drive a steam turbine which generates further electricity for the grid. The waste gases are expelled to the atmosphere via the stack.

The spent steam is then passed through a condenser. The condensate is then cycled back through the heat recovery boiler. The condenser may either require large quantities of cooling water (which is typically drawn from local surface waters) or may include Air Cooled Condensers (ACCs). ACCs condense the steam to water and feed it back through to the turbines in a closed loop system without the need to abstraction.

There are several operational CCGTs throughout the UK and typically operate at 800MW and above.

Figure 3.1 – Typical CCGT Configuration



3.1.2 Associated Infrastructure

Natural gas is supplied via pipeline which is connected to the National Transmission System (NTS). Dependent upon the ground conditions, the pipe will either be drilled using pipe-jack or Horizontal Directional Drill (HDD) technology or open-cut trenches. Pressure Reduction Stations (PRS) or Above Ground Installations (AGIs) may be required to pump the gas to the power station.

Other associated infrastructure required includes a substation and grid connection. Given the close proximity of a high voltage connection, a small off take will be required.

It is currently not possible to confirm the length or route of the associated pipeline or grid connection due to the premature nature of this specific project at Huntspill Energy Park.

3.1.3 Planning Regime

As the proposed energy generation is over 50MW, this will require determination under the *Planning Act 2008* by the Planning Inspectorate. This application will also take account of the gas pipeline and grid connection.

3.2 Introduction to the Scheme

3.2.1 Reasonable Assumption

The scheme that is proposed to be used as a reasonable assumption is the 800MW Severn Power CCGT power station, located in Newport, South Wales. The scheme was given Section 36 consent by the Department of Trade and Industry in 2009, and is currently operational.

Figure 3.2 – Photomontage of the Severn Power CCGT Station

3.2.2 Site Description

The Severn Power CCGT station is located on the site of a former coal fired power station, and is approximately 6ha in size. The power station is located on a peninsular at the confluence of the River Usk and Severn Estuary. The site is surrounded by national, European and international designations including the River Usk SSSI and SAC, Gwent Levels SSSI and the Severn Estuary RAMSAR, pSAC and SPA.

Adjacent to the CCGT is an operational coal fired power station called Uskmouth, which is currently owned by SSE.

3.3 Project Description

3.3.1 Key Components

Section 3.1.1 provides an outline of the CCGT technology.

3.3.2 Building Dimensions

The following table outlines the building dimensions:

Table 3.1 – Building Dimensions

Building	Grid Reference x	Grid reference y	Height	Length of x	Length of y
Condenser 1	332371	183642	26	47. 0	43.1
GT Hall 1	332431	183652	26	54.4	37.5
HRSG1	332503	183690	34	12.5	18.7
Condenser 2	332402	183575	26	46.4	44.0
GT Hall 2	332461	183585	26	53.3	38.7
HRSG 2	332533	183624	34	12.4	20.4
Switchyard	332384	183718	15	164.0	28.0

3.3.3 Materials and Appearance

Any elements of the power station buildings were clad in two different shades of green, a darker green up to 2m in height and then a lighter green above. The exceptions were the grey stacks and visible pre-cast concrete.

3.3.4 Orientation

The orientation of a CCGT plant is often related to the location and proximity of the gas pipeline. In the case of Severn Power, the Above Ground Installation (AGI) brought the gas pipeline onto site and is approximately 100m away from the gas turbine halls. The remainder of the CCGT plant is often laid out in a linear fashion behind the turbine hall/stack towards the ACCs.

There is no restriction on landscaping and this should be possible throughout the CCGT layout as appropriate although no tree planting will be possible on the pipeline route from AGI to the power station.

3.4 Construction Phase

3.4.1 Duration

The construction phase of the Severn Power project lasted for 30 months, and was limited to the daylight hours of 07.00 to 19.00 Monday to Friday and 07.00 to 13.00 on Saturday.

Several piling rigs were present for approximately four to six months at the start of the construction period, once ground enabling works had commenced. Cranes of various heights were employed to assist in construction of the taller structures. In the case of the ACC's the cranes were constructed inside the facility and screened to a certain degree. Other cranes were used for the construction of the stacks but again were present for short periods of time.

3.4.2 Workforce & Construction Value

It was proposed that a total of 400 workers would be onsite at peak construction times. Studies were undertaken to demonstrate that the local housing stock could accommodate such a temporary influx. In addition, to minimise impact to the local village of Nash, a temporary park and ride scheme was implemented during construction, and a strict time period of deliveries had to be adhered to.

The estimated man years for this 30 month construction phase are 1090 man years.

The value of the project was estimated at £650 million.

3.4.3 Traffic

The highest predicted construction traffic (including predicted HGVs occurs in 2008 with the number of construction-related vehicle movements being predicted at 260 per day. The operation of the proposed development will result in far fewer traffic movements than those associated with the construction, and are estimated to be in the order of 44 per day. A large proportion of these movements will be due to the 25-30 staff operating the plant and, therefore, the majority of journeys will be local. The maximum number of vehicles arriving at site during each shift change will be less than 25.

Table 3.2 – Traffic Movements

Type of vehicle	Cars	LGV	HGV	Total
Construction-related vehicles only	188	38	34	260
Proposed station vehicles only	40	2	2	44

3.4.4 Abnormal Loads

The ES outlined the potential for up to 70 two-way abnormal load movements over the 30 month construction period. The following information is taken from the Severn power CCGT project which outlines the component and weight of the abnormal load and time during the construction phase. No details are provided on dimensions or measurements of the abnormal loads and are therefore assumed to be the maximum legal articulated lorry size.

Table 3.3 – Construction Traffic Components

Component	Approximate Weight (tonnes)	Approximate delivery month during construction period
H Turbine (per train)	1 x 52	13
E Turbine (per train)	1 x 185	13
Condenser	1 x 122	15
Gas Turbine	1 x 330	13
Gen.Stator	1 x 295	14-16
Gen/Rotor	1 x 56	14-16
Gen.Transformer	1 x 280	14-16
Hp drum	1 x 105	14-16
Boiler modules	21 x (50-106)	15-17
Filterhouse modules	2 x 39	15-18
Diffuser	4 x 8.5	19

A transport management plan was agreed with the Highways Agency which outlined the route of the abnormal loads and a commuted sum was agreed for any improvements to the highways resulting from increased construction traffic.

The technical appendices of the Transport Chapter of the Severn Power CCGT ES are contained within Appendix B.

3.5 Operational Phase

3.5.1 Commissioning

Commissioning the two CCGT units lasted approximately four months, in which time higher than average emissions of nitrogen oxides were present but this was temporary. CCGT are often called “peaking plants” as they can respond quickly to times of peak demand in the energy network, and can start up promptly. This is the opposite to “base-load” plants such as coal, energy from waste and biomass.

3.6 Decommissioning

It is anticipated that the Severn Power CCGT has an operational life span of 35 - 40 years. When decommissioned, the steel structure would be removed and recycled and pre-cast concrete broken and crushed for reuse.

It was anticipated that the decommissioning process would generate a similar level of operations associated with the construction phase.

3.7 Air Quality

Emissions to air from point sources comprise of:

- Emissions from the main stack (flue gases containing carbon dioxide, carbon monoxide, oxides of nitrogen, traces of particulate matter and volatile organic compounds when gas firing);
- Emissions from safety vents on the natural gas system;
- Emissions of carbon dioxide from steam condenser/de-aerator; and
- Emissions of steam from de-aerator/steam vents.

Apart from the emissions of flue gas from the main stack all other point source emissions are minor and have no impact on the environment.

Under certain infrequent weather conditions, the gaseous discharges from the chimney may be visible. Additionally at start-up, under certain weather conditions, a faint brown haze may be seen.

The CCGT plant will emit approximately half the quantity of CO_2 per unit of electricity produced compared to existing fossil fuel plant, while the use of natural gas will result in negligible SO_2 emissions. In addition, the use of a gas turbine, HRSG and condensing steam turbine results in the highest efficiency of fuel usage and thus minimises the quantities of carbon dioxide emitted compared with other combustion techniques.

3.7.1 Stack Parameters

The following table outlines the stack parameters for this example CCGT. The mass release at the emission limit value is based on the normalised volumetric value (referenced to 273K, 11% O_2). Discharge parameters from CCGT power station have been provided by the design firm Mott MacDonald. The hours of operation have been assumed to be continuous throughout the year (8,760 hours). However, it is anticipated that the proposed station would operate approximately 7,884 hours per year.

Table 3.4 – Stack Parameters

Parameters	CCGT Power Station (Stack 1)	CCGT Power Station (Stack 2)
Grid reference (x,y)	332515, 183704	332545, 183637
Hours of operation per year (hr)	8,760	8,760
Stack height (m)	65	65
Inner stack diameter (m)	7	7
Exit velocity (m/s)	17	17
Efflux volume (m^3/s)	654	654
Efflux temperature (℃)	100	100
NO_x (as NO_2) average emission rate (g/s)	32.7	32.7

When operating on natural gas the plant will utilise a dry low NO_x, (DLN) combustion system which is considered best practice as the dry low NO_x burners reduce the peak flame temperature.

Emissions of NO_x are not expected to exceed an hourly average of 50mg/rn³ as NO (24.4 ppmv) (at standard reference conditions of 15% oxygen, dry, 0℃, 1013 bar a) during normal full load operation on gas fuel, with no water or steam injection. The exhaust flow and emission rate will depend on the throughput of gas and air in the gas turbine, as these are functions of ambient temperature, pressure and load.

3.7.2 Emissions from Traffic

The ES states that the existing air quality in the vicinity of the site is less than 40% of the air quality objective of Newport with pollutant concentrations predicted to decline in future years. It goes on to state that given that background air quality would be expected to increase by less than 2% as a result of the additional construction-related vehicles, air quality in the vicinity of the site was predicted to meet all relevant air quality objectives prior to development, during construction and following the operation of the CCGT Severn Power Station.

3.7.3 Odour

No odour issues are associated with gas CCGT as such no significant issues anticipated from these plants.

3.7.4 Assessment of Significance

It was considered that impacts to air quality from construction plant and equipment would be moderately significant. Impacts during commissioning and testing were considered negligible. Dust can be controlled through appropriate mitigation measures and therefore the impact from dust was classed as negligible.

Additional contributions from traffic during construction and operation were also predicted to have a minimal impact upon the air quality in the area.

Impacts from nitrogen deposition on ecological features and designated sites were predicted to not exceed any critical levels. Impacts on human health were also predicted to not exceed any the limit value for human health impacts.

It was recognised that the CCGT will be regulated and monitored by the environmental permit and will be using Best Available Technology to ensure that emissions are minimised.

3.7.5 Vapour & Plume Visibility

During start-up of the gas turbines and in combination with certain meteorological conditions, emissions of NO_x can contribute to a slight visible haze caused by the formation of nitrogen dioxide (NO_2).

Like the Rookery EfW and Nevis Power Biomass Plant both these facilities will use air cooled condensers (ACC) rather than hybrid or mechanical draft cooling towers. Due to the low water vapour content of natural gas no visible plume was anticipated from the Seven Power CCGT and, as such, no plume assessment was undertaken and the ES stated that this was anticipated to not have any significant impact upon human health or ecosystems.

3.8 Noise

The principal sources of noise during operation of a CCGT plant are:

- Air inlets;
- Gas turbines;
- Exhaust stack;
- HRSGs;
- Steam turbine plant;
- Air-cooled condenser;
- Generators; and
- Transformers.

The noise will be of a steady nature. There may be some tonal content due to the transformers. The best available technology and operating techniques will be addressed in the plant design to ensure appropriate noise attenuation measures. These are likely to include:

- High performance splitter silencer to the gas turbine inlet providing maximum attenuation at high frequencies, and abatement of the compressor whine in particular;
- High performance close fitting or spaced-off acoustic cladding on walls of the HRSG;
- High performance silencer to the outlet of the HRSG, tuned to attenuate low frequencies from the gas turbine exhaust. An additional primary silencer may be required in order to reduce noise radiated from the boiler walls;
- High performance acoustic insulation to the gas turbine inlet ductwork downstream of the inlet silencer, to reduce duct noise breakout in this area;
- The turbine building walls and roof to incorporate acoustic panelling possibly comprising a double skin with plasterboard and an absorbent infill. The inner skin to be perforated to gain maximum absorption benefit within the turbine building;
- Within the turbine building, the gas turbine to be housed inside its own acoustic enclosure. The acoustic enclosure will be of ‘heavy’ construction with acoustic doors;
- ‘Low noise’ trims used on noise generating steam valves and acoustic lagging on pipe work used extensively;
- Ventilation systems serving the turbine building, admin/control building and equipment enclosures to be fitted with silencers to attenuate ventilation fan noise and internal machinery noise;
- Air-cooled towers likely to have a combination of low speed (low noise) fans and inlet/discharge silencers; and
- Intermittent sources such as start-up and emergency steam vents to be fitted with proprietary diffuser/absorptive silencers.

The principal sources of intermittent noise will be the operation and testing of safety valves. This will be an infrequent occurrence. Testing of these valves will be during daylight hours. Silencers will be installed to minimise this source of noise.

3.8.1 Construction Noise

Construction activities are assumed to take place with normal construction plant and auger piling plant. Percussion piling methods will not be employed. The construction plant complement is set out in the following tables with the reference noise level data for noise prediction purposes.

Table 3.6 - Items of Plant to be used on Site for Concrete Breaking and General Site Clearance; (6 months – SPL at 10m)

Item of plant or activity	Source of Noise Data	Reference	Reference Noise Level dB LAeq,t	Number of Items	On-time %	Effective noise level dB LAeq,1h
Breaker mounted on Wheeled Backhoe, 74 mm dia / DEFRA	DEFRA	1 2	92.1	2	100	95.1
Hand-held Pneumatic Breaker	DEFRA	1 6	83.5	4	100	89.5
Tracked Excavator (Loading Dump Truck), 228 kW, 44 DEFRA	DEFRA	1 10	85	4	100	91
Articulated Dump Truck (Dumping Rubble), 250 kW DEFRA	DEFRA	1 11	80.2	4	100	86.2
					Total	**97.7**

Table 3.7 - Items of Plant to be used on Site for Piling and General Site Activities; (3 months – SPL at 10m)

Item of plant or activity	Source of Noise Data	Reference	Reference Noise Level dB LAeq,t	Number of Items	On-time %	Effective noise level dB LAeq,1h
Tracked Excavator, 72 kW, 16 t	DEFRA	2 5	76.4	4	100	82.4
Dozer, 179 kW, 28 t	DEFRA	2 11	79	3	100	83.8
Crawler Mounted Piling Rig, 150 kW, 35 t	DEFRA	3 21	79.4	2	100	82.4
Mobile Telescopic Crane, 280 kW, 100 t	DEFRA	4 41	71.1	2	100	74.1
					Total	87.9

Table 3.8 - Items of Plant to be used on Site for Piling and General Site Activities; (16 months – SPL at 10m)

Item of plant or activity	Source of Noise Data	Reference	Reference Noise Level dB LAeq,t	Number of Items	On-time %	Effective noise level dB LAeq,1h
Tracked Excavator, 107 kW, 22 t	DEFRA	4 64	74.9	4	100	80.9
Dumper, 56 kW, 5 t	DEFRA	4 7	77.4	3	100	82.2
Large Lorry Concrete Mixer, 216 kW	DEFRA	4 21	77	3	100	81.8
Concrete Pump + Concrete Mixer Truck (idling)	DEFRA	4 26	75.1	2	100	78.1
Diesel Generator, 15 kW	DEFRA	4 86	65.5	2	100	68.5
Angle Grinder (Grinding Steel), 3.75 kW,	DEFRA	4 93	80.7	5	100	87.7

Item of plant or activity	Source of Noise Data	Reference	Reference Noise Level dB LAeq,t	Number of Items	On-time %	Effective noise level dB LAeq,1h
105 kg						
Road Sweeper, 70 kW	DEFRA	4 90	75.9	2	100	78.9
Road Lorry (Full)	DEFRA	6 21	80.6	10	100	90.6
Mobile Telescopic Crane, 315 kW, 80 t	DEFRA	4 39	76.7	2	100	79.7
					Total	93.8

Table 3.9 - Items of plant to be used on site for mechanical erection and commissioning; (11 months – SPL at 10m)

Item of plant or activity	Source of Noise Data	Reference	Reference Noise Level dB LAeq,t	Number of Items	On-time %	Effective noise level dB LAeq,1h
Diesel Generator, 15 kW	DEFRA	4 86	65.5	2	100	68.5
Angle Grinder (Grinding Steel), 3.75 kW, 105 kg	DEFRA	4 93	80.7	2	100	83.7
Road Lorry (Full)	DEFRA	6 21	80.6	10	100	90.6
					Total	**91.4**

3.8.2 Noise from Traffic

See section 3.4.3 for traffic data

3.8.3 Operation

Definitive noise data for the operation of the Severn Power Station was not yet available when the ES was being compiled so the reference noise level data used was based on figures for broadly similar (unspecified) CCGT power station sites from a distance of 100m. No further data in relation to sources is available within the ES.

Table 3.11 – Operational Noise

Item of plant or activity	Source of Noise Data	Reference	Reference Noise Level dB LAeq,t	Number of Items	On-time %	Effective noise level dB LAeq,1h
Air-Cooled Condensers	TBC	Pe 1	56	2	100	59
HRSG -B (HRSG not enclosed)	TBC	Ba 3	63	2	100	66
GT Inlet (including some T/X noise) - 1	TBC	So 1	58	2	100	61
					Total	**67.8**

3.8.4 Assessment of Significance & Mitigation Measures

Further to baseline noise and vibration baseline surveys, it was deemed that noise from construction would be compliant with the requirements of BS 5228 and that limited impact would be had on human health and the adjacent ecosystems. Worst case scenarios of construction noise would be from the piling phases but this would be minimised due to the use of continual flight auger piles as opposed to percussive, and also limited to set times of the year to avoid disturbance to the migratory fish populations in the River Usk.

It was recognised that impacts to human health, mainly the residents of the Nash village would experience a slight adverse impact but that the noise from construction would not be audible.

During normal steady state operation of the CCGT, the ES stated that adverse off-site impacts were no likely due to design implementations. However commissioning and start-up of the plant would have some short term noise impacts although these would be temporary.

3.9 Lighting

3.9.1 Stack Aviation Lighting

With respect to the Severn Power CCGT project, the 65m stack was lit with medium intensity red obstruction lights in compliance with regulations due to the proximity to Bristol and Cardiff airports, the flight path along the Severn Estuary and also proximity to Newport Port.

3.10 Carbon Capture & Storage

In response to the publishing of EU Directive 2009/31/EC, the UK Government (DECC) issued its document "Towards Carbon Capture and Storage: Government Response to Consultation" and DECC's consultation document entitled "Guidance on Carbon Capture Readiness and Applications under Section 36 of the *Electricity Act 1989*", the any gas-fired power station has to be designed to be Carbon Capture Ready (CCR).

CCR is the process of building new combustion plant so that it can be economically retrofitted with carbon capture technology, and linked via appropriate transport routes to long-term storage, when the technology becomes technically and economically viable.

This will be considered by any future developer at Huntspill Energy Park although there is yet to be a power station consented and/or operational in the UK where this has been applied.

4. Plot K1 - Peaking Plant

4.1 Type of Energy Generation

Given the size of Plot K1 and proximity to the CCGT, a peaking plant such as an Open Cycle Gas Turbine would be appropriate.

4.1.1 Technology

A peaking plant is a gas or diesel fired backup power station that operates when there are high levels of demand for electricity (peak demand) or shortfalls of electricity supply. Due to the increasing reliance on renewable technologies in the UK (such as wind) it is important that a supply of backup power supply is available for when these technologies cannot produce the required output.

Modern peaking plants benefit from catalytic convertor systems reducing emissions of NO_x into the atmosphere. The thermodynamic efficiency of simple-cycle gas turbine power plants ranges from 20 to 42%, with between 30 to 42% being average for a new plant.

A peaking plant is anticipated to run between 100–300 hours during the year. This equates to 4.2–12.5 days over a whole year.

4.2 Introduction to Scheme

4.2.1 Reasonable Assumption

Wyre Power Ltd proposed to build an 850MWe combined cycle gas turbine (CCGT) and 25MWe open cycle gas turbine (OCGT) power station on land near Fleetwood, Lancashire. The proposed power station will be built on the Hillhouse International Business Park (HIBP), formerly occupied by the ICI Hillhouse Chemical works, on the western bank of the River Wyre. An application for consent under Section 36 has been submitted to the Department of Energy and Climate Change, and is currently in the last stage of determination. No objection has been made by Wyre Borough Council.

For the purposes of this reasonable assumption a 25MW plant has been identified and where possible up-rated to 50MW to provide additional information should the capacity be varied.

4.2.2 Site Description

The overall site is located approximately 1.5km north of Thornton, near Blackpool, and is approximately 4.5ha in size, although the OCGT will occupy much less than that. During construction this footprint will extend to 13ha to take account of contractor laydown areas.

4.3 Project Description

4.3.1 Key Components

The Wyre Power OCGT operates by using liquid fuel which is atomised in the combustors to fuel a gas turbine which then spins a generator to make electricity. This operation is similar to a CCGT, but is powered by natural gas and also uses the heat from the turbine exhaust to heat water in a boiler to generate steam, which then powers a steam turbine and second generator. There is no requirement to extract water for the OCGT.

The OCGT generating set (a single unit with a total capacity 25 MW) was proposed at the specific request of National Grid for the purpose of providing rapid response capability and other essential ancillary services. The OCGT is located along the eastern limit of the application site boundary, northeast of the CCGT power station.

The purpose of this element of the scheme is to meet quickly meet local short-term peak energy demands. The primary fuel for the Wyre Power OCGT was a low sulphur distillate liquid fuel or kerosene imported to the site by standard tanker via the road network.

Following discussions with National Grid it was envisaged that this element of the project would only be required for limited periods and is unlikely to operate for more than 200 hours per annum.

4.3.2 Building Dimensions

The table below outlines the dimensions for the 25MW OCGT and associated equipment: *Table 4.1 – Building Dimensions*

	Easting	Northing	Height m	Length m	Width m	Angle Degrees
OCGT block	334271	443384.9	3	11	26	57
Switch gear building	334298.2	443369.8	3	3	4	-29.5
Generator setup transformer building	334300	443344.5	4	11	6	-32.6
Fuel storage tank 2 for OCGT	334308.9	443385.8	5	5 (r)	-	-
Power control building	334311.9	443356.5	4	4	11	-34.9
Fuel storage tank 1 for OCGT	334323.7	443388.5	5	5 (r)	-	-

Notes: Building 17 is the OCGT stack. Grid reference refers to the southwest corner of building. Angle measured from north taken as zero.

Should a 50MW peaking plant be proposed, the building sizes would increase by approximately 20% in both length and diameter. The fuel tanks should have capacity for 24-48 hours operation, fed from a main storage tank. Given the length of time this peaking plant would operate, the assumption is to keep the storage tanks the same size as per the 25MW. It is recognised that this may result in an increase of tankers to site as it may need to fill it more frequently.

4.3.3 Orientation

There is no fixed orientation of the OCGT as it is fuelled by localised fuel storage tanks. Planting and landscaping will be allowed surrounding the plant although there will be limited opportunity for trees and shrubs close to the fuel tanker as the root systems may comprise the tank.

In addition, there is a mandatory requirement to keep a spark-free zone around the fuel tanks of approximately 6-8m. This is to minimise explosion risk, and specialist bonding material must be used around metal pipes or general metal work and certain plastics which may release a static charge. Certain types of concrete or tarmac will also have to be used to minimise the risk further. All relevant petrochemical and petroleum regulations will apply upon the storage and refuelling of the tanks.

4.4 Construction Phase

4.4.1 Duration

Whilst the entire construction phase of the development (including CCGT) is 40 months, it was estimated that the OGCT component would be approximately 12 months.

4.4.2 Workforce

It is anticipated that that 650 workers will be onsite during peak construction during months 19-22. During operation, 40 permanent jobs will be created. However this relates to the entire development. Therefore it can be assumed that a permanent workforce will be approximately 15 people during operation and that 80-100 workers will be required during construction for the OCGT, although this cannot be confirmed.

Using these assumptions for the OCGT, this equates to between 87 and 109 man years, although this cannot be confirmed.

4.4.3 Construction Value

The overall investment for the Wyre power facility was £600 million. However no information is available separately for the OCGT although other examples are available. For example, the Cowes power station (or Kingston power station) is a 140MW OCGT station powered by two 70MW units and is the Isle of Wight's only power generation source other than power from the mainland. The station was built in 1982 at a cost of £30 million and is owned and operated by RWE npower.

4.4.4 Traffic

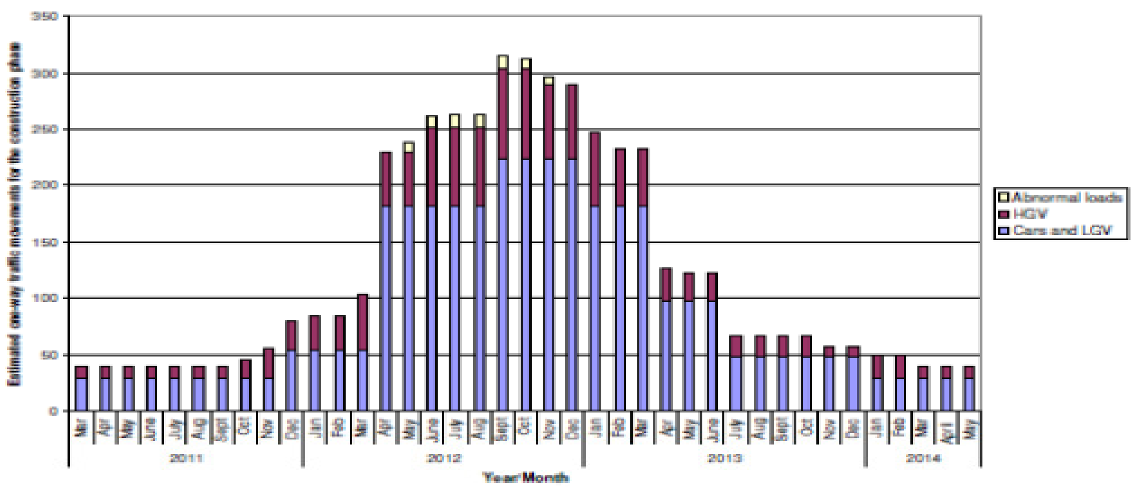
A Traffic Management Plan is to be agreed in writing prior to works commencing with HGVs using dedicated routes, especially for abnormal loads. However during the 39 month construction period approximately 70 abnormal loads are expected, their weights ranging from 10 tonnes to 330 tonnes. It was agreed that construction traffic would come in by road as arrival by sea and rail were not feasible.

Peak HGV traffic is expected in months 19 and 20 with up to 80 one-way HGV movements (therefore 160 two-way movements) per day. Outside this period, HGV movement will be in the region of 65-70 movements one-way per day.

Peak construction traffic from workers is expected in month 20-22 to coincide with peak workers onsite. Prior to this, the number of workers was predicted to significantly increase from month 14 from 120 to 480. The number of staff is then estimated to decrease in month 26 to 240 and then to 100 in month 29.

The ES stated that a car-share or offsite construction park and ride scheme would be implemented to minimise and reduce impacts to the local residents. This would form part of the travel plan to be submitted as part of the EIA application.

Figure 12.4: Construction traffic flow profile



4.5 Operational Phase

4.5.1 Storage of Fuel

The 25MW OCGT will be fuelled by distillate or kerosene, which will be stored in two tanks. These will have a capacity of 200,000 litres each, with the total quantity of fuel stored on site not exceeding 400,000 litres. Due to the quantity of fuel to be stored Hazardous Substance Consent may not be required, and is subject to discussions with the HSE and Environment Agency.

As mentioned in 4.3.3, all measures must be undertaken to maintain a spark free zone, and the mandatory use of protective clothing and footwear must be adhered to.

4.5.2 General Operation

In the case of the Wyre Power OCGT, it is proposed that this plant will be operational in times of peak demand for approximately 224 hours per year. This is a typical operation of a peaking plant.

Using the Cowes/Kingston Power plant again as an example in operation, both units run on light fuel oil and operate at either peak time or when the grid requires frequency response. The station is either run locally or by remote from Fawley Power Station. The gas turbine engines have a total output of 200,000 horsepower and use 762 litres of fuel oil per minute when running at maximum output.

4.6 Decommissioning

It was anticipated that the decommissioning process would generate a similar level of activity associated with the construction phase.

4.7 Air Quality

Emissions from the OCGT operation are relevant to short-term impacts only due to limited operating hours. These emissions were not quantified within the EIA but were not anticipated to cause a significant degradation of local air quality

4.7.1 Stack Parameters

Table 4.2 – Stack Parameters

Emission Source	25 MW OCGT	50MW (Scaled up)
Source Location (Easting, Northing)	334279.6, 443373	334279.6, 443373
Stack Height, m (from ground level)	15	15
Stack Diameter, m	2.7	3.89
Efflux Temperature, deg K	798.1	798.1
Efflux Velocity, m/s	31.3	31.3
Stack volumetric flow @ actual discharge conditions, m^3/s	185.6	371.2
Stack emission concentration @ reference conditions (273^{o}K, 15% oxygen content and dry exhaust conditions), mg Nm^{-3}	NO_x as NO_2: 120 SO_2: 54 CO: 5	NO_x as NO_2 : 120 SO_2: 54 CO: 5
Emission Rates, g/s	NO_x as NO_2: 9.8 SO_2: 4.4 CO: 0.4	NO_x as NO_2: 19.6 SO_2: 8.8 CO: 0.8
Operating Hours	224 hours per year	

Note: Oxygen and water content of the flue gas has not been provided in the Wyre ES, nor has the normalised flow. OCGT has been assumed to be operating 7-9am and 4-6pm during January and February every year.

4.7.2 Key Pollutants

Based on 224 hours per year, the following pollutants have been derived:

Table 4.3 – Key Pollutants

Parameter	NOx & NO_2	SO_2	CO_2
Annual emissions, tonnes per annum	7	3.2	0.3

4.7.3 Emissions from Traffic

The Wyre Power ES does not give a breakdown of traffic movements for the CCGT vs. the OCGT as such the values provided are anticipated to be for the construction of the whole facility not just the peaking plant. However it can be assumed that given the size of the OCGT, approximately 10-20% of the construction traffic can be attributed to the OCGT.

Table 4.4 – Emissions from Traffic

	AADT
Peak Year of Construction	833
Operation Traffic	40

4.7.4 Odour

No odour issues are associated with OCGT as such no significant issues are anticipated from these plants.

4.7.5 Vapour & Plume Visibility

The Wyre OCGT will use a liquid fuel (low sulphur distillate liquid fuel or kerosene) which may have slightly higher moisture contents than natural gas, although no visible plume would be anticipated due to the high emission temperature (798 K).

4.8 Noise

4.8.1 Construction

Construction of the OCGT was considered as a single phase within the ES. Plant used to predict construction noise levels are detailed below.

Table 4.5 – Construction Noise

Plant Item	Sound Power	No.	% On Time	Data Source
Articulated Dump Truck	108	2	40	BS5228, C4. Ave 1-2
Tractor	108	2	20	BS5228, C4. Ave74-75
Tracked Mobile Crane	97	2	50	BS5228, C3, 28-30
Concrete Mixer Truck	105	2	50	BS5228, C4, Ref Av 21-22
Concrete Pump	105	2	50	BS5228, C3, 25-26
Poker Vibrator	104	1	100	BS5228, C4, 33-34
CFA Piling Rig	108	2	60	BS5228, C3, Av 21-22
Tracked Excavator CFA Operations)	99	2	40	BS5228, C3, 23-24
Gas Cutter	95	2	10	BS5228, C3, 34-35
Generator	101	1	100	BS5228, C3, Ref 32
Angle Grinder	108	2	10	BS5228, C4, 93

4.8.2 Noise from Traffic

No traffic data was presented in the noise chapter of the ES. Consequently, road traffic flows from the air quality assessment are to be used.

4.8.3 Operation

The OCGT has the potential to develop significant levels of noise, although it only operates to meet short term peaks in grid demand that occur when the main CCGT power plant is not running. This is because the OCGT does not require a significant periods of time to start up and reach base load like the CCGT (approximately 15 minutes as opposed to six hours).

During operation, the main sources of noise will come from air inlets, power block, the exhaust stacks, HRSGs, ACCs and transformers. These will be designed to have minimal noise impact locally. The plant design will adopt best available techniques (BAT) that incorporate noise reduction measures in all appropriate elements. Elevated noise levels will occur during the short-term construction period, but working hours will be limited to minimise disturbance to local residents during this period.

The OCGT station was considered as a single noise source for noise predictions in the ES using BS 4215, based on a comparison between $L_{Ar,Tr}$ rating noise levels from the proposed development with recorded L_{A90T} background noise levels at noise-sensitive receptors in the vicinity. This assessment assumed that the OCGT would be fitted with acoustic cladding and silencers to reduce noise emission levels.

Spectral noise data for the operation of the OCGT are presented in the table below.

Table 4.6 – Spectral Noise Data

Source	Sound Power Level, Lw	1/1 Octave Spectrum, Per Item / Unit Area									
		31.5	63	125	250	500	1K	2K	4K	8K	A	Lin
OCGT LM2X	107.8	98	98	99	94	85	81	85	79	77	91	104

4.8.4 Mitigation

The total L_w sound power level from the OCGT assumed in the prediction and assessment of noise levels was 107.8 dB(A). On the basis of the BS 4142 assessment, levels of noise from this source needed to be reduced by at least 1.8 dB to ensure that the requirements of residual BAT are achieved and that $L_{Ar,Tr}$ rating noise levels remain at or below the numerical value of existing $L_{Ar,Tr}$ background noise levels during the worst-case night-time period.

The application of engineering solutions to reduce the total sound power level to 106 dB(A) or less would be sufficient to control the impact from this source. It is likely that a wide range of solutions would be capable of achieving such a reduction, such as fitting an increased performance silencer to the outlet of the stack, tuned to attenuate low frequencies from the gas turbine exhaust, fitting performance acoustic insulation to the gas turbine inlet ductwork downstream of the inlet silencer, to reduce duct noise breakout in this area; and acoustically enclosing particularly noisy elements of the OCGT.

For Wyre Power OCGT the mitigation included insulation, building envelope design and potentially an acoustic barrier of sufficient size and mass. However this could be confirmed for the proposal at the Huntspill Energy Park without a specific thermal plant and noise assessment.

4.9 Lighting

4.9.1 Stack Aviation Lighting

There is no information regarding the lighting arrangements of the OGCT 15m stack, although it can be assumed for consistency with the adjacent CCGT stacks, that it would have a medium intensity red aviation light.

5. Plot K2 – Biomass

5.1 Type of Energy Generation

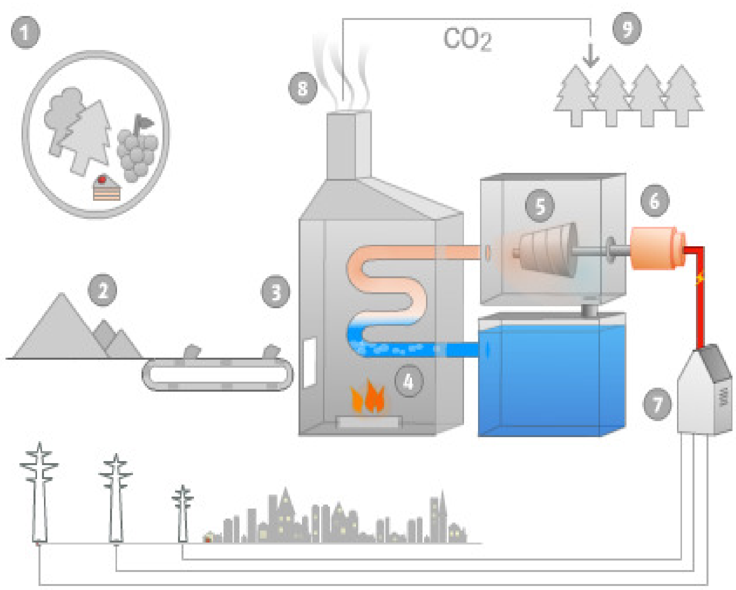
Given the size of Plot K2 and recognition of the other technologies within the energy park, it has been suggested that a 50MW facility such as a biomass, biomass combined heat and power (CHP) facility would be appropriate in this location. Anaerobic digestion would also be appropriate although at a lower capacity as current commercial opportunities relate to <5MW facilities. In addition, biomass provides a further opportunity to supply heat and power to the adjacent energy park.

Biomass (as a renewable energy source) is biological material from living, or recently living organisms. As an energy source biomass can either be used directly or converted into other energy products such as biofuel.

As a direct source of energy biomass is plant matter used to generate electricity with steam turbines and gasifiers or produce heat, usually by direct combustion. Examples include forest residues (such as dead trees, branches and tree stumps), yard clippings, wood chips and even municipal solid waste. As a source of other energy products, biomass includes plant or animal matter that can be converted into fibres or other industrial chemicals, including biofuels.

A biomass power station with an approximate generating capacity of 49MW, would displace approximately 170,000 tonnes of carbon dioxide each year by burning wood in place of traditional fuels like fossil fuels and provide electricity for over 75,000 homes. The schematic below shows how energy is generated from biomass.

Figure 5.1 – Schematic of Biomass Operation



1. Sources of biomass e.g. sewage or municipal waste
2. Biomass is collected and taken into power station
3. Fuel is fed into furnace where it is burnt
4. Heat generated from burning the biomass boils water, generating steam
5. Steam turns turbines
6. Turbines are connected to generators. Mechanical energy is converted into electrical energy
7. Output passes through transformer and transmitted into National Grid network.

5.2 Introduction to Scheme

5.2.1 Reasonable Assumption

In order to provide reasonable assumptions, the Nevis Power Station located within the Associated British Port facility in Newport, South Wales is being used. The proposed biomass scheme has an capacity of 49MWe through the combustion of up to 370,000 tonnes per annum of biomass material comprising primarily wood chip, fruit-based biomass and energy crops. This power station was granted planning permission by Newport City Council in 2009 under reference 08/1257 and was supported by a full Environmental Impact Assessment.

5.2.2 Site Description

Approximately 4.45ha in size, the site is located on the confluence of the River Ebbw and River Usk within the industrialised port area of Newport known as South Dock. The power station was sited on a brownfield site, used at the time for storage of aggregates and vehicles by Customs and Excise. However it was surrounded by the several national and European designations such as the River Usk SSSI and Lower River Usk SAC, adjacent to the Gwents Levels SSSI and in close proximity to the Severn Estuary RAMSAR, SPA and pSAC. The site was also at risk of flooding and impacted by invasive species.

5.3 Project Description

5.3.1 Key Components

Principal plant buildings and their dimensions are as follows.

- Wood fuel reception and storage would be in a timber A-frame structure 140m x 73m x 45m high, to accommodate bulk storage of fuel in a dry environment.
- The boiler building would be steel framed and metal clad, approximately 30m x 42m x 45m high. This would hold all the main plant items associated with biomass combustion and steam generation. The fabric of the building would be designed to accommodate noise suppression measures.
- The turbine building would be approximately 35m x 30m x 20m high, steel framed and metallic clad, and would be annexed to the side of the boiler building. Plant in this building would be complete with acoustic enclosures to ensure low noise levels and a safe working environment for the staff. The building fabric would also be designed to accommodate noise suppression measures, and would enclose the main control room and sample analysis laboratory.
- The offices / administration building would be brick built or architectural equivalent, approximately 20m x 16m x 8m high. This would be constructed in a concrete frame with brick fascia, and would include a reception area, individual offices, a food preparation area and toilets. A visitor facility would be provided in these offices, including wheelchair access.
- Workshops would be approximately 33m x 11m x 10m high and be constructed to house electrical plant as a maintenance facility.
- High voltage substation including switchgear and transformers approximately 4m high, contained in a compound approximately 50m x 25m. There would also be a control room of the order of 5m x 6m x 4m high containing control equipment and meters.
- Switchgear and metering transformers are approximately 4m high and would be housed in a compound surrounded by a chain link fence with authorised access only.

Ancillary structures would include chemical and firewater tank stores, and a site effluent treatment plant. A 4m high noise barrier along the boundary with the River Ebbw is also included in the design as a mitigation measure for acoustics and visual disturbance to the adjacent mudflats, designated for wintering and breeding birds. Although this will be subject to a detailed noise assessment at the appropriate detailed design stage for the proposed facility at the Huntspill Energy Park.

Figure 5.2 – Visualisation of Nevis Biomass Plant

5.3.2 Employment

The proposed scheme would be directly responsible for the creation of up to 30 permanent jobs (comprising 10 technical, administration and managerial staff plus 20 operational shift staff).

5.3.3 Potential Heat Loads & Design of the Power Station

In order to comply with the recommendations of the EU Cogeneration Directive, it was determined that a heat load of 50MWth (megawatt thermal) would be required in the local area. Following a review of available information as part of the EIA process, it was identified that there was no single heat load identified in excess of 5MWth within the area, and that aggregation of all heat loads produced a demand of less 20MWth. It was concluded that a CHP plant of the capacity envisaged by the applicant would not be feasible, based on current heat loads for local industry. Accordingly, the incorporation of CHP plant technology was not taken forward as part of the proposed scheme. Feasibility at the Huntspill Energy Park may be provided through the local heat and power requirements of the

Energy Park itself and localised residential areas. However the for the purpose of reasonable assumptions, it is assumed that CHP is not to be integrated into the Huntspill Energy Park at this stage.

With regard to the design of the power station, available combustion methods that were investigated included fixed grates, mechanical moving grates, and fluidised bed systems. A review of these methods concluded that an inclined travelling grate was the most appropriate mechanism as this provides a degree of flexibility on the types of fuel that can be processed. Other methods were discounted as viable alternatives due to their economics, inflexibility, or inefficiency.

Potential cooling systems included water based and air cooled methods and a review of these mechanisms concluded that the use of air cooling was the most applicable method, given the unavailability of sufficient volumes of water from the nearby protected and designated River Usk and River Ebbw. Cooling towers were initially considered, although it was concluded that the proposed development site would not be able to accommodate their footprint. Furthermore, cooling towers were considered to be potentially more visually conspicuous when compared to the chosen option of ACC units. For Huntspill Energy Park it is unlikely that any extraction from the Huntspill River will be required due to the common use of ACC units.

5.3.4 Environmental Mitigation & Design Iterations

Ongoing design iteration of the proposed Nevis Power scheme was undertaken throughout the EIA process to avoid or minimise potential adverse environmental impacts, and/or to incorporate essential mitigation into the overall development. Essential mitigation was identified in respect of potentially significant landscape, ecological, flood risk and acoustic impacts. In light of the early outcomes of the EIA, the proposed scheme was modified to incorporate the following environmental mitigation measures which may be applicable once detailed assessment has been undertaken at the specific plot on Huntspill Energy Park.

5.3.4.1 Land Raising

The existing profile of the entire proposed development site is proposed to be raised to a height of 9.25m AOD to counter potential flood risk.

5.3.4.2 Acoustic Barrier

A 4m high acoustic barrier is proposed along the entire length of the south-west boundary, adjacent to the River Ebbw, and turning through 90 degrees across the southern end of the proposed development site. This was to minimise impact specifically to wintering and wading bird populations on the River Usk and Ebbw.

An acoustic bund for ecological reasons is unlikely at Huntspill Energy Park but will be subject to a detail noise assessment.

5.3.4.3 Landscaping

Planting measures were proposed both onsite and offsite to provide a degree of visual containment and protection for sensitive receptors, and to improve overall integration of the proposals into the receiving environment.

5.3.4.4 Ecological Habitat

An area of land located at the far southern tip of the power station site was allocated for biodiversity enhancement through habitat creation for rare invertebrates

5.3.4.5 Plant Modifications

Modifications were also made to the means of fuel storage. A series of 30m high silos were originally proposed for dry storage; however these were subsequently replaced by a proposed single A-frame timber structure due to potential visual implications noted in the EIA. For the Huntspill plant, a similar design may be more viable although this is subject to detailed design at the appropriate stage. .

5.3.5 Orientation

It is assumed that the biomass plant will incorporate an element of railhead, and therefore follow the same configuration as the energy from waste facility. Again there are no restrictions on landscaping.

5.4 Construction Phase

5.4.1 Duration

The construction phases of this project were scheduled to last 18 months, and were limited to daylight hours of 07:00 to 19:00, Monday to Saturday. The timing of certain activity such as piling was restricted due to the migratory season of designated fish of the River Usk SAC.

5.4.2 Traffic Movements

It was anticipated that the peak workforce on-site at any one time during the construction phase would be 200 persons. Due to the proposed development site's location, it is assumed that workers would arrive by car, van or by minibus. It is assumed that 90% of the construction workers would travel by car, with an average car occupancy rate of two persons per vehicle. The peak construction worker traffic generation would be 90 cars and two minibuses (i.e. 184 two way trips per day). Vehicles would arrive between 06:30-07:00 hours and depart between 19:00-19:30 hours, outside the highway peak periods.

By way of comparison to other similar power plant facilities which do not have the potential for dock or rail facilities, the anticipated delivery/construction vehicles would equate to 15 light goods vehicles and 45 HGVs per day (over a 12 hour period) (i.e 120 two way trips per day), the total significantly reduced by the largest plant sub assemblies envisaged to arrive at the proposed development site via ship through Newport port facilities. Therefore the total potential traffic attraction during construction for a plant without the same facilities as Nevis Power would equate to 304 two-way vehicle trips per day. Therefore the use of the rail head at Huntspill is preferable but would be subject to detailed design of the plant and delivery facilities.

This would be similar at Huntspill Energy Park as it would be assumed that most of the large generating equipment would be delivered to Avonmouth port facilities and brought to site on abnormal loader.

5.4.3 Delivery of Turbine

For the Nevis Power Station, delivery of the turbine was by sea given proximity to port facilities. However for Huntspill it is assumed that this will be delivered to Avonmouth Port and delivered by road or rail head to site.

Using a Siemens SST-300 turbine as an example (see Figure 5.3), typical dimensions would be length 21m, width 11.5mand 7.5m high and will be delivered in modular arrangement of turbine casing, exhaust, gearbox, generator and base frame.

Figure 5.3 - Siemens SST-330 turbine

5.4.4 Construction Value

Unfortunately the construction value has not been disclosed.

5.4.5 Workforce

Approximately 200 people are estimated to work on the project at peak times. This equates to 327 man years for the construction period.

5.5 Operational Phase

5.5.1 Operation

The operational electrical load of the proposed scheme is anticipated to be approximately 5MW or 5000 kW. Again, assuming a 8000-hour per annum operating profile, this is equivalent to 40,000 MW-hr and, using the same emission factor, 21500 tonnes production or emission of CO_2 per annum.

5.5.2 Delivery of Biomass

For the Nevis Power Scheme, a total of 370,000 tonnes per annum of pure biomass fuel would be processed comprising of primarily wood chip, fruit-based biomass and energy crops. Biomass material would be imported and delivered in bulk container ships directly to the dockside every two weeks in shipments of between 11,500 tonnes and 17,000 tonnes, with on-site storage sufficient for 15 days. Fuel would be supplied in a dry state and would enter the proposed development via a conveyor system.

At Huntspill Energy Park it is likely that road will be the most appropriate method of delivery. An equivalent figure for road transport of biomass, assuming that the biomass is available from Avonmouth Dock would be approximately 12,333 HGV vehicles of 30 tonnes capacity annually or approximately 237 vehicle movements per week.

5.5.3 Operational Traffic Flows

Staff would work a five-shift system with six people on each shift. At worst, assuming each shift would result in approximately 4 additional vehicles (for visitors, delivery of consumable items such as distillate fuel oil or other suppliers, and maintenance purposes), a maximum total of 10 vehicles (20 two way trips) per shift could be assumed. For a five-shift system this equates to 100 trips per day, divided into 6 arrivals and 6 departures five times a day outside highway peak periods, plus deliveries and visitors across the day.

During the operational period dry fly ash (40%) and wet bottom ash (60%) would be removed by lorry, requiring 143 lorries and 305 lorries per year respectively. This equates to 8-9 HGV movements per week (of 30 tonnes capacity), equating to a little over one HGV per day. These vehicle numbers represent a potential worst-case, which would reduce proportionately should any of the residues be removed by rail.

5.6 Decommissioning

It is anticipated that the decommissioning process would generate approximately 30% of the operations associated with the construction phase. The associated traffic is accordingly assumed to represent 30% of the construction movements, equating to 30 cars and one minibus per day outside the highway peak periods plus five light goods vehicles and 15 HGVs per day (12 hour period).

Total traffic attraction for the proposed development site during decommissioning equates to 102 vehicle trips per day.

5.7 Air Quality

The following information upon emissions from this power station has been provided using the detail provided in the Environmental Statement.

5.7.1 Stack Parameters

The following information was given on the stack parameters:

Table 5.1 – Stack Parameters

Emission Source	Parameters
Source Location (Easting, Northing)	331438, 184168
Stack Height, m (from ground level)	50
Stack Diameter, m	2.49
Efflux Temperature, deg K	388

Efflux Velocity, m/s	20
Stack volumetric flow rate at actual discharge conditions, m^3/s	97.39
Emission Rates, g/s	NO_X 22.0 SO_2 15.0 PM_{10} 2.2

Unfortunately no information is provided in the ES relating to normalised flow, emission concentration, oxygen or moisture content of the stack gasses.

5.7.2 Pollutants

The proposed scheme would combust primarily wood chip, fruit-based biomass and energy crops to generate the required thermal energy for steam production to generate electricity. Data supplied by the process engineering contractor indicates that the key combustion releases from the stack would be nitrogen oxides (NO_X), sulphur dioxide (SO_2) and fine particulate matter (PM10). Emission rates employed in the dispersion model for each of these parameters are listed below.

Table 5.2 – Key Pollutants

Parameter	NOx	SO_2	PM10
Emission Rate (g/s)	22.0	15.0	2.2

5.7.3 Vapour & Plume Visibility

Vapour or venting of steam from the stacks commonly occurs and is normally visible during the start-up procedure, which is necessary to protect the steam turbine, but takes place for a relatively short period of time. Sometimes it can occur during emergency venting of steam, which is expected to occur infrequently.

The Nevis Power ES did not include a plume visibility assessment nor was any water vapour information provided within the planning application. It is therefore not possible to provide the water vapour content of the plume for this facility. However, the Ince Marsh 35MW biomass facility ES does provide information on the moisture content of the plume which was reported as 11% H_2O. While this is a smaller facility than the Nevis Power facility and will operate using both virgin and recycled waste wood the volume of water emitted from the facility is anticipated to be similar, though may reduce if the facility were to only operate using wood pellets rather than chips which generally have a lower moisture content.

Assuming that the Nevis Power facility has a typical plume moisture content of 11% H_2O then the mass of water emitted from the facility will be approximately 0.07 kg per kg flue gas.

5.7.4 Abatement Methods

Generally, biomass plants in the UK use Selective Non-Catalytic Reduction (SNCR) for the control of nitrogen oxides and therefore emissions are kept within EU set limits. Other emissions can be managed via careful control of combustion conditions along with the use of ammonia/urea injection (acid gas control), activated carbon injection to control the emission of metals and bag filters to reduce particulate/metal emissions. As the biomass facility will burn only virgin timber, metal and dioxin control may not be required however the plant would still need a system to reduce particulate emissions and acid gasses.

Whilst the vast majority of water is recycling through the ACCs, water will be lost through vapour through the stack during the combustion process.

5.7.5 Assessment of Significance & Mitigation Measures Imposed

Further to dispersion modelling against the proposed biomass facility, it was determined that impacts from industrial emissions would be negligible as it would not exceed any levels affecting human health or ecosystems.

In relation to traffic, the ES refers to the NSCA guidance where the magnitude of change in PM10 was "extremely small" and therefore were classed as negligible.

Significant impact from nitrogen deposition on designated sites within the area was also considered unlikely and it was recognised that this would be monitored and controlled by the Environmental Permit.

Any impacts from dust during construction and storage of biomass in operation would be covered by the Environmental Management Plan.

5.8 Noise

5.8.1 Construction Phase

During construction the following equipment and plant were to be used:

Table 5.3 – Construction Plant

Phase	Plant
Site Levelling and Drainage	4 × Bulldozer, 4 × Grader, 2 × 30T Articulated Dump 2 × Trucks, 2 × 360 Excavator, 2 × Backhoe , 2 × Concrete Truck, 2 × Concrete Pump, 2 × Road Trucks,
Preparation laydown area	2 × 360 Excavator, 2 × Backhoe, 2 × Asphalt Paver, 2 × Concrete Truck, 2 × Concrete Pump, 2 × Road 2 × Trucks, 2 × Small Truck Mounted Auger
Construction of Foundations	2 × auger piling rigs, 2 × 40 tonne Mobile Crane, 2 × Concrete Truck, 2 × Concrete Pump, 2 × Diesel Generator
Construction of Boilers, Turbines, Fuel transport Plant and Buildings	2 × 500 tonne Cranes, 2 × Forklift, 2 × Cherry Picker, 2 × Road Trucks, 2 × Diesel Generator, 2 × Hand Tools
Commission and Performance Testing	Noise levels similar to normal Power Station Operation

The Sound Power Levels used in Construction Noise Calculations in the ES are shown in the table below. These sound power levels have been taken from BS5228. Where BS5228 does not provide a sound power level for a particular type of machine a sound power level based on previous experience has been used.

Table 5.4 – Construction Plant Noise Levels

Plant Item	% on Time	Sound Power Level
Bulldozer	50	116
Grader	50	113

Plant Item	% on Time	Sound Power Level
360 Excavator	50	113
Concrete Truck	30	109
Concrete Pump	30	109
Road Truck	30	105
Backhoe/wheeled excavator	100	110
600 Tonne Crane	50	114
Cherry Picker	50	105
Fork lift	50	116
Road Truck	30	105
Truck Mounted Auger	50	107
CFA Piling Rig	50	116
40 ton Crane	50	109
Jackhammer	30	119
Diesel Generator	100	108

5.8.2 Operational Noise

These sound power levels used in the noise assessment were based on data provided by potential tenderers for the various installation contracts and on previously measured plant from similar installations modified for specific conditions (for example installation within a building or enclosure and use of attenuators).

Table 5.5 – Operational Noise

Plant Item	Height m	Sound Power Level dB									
		31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz	8k Hz	A
Screw Extractors Enclosed within Fuel storage building x 5	2	77	72	72	77	72	71	67	61	34	75
Acoustically Enclosed conveyors	30	99	95	88	87	84	84	81	75	71	88*
Turbine Building (designed for noise control with internal absorption)	20	82	85	94	90	90	99	78	75	73	101
Power House Silenced ventilation openings	15	106	110	101	91	77	64	68	73	68	89
Boiler House (designed for noise control with internal absorption)	45	113	113	106	91	80	76	70	65	59	93
Boiler Feedwater Pumps	8	104	98	99	87	86	86	78	77	69	90
Air Cooled Condensers with Silencers and Acoustics Screens x 6	20	100	98	90	85	88	86	83	80	73	91
Extractors Within Ash Silos x 2	2	98	93	90	98	92	91	86	82	75	95
Air compressor building	5	101	92	96	91	84	86	71	64	59	89
Workshop building	8	89	85	84	73	65	51	50	51	49	71
Waste Water treatment plant	3	91	81	85	81	84	84	87	80	73	90
Sanitary Treatment Plant	3	91	81	85	81	84	84	87	80	73	90
Water Treatment Plant	3	91	81	85	81	84	84	87	80	73	90

Plant Item	Height	Sound Power Level dB									
Flash Slip	2	88	83	80	88	82	81	76	72	65	85
Transformers House with building	4	93	97	109	107	89	84	73	79	64	100
Electrostatic Filter	30	111	111	103	95	90	83	83	82	84	94
Stack with Stanck Attenuator	35	115	107	94	88	86	83	79	76	71	90
Ship Auxiliary Power Unit	12	117	113	111	113	111	108	103	95	87	113

5.8.3 *Assessment of Significance & Mitigation Measures Imposed*

It was considered that the Nevis biomass plant had the potential to have significant impacts on the adjacent designated sites and the qualifying features, although it was mentioned that ecology within the area was probably habituated to the industrial nature of the port facility. Therefore it was proposed to provide a 4m high acoustic barrier, which was installed prior to construction. This would also act as a visual barrier as well to the wintering and breeding birds on the adjacent mudflats. Due to the construction of the noise barrier this would also minimise the operational noise levels and therefore disturbance to the adjacent mudflats.

The ES outlined that moderate impacts would be made at residential dwellings within the area from construction noise, but that would be temporary in nature and at controlled times of the day. Operational noise at these dwellings was predicted to be below the level for marginal significance during the night.

Noise from construction and operational traffic was also considered to have a negligible impact.

5.9 Lighting

In addition to standard regulations on aviation lighting which were applied to Nevis Power, it was agreed that that there would be no uplighters used on the site and lux levels would be kept to a minimum (0-2 lux) which would reduce the level of light pollution at the site in order to minimise impact to adjacent ecology.

7. Commercial Review

7.1 Introduction

The following sections outline the commercial analysis and market drivers for the proposed energy generation at Huntspill Energy Park.

7.2 Plot E – Energy from Waste

7.2.1 Technology Options

Several technology options are available in the UK energy from waste marketplace, but all have differing drivers for a scheme of this size.

Technology	Fuel Type	Proven	Bankability	Public Perception
Incineration	Unsorted MSW or RDF	High	High/Medium	Poor
Gasification/Pyrolysis to Steam Cycle	Refined RDF or SRF	Medium	Medium/Low	Good
Gasification/Pyrolysis to Gas Engine/ Turbine	Refined RDF or SRF	Low	Low	Good

Both Gasification and Pyrolysis technologies require an amount of mechanical pre-treatment of unsorted wastes to achieve a feedstock stream for thermal treatment

7.2.2 Volume & Scale Expectations

Due to the expectation of a 50MW Energy from Waste plant, imported tonnages will range from 450,000t to nearly 800,000t per annum of unsorted waste feedstock. It would be expected that due to the nature of the surrounding population, that these significant tonnages would have to be serviced by rail or water, alongside a minor amount of local sourced supply

Technology Benchmark Assessment	Incineration	Gasification/Pyrolysis to Steam Cycle	Gasification/Pyrolysis to Gas Engine/Turbine
Feedstock	Unsorted MSW	Unsorted MSW converted to RDF	Unsorted MSW converted to RDF
Powerplant Tonnage / MW	10,000t / MW	8,500t / MW	5,000t / MW
Powerplant Typical Built Area (excl externals)	200m2 / MW	600m2 / MW	600m2 / MW
Pre-processing conversion to fuel	n/a	55%	55%
Pre-processing Typical Built Area (excl externals)	n/a	20t / m2	20t / m2
Expected Tonnage for 50MW	500,000t	775,000t	455,000t
Expected Built Area (excl externals) for 50MW	10,000m2	68,750m2	68,750m2

7.2.3 Capital Investment Considerations

Technology	Fuel Type	Low	High
Incineration	Unsorted MSW or RDF	£262.5m (£5.25m/MW)	£325m (£6.5m/MW)
Gasification / Pyrolysis to Steam Cycle	Unsorted MSW or RDF	£275m (£5.5m/MW)	£375m (£7.5m/MW)
Gasification / Pyrolysis to Gas Engine / Turbine	Unsorted MSW or RDF	£250m (£5m/MW)	£425m (£8.5m/MW)

Greater cost certainty in capital investment valuations are more considered for Incineration schemes due to the amount of infrastructure installed under project finance packages. However gasification and pyrolysis projects have seen very little infrastructure deployment due to “bankability” issues around technology reliability and ROC banding uncertainty

7.2.4 Commercial Viability Considerations

Energy from Waste facilities are commercially driven from revenues from

1. Gate Fees for taking unsorted wastes (whether Municipal Solid Waste, Commercial and Industrial Waste or Construction and Demolition waste), or Refuse Derived Fuels (RDF) or Solid Recovered Fuels (SRF).
2. Exported Electricity revenues from Power Purchase Agreements with Utilities or End Users
3. Renewable Obligation Certificates – for proportions of % biomass by energy content for qualifying technologies

4. Heat Revenues from CHP or District Heating systems, which can include the recently announced Renewable Heat Incentive (RHI)

ROC Banding Review (October 2011 consultation)

The UK EfW market has seen significant turmoil with the effects of the latest consultation on the ROC banding, which incentivises renewable energy generation by providing a certificate that can be traded to large carbon emitting utilities. The UK government issued it's consultation on the changes to the ROC banding in October 2011, and to date (April 2012), has not concluded this consultation following various calls for evidence.

These changes have significantly impacted the commercial viability of EfW schemes in the UK which were based on Gasification or Pyrolysis technologies utilising steam cycle power generation sets. It is considered that only developers with lower range capital investment values, and high gate fees can achieve commercial viability under these technologies. Furthermore, the incentivisation of heat off take under CHP from Incineration schemes has been reduced, bearing in mind unsorted waste is typically 50% biomass by energy content, giving a net 0.25 ROC/MW.

Those qualifying technologies that are affected can be summarised in the below:

Technology	Current ROC Banding (up to 2013 connections)	Proposed ROC Banding (2013 – 2017 connections)	Comments
Incineration with CHP	1	0.5	
Standard Gasification to Steam Cycle	1	0.5	
Advanced Gasification to Steam Cycle	2	0.5	Gasification to Steam Cycle will be considered standard
Standard Gasification to Gas Engine / Turbine	1	2 1.9 in 2012/16 1.8 in 2016/17	Gasification to Gas Engine / Turbine will now be considered Advanced
Advanced Gasification to Gas Engine / Turbine	2	2 1.9 in 2012/16 1.8 in 2016/17	
Standard Pyrolysis to Steam Cycle	1	0.5	
Advanced Pyrolysis to Steam Cycle	2	0.5	Pyrolysis to Steam Cycle will be considered Standard
Standard Pyrolysis to Gas Engine / Turbine	1	2	Pyrolysis to Gas Engine / Turbine will not be considered Advanced
Advanced Pyrolysis to Gas Engine / Turbine	2	2 1.9 in 2012/16 1.8 in 2016/17	

7.2.5 Revenue Splits – Based on Current ROC Banding (prior to October 2011 Consultation)

Technology	Proportion of Revenues		
	Gate Fee	Electricity	ROCs (pre consultation)
Incineration	66%	33%	0%
Gasification / Pyrolysis to Steam Cycle (with pre processing facility)	45%	25%	30% (2 ROCs)
	60%	25%	15% (1 ROC)
Gasification / Pyrolysis to Gas Engine / Turbine (with pre processing facility)	55%	15%	30% (2 ROCs)
	70%	15%	15% (1 ROC)

7.2.6 Revenue Splits – Based on Proposed ROC Banding (as October 2011 Consultation)

Technology	Proportion of Revenues		
	Gate Fee	Electricity	ROCs (post consultation)
Incineration	66%	33%	0%
Gasification / Pyrolysis to Steam Cycle (with pre processing facility)	65%	25%	10% (0.5 ROCs)
Gasification / Pyrolysis to Gas Engine / Turbine (with pre processing facility)	55%	15%	30% (2 ROCs)

7.2.7 Heat Offtake Revenues – Renewable Heat Incentive / ROC Improvement in CHP

Heat revenues can be generated by exporting medium or low grade heat to end users on the surrounding building and land uses. Further revenues can be generated by incentive schemes supported by UK government intervention. The two main mechanisms for supporting heat revenues are:

1. Enhancement in Renewable Obligation Certificates – by achieving “good quality CHP” a generator offtaking heat, can gain additional ROCs for their electricity generation. Therefore providing certain levels of heat is utilised, then the enhancement can be claimed. This can be achieved with Incineration for sites connected prior to 2013 with 1 ROC enhancement, and the recent consultation proposed a reduced 0.5 ROC enhancement from 2013.
2. Renewable Heat Incentive – this has been recently introduced, as an incentive that is provided from central government budgets to progress the adoption of low carbon heat.

Those projects that claim the RHI, cannot claim the enhanced ROC allowances, and vice-versa. Applicability can be demonstrated in the below:

Technology	Current ROC Enhancement (up to 2013 connections)	Proposed ROC Enhancement (2013 – 2017 connections)	RHI Applicability
Incineration with CHP	1	0.5	Only public sector derived wastes
Gasification / Pyrolysis to Steam Cycle	None	None	Only public sector derived wastes
Gasification / Pyrolysis to Gas Engine / Turbine	None	None	Only public sector derived wastes

It should be considered that the only commercial improvement in heat revenues (outside of paying for MW thermal), would be the enhancement in ROC revenue for Incineration with CHP. It is unlikely that the large volumes stated above to satisfy a 50MW plant, will all be public sector derived wastes, in order to secure the RHI revenues.

7.3 Plot J - CCGT

New build CCGT has a key role in the UKs transition to low-carbon power generation. It is the cheapest and most tried and tested technology when compared with renewable, nuclear and coal/Carbon Capture and Storage (CCS) power generation alternatives and will meet the Government's emissions target (subject to legislation). However uncertainty around UK legislation, fluctuating gas prices and security of the UKs future gas supply is currently restricting investment.

7.3.1 Legislative drivers

The UK Government is currently developing and implementing legislation aimed at transforming the UK into a low-carbon economy to meet a 15% renewable energy target by 2020 (Renewable Energy Directive) and 80% carbon reduction target by 2050, relative to 1990 levels (Climate Change Act). In order to achieve the 80% carbon reduction target it is estimated that power sector emissions need to be largely decarbonised by the 2030's. This is all to be delivered in the context of the UK's overall demand for electricity doubling by 2050, losing between a fifth to a third of existing power generation capacity as a result of plant closures in the next decade and the existing fleet of nuclear power stations reaching the end of their lives by 2023.

New legislation to decarbonise the power sector will be aimed at encouraging investment in renewable/low carbon technology and a commitment to a programme of nuclear new build (NNB). However the renewables sector faces significant planning and new technology risk and NNB is not likely to contribute to the UKs base load until after 2020. Therefore, the UK will need to develop significant volumes of new thermal power generating capacity to replace retiring capacity (coal, gas and nuclear) in the short to medium term and provide flexible backup for renewable generation in the medium to long term.

7.3.2 The case for gas power generation

New build gas power generation provides a solution during the low carbon transition period as it benefits from:

- Low capital costs compared with other technologies (CCGT EPC cost order of £600-750/kW[1])
- Simple, demonstrable, efficient, and bankable technology

[1] Figures based on CCGT> 500MW excluding CCS, figures sensitive to market competition / capacity for technology if new build CCGT becomes the UKs short term power generation solution.

- Quick build time to meet low-carbon programme
- Construction that can be modular allowing phased construction to meet investment profile
- A high degree of automation resulting in low maintenance and operational costs (depending on usage)
- Large scale CCGT emissions that are below the UK Government's annual 450g/kWh Emissions Performance Standard (EPS) (subject to legislation)
- An ability to retrofit Carbon Capture and Storage technology (CCS) once it has been market proven in order to maintain future position as a base load electricity supplier (subject to feasibility/cost of CO2 transport and storage)
- Flexible generation with a quick start up, ideally suited to peaking system demand to cover renewable intermittency (with impact on maintenance costs)
- A lack of competition from conventional coal generation due to the EPS.
- Smaller scale peaking plant OCGT base-load emissions generally being above the EPS but satisfying the limit as an annual average due to intermittent emissions at peak times only.

7.3.3 Current market position

There is continued market uncertainty on the impact of the following UK Government Electricity Market Reform (EMR) proposals of:

- Long term contracts for investors in low carbon electricity generation (FiT/CfD/ROCs)
- A Carbon Price Floor (CPF) to improve incentives for low carbon generation
- An EPS to regulate the performance of new fossil fuelled plant
- A Capacity Mechanism to remunerate providers of generating capacity and ensure system adequacy

Furthermore, spark spreads (CCGT generating margins) have fallen, resulting in generating companies with existing CCGT assets threatening closure. For example Centrica have confirmed that they are likely to close two operational gas-fired electricity plants in the UK by June 2012, citing no prospects of a medium-term improvement in spark spreads.

The market indicates that an average base-load equivalent clean spark spread in the range of £12 - £14/MW is required to support a new build CCGT over a 20 year economic lifespan, the UKs clean spark spread dropped as low as circa £3/MW at the end of 2011. Centrica has consent to build a 1GW gas-fired plant at a site in Kings Lynn, but they have confirmed that their final decision on proceeding is dependent on "improved market conditions" and the finer details of the government's electricity market reform.

Hedging generation margins will be the biggest challenge to future CCGT developers and investors as they seek a robustly realistic position on:

- Volatility in wholesale gas market prices
- Influence of CPF on cost base
- Influence of FiT/CfD/ROCs on electricity market price
- Influence of Capacity Mechanism on electricity price

- Future legislation changes
- Competition from life extensions to existing plant
- Competition from existing coal fired plant benefitting from the low cost of EU Emission Trading Scheme carbon credits.

As the UK Government manipulates the market through the EMR, e.g. making renewable generation ‘must-run plants’, then CCGT plants are likely to function as peaking plant. In this scenario CCGT operators will not be able to rely on base-load margins but will increasingly have to focus on peak margins.

7.3.4 Future market

The UK Government released a statement in March 2012 that recognised the role CCGT will have to play in the transition to a decarbonised energy sector by confirming power stations consented under the 450g/kWh EPS base level would then be subject to that level until 2045, a process called ‘grandfathering’ aimed at long-term certainty for CCGT investors. They have also stated they will publish a new gas generation strategy in autumn 2012 that will “*focus on ensuring security of supply by setting out any necessary government interventions needed to address barriers to investment in gas generation*.”

This statement suggests that CCGT can be built without needing to be Carbon Capture ready, hence maintaining its commercial advantage over other alternative forms of generation. New build CCGT has a key role in the transition to low-carbon power generation provided the UK government can provide the necessary comfort to developers and investors which should be forthcoming in the next 12-24 month period.

7.3.5 Next Steps

We would recommend that BAE undertake a detailed option analysis for the Huntspill Energy Park development to identify the optimum mix of power generation technology for the site. The analysis should consider:

- Current and future UK legislation
- Local, national and international fuel supply
- Utility supply
- Grid connection
- On-site power and heat distribution
- Local power and heat distribution
- Planning / permitting risk
- Cost / budget
- Detailed risk analysis
- Programme
- CCS feasibility
- Supply chain capacity
- Procurement strategy
- Development / investment / asset disposal strategy
- Funding availability
- Developments in wholesale energy market
- Other site specific issues

7.4 Plot K – Biomass or Anaerobic Digestion

7.4.1 Technology Options

Biomass feedstock can come in several forms, and for the purposes of this review, it is considered that the feedstock is clean biomass, which doesn't have a requirement for a WID compliant technology. Several technology options are available in the UK energy from waste marketplace, but all have differing drivers for a scheme of this size.

Technology	Fuel Type	Proven	Bankability	Public Perception
Incineration	Clean biomass (wood chip, etc)	High	High / Medium	Neutral / Negative
Gasification / Pyrolysis to Steam Cycle	Clean biomass (wood chip, etc)	Medium	Medium	Good
Gasification / Pyrolysis to Gas Engine / Turbine	Clean biomass (wood chip, etc)	Low	Medium / Low	Good
Anaerobic Digestion	Maize, grass and agricultural biomass (non food waste)	High	High / Medium	Good

Unlike under waste feedstock both Gasification and Pyrolysis technologies have more reference projects running on clean biomass feedstock, as the consistency of input material can be better catered in the conversion to syngas and power generation.

7.4.2 Volume & Scale Expectations

We understand that it is expected that the Biomass or Anaerobic Digestion Plant will be sub 50MW, but for the purposes of this assessment we've assumed a 50MW plant. In similarity to the Energy from Waste plant, the tonnages expected to be received to fuel these scales of plant would require significant fuel procurement strategies, utilising the rail terminal, and more than likely require importation of clean biomass from outside of the UK to service the requirement.

Technology	Fuel Type	Tonnage / MW	Tonnage for 50MW
Incineration	Clean biomass (wood chip, etc)	7,000t / MW	350,000t
Gasification / Pyrolysis to Steam Cycle	Clean biomass (wood chip, etc)	9,500t / MW	475,000t
Gasification / Pyrolysis to Gas Engine / Turbine	Clean biomass (wood chip, etc)	5,500t / MW	275,000t
Anaerobic Digestion	Maize, grass and agricultural biomass (non food waste)	22,500t / MW	1,125,000t

If a strategy was in place to only source indigenous biomass feedstocks to fuel the biomass or anaerobic digestion plant, then these levels would normally be expected in the 100,000t to 150,000t per annum level. At this level, longer term fuel supply strategies can be achieved within the UK. The reflection of these volumes can dictate the scale of plant, should a developer wish to use UK only feedstock.

Technology	Fuel Type	Expected Scale from 100,00t/a UK supply	Expected Scale from 150,00t/a UK supply
Incineration	Clean biomass (wood chip, etc)	14 MW	21 MW
Gasification / Pyrolysis to Steam Cycle	Clean biomass (wood chip, etc)	11 MW	16 MW
Gasification / Pyrolysis to Gas Engine / Turbine	Clean biomass (wood chip, etc)	18 MW	27 MW
Anaerobic Digestion	Maize, grass and agricultural biomass (non food waste)	4.5 MW	6.5 MW

7.4.3 Capital Investment Considerations

Technology	Fuel Type	Low	High
Incineration	Clean biomass (wood chip, etc)	£163m (£3.25m/MW)	£188m (£3.75m/MW)
Gasification / Pyrolysis to Steam Cycle	Clean biomass (wood chip, etc)	£175m (£3.5m/MW)	£250m (£5m/MW)
Gasification / Pyrolysis to Gas Engine / Turbine	Clean biomass (wood chip, etc)	£188m (£3.75m/MW)	£300m (£6m/MW)
Anaerobic Digestion	Maize, grass and agricultural biomass (non food waste)	£137.5m (£2.75m/MW)	£187.5m (£3.75m/MW)

7.4.4 Commercial Viability Considerations

Biomass and anaerobic digestion plants in the UK are commercially driven from revenues from

1. Exported Electricity revenues from Power Purchase Agreements with Utilities or End Users
2. Renewable Obligation Certificates – according to banding of qualifying technologies
3. Heat Revenues from CHP or District Heating systems, which can include the recently announced Renewable Heat Incentive (RHI)

ROC Banding Review (October 2011 consultation)

ROC income incentivises renewable energy generation by providing a certificate that can be traded to large carbon emitting utilities. The UK government issued it's consultation on the changes to the ROC banding in October 2011, and to date (April 2012), has not concluded this consultation following various calls for evidence.

Biomass facilities have been given a continuation of the ROC banding, however see a digression in later years. Advanced Thermal Technologies (Gasification and Pyrolysis) will receive either dedicated biomass or higher levels if using gas engines/turbines.

Anaerobic Digestion will also receive a continuation of ROC support, but also digression in later years. It is worth noting that Anaerobic Digestion receives incentive support for facilities with a declared net capacity below 5MW.

Those qualifying technologies that are affected can be summarised in the below:

Technology	Current ROC Banding (up to 2013 connections)	Proposed ROC Banding (2013 -2017 connections)	Comments
Dedicated Biomass (Incineration)	1.5	1.5 to 31/03/16 1.4 from 01/04/2016	
Dedicated Biomass with CHP (Incineration)	2	2 to 2014/15	
Standard Gasification to Steam Cycle	As dedicated biomass as technology lower	As dedicated biomass as technology lower	
Advanced Gasification to Steam Cycle	2	As dedicated biomass as technology lower	Gasification to Steam Cycle will be considered Standard
Standard Gasification to Gas Engine / Turbine	As dedicated biomass as technology lower	2 1.9 in 2015/16 1.8 in 2016/17	
Advanced Gasification to Gas Engine / Turbine	2	2 1.9 in 2015/16 1.8 in 2016/17	
Standard Pyrolysis to Steam Cycle	As dedicated biomass as technology lower	As dedicated biomass as technology lower	
Advanced Pyrolysis to Steam Cycle	2	As dedicated biomass as technology lower	Pyrolysis to Steam Cycle will be considered Standard

Technology	Current ROC Banding (up to 2013 connections)	Proposed ROC Banding (2013 -2017 connections)	Comments
Standard Pyrolysis to Gas Engine / Turbine	As dedicated biomass as technology lower	2 1.9 in 2015/16 1.8 in 2016/17	Pyrolysis to Gas Engine / Turbine will now be considered Advanced
Advanced Pyrolysis to Gas Engine / Turbine	2	2 1.9 in 2015/16 1.8 in 2016/17	
Anaerobic Digestion	2	2 in 2013 - 2015 1.9 in 2015/16 1.8 in 2016/17	

7.4.5 Heat Offtake Revenues – Renewables Heat Incentive / ROC Improvements in CHP

Heat revenues can be generated by exporting medium or low grade heat to end users on the surrounding building and land uses. Further revenues can be generated by incentive schemes supported by UK government intervention. The two main mechanisms for supporting heat revenues are:

1. Enhancement in Renewable Obligation Certificates – by achieving "good quality CHP" a generator offtaking heat, can gain additional ROCs for their electricity generation. Therefore providing certain levels of heat is utilised, then the enhancement can be claimed. 2 ROCs can only be achieved until 2014/15 year of banding.
2. Renewable Heat Incentive – this has been recently introduced, as an incentive that is provided from central government budgets to progress the adoption of low carbon heat. RHI payments can generate 1p/kWh thermal exported heat to users.

Those projects that claim the RHI, cannot claim the enhanced ROC allowances, and vice-versa.

It should be considered that due to support to biomass facilities, rather than EfW facilities, in the RHI in the long term, that district heating and heat networks should be concentrated to biomass facilities. Any RHI payments would then benefit heat offtakers in assumed lower heat charges.

Under the RHI support is provided to Anaerobic Digestion biogas injection to the national gas network, however this only applies to waste streams, and not energy crops. Therefore a clean biomass or energy crop feedstock with anaerobic digestion would be best placed generating electricity.

Figure 1 - Masterplan

Appendix A – Rookery South Traffic Data

The following tables have been taken from the Rookery South ES and outline predicted two-way construction impact over a 24 period

Predicted impact in Month 5 (peak) during construction phase

Highway Link		Flow (Vehicles/ HGVs) (PCUs)								
		Base inc LLRS		Development Flow		Total		% Increase		Severity of Impact (% HGV)
		Car/ LGV	HGV	Car/ LGV	HGV	Car/ LGV	HGV	Car/ LGV	HGV	
1	Green Lane east of site access	2438	159	16	0	2454	159	1%	0%	Slight
2	Green Lane west of site access	2470	138	122	632	2592	770	5%	458%	Substantial
3	Stewartby Way between Churchill Close and Park Crescent	1058	44	16	0	1074	44	1%	0%	Slight
4	B530 north of Stewartby Way	10,153	648	4	0	10,157	652	0%	0%	None
5	B530 south of Stewartby Way	8,855	565	12	0	8,867	595	0%	0%	None
6	Existing A421 alignment north between Green Lane and Broadmead Road	2,555	68	97	316	2,652	384	4%	464%	Substantial
7	Existing A421 alignment south between Green Lane Hoo Lane	5,950	374	25	316	5975	690	0%	84%	Substantial

Predicted impact in Month 20-28 (peak) during construction phase

Highway Link		**Flow (Vehicles/ HGVs) (PCUs)**								
		Base		**Development Flow**		**Total**		**% Increase**		**Severity of Impact (% HGV)**
		Car/ LGV	**HGV**	**Car/ LGV**	**HGV**	**Car/ LGV**	**HGV**	**Car/ LGV**	**HGV**	
1	Green Lane east of site access	2377	164	66	0	2443	164	3%	0%	**Slight**
2	Green Lane west of site access	2502	142	518	254	3020	396	20%	179%	**Substantial**
3	Stewartby Way between Churchill Close and Park Crescent	1058	44	66	0	1124	104	6%	0%	**Slight**
4	B530 north of Stewartby Way	10,153	648	17	0	10170	648	1%	0%	**Slight**
5	B530 south of Stewartby Way	8,855	565	49	0	8904	565	1%	0%	**Slight**
6	Existing A421 alignment north between Green Lane and Broadmead Road	2,679	75	411	127	3090	202	15%	169%	**Substantial**
7	Existing A421 alignment south between Green Lane Hoo Lane	6,372	378	518	127	6890	505	8%	34%	**Moderate**

The following table outlines the predicted two-way traffic impact over a 24 hour day during operation using a nominal throughput of 585,000tpa (Taken from Table 7.13 Traffic & Transport)

Highway Link		Flow (Vehicles/ HGVs) (PCUs)			
		Base	Nominal throughput Flow	Total	% Increase
1	Green Lane east of site access	2753	14	2767	0%
2	Green Lane west of site access	2768	866	3634	31%
3	Stewartby Way between Churchill Close and Park Crescent	1488	14	1502	0%
4	B530 north of Stewartby Way	11873	6	11879	0%
5	B530 south of Stewartby Way	10449	8	10457	0%
6	Existing A421 alignment north between Green Lane and Broadmead Road	3224	242	3466	8%
7	Existing A421 alignment south between Green Lane Hoo Lane	7343	624	7967	8%
8	New A421 dual north of Marsh Leys Junction	74379	182	74561	0%
9	New A421 dual south of Marston Junction	55780	610	56390	1%
10	A5134 towards Kempston – i.e. NW of Marsh Leys Roundabout	16646	48	16694	0%
11	Bedford Western Bypass – NW of Marsh Leys Roundabout	24303	14	24317	0%
12	New A421 – North of Marston Junction	63807	0	63807	0%
13	Beancroft Road – Between Marston Southern and Middle Roundabouts	21823	624	22447	3%
14	Beancroft Road – Between Marston Northern and Middle roundabouts	16669	319	16988	1%
15	Bedford Road (Marston Moretaine)	347	0	347	0%
16	Existing A421 alignment south of Bedford Road	5191	624	5815	12%

Appendix B – Severn Power CCGT Traffic Data

Table A – Junction 3 -12 hour two-way flows for the Meadow road (labelled Nash), the Queensway Meadow road (labelled Queensway), the Queensway (labelled Steelworks) and Longditch road.

Meadow rd, Queensway Meadow and Queensway roundabout- Friday 11th October 2002

	Steel works		Queensway		Nash		Longditch		2 way	Adjusted to 2006 flow
	to	from	to	from	to	from	to	from	12 hr flows	
am peak	257	49	184	589	283	147	78	17	1604	1610.416
pm peak	37	93	319	191	153	169	20	76	1058	1062.232
										0
total	1373	1447	3652	3697	2275	2161	487	248	15340	15401.36
Grand Total		2820		7349		4436		736		

HGV content of the above 12hr flow 7.9%

Table B – Junction 4 -12 hour two-way flows for the roundabout junction of the SDR, Queensway Meadows road and Leeway

Leeway, Meadows rd, SDR roundabout - Wednesday July 2005 - Traffic Flows

	Arm A		Arm B		Arm C		Arm D		2 way	Adjusted to 2006 flow
	to	from	to	from	to	from	to	from	12 hr flows	
am peak	826	1002	329	113	880	239	535	1216	5140	5160.56
pm peak	1144	1169	135	235	693	833	1316	1075	6600	6626.4
total	10607	10895	1822	2058	8005	5942	9546	11085	59960	60199.84

KEY	
Junction A	*Southern Distributor Road*
Junction B	*Lee Way*
Junction C	*Queensway Meadow*
Junction D	*Southern Distributor Road*

HGV 10.1% of the above 12hr flows

Table C – Average daily two-way vehicle movement for the construction period – Monthly division

			two-way daily vehicle movements			
		# staff	Proposed construction			
Type of vehicle			Cars	LGV	HGV	Abnormal loads
2007	March	20	24	4	4	
	April	20	24	4	6	
	May	20	24	4	6	
	June	20	24	4	6	
	July	20	24	4	6	
	August	20	24	4	6	
	September	50	38	8	6	
	October	50	38	8	6	
	November	50	38	8	10	
	December	50	38	8	10	
2008	January	200	152	28	16	0.4
	February	200	152	28	16	0.5
	March	200	152	28	16	0.6
	April	200	152	30	16	0.6
	May	200	152	30	16	0.6
	June	250	152	30	20	0.5
	July	250	188	38	22	0.4
	August	250	188	38	28	
	September	250	188	38	34	
	October	200	188	38	32	
	November	200	188	38	28	
	December	200	188	34	22	
2009	January	100	76	16	10	
	February	100	76	16	10	
	March	100	76	16	8	
	April	60	46	10	6	
	May	60	46	10	6	
	June	60	46	10	6	
	July	60	46	10	6	
	August	60	46	10	6	
	September	60	46	10	6	
		60	46	10	6	

Table D – Junction 3 -12 hour two-way flows for the Meadow road (labelled Nash), the Queensway Meadow road (labelled the Queensway), the Queensway (labelled Steelworks) and Longditch road with construction traffic for the Severn Power Station.

The yellow column indicates effect of the Severn Power Station of baseline traffic flows at this junction for the period 2007-2009. The figure is the total two-way flow for a 12-hour period and as a percentage change from baseline.

		Type of movement		Year - Baseline traffic flow and changed flows with development (and % change)								
Junction	Period	to	from	total 2005	Total 2006	Total 2007	with dev	Total 2008	with dev	Total 2009	with dev	Total 2010
Steel works	am peak	257	49	306	307.224	309.3746		311.5402		313.721		338.1912
	pm peak	37	93	130	130.52	131.4336		132.3537		133.2802		143.676
	total	1373	1447	2820	2831.28	2851.099		2871.057		2891.154		3116.664
					0	0		0		0		0
Queensway	am peak	184	589	773	776.092	781.5246		786.9953		792.5043		854.3196
	pm peak	319	191	510	512.04	515.6243		519.2336		522.8683		563.652
	total	3652	3697	7349	7378.396	7430.045		7482.055		7534.429		8122.115
					0	0		0		0		0
Nash	am peak	283	147	430	431.72	434.742		437.7852		440.8497		475.236
	pm peak	153	169	322	323.288	325.551	**1% flow**	327.8299	**4.9% flow**	330.1247	**1.6% flow**	355.8744
	total	2275	2161	4436	4453.744	4484.92	4526.92	4516.315	4741.315	4547.929	4621.929	4902.667
					0	0		0		0		0
Longditch	am peak	78	17	95	95.38	96.04766		96.71999		97.39703		104.994
	pm peak	20	76	96	96.384	97.05869		97.7381		98.42227		106.0992
	total	487	248	735	737.94	743.1056		748.3073		753.5455		812.322
					0	0		0		0		0
Totals												
2 way	am peak	n/a	n/a	1604	1610.416	1621.689		1633.041		1644.472		1772.741
12 hr flows	pm peak	n/a	n/a	1058	1062.232	1069.668	**>1% flow**	1077.155	**1.5%flow**	1084.695	**>1%flow**	1169.302
	total	n/a	n/a	15340	15401.36	15509.17	15551.17	15617.73	15842.73	15727.06	15801.06	16953.77

HGV content for the nash junction increased from 7.9% to 8.4% for 2008

Table E– Junction 4- 12 hour two-way flows for the roundabout junction of the SDR (Arm A & D), Queensway Meadows road (Arm C) and Leeway (Arm B) with construction traffic for the Severn Power Station.

The yellow column indicates effect of the Severn Power Station on baseline traffic flows at this junction for the period 2007-2009. The figure is the total two-way flow for a 12-hour period and as a percentage change from baseline.

Junction	Period	Type of movement		Year - Baseline traffic flow and changed flows with development (and % change)								
		to	from	total 2005	Total 2006	Total 2007	with dev	Total 2008	with dev	Total 2009	with dev	Total 2010
Arm A	am peak	826	1002	1828	1835.312	1848.159		1861.096		1874.124		2020.306
	pm peak	1144	1169	2313	2322.252	2338.508		2354.877		2371.361		2556.328
	total	10607	10895	21502	21588.01	21739.12		21891.3		22044.54		23764.01
Arm B		to	from									
	am peak	329	113	442	443.768	446.8744		450.0025		453.1525		488.4984
	pm peak	135	235	370	371.48	374.0804		376.6989		379.3358		408.924
	total	1822	2058	3880	3895.52	3922.789		3950.248		3977.9		4288.176
Arm C		to	from									
	am peak	880	239	1119	1123.476	1131.34		1139.26		1147.235		1236.719
	pm peak	693	833	1526	1532.104	1542.829	>1% flow	1553.629	2% of flow	1564.504	>1% flow	1686.535
	total	8005	5942	13947	14002.79	14100.81	14142.81	14199.51	14424.51	14298.91	14372.91	15414.22
Arm D		to	from									
	am peak	535	1216	1751	1758.004	1770.31		1782.702		1795.181		1935.205
	pm peak	1316	1075	2391	2400.564	2417.368		2434.29		2451.33		2642.533
	total	9546	11085	20631	20713.52	20858.52		21004.53		21151.56		22801.38
Totals												
2 way	am peak			5140	5160.56	5196.684		5233.061		5269.692		5680.728
12 hr flows	pm peak			6600	6626.4	6672.785	>1% flow	6719.494	>1% flow	6766.531	>1% flow	7294.32
	total			59960	60199.84	60621.24	60663.24	61045.59	61270.59	61472.91	61524.91	66267.79
12 hr two way flow SDR				42133	42301.53	42597.64		42895.83		42597.64		45920.26

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