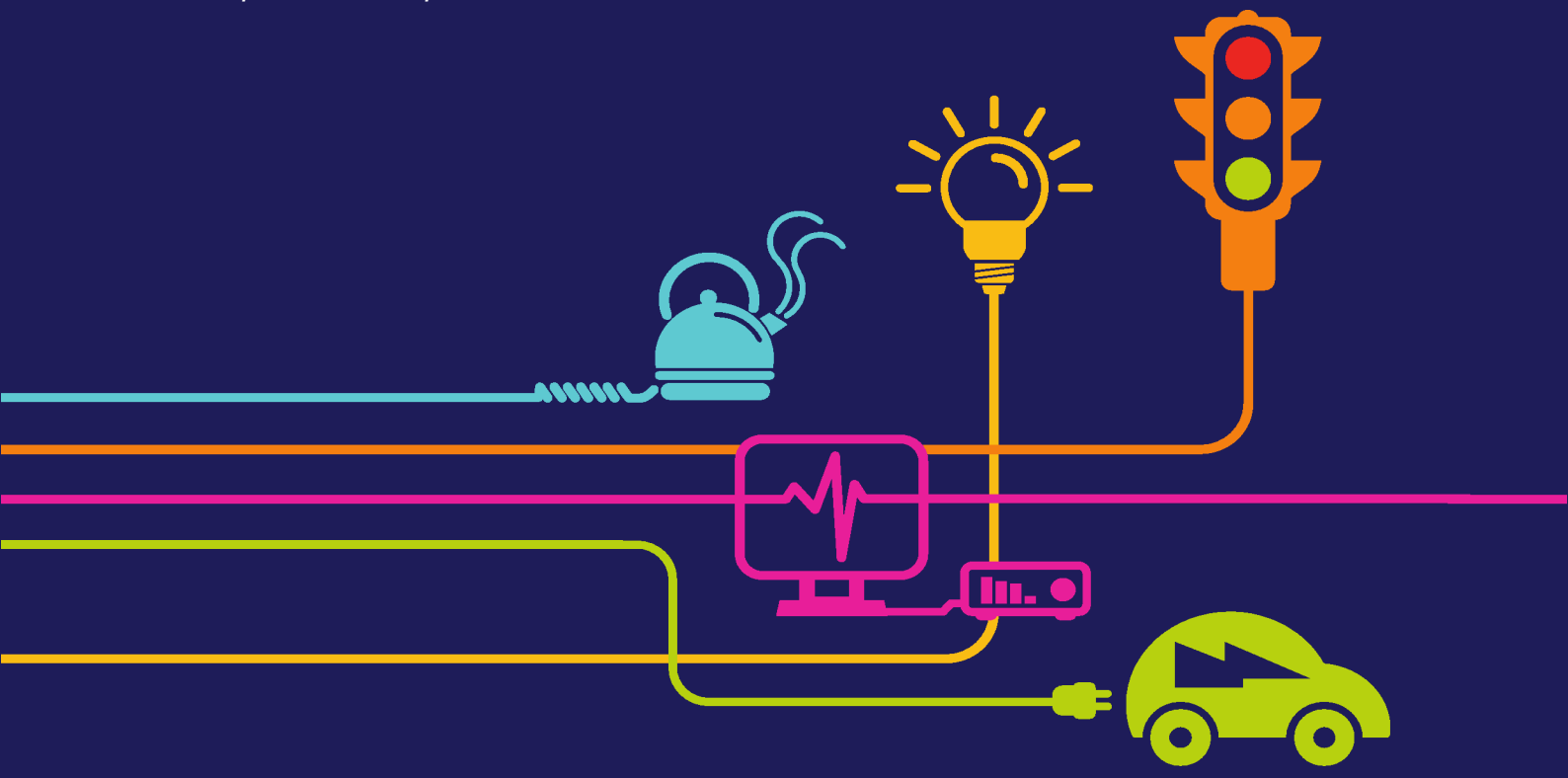
DOCUMENT 9.6

Menai Strait Crossing Report (2016)

National Grid (North Wales Connection Project)

Regulation 5(2)(q) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

First published September 2016



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nationalgrid

North Wales Connection Project

Menai Strait Crossing Report

(Document 2.3)

National Grid
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA

September 2016

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1. INTRODUCTION

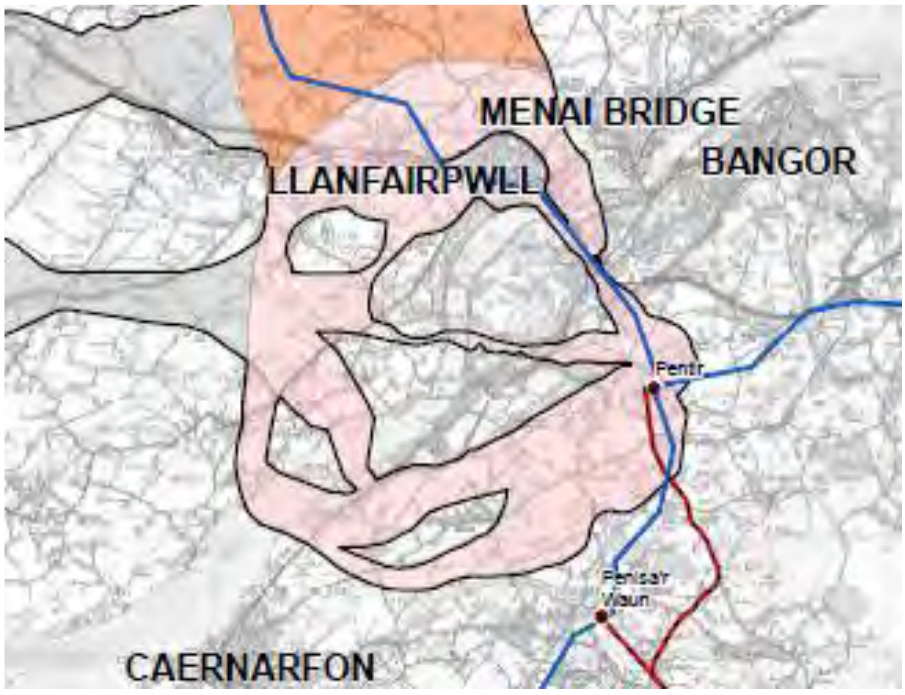
1.1 Background

1.1.1 National Grid owns and operates the national electricity transmission system in Wales and England – the network of cables and pylons that connects the UK's power stations to homes and businesses. This connecting role puts National Grid at the centre of solving the UK energy industry's major challenge: delivering low carbon energy in an affordable, secure and sustainable way.

1.1.2 The North Wales Connection is a proposed new connection for the Wylfa Newydd nuclear power station on Anglesey. There is an existing line in North Wales, but an additional, new connection is required to get the amount of power from the new station to the homes and businesses that need it. The new connection is a crucial part of providing reliable low carbon power and unlocking the investment the new power station will bring for North Wales.

1.1.3 In 2012 National Grid presented information for public consultation which identified a common area within which the new connection would approach and cross the Menai Strait and continue to the existing 400kV substation at Pentir (see Figure 1.1 below)[1].

Figure 1.1



[1] Extract from National Grid: Wylfa to Pentir Initial Route Corridor Report (October 2012)

1.1.4 In January 2015, National Grid announced a preferred route corridor for the development of the new electricity transmission line connection between Wylfa and Pentir. At the same time, National Grid also announced that overhead lines would not be used to cross the Anglesey Area of Outstanding Natural Beauty (AONB) and the Menai Strait.

> '*You also told us that the Menai Strait is particularly sensitive, so we've decided to place the cables underground here, to minimise the impact on the views both at the Menai Strait and in the Anglesey Area of Outstanding Natural Beauty (AONB)*'[2].

1.1.5 Further work was undertaken to review the common area in order to ascertain whether it continued to be a suitable search area for the routeing of the underground cables that would now be required[3].

1.1.6 In summary, the search area was defined at the eastern end by the edge of the built-up area of Menai Bridge and at the western end, by Moel-y-Don on Anglesey and Port Dinorwig on the mainland as:

- it was not felt necessary to consider routeing underground cables beneath or through residential areas in this instance, given the geography of the search area. Y Felinheli occupies a long length (approximately 1.8km) of the Gwynedd foreshore from Port Dinorwig westwards, so a significant extension of the search area westwards would have been required to avoid the settlement;
- the technical constraints west of Y Felinheli imposed by the mobile sediments and rapidly changing bed profiles associated with this part of the Menai Strait and the length of the crossing that would be required (as noted in the Preferred Route Corridor Selection Report);
- the risk of potential adverse effects of skylining panoramic views of Snowdonia from the north due to extending the overhead line and cabling connections through the Dinorwig Registered Landscape of Outstanding Historic Interest west of Pentir (as noted in the Preferred Route Corridor Selection Report); and
- a route south of Y Felinheli would represent a longer connection (connecting the Orange Route Corridor to the north-west of Llanfairpwllgwyngyll and Pentir Substation). This longer route length would result in risk of greater adverse effects upon communities that would otherwise be largely unaffected, such as Y Felinheli and Bethel, and other environmental and socio-economic receptors, such as Greenwood Forest Park.

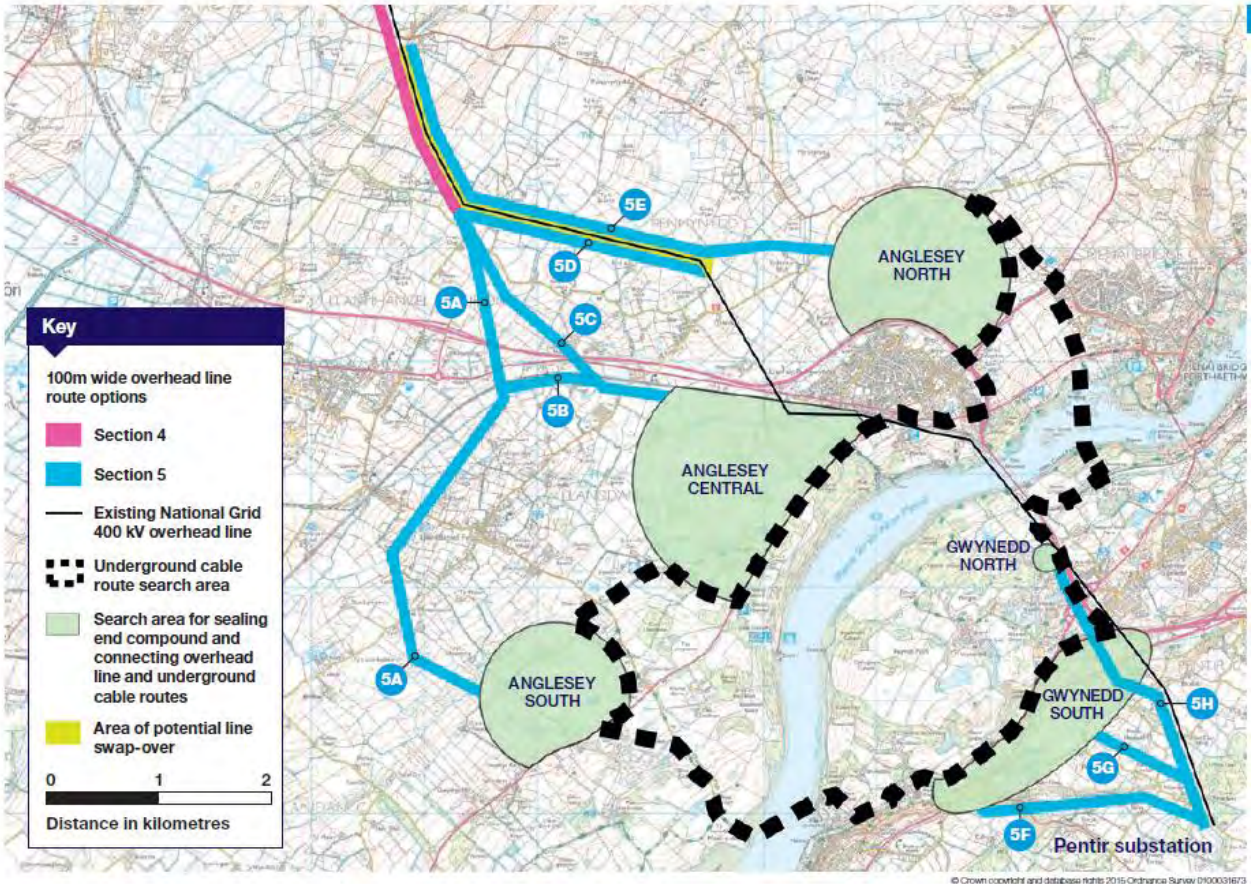
[2] Extract from National Grid, North Wales Connection; Project News January2015

[3] National Grid: Wylfa to Pentir Route Options Report (October 2015)

1.1.7 In October 2015 National Grid undertook its Stage 2 Consultation identifying the area around the Menai Strait as 'Section 5' of the Project. In order for the connection to go underground cable sealing end compounds would be required, both on Anglesey and in Gwynedd, to make the change from an overhead line to an underground cable. Five search areas were identified, three on Anglesey and two on Gwynedd. All of the search areas are outside of the Anglesey AONB and avoid Plas Newydd and the Vaynol Registered Parks and Gardens.

1.1.8 Five proposed overhead line route options (5A–5E) were identified to reach the sealing end compound search areas on Anglesey and three proposed overhead line route options (5F–5H) from the sealing end compound search areas in Gwynedd to the existing substation at Pentir (see Figure 1.2 below).

Figure 1.2[4] Overhead Line Route Corridors and CSEC Search Areas (October 2015)



[4] Extract from Project News: North Wales Connection (National Grid Autumn 2015)

1.2 Purpose of Report

1.2.1 This Report identifies National Grid's the preferred option for crossing the Menai Strait with a new 400 kV connection.

1.2.2 This report provides information as to the work National Grid has undertaken since the Stage 2 Consultation for Section 5 of the project, the options that have been developed and considered. The Report identifies the preferred option for the connection through this Section that is being taken forward to statutory consultation prior to an application being made for a DCO.

1.3 Structure of the Report

1.3.1 As Section 5 potentially includes a number of elements (overhead line, cable sealing end compounds, underground cable. Menai Crossing) these have been considered individually and initial preferences expressed. In addition, as the connection from Section 4 to Pentir Substation needs to be considered in its entirety, a number of 'end – to end' options have been appraised and an overall preference identified.

1.3.2 The Report is structured as follows:

- Chapter 1: Introduction;
- Chapter 2: National Grid's Duties and Policies - describes National Grid's duty to provide a connection taking account of commercial considerations and its duty to protect the environment;
- Chapter 3: Context for the Appraisal - provides an overview of the appraisal process and the factors considered;
- Chapter 4: Overview – provides a brief overview of the local environment within Section 5 and the surrounding area;
- Chapter 5: Construction Considerations – New National Grid Infrastructure – describes the construction of pylons and underground cables together with the means by which a connection may be made beneath the Menai Strait;
- Chapter 6: Construction Considerations – Other Infrastructure – describes how the connection may be made by using existing infrastructure and considers the feasibility of such means;
- Chapters 7 – 10: 'Overhead Lines', 'Cable Sealing End Compounds', 'Underground Cables' and the 'Menai Crossing' respectively – describe and appraise those individual elements and provide initial preferences based on environmental, socio economic and technical considerations, and consultation feedback;
- Chapter 11: Pentir Substation – describes and appraises the options for the required extension to the existing substation and identifies the preferred option;

- Chapter 12: 'End – to – End Options Considered – describes a number of end – to end options (made up of the individual elements described above) and using the appraisals of those individual elements considers on balance, including cost which 'complete' option is preferred for making the connection;
- Chapter 13: Proposed Design – takes forward the preferred option and refines it into a proposed design for consultation; and
- Chapter 14: The Way forward – describes the nest stages in the development of the project including the application for a Development Consent Order (DCO.

1.3.3 A summary of the findings is provided in the Overview Report[5] which forms part of the consultation materials.

1.3.4 Although the route corridor from Wylfa to the existing Pentir Substation has been divide into sections (1 – 5), which were broadly based on geographical features and were defined using professional judgement, National Grid has considered the various ways in which the section 4 and 5 (which include the Menai Crossing) might interact during the appraisal process.

1.4 Outcome

1.4.1 The outcome of the appraisals described in this Report is the identification of a preference for the connection in Section 5 to be by means of a new 400 kV overhead line within Option 5C to a site in Anglesey South (identified as AC6), where a cable sealing end compound (CSEC) and tunnel head house will be located, then by means of a tunnel to a site for a CSEC and tunnel head house in Gwynedd North, identified as GS1, and a new 400 kV overhead line to the existing Pentir Substation.

[5] National Grid 2016: Document 1.2 of the Consultation Materials

2. NATIONAL GRID DUTIES AND POLICIES

2.1 Introduction

2.1.1 National Grid owns and operates the national electricity transmission network in England and Wales, connecting electricity from generating stations to local distribution companies. National Grid does not distribute electricity to individual premises, but its role in the wholesale market is fundamental to ensuring a reliable and quality supply to all.

2.1.2 National Grid's high voltage electricity system which operates at 400,000 (400 kV) and 275,000 (275 kV) volts, is made up of approximately 22,000 pylons with an overhead line route length of 7,200 kilometres (km), 700km of underground cable and 337 substations. Separate regional companies own and operate the electricity distribution networks that comprise overhead lines and cables at 132,000 (132 kV) volts and below. It is the role of these local distribution companies to distribute electricity to homes and businesses.

2.1.3 National Grid has duties placed upon it by the Electricity Act 1989 and operates under the terms of its transmission licence. Those duties and terms relevant to the North Wales Connection Project are described below.

2.2 Duty to Provide a Connection

2.2.1 Under Section 9(2) of the Electricity Act 1989, National Grid has a duty to "*facilitate competition in the supply and generation of electricity*". National Grid must therefore do what it can to provide the connection of new power generation to the transmission system. When a power generation developer applies for a connection to the national transmission system, National Grid has a statutory obligation under the terms of its transmission licence to offer a new connection, or to modify an existing connection.

2.2.2 Condition C8 (requirement to offer terms) of National Grid's operating licence also requires the connection agreement to set a date by when any works required to permit access to the transmission system (including any works to reinforce or extend the transmission system) shall be completed.

2.2.3 As a result of an application by Horizon Nuclear Power for the connection of their proposed Wylfa Newydd Power Station, National Grid's subsequent offer and the completed 'Connection Agreement' contract, National Grid has a contractual obligation to endeavour to provide a transmission connection to the proposed new power station by 2024/25.

2.3 Economic Duties

2.3.1 Section 9(2) of the Electricity Act 1989 also requires National Grid to "*develop and maintain an efficient, co-ordinated and economical system of electricity transmission*". National Grid is regulated by the Office of Gas and Electricity Markets (OfGEM), which sets the level of charges that National Grid is allowed to make for the use of the transmission system. These charges are indirectly passed on to consumer bills, so OfGEM also seeks to prevent unnecessarily high levels of cost when developing the transmission system. These statutory and licence obligations to develop the transmission system economically and efficiently are important considerations for National Grid.

2.4 Duty to Protect the Environment

2.4.1 As the holder of the electricity transmission licence for England and Wales, National Grid has a statutory duty under Section 38 of the Electricity Act 1989 to consider the amenity impacts of its work. When formulating a proposal to develop an overhead electricity line, or carry out other works to the transmission system, Schedule 9(1) of the Electricity Act 1989 specifically requires National Grid to:

> "*have regard to the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest and or protecting sites, buildings and objects of architectural, historic or archaeological interest; and shall do what it reasonably can to mitigate any effect which the proposals would have on the natural beauty of the countryside on such flora, fauna, features, sites, buildings or objects*."

2.4.2 When determining any application for consent to undertake works to the transmission system, the Secretary of State for Business, Energy and Industrial Strategy must also consider the extent to which National Grid has complied with these duties.

2.4.3 As a statutory undertaker, National Grid also has other duties relating to amenity and environmental considerations. In relation to designated landscapes, the National Parks and Access to the Countryside Act 1949 and the Countryside and Rights of Way Act 2000 require all statutory undertakers to have regard to the purposes of National Parks and AONBs, respectively, when carrying out their statutory duties. Government guidance acknowledges that "*the duties do not override particular obligations or considerations which have to be taken into account by relevant authorities in carrying out any function*", but goes on to explain that the purposes of designating nationally protected landscapes need to be "*recognised as an essential consideration in reaching decisions or undertaking activities that impact on those areas*".

2.5 Stakeholder, Community and Amenity Policy

2.5.1 National Grid's Stakeholder, Community and Amenity Policy6 sets out how the company will work with stakeholders and communities to meet the environmental duties placed on it by Schedule 9 of the Electricity Act and includes ten commitments. Of particular relevance to this project are the following:

i. *Establishing need.*
ii. *Involving stakeholders and communities.*
iii. *Routeing of networks and site selection – seeking to avoid areas which are nationally or internationally designated for their landscape, wildlife or cultural significance.*
iv. *Minimising the effects of works and new infrastructure on communities, by having particular regard to safety, noise and construction traffic, and on areas which are nationally or internationally designated for their landscape, wildlife or cultural significance and other sites valued for their amenity such as listed buildings, conservation areas, areas of archaeological interest, local wildlife sites, historic parks and gardens and historic battlefields (taking into account the significance of these and other areas through consultation with local authorities and other stakeholders with particular interests in such sites).*
v. *Mitigating adverse effects of works – through the application of environmental assessment techniques.*

2.6 Transmission Line Design and Routeing

2.6.1 In 2012, National Grid published a document entitled '*Our Approach to the Design and Routeing of New Electricity Transmission Lines*'[7], which sets out how the most appropriate route and technology for any new transmission line should be identified in order to best satisfy society's needs. It also sets out how National Grid will collect data, undertake research and analysis, consult stakeholders and communities and listen to feedback to inform National Grid's judgements.

[6] National Grid (2010) National Grid's commitments when undertaking works in the UK: Our stakeholder, community and amenity policy
[7] National Grid (2010) *Our approach to the design and routeing of new electricity transmission lines* ttp://northwalesconnection.com/supporting-information-and-factsheets.aspx

3. CONTEXT FOR THE APPRAISAL

3.1 Factors in Appraising Options

3.1.1 This section outlines the factors taken into account in appraising options. The identification of these factors has been influenced by:

- National Grid's statutory duties and policies;
- the requirements of the Planning Act 2008 and associated Regulations, including the duties as regards consultation; and
- local planning policy.

3.2 Statutory Duties

3.2.1 Section 9 of the Electricity Act places an obligation on National Grid to develop and maintain an efficient, co-ordinated and economical system of electricity transmission. In addition, Section 38 and Schedule 9 of the Act require National Grid to give consideration to the impact of its works on amenity by having regard to:

> "*the desirability of preserving natural beauty, of conserving flora, fauna, and geological or physiographical features of special interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest*".

3.3 Planning Act 2008

3.3.1 The Planning Act 2008 defines certain energy projects as being 'Nationally Significant Infrastructure Projects' (NSIPs) which require a Development Consent Order (DCO).

3.3.2 In determining an application for development consent there are a number of issues which the Secretary of State must have regard to. In summary, these are:

- any relevant National Policy Statement;
- any local impact report;
- any matters prescribed by regulations; and
- any other matters which the decision maker considers to be both important and relevant to the decision.

3.3.3 National Policy Statements were adopted in July 2011 and take primacy in decisions about NSIPs; further detail is provided below.

3.3.4 The Infrastructure Planning (Decisions) Regulations 2010[8] set out additional regulations regarding issues which must be taken into account by decision makers in certain circumstances. Regulations 3 and 7 are of particular relevance. Regulation 3 states that the decision maker shall have regard to the desirability of:

- preserving Listed Buildings or their setting or any features of special architectural or historic interest which they possess;
- preserving or enhancing the character or appearance of Conservation Areas; and
- preserving Scheduled Monuments or their settings.

3.3.5 Regulation 7 states that the decision maker shall have regard to the United Nations Environment Programme Convention on Biological Diversity[9], one of whose objectives is the conservation of biological diversity.

3.3.6 The Planning Act 2008 requires applicants to undertake consultation, including with people living in the vicinity of proposed works, in advance of any DCO application, and to detail how consultation responses have influenced the proposal for which consent is applied. Responses to consultations undertaken to date have formed part of the evaluation process and evolution of the Project.

3.4 National Policy Statements

3.4.1 The Planning Act 2008 defines the construction of an above ground transmission connection of 132kV or above and over 2km in length as being a 'Nationally Significant Infrastructure Project' (NSIP). The delivery of energy related NSIPs is covered by NPSs. The Secretary of State determines consent applications for NSIPs in accordance with NPSs.

3.4.2 The relevant NPSs for the Wylfa to Pentir transmission connection are the Overarching NPS for Energy (EN-1)[10] and the NPS for Electricity Networks Infrastructure (EN-5)[11] (which should be read in conjunction with EN-1 Overarching NPS for Energy (EN-1)).

3.4.3 NPS EN-1 requires the decision maker to take account of adverse impacts - environmental, social and economic - and weigh these against the benefits of the proposal. It identifies the generic issues which should be taken into account in assessing applications for development consent, recognising that these are the issues which are likely to arise most frequently but that they are not equally applicable to all projects.

[8] Infrastructure Planning (Decisions) Regulations 2010 : SI 2010 No.305

[9] United Nations Environment Programme : Convention on Biological Diversity : December 1993

[10] Department for Energy and Climate Change (2011) Overarching National Policy Statement for Energy

[11] Department for Energy and Climate Change (2011) National Policy Statement for Electricity Networks Infrastructure

3.4.4 EN-1 sets out a number of 'Assessment Principles' (Part 4) which the Planning Inspectorate should take into account in considering any proposed development, and in particular when weighing up the beneficial and adverse effects. These include:

- The potential benefits, including contributions to energy infrastructure, job creation and any long term or wider benefits.
- The potential adverse effects, including any long term and cumulative adverse effects, as well as any mitigation measures incorporated to reduce these adverse effects.

3.4.5 EN-5 (paragraph 2.8.8) states that the Government expects it would often be appropriate to fulfil the need for new electricity lines of 132kV and above through the development of overhead lines, though there will be cases where this is not so. Paragraph 2.8.7 supports the use of the 'Holford Rules' when deciding routes for overhead lines, and in relation to designing a connection NPS EN-5 states that:

> "… *wherever the nature or proposed route of an overhead line proposal makes it likely that its visual impact will be particularly significant, the applicant should have given appropriate consideration to the potential costs and benefits of other feasible means of connection or reinforcement, including underground and sub-sea cables where appropriate*." (paragraph 2.8.4).

3.4.6 EN-5 goes on to state: "… *Government has not laid down any general rule about when an overhead line should be considered unacceptable. The IPC*[12] *should, however only refuse consent for overhead line proposals in favour of an underground or subsea line if it is satisfied that the benefits from the non-overhead alternative will clearly outweigh any extra economic, social and environmental impacts and the technical difficulties are surmountable*." (paragraph 2.8.9).

3.4.7 EN-5 explains how new proposals will be assessed, and the supporting evidence needed, before being allowed to proceed. Any assessment will also need to cover issues raised in EN-1.

3.4.8 The generic issues raised by EN-1 and EN-5 include:

- air quality and emissions;
- biodiversity and geological conservation, noting particularly the effects on designated sites. NPS EN-5 seeks information on the impacts on birds and their flight paths;
- civil and military aviation and defence interests;
- coastal change;
- dust, odour, artificial light, smoke, steam and insect infestation;

[12] Footnote from EN-5 …*IPC = Infrastructure Planning Commission, introduced in 2009 under the Planning Act 2008 to examine and decide on NSIP applications. In 2012 the IPC was abolished and the relevant Secretary of State became the decision maker on NSIPs. The Planning Inspectorate took over the functions of the IPC and is responsible for the examination of NSIP proposals*.

- flood risk and climate change resilience;
- historic environment, noting particularly the effects on designated sites;
- landscape and visual impacts, noting particularly the effects on nationally designated landscapes. NPS EN-5 promotes the use of the Holford Rules and outlines the approach to the consideration of undergrounding;
- land use, including open space, green infrastructure and Green Belt;
- noise and vibration. NPS EN-5 notes that noise from overhead lines is unlikely to lead the determining authority to refuse an application;
- socio-economic impacts;
- traffic and transport impacts;
- waste management; and
- water quality and resources.

3.4.9 In addition, NPS EN-5 notes that with regard to electric and magnetic fields (EMF), the determining authority will need to satisfy itself that ICNIRP[13] guidelines are met.

3.4.10 In the subsequent chapters of this report, for the purposes of the appraisal, waste management has been considered in combination with traffic and transport.

Factors Discounted in Appraising Options

3.4.11 With respect to environment and socio-economic considerations the appraisal carried out has considered only those factors which provide a differentiator between options.

3.4.12 A number of factors which appear in the generic list of issues included in the NPS EN-1, and others put forward by respondents to the Stage One Consultation were considered more briefly than others within this evaluation as they could not assist significantly in comparing the merits of different routes / technologies / site locations. Should consultation responses or other reasons necessitate reconsidering, there will be a 'back-check' and review of these matters. These factors may also be considered within the Preliminary Environmental Information Report and the environmental impact assessment of the connection.

3.4.13 These factors were as follows:-

Civil and military aviation and defence interests

3.4.14 Based on our work to date there is no evidence to suggest that there would be a significant difference between routes / technologies / site locations in terms of effects on civil and military aviation and defence interests arising from either the construction works or permeant structures.

[13] International Commission on Non-Ionising Radiation Protection: Guidelines for limiting exposure to time varying electric, magnetic and electromagnetic fields : 1998

Air Quality and Emissions

3.4.15 Based on our work to date potential effects on air quality would be temporary, and mostly related to construction traffic (which is considered). There is no evidence to suggest that there would be a significant difference between routes / technologies / site locations in terms of effects on air quality and emissions arising from the construction works.

Coastal Change

3.4.16 Although this generic impact is included in NPS EN-1, based on our work to date it is considered that no elements of the connection have the potential to affect, or be affected by, coastal processes.

Dust, Odour, Artificial Light, Smoke, Steam and Insect Infestation

3.4.17 Based on our work to date it is considered that the scheme would only have the potential to temporarily give rise to effects during the construction phase. There is no evidence to suggest that there would be a significant difference between routes / technologies / site locations with regard to these effects.

Electric and Magnetic Fields (EMFs)

3.4.18 Representations to Stage One and Stage Two Consultations from members of the public expressed concern about the potential impact of EMFs on a range of health issues. In addition NPS EN-5 raises this as an issue. National Grid designs all of its system to be compliant with UK Government Guidelines on EMFs in terms of the EU recommendation, and the connection design will take these guidelines fully into account, whichever option is selected. An assessment of the potential impact of electric and magnetic fields will be included as a standalone document in support of the environmental impact assessment (EIA) of the preferred scheme.

3.4.19 NPS EN-5 notes only that the determining authority will need to be satisfied that ICNIRP guidelines are met.

Land Ownership

3.4.20 In general, land ownership would not affect alternative options and the selection of siting areas. At this stage, land ownership issues would not prevent National Grid pursuing an otherwise preferred scheme.

Effect on Residential Amenity

3.4.21 A large number of individual respondents to the previous consultations were concerned about the proximity of a connection to residential properties.

3.4.22 The options within Section 5 at the previous stage of consultation were defined, in part, by reference to Supplementary Note A to the Holford Rules which states that routes should ‘avoid routeing close to residential areas on the grounds of general amenity’. The route corridors therefore, sought to avoid the main population centres wherever possible. Options considered at this stage has similarly sought to avoid / reduce effects on settlements and residential properties.

3.4.23 It is accepted that effects on residential amenity can take various forms, including visual effects, noise, construction disturbance etc. All these types of effect were mentioned by respondents to the consultations and their responses are considered within the Consultation Feedback Reports[14]. The degree to which effects are experienced by individual properties will be heavily influenced by the detailed design of the connection, including technology and pylon locations. The EIA work to be undertaken as the project design develops, will further address such issues.

House Prices and Land Values

3.4.24 Effects on house prices and land values, both in general terms and in respect of specific properties, have not been used as a factor in routeing or site selection. This is because any potential effects will vary from one case to another depending on a number of factors, including how the connection is made, the local property market, the nature of the property, its orientation and setting relative to the connection and the distance between the property and connection infrastructure. Land ownership and liability for compensation payments, in line with statutory provisions, will be addressed through discussions with individual landowners once detailed designs are available.

[14] National Grid; Stage 1 Consultation Feedback Report (June 2014) and Stage 2 Consultation Feedback Report (May 2016)

4. OVERVIEW

4.1 Introduction

4.1.1 This section provides an overview of the search area for the Menai Crossing (see Figure 1.2).

4.2 Landscape

4.2.1 The Anglesey Area of Outstanding Natural Beauty (AONB) forms a coastal fringe around the island, extending between 0.4km and 1.7km inland along the Menai Strait coastline.

4.2.2 The Grade I Registered Park and Garden, Plas Newydd, lies within the AONB. The Park and Garden includes areas of formal lawn and gardens, arboretum and natural woodland.

4.2.3 Areas of ancient woodland are dispersed throughout the AONB, adding to the mature and scenic landscape quality which extends down to the tidal waters of the Menai Strait.

4.2.4 The proposed JLDP Southern Anglesey Estate lands Special Landscape Area (SLA) forms an approximately 1km-wide band between Llanfairpwllgwyngyll and Brynsiencyn, outside the AONB.

4.2.5 The extensive Vaynol Estate, a Grade I Registered Park and Garden bounded by a distinctive wall, is the main landscape component on the south side of the Menai Strait. This comprises walled parkland, gardens and agricultural land uses.

4.2.6 From the southern side of the Menai, close to the Menai Strait, there are long distance views towards the AONB. This area on the mainland falls within the proposed JLDP Menai SLA.

4.2.7 The existing 400 kV overhead line traversing the Menai Strait, constructed in the 19060s, forms a prominent feature and a highly visible landscape component in this area.

4.2.8 Forming a panoramic backdrop to long distance views from Anglesey, is the Snowdonia National Park.

4.3 Historic Environment

4.3.1 The Plas Newydd Grade I Registered Park and the Grade I Listed Plas Newydd House and other associated Grade II listed buildings lie close to the Anglesey shoreline of the Menai Strait. In the late 18th century to complement changes made to the house, the driveway was realigned so that visitors would experience a dramatic view of the house against the backdrop of the Menai Strait, the Vaynol and the mountains of Snowdonia. Views out from Plas Newydd and certain views towards it, particularly from the Vaynol, contribute to its setting and are considered particularly sensitive to change.

4.3.2 South-east of Llanfairpwllgwyngyll is the Grade II* Listed Anglesey Column and in the centre and on the north shores of the Menai Strait, east of the Britannia Bridge, lie several scheduled monuments related to fish weirs.

4.3.3 Vaynol Park has its origins in the 16th century, with extensive landscaping undertaken in the 18th and 19th centuries. Its landward side is largely screened by dense woodland planting and 11km of stone boundary walls topped with slate. The northern and north-eastern aspects overlooking the Menai Strait and Plas Newydd form an important element in the Park's wider landscape setting. To the south of the Vaynol Estate on the Menai Strait shoreline, is the historic Port Dinorwig.

4.3.4 Most of the search area in Gwynedd (as well as Pentir Substation itself) lies within the Dinorwig Registered Landscape of Outstanding Historic Interest.

4.3.5 Vaynol Hall, Vaynol Old Hall, St Mary's Chapel and the Menai Suspension Bridge are all Grade I listed structures.

4.4 Ecology

4.4.1 The Menai Strait forms part of the Y Fenai a Bae Conwy / Menai Strait and Conwy Bay Special Area of Conservation (SAC) comprising some 26,400 hectares of European designated habitats. The SAC features include: large shallow inlets and bays; mudflats and sandflats not covered by seawater at low tide; reefs; sandbanks that are slightly covered by seawater all the time; and submerged or partially submerged sea caves. Reef habitat encompasses the majority of subtidal habitat between Y Felinheli and Menai Bridge. Further west this habitat is limited to the shallow subtidal areas. Intertidal mudflats and sandflats and subtidal sandbanks are present in the south.

4.4.2 Several Sites of Special Scientific Interest (SSSIs) are also found along the Menai Strait, including: Glannau Porthaethwy which extends along 4km of the shore and supports a significant diversity of marine plants and animals. Glannau Porthaethwy SSSI is the only part of the intertidal zone to be incorporated in the SAC. Features here include: five marine communities of restricted national distribution; five diverse rockpool and overhang communities; and comprehensive examples of community zonation characteristic of sheltered rocky shore.

4.4.3 Coedydd Afon Menai SSSI comprises a woodland on the Gwynedd shoreline of the Menai Strait, west of Britannia Bridge, designated for its narrow strips of broadleaved woodland.

4.5 Marine Ecology

4.5.1 The subtidal areas of the Menai Strait are characterised by a mixture of hard and soft substrata, with five discrete biotopes identified. Current swept rocky reef habitats are evident in the north eastern area between the bridges, with the middle and southern areas being dominated by mixed coarse sediment habitats, with outcrops of boulder/cobble substrate. The rocky reef areas support species rich communities, including hydroids, anemones and sponges. The mixed coarse sediment communities are characterised by sabellid worms and brittlestars.

4.5.2 The intertidal areas of the Strait are characterised by rocky habitats, with sedimentary habitats present predominantly in the south west area towards Y Felinheli. The rocky habitats are characterised by macroalgal dominated communities, and the sedimentary habitats comprised primarily of muddy sands dominated by polychaete worm communities.

4.6 Local Economy

4.6.1 The main settlement on the Anglesey side close to the Menai Strait crossing area is Llanfairpwllgwyngyll. This was excluded from the search due to the technical challenges of identifying a route for multiple transmission cables through heavily built-up areas and the disruption that any such routeing would inevitably cause to the community. In Gwynedd, the Menai Strait crossing would lie between Bangor and Y-Felinheli.

4.6.2 There is tourist accommodation located within search area, most notably Gwesty Carreg Bran Hotel at Llanfairpwllgwyngyll and the Premier Inn at Parc Menai. The Nuffield Trust Centre, at HMS Indefatigable, lies on the shores of the Menai Strait.

4.6.3 Plas Newydd House and Gardens is a major National Trust visitor attraction. Consultation feedback has indicated that the A4080 is a tourist route from the A55, past Plas Newydd and on to some of the tourist areas on the south and west coasts of Anglesey.

4.7 Transport

4.7.1 The main transport infrastructure serving the Menai Strait comprises the A55 trunk road to Holyhead and the North Wales Mainline railway line (to Holyhead). Both the A55 trunk road and the railway line are carried over the Menai Strait on the Britannia Bridge, while further east is the Menai Suspension Bridge, which carries road traffic on the A5 between Bangor and Menai Bridge.

4.7.2 The A4080 crosses the search area, running adjacent to the northern edge of the Anglesey AONB. In Gwynedd the A487 crosses the search area along the southern edge of the Vaynol Estate, linking Bangor to Caernarfon.

4.8 Hydrology and Flood Risk

4.8.1 The sloping topography on both the north and south side of the Menai Strait supports effective drainage of the local watercourses, which discharge northwards and southwards into the Strait. On Anglesey, the principal hydrological catchments are the Ceint River catchment (moderate WFD status), the upper Braint catchment (good WFD status), and the lower/southern Braint catchment (moderate WFD status). On Gwynedd, the principal hydrological catchments are the Nant y Garth (good WFD status) and the Cegin (moderate WFD status). The WFD catchments include smaller water courses and drains that are tributaries of these principal rivers. The terrestrial area adjacent to the Menai Strait is a non-reportable WFD water body and, as such, does not have any WFD status classification. The Menai Strait itself is a coastal WFD water body that currently attains good WFD status.

4.8.2 On Anglesey, there are a number of areas of Development Advice Zone C2 floodplain along the Afon Braint. National Resources Wales (NRW) tidal and fluvial mapping indicates that the majority of these areas fall within Flood Zone 3[15]. Furthermore, adjacent to both sides of the Menai Strait, there is also a continuous area of mapped Flood Zone 3 that is associated with tidal flooding. The floodplain of the Nant y Garth valley, in Gwynedd, is fairly minor due to the steep-sided valley profile with limited low lying flat areas. The river is also substantially culverted along the A4087 due to numerous crossings and intersecting roads. There is only a small portion of this watercourse which has a mapped Development Advice Zone C2 floodplain, however, the remaining extent of the watercourse will likely have some floodplain associated with it even though it is not presented in the NRW modelled flood extents.

4.9 Geology

4.9.1 Within much of the search area, either side of the Menai Strait, the solid geology comprises carboniferous limestone, with notable sandstone strata interspersed on the mainland side within the northern part of the Vaynol Estate. This limestone gives way to sedimentary mudstones and sandstones (the 'Menai Straits formation') on the mainland, either side of Britannia Bridge. Older metamorphic rocks are found in the Anglesey Shear Zone on Anglesey around Britannia Bridge and underlying Llanfairpwllgwyngyll. On Anglesey there are igneous intrusions recorded that form a dyke south of Plas Newydd, and smaller intrusions around Britannia Bridge.

4.9.2 The area is known to be heavily faulted, and may have seismic activity. The varied and transformed nature of the solid geology represents a technical challenge. Table 4.1 details strata recorded within the area of the Menai Strait which could be encountered. Table 4.2 details how geological features may affect the method / technique for crossing the Strait.

[15] Land at greater than 1% AEP risk of flooding

4.10 Topography and Bathymetry

4.10.1 South and west of Britannia Bridge the topography on Anglesey within the search area rises to a maximum local elevation of around 35 – 40m AOD. Whilst generally sloping gently eastwards, along the Plas Newydd shoreline there is a notable section of steeper ground which in places forms low cliffs to the foreshore. Further south, the ground profile then slackens to form a larger area of lower-lying ground north of Moel–y-don. There is also an area of shallower slopes to the south of Llanfairpwllgwyngyll, with larger areas of flatter ground adjacent to the Menai Strait beside HMS Indefatigable.

4.10.2 East of Britannia Bridge on Anglesey the ground profile is steeper and more even, with an average slope of around 1:7, rising to a maximum elevation of more than 60m AOD.

4.10.3 On the Gwynedd side of the Menai Strait the profiles are generally shallower, with maximum elevations of around 50m set further back from the Menai Strait. The shoreline steepens significantly to the east of Britannia Bridge, where again low cliffs can be found. The levelled profiles of Bangor University's sports ground, south-east of Britannia Bridge, are a notable topographical feature.

4.10.4 Bathymetric survey data provided by the University of Bangor indicates that the depth of the Strait varies throughout the search area. The deepest area of the Menai Strait within the area, known as the Swellies, is located immediately south-west of Britannia Bridge and is approximately 28m in depth within the centre of the channel. This is in marked contrast to the area around Ynys Gored Goch to the east of the Bridge where the maximum seabed depth is around 12m. The remainder of the Menai Strait within the search area varies in depth between around 13m and 20m, with the deeper area located between Plas Newydd and Port Dinorwig.

4.10.5 The southern part of the Menai Strait in the search area is marked by steeper subtidal edge profiles, particularly on the Anglesey side, whilst slopes on the bed of the main channel do not exceed 10 degrees. In contrast, the rocky nature of the seabed either side of Britannia Bridge has resulted in a far more uneven seabed profile. South of the Swellies the profile of the Menai Strait close to the Gwynedd shoreline is also steep.

4.11 Seabed Morphology

4.11.1 Towards the north-eastern end of the search area the seabed is a mosaic of coarse sediments and rocky outcrops with appreciable variation in depth profile across the waterway, particularly in the Swellies. Towards the south-western half of the search area, bed characteristics are more sedimentary with a more even bed profile

4.11.2 The inherently high tidal currents are of note as within the sedimentary areas of the Menai Strait the bed profile can vary appreciably over short periods of time.

Table 4.1 Solid and Superficial Geology

Solid Geology				
Rock Unit (previous name brackets)		BGS Lexicon Code	Period / Era	Lithological Description
Unnamed Dyke, Palaeogene		UDG	Cenozoic	Microgabbro
Clwyd Limestone Group	Clwyd Limestone Group	CLWYD	Carboniferous	Limestone with subordinate Mudstone, Sandstone, Breccia, Conglomerate, especially towards the base.
	Red Wharf Limestone Formation (Dinorwic)	REL	Carboniferous	Limestone, Breccias, Chert, Conglomeratic Sandstone
	Loggerheads Limestone Formation (Treborth)	LGHL	Carboniferous	Limestone with subordinate Sandstone
Menai Strait Formation (Fanogle or Bridges)		MEST	Carboniferous	Mudstone, Sandstone, Breccia, Conglomerate
Allt Lwyd Formation		ALL	Ordovician	Siltstone and Sandstone
Nant Ffrancon Subgroup		NFR	Ordovician	Siltstone and Mudstone
Gwna Group		NGW	Pre-Cambrian	Schist with subordinate Meta-basaltic rock
Central Anglesey Shear Zone and Berw Shear Zone (Undifferentiated)		CABSZ	Pre-Cambrian	Schist Glaucophane, Schist Hornblende, Schist Mica

Superficial Geology		
Soil Unit	BGS Lexicon Code	Lithological Description
Made Ground	MG	Highly variable within a matrix of sand, silt, clay with cobbles and boulders.
Alluvium	ALV	Normally soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel. A stronger, desiccated surface zone may be present.
Peat	PEAT	Two main lithologies: 'brushwood' (freshwater) peat and 'phragmites' (brackish water) peat; may be an organic-rich clay; humic deposits.
Head	HEAD	Comprises gravel, sand and clay depending on upslope source and distance from source. Poorly sorted and poorly stratified deposits formed mostly by solifluction and/or hillwash and soil creep
Lacustrine Deposits	LDE	Silt and clay (can include organic and/or calcareous muds); of lacustrine origin.
Marine Beach Deposits	MBD	Shingle, sand, silt and clay; may be bedded or chaotic; beach deposits may be in the form of dunes, sheets or banks; in association with the marine environment.
Marine Estuarine and raised beach deposit	MERB	Sand, gravel and clay
Coastal Zone Deposits	CZD	Shingle, gravel, sand, silt and clay, locally with peat layers; may be bedded or chaotic; from the coastal zone.
Alluvial Fan Deposits	ALF	Alluvium with a low-angle cone form developed at the mouths of tributary valleys; very localised source.
Glacial Till, Devensian	TILLD	Clay, sand, gravel, boulders
Glaciofluvial Deposits,	GFDUD	Sand, gravel, boulders

Superficial Geology		
Soil Unit	BGS Lexicon Code	Lithological Description
Devensian		

Table 4.2 Potential Effects of Geological Features

Parameter		Hazard
Rock	Intact Rock Strength	Higher rock strengths require increased effort to excavate through the rock. However, the corresponding excavation could be more stable.
	Mineralogy and Abrasivity	Increased quartz content and other hard minerals increase abrasivity. Abrasive material may cause accelerated wear to cutter heads and other excavation machinery.
	Discontinuity Frequency Orientation and Nature	Effect the rate of drilling advance and cutter wear
Rock Characteristics	Geological Faults	Encountering a geological fault may affect the stability and progress of any excavations. Faults range considerably in size. At width of < 1 m faults normally have minimal disturbance on the surrounding rock. At large widths however (> 30 m) faults may cause major alteration and degradation of the surrounding rock. The size of a fault is determined by the properties of the surrounding rock, geological pressures and degree of movement.
	Geological Weakness Zones	Smaller weakness zones (<1m) are often associated with large faults and can be frequent and persistent. These can alter the hydrogeological model by either having increased permeability (gravel infill) or decreased permeability (clay infill). Their frequency and nature could have an effect

Parameter		Hazard
		on any excavation works (water inflow, collapse, etc.).
Rock Characteristics	Geological Fault Infill	Swelling or squeezing clay is often associated with geological faults. Excavation within this material causes clay to swell and exert considerable forces on the excavation equipment and potentially collapse of the excavations. Low strength materials including Chlorite, Talc, Graphite and Serpentine which may be present and may lead to block failure or ravelling. Porous or flaky Calcite or Gypsum may dissolve if groundwater is allowed to flow through the area due to excavation. This may lead to weaker and more permeable rock mass. Quartz or Epidote minerals can form within faults which are hard minerals and affect the rate of advance and accelerate wear on cutter heads. Crushed rock or sand filling would be unstable if open excavations are performed.
	Dissolution Features within Carboniferous Limestone Series	Dissolution features lead to a highly variable rock mass, with respect to permeability, material and strength. Limestone can be very strong whereas the dissolution features can remain as voids or be filled with clay and sand.
	Deep Scour Channels within the Menai Strait	Scour channels may exist within the Menai Strait or on land formed by various episodes of glacial processes. These may create deeper rock surfaces than currently recorded or anticipated.
	Mixed Face Drilling	Sub-horizontal beds of weak and storing rock have been recorded in the Carboniferous Limestone Series. Therefore large lengths of horizontal tunnels could be excavated in mixed face conditions which may result in reduced performance, increased wear and reduced penetration rate.

Parameter		Hazard
	Igneous Intrusions (dykes, sills, etc.)	Can be made up of high strength and highly abrasive material which could cause mixed face conditions. Can cause increased cutter wear and decreased penetration rate.
Rock Characteristics	In-situ Stress	The orientation and magnitude of locked in stresses from geological processes can be significant. They can be beneficial for excavation but can also cause decreased stability and additional pressure on excavation support, which requires increased support measures.
Superficial Material	Classification and Strength	Low strength may indicate more significant temporary works are required during excavations.
	Compressibility	Highly compressible materials may cause increased settlement if changes to groundwater or loading are experienced.
	Compaction	Determines whether the material is suitable for re-use on the project.
	Glacial Till	This material is highly variable and can contain large boulders from various litholigies which can cause mixed face conditions and obstructions to excavations.
	Made Ground	Contamination of aquifer. Variable composition leading to differential settlement.
Ground	Ground Gas	Natural ground gas (Carbon Monoxide, Methane, Radon, etc) can cause problems during tunnelling or accumulate within underground excavations.
General	Seismicity	Seismic events can cause detrimental effects on buried and surface structures. The values set in the guidance documents need to be considered during design to ensure that seismic events are allowed for.

Parameter		Hazard
General	Hydrogeology	Large heads of groundwater can cause increased water pressure and flow into excavations. The Carboniferous Limestone Series is a Principal Aquifer. Flow of groundwater through this aquifer is evident from the numerous springs that emerge from the banks of the Menai Strait.
	Permeability	Highly permeable material may cause increased groundwater flow into the excavation requiring additional effort to prevent this groundwater flow.

5. CONSTRUCTION CONSIDERATIONS – NEW NATIONAL GRID INFRASTRUCTURE

5.1 Introduction

5.1.1 This chapter sets out a description of the new National Grid infrastructure that maybe required for the connection and the techniques involved in constructing that infrastructure above and below ground.

5.1.2 In addition to new infrastructure the installation of cables within other existing or proposed infrastructure, owned by others, has also been considered. Responses to previous consultations have suggested that National Grid should consider;

- Installation on the Britannia Bridge;
- Installation in an existing disused pipeline across the Lavan Sands; and
- Installing the cables in a new road crossing (the 'Third Menai Crossing').

5.1.3 These options are considered in the following chapter (Chapter 5) of this Report.

5.2 Overhead Line

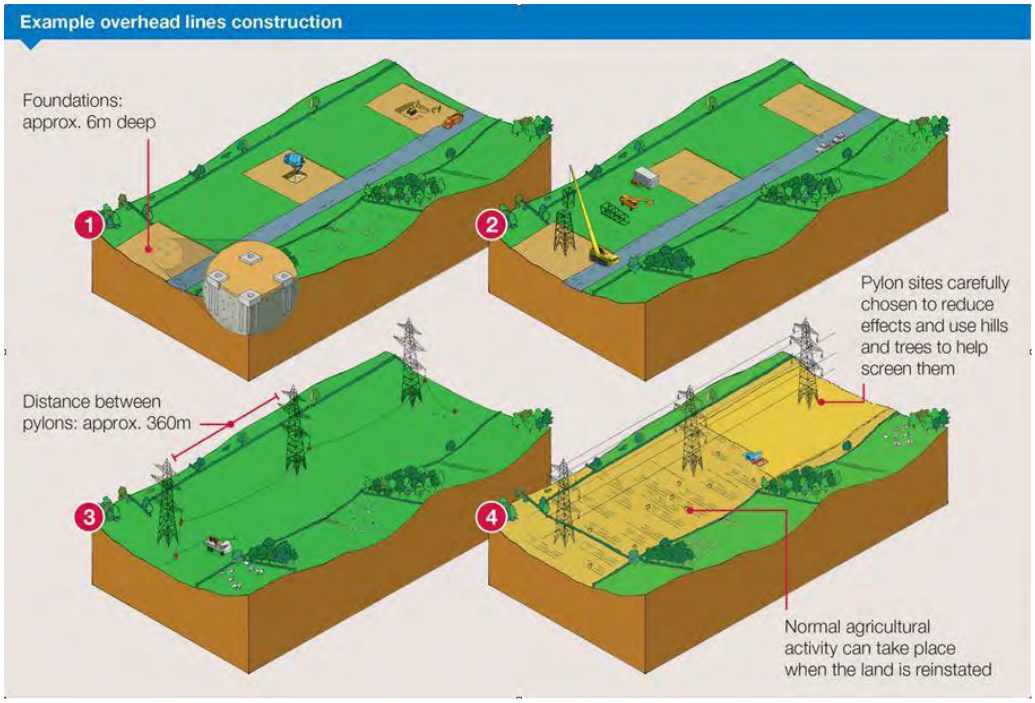
5.2.1 The key components of an overhead line are as follows:

- *Pylons*: Steel lattice structures, which typically will be around 50m (164 feet) in height, and spaced approximately 360m apart;
- *Earth Wire*: The highest most line connecting the towers and connected to the ground at every tower in order to protect the overhead line and towers during lightning strikes.
- *Conductor*: Wire strung between pylons, used for transmitting electricity.
- *Crossarm*: Arms of the tower that carry the wires and keep them separated.
- *Insulator*: Holds the conductors to the tower arms and provides electrical clearance from the ground and tower structure.
- *Spacers*: Keep a bundle of conductors separated from each other.
- *Damper*: Prevents the wind causing wear and tear damage to the conductors and static wires.
- *Anti-Climbing Device*: Prevent unauthorised climbing access to the pylon.

5.2.2 Pylons (also known as towers) can be either 'Suspension', which are primarily used to support the conductors along a straight line, or 'Tension' which are used to change the direction of the transmission line

5.2.3 A schematic of typical overhead line construction is provided in Figure 5.1 below.

Figure 5.1: Schematic of Overhead Line Construction



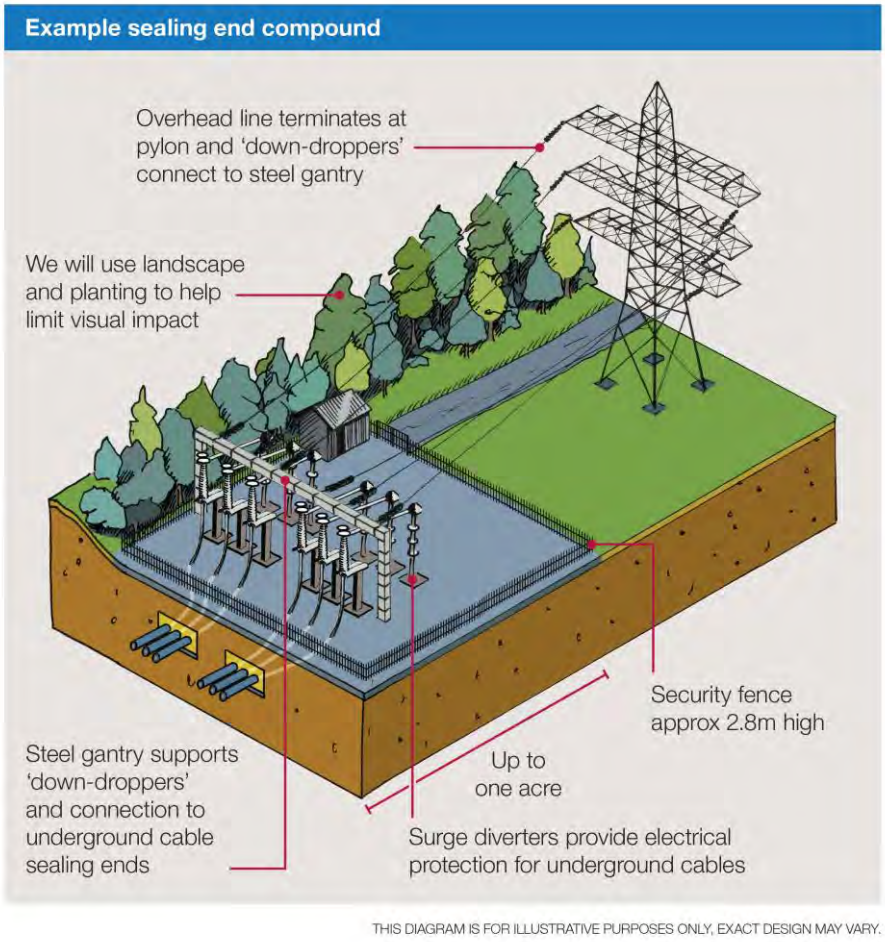
5.3 Cable Sealing End Compounds

5.3.1 A Cable Sealing End Compound (CSEC) is required when an overhead line changes to an underground cable or vice versa.

5.3.2 CSECs are secure sites surrounded by a palisade fence where the overhead conductors are connected to the ends of buried cables which are brought vertically upwards out of the ground. The cable ends are supported within insulated columns. The site may also accommodate equipment for the protection of the cables that would prevent electrical power surges or allow the cables to be isolated from the transmission system. Small kiosks containing monitoring equipment for the cables may also be located within the compound. A permanent access track is required to the compound, but maintenance traffic is generally infrequent and light. A schematic of typical CSEC is provided in Figure 5.2 below.

5.3.3 To inform the studies a typical CSEC area of 100m x 60m was assumed. This would be capable of accommodating two 400kV circuits, each comprising six cables (i.e. the maximum 12 cables that could be required) and a full tension gantry. Potential CSEC siting areas have been identified which could accommodate this area.

Figure 5.2: Schematic of Typical Sealing End Compound



5.4 Underground Cables

5.4.1 There are several methods for installing underground cables. The preferred technique, due to significantly lower installation costs, is laying underground cables in open cut trenches (or directly on the seabed for marine crossings). Where environmental considerations or physical obstructions preclude this approach, such as major roads and railways, alternative trenchless techniques, such as Horizontal Directional Drill (HDD), are also considered.

5.4.2 In designing a 400kV cable system, if the electrical performance of the cables is not to be compromised, it is important that the physical environment of the cables enables:

- heat dissipation: to prevent overheating and subsequent reduction in cable rating (capacity for carrying current);
- physical protection: so that the cable does not become damaged or become a potential danger to third parties; and
- proper access in order to ensure efficient inspection repairs or replacement.

5.4.3 The ability of the rock or soil that surrounds underground cables to dissipate the heat emitted by the cables could determine the number of cables required. This is because heat build-up reduces the current that the cables are able to carry, potentially requiring the installation of further cables to make up for any capacity shortfall. To meet the double circuit rating of 3000MVA required for this connection, based on our work to date and the preliminary rating studies, a cable system with a maximum of twelve cables is required, with six cables per circuit (two cables per phase).

5.4.4 For open cut direct buried cable installation, for 12 cables, typically four trenches are required, each accommodating three cables. Each 1.5m wide by 1.2m deep trench accommodates 3 cables with approximately 4m clear distance horizontally between two sets of cables (one circuit). The two cable circuits are installed at a separation of 10metres. Typically a central construction haul route is established, and peripheral drainage installed along the construction corridor. The soils excavated from the access track and working areas are also stored within the corridor. These requirements result in a typical construction swathe of 60m, although this can be reduced in localised areas to avoid sensitive sites or features. A schematic of underground cable construction by open cut trenching is provided in Figure 5.3 below.

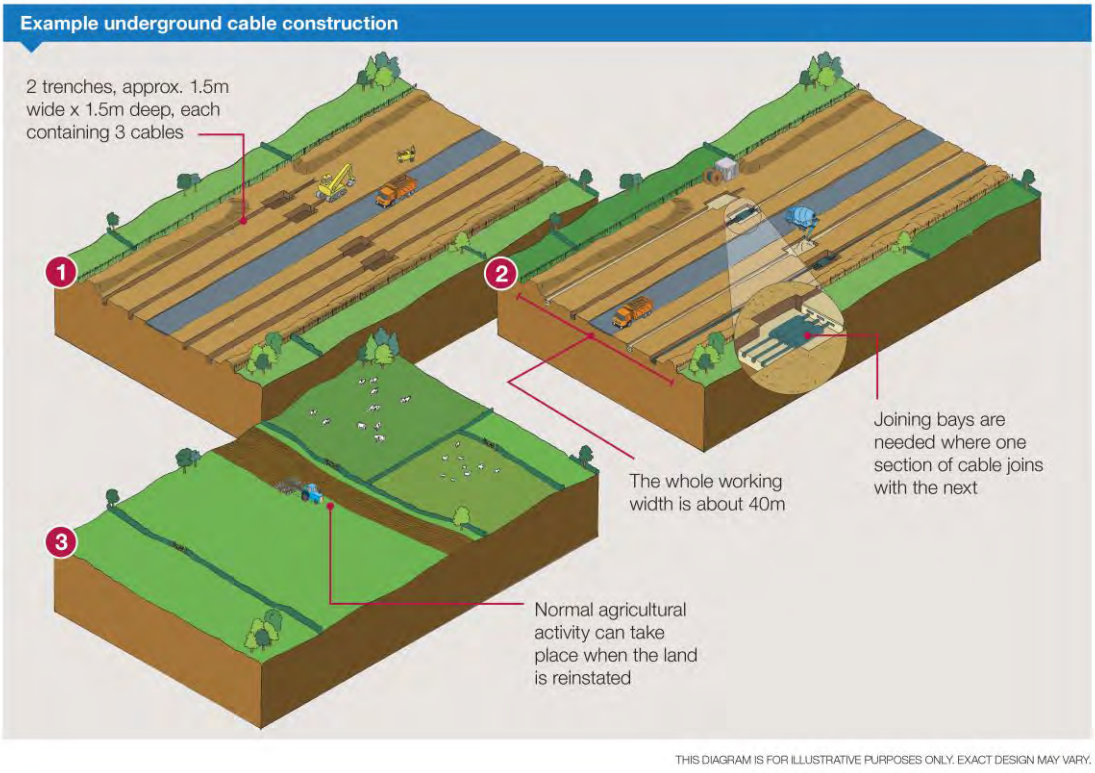


Figure 5.3 Schematic of Underground Cable Construction

5.4.5 During the operational lifetime, regular testing is required to assess the integrity of the cable outer sheath. To allow for this, permanent access is required to the link pillars installed at joint bays. To minimise disruption to land owners and users, joint bays and the associated link pillars are sited where possible on field boundaries or adjacent to existing access ways.

5.4.6 The cable circuit is installed at a depth to allow the continuation of agricultural works over the cable circuit. At field boundaries it is possible to reinstate hedgerows and dividing walls or fences. However, tree planting is limited to a minimum of 2.5 m from the boundary of the cable route to prevent tree roots interfering with the installation or reducing the rating.

5.4.7 Future building and drainage developments over the cable route are restricted to ensure that the cables are not damaged. Changes to the topography over the cable circuit, in particular excavation or raising of ground for temporary or permanent purposes, are not be permitted.

5.5 Crossing Techniques for the Menai Crossing

Surveys to Date

5.5.1 Bathymetric and seismic refraction surveys of the Menai Strait, undertaken by Bangor University, have provided data which has been used to inform the work to date. National Grid have, in addition, conducted hydrographic and geophysical surveys of the Menai Strait. This data is currently being processed and will be incorporated into a ground model for the purposes of further understanding and evaluating the geological hazards, and undertaking risk assessments.

5.5.2 Onshore ground investigation studies have been undertaken in order to inform the crossing technique and provide additional information which will be used to inform the detailed design for the selected location / method. These works, referred to as Phase 1, comprised 6 rotary boreholes (3 either side of the Menai Strait) of up to 77m depth. Piezometers were installed and remain in place to monitor water levels. Phase 2 investigations at additional locations are expected to take place next year.

5.5.3 Ecological surveys of the inter-tidal and sub-tidal areas of the Menai Strait, comprising walk-over surveys, grab sampling of seabed sediments and drop-down camera surveys have also been undertaken. The results of these surveys have supplemented the existing intertidal habitats/communities data provided by Natural Resources Wales (NRW).

Crossing Techniques

5.5.4 A number of techniques have been considered for crossing the Menai Strait by the use of new National Grid infrastructure. These are:

- Tunnelling;
    - Large Bore Tunnel (sufficient to house two cable circuits plus additional supporting infrastructure);
    - Small Bore Tunnel (sufficient to house a single circuit therefore requiring two separate tunnels);
- Horizontal Directional Drill; and
- Seabed installation (laid either on or in the seabed).

5.5.5 These options are described in more detail below.

Tunnelling

Large Bore Tunnel

5.5.6 Based on our work to date it is currently anticipated that a tunnel of up to 5m internal diameter would be required.

5.5.7 With the expected ground conditions there are two primary methods for the construction of large bore tunnels:

- using a tunnel boring machine (TBM) and lining with precast segments;
- excavation by drill and blast or road header machine, with sprayed concrete lining (SCL).

5.5.8 The depth of the tunnel would be determined by the need for adequate cover of bed rock.

5.5.9 For both techniques tunnelling operations require the movement of large quantities of spoil.

Tunnel Boring Machine (TBM)

5.5.10 A TBM is normally launched from the base of a deep excavation or shaft and driven to a reception shaft. The distance between launch and reception shafts is constrained by a number of factors including the ability to evacuate personnel in event of an incident.

5.5.11 The type of TBM would be defined by the actual ground conditions.

5.5.12 Tunnelling operations require level working areas at the surface, particularly around the shaft working area, and good access links for movement of heavy machinery, equipment and large quantities of spoil material during construction. Spoil and material brought out from the shaft and tunnel excavations has to be managed and construction compounds require drainage and attenuation systems. Transporting the various components of a large TBM to site may require upgrading of local access roads or consideration of alternative transport methods. Construction haul roads have to be designed accordingly. Tunnelling operations require power to supply cranes, plant and the TBM and its trailing systems.

5.5.13 TBMs typically use precast concrete segments to support the ground and create a reliable and high quality lining. Modern excavation methods and precast quality control would allow a tunnel structure to retain a 120 year design life.

5.5.14 In order to operate and maintain the cable circuits, ventilation and service infrastructure would be required. This would consist of a head-house on each side of the crossing to contain active and passive ventilation system, personnel access and operational equipment (see below). The head house also provides security against unauthorised entry into the shaft and tunnel.

5.5.15 TBMs are designed specifically for the ground conditions and water pressures they have to work within. TBMs and their component parts are typically manufactured for a specific scheme then shipped and transported to site. Manufacture takes approximately one year. It is expected that the civil works for a tunnel, including shaft construction would be of the order of 2 to 3 years. Progress rates for a TBM accelerate following the initial installation period, depending on ground conditions rates may range between 80m and 150m per week.

5.5.16 A tunnel allows access for installation, inspection and maintenance throughout the operational life cycle of the cable circuit enabling the replacement of cables and thereby in this instance extending the overall design life of the connection.

Sprayed Concrete Lining (SCL)

5.5.17 Sprayed concrete lining (SCL) is a flexible and widely used method for creating large diameter tunnels. The method has significant benefits in terms of flexibility and efficiency.

5.5.18 The method uses either mechanical excavation (soft ground conditions) or drill and blast excavation (hard rock) or a combination of the two. The ground is supported with an accelerated concrete lining which is applied using high pressure sprayed air and water. Sprayed concrete is typically reinforced with either steel fibre or steel bar reinforcement to provide sufficient tensile strength and crack resistance.

5.5.19 As the tunnel is excavated, the surrounding ground is supported. Typically, the entire tunnel is excavated with a primary SCL to initially support the ground in a temporary state followed by the application of a waterproofing membrane (sprayed or sheet) to ensure water-tightness. Finally a permanent cast or sprayed secondary lining system creates the permanent structural lining and provides a structure sufficient to hang, in this instance, cable brackets and other fixings.

5.5.20 The high volume and complexity of sprayed concrete mix needed for lining of the tunnel would require a local batching plant to ensure a constant advance rate.

5.5.21 Drive and reception shafts would be required similar to those required for a TBM tunnel.

5.5.22 The exposed nature of the tunnelling face means that this method is most suited to stable and dry ground conditions. However, in more complex ground conditions the method is possible with the implementation of ground stabilisation techniques. The varied and challenging ground conditions in the Menai Strait are likely to require ground treatment in advance of tunnelling in places to permit the advance of a SCL tunnel. Faulting of the rock is likely to mean grouting is required to seal fissures and joints to prevent water ingress.

5.5.23 Progress rates for a SCL driven tunnel is likely to be slower than for a TBM tunnel although the initial setup phase is generally shorter. Progress depends highly on ground conditions and the amount of ground treatment required. It is expected the duration of the construction period to be similar to that of a TBM tunnel at 2 to 3 years.

5.5.24 In order to operate and maintain the cable circuits, as with the TBM option, ventilation and service infrastructure would be required, and would be likely to consist of a head-house on each side of the crossing to contain active and passive ventilation system, personnel access and basic operation equipment.

5.5.25 The SCL tunnel can be designed to achieve a design life in excess of 100 years, therefore providing the opportunity to prolong the design life of the connection through maintenance and replacement. The tunnel allows access for installation, inspection and maintenance throughout the operational life cycle of the cable circuit enabling the replacement of cables thereby extending the overall design life of the connection.

Small Bore Tunnel

5.5.26 For the installation of a single cable circuit and associated services a 2.5m internal diameter tunnel has been considered. Two small bore tunnels would be needed to house the 12 cables required.

5.5.27 Based on the expected ground conditions it is likely that pipe jacking would to be used to construct the two small bore tunnels. Pipe jacking is a versatile trenchless technique that can bore through gravel, sand, clay, compact clay, soft rock or hard rock and cope with a wide range of ground water pressures.

5.5.28 Pipe jacking uses a remotely operated tunnel boring machine and hydraulic jacks to install prefabricated pipes under the ground from a drive shaft to a reception shaft. The pipe is thrusted by jacks located in the drive shaft and the jacking force is transmitted through the pipeline to the face of the tunnel boring machine. Excavated soil is typically transported along the pipe jack in a pressurised slurry pipeline. After each pipe has been installed, the rams of the jacks are retracted so that another pipe length can be placed in position.

5.5.29 The Menai Strait crossing would be likely to be constructed using a slurry supported tunnel boring machine with a rock cutting head. During the jacking process, a polymer based drilling fluid (slurry) is injected into the face. The fluid serves two purposes; filling the void space, exerting pressure to stabilize the face and as a lubricant reducing friction along the line of the pipe jack.

5.5.30 As with construction using a TBM, after completion of the tunnel, cement grout is injected into the annulus surrounding the pipe, which mitigates the risk of further ground movement and water ingress.

5.5.31 In a typical jacking arrangement, a drive shaft and reception shaft would be required for each tunnel drive, resulting in the construction of 4 deep shafts for the two tunnels. Alternatively it may be possible to construct larger drive and reception shafts to launch and receive both tunnels.

5.5.32 As with a TBM tunnelling operations pipe jacking requires level working areas at the surface with good access links for movement of heavy machinery during construction. The site must provide space for the shaft and the required site equipment which would include controls, containers, generator and crane, spoil removal, pipe storage and a slurry separation plant.

5.5.33 A pipe jacked tunnel allows access for cable installation, inspection, maintenance and replacement throughout its serviceable life cycle but may require de-energisation of the circuit due to the available working space.

5.5.34 Operation of the small bore tunnels would require a maintenance and inspection regime and ventilation for cooling the cables. A head house with a ventilation plant room would be required above the drive shaft and a ventilation exhaust facility would be required above the reception shaft.

5.5.35 The duration of the construction programme would be similar to that for the large bore tunnel options, i.e. 2 to 3 years.

Vertical Shafts

5.5.36 For all tunnelling options access for construction or maintenance is provided by vertical shafts from the surface to the level of the tunnel. It is estimated a minimum internal diameter of 12.5m would be required to allow for installation of the cable circuits. If a TBM were to be used a wider shaft is required to provide sufficient space for assembly of the TBM.

5.5.37 From a construction perspective the reception shaft can be smaller than the launch shaft, however, the minimum diameter would ultimately be constrained by the requirements for installing the cables and associated services.

5.5.38 The depth of each shaft is largely dependent on the crossing location and on the required cover depth. .

5.5.39 Launch and reception shafts would accommodate the following:

- Permanent stair case
- Cable brackets
- Platform lift
- Ventilation ducts
- Sump pit and pump

5.5.40 Shafts would be sunk by drill and blast excavation or road header depending on the rock quality (harness and degree of fissuring). The lining of the shaft may be precast (likely in the upper section) and SCL at depth, particularly around the tunnel junction. Figure 5.4 below illustrates tunnel shaft construction for the London Tunnels.

5.5.41 Ground treatment (grouting of the area surrounding the shaft in advance of excavation) would be required to prevent water ingress during excavation.

Figure 5.4: Tunnel shaft in construction (National Grid: London Tunnels)

Cable Installation and Maintenance

5.5.42 Installation of 400 kV cables down deep shafts presents some complex problems. At all times during the lowering or raising of the cable within the shaft, the cable must be held along its' length and must never be self-supporting. Due to its' own weight (up to 5 tonnes) damage could occur which may not be visible but would be detected during commissioning tests. The installed cable are cleated to a frame running the full depth of the shaft and snake down rather than running straight down. No joints can be made in the cable section which runs down the shaft. Deeper shafts create greater issues in supporting the cable and require larger supporting frames.

5.5.43 Cables would be installed in the tunnel on supporting racks, fastened by cable cleats. Typically cables are installed in a semi-flexible snaking formations which enables thermal cable expansion and contraction to be absorbed by the lateral displacements of the cable along the tunnel (see Figure 5.5).

5.5.44 At the shafts where the cables are brought up to the surface the cables can be cleated to the shaft walls or to metallic support structures. These structures must be capable of controlling and dissipating the force generated by the cables during operation and fault events.

5.5.45 Cables are typically installed from the surface mechanically drawn off the cable reels, down the drive or reception shaft. A number of techniques are available including powered rollers or cable caterpillars, magnetic belts, or locomotive or trolley system

5.5.46 During normal operation maintenance would involve regular inspection of the cable circuit and supporting structures for fatigue or damage. Sheath testing is also undertaken to assess the integrity of the cable sheath. Within a tunnel the cable installation can be visually inspected without civil works (and associated disruption) to expose the cable. In the case of small tunnels the cables may have to be de-energised for any inspection or repair works in the tunnel. Figure 5.5 illustrates 3 cables running along the side of tunnel, spaced to allow for cooling. Tunnels must be large enough to allow for cooling ventilation.

Figure 5.5: Cables running along the side of tunnel (Note: the tunnel illustrated only accommodates 3 cables)

Tunnel Head Houses

5.5.47 As noted above, tunnel head houses would be required on top of the shaft cover slabs to provide direct access into the shafts and tunnel for inspection and maintenance. The head house also contains all necessary ventilation equipment and utilities.

5.5.48 The tunnel head house would be approximately 36m x 23m x 10m (internal dimensions). An illustrative layout for a typical tunnel head house is provided at Figure 5.6 below. Typically equipment inside the head house, shaft and tunnel would comprise:

- lighting systems;
- heating and air conditioning units;
- radio systems (for personnel to communicate with each other when in the tunnel during construction and over operational life of the asset;;
- stairwell ventilation (required to maintain safe and clean air for personnel to enter the tunnel via the shaft);
- person and goods lift (capable of taking persons and equipment into the tunnel);

- fire suppression (for the unlikely event of a fire in the tunnel. Fire suppression is also required in the head house itself);
- system ventilation (needed primarily to maintain a correct temperature in the shaft and tunnel to ensure that the cables do not overheat. It can be natural air flow backed up with mechanical fans if required);
- gas monitors (to ensure tunnel is free from gas ingress before workers persons enter);
- Distributed Temperature System (DTS) (to measure the temperature of a core/cable. This is part of the overall system design and works in conjunction with the system ventilation);
- pumped drainage (to collect and pump out ground water in the tunnel and shaft);
- generators (maybe permanent or temporary) (a tunnel requires a power supply, and a backup system should this supply fail. Generators can either brought to site in the event of a failure or left in situ); and
- tunnel inspection vehicle (a vehicle used travel along a tunnel for the purpose of inspection of the cables and carrying equipment to point of any cable or joint failure).

Figure 5.6 Tunnel Head House under Construction

Environmental Considerations

5.5.49 Bored tunnels are significant engineering projects. The benefits are that almost all effects on the marine environment can be avoided, assuming that the drive and reception shafts are located above the mean spring high water mark, and intertidal habitats are not impinged upon.

5.5.50 Potential effects include ground borne noise / vibration issues due to the action of the TBM drilling head and the accidental release of drilling fluids via fissures in the rock at the drilling face. These are considered low risk and depending on the ground conditions and clearance depth between the tunnel and the overlying water body, are likely to be avoided. Should effects arise, they are likely to be temporary and of low significance.

5.5.51 The benefits of using pipe jacking are very similar to those of a bored tunnel, in that almost all effects on the marine environment can be avoided. As with the bored tunnel option, it is assumed that the drive shafts/launch areas would be located above the mean spring high water mark.

5.5.52 Potential effects are similar to those of the bored tunnel, but on a much smaller scale, and include ground borne noise / vibration impacts and the potential release of drilling fluids. These are considered low risk and, depending on the ground conditions and clearance depth between the tunnel and the overlying water body, are likely to be avoided. Should effects arise, they are likely to be temporary and of low significance.

5.5.53 Tunnel head houses can require forced ventilation which can require appropriate acoustic design and mitigation to meet appropriate noise levels at the nearest receptors. If passive ventilation is required then there may be no noise source and noise effects would be expected to be negligible.

Horizontal Directional Drilling (HDD)

5.5.54 Horizontal Directional Drilling (HDD) is a multistep process;

- a small diameter pilot bore is drilled along the prescribed route from launch to reception pits;
- the pilot bore is then enlarged by pulling a larger drilling tool (back reamer) from the reception pit to the launch pit connected to the drill rods installed during pilot boring. The back reamer is rotated during the pull-back, enlarging the pilot bore to later fit the permanent duct. If required, the reaming stage may be repeated to achieve larger bores; and
- the permanent duct is installed by pulling it back through the bore enlarged by the reaming process.

5.5.55 Throughout all drilling stages of the process a drilling fluid is pumped down the bore to the drill head. The fluid pressure drives the rotation of the mud motor, facilitates the removal of cuttings, stabilises the bore hole, cools the drill head and transmitter, and lubricates the passage of the duct. The constituents of the drilling fluid are selected to reflect the properties of the ground being drilled, typically they contain bentonite. Shallow launch and reception pits are dug at either end of the bore to collect the drilling fluid throughout the process either for recycling during tunnelling or removal for disposal upon completion

5.5.56 Current understanding of the ground conditions indicates that a 300mm diameter duct would be suitable; requiring an excavation of approximately 450mm diameter.

5.5.57 A HDD installation requires a wide frontage on either side of a crossing to allow the installation of multiple ducts. Assuming a 10m separation between ducts, for 12 cables the minimum construction site width is 120m. Allowing for a spare duct and a duct for telecoms the width would increase to 170m. For the Menai crossing however this should be considered a minimum as, in event that geological issues are encountered and more drilled bores are required, the width would increase accordingly.

5.5.58 A site length of at least 60m is also required for HDD drilling to allow for movement of materials and sufficient working space for the drilling operations. During duct installation a layout area approximately 5m wide and, if possible, equal to the full length of the pipe would be required. If the full layout length is not possible, then 200m to 250m lengths of duct can be jointed on site

5.5.59 As it is not feasible to include standard cable joints within the HDD duct, installation lengths are typically limited to the length of cable that can be transported to site, pulling tension and duct alignment.

5.5.60 A winch is used to draw the cables through ducts with the cables attached to the pulling line by a cable eye attached directly onto the end of the cable. The cable pull can be assisted by the use of cable caterpillars at the entrance to the duct to push the cable. As well as the maximum cable length the permissible pulling tension for the design of cable being installed would also limit the length of a viable HDD installation.

5.5.61 The rate of drilling is largely dependent on ground conditions. A single bore and the installation of the duct to house the cable is expected to take between two to three months. The construction period can however be significantly shortened by employing multiple rigs for synchronous boring. An example of a HDD rig is provided at Figure 5.7 below.

5.5.62 HDD can provide advantages over the other techniques;

- it uses relatively lightweight machinery, compared to TBM, SCL and pipe jack installations
- it requires fewer materials delivered to and removed from site.
- It provides the opportunity to bore from the surface, thus removing the need for constructing deep shafts.

5.5.63 HDD drives are restricted by:

- the elevation difference between drive and reception site (to ensure that the fluid pressure within the bore does not exceed the natural resistance).
- total elevation difference between the surface and formation level (deeper HDD drives increase the friction and gravitational forces due to greater bends within the drive and pulling the pipe length up a significant elevation difference).

5.5.64 For cables installed using HDD it is not possible to undertake direct inspections or maintenance, though in-situ testing (sheath tests, etc) is still possible.

5.5.65 Replacement of the cable circuit in the HDD section due to faults or at the end of the operating life of the cable would require opening of the ducts at the sending and receiving ends and removal and replacement of the entire section length.

Figure 5.7: Horizontal Drilling Rig

Environmental Considerations

5.5.66 HDD results in a number of small bore pipes / ducts through which the cables are pulled. The benefits of using this technique is very similar to those of a bored tunnel, in that almost all the effects on the marine environment can be avoided. As with the bored tunnel option, this assumes that the drive shafts/launch areas are located above the mean spring high water mark, and do not impinge on intertidal habitats.

5.5.67 In certain geology there can be the potential for frack out (loss of drilling fluid to the environment and potential failure of the bore) and, where the rock formations are loosely bound, losing control of the drill path and collapse of the bore. Potential effects otherwise are similar to those of the bored tunnel, but on a much smaller scale, and include ground borne noise / vibration impacts and the potential release of drilling fluids. These are considered as low risk effects and depending on the ground conditions and clearance depth between the ducts and the overlying water body, are likely to be avoided. Should impacts arise, they are likely to be temporary and of low significance.

Seabed Installation

5.5.68 Seabed installation can involve;

- marine works within the main channel; and
- installation in the inter-tidal and shoreline areas (landfall).

Marine Works within the Main Channel

5.5.69 Three options have been considered for installing the cables:

- laid on the seabed and inter-tidal areas
- directly buried in the seabed
- installed in cable ducts, directly buried in the seabed.

Laid on the Seabed and Intertidal Areas

5.5.70 Installation on the seabed is the simplest subsea installation and offers the flexibility of utilising a shoreline or barge installation. In each case the cables are floated across the waterbody, sited and subsequently sunk into position.

5.5.71 Shoreline installation avoids the need for large marine plant by drawing the cable from landfall to landfall. The achievable installation length is generally limited to the maximum length of cable that can be transported to site and by the pulling tension the cable is capable of withstanding.

5.5.72 For longer crossings or where greater control over the route is required the cable can be installed from a barge or cable laying vessel. The use of a barge also allows for the installation of longer cable lengths, although this is dependent on the carrying capacity of the barge and available support craft.

5.5.73 Large marine vessels and barges are subject to restrictive operational criteria (e.g. maximum tidal flow, minimum water depth, adverse weather). In general, they cannot operate in flow speeds greater than 2kn and depths less than 5m.

5.5.74 To prevent movement of the cable from the seabed they are typically pinned to the bedrock using remote operated vehicles (ROVs) or divers depending on depth and water conditions. Soft or mobile sediment deposits over the bedrock may prevent on-bed installations if sufficient anchoring cannot be achieved.

5.5.75 Alternative cable protection devices such as rip-rap, rock bunds or concrete mattresses can be used. These serve a dual function of shielding the cable and fixing the cable in position by their self-weight.

5.5.76 Cables are installed by mechanical winch either across the waterway from landfall to landfall or spooled from the back of the vessel to the landfall.

5.5.77 For a shoreline installation the cable is floated into position during the pull using small boats and floats. Upon siting, the floats are released and the cable allowed to sink into position.

5.5.78 In a barge installation the cable is installed from the barge, first drawn off to one of the landfall sites then released as the barge then travels between landfall sites. Small boats and floatation devices are used to align the cable before sinking into its final position.

5.5.79 Once installed testing of the cable (sheath tests, insulation tests) can be performed from the shore without disturbing the cable. Distributed temperature sensing (DTS) systems allow for ongoing condition monitoring.

5.5.80 In the event of a fault the cable can be replaced in its entirety (landfall to landfall) or a repair joint inserted across the damaged section.

Directly Buried in the Seabed

5.5.81 Direct burial in the seabed can be achieved either by liquefaction of the sediment immediately surrounding a cable (jet trenching) or opening of a trench to lay the cables in (dredging) depending on the composition of the seabed.

5.5.82 For 400 kV cables it would be expected that either jet trenching equipment or dredging from a surface vessel would be used with rock cutting tools supporting the installation in areas where the seabed was composed of hard materials.

5.5.83 Open trenching in marine environments requires additional vessels to support the cable laying operation by opening and closing the cable trenches, although the construction can be staged to reduce the number of vessels required to operate simultaneously.

5.5.84 To provide additional protection devices such as rip-rap, rock bunds or concrete mattresses can be used.

5.5.85 Three methods are available for a buried cable installation:

- simultaneous lay and burial (the cable is laid into the trench as it is opened). The cable is laid directly to its intended burial depth as the laying vessel travels between landfall sites. Depending on the terrain and composition of the seabed tracked or free-swimming ROVs with jet trenching tools or cable ploughs, augmented with rock cutting tools if necessary for harder strata, are used to lay the cable;
- post lay burial (the cable is temporarily laid on the seabed the buried in a separate operation). The cable is laid on the seabed as described above. A ROV or sled with jet trenching tools then fluidises the soil around the cable sinking it to the desired burial depth; and
- pre-lay trenching (the cable is laid into the trench after the trench is opened along its entire length). A trench is opened, depending on the composition of the seabed by dredging or cutting using chain or rock wheel cutters. The cable is then laid as described above in a separate operation and the trench backfilled

5.5.86 Selection of an appropriate method would be dependent on the composition of the seabed, length of the crossing, available plant and operational constraints (working time, currents, sediments, etc.)

5.5.87 As with cables laid on the seabed testing and monitoring can be carried out without disturbing the cable. In the event of a fault the cable can be replaced in its entirety or a repair joint inserted.

Installed in Cable Ducts, Directly Buried in the Seabed.

5.5.88 Cables can also be installed in in ducts directly buried in the seabed, although this method may not be possible where the seabed material is very stiff and it is not possible to trench. Cable ducts are installed using similar methods to the direct burial method, and once in place a cable is drawn through the duct from landfall to landfall.

5.5.89 With a ducted method it may be possible to sectionalise the installation, installing the ducts in short sections or alternatively the ducts could be pulled the length of the installation from landfall to landfall. The longer pull would however be contingent on there being sufficient material above the ducts through the landfall to prevent uplift of the ducts during the pull. Once the ducts are installed a winch is used to draw the cables through ducts.

5.5.90 The achievable installation length is generally limited to the maximum length of cable that can be transported to site and by the pulling tension the cable is capable of withstanding.

5.5.91 As with other methods, to provide additional protection, devices such as rip-rap, rock bunds or concrete mattresses can be employed.

5.5.92 Once installed this method removes the requirement for marine vessels to perform maintenance operations and provides an additional degree of mechanical protection to the cables. As with cables laid on the seabed testing and monitoring can be carried out without disturbing the cable however, as the ducts limit access to cables it is not possible to undertake direct inspections or maintenance.

5.5.93 Replacement of the cable circuit due to faults or at the end of the operating life of the cable would require opening of the ducts at the landfall sites and removal and replacement of the entire section length.

Installation in the Inter-Tidal and Shoreline Areas (Landfall).

5.5.94 The landfall is the location where the cable transitions from a terrestrial installation to a marine/subsea installation. Landfall installations tend to be more challenging areas for construction due existing land features (cliffs, rocky outcrops, tree coverage) and variable topography between marine and terrestrial construction.

5.5.95 Typically there are three methods of installing cables at a landfall:

- open trenching
- HDD ducts
- cable ploughs

5.5.96 The choice of technique is dependent on the type of cable to be installed, and the profile of the intertidal area and the hinterland beyond.

Open Trenching

5.5.97 In areas where the ground allows (beaches, mudflats, sandflats, etc.) open trenching is similar to cable installations on land. Amphibious-grade plant may be required in beach and intertidal areas.

5.5.98 When working in intertidal areas for extended periods there is the risk of inundation of work areas or collapse of excavations. Stabilisation of the trench walls can involve temporary trench shields or, in severe cases, permanent sheet piling panels. At the interface between marine based cable laying and construction in the inter-tidal environment cofferdams may be required.

HDD Ducts

5.5.99 HDD is used to install cables underground typically from solid land to below the lowest astronomical tide. HDD techniques are suitable in areas where, for example, a cable route has to cross cliffs or hard rock that cannot be easily excavated.

5.5.100 An advantage of HDD techniques is the ducts can be installed from the land removing the risk associated with working in intertidal areas.

5.5.101 HDD installations typically require a wide frontage of land to install the cable circuits. For a seabed installation a wide separation is also required for the marine side of the installation due to the achievable accuracy of the marine plant.

Cable Plough

5.5.102 This is a towed system, commonly used for simultaneous lay and burial operations. The plough's share cuts into the soil, opening a temporary trench which is held open by the side walls of the share. The cable is guided through the plough into the opened trench and pushed down by a depressor before the soil naturally backfills over the cable.

Plough installations are limited by site conditions, in particular steep slopes (risk of overturning), very soft soils (risk of sinking or becoming stuck) and large boulders (misaligns the plough) restrict ploughing operations. Ploughs also have limited manoeuvrability, affecting their ability to operate in close proximity of obstructions or existing infrastructure.

Environmental Considerations

5.5.103 In terms of potential impacts on the marine environment, direct burial can pose a significant risk to sensitive intertidal and subtidal habitats. The effects on habitats and species can include direct destruction and/or mortality during trench excavation and deposition of the material removed if 'side cast' along the length of the trench. Structure and function of the habitats affected are immediately impacted by the trenching activity.

5.5.104 Recovery of the affected areas is dependent on the habitat and species' ability to tolerate disturbance. In areas of soft sediments, where tidal currents and wave energies are high (e.g. shallow sand dominated coastal areas) the effects of direct burial may be of low significance, as the communities are already predisposed to disturbance and as such recovery may occur over the short- to medium-term. In areas of lower tidal currents where the benthic communities are more stable (e.g. sea loch mud communities), the effects of direct burial may be longer-term or permanent.

5.5.105 Other potential effects include the release of high concentrations of suspended solids and contaminants during excavation activities. These effects have the potential to impact habitats and species through smothering and increased availability of contaminants. The extent of the area affected is highly dependent on the water mixing patterns in the vicinity of the works.

5.5.106 Trenching activities may also create underwater and airborne noise impacts, as well as potential visual disturbance that could affect birds, sea mammals and fish in the vicinity of the works.

5.5.107 Environmental considerations associated with installation of cables by HDD has been noted above.

5.6 Initial Preference

5.6.1 All techniques have been considered further, with respect to the specific crossing zones identified, see Chapter 9 of this Report

6. CONSTRUCTION CONSIDERATIONS – OTHER INFRASTRUCTURE

6.1 Introduction

6.1.1 A number of options have been considered for using existing or proposed infrastructure to carry the cables across the Menai Strait. These included:-

- installation on the Britannia Bridge;
- utilising the redundant pipelines across the Lavan Sands; and
- installing the cables in a new road bridge, the 'Third Menai Crossing'.

6.1.2 All options would require a CSEC at either end of the cable sections to link with the new overhead line.

6.2 Consultation Feedback

6.2.1 A couple of respondents suggested making use of a disused underground connection which linked the oil terminal at Amlwch to the Stanlow Refinery at Ellesmere Port, and went under the Menai Strait.

6.2.2 Respondents also called for the cables to be placed on the service deck of the Britannia Bridge, in a power tray under the bridge, or on the potential new bridge that they believe the Welsh Government is considering building.

6.2.3 Llanfair Householders Association suggested that National Grid could consider using the two disused Faenol railway tunnels in order to reduce cost. This is considered in Chapter 8 below.

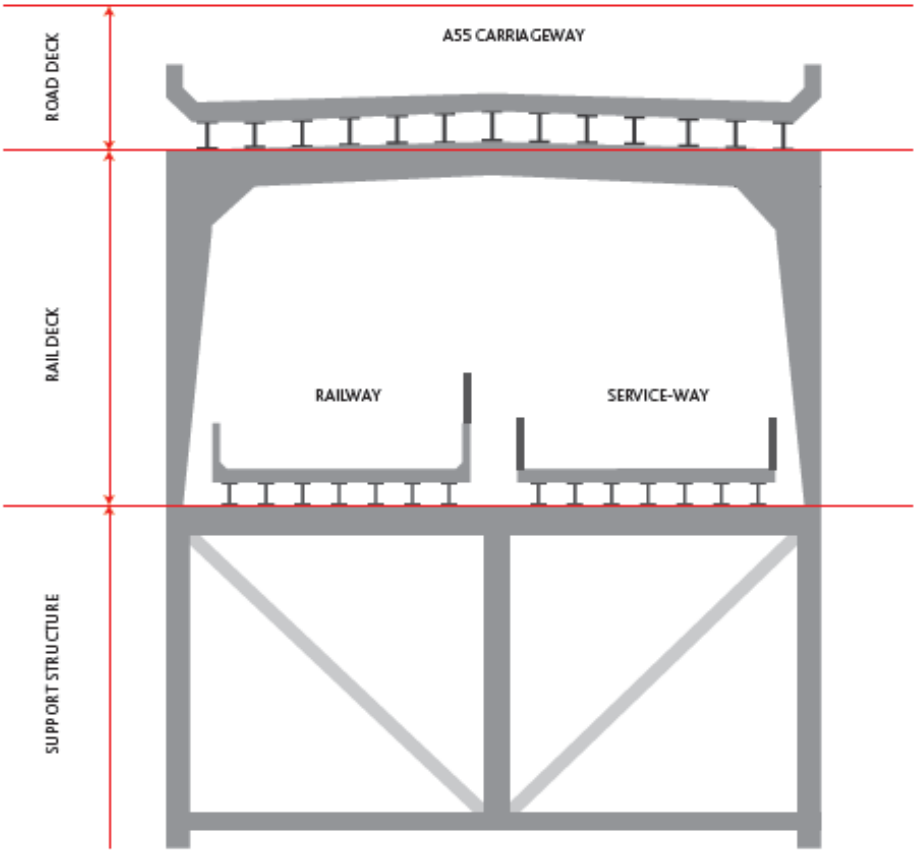
6.3 Installation on the Britannia Bridge

6.3.1 The Britannia Bridge is one of two bridges that connects Anglesey to the mainland and is part of the Trans-European Road network (route E22). The bridge is a two deck truss arch design with a central tower crossing the Menai Strait between Capel-Y-Graig and Llanfairpwllgwyngyll. The bridge is a Grade II listed structure.

6.3.2 Figure 6.1 below illustrates a cross section of the Britannia Bridge looking from Gwynedd towards Anglesey. A number of installation configurations have been considered including the road deck, the rail deck and the support structure.

6.3.3 As with the options in Chapter 4 above, installing the cables on the Britannia Bridge would require twelve cables.

Figure 6.1 Cross Section through Britannia Bridge



Road Deck

6.3.4 The road deck of the Britannia Bridge forms the upper deck of the structure and consists of steel reinforced concrete deck sections supported on transverse steel beams. On both sides of the Menai Strait, between the abutments and land towers (at the foreshore on either side of the Strait), the road deck is supported above the ground level by reinforced concrete crossbeams on columns. Between the bridge towers the road deck is supported on steel portals, with expansion joints at the towers.

6.3.5 The road deck is at its widest at the Anglesey Road Abutment (approximately 40m narrowing across the bridge to 16m (including service footpaths and parapets). The road width along the length of the bridge is approximately 10m.

6.3.6 Assessment were undertaken as to whether the cables could be installed in ducts within the existing road deck or, if there was insufficient space for the ducts the existing road deck could be 'built up'.

6.3.7 Based on the drawings provided by Welsh Government the road deck consists of approximately 85mm hot rolled asphalt over steel reinforced concrete deck sections with a thickness of 200mm - 240mm, supported on transverse steel beams.

6.3.8 As the ducts required to house the cables would be approximately 230mm outer diameter there is no opportunity to install the ducts within the 240mm slab whilst providing sufficient cover to provide strength protection.

6.3.9 An alternative option would be to build upon the existing deck slabs to accommodate the cables in ducts within a 400mm thick concrete surround. Metal ducts and the reinforced concrete surround would be required to provide adequate protection to the cables beneath the asphalt.

6.3.10 Works on the road deck during installation or maintenance operations would be likely to require complete lane closures restricting the movement of road traffic across the bridge.

Cable Installation Leading On and Off the Road Deck.

6.3.11 Figure 6.2 presents an illustrative cable route to / from Britannia Bridge road deck, between fields on either side of the bridge.

Figure 6.2: Britannia Bridge – Road Deck Installation Illustrative Cable Routeing

6.3.12 The illustrative cable route would run from a field north of the Britannia Bridge and the A55 opposite Coed Môr woods, across the bridge to a field adjacent to the A55.

6.3.13 To access the roadway across the bridge the cables would have to be installed up the slip roads (A55, Junction 8A). Due to the width of the slip roads (approximately 8m) it would be necessary to use both the on and off roads, routeing one circuit underneath the A55 via the A5.

6.3.14 The use of the existing slip-roads and crossing under the A55 road bridge would be likely to require diversions of existing services, utility searches to date have identified buried gas and electrical (distribution) infrastructure. Routeing of the cables could also require the removal of areas of woodland within the Coed Môr woods.

6.3.15 From the Anglesey Road Abutment the cables would be installed in the road deck to where the cable would transition to a standard open trench roadway installation, turning south to enter a field adjacent to the A55, over sailed by the existing 400 kV overhead line.

6.3.16 In all cases the pulling tension required to draw cables along the land route and across the bridge would significantly exceed the tension standard cable designs are capable of withstanding and would therefore introduce a greater likelihood of failure.

Risks and Constraints

6.3.17 Raising the road deck would reduce the headroom clearance and may require modifications to the masonry towers.

6.3.18 Raising the road would also result in the access footpaths being below the level of the road, presenting a risk to motorists and maintenance staff[16]. The footpaths would have to be raised to maintain their existing level above the road services, further increasing the dead-load added to the bridge. The parapets and drainage would also require modification to allow for effective removal of surface water from the road.

6.3.19 Works to install the cables across the bridge using the road deck would require either:

- simultaneous installation – complete closure of the Britannia Bridge to install both circuits (this would be likely to take several months); or
- phased installation – closure of one side of the bridge and A55 Junction 8A slip road at a time, completing the installation (including installation of the cables) before moving onto the opposite side.

6.3.20 Simultaneous installation has advantages in that it would remove the hazards from working alongside high speed vehicles using the bridge and may reduce the construction period as both circuits could be installed together. Phased installation would require controlled flow of traffic across the bridge and would put workers at risk of impact from traffic during the works. Closure of the slip-roads would also be likely to result in an increase in the traffic flow through Llanfairpwllgwyngyll as access to the A55 would require vehicles use Junction 7 via the A5/A5152 roundabout.

6.3.21 Due to the diameter of the cable ducts it would not be possible, in the event of a fault or other cable failure, to replace a section of the route with a repair joint, and accessing the cable ducts would be likely to be challenging due to the reinforced concrete surround installation. In the event of a fault an entire section of cable would have to be replaced requiring opening of the A55 on both sides of the bridge to draw a new cable section across the bridge.

[16] These footpaths are not open to the public.

Rail Deck

6.3.22 The rail deck of the Britannia Bridge forms the lower deck of the structure. The rail deck consists of a:

- single track railway line forming part of the North Wales Mainline railway line; and
- a service-way used to facilitate access for maintenance and inspections of the bridge (see Figure 6.3).

6.3.23 The railway is currently used by diesel powered locomotives carrying both freight and passengers. If the line remains non-electrified there may be sufficient clearance to install the cables over the railway, though the available working clearance would make installation and maintenance of the cables challenging.

6.3.24 Working above a live railway line, while also at height over water, increases the safety risk. As a result of these safety concerns in addition to the potential impact on a working railway means that this option has not been considered further.

6.3.25 The service-way is currently used to cross the Menai Strait by a number of utilities including a 33 kV cable circuit, a water main, a rising sewer main, a high pressure gas main, and signal and telecom cables. It is understood that Network Rail regularly use the service-way for maintenance teams to maintain the track and bridge. Network Rail has indicated that they wish to retain the ability to introduce a second track to the Bridge in future should it be required.

Figure 6.3 Photo of Service-way

6.3.26 A number of options were considered for installing the cables on the rail deck service-way. These included:

- installation within the existing service-way in cable ducts;
- Installation on top of the service-way in ducts, building up the existing deck slabs;
- installation in cable troughs installed on the service-way; and
- installation in air on cable trays

6.3.27 None of these methods were considered feasible due to:

- the need for significant alteration to the internal structure of deck slabs;
- insufficient installation width through the towers and rail abutments to allow for spare ducts;
- the need to offset cable troughs from the edge of the service-way (due to the narrowing of the service-way through towers) in order to maintain a straight alignment across the bridge; and
- the need to be divert the existing services to allow for installation of the frames required to support the cable installation. In their current locations the services would be intersected by the frames.

Cable Installation Leading On and Off the Rail Deck.

6.3.28 An illustrative route has been identified from a field north of the Britannia Bridge and the Holyhead Road (A5) opposite Coed Môr woods, across the bridge using the rail deck, to the grounds of the Treborth Athletics Track (part of Bangor University) on the mainland (see Figure 6.4 below). There are significant level differences between the rail deck and the surrounding topography, particularly on Anglesey which would be challenging for cable routeing.

Figure 6.4: Britannia Bridge – Road Deck Installation Illustrative Cable Routeing

6.3.29 Crossing the A5 into the Coed Môr Woods the cables may have to be ducted with, the ducts installed by HDD, due to the level difference across the road and retaining wall along the south of the A5. A HDD crossing of the A5 would require a wide separation between ducts of 10m – 15m due to the installation depth. Areas adjacent to the A5 would need to be cleared of vegetation and levelled to provide a suitable working area. A cable route would then have to cross the Coed Môr Woods, which are on a steep gradient. Cable installation would require significant earthworks and permanent tree clearance.

6.3.30 In order to reach and leave the level of the rail deck cable troughs would have to be installed up the earth embankment. (see Figure 6.5 below) It is likely that significant earthworks would be needed to support the installation of these surface troughs.

6.3.31 In Gwynedd the railway is built into a cutting 6m below the level of the surrounding fields. For the cables to cross the cutting HDD installation would be likely to be required. The depth of the cutting would require a wide separation between ducts of 10m – 15m.

6.3.32 In order to install the cables in ducts or toughs the pulling tension required to draw cables would exceed the tension standard cable designs are capable of withstanding and as such would increase the likelihood of failure.

Risks and Constraints

6.3.33 The 'Risks and Constraints' have been identified in paragraph 6.3.27 above. In addition installation of cables could possibly restrict access to the service-way for vehicles, affecting access for maintenance crews.

6.3.34 For the reasons noted above and as Network Rail has indicated that they wish to retain the ability to introduce a second track to the Bridge in future installation on the Britannia Bridge rail deck has been discounted.

Support Structure

6.3.35 The supporting structure of the Britannia Bridge consists of two steel spandrel braced arches between the land towers (Anglesey and Caernarfon) and the central tower (Britannia Tower). The arches, each consisting of three main ribs were built as part of the reconstruction of the bridge in the 1970's while the towers were modified from the original structures built in the late 1840's to accommodate the replacement rail deck and the road deck above.

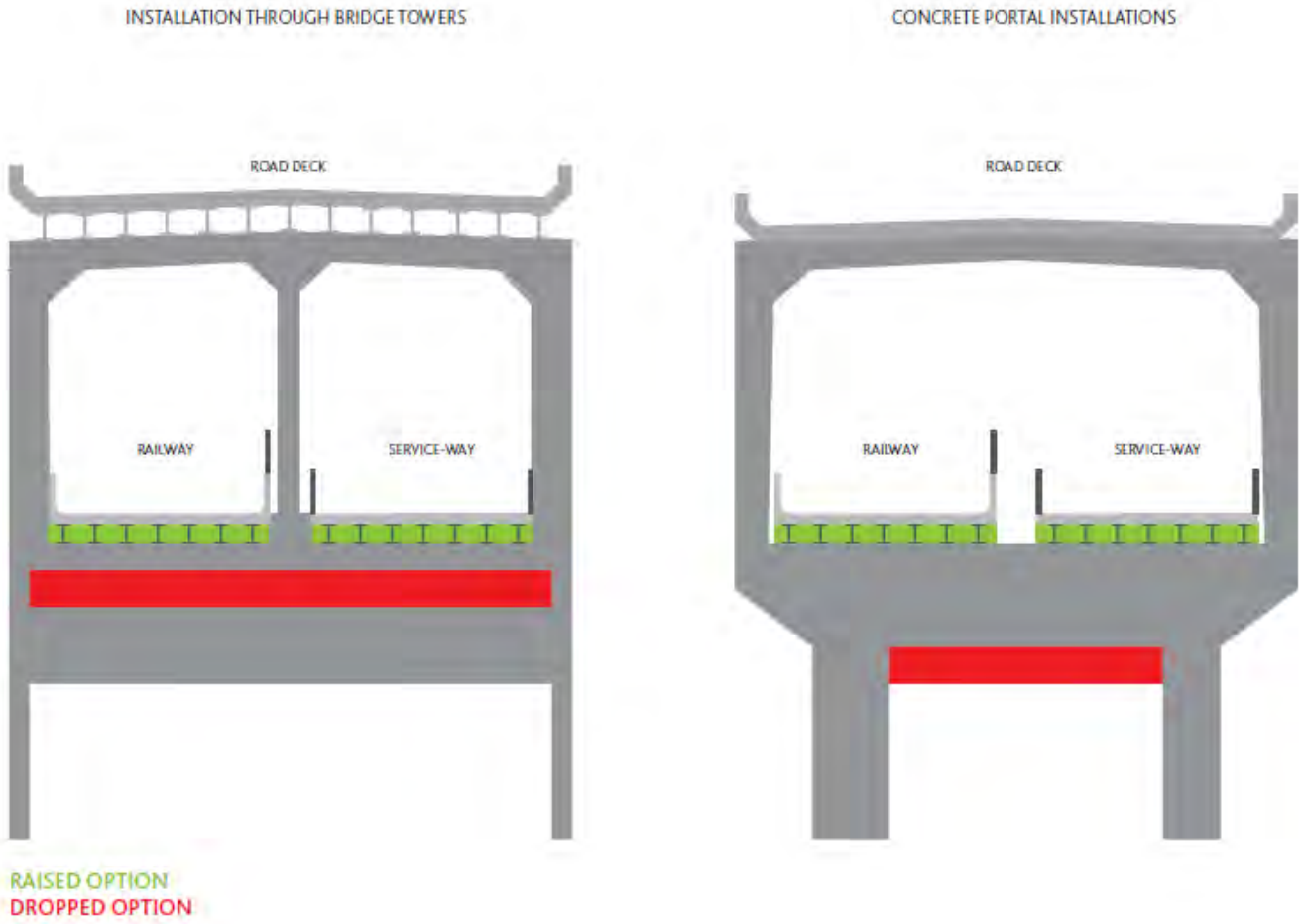
6.3.36 For installation on the support structure, two options have been considered:

- installation underneath the Rail Deck; and
- installation in casings/steelwork affixed to the outside faces of the bridge

6.3.37 Underneath the rail deck the cables would be installed in air on cable trays, suspended from the longitudinal girders forming the railway and service-way. Two options were initially considered;

- raised option (beneath the service-way and railway, between the transverse beams (steel stringers) supporting the deck slabs); and
- dropped option (below the lintels supporting the railway and service-way, through the masonry towers) (see Figure 6.5 below).

Figure 6.5 Installation under the Rail Deck



6.3.38 From a review of existing information cross bracing installed between the beams (stringers) running the length of the bridge has been identified. Through the towers the available space for cable installation is constrained to the height of the stringers. As installation through the towers would require removal of the service-way and railway to alter the cross bracing the 'raised option' is considered impractical and has been discounted.

6.3.39 The 'dropped option' would avoid the cross bracing. The cable installation would be supported below the level of the stringers, with the cables cleated to perforated cable trays crossing through the masonry towers.

6.3.40 This would require modifications to the towers to provide an opening of sufficient width and height to install the cables, with further works likely required to prevent exposure of the internal structure of the masonry towers to the environment. This is likely to be very challenging due to the existing span support arrangements and cross beams supporting the rail deck within the masonry towers. It is likely that complete closure of the bridge would be required to allow such structural changes to the towers to take place and as result of this it is considered impractical and has been discounted.

6.3.41 To avoid installing cables through the bridge towers, an alternative option would be to install the cables on the face of the bridge, in a vertical formation, in enclosed cable trays.

6.3.42 Due to the bridge standing proud of the arches, to minimise bending of the cables along the length of installation, it would be expected that the cables would be installed in line with the towers, supported from the arches by frames extending out towards the cable trays (approximately 1.5m to 2m).

6.3.43 For visual symmetry and to balance the additional loading across the bridge it would be expected that one circuit would be installed on the south face of the bridge and the second on the north face.

Cable Installation.

6.3.44 As with other options there are a number of considerations for cable routeing to / from the Bridge, if the support structure were utilised.

6.3.45 As with cable installation from the road or rail deck an indicative route would utilise the fields on either side of the Bridge and the issues would be comparable to those described above. Different transitional and protection arrangements would be required at the bridge abutments.

Risks and Constraints

6.3.46 With the cables installed in the air the cables are at greater risk of third party disruption. However, installed beneath the level of the rail deck, access to the cables from third parties would be limited.

6.3.47 During construction access to the works site would require scaffolding up to the installation area from the ground level or from jack up barges, or due to the height of the works area from ground level, top down scaffolding, working from the rail deck. In both cases, workers would be exposed to risks from working at height and over water. If installed on the faces of the bridge, workers would also be exposed to risks from working adjacent to a live railway.

6.3.48 Installation of the cables on both sides of the bridge the cables would be challenging due to the height differences and the multiple 90º bends in the cables that would be required.

6.3.49 Due to the diameter of the cable ducts it would not be possible, in the event of a fault or other cable failure, to replace a section of the route with a repair joint, necessitating the replacement of the entire length of cable.

6.3.50 Access to the bridge arch is limited, therefore maintenance inspections would be likely to be constrained to areas that can currently be accessed by existing catwalks. Other areas of the installation would require roped workers descending either from the rail or road decks.

6.3.51 Installations on the support structure of the bridge are likely to be the most visually intrusive of the options for installation on the bridge, which as noted above is a Grade II listed structure.

6.4 Disused Pipeline Across the Lavan Sands

6.4.1 Two disused 40" (1016 mm) Shell oil pipelines crosses the Lavan Sands and Menai Strait between Abergwyngregyn (Gwynedd) and Beaumaris (Anglesey), a distance of approximately 5.4km.

6.4.2 The Lavan sands are a large intertidal area of sand and mud-flats lying at the north-eastern edge of the Menai Strait. Designated as a Special Protection Area (SPA), the sands are an important site for wintering water birds.

6.4.3 The pipeline was previously used to carry crude oil 127km from the single buoy mooring (SBM) floating oil receiving station off the coast of Amlwch to the oil refinery at Stanlow. It operated between 1974 and 1990.

6.4.4 Placing the cables inside the existing pipelines in a number of different configurations has been investigated. In each case the heat generated around the circuits would not allow enough load to be transmitted through the circuit. Installation in the existing Shell pipelines cannot therefore meet the required rating of 3000 MVA.

6.5 Third Menai Crossing

6.5.1 Consultation responses have raised the question of consideration of a new road bridge across the Menai and the potential for locating cables within this structure.

6.5.2 The Welsh Government has recently been quoted in the Press as saying that '*the construction of a third crossing over the Menai Strait could begin by 2021 if it gets the go ahead*' (BBC 11th August 2016)[17].

6.5.3 The article goes on:

> *A Welsh Government spokesman said: "We are currently in the process of procuring consultants to carry out a route selection study for the third Menai crossing. This will appraise various options and designs for the third crossing and will include a public consultation. Construction could start in 2021 subject to gaining all the necessary statutory consents…….Funding options to pay for the scheme are also to be examined'.*

6.5.4 National Grid have been in discussions for some time with the Welsh Government to understand their plans for a Third Menai Bridge.

6.5.5 As plans for a potential third bridge across the Menai Strait become more defined National Grid will continue to review its proposals. At this time the Third Menai Bridge project is still not confirmed and until there is a final design, with funding and consents confirmed, National Grid are required to progress with its current plans to connect the Wylfa connection.

[17] http://www.bbc.co.uk/news/uk-wales-politics-37037170

6.6 Outcome

6.6.1 The Britannia Bridge is not suitable for cable installation due to the many technical challenges that would arise. .

6.6.2 These include;

- lack of appropriate clearances and/or cover;
- the length of the overland routes required for the cables to and from the bridge;
- modifications to the listed bridge structure that would be required to allow cables to pass through the bridge towers;
- the complex installation arrangements on the approach to the Britannia Bridge and on the bridge itself, requiring complex structures to transition between installations (e.g. surface troughs to in air);
- safety issues during installation, inspection, maintenance and/or replacement;
- limitations on repair works;
- the numbers of utility crossings that would be required (particularly around Treborth Waste Water Works and around the Anglesey and Caernarfon Rail Abutments), and the interactions that would require agreements with third parties;
- the high number of significant obstacles which would need to be crossed and would be likely to require HDD installations. Depending on detailed routeing between six and eight HDDs would be anticipated;
- extensive preparatory works that would be required for the cable routes (earthworks, tree loss, etc.);
- the likely timescales involved in gaining approval from the owners of the bridge and the owners of the existing services using the bridge; and
- the road closures that would be required in order to install the cables on the Bridge and route the cables onto and off the Bridge.

6.6.3 It is understood that Network Rail regularly use the access way on the rail deck for maintenance teams to maintain the track and bridge. Network Rail has indicated that they wish to retain the ability to introduce a second track to the Bridge in future should it be required. Installation on the Britannia Bridge rail deck has therefore been discounted.

6.6.4 Installation in the existing Shell pipelines has not been considered further as the ratings target could not be achieved and the installation represented an unacceptable level of risk, requiring construction on the Lavan Sands.

6.6.5 Installation of the cables in a new third road bridge across the Menai Strait is not currently considered feasible within the timescales for the delivery of this connection.

7. OVERHEAD LINE ROUTE CORRIDORS

7.1 Introduction

7.1.1 During previous stages of the project's development the route from Wylfa to the existing Pentir Substation has been described by Sections (1 – 5) which were broadly based on geographical features. These areas were defined during route development using professional judgement. However, for Section 5 consideration has been given, during the appraisal, to the interface between Section 4 and Section 5, and the connection into Pentir Substation.

7.1.2 National Grid has considered the use of alternative conductors and pylon types, including the new T-pylon design. In doing this National Grid has regard to its statutory duties, policy considerations and environmental and socio-economic issues and technical factors including its Stakeholder Community and Amenity Policy[18] and its 'Approach to the Design and Routeing of New Electricity Lines'[19]. Further information is provided in the North Wales Connection: Preferred Route Option Selection Report[20] and the North Wales Connection: Draft Route Alignment Report[21].

7.2 Consultation Feedback

General Feedback

7.2.1 Many respondents, including the Menai Bridge Community Heritage Trust and local community councils, objected to another overhead line in this area, calling for the proposed connection to be placed underground or subsea. Many other respondents called for the proposed line to be undergrounded in this section of the route, citing environmental sensitivity and the high population of the area. Specific stretches where undergrounding is requested are Penmynydd to Pentir, Menai Strait to Pentir, Cefn Poeth to Pentir, Ceint to Pentir, and Star to the coast.

7.2.2 Respondents highlighted their concern regarding the cumulative visual impact a second overhead line may impose on local landowners. Places identified as particularly vulnerable to this are Star and the area between Caergeiliog and Llanfairpwll. These views are in contrast to those expressed by other members of the public who called for the proposed line to closely follow the existing line in order to avoid impacting on currently unaffected areas.

Anglesey

7.2.3 Some respondents expressed explicit support for one or more of the proposed options within Anglesey, although respondents often expressed an overall preference for the proposed line to be placed underground or subsea.

[18] National Grid plc : National Grid's commitments when undertaking works in the UK - Our Stakeholder, Community and Amenity Policy: February 2010

[19] http://www.nationalgrid.com/NR/rdonlyres/5DF82B31-8ED8-4795-AAE0-AA83E072204B/49026/OurApproach.pdf

[20] National Grid September 2016

[21] National Grid September 2016

7.2.4 Option 5A was the most opposed option. Respondents described this part of the route as unspoilt and raised concerns about the potential impact on local wildlife, landscape and cultural heritage. Respondents also raised concern that Option 5A (and Options 5B and 5C) would encircle the village of Star.

7.2.5 In contrast, some respondents expressed support for Option 5A as it would not follow the existing line, thereby it would not impact on those property owners who are already exposed to one set of lines. Some added that this option would have less impact on Menai Bridge.

7.2.6 The Historic Environment Branch of Cadw expressed concerned that the area suggested for route options 5A and 5C is famous for its views and they would be adversely affected by the proposed infrastructure.

7.2.7 Many of the concerns raised in relation to Option 5A also relate to Options 5B and 5C, such as effects on properties (visual, noise, property value) tourism and businesses, and effects on wildlife and the currently unspoilt nature of the area. A number of respondents noted that Options 5B and 5C would completely enclose the community of Star.

7.2.8 Cadw noted that Option 5C could impact the Neolithic site of Capel Eithin.

7.2.9 In contrast a small number of respondents favoured option 5C as it is close to the existing 400 kV overhead line, close to the A55 and would be less visually intrusive.

7.2.10 One respondent noted that Option 5C would avoid bringing pylons closer to the A5025 which is popular with tourists.

7.2.11 Route options 5D and 5E were the most supported options with slightly higher preference expressed towards Option 5E.

7.2.12 For those respondents who preferred 5E the main reasons cited were that this option follows the existing OHL, is shorter, avoids crossing the A5 and A55 and would be less detrimental to tourism. Some respondents expressed concern over the potential cumulative effect and impact on Star, together with impacts on water supplies, their businesses and views to and from Snowdonia, Penmynydd and Gwynedd and effects on a local historical village[22].

7.2.13 However, many qualified their support, stating a preference for an underground connection with some noting that undergrounding in Option 5E would be particularly easy due the open nature of the landscape.

7.2.14 Those respondents who explicitly opposed Options 5D and 5E expressed concerns about the potential impact on Star and Penmynydd, as well as the cumulative visual impact on those communities who are already close to the existing line.

Gwynedd

7.2.15 A few respondents explicitly stated their preference for Option 5H mainly due to their support for Options 5D and 5E on Anglesey, but also because this option is close to the existing line.

[22] The name of this village wasn't specified

7.2.16 Only one respondent stated their explicit preference for Option 5F noting that it is in the least densely populated area, so the visual impact would be less significant. Other feedback received opposes Option 5F due to proximity to property.

7.2.17 Coed Cymru noted that Option 5G is favourable because it would have less impact on the woodland, but overall they prefer Option 5D / 5E.

7.2.18 Gwynedd Archaeological Planning Service (GAPS) found all three of the Gwynedd route options unsuitable as they fall partially within the Dinorwic Registered Landscape of Outstanding Historic Interest.

7.2.19 GAPS also noted concern that the scheduled monument, Fodol Ganol Enclosed Hut Group, would be affected by Option 5G and Cadw highlighted concerns about effects on views in to and out, and between Plas Newydd and Vaynol Estate

7.2.20 GAPS expressed concern that the scheduled monuments Cors y Birthdir would be affected by Option 5H. This is caveated by the need to carefully consider views to and from the Registered Parks and Gardens.

7.2.21 Cadw highlighted their concern that Option 5F, 5G and 5H would affect the views in to, out of and between Plas Newydd and the Vaynol Estate.

7.3 Description of Options

Overview

7.3.1 All options identified on Anglesey (see Figure 1.2) are located within the East Central Anglesey Landscape Character Area (LCA) (Dwyrain Canol Ynys Mon) which forms the inland buffer zone to the Menai Strait and AONB. Since all the options are located in this LCA and would have similar effects, this is not considered to be a differentiator. Similarly, LANDMAP Overall Visual and Sensory Aspect Areas indicate that all options are located in areas of moderate value with a small section of low along the A55.

7.3.2 The sensitivity of the landscape to a new 400 kV overhead line in Section 5 on Anglesey has been assessed as being medium-high. There is a narrow section along the A55 which has been assessed as low.

7.3.3 In terms of landscape character, all options identified in Gwynedd are located within the Bangor Coastal Plain LCA with the exception of Option 5H a small section of which, in proximity to the Gwynedd North Search Area, falls within the Menai Coast LCA. LANDMAP Overall Visual and Sensory Aspect Areas indicate that all options are located in areas of moderate value.

7.3.4 The sensitivity to a new 400 kV overhead line in Gwynedd has been assessed as being medium-high. There is a small section along the A55 which has been assessed as medium.

7.3.5 The existing Pentir Substation is located within Dinorwig Registered Landscape of Outstanding Historic Interest; all overhead line options are located within this designation with the exception of a section of Option 5H around Capel-y-graig.

7.3.6 In terms of hydrology and flood risk, whilst the overhead line conductors would not interact with the surface water environment, there would need to give careful consideration to the micrositing of pylons or other infrastructure in order to reduce effects on hydrology and flood risk receptors.

7.3.7 All overhead line options that lead to Anglesey Central and Anglesey North (5A (part) 5B, 5C, 5D and 5E) would cross the Afon Braint. In these locations the Afon Braint floodplain includes up to approximately 100m of the overhead line route corridors. Any new overhead line infrastructure (e.g. pylons, access tracks and watercourse crossings) would be assessed fully in a Flood Consequence Assessment (FCA). Should an access track be required to cross the Afon Braint, it would need to be a clear span crossing (as this is a Natural Resources Wales (NRW) Main River). This would be assessed as part of a Water Framework Directive (WFD) assessment.

7.3.8 No hydrological or flood risk receptors have been identified with respect to the overhead line options in Gwynedd.

Option 5A (Anglesey)

7.3.9 This option would result in a new overhead line extending from the existing 400 kV overhead line in a southerly direction, crossing the A5, A55 and railway line before turning southwest, passing to the west of Llanddaniel, and then curving around the south side of the settlement to terminate in the Anglesey South CSEC Search Area.

Landscape and Visual

7.3.10 Option 5A is the longest of the Anglesey options. The southern end of this option is located within the Southern Anglesey Estatelands Special Landscape Area (SLA), the extent of which would be determined by the exact location of a CSEC.

7.3.11 Option 5A diverges from the existing 400 kV overhead line at the existing angle pylon north of Gaerwen, heading south before crossing the A55 and A5 to the east of Gaerwen. As it moves away from the existing 400 kV overhead line it would pass close to four properties. The two properties on the east at Cefn Du Isaf and Tyn-cae would become encircled[23] by the existing and proposed overhead lines.

7.3.12 An overhead line in Option 5A would interrupt views towards Snowdonia from the A55. It would span across the A55 at the point where views for people travelling south open up after the ridgeline at Gaerwen. Similarly there would be effects on views from people travelling south on the A5 and from people living on Chapel Street in Gaerwen, where properties have uninterrupted views towards the National Park.

[23] This appraisal considers those properties encircled to be ***within*** approx. 600m of the centre line of an indicative alignment ***and*** the centre line of the existing 400 kV overhead line. This is a conservative approach in response to the high sensitivity of residential receptors.

7.3.13 A new overhead line would travel south-west after crossing the railway line passing to the west of Llanddaniel Fab before turning south-east towards the Anglesey South Search Area. Although much of the overhead line would be located in the lowest area between the low ridgelines of Gaerwen and Llanddaniel Fab, it would still skyline in views between these two settlements, although there may be opportunities to reduce this effect e.g. by the use of lower height pylons. The overhead line would traverse one of the ridgelines to the west of Llandaniel Fab thus further increasing its visibility on the skyline and interrupting views towards Snowdonia. A new overhead line in Option 5A would closely wrap around Llanddaniel Fab, potentially affecting views from the settlement to the north, west and south.

7.3.14 Option 5A crosses National Cycle Route 8 (Lôn Las Cymru) to the west of Llanddaniel Fab although all options would cross this cycle route at some point. People using the Wales Coast Path may have views of the new overhead line where it crosses the ridgeline to the west of Llandaniel Fab. This is due to the fact that the path diverts inland around Plas Newydd.

7.3.15 There is potential to affect views from Bryn Celli Ddu, a Cadw site which is popular with tourists, as a new overhead line in Option 5A would travel down the slope from Llanddaniel Fab. Although at some distance, approx. 2km, there is the potential for a new overhead line to be visible above vegetation, although again there may be opportunities to potentially reduce this effect from Bryn Celli Ddu for example by the use of lower height pylons.

Historic Environment

7.3.16 While Option 5A would not directly disturb any designated historic assets, there is likely to be effects on the wider setting of Scheduled Ancient Monument complex of Bryn Celli Ddu, and Tyddyn-Bach Standing Stone by extending an overhead line to the west and southwest of the scheduled monuments (AN002, AN084). The scheduled remains of an early medieval cemetery and multi period settlement site (AN120) are located to the west of the northern end of Option 5A. While there are little or no above ground traces of the monument, the site still has a setting which helps define its significance. There may be adverse impact to the setting of Capal Cana and School Rooms in Llanddaniel (LB175754) by introducing pylons which would be visible behind the listed building.

7.3.17 Option 5A would also not directly disturb any known non designated heritage assets recorded on the Historic Environment Record, however any groundworks may disturb any previously unrecorded archaeological remains.

Ecology

7.3.18 Option 5A passes through predominantly grazed improved grassland intersected by hedgerows and watercourses. Small pockets of marshy grassland, semi-improved grassland (poor and acid), dense scrub and areas of broadleaved woodland are also present.

7.3.19 Option 5A has the potential to affect a number of areas of high biodiversity value on a National, County and Local scale, including:

- the Gwydryn County Wildlife Site (CWS) (also included on the National Forest Inventory). This option would result in habitat loss and fragmentation (including, potentially, broadleaved semi-natural woodland, scrub and grassland habitats). Option 5A also lies within 500m of Coed Glanyrafon CWS, which is an area of restored ancient woodland;
- an area allocated under the Woodland Grant Scheme (approximately 30m from the route corridor boundary). Although there would be no direct effects, indirect effects could result;
- a RSPB Reserve and SSSI[24] (approximately 2.5km to the west of the route corridor boundary, and also between these designations) and the Y Fenai a Bae Conwy / Menai Strait and Conwy Bay SAC. There would be risk of collision strike from overflying birds, dependant on the habitats in the reserve.
- 10 watercourses which potentially may need to be crossed. There are records of both water voles and otter on Anglesey and these species could be present on any of the watercourses; and
- ponds (in the vicinity).

7.3.20 Based on our current understanding there is the potential for protected species to be present. There are existing records of barn owl and common lizard and habitats present which are considered suitable for bats, great crested newt, other reptile species, invertebrates, otter and water vole.

Soils and Agriculture

7.3.21 The provisional 1:250,000 scale Agricultural Land Classification (ALC) mapping[25] (ADAS, 1977) shows the ALC grade of agricultural land throughout Option 5A is predominately Grade 3 (Good to Moderate quality) and Grade 4 (Poor quality), with small areas of Grade 5 (Very Poor quality).

7.3.22 Data from the Soil Survey of England and Wales shows that the Brickfield 2 (713f) soil association predominates Option 5A, with small areas of the East Keswick 1 (541x) soil association also present. The Brickfield 2 soils are seasonally waterlogged and therefore could require longer periods of restricted handling to prevent structural damage; whereas East Keswick 1 comprises well drained loamy soils which can be handled over longer periods. East Keswick 1 soils can be used for arable agriculture including the production of early potatoes and field vegetables; and soils of both associations are suitable for stock rearing on permanent grassland.

[24] Malltraeth Marsh consists of 273ha of reedbeds, marshes, wet grassland and small pools/lakes. Bitterns have bred in the past and birds now winter in most years. The reserve is also important for wintering wildfowl, and forms part of the Malltraeth Marsh (Cors Ddyga) SSSI, which is particularly important for the ditch fauna and flora, and the range of breeding wetland birds.

[25] ADAS 1977

7.3.23 Option 5A is composed primarily of pasture land, with an arable organic farm located at the southern tip, as identified from the land owner consultations carried out by National Grid. Land is also currently enrolled in an Agri-environmental Scheme (AES) however the area of land subject to the AES and the type of AES are not known at this time[26].

7.3.24 The presence of organic and arable farming within Option 5A, indicates the potential for Best and Most Versatile (BMV) agricultural land to be present.

7.3.25 The Option 5A represents the longest route on Anglesey; and therefore it is anticipated that this Option would result in the highest level of disturbance to agricultural land due to a greater number of pylons and associated accesses; and / or a greater number of individual land owners being affected.

Traffic and Transport

7.3.26 Option 5A would cross the A55, A5, the North Wales Mainline railway line, the unnamed road linking the A4080 to Llanddaniel and National Cycle Route 8. Crossings over the aforementioned highway and railway infrastructure would likely result in closures (most likely overnight) or diversions (where possible) during the construction phase. Option 5A route is longer than other options and therefore it is anticipated that there would be an increase in construction traffic volumes and access provisions.

Construction Noise

7.3.27 Option 5A contains a mixture of land uses including farmland, isolated residential dwellings, small communities, some industry and commerce and the A55 / rail corridor. Baseline noise levels will therefore range from low to high dependant on the proximity of major noise sources. Construction works in this area would be relatively short-term and would involve construction of the pylons and stringing. With careful routeing and micro siting to maximise proximity to Noise Sensitive Receptors (NSRs), few if any significant effects would be anticipated.

Operational Noise

7.3.28 Option 5A would introduce a new section of overhead line into an area not currently affected by overhead line noise and where baseline levels away from the A55 dual carriageway are likely to be very low, especially at night. The route would pass numerous isolated residential properties, although it is likely that an alignment could be designed that could maintain a distance exceeding 50m and probably 100m. Given the larger, and hence quieter, design of line that is currently preferred[27] major adverse effects are unlikely to be predicted. On this basis it is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5.

[26] Upon consultation the Welsh Government confirmed that the area covered by all Route Options in Section 5 was too large for AES data to be provided. These data will be made available for the preferred option once routing is more defined.

[27] National Grid: Preferred Route Option Selection Report (September 2016)

Socio Economic

7.3.29 This option is in proximity to the community of Llanddaniel Fab. Passing south across the A55, the A5 and the North Wales Mainline railway line to the east of the A5152 it then heads southwest to passing to the north of Lllanddaniel Fab. To the west of the settlement it heads south passing across the Penryhn Golf Complex (driving range and nine hole par 3 course) before crossing the National Cycle Route 8 (Lôn Las Cymru). At its southernmost point it is approximately 1.3km from the Wales Coast Path as it passes Byrn Celli Ddu a prehistoric burial chamber that has been developed for visitor access and therefore a tourism receptor.

Technical

7.3.30 Option 5A is the longest in length, the least direct and would have a greater quantity of the larger angle type structures when compared against the other Anglesey options.

7.3.31 Additional challenges are that approximately 2km of the route to the west of Llanddaniel Fab traverses an area of low lying wetland adjacent a strip of land identified as Flood Zone 3. Additionally at the end point of the corridor where it meets the Anglesey South it would have to cross another area of Flood Zone 3. These issues can restrict the potential flexibility for detailed routeing and locating individual pylons.

7.3.32 Access would be from the local road network. However, the construction of such accesses and the pylons themselves may prove challenging due to the high probability of wet/poor ground conditions within the low lying wetland area and within/adjacent Flood Zone 3 areas. There may be further construction implications to working in proximity to a wildlife site (see 'Ecology' above).

7.3.33 This option also presents construction and protection challenges with regards the crossing of the A55 dual carriageway, the A5 and the main line railway to Holyhead. Crossing protection[28] would also be required at three other local road crossing locations.

Option 5B (Anglesey)

7.3.34 Option 5B would result in a new overhead line extending from the existing 400 kV overhead line in a southerly direction, crossing the A5, A55 and railway line before turning 90 degrees eastwards to follow the southern side of the railway line terminating within the Anglesey Central CSEC Search Area.

Landscape and Visual

7.3.35 The eastern end of this option is located within the Southern Anglesey Estatelands SLA, the extent would be determined by the exact location of the CSEC.

[28] Netting beneath the conductors attached to anchored scaffolds which provides protection to the road, railway or other service below, in case conductor pulling operations allow the conductors to descend below intended design height

7.3.36 Option 5B follows the same route as Option 5A until it crosses the railway line where it turns sharply east heading towards Anglesey Central CSEC Search Area. The 90 degree change of direction would require a pylon which would appear heavier in appearance with thicker metalwork and a larger footprint. Views from Gaerwen may be affected, although the spread of effects in views from the settlement would be more limited than for Option 5A as the route follows the railway line.

7.3.37 A new overhead line would affect the currently uninterrupted views towards Snowdonia as experience by people travelling east on the A5. It would also cross National Cycle Route 8 (Lôn Las Cymru) to the east of Llanddaniel Fab although all options would cross this cycle route at some point. People using the Wales Coast Path may have glimpsed views of the new overhead line as the path diverts inland around Plas Newydd.

7.3.38 There is potential to affect views north from Bryn Celli Ddu. The existing 400 kV overhead line is visible from here and Option 5B would be closer to this Cadw site which is popular with tourists.

7.3.39 This last section of Option 5B would also have the potential to affect views south and west from Star; an elevated settlement to the north of the A55 which would become encircled by the new and existing overhead lines. Many people living in Star have views towards Snowdonia, parts of the view are already affected by the existing 400 kV overhead line which runs to the north and east of the settlement. Views from the settlement would look down towards Option 5B and so pylons would potentially benefit from backclothing. There may also be opportunities to reduce this effect for example by the use of lower height pylons.

Historic Environment

7.3.40 This option would not directly disturb any designated heritage assets, however as with Option 5A, the scheduled remains of an early medieval cemetery (AN120) are located to the west. There are little or no above ground traces and therefore any impact on setting would be slight.

7.3.41 The wider setting of Bryn Celli Ddu (AN002) and Tyddyn-Bach Standing Stone (AN084) may be slightly affected by the addition of pylons on the northern horizon.

7.3.42 This option would not affect any known non designated heritage assets recorded on the Historic Environment Record, however any groundworks may affect previously unrecorded archaeological remains.

Ecology

7.3.43 As with Option 5A, Option 5B also passes through predominantly grazed improved grassland intersected by hedgerows and watercourses. Areas of marshy grassland, semi-improved grassland (poor and acid), and small areas of mixed broadleaved woodland are also present.

7.3.44 This option has the potential to affect a number of areas of high biodiversity value on a National, County and Local scale, including:

- a RSPB Reserve and SSSI (the option lies approximately 2.5km to the west), and the Y Fenai a Bae Conwy / Menai Strait and Conwy Bay SAC. Considerations are therefore, similar to Option 5A and there is a risk of collision strike from overflying birds. The potential for effects is less than for Option 5A as this option does not lie between the designated sites;
- potentially 5 watercourses may need to be crossed. As there are records of both water voles and otter on Anglesey it is possible these species could be affected;
- a small area of woodland (depending on the exact location of the CSEC); and
- ponds (in the vicinity).

7.3.45 There are existing records[29] of barn owl, and otter (in particular for the Afon Braint), and there are habitats present which are considered suitable for bats, red squirrel, invertebrates, badger and water vole.

Soils and Agriculture

7.3.46 The provisional 1:250,000 scale ALC mapping shows that Option 5B is comprised of Grade 4 (Poor quality) and Grade 5 (Very Poor quality) agricultural land.

7.3.47 Data from the Soil Survey of England and Wales shows that all soils within Option 5B belong to the Brickfield 2 (713f) soil association, a seasonally waterlogged soil which could require longer periods of restricted handling to prevent structural damage.

7.3.48 Land within Option 5B is primarily used as pasture land, with the exception of Tyddyn Isaf which National Grid have identified, through consultations with landowners, as an organic farm comprising conservation land, a permanent hay meadow, orchids, and a wetland. It is currently not known if this land is certified organic, or just farmed in an organic manner. The wetland (including a wildlife pond) is located to the north east. This marshy area will be of lower agricultural grade than the surrounding non-marshy land, and therefore would provide a more attractive route in terms of avoiding better quality agricultural land, however the engineering constraints associated with construction on marshy land and the organic status of the land would be considerations.

7.3.49 No formalised AES has been identified within Option 5B.

[29] Ecological surveys have not been completed, the potential for species to be present, and therefore affected for all Options has been gauged from existing records, and habitat potential.

Traffic and Transport

7.3.50 Option 5B (and Option 5C) would cross the A55, A5, and North Wales Mainline railway line and broadly follow a similar route, with only minor differences between each option in traffic and transport terms. Crossings over the aforementioned highway and railway infrastructure would likely result in closures (most likely overnight) or diversions (where possible) during the construction phase.

Construction Noise

7.3.51 Options 5B and 5C, connecting to Anglesey Central, contain a mixture of land uses including farmland, isolated residential dwellings, small communities, some industry and commerce and the A55 road / rail corridor. Baseline noise levels will therefore range from low to high dependant on the proximity of major noise sources. . Construction works in this area would be relatively short-term and would involve construction of the pylons and stringing. With careful routeing and micro siting to maximise proximity to NSRs, few if any significant effects would be anticipated.

Operational Noise

7.3.52 Option 5B would introduce a shorter new section of overhead line compared to Option 5A. The route deviates to follow the railway line and A55 where the character of the area is less rural with some commercial development. Baseline levels are likely to be held up by traffic on the A55 although there will be periods of time when this is likely to be very low, especially at night. The route would pass a few isolated residential properties in the north, although it is likely that and alignment could be designed that could maintain a distance exceeding 50m and possibly 100m. Given the larger, and hence quieter, design of line that is currently preferred major adverse effects are unlikely to be predicted. On this basis it is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5.

Socio Economic

7.3.53 Having crossed the A55 and the A5, this option runs in an easterly direction parallel to the Mainline railway line. A cluster of commercial businesses lie between the railway line and the A5. These include a garden nursery, a hand car wash, a furniture showroom and a window sales centre. Further east Options 5B and 5C would both cross National Cycle Route 8 south of the railway line to the south east of Star; passing south of a small cluster of predominantly retail warehouse businesses. Due to the nature of their trade and operations, none of the businesses / commercial properties are likely to experience a loss in trade as a result of amenity effects from the introduction of an overhead line.

Technical

7.3.54 Option 5B is comparable to Option 5E in length, and is relatively direct although it would require numerous larger angle type pylons; it is also the only option that would require a major angle structure (south of the A55, A5 and railway crossing).

7.3.55 An additional challenge is that the major angle required directly south of the railway crossing would be situated in a wetland area identified as Flood Zone 3. This may restrict the location of the pylon and present difficulties during construction.

7.3.56 For approximately 1.5km Option 5B runs parallel to the railway line thus creating an infrastructure corridor.

7.3.57 Access to Option 5B would be from the local road network. However, the construction of such accesses and the pylons themselves may prove challenging in the area directly to the south of the railway crossing due to the high probability of wet/poor ground conditions within the low lying wetland area within / adjacent to the Flood Zone 3 area.

7.3.58 The option would also present similar challenges to Option 5A with regards the construction and protection of the crossing of the A55 dual carriageway the A5 and the railway line. Crossing protection would also be required at two other local road crossing locations.

Option 5C (Anglesey)

7.3.59 Option 5C follows a more direct route than Option 5B, and over sails the A5, A55 and railway line at a more acute angle than Option 5A, before following the southern side of the railway line and terminating within the Anglesey Central CSEC Search Area.

Landscape and Visual

7.3.60 Option 5C diverges from the existing 400 kV overhead line at the existing angle pylon to the north of Star, heading south-east before crossing the A55 and A5 near Garnedd-fawr, approx. 1.5km to the east of Gaerwen.

7.3.61 As with Options 5A and 5B, as Option 5C moves away from the existing 400 kV overhead line it passes close to four properties, closer to Tyn-cae than the other options. Cefn Du Isaf and Tyn-cae would become closely encircled by the new and existing overhead line. Further east, property at Garredd Newydd and Keeper's Lodge would also become encircled.

7.3.62 A new overhead line would cross the A55 and A5 where the two roads run adjacent to each other and in close proximity to a small number of properties and buildings including businesses on the A5. The properties at Garnedd-fawr and Garnedd-ddu would be in close proximity to the crossing point. Spanning the roads at this location would reduce the effects on Gaerwen in comparison to Options 5A and 5B, as a new overhead line would be further from the settlement and at a lower elevation. As with other options, a new overhead line would affect views towards Snowdonia from the A55, however effects would be lessened in this location due to existing vegetation along the A55 and the more limited views of Snowdonia from a shorter stretch of road. There would still be effects on people travelling on the A5 as the pylons would interrupt views towards Snowdonia.

7.3.63 A new overhead line would cross National Cycle Route 8 (Lôn Las Cymru) to the east of Llanddaniel Fab, although all options would cross this cycle route at some point. People using the Wales Coast Path may have glimpsed views of a new overhead line as the path diverts inland around Plas Newydd.

7.3.64 Since the A55 crossing is further east, a new overhead line would be closer to Star than Options 5A and 5B, affecting people with views west. Option 5C would also have a greater influence on the local lane with runs west from Star. The last section of Option 5C follows the same route as Option 5B connecting to Anglesey Central CSEC Search Area. The potential effects on Bryn Celli Ddu and the SLA are as set out for Option 5B.

Historic Environment

7.3.65 This option would not directly affect any designated heritage assets, however as with Option 5A and 5B, the scheduled remains of an early medieval cemetery (AN120) are located to the west. There are little or no above ground traces and therefore any impact on setting would be slight, Option 5C would take the pylons further to east than Options 5A and 5B and would therefore lessen any setting impact.

7.3.66 The wider setting of Bryn Celli Ddu (AN002) and Tyddyn-Bach Standing Stone (AN084) may be slightly affected by the addition of pylons on the northern horizon.

7.3.67 This option would not affect any known non designated heritage assets recorded on the Historic Environment Record, however any groundworks may affect previously unrecorded archaeological remains.

Ecology

7.3.68 Option 5C commences along the same route as Options 5A and 5B before moving away to the east side of the other options, and re-joining Option 5B south of the railway line. This alternative section is also predominantly grazed improved grassland intersected by hedgerows and watercourses. Small pockets of marshy grassland, and semi-improved acid grassland are also present.

7.3.69 This option has the potential to affect a number of areas of high biodiversity value on a National, County and Local scale, including:

- a RSPB Reserve and SSSI (the option lies approximately 2.7km to the west), and also the Y Fenai a Bae Conwy / Menai Strait and Conwy Bay SAC. The potential effects are the same as those identified for Option 5B;
- potentially 7 watercourses may need to be crossed. There are records of both water voles and otter on Anglesey and these species could be present on any of the watercourses;
- a small area of woodland (depending on the exact location of the CSEC); and
- ponds (in the vicinity).

7.3.70 There are existing records of barn owl and otter (in particular for the Afon Braint), and there are habitats present which are considered suitable for bats and water vole.

Soils and Agriculture

7.3.71 The provisional 1:250,000 scale ALC mapping shows Option 5C is predominately Grade 3 (Good to Moderate quality) and Grade 5 (Very Poor quality) agricultural land.

7.3.72 Data from the Soil Survey of England and Wales shows that the Brickfield 2 (713f) soil association predominates Option 5C, with small areas of the East Keswick 1 (541x) soil association also present. The Brickfield 3 soils are seasonally waterlogged and therefore could require longer periods of restricted handling to prevent structural damage; whereas East Keswick 1 comprises well drained loamy soils which can be handled over longer periods. East Keswick 1 soils can be used for arable agriculture including the production of early potatoes and field vegetables; and soils of both associations are suitable for stock rearing on permanent grassland. Option 5C is composed primarily of pasture land.

7.3.73 During consultations with land owners National Grid has identified that Option 5C contains one area described by the land owner as a Higher Level Stewardship Glastir scheme; this is presumed to be a Glastir Advanced scheme as Higher Level Stewardship is not a category within Glastir. This land straddles the entire width of Option 5C at its southernmost end; and therefore could not be avoided if this route option were preferred. However, the extent of the AES is not currently known.

Traffic and Transport

7.3.74 As noted above Option 5C would cross the A55, A5, and North Wales Mainline railway line and broadly follow a similar route, with only minor differences between each option in terms of traffic and transport. Crossings over the highway and railway infrastructure would likely result in closures (most likely overnight) or diversions (where possible) during the construction phase.

Construction Noise

7.3.75 All options connecting to Anglesey Central contain a mixture of land uses including farmland, isolated residential dwellings, small communities, some industry and commerce and the A55 road / rail corridor. Baseline noise levels will therefore range from low to high dependant on the proximity of major noise sources. Construction works in this area would be relatively short-term and would involve construction of the pylons and stringing. With careful routeing and micro siting to maximise distance to NSRs, few if any significant effects would be anticipated.

Operational Noise

7.3.76 Option 5C would introduce a shorter new section of overhead line compared to Option 5A. The option deviates sooner than Option 5B to cross the A55 and follow the railway line where the character of the area is less rural with some commercial development. Baseline levels are likely to be elevated due to traffic on the A55 although there would be periods of time when this is likely to be very low, especially at night. A new overhead line would pass a few isolated residential properties in the north and near the A55, although it is likely that an alignment could be designed that could maintain a distance exceeding 50m and possibly 100m. Given the larger, and hence quieter, design of line that is

currently preferred major adverse effects are unlikely to be predicted. On this basis it is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5.

Socio Economic

7.3.77 This option crosses the A55 and A5 between a cluster of commercial properties immediately south of the A5/A55. It then follows the same route as Option 5B crossing National Cycle Route 8 south of the railway line to the south east of Star; passing south of a small cluster of predominantly retail warehouse businesses. As for Option 5B, none of the businesses / commercial properties in the vicinity of Option 5C are likely to experience a loss of trade as a result of amenity effects from the introduction of an overhead line.

Technical

7.3.78 Option 5C is the shortest of the options in length, and is relatively direct, although it would require several larger angle type pylons.

7.3.79 Option 5C crosses the A55, A5 and railway line at an acute angle which can increase the length of scaffold protection measures required. In addition, the protection and construction of the scaffolds would be further complicated by the embankment and lay-by at the A55 crossing, the ground level differential from the A55 across to the south side of the A5 and the restricted area by the commercial units on the south side of the A5, these units may also require further protection measures.

7.3.80 For approximately 0.5km Option 5A runs parallel to the railway line thus creating an infrastructure corridor.

7.3.81 Access would be from the local road network. The acute crossing of the A55, A5 and railway line would present construction challenges. This option would have fewer pylons when compared to Options 5A and 5B. Crossing protection would also be required at two other local road crossing locations.

Options 5D and 5E (Anglesey)

7.3.82 Both these options initially run parallel to the existing 400 kV overhead line and would connect to the Anglesey North CSEC Search Area. These two options are discussed together as the effects are similar.

Landscape and Visual

7.3.83 Unlike the other options assessed, there is a requirement to transpose between the existing and new overhead lines for Options 5D and 5E. As the proposed overhead line in Section 4 is located on the western side of the existing 400 kV overhead line, and Anglesey North CSEC Search Area is located to the east, a swap from one side of the line to the other is required known as a transposition[30]. Option 5D parallels, on the south side, the existing 400 kV overhead line until the angle pylon to the north of Gaerwen where it transposes to head east towards Anglesey North CSEC Search Area. Option 5E parallels, on the north side, the existing 400 kV overhead line, transposing at pylons near Ceint-fawr after crossing the B5420.

[30] See North Wales Connection; Preferred Route Option Selection Report (National Grid, September 2016) Ch. 5 for more details on transpositions.

7.3.84 Closely paralleling the existing 400 kV overhead line for as long as possible reduces the overall spread of the effects of an overhead line when compared to the other options. The parallel options also potentially require the least numbers of new pylons; dependent on exact location of the CSEC within Anglesey North.

7.3.85 Few close proximity properties would be affected, including those at Cefn Du Isaf, Llinos-fawr and Tyddyn-y-felin and no properties would become encircled. Views towards Snowdonia would still be affected, but overall there would be fewer receptors. A new overhead line would cross National Cycle Route 8 (Lôn Las Cymru) to the north of Llanfairpwllgwyngyll, although all options would cross this cycle route at some point.

7.3.86 Since the existing 400 kV overhead line is visible from Bryn Celli Ddu it is likely that these options would also be visible, but would be seen in the context of the existing overhead line and at a distance.

Historic Environment

7.3.87 Both options would enter Anglesey North on approximately the same route and therefore the same issues apply equally to both. Any new pylons are likely to effect the settings of two Grade II listed farmsteads, Braint Farmhouse (LB26146) and associated farm buildings (marked on OS map as Gwyndy), and Bryngof Bella (LB5449). In addition a Grade II listed C18th bridge over the Afon Braint (LB5556) could be affected by increased heavy construction traffic.

7.3.88 These options would not affect any known non designated heritage assets recorded on the Historic Environment Record, however any groundworks may affect previously unrecorded archaeological remains.

Ecology

7.3.89 Options 5D and 5E pass through a mixture of arable fields, grazed improved grassland, marshy grassland, and semi-improved acid grassland intersected by hedgerows and watercourses.

7.3.90 These options have the potential to affect a number of areas of high biodiversity value on a National, County and Local scale, including:

- the Coed Braint / Syglen / Dyfnia CWS. Depending on the exact location of the CSEC, Options 5D and 5E could pass through this CWS resulting in habitat loss and fragmentation;
- Cors Bod-Ynys CWS. Option 5E runs approximately 300m south of this CWS, closer than Option 5D;
- an area of Ancient Semi-Natural Woodland. Options 5Dand 5E would lie within 100m of this woodland;
- a RSPB Reserve and SSSI (these options lie approximately 2.8km (Option 5D) and 2.9km (Option 5E) to the west), and also the Y Fenai a Bae Conwy / Menai Strait and Conwy Bay SAC. The same potential effects arise as for Option 5B;
- potentially 9 watercourses may need to be crossed. There are records of both water voles and otter on Anglesey and these species could be present on any of the watercourses; and

- ponds (in the vicinity).

7.3.91 There are existing records of peregrine, otter (spraint recorded within 100m of Option 5E), brown long-eared bat roosts (recorded within 500m west of Options 5D and 5E), barn owl and common lizard, and there are habitats present which are considered suitable for great crested newt, other reptile species, invertebrates, and water vole.

Soils and Agriculture

7.3.92 The provisional 1:250,000 scale ALC mapping shows the ALC grades of agricultural land throughout Options 5D and 5E is predominately Grade 3 (Good to Moderate quality) and Grade 4 (Poor quality).

7.3.93 Consultations with landowners undertaken by National Grid indicates that the majority of agricultural land within Options 5D and 5E is pasture. The exceptions are an area of land located in the central area of both Options, near Penmynydd, which is under pasture and arable and also has an option for wind turbines. A further area located near Penmynydd towards the southern extent of Option 5E is currently receiving payment as an organic farm under pasture and arable rotation. The identification of areas of organic and arable farming within Options 5D and 5E, indicates the potential for BMV agricultural land to be present.

7.3.94 Data from the Soil Survey of England and Wales shows that the Brickfield 2 (713f) soil association predominates in Options 5D and 5E, with small areas of the East Keswick 1 (541x) soil association also present. The Brickfield 2 soils are seasonally waterlogged and therefore could require longer periods of restricted handling to prevent structural damage; whereas East Keswick 1 comprises well drained loamy soils which can be handled over longer periods. East Keswick 1 soils can be used for arable agriculture including the production of early potatoes and field vegetables; and soils of both associations are suitable for stock rearing on permanent grassland.

Traffic and Transport

7.3.95 Considerations for Options 5D and 5E are dependent on the location and alignment of access tracks for construction of a new overhead line. Generally access via the B5420 to the east would be preferable to access from the direction of Star, particularly due to existing culverts and a tight horizontal vertical alignment along National Cycle Route 8.

Construction Noise

7.3.96 These options would be within a very rural area where there are few NSRs, and baseline noise levels are likely to be very low. Construction works in this area would be relatively short-term and would involve construction of the pylons and stringing. With careful routeing and micro siting to maximise proximity to NSRs, few if any significant effects would be anticipated.

Operational Noise

7.3.97 Options 5D and 5E would follow the existing 400 kV overhead line and introduce a short new section of overhead line to the northwest and north of Llanfairpwllgwyngyll. The character of the area is generally rural where baseline levels are likely to be very low, especially at night. A new overhead line would pass a few isolated residential properties; minimum distances would depend on the location of the CSEC. Given the larger, and hence quieter, design of line that is currently preferred major adverse effects are unlikely to be predicted. On this basis it is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5.

Socio Economic

7.3.98 Neither Option 5D or 5E run in close proximity to socio-economic receptors. Like all of the options, there are scattered residential properties close by. Individual residences are not considered as socio-economic receptors. However, there is a greater likelihood of community effects such as severance and amenity to occur where there are higher numbers of residences affected. In this case, both Option 5D and 5E are in proximity to a relatively small number of residential properties; as such there is nothing significant to distinguish these options from a socio-economic perspective.

Technical

7.3.99 Options 5D and 5E are relatively comparable to Option 5B in length. These options are direct and would require few angle type towers. They would largely parallel the existing 400 kV overhead line thus creating an infrastructure corridor.

7.3.100 The options are constrained by three small areas/strips of land identified as Flood Zone 2 or 3, thus potentially restricting the flexibility for detailed routeing of an alignment and locating pylons.

7.3.101 Access to both options would be from the local road network. Both options would require some access works adjacent to / crossing land identified as Flood Zone which may increase construction complexity. These options would have the least number of pylons when compared to other options. Crossing protection would be required at one local road crossing location for both options.

7.3.102 The construction complexity of both options is increased as a transposition is required to enable an alignment to cross from the west to the east side of the existing 400 kV overhead line.

Option 5F (Gwynedd)

7.3.103 Option 5F would run from the Gwynedd South CSEC Search Area, north of Aberpwll, and up over the valley side to link to the existing Pentir Substation.

7.3.104 Option 5F is the southernmost option connecting Gwynedd South to Pentir. It would connect a CSEC close to the Y Felinheli side of the CSEC Search Area. Depending on the location of the CSEC, this option may need to cross the A487 which forms the main tourist route to Caernarfon and the Llyn Peninsula.

Landscape and Visual

7.3.105 This option potentially requires the removal of areas of vegetation as it would follow a route along Coed Nant-y-garth. Much of this vegetation is ancient woodland. Removal would be dependent on clearance requirements, as much of the vegetation is located within the bottom of a steep valley.

7.3.106 There are a number of properties to the south which would have close proximity views including Garth Fawr and Garth Farm. As these properties have an elevated position, they have long distance views towards Anglesey which would be interrupted by this option.

Historic Environment

7.3.107 There are no designated heritage assets that would be affected directly by the construction of an overhead line within this option. However the setting impact on a terrace of Grade II listed buildings (1-3 Singrig, LB 18340,18353 & 18354), the Vaynol Grade I Registered Park and Garden and a Scheduled standing stone (Coed Nant-y-garth, standing stone, AN375) make the landscape within which the option passes through, of high value. It is also wholly within the Arfon Plateau character area of the Dinorwig Registered Landscape of Outstanding Historic Interest.

Ecology

7.3.108 Option 5F is routed though areas of woodland comprising mixed plantation, mixed semi-natural and coniferous plantation woodland, and grazed improved grassland intersected by hedgerows and watercourses. Small pockets of semi-improved grassland, and scattered and dense scrub are also present.

7.3.109 This option has the potential to affect a number of areas of high biodiversity value on a National, County and Local scale, including:

- a number of CWSs including the Pentir Substation CWS, Coed Nant y Garth CWS, and Coed Pont Ladi-wen CWS, potentially resulting in habitat loss and fragmentation, the majority of which would consist of woodland habitats, which could not be replaced beneath an overhead line;
- areas of restored ancient woodland and plantation on ancient woodland sites (such sites are difficult to mitigate for);
- a section of woodland edge. This could be difficult to mitigate for a number in relation to woodland edge species, including bats, birds and invertebrates;
- potentially 2 watercourses which may need to be crossed; and
- ponds (in the vicinity).

7.3.110 There are existing records of grass snake, otter, birds of prey, red squirrel and harvest mouse, and there are habitats present which are considered suitable for great crested newt, badger, bats and water vole.

Soils and Agriculture

7.3.111 The provisional 1:250,000 scale ALC mapping shows the agricultural land within Option 5F is predominately Grade 4 (Poor quality), with small areas of Grade 3 (Good to Moderate quality) and Grade 5 (Very Poor quality).

7.3.112 Data from the Soil Survey of England and Wales shows that the Wick 1 (541r) soil association) is predominant across Option 5F, with a small area of Fforest (713c) soil association present at Pentir. The Wick 1 soils are coarse, well drained sandy loams, whereas Fforest are seasonally waterlogged loamy soils, and therefore could require longer periods of restricted handling to prevent structural damage.

7.3.113 No formalised AES have currently been identified in Option 5F.

Traffic and Transport

7.3.114 Option 5F would require access tracks to be constructed from Pentir Substation as the existing configuration of the land and narrow local roads make direct access from the strategic highway network extremely challenging. Access to Options 5F, 5G and 5H would sever one local road, an Unnamed Road to the north of Pentir Substation, which lies between Seion to the west and Ffordd Fodlodydd to the east. Temporary road closures might therefore be required. Construction traffic could utilise the existing substation access junction along the B4547.

Construction Noise

7.3.115 With regard to potential construction noise and vibration effects, this option is very rural and hence has a low baseline noise environment. Few NSRs would be affected. Construction works in this area would be relatively short-term and would involve construction of the pylons and stringing. With careful routeing and micro siting to maximise proximity to NSRs, few if any significant effects would be anticipated

Operational Noise

7.3.116 Option 5F would introduce a new short section of overhead line into a predominantly rural area. Baseline levels are likely to be elevated slightly by distant traffic on the nearby roads, there will be periods of time when this is likely to be very low, especially at night. A new overhead line would pass a few isolated residential properties although it is likely distances could be maintained beyond approximately 70m. Given the larger, and hence quieter, design of line that is currently preferred then major adverse effects are unlikely to be predicted. On this basis it is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5.

Socio Economic

7.3.117 Option 5F is in close proximity to a small number of isolated dwellings but is removed from any settlements. There are holiday cottages at Glyndwr between Bangor Street (B4547) and the Y Felinhelli Bypass which are located approximately 0.5km from Option 5F. At its easternmost, this option is less than 300m from National Cycle Route 8.

7.3.118 Option 5F also passes in close proximity to a disused quarry which has consent as an inert landfill. Planning consent was granted in May 2016 for minor amendments to the finished profile of the landfill so as to allow ease of reinstatement and create a landform capable of establishing a woodland. This site does not appear to be currently active.

Technical

7.3.119 Option 5F is the second longest of the three options in Gwynedd. It is relatively direct would require a low number of angle type structures. The option would involve crossing a wooded gorge (see 'Ecology' above), the B4547 and thereafter would traverse a ridgeline adjacent to a landfill site (former quarry) that is also constrained by a residential property. Much of the option also traverses through Coed Nant y Garth (a wildlife site). These considerations would be likely to reduce flexibility for a detailed alignment and locating pylons.

7.3.120 Access would be from the local road network. The gorge, landfill site and wildlife site would increase construction complexities. Crossing protection would be required at the B4547 and at one other local road crossing location.

Option 5G (Gwynedd)

7.3.121 Option 5G would be a more direct link, the shortest of the proposed options from the Gwynedd South CSEC Search Area to the existing Pentir Substation, running from the A4087/B4547 roundabout and up over the valley side to link to the existing Pentir Substation. This option would require little vegetation removal as it travels through fields towards the substation.

Landscape and Visual

7.3.122 Properties on Fodolydd Lane and to the south of a new overhead line would have long distance views towards Anglesey and the existing 400 kV overhead line. A new overhead line would be in close proximity to the properties on Fodolydd Lane. The property at Rhos-fawr to the north-west of Pentir Substation would also be affected as this property also has long distance views north-west towards Anglesey.

7.3.123 A new overhead line would also be visible for people travelling south on the A487 from the junction with the A55; this section of the road is at a similar elevation and would have views directly across to it. This section of the A487 forms part of National Cycle Route 8 (Lôn Las Cymru) and the Wales Coast Path.

7.3.124 At Pentir Substation tree removal would be required for the line entries, some of which is ancient woodland. This may open up views of the substation from the minor road to the north.

Historic Environment

7.3.125 The option would cross over a Scheduled Ancient Monument (SAM AN175). In addition, there is potential setting impact on two other Scheduled Ancient Monuments (AN375 and CN203), which include a standing stone. It is also wholly within the Arfon Plateau historic character area of the Dinorwig Registered Landscape of Outstanding Historic Interest.

Ecology

7.3.126 Option 5G is routed though areas of woodland comprising mixed plantation, mixed semi-natural and coniferous plantation woodland, and grazed improved grassland intersected by hedgerows and watercourses. Small pockets of marshy grassland, poor semi-improved grassland, and dense scrub are also present.

7.3.127 This option has the potential to affect a number of areas of high biodiversity value on a National, County and Local scale, including:

- a number of CWSs including the Pentir Substation CWS, Fodol Ganol CWS, Coed Rhos-fawr CWS, which would result in habitat loss and fragmentation, the majority which comprises woodland habitats which could not readily be replaced beneath an overhead line;
- areas of ancient woodland of unknown category and plantation on ancient woodland sites (such sites are difficult to mitigate for);
- an area allocated under the Woodland Grant Scheme;
- potentially 1 watercourse may need to be crossed; and
- ponds (in the vicinity).

7.3.128 There are existing records of badger and pole cat, and there are habitats present which are considered suitable for great crested newt, bats, red squirrel.

Soils and Agriculture

7.3.129 The provisional 1:250,000 scale ALC mapping shows the agricultural land throughout Option 5G is classed as Grade 4 (Poor quality) and Grade 5 (Very Poor quality).

7.3.130 Data from the Soil Survey of England and Wales shows that the Wick 1 (541r) soil association) is predominant across Option 5G, with a small area of Fforest (713c) soil association present at Pentir. The Wick 1 soils are coarse, well drained sandy loams, whereas Fforest are seasonally waterlogged loamy soils, and therefore could require longer periods of restricted handling to prevent structural damage.

7.3.131 No formalised AES have currently been identified in Option 5G.

Traffic and Transport

7.3.132 As with Option 5F, Option 5G would require access tracks to be constructed from Pentir Substation as the existing configuration of the land and narrow local roads make direct access from the strategic highway network extremely challenging. Access to Options 5F, 5G and 5H would sever one local road, an Unnamed Road to the north of Pentir Substation, which lies between Seion to the west and Ffordd Fodlodydd to the east. Temporary road closures might therefore be required. Construction traffic could utilise the existing substation access junction along the B4547.

Construction Noise

7.3.133 With regard to potential construction noise and vibration effects, this option is very rural and hence has a low baseline noise environment. Few NSRs would be affected. Construction works in this area would be relatively short-term and would involve construction of the pylons and stringing. With careful routeing and micro siting to maximise proximity to NSRs, few if any significant effects would be anticipated

Operational Noise

7.3.134 Option 5G would introduce a short new section of overhead line into a predominantly rural area. Baseline levels are likely to be elevated slightly by distant traffic on the nearby roads, however there will be periods of time when this is likely to be very low, especially at night. A new overhead line would pass a few isolated residential properties although it is likely greater distances could be maintained for this option compared to Options 5F or 5G. On this basis it is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5.

Socio Economic

7.3.135 Option 5G runs through open countryside although there are a small number of scattered residential properties. As previously explained, individual residences are not considered as socio-economic receptors; as such there is nothing significant to distinguish this option from a socio-economic perspective.

Technical

7.3.136 Options 5G is the shortest of the three options in Gwynedd, is the most direct and would require a low number of angle type structures. Crossing protection would be required at two local road crossing location.

7.3.137 Access would be from the local road network. Some accommodation and upgrade works would be likely to be required on the narrow local road running parallel to the west of the option.

Option 5H (Gwynedd)

7.3.138 Option 5H would link the Gwynedd North CSEC Search Area to the existing Pentir Substation. It runs generally parallel to the existing 400 kV overhead line adjacent to the A55 and up over the valley side to link to the substation. This area is part of the Menai SLA

7.3.139 Option 5H is the only option to connect Gwynedd North to Pentir Substation and is the longest of the proposed options. It is also the only option that offers the opportunity to closely parallel the existing 400 kV overhead line. The route runs adjacent to the A55 before travelling south-east past Capel-y-graig, crossing the A4087 and heading up the slope towards Pentir Substation.

Landscape and Visual

7.3.140 This option would require removal of ancient woodland around the Parc Menai Business Park as it exits Gwynedd North. The first section of the overhead line would also be visible from the promoted viewpoint on the Anglesey side of the Menai; a very popular tourist stop where visitors have views towards Snowdonia National Park. A new overhead line would be visible directly below Snowdon and in combination with the existing 400 kV overhead line.

7.3.141 A new overhead line and the existing 400 kV overhead line would straddle a short section of the A55 creating a corridor of pylons either side of the road which is used by many people visiting Anglesey, or entering Gwynedd after travelling from Holyhead. .

7.3.142 The settlement of Capel-y-graig would be affected by Option 5H as is passes between Bryniau-heulog and the properties along Penrhos Road. Bryniau-heulog would become closely encircled by the existing 400 kV overhead line and a new overhead line within Option 5H. Properties on Penrhos Road have filtered views towards Snowdonia and a new overhead line would be in close proximity and affect these views. The new overhead line would cross the A4087 but would span at a high level as the road in this location is in cutting and benefits from vegetation either side which contains views to the road corridor.

7.3.143 After it crosses the A4087, the new overhead line would pass between properties at Hafod-yr-Haf and Tyddyn-dû. Tyddyn-dû has views west towards Option 5H and would be closely encircled by the existing 400 kV overhead line and Option 5H. As Option 5H travels towards Pentir some vegetation loss may be required at Gors y Brithdir; it would also pass close to property at Hafodal-newydd which has views east.

7.3.144 As Option 5H approaches Pentir Substation, tree removal would be required, some of which is ancient woodland. This may open up views of the substation from the minor road to the north.

Historic Environment

7.3.145 This option crosses directly over a Scheduled Ancient Monument (SAM CN203). In addition there is potential setting impact on two other Scheduled Ancient Monuments (AN175 and CN203) which make the historic landscape within which the option passes of high value. It is also within the Vaynol and Arfon plateau character areas of the Dinorwig Landscape of Outstanding Historic Interest.

Ecology

7.3.146 Option 5H is routed though areas of woodland comprising mixed plantation, mixed semi-natural and coniferous plantation woodland, and grazed improved grassland intersected by hedgerows and watercourses. Small pockets of marshy grassland, poor semi-improved grassland, and dense scrub are also present.

7.3.147 This option has the potential to affect a number of areas of high biodiversity value on a National, County and Local scale, including:

- a number of CWSs including the Pentir Substation CWS, Coed Rhos-fawr CWS, and Park Menai Woodlands which would result in habitat loss and fragmentation, some of which comprises woodland habitats which could not be replaced beneath an overhead line. This option also lies in close proximity to further CWSs such as Fodol Ganol;
- areas of ancient semi-natural woodland, restored ancient woodland and plantation on ancient woodland sites (such sites are difficult to mitigate for);
- an area allocated under the Woodland Grant Scheme;
- Coedydd Afon Menai SSSI (located 0.65km north west of the route corridor boundary at its closest point). Important for its birds, butterflies, reptiles and insects, there is potential for collision risk from overflying birds. Other species are unlikely to be affected;
- Eithinog SSSI (approximately 1.3km east of Option 5H), designated for its diverse grassland and fungi. There would be no effects upon the designating features of the site;
- potentially 3 watercourses may need to be crossed; and
- ponds in the vicinity.

7.3.148 There are existing records of slow worm, barn owl, otter, red squirrel, and peregrine, and there are habitats present which are considered suitable for to great crested newt, bats, reptiles, badger and water vole.

Soils and Agriculture

7.3.149 The provisional 1:250,000 scale ALC mapping shows the agricultural land within Option 5H is classed as ALC Grade 3 (Good to Moderate quality), Grade 4 (Poor quality) and Grade 5 (Very Poor quality).

7.3.150 Data from the Soil Survey of England and Wales shows the Wick 1 (541r) soil association is predominant across Option 5H; with small sections of Brickfield 2 (713f) and East Keswick 3 (541z) at Gwynedd north; and a small section of Fforest (713c) soil association at Pentir. The Fforest and Brickfield 2 are seasonally waterlogged loamy soils, and therefore could require longer periods of restricted handling to prevent structural damage; whereas the Wick 1 and East Keswick 3 soils are well drained sandy loams which can be handled over longer periods.

7.3.151 No formalised AES have currently been identified in Option 5H.

Traffic and Transport

7.3.152 Option 5H would need to cross significant highway infrastructure (A487) making it challenging in terms of transport and access. As with Options 5F and 5G, access for Option 5H would sever one local road, an Unnamed Road to the north of Pentir Substation, which lies between Seion to the west and Ffordd Fodlodydd to the east. Temporary road closures might therefore be required. Construction traffic could utilise the existing substation access junction along the B4547.

Construction Noise

7.3.153 On the western side of the A55, there are very few NSRs, noise from construction activity would be masked by traffic noise from the A55 for those NSRs on the eastern side. South of where the A55 deviates to the east, the option passes a number of houses (Capel-y-Graig) and a farm but baseline noise levels will be elevated due to road noise. From the A4087 crossing, the area is primarily open farmland with no dwellings in close proximity.

7.3.154 Option 5H contains high to low baseline noise environments but few NSRs would be affected. Construction works in this area would be relatively short-term and would involve construction of the pylons and stringing. With careful routeing and micro siting to maximise proximity to NSRs, few if any significant effects would be anticipated.

Operational Noise

7.3.155 Option 5H would follow the existing 400 kV overhead line and the A55 as far as practicable and would introduce the longest section of new overhead line in Gwynedd. The area is predominantly urban to the north and rural to the south. Baseline levels are likely to vary greatly, being much higher in the urban area than the more rural area. However, there will be periods of time when this is likely to be very low, especially at night. A new overhead line would pass the closest to residential properties, with the closest being approximately 50m.

7.3.156 Given the larger, and hence quieter, design of line that is currently preferred major adverse effects are unlikely to be predicted. On this basis it is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5, although the alignment may present more challenges that the other options.

Socio Economic

7.3.157 Option 5H runs south through the Parc Menai Business Park The Parc contains a wide range of public, private and voluntary sector businesses as well as Coleg Menai, a hotel and a children's nursery. A new overhead line would run parallel to the A55 (the primary route to Anglesey), over its junction with the A487 in close proximity to the Wales Coast Path and across National Cycle Route 8, which runs parallel to the A487.

7.3.158 At it runs south of the A487 this option would pass adjacent to clusters of residential properties at Capel-y-graig and Bryniau-heulog. As previously explained, individual residences are not considered as socio-economic receptors; however where there are groups of residences in proximity, this could result in community effects such as severance and amenity. .

Technical

7.3.159 Option 5H is the longest of the three options in Gwynedd. It is relatively direct, generally following the existing 400 kV overhead line and would require a number of angle type structures in order to avoid constraints. The option is extremely constrained at the northern end by the Treborth Wastewater Treatment Works, a lower voltage substation, Parc Menai Business Park, the A55, A4087, numerous slip roads and the existing 400 kV overhead line.

7.3.160 Major crossing protection would be required at the A487, A4087, slip roads on and off the A55. Crossing protection would be required at four other local road locations. Further south the option crosses a Scheduled Ancient Monument (see 'Historic Environment' above). The option would present numerous challenges regards restricting the flexibility for detailed routeing of an alignment and locating pylons, especially in the vicinity of the wastewater treatment works and substation where there are many buried services.

7.3.161 Access to the option would be from the local road network. The constrained nature of the area as identified above and particularly the presence of some important A roads would be likely to create major construction challenges for this option.

7.4 Consideration of Options

7.4.1 On Anglesey Option 5A was the most opposed option, although feedback responses provide comments on all the options. Similarly in Gwynedd feedback provided comments on all options.

Landscape and Visual

7.4.2 On Anglesey, Options 5D and 5E are preferred. These options would reduce the spread of the influence of overhead lines, are the shortest options, would reduce the potential effects on Star and would not need to cross the A55 or A5 thus avoiding affecting views towards Snowdonia for an increased number of people using these routes. These options would also avoid the SLA, reduce potential effects on Bryn Celli Ddu and would not closely encircle any properties.

7.4.3 The least preferred option is Option 5A. It is the longest option and would increase the influence of overhead lines on Anglesey affecting the uninterrupted views which many people have towards Snowdonia. Option 5A would affect the settlements of Gaerwen and Llanddaniel Fab by introducing pylons into views between the settlements. This option would potentially be visible to the west of Bryn Celli Du where there is currently no infrastructure of this type and would introduce an overhead line into the SLA.

7.4.4 In Gwynedd, Option 5G is preferred. This option is significantly shorter than the other options and, although it would affect three properties in quite close proximity, it would affect fewer receptors than the other options assessed.

7.4.5 Option 5H is least preferred due to the potential effects on the A55, Capel-y-graig, enclosing of properties and most significantly the effects on the promoted viewpoint on Anglesey and views towards Snowdonia.

Historic Environment

7.4.6 Of options on Anglesey Option 5C is preferred as this a shorter route and would be further away from the scheduled remains of an early medieval cemetery (AN120). It would also keep the pylons at the furthest distance from Bryn Celli Ddu Burial Chamber and Tyddyn-Bach Standing Stone. This shorter route may also limit the potential for effects on previously unrecorded archaeological remains as it would be likely to involve a smaller area that may be affected by groundworks associated with construction.

7.4.7 Option 5A is the least preferred as while it would not directly affect any designated heritage assets, the anticipated groundworks associated with its construction would result in greater disturbance to potential previously unrecorded archaeological remains. It would also affect the wider setting of Bry Celli Ddu and Tyddyn-Bach Standing Stone, both Scheduled Ancient Monuments.

7.4.8 In Gwynedd Option 5H is preferred. Although this could entail oversailing a Scheduled Ancient Monument (CN203), the existing overhead line already passes close to this monument.

7.4.9 Although Option 5G could oversail the Scheduled Ancient Monument (CN175) with detailed routeing / micrositing this may be avoided. Option 5F is therefore least preferred.

Ecology

7.4.10 On Anglesey Options 5B and 5C are preferred.

7.4.11 Option 5A is the least preferred as it would have an increased risk of bird collision, due to being located between a site designated for its bird interest and the Menai Strait. It would also pass through a CWS thereby resulting in habitat loss which could not easily replaced due to restrictions on planting beneath overhead lines.

7.4.12 Options 5D and 5E both potentially terminate within a CWS and habitat of greater value than the mainly grazed improved grassland in the area. In addition to the direct effects on the habitat and species associated with it, indirect effects could also include habitat loss due to changes in local hydrology where construction lies outside of, but close to, the CWS.

7.4.13 Within Gwynedd, Option 5G is preferred as it would potentially have less effect on CWSs and ancient woodland than Options 5F and 5H. It is also substantially shorter.

Soils and Agriculture

7.4.14 On Anglesey, Options 5B is most preferred against 'Land Use and Agriculture' considerations as all land is identified as non-BMV, (ALC Grades 4 and 5), however it is noted that this option contains 'organic' land which is managed for nature conservation. Options 5C, 5D and 5E are next preferred as they all contain areas of Grade 3 land and arable farming has been identified, therefore development of these Options may impact BMV agricultural land.

7.4.15 On Anglesey, Option 5A is the least preferred. Option 5A represents the longest route; and therefore it is anticipated that this Option would result in the highest level of disturbance to agricultural land due to a greater number of pylons and associated accesses; and / or a greater number of individual land owners being affected. Grade 3 land, arable farming practices and the potential for impact to impact BMV agricultural land has also been identified within this Option.

7.4.16 In Gwynedd, Option 5G is preferred as it represents the shortest route. It is therefore anticipated that Option 5G would result in the least amount of disturbance to agricultural land due to a requirement for fewer pylons and associated accesses; and / or a fewer number of individual land owners being affected. Additionally, this Option is located on Grade 4 and 5 (non-BMV) land and no AES have currently been identified.

7.4.17 In Gwynedd, Options 5F and 5H are least preferred due to their increased length and the presence of Grade 3 land (potential for BMV).

Traffic and Transport

7.4.18 With regard to traffic and transport, the preferred option on Anglesey is Option 5E, as this would avoid the need to cross significant transport infrastructure, i.e. the A55, A55 and the railway line.

7.4.19 The preferred option in Gwynedd is Option 5F, or Option 5G. Each of these options would have the potential to utilise construction access tracks which could be shared with other scheme elements therefore limiting the number of construction vehicles on the local highway network.

7.4.20 Option 5H from Gwynedd North would involve the need to cross the A487, which would involve some complexity due to differences in topography. This option is therefore least preferred.

Construction Noise

7.4.21 In relation to the potential construction noise and vibration effects associated with each overhead line option, construction works are generally unlikely to result in significant effects. With careful routeing and micro siting to maximise distances to NSRs, few if any significant effects are anticipated for any of the options and there is therefore no preference.

Operational Noise

7.4.22 Given the larger, and hence quieter, design of line that is currently preferred major adverse effects are unlikely to be predicted at it is considered that all options could be designed to satisfy the requirements of EN-1 and EN-5.

7.4.23 On Anglesey Option 5A is least preferred due the length of new overhead line in an area with few existing noise sources, in Gwynedd Options 5D and 5E are not preferred due to the length of new overhead line that would be required. There is however little to differentiate between the options for Gwynedd.

Socio Economic

7.4.24 On Anglesey Options 5D and 5E are preferred as no significant socio-economic receptors have been identified. Option 5A is the least preferred option as it is the longest overhead line route as well as passing in proximity to the communities of Llandaniel Fab and Star, and in proximity to Bryn Celli Ddu. Options 5B and 5C are both less preferred primarily due to landscape and visual concerns over the community of Star which in combination with other environmental effects could result in amenity effects on these communities.

7.4.25 In Gwynedd Option 5G is the preferred option as there are no significant socio-economic receptors identified and it is the shortest overhead line route. Option 5H is the least preferred option as it would pass through Parc Menai which includes businesses, a hotel and restaurants.

Technical

7.4.26 On Anglesey, Options 5D and 5E are preferred. These options would not need to cross the A55, A5 and the railway line thus reducing construction complexity when compared against other options. The least preferred is Option 5A as it would be the longest, and as such require the most new structures. Additionally Option 5A would traverse a stretch of low lying wetland that may increase construction complexity.

7.4.27 In Gwynedd, Option 5G is preferred. This option would be significantly shorter than other options, reducing the volume of new build structures and as such reducing the construction complexity. Option 5H is the least preferred option as it is severely constrained by existing infrastructure.

7.5 Initial Preference

7.5.1 There is no definitive outcome identifying a preferred options in either Anglesey or Gwynedd.

7.5.2 On Anglesey no discipline preferred Option 5A and of those which expressed a preference for a number it was least preferred (Landscape and Visual, Historic Environment, Ecology, Land Use and Agriculture, Socio Economic, and Technical).

7.5.3 Without considering the CSEC Search Area, on Anglesey Option 5A would be discounted as other options are more favourable. Although Options 5D / 5E were favoured by a number of disciplines other options could not be discounted at this stage without consideration of other elements of the project (CSEC siting areas, cable routes, crossing zones etc.).

7.5.4 In Gwynedd there was a similarly no definitive outcome although Option 5H was least favoured by all disciplines with the exception of Historic Environment (for which it was the preferred option). Option G would raise significant technical challenges. Option 5G was the preferred option for all disciplines except Historic Environment.

7.5.5 Without considering the CSEC Search Areas, although favoured by Historic Environment Option 5H would be discounted as there are significant technical challenges and other options are more favourable. Neither Option 5F nor 5G could not be discounted at this stage without consideration of other elements of the project (cable routes, crossing zones etc.).

8. IDENTIFICATION OF SEALING END COMPOUND SITING AREAS

8.1 Introduction

8.1.1 A Cable Sealing End Compound (CSEC) is be required to change from an overhead line to an underground cable or vice versa (see Figure 5.2). To inform the studies it has been assumed that CSEC size of approximately 100m x 60m would be required, which would be capable of accommodating two 400kV circuits, each comprising six cables (i.e. the maximum 12 cables that could be required).

8.2 Considerations for Siting

8.2.1 Environmental[31] and engineering factors were considered in the initial identification and review of siting areas, including:

- Landscape and Visual;
- Historic Environment;
- Ecology;
- Soils and Agriculture;
- Hydrology and Flood Risk;
- Traffic and Transport;
- Socio economic; and
- Technical / Constructability

8.2.2 From a landscape and visual perspective, the guiding influence on the location of a CSEC will be the route of the proposed overhead line as this will be the most visible part of the scheme. CSECs require appropriate siting in line with the Horlock Rules[32], however, the effects of a CSEC are more easily mitigated than those of the overhead line. The considerations and preference for overhead line options has been discussed previously in Chapter 6 of this Report. The appraisal, in terms of 'landscape and visual' considerations has had regard to the conclusions for the overhead line options but has also considered the effects of each of the CSEC siting areas and the requirements for routeing overhead line options to the particular siting areas.

[31] Constraints Plans have previously been included in National grid: Wylfa Pentir Route Options Report (with Appendices October 2015 (see Figures B5-1A and B5-1B).
http://nationalgrid.opendebate.co.uk/files/nationalgrid/North_Wales/WP%20Route%20Optns%20Rpt_Final%20(Full%20Issue),%20Oct15_LR.pdf

[32] Horlock Rules, National Grid, 2003

8.2.3 From an ecological perspective the siting of a CSEC within a search area needs to give consideration to the potential area of permanent habitat loss and the effect on associated species. Routeing of an overhead line / cable connection is also an important consideration, in particular where the loss of habitat type beneath the overhead line and above the cable would prevent replacement of lost habitat, for example trees / woodland.

8.2.4 National Grid considers flood risk when siting new installations. Wherever possible CSEC siting options have been identified in areas with the lowest probability of flooding (indicative Flood Zone 1). This is in accordance with NPS EN-1.

8.2.5 Technical considerations include features such as topography, slopes and existing services / infrastructure. A flat level site and access close to existing highways is preferred, where possible avoiding other significant services, for example high pressure gas and water infrastructure, and their easements. Rock and geological features are also considered as are water courses.

8.2.6 Overhead line route corridors were refined, where necessary, to connect with the CSEC siting areas and cable routes identified to the Crossing Zones (see Chapters 8 and 9 of this Report). Environmental and engineering factors were again considered and engineering site visits were undertaken.

8.2.7 The CSEC siting areas identified are illustrated on Figure 8.1.

8.3 Consultation Feedback

General

8.3.1 Some respondents stated that they could not provide feedback at this stage as the search area for sealing end compounds were too wide and the crossing options for the Menai Strait are not yet decided.

8.3.2 Property owners also voiced concerns that a sealing end compound may obstruct the access to properties.

Anglesey North Search Area

8.3.3 Anglesey North was the most preferred search area (mainly because it would connect to Options 5D / 5E the most widely supported routes). Other reasons noted were that it is a comparatively less populated, a less environmentally sensitive area and that it is already industrialised. One respondent noted that there are important habitats in this area.

8.3.4 One respondent objected to Anglesey North, stating that it would bring the pylons closer to the A5025 which is a major tourist route.

8.3.5 Concerns were also raised over the significant disruption to the A5025 and the A5 that the undergrounding process would cause.

8.3.6 Cadw noted that the proposed Anglesey North CSEC Search Area has the potential to affect Ty Mawr and Pen Y Berth burial chamber.

8.3.7 NRW noted that Anglesey North contains an area prone to flooding.

IACC preferred Anglesey North.

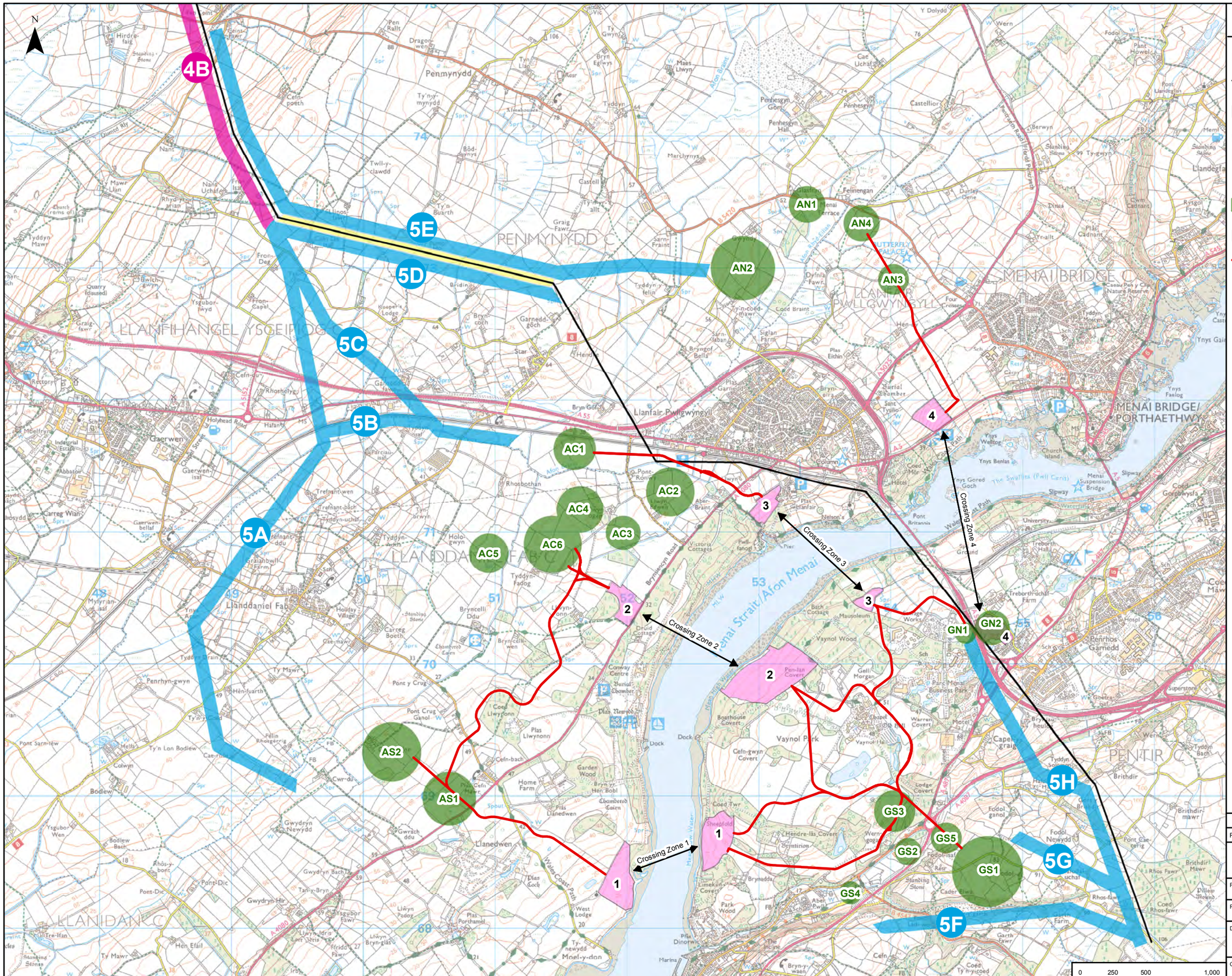


Figure 8.1

Legend

- Existing National Grid 400 kV overhead line
- Area of potential line swap-over

Overhead Line Route Options

- Section 4
- Section 5
- Cable Sealing End Compound (CSEC) Siting Areas
- Crossing Zones
- Underground Cable Routes

Rev	Date	Description	GIS	Chk	App
0	22/09/2016	Initial Issue	JB	JF	JC

nationalgrid

Project Name: NORTH WALES CONNECTION PROJECT

Report Title: MENAI STRAIT CROSSING REPORT

Document Title: FIGURE 8.1
OVERHEAD LINE ROUTE CORRIDORS, UNDERGROUND CABLE ROUTE CORRIDORS AND MENAI CROSSING ZONES

Creator:	Date:	Checker:	Date:	Approver:	Date:
JB	22/09/2016	JF	22/09/2016	JC	22/09/2016

Document Type:	Scale:	Format:	Sheets:	Rev:
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Anglesey Central Search Area

8.3.8 Those respondents who supported this search area did so because it is close to existing infrastructure (A55 and A5), has already experienced industrial developments (particularly in its eastern end), and would have the least impact on the local landscape. Some respondents also noted that Anglesey Central would provide the shortest distance for the proposed pylons and is relatively close to the Gwynedd North and Gwynedd South CSEC Search Areas.

8.3.9 Gwynedd County Council expressed concern about the visual effect of locating a Sealing End Compound in Gwynedd South, adding that this area does not have a visual relationship with the existing overhead lines. Gwynedd County Council was supportive overall of the identified CSEC search areas as long as they avoid statutory designated conservation area, but between the two are most concerned about the location of Gwynedd South.

8.4 Description of Options

Anglesey North Search Area

8.4.1 Five siting areas have been identified, all located north of the A55 and north of Llanfairpwllgwyngyll in a very rural area and within the crescent formed by the B5420. The sites are all in agricultural use.

8.4.2 CSEC siting areas within Anglesey North have the potential to affect the CWS Coed Braint / Syglen / Dyfnia and the restored ancient woodland site. These sites are within the Anglesey North Search Area and could be affected either directly or indirectly (through hydrological impacts). Other habitats present in the search area include the Afon Rhyd Eilian and the marshy grassland associated with the above CWS.

8.4.3 CSEC siting areas in Anglesey North are all in close proximity to Afon Rhyd Eilian and associated Development Advice Zone C2[33]. The Anglesey North CSEC siting areas are located in the Upper Braint River Catchment which has a WFD status of good.

8.4.4 Access to a CSEC in Anglesey North would be achieved from an unnamed road between Star and the B5420. The most suitable construction traffic route would be from the west from Junction 8 of the A55 utilising the A5025 and the B5420 towards Penmynydd. From the east, narrow roads and issues with horizontal alignment make this direction less desirable. Some temporary traffic management would be likely to be required to ensure vehicle speeds within the vicinity of the construction bellmouths could be reduced and safe Site Stopping Distances (SSD's) achieved. Temporary remedial works at Junction 8, Four Crosses Roundabout and along the B5420 may be required to ensure Abnormal Indivisible Loads are facilitated safely along the construction traffic route. Further investigation would be required to determine the traffic impact along the routes outlined above.

[33] Welsh Assembly Government. Technical Advice Note 15, Development & Flood Risk. Development Advice Map. [Online] http://data.wales.gov.uk/apps/floodmapping/

AN1

8.4.5 Siting area AN1 consists of pastoral fields adjacent to the B5420 to the north of the search area.

Landscape and Visual

8.4.6 AN1 is located opposite a group of properties at Glasfryn, Felinengan and Menai Terrace on the B5420 which have views towards Snowdonia; there are filtered views of the existing 400 kV overhead line from here. A CSEC located within AN1 would bring the new overhead line in close proximity to these properties and the property at Gwyndy. This location would be visible from the road and properties although there is scope for introducing planting as mitigation; such measures would reflect and enhance the character of the landscape which contains a number of woodland areas and tree lined hedges. Although mitigation planting would help to screen the CSEC it may also restrict views towards Snowdonia.

Historic Environment

8.4.7 AN1 is located north east of a group of Grade II listed buildings at Gwyndy. While no formal setting study has been carried out, the current principal view of the farmstead is down the entrance track from the west looking due east and from the road looking east. Views of the farmstead from the west looking east would have the CSEC in the background.

8.4.8 AN1 would not affect any known non designated heritage assets recorded on the Historic Environment Record, however any groundworks associated with this option may affect previously unrecorded archaeological remains.

Ecology

8.4.9 Habitats present within AN1 include improved grassland, marshy grassland and hedgerows.

8.4.10 The siting area would have the potential to affect, either directly or indirectly (e.g. through hydrological effects), the following:

- Ancient Woodland and a CWS, Coed Braint, Syglen and Dyfnia, (immediately to the south);
- additional SSSIs, CWSs and NWWTs, located more than 1km from the siting area, and the SAC Y Fenai a Bae Conwy / Menai Strait and Conwy Bay and the SSSI Glannau Porthaethwy (approximately 1.9km south east). These are unlikely to be directly affected by the CSEC itself but could be indirectly affected through the routeing options;
- numerous drains with water vole records (immediately to the south);
- the Afon Rhyd Eilian (approximately 65m to the east); and
- a large area of marshy grassland (immediately to the south).

8.4.11 There would also be the potential to affect protected / notable species such as great crested newt, water vole, otter, badger, invertebrates, bats and red squirrel.

Soils and Agriculture

8.4.12 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land at AN1 is Grade 4 (Poor quality).

8.4.13 Data from the Soil Survey of England and Wales shows that AN1 is comprised of soils from the Brickfield 2 (713f) and East Keswick 1 (541x) soil associations. The Brickfield 2 soils are seasonally waterlogged and therefore could require longer periods of restricted handling to prevent structural damage; whereas East Keswick 1 comprises well drained loamy soils which can be handled over longer periods. Soils of both associations are suitable for stock rearing on permanent grassland; and, although East Keswick 1 soils can be used for arable agriculture including the production of early potatoes and field vegetables, data from consultations with landowners undertaken by National grid and aerial imagery indicates that land use within AN1 is pasture.

Construction Noise

8.4.14 AN1 is in an area in agricultural use with a small community to the north. A Recycling Centre lies to the west. There are also a small number of properties ((two/three) to the east. This option would have residential NSRs in close proximity in a very quiet/quiet baseline noise environment.

Operational Noise

8.4.15 AN1 is in a very quiet baseline area and is close to residential properties at Glasfryn. Although only low levels of operational noise would be predicted from overhead line equipment within the CSEC and it is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5, this location would not be preferred.

Socio Economic

8.4.16 No socio-economic receptors have been identified in proximity to this siting area.

Technical

8.4.17 In summary

- the topography varies from very steep (where extensive earthworks would be required, to flat (minimal earthworks required). The extent of earthworks would be dependent on the detailed siting of a CSEC;
- some areas of very wet poor ground conditions are anticipated;
- a good permanent maintenance access route may be possible from the B5420;
- rock outcrops are present. Shallow rock is anticipated which would impact both programme and costs;
- an existing water pipe may require diverting subject to detailed siting of a CSEC; and
- close to a public highway and therefore construction access would be good.

AN2

8.4.18 AN2 is located to the west of the search area and would require the shortest length of additional overhead line.

Landscape and Visual

8.4.19 The closest properties lie to the north of the siting area at Gwyndy and to the south at Ty'n-coed-mawr. These properties benefit from existing tree planting within their curtilages which would help to filter views. There is scope for introducing additional planting as mitigation for the CSEC; such measures would reflect and enhance the character of the landscape which contains a number of woodland areas and tree lined hedges. The AN2 siting area spans a local road which is also National Cycle Route 8 (Lôn Las Cymru).

Historic Environment

8.4.20 AN3 is located west of a group of Grade II listed buildings at Gwyndy. While no formal setting study has been carried out, the current principal view of the farmstead is down the entrance track from the west looking due east. Views of the farmstead from the north looking south would have the CSEC in the background.

8.4.21 AN2 would not affect any known non designated heritage assets recorded on the Historic Environment Record, however any groundworks associated with this option may affect previously unrecorded archaeological remains.

Ecology

8.4.22 Habitats present include arable, improved grassland, marshy grassland and hedgerows.

8.4.23 The siting area would have the potential to affect, either directly or indirectly (e.g. through hydrological effects), the following:

- Ancient Woodland (within approximately 30m to the north east);
- a CWS, Coed Braint, Syglen and Dyfnia, (immediately to the north east);
- additional SSSIs, CWSs and NWWTs, located more than 1km from the siting area, and the SAC Y Fenai a Bae Conwy / Menai Strait and Conwy Bay and the SSSI Glannau Porthaethwy (approximately 1.8km south east). These are unlikely to be directly affected by the CSEC itself but could be indirectly affected through the routeing options;
- numerous drains with water vole records (approximately 30m to the north east); and
- Afon Rhyd Eilian (approximately 160m to the east) which is linked to the siting area via marshy grassland.

8.4.24 There would also be the potential to affect protected / notable species such as great crested newt, water vole, otter, badger, bats and red squirrel. In addition, due to technical considerations, there would be the potential for an underground cable exiting the CSEC to be routed through the CWS

Soils and Agriculture

8.4.25 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land at AN2 is Grade 4 (Poor quality).

8.4.26 Data from the Soil Survey of England and Wales shows that AN3 is comprised of soils from the Brickfield 2 (713f) and East Keswick 1 (541x) soil association. The Brickfield 2 soils are seasonally waterlogged and therefore could require longer periods of restricted handling to prevent structural damage; whereas East Keswick 1 comprises well drained loamy soils which can be handled over longer periods. Soils of both associations are suitable for stock rearing on permanent grassland; and, although East Keswick 1 soils can be used for arable agriculture including the production of early potatoes and field vegetables, consultations with landowners undertaken by National Grid and aerial imagery indicates that land use within AN2 is pasture.

Construction Noise

8.4.27 AN2 is within the crescent formed by the B5420 and would be to the north west of Llanfairpwllgwyngyll. There are a number of isolated properties in the area but none are in close proximity. Careful micrositing could avoid the CSEC being in close proximity to any NSR.

8.4.28 This area has a very quiet/quiet baseline noise environment.

Operational Noise

8.4.29 AN2 is in a very quiet baseline area and it is likely it could be micro-sited to by away from residential properties. This location requires the shortest length of new overhead line and paralleling of the existing 400 kV overhead line, which is considered beneficial compared to other options. In addition, only low levels of operational noise would be predicted from overhead line equipment within the CSEC. From a noise perspective this is a preferred option.

Socio Economic

8.4.30 AN2 lies approximately 500m north of the A55 as it passes around the northern boundary of Llanfairpwllgwyngyll. A short length of the National Cycle Route 8 passes through AN2.

Technical

8.4.31 In summary:

- the siting area has variable topography, the extent of earthworks would be dependent on the detailed siting of a CSEC;
- permanent maintenance access may be possible via the B5420. This would be more difficult from some parts of the siting area; and
- existing BT infrastructure and a lower voltage overhead line may require diverting subject to detailed siting of a CSEC.

8.4.32 During a site walkover survey it was noted that an area to the east of the siting area was very wet marshland which may constrain routeing for an underground cable.

AN3

8.4.33 AN3 is located to the east of the Anglesey North Search Area close to the Pili Palas Nature World (Butterfly and Bird Place).

Landscape and Visual

8.4.34 AN3 would require the longest amount of new overhead line. This would affect views towards Snowdonia that are afforded from properties and people travelling along the B5420. There is scope for introducing planting as mitigation for the CSEC; such measures would reflect and enhance the characters if the landscape which contains a number of woodland area and tree lined hedges.

8.4.35 The AN3 siting area is adjacent to Pili Palas Nature World, a key tourist attraction. An existing belt of tree planting along the southern boundary of Pili Palas which would screen views of the CSEC. The new overhead line required to connect to a CSEC may however be visible to visitors.

Historic Environment

8.4.36 AN3 is located to the north west of a Grade II listed building known as Hen-Dy (LB19666). While no formal setting study has been carried out, the current principal view of the farmstead is down the entrance track from the east looking due west. A prominent ridge of high ground screens the site from north and west.

8.4.37 AN3 would not affect any known non designated heritage assets recorded on the Historic Environment Record, however any groundworks associated with this option may affect previously unrecorded archaeological remains.

Ecology

8.4.38 Habitats present in the AN3 siting area include improved grassland and hedgerows, but bordering marshy grassland.

8.4.39 The siting area would have the potential to affect either directly or indirectly (e.g. through hydrological or other effects), the following:

- a pond (approximately 100m to the east);
- additional SSSIs, CWSs and NWWTs, located within the wider area, and the SAC Y Fenai a Bae Conwy / Menai Strait and Conwy Bay and the SSSI Glannau Porthaethwy (approximately 1.3km south). These are unlikely to be directly affected by the CSEC itself but could be indirectly affected through the routeing options;
- woodland (immediately to the north); and
- a CWS, Coed Braint, Syglen and Dyfnia (immediately to the north west).

8.4.40 There would also be the potential to affect protected / notable species such as GCN, badger, bats and red squirrel. In addition, due to technical consideration there would be the potential for an overhead line connection to the CSEC being routed through the CWS.

Soils and Agriculture

8.4.41 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land at AN3 is Grade 4 (Poor quality).

8.4.42 Data from the Soil Survey of England and Wales shows that AN3 is comprised of soils from the Brickfield 2 (713f) and East Keswick 1 (541x) soil association. The Brickfield 2 soils are seasonally waterlogged and therefore could require longer periods of restricted handling to prevent structural damage; whereas East Keswick 1 comprises well drained loamy soils which can be handled over longer periods. Soils of both associations are suitable for stock rearing on permanent grassland; and, although East Keswick 1 soils can be used for arable agriculture including the production of early potatoes and field vegetables, consultations with landowners undertaken by National Grid and aerial imagery indicates that land use within AN3 is pasture.

Construction Noise

8.4.43 AN3 is within the B5420 crescent, to the north east of Llanfairpwllgwyngyll adjacent to the Pili Palas Nature World (which includes a residential property). This area has a very quiet baseline. Careful micrositing could avoid the CSEC being in close proximity to any NSR.

Operational Noise

8.4.44 AN3 is in a very quiet baseline area. Careful micrositing could avoid the CSEC being in close proximity to residential properties. This location requires the longest length of new overhead line in Anglesey North. It would require careful routeing of an alignment approaching AN3; although paralleling of the existing 400 kV overhead line is considered beneficial compared to other options. Only low levels of operational noise would be predicted from overhead line equipment within the CSEC. It is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5.

Socio Economic

8.4.45 AN3 lies adjacent to Pili Palas Nature World, a local tourist attraction offering outdoor and indoor activities including children's play areas and animal enclosures.

Technical

8.4.46 In summary;

- there is flat topography to the north of the siting area where minimal earthworks would be required. Steep topography to the south would require extensive earthworks;
- permanent maintenance access may be possible via the B5420;
- shallow rock is anticipated which would impact both programme and costs; and
- no routeing difficulties for underground cables are envisaged immediately south of the siting area.

AN4

8.4.47 As with AN1, AN4 is located opposite a group of properties on the B5420 at Felinengan and Menai Terrace

Landscape and Visual

8.4.48 As with AN1, AN4 would bring a new section of overhead line in close proximity to properties and the road. These properties, and people travelling on the B5420, have views towards Snowdonia. As with other options there is scope for introducing planting as mitigation for the CSEC; such measures would reflect and enhance the character of the landscape which contains a number of woodland areas and tree lined hedges. Although mitigation planting would help to screen the CSEC it may also restrict views towards Snowdonia.

Historic Environment

8.4.49 AN4 would have no significant effects on designated heritage assets and would not affect any known non designated heritage assets recorded on the Historic Environment Record, however any groundworks may affect previously unrecorded archaeological remains.

Ecology

8.4.50 Habitats present include arable, improved grassland and hedgerows, and there is marshy grassland bordering the site.

8.4.51 The siting area would have the potential to affect, either directly or indirectly (e.g. through hydrological effects),the following:

- a CWS, Coed Braint, Syglen and Dyfnia, (within approximately 50m to the west);
- additional SSSIs, CWSs and NWWTs, located within the wider area, and the SAC Y Fenai a Bae Conwy / Menai Strait and Conwy Bay and the SSSI Glannau Porthaethwy (approximately 1.7km south). These are unlikely to be directly affected by the CSEC itself but could be indirectly affected through the routeing options;
- the Afon Rhyd Eilian (approximately 20m to the west); and
- a red squirrel record within the siting area.

8.4.52 There would also be the potential to affect other protected / notable species such as water vole, otter, badger and bats.

Soils and Agriculture

8.4.53 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land at AN4 is Grade 4 (Poor quality).

8.4.54 Data from the Soil Survey of England and Wales shows that AN4 is comprised of soils from the Brickfield 2 (713f) and East Keswick 1 (541x) soil association. The Brickfield 2 soils are seasonally waterlogged and therefore could require longer periods of restricted handling to prevent structural damage; whereas East Keswick 1 comprises well drained loamy soils which can be handled over longer periods. Soils of both associations are suitable for stock rearing on permanent grassland; and, although East Keswick 1 soils can be used for arable agriculture including the production of early potatoes and field

vegetables, consultations with landowners undertaken by National Grid and aerial imagery indicates that land use within AN4 is pasture.

Construction Noise

8.4.55 AN4 is in a very quiet baseline area, a small number of NSRs lie to the north of the AN4 area on the northern side of the B5420.

Operational Noise

8.4.56 AN4 is in a very quiet baseline area and it is located further away from residential properties than AN1 or AN3. This location would require careful alignment of a new overhead line; although paralleling the existing 400 kV overhead line is considered beneficial compared to other options. Only low levels of operational noise would be predicted from overhead line equipment within the CSEC. It is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5.

Socio Economic

8.4.57 AN4 lies immediately south of the B5420, just to the west of AN1. Pili Palas Nature World is approximately 150m from the siting area to the south east.

Technical

8.4.58 In summary:

- topography is flat to the east of the siting area and would require minimal earthworks. Steeper topography to the east would require extensive earthworks;
- shallow rock, as Indicated by a rocky outcrop, would impact programme and cost;
- proximity to a potential flood risk area to the north west;
- creating a permanent maintenance access route would be difficult due to poor visibility on B5420; and
- no routeing difficulties are envisaged for underground cables.

Anglesey Central Search Area

8.4.59 Six options have been identified all located south of the A55 and A5 roads and rail line to the south west of Llanfairpwllgwyngyll and north east of Llanddaniel in an otherwise very rural area. The siting areas are all in agricultural use.

8.4.60 With regard to ecology there are no designated sites within the Anglesey Central Search Area. Habitats present include arable, improved grassland, marshy grassland, scrub and woodland. Hedgerows and watercourses bisect these habitats. Options within Anglesey Central have the potential to affect the habitats and associated species present, either directly or indirectly.

Traffic and Transport

8.4.61 The A4080 is a potential route from which any CSEC in Anglesey Central could be accessed via a new construction access bellmouth. Concerns however exist at the Tollgate junction with the A5, where the carriageway crosses a bridge structure and the carriageway width and alignment present challenges. The type of construction traffic using this route may therefore be limited.

Furthermore, traffic management is likely to be required as vehicle speeds along this route may be in excess of 50mph and the alignment of the carriageway may prevent SSDs being achievable.

8.4.62 An alternative access route to the east of the A55 off-slip and Junction 7a would cross a bridge structure across the North Wales Mainline railway line. This route runs from north to south and the unnamed road provides a link between the A5 and A4080. There is potential for access bellmouth provision along this route and there could be scope for smaller construction vehicles to use this access.

8.4.63 The most likely route to access a CSEC in Anglesey Central would be via the A55 Junctions 7 or 7a, the A5, and then via the unnamed road between Dicks Shoe Store and Llandaniel Fab. The unnamed road also crosses a bridge structure over the North Wales Mainline railway which would require further detailed investigation into structural suitability. Anglesey Central is however close to the strategic road network and the junction with the A5.

8.4.64 For AC6 the potential for several bellmouth locations to access the CSEC could mean that construction traffic is distributed more evenly across the local highway network.

8.4.65 For all CSECs where bellmouth access points are provided, appropriate traffic management would need to be implemented.

Hydrology and Flood Risk

8.4.66 Within Anglesey Central AC1 has small areas within Development Advice Zone C2 alongside the A5, the main road through Llanfairpwllgwyngyll (which also has a culverted section of the Afon Braint). The northern part of AC2 is within Development Advice Zone C2. AC3 and AC4 are not located within any Development Advice Zone. The west of AC6 is located within Development Advice Zone 2.

8.4.67 AC1, AC2 and AC3 are located in the Upper Braint River Catchment which has a WFD status of good. AC4 is located across the Upper Braint River Catchment and the Lower Braint River Catchment, which currently attains a WFD status of moderate. AC5 and AC6 are also located in the Lower Braint River Catchment.

AC1

8.4.68 AC1 is located to the north of the search area adjacent to the railway line and the A55 road corridor.

Landscape and Visual

8.4.69 This option is within the Southern Anglesey Estatelands SLA.

8.4.70 This CSEC siting area would utilise the shortest overhead line option (5C) and would require just a short section of additional new overhead line within the search area.

8.4.71 This option would result in Star becoming encircled by the existing 400kV overhead line and new overhead line; however, due to Star's elevated location above AC1 a new overhead line may be backclothed. As discussed in Chapter 6, there may be opportunities to reduce this effect e.g. by the use of lower height pylons. People using both National Cycle Route 8 (Lôn Las Cymru) and the Wales Coast Path may also have glimpsed views of the new overhead line within the search area. Screen planting around the CSEC would help to reduce the visibility of the CSEC but may not be effective in mitigating views from Star due to the elevated situation of the settlement.

Historic Environment

8.4.72 There are no designated heritage assets within the immediate vicinity and no known non-designated. There is high potential for the presence of previously unrecorded archaeological remains.

Ecology

8.4.73 Habitats present include improved grassland and hedgerows.

8.4.74 The siting area would have the potential to affect, either directly or indirectly, (e.g. through hydrological effects) the following:

- the SAC Y Fenai a Bae Conwy / Menai Strait and Conwy Bay and the SSSI Glannau Porthaethwy (approximately 1.4km south east). These are unlikely to be directly affected by the CSEC itself but could be indirectly affected through the routeing options; and
- the Afon Braint (approximately 65m to the south). Water vole potential has been noted during the Phase 1 surveys.

8.4.75 There would also be the potential to affect protected / notable species such as water vole, barn owl and otter.

Soils and Agriculture

8.4.76 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land at AC1 is Grade 5 (Very Poor quality).

8.4.77 Data from the Soil Survey of England and Wales shows that the AC1 is comprised of soils from the Brickfield 2 (713f) soil association. The Brickfield 2 soils are seasonally waterlogged and therefore could require longer periods of restricted handling to prevent structural damage.

8.4.78 Consultations with landowners undertaken by National Grid and aerial imagery indicates that land use within AC1 is pasture land.

Construction Noise

8.4.79 AC1 is the most northerly of the options in Anglesey Central and is located just to the south of the rail line, the A5 and the A55. There are no NSRs in the immediate vicinity although the edge of Llanfairpwllgwyngyll lies some 500m to the east. Due to the proximity of these noise sources, baseline noise levels will be elevated.

Operational Noise

8.4.80 As noted above AC1 is close to the railway line and A55 and baseline levels are likely to be elevated due to these noise sources. The nearest residential receptor would be approximately 300m away and hence any operational noise impacts are likely to be negligible. It is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5.

Socio Economic

8.4.81 The Wales Coast Path is approximately 1km to the south east of AC1 and the National Cycle Route 8 (Lôn Las Cymru) is approximately 650m to the west of the siting area. It is also located approximately 1km from Llanfairpwllgwyngyll railway station which is a tourist attraction; although AC1 is not expected to be visible from the station.

Technical

8.4.82 In summary:

- the topography varies (potential earthworks would be dependent on detailed siting of a CSEC within this siting area);
- the proximity to the Mainline railway line may impose design constraints and would require agreement with relevant stakeholders;
- good permanent maintenance access would be possible using the existing railway bridge subject to loading capacity; and
- the siting area is in close proximity to a potential flood risk area and there are also a number of drainage ditches in close proximity.

AC2

8.4.83 This option is located on the eastern side of the search area close to the existing 400 kV overhead line, near Llanfairpwllgwyngyll.

Landscape and Visual

8.4.84 This option is within the Southern Anglesey Estatelands SLA.

8.4.85 AC2 would require the longest length of additional new overhead line within the search area which would run close to properties at Pont-Ronwy and Llwyn Edwen. This option would result in Star becoming completely encircled by the existing 400 kV overhead line and new overhead line; however, due to Star's elevated location above AC2 the new overhead line may be backclothed. As discussed in Chapter 6, there may be opportunities to reduce effects such as by the use of lower height pylons. People using both National Cycle Route 8 (Lôn Las Cymru) and the Wales Coast Path may have glimpsed views of the additional section of new overhead line. Glimpsed views of the CSEC may also be afforded from Llanfairpwllgwyngyll. The area does benefit from a number of woodland areas and tree lined hedges which would help to screen the CSEC from the Star, Llanfairpwllgwyngyll and the AONB.

Historic Environment

8.4.86 AC2 is located to the rear of a number of Grade II listed buildings that face onto the A4080 close to the main entrance to the Plas Newydd Grade I Registered Park and Garden, including Victoria Cottages (LB19672), Tyddyn Pwyth (LB19671) and Aberbraint Lodge (LB5468). While existing semi natural screening exists, the height of the CSEC and approaching pylons would be likely to have a negative effect on the setting of the listed buildings and to a lesser degree on Plas Newydd.

8.4.87 There is high potential for previously unrecorded archaeological remains.

Ecology

8.4.88 Habitats present include improved grassland and hedgerows.

8.4.89 This siting area would have the potential to affect, either directly or indirectly, the following:

- The Afon Braint (immediately to the north, south and east); and
- areas of ancient woodland, present within the wider area, and the SAC Y Fenai a Bae Conwy / Menai Strait and Conwy Bay and the SSSI Glannau Porthaethwy (approximately 650m south east). These are unlikely to be directly affected by the CSEC itself but could be indirectly affected through the routeing options.

8.4.90 There would also be the potential to affect protected / notable species such as bats, water vole and otter.

Soils and Agriculture

8.4.91 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land at AC2 is Grade 4 (Poor quality).

8.4.92 Data from the Soil Survey of England and Wales shows that AC2 is comprised of soils from the Brickfield 2 (713f) and East Keswick 1 (541x) soil association. The Brickfield 2 soils are seasonally waterlogged and therefore could require longer periods of restricted handling to prevent structural damage; whereas East Keswick 1 comprises well drained loamy soils which can be handled over longer periods. Soils of both associations are suitable for stock rearing on permanent grassland; and, East Keswick 1 soils can be used for arable agriculture including the production of early potatoes and field vegetables.

Construction Noise

8.4.93 AC2 lies to the south east of AC1 and south west of Llanfairpwllgwyngyll close to where the existing 400 kV overhead line changes direction to the east. This is further from the A5 (the A55 deviates to the north east) and rail line than some other options in Anglesey Central but the baseline noise environment will still be elevated due to these noise sources.

8.4.94 There are a number of isolated properties in the area and a small terrace of six properties to the south west but none that are in very close proximity area.

8.4.95 Careful micrositing could avoid the CSEC being in close proximity to any NSR.

Operational Noise

8.4.96 AC2 would require the longest length of new overhead line in Anglesey Central. Baseline levels are likely to be slightly elevated due to distant traffic noise from the main roads in the area. This CSEC siting area is one of the closest to the existing 400 kV overhead line. Careful micro-siting could mean that the nearest residential properties may be approximately 200m away. Only low levels of operational noise would be predicted from overhead line equipment within the SEC. It is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5.

Socio Economic

8.4.97 This option lies approximately 200m south of the railway station at Llanfairpwllgwyngyll, which is a tourist attraction. This option is close to the A4080 (Brynsiengyn Road) – which is also the route of the Wales Coast Path. Immediately south of the A4080 is woodland which is part of the Plas Newydd Registered Park and Garden (National Trust property) running alongside the Menai Strait.

Technical

8.4.98 In summary:

- the topography varies (the extent of earthworks will be dependent on detailed siting of the CSEC);
- good permanent maintenance access route would be possible, most likely using the road running between A5 and A4080 existing railway bridge, subject to loading capacity;
- an existing 11kV overhead line may require diverting subject to detailed siting of a CSEC; and
- no routeing difficulties are envisaged for underground cables.

AC3

8.4.99 This option is located to the east of the search area near property at Llŵyn-ogan.

Landscape and Visual

8.4.100 This option is within the Southern Anglesey Estatelands SLA.

8.4.101 Option AC3 would require a longer length of additional new overhead line in the search area. This would pass between Llŵyn-ogan and Tyddyn-Fodog; Llŵyn-ogan benefits from some vegetation around its southern boundary. As with AC1 this option would result in Star becoming almost encircled by the existing 400 kV overhead line and a new overhead line; however, the additional new overhead line would be more distant than for AC1 and due to the elevated position of Star the line may be backclothed in views from the settlement. As discussed in Chapter 6, there may be opportunities to reduce effects, for example by the use of lower height pylons. People using both National Cycle Route 8 (Lôn Las Cymru) and the Wales Coast Path may have glimpsed views of the additional section of new overhead line. Glimpsed views of the CSEC may also be afforded from Llanfairpwllgwyngyll. A CSEC in this location would benefit from screening that existing vegetation would provide and there is

scope for introducing planting as mitigation for the CSEC to tie into the existing vegetation.

Historic Environment

8.4.102 AC3 would not directly affect any designated assets, but would affect the setting of the Grade II listed building, Victoria Cottages (LB19672), and would abut the essential setting of Plas Newydd Registered Park and Garden.

8.4.103 There is high potential for previously unrecorded archaeological remains.

Ecology

8.4.104 Habitats present include improved grassland, marshy grassland and hedgerows.

8.4.105 The siting area would have the potential to affect, either directly or indirectly (e.g. through hydrological or other effects), the following:

- a watercourse partially within the siting area;
- a pond (approximately 50m to the south);
- areas of ancient woodland, present within the wider area, the SAC Y Fenai a Bae Conwy / Menai Strait and Conwy Bay, and the SSSI Glannau Porthaethwy (approximately 840m south east). These are unlikely to be directly affected by the CSEC itself but could be indirectly affected through the routeing options; and
- an area of possible marshy grassland within the siting area. This habitat has been recorded by CCW.

8.4.106 There would also be the potential to affect protected / notable species such as bats, great crested newt, water vole and invertebrates.

Soils and Agriculture

8.4.107 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land at AC3 is Grade 4 (Poor quality).

8.4.108 Data from the Soil Survey of England and Wales shows that AC3 is comprised of soils from the Brickfield 2 (713f) and East Keswick 1 (541x) soil association. The Brickfield 2 soils are seasonally waterlogged and therefore could require longer periods of restricted handling to prevent structural damage; whereas East Keswick 1 comprises well drained loamy soils which can be handled over longer periods. Soils of both associations are suitable for stock rearing on permanent grassland; and, East Keswick 1 soils can be used for arable agriculture including the production of early potatoes and field vegetables.

Construction Noise

8.4.109 AC3 lies to the south of AC1 and south west of AC2. As for AC2, the siting area is parallel with the A4080 but set back to the north east. This is further from the A5 (the A55 deviates to the north east) and rail line than some other options in Anglesey Central but the baseline noise environment may still be elevated due to these noise sources.

8.4.110 There are a number of isolated properties in the area and a small terrace of six properties to the north east. These lie close to the siting area to the north east of but no others lie in very close proximity.

Operational Noise

8.4.111 AC3 would require a relatively long length of new overhead line to connect to the CSEC. Baseline levels are likely to be slightly elevated due to distant traffic noise from the main roads in the area, although marginally quieter than AC2. The nearest residential properties may be approximately 150m away. Only low levels of operational noise would be predicted from overhead line equipment within the CSEC. It is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5.

Socio Economic

8.4.112 AC3 lies approximately 300m from the Wales Coast Path and the woodlands at Plas Newydd (National Trust and Registered Park and Garden) to the south of the A4080.

Technical

8.4.113 In summary:

- there is variable topography (the extent of earthworks will be dependent on detailed siting of CSEC);
- good permanent maintenance access would be possible, most likely to using the road running between A5 and A4080 existing railway bridge, subject to loading capacity;
- existing BT infrastructure and a lower voltage overhead line may require diverting subject to detailed siting of the CSEC;
- proximity to potential flood risk area to the south;
- considerable routeing difficulties are envisaged for underground cables; and
- considerable routeing difficulties are envisaged for an overhead line connection due to close proximity to existing properties to the north.

AC4 and AC6

8.4.114 AC4 and AC6 are located in adjacent fields towards the centre of the Anglesey Central CSEC Search Area.

Landscape and Visual

8.4.115 Due to their proximity AC4 and AC6 are discussed together as the effects are similar.

8.4.116 AC4 and AC6 are both within the Southern Anglesey Estatelands SLA.

8.4.117 Slightly longer sections of additional new overhead line within the search areas would be required for these options when compared to AC1 and AC5, but it would be shorter than for option AC2s and AC3. Although an additional section of overhead line would extend its influence in the landscape it would not result in encirclement of the settlement of Star in the same way that AC1, AC2 and AC3 would, as there would be more of a gap between the two lines in views to

the south-east. Due to the elevated position of Star the proposed overhead line may be backclothed in views from the settlement. As discussed in Chapter 6, there may be opportunities to reduce this effect e.g. by the use of lower height pylons. People using both National Cycle Route 8 (Lôn Las Cymru) and the Wales Coast Path may have glimpsed views of the section of additional new overhead line.

8.4.118 A CSEC in AC4/AC6 would benefit somewhat from screening that existing vegetation provides but this area is slightly more open with a larger field pattern than other siting areas. There is scope for introducing large areas of planting as mitigation for the CSEC; such measures would reflect and enhance the character of the landscape which contains a number of woodland areas and tree lined hedges. There is potential to affect views north from Bryn Celli Ddu. The existing 400 kV overhead line is visible from here and this CSEC location would require an additional section of overhead line in closer proximity to this site

Historic Environment

8.4.119 AC4 would not directly affect any designated heritage assets and is likely to be of sufficient distance from the Plas Newydd and listed buildings to have a lower impact on their setting that would be easier to mitigate through appropriate screening. There is high potential for previously unrecorded archaeological remains.

8.4.120 AC6 would not directly affect any designated heritage assets, and due to existing topographic and woodland screening is unlikely to significantly affect the settings of any assets, including Bryn Celli Ddu. There is high potential for previously unrecorded archaeological remains.

Ecology

8.4.121 Habitats present in Ac4 and AC6 include arable and improved grassland, and hedgerows.

8.4.122 The AC4 siting area would have the potential to affect, either directly or indirectly (e.g. through hydrological effects), the following:

- woodland allocated under the Woodland Grant Scheme (immediately to the east);
- a pond (approximately 180m to the south); and
- areas of ancient woodland, present within the wider area, the SAC Y Fenai a Bae Conwy / Menai Strait and Conwy Bay, and the SSSI Glannau Porthaethwy (approximately 990m south east). These are unlikely to be directly affected by the CSEC itself but could be indirectly affected through the routeing options.

8.4.123 There would also be the potential to affect protected / notable species such as great crested newt, badger, bats and red squirrel.

8.4.124 The AC6 siting area would have the potential to affect the following:

- a pond (approximately 190m to the east);
- a watercourse (approximately 80m to the west); and
- areas of ancient woodland, present within the wider area, the SAC Y Fenai a Bae Conwy / Menai Strait and Conwy Bay, and the SSSI Glannau Porthaethwy (approximately 950m south east). These are unlikely to be directly affected by the CSEC itself but could be indirectly affected through the routeing options).

8.4.125 There would also be the potential to affect protected / notable species such as great crested newt, water vole, and otter.

Soils and Agriculture

8.4.126 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land at AC4 is Grade 4 (Poor quality).

8.4.127 Data from the Soil Survey of England and Wales shows that AC4 is comprised of soils from the Brickfield 2 (713f) and East Keswick 1 (541x) soil association. The Brickfield 2 soils are seasonally waterlogged and therefore could require longer periods of restricted handling to prevent structural damage; whereas East Keswick 1 comprises well drained loamy soils which can be handled over longer periods. Soils of both associations are suitable for stock rearing on permanent grassland; and, East Keswick 1 soils can be used for arable agriculture including the production of early potatoes and field vegetables

Construction Noise

8.4.128 AC4 is located in a very rural area with few nearby NSRs although there is a farm building to the north east (this may be unoccupied and could be derelict). Careful micrositing could avoid close proximity to this NSR.

8.4.129 AC6 lies adjacent to AC4 on the southern side.

Operational Noise

8.4.130 AC4 and AC6 would require a moderate length of new overhead line within the search area to connect the CSEC, and this may mean passing within 50m of residential receptors to the northwest. Baseline levels are likely to be slightly elevated due to distant traffic noise from the main roads in the area, however there may times when baseline level are very low, especially at night. AC6 is further away from the nearest residential properties than AC4 and careful micro-siting could ensure a minimum distance of 300m. Only low levels of operational noise would be predicted from overhead line equipment within the CSEC. Assuming an acceptable overhead line design and alignment, it is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5. Out of the two AC6 is preferred.

Socio Economic

8.4.131 AC4 and AC6 are both removed from any settlements or commercial development. Both AC4 and AC6 lie approximately 750m from National Cycle Route 8 and less than 500m from the Wales Coastal Path.

Technical

8.4.132 Siting areas AC4 and AC6 have a range of constraints including:

- topography which varies from flat areas to steep slopes;
- rock, anticipated to be present at least to the east of AC6;
- a river/brook to the north;
- an existing lower voltage overhead line which crosses the area; and
- new access road would be need to be constructed across fields as AC^ is not close to a public highway. A permanent access route would have to be created either by a new track or with agreement to use or upgrade existing tracks.

AC5

8.4.133 AC5 is located to the west of the Anglesey Central Search Area.

Landscape and Visual

8.4.134 AC5 is the only option in Anglesey Central outside of the Southern Anglesey Estatelands SLA.

8.4.135 It would require one of the shorter new overhead line options although is the closest option to Bryn Celli Ddu which would affect views north from the site. The existing 400 kV overhead line is visible from Bryn Celli Ddu and this CSEC location would require a new overhead line to be routed in closer proximity to the site.

8.4.136 Although an additional new section of overhead line in this search area would extend its influence in the landscape it would not result in encirclement of the settlement of Star in the same way that AC1, AC2 and AC3 would as there would be more of a gap between the two lines in views to the south-east. Due to the elevated position of Star a new overhead line may be backclothed in views from the settlement. As discussed in Chapter 6, there may be opportunities to reduce this effect e.g. by the use of lower height pylons. People using both National Cycle Route 8 (Lôn Las Cymru) and the Wales Coast Path may have glimpsed views of the additional new section of overhead line. A CSEC in this location would benefit from some screening by vegetation to the south and there is scope for introducing planting as mitigation for the CSEC to tie into the existing vegetation.

Historic Environment

8.4.137 AC5 would not directly affect any designated heritage assets, however it is likely to affect the setting of Bryn Celli Ddu and Tyddyn-Bach Standing Stone (Scheduled Ancient Monuments). There is high potential for previously unrecorded archaeological remains.

Ecology

8.4.138 Habitats present include improved grassland, broad leaved semi-natural woodland and hedgerows.

8.4.139 This siting area would have the potential to affect, either directly or indirectly (e.g. through hydrological effects), the following:

- a pond (approximately 20m to the east);
- woodland (within the siting area). This would potentially be lost and /or fragmented;
- the Afon Braint (approximately 40m to the east); and
- areas of ancient woodland, within the wider area, the SAC Y Fenai a Bae Conwy / Menai Strait and Conwy Bay, and the SSSI Glannau Porthaethwy (approximately 1.5km south east). These are unlikely to be directly affected by the CSEC itself but could be indirectly affected through the routeing options).

8.4.140 There would also be the potential to affect protected / notable species such as great crested newt, water vole, otter, badger, bats and red squirrel.

Soils and Agriculture

8.4.141 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land at AC5 is Grade 3 (Good to Moderate quality) and Grade 4 (Poor quality).

8.4.142 Data from the Soil Survey of England and Wales shows that AC5 is comprised of soils from the Brickfield 2 (713f) soil association. The Brickfield 2 soils are seasonally waterlogged and therefore could require longer periods of restricted handling to prevent structural damage.

Construction Noise

8.4.143 AC5 lies to the south west of AC4 in a very remote area with no nearby NSRs nearby.

Operational Noise

8.4.144 AC5 would require a shorter length of overhead compared to AC4 and AC6, however this may mean passing within 50m of residential receptors to the northwest. Baseline levels are likely to be slightly elevated due to distant traffic noise from the main roads in the area, however there may times when baseline level are very low, especially at night. AC5 is further away from the nearest residential properties than all other AC options. Assuming an acceptable overhead line design and alignment, it is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5.

Socio Economic

8.4.145 AC5 lies within 300m of Bryn Celli Ddu (Scheduled Ancient Monument) which has been developed for visitor access and is therefore a tourism receptor. The Wales Coastal Path passes approximately 300m in proximity along with National Cycle Route 8 which is approximately 550m to the west.

Technical

8.4.146 In summary:

- the topography varies within the siting area. The siting area contains some flat areas with more steep areas particularly to the north and east where there is also an area of marshland;
- an existing overhead line crosses the siting area; and
- it has been noted that ground is very wet at this siting area and there are drainage ditches.

Anglesey South Search Area

8.4.147 Both the options in Anglesey South are located south of Llanddaniel on greenfield sites in agricultural use.

8.4.148 With regard to ecology there is a CWS (Coed Glanyrafon) present within the Anglesey South Search Area. Habitats present within the search area include arable, improved grassland, marshy grassland, semi-improved neutral grassland, scrub and semi-natural broad leaved woodland. Hedgerows and watercourses bisect these habitats, and ponds are present. Options within Anglesey South would have the potential to affect the habitats and associated species present, either directly or indirectly.

Traffic and Transport

8.4.149 As for Anglesey Central a CSEC siting areas in Anglesey South could be accessed using the A4080. The implications of the railway structures remains consistent with the discussion above. The lack of alternative routeing to the siting areas is of concern and there would be an intensification of construction traffic to one access point along this route, without the scope to alleviate traffic by using several construction routes, which would be possible for a siting area in Anglesey Central. The only alternative route would see construction traffic routeing through the village of Llandaniel, which is not preferred.

Hydrology and Flood Risk

8.4.150 With respect of flood risk, neither of the CSEC siting area within Anglesey South are located within any Development Advice Zones.

8.4.151 AS2 is located in the Lower Braint River Catchment which currently attains a WFD status of moderate. The majority of the AS1 siting area is located within the Lower Braint River Catchment, whilst the south eastern extent is located within a non- reportable WFD water body adjacent to Y Felinheli.

AS1

8.4.152 AS1 is located to the southern side of the search area towards the top of a low ridgeline.

Landscape and Visual

8.4.153 As the boundary of the AONB runs along the A4080, this option is closest to this designation although would not directly affect it. This area is within the Southern Anglesey Estatelands SLA.

8.4.154 This option would require the longest section of new overhead line within the search area which would extend further the longest overall overhead line option on Anglesey (Option 5A). This additional section of new overhead line connecting to AS1 would become more widely visible in the landscape as it approaches the CSEC due to the nature of the rising landform.

8.4.155 The siting area is adjacent to the A4080, between properties at Plas Cefn Mawr and Gwrach ddu, and consists of large regular fields with hedgerow boundaries. This location would be visible from the road although there is scope for introducing planting; such measures would reflect and enhance the character of the landscape which contains a number of woodland areas and tree lined hedges. People using the Wales Coast Path may also have glimpsed views of the additional section of new overhead line and CSEC as it crosses the A4080 and heads north along the lane to Bryn Celli Ddu.

Historic Environment

8.4.156 There are no designated heritage assets within AS1, however it is within 200m of the Plas Newydd Grade I Registered Park and Garden, and Farm Lodge and gates, both Grade II listed buildings (LB 19755). To the north the setting of a listed workers cottage, Ty'n-llidiart (LB19745), is unlikely to be significantly affected while the listed buildings at Plas Llwynonn (LB 19746) including coach house and service range to rear are screened by woodland.

8.4.157 There is high potential for previously unrecorded archaeological remains.

Ecology

8.4.158 Habitats present include improved grassland and hedgerows, with one pond present.

8.4.159 This siting area would have the potential to affect, either directly or indirectly (e.g. through hydrological effects), the following:

- Ancient Woodland and TPOs (bordering the siting area to the south). These may be indirectly affected;
- areas of ancient woodland and CWSs, present within the wider area, the SAC Y Fenai a Bae Conwy / Menai Strait and Conwy Bay, and the SSSI Glannau Porthaethwy (approximately 1.5km south east). These are unlikely to be directly affected by the CSEC itself but could be indirectly affected through the routeing options.; and
- a pond (within the siting area and potentially affected).

8.4.160 There would be the potential to affect protected / notable species such as badger, bats, red squirrel and great crested newt.

Soils and Agriculture

8.4.161 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land at AS1 is Grade 4 (Poor quality).

8.4.162 Data from the Soil Survey of England and Wales shows that AS1 is comprised of well drained loamy soils from the East Keswick 1 (541x) soil association. The good drainage of these soils means that they can be handled over a longer period without damaging their structure. They can also be used for arable agriculture including the production of early potatoes and field vegetables in some cases; however, this is considered unlikely in AS1 as the ALC grading is Grade 4 (poor quality) and would therefore not be expected to support arable agriculture.

Construction Noise

8.4.163 AS1 is adjacent to the A4080. There are a few isolated farms and businesses in the area; baseline levels will generally be low.

Operational Noise

8.4.164 AS1 would require the longest section of new overhead line, with Option 5A potentially passing many residential receptors. Baseline levels are likely to be very low due to the more remote and rural location. Careful micro-siting within AS1 should ensure distance to nearest NSRs is greater than 200m. Only low levels of operational noise would be predicted from overhead line equipment within the CSEC. Assuming an acceptable overhead line design and alignment, it is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5.

Socio Economic

8.4.165 This siting area is located north of Plas Coch holiday home complex, on the opposite side of the A4080, and approximately 1km from Plas Newydd(National Trust and Registered Park and Garden) a major visitor attraction. A section of the Wales Coast Path is also located approximately 150m to the west of the siting area.

Technical

8.4.166 In summary:

- the topography is flat so minimal earthworks would be required;
- an existing 11kV overhead line may require diverting subject to detailed siting of a CSEC;
- good permanent maintenance access would possibly be available from the A4080; and
- some routeing difficulties are envisaged for underground cables (for example due to the location of the Plas Coch holiday complex on the south side of the A4080.

AS2

8.4.167 AS2 is located in the fields to the south of the search area to the south of property at Glanyraron.

Landscape and Visual

8.4.168 This area is within the Southern Anglesey Estatelands SLA.

8.4.169 A CSEC in this location would bring a new overhead line in close proximity to the property at Glanyraron and would more closely wrap around the settlement of Llandaniel Fab. The location is set back from the A4080 and there is scope for introducing planting as mitigation for the CSEC; such measures would reflect and enhance the character of the landscape which contains a number of woodland areas and tree lined hedges. People using the Wales Coast Path may also have glimpsed views of the additional section of new overhead line and CSEC as it crosses the A4080 and heads north along the lane to Bryn Celli Ddu.

Historic Environment

8.4.170 There are no designated heritage assets within AS2, however it is within 100m of a Grade II listed building, a workers cottage, Ty'n-llidiart (LB 19745). The setting of this building would be affected.

8.4.171 There is high potential for previously unrecorded archaeological remains.

Ecology

8.4.172 Habitats present include arable, improved grassland and hedgerows.

8.4.173 This siting area would have the potential to affect, either directly or indirectly (e.g. through hydrological effects), the following:

- Ancient Woodland and a CWS, Coed Glanyrafon, (immediately to the south). These areas may be indirectly affected;
- a CWS (approximately 215m to the north east;
- areas of ancient woodland and further CWSs, present within the wider area, the SAC Y Fenai a Bae Conwy / Menai Strait and Conwy Bay, and the SSSI Glannau Porthaethwy (approximately 1.9km east). These are unlikely to be directly affected by the CSEC itself but could be indirectly affected through the routeing options;
- a pond (approximately 500m to the south); and
- a large area of marshy grassland (immediately to the south).

8.4.174 There would also be the potential to affect protected / notable species such as bats, badger, red squirrel and great crested newt.

Soils and Agriculture

8.4.175 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land at AS2 is Grade 4 (Poor quality).

8.4.176 Data from the Soil Survey of England and Wales shows that the AS2 is comprised of soils from the Brickfield 2 (713f) soil association. The Brickfield 2 soils are seasonally waterlogged and therefore could require longer periods of restricted handling to prevent structural damage.

Construction Noise

8.4.177 AS2 is remote from the road network although there are a number of isolated farms in the area with some being fairly close. Careful micrositing could avoid a CSEC being in close proximity to any NSR.

Operational Noise

8.4.178 AS2 would be connected via Option 5A, potentially passing many residential receptors. Baseline levels are likely to be very low due to the more remote and rural location. Careful micro-siting within AS2 should ensure distance to nearest NSRs is greater than 200m. Only low levels of operational noise would be predicted from overhead line equipment within the CSEC. Overall, assuming an acceptable overhead line design and alignment, it is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5.

Socio Economic

8.4.179 Of the two siting areas in Anglesey South this option is furthest away from Plas Coch holiday home complex. The Wales Coast Path is approximately 200m to the east. Meithrinfa Siwgr Plwm day nursery is located approximately 1km to the north east however there are no effects anticipated due to the distance from this receptor.

Technical

8.4.180 In summary:

- the topography is flat so minimal earthworks wold be required;
- a permanent maintenance access route will be dependent on detailed siting of a CSEC;
- an existing 11kV overhead line may require diverting subject to detailed siting of a CSEC; and
- routeing of underground cables would be dependent on detailed location of CSEC but could be difficult.

Gwynedd North Search Area

8.4.181 Two siting areas have been identified within Gwynedd North, both located to the south of Britannia Bridge, one either side of the A55. GN1 is located to the west of the A55 on a brownfield site and GN2 to the east of the A55 and is in agricultural use.

8.4.182 Gwynedd North lies within the Dinorwig Landscape of Outstanding Historic Interest, with the character areas of the Arfon Plateau and Vaynol.

8.4.183 With regard to ecology the search area is predominantly improved grassland with drains and hedgerows. Options within Gwynedd North have the potential to affect the Treborth Hall Lake and Woods CWS, Parc Menai Woodlands CWS and the restored ancient woodland site adjacent to the Gwynedd North Search Area, either directly or indirectly.

Traffic and Transport

8.4.184 GN1 is highly accessible from Junction 9 of the A55, however, it would be necessary to route traffic though Parc Menai, where there are constraints in terms of width and clear routes to the siting area. Alternatively, construction traffic could be routed via the overbridge across the A55 from Ffordd Bronwydd. This structure is narrow and would require further investigation. Furthermore, the route passes several residential dwellings and the type of vehicle able to utilise this route may be limited.

8.4.185 GN2 is located in close proximity to the strategic road network, namely junction 9 of the A55 and A487. Direct access to the site from the strategic road network is however considered problematic given the existing constraints within the area.

Hydrology and Flood Risk

8.4.186 GN1 and GN2 are both located within a non-reportable WFD waterbody[34]. Non-reportable water bodies do not have specific objectives to achieve good status in the Cycle 2 River Basin Management Plans.

GN1

8.4.187 GN1 is located adjacent to the Treborth Wastewater Treatment Works and an existing lower voltage substation on a brownfield site the north of Parc Menai Business Park.

Landscape and Visual

8.4.188 The siting area is covered by two landscape designations; Vaynol Estate and Surrounds SLA and Dinorwig Landscape of Outstanding Historic Interest.

8.4.189 GN1 is well screened, benefiting from the ancient woodland around the north side of Parc Menai and the vegetation along the A55 embankments. The siting area itself is a good location for a CSEC, utilising a pre-existing industrial site in a well screened location, however, there are significant issues with the overhead line option (5H), which would be required to connect to the CSEC. This has previously been discussed in Chapter 6 of this Report.

Historic Environment

8.4.190 There are no designated or non-designated heritage assets that would be adversely affected.

Ecology

8.4.191 Habitats present include improved grassland, drains and hedgerows.

[34] Non-reportable WFD river water bodies are usually catchments adjacent to the coast, generally with an area of <10km^2. Whilst NRW are not required to monitor, classify or report on these water bodies, they do still receive protection under the Water Framework Directive to prevent any deterioration from the current quality of their aquatic environment.

8.4.192 This siting area would have the potential to affect, either directly or indirectly (e.g. through hydrological effects), the following:

- Ancient Woodland & CWS, Parc Menai Woodlands, (within the siting area);
- areas of ancient woodland and further CWSs and SSSIs, present within the wider area, the SAC Y Fenai a Bae Conwy / Menai Strait and Conwy Bay, and the SSSI Glannau Porthaethwy (approximately 600m north). These are unlikely to be directly affected by the CSEC itself but could be indirectly affected through the routeing options;
- numerous ponds (within 500m) Survey results to date have indicated negative GCN presence;
- otter (record 450m to the south); and
- red squirrel (record approximately 650m to the south within Ancient Woodland).

8.4.193 There would be the potential to affect other protected / notable species such as badger, barn owl and bats.

Soils and Agriculture

8.4.194 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land at GN1 is Grade 3 (Good to Moderate quality).

8.4.195 Data from the Soil Survey of England and Wales shows that GN1 is comprised of soils from the Brickfield 2 (713f) and East Keswick 3 (541z) soil associations. The Brickfield 2 soils are seasonally waterlogged and therefore could require longer periods of restricted handling to prevent structural damage; whereas East Keswick 3 comprises well drained loamy soils which can be handled over longer periods. Soils of both associations are suitable for stock rearing on permanent grassland; and, although East Keswick soils can be used for arable agriculture including the production of early potatoes and field vegetables, consultations with landowners undertaken by National Grid have identified that land use within GN1 is pasture.

Construction Noise

8.4.196 This option is located adjacent to the A55 south of the Britannia Bridge to the north east of Parc Menai. There are residential NSRS on the eastern side of the A55 at Treborth. Baseline noise levels will be high in this area due to traffic on the A55.

Operational Noise

8.4.197 GN1 is located close to the A55 the nearest residential receptors on the far side of the carriageway at least 250m away. Baseline levels are likely to be elevated due to traffic noise and local commercial activity. A new overhead line would follow the existing 400 kV overhead line to Pentir Substation potentially passing some residential receptors within approximately 50m. Only low levels of operational noise would be predicted from overhead line equipment within the CSEC. Overall, assuming an acceptable overhead line design and alignment, it is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5.

Socio Economic

8.4.198 GN1 lies between to the A55 approach to the Britannia Bridge an existing sub-station and a wastewater treatment works. Parc Menai (home to commercial businesses, public and voluntary services, education campus and a hotel) lies immediately to the south, with the Coleg Menai buildings in close proximity.

Technical

8.4.199 GN1 is in proximity to the A55, a wastewater treatment works, a substation, a property and the existing 400 kV overhead line. There are also a number of underground services and main sewers. Access to the area is served by the road overbridge that spans across the A55. Due to the location of the existing utilities there would be routeing difficulties for underground cables and the new 400 kV overhead line.

GN2

8.4.200 GN2 is located just north of the residential properties on Ty'n-y-Lon and is bounded to the west by the A55 and east by Ffordd Bronwydd.

Landscape and Visual

8.4.201 The siting area is within the Vaynol Estate and Surrounds SLA.

8.4.202 It is in close proximity to properties with the potential to affect views from properties on Glan Menai as well as Ty'n-y-Lon, but many of the views towards the site from properties are partly screened by topography and filtered by vegetation. There are open views from the A55 and Ffordd Bronwydd. The promoted viewpoint on Anglesey looks towards the siting area, but the high level of vegetation cover would screen views. There is scope for introducing planting as mitigation for the CSEC; such measures would reflect and enhance the character of the landscape which contains a number of woodland areas and tree lined hedges.

8.4.203 There are significant issues with the overhead line option (5H), which would be required to connect to the CSEC. This has previously been discussed in Chapter 6 of this Report.

Historic Environment

8.4.204 There are no designated or non-designated heritage assets that would be adversely affected however, there is potential for previously unrecorded archaeological remains.

Ecology

8.4.205 Habitats present include improved grassland and hedgerows.

8.4.206 The siting area would have the potential to affect, either directly or indirectly (e.g. through hydrological effects), the following:

- Ancient Woodland and CWS, Parc Menai Woodlands, (approximately 70m to the south west), and CWS sites Treborth Hall Lake and woods and Ysgol Faenol, (75m to the east, and 135m to the south respectively);

- areas of ancient woodland and further CWSs and SSSIs, present within the wider area, the SAC Y Fenai a Bae Conwy / Menai Strait and Conwy Bay, and the SSSI Glannau Porthaethwy (approximately 680m north). These are unlikely to be directly affected by the CSEC itself but could be indirectly affected through the routeing options numerous ponds (within 500m) Survey results to date have indicated negative GCN presence;
- otter (record 450m to the south); and
- red squirrel (record approximately 650m to the south within Ancient Woodland).

8.4.207 There would also be the potential to affect other protected / notable species such as badger, barn owl and bats.

Soils and Agriculture

8.4.208 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land at GN2 is Grade 3 (Good to Moderate quality).

8.4.209 Data from the Soil Survey of England and Wales shows that GN2 is comprised of soils from the Brickfield 2 (713f) and East Keswick 3 (541z) soil associations. The Brickfield 2 soils are seasonally waterlogged and therefore could require longer periods of restricted handling to prevent structural damage; whereas East Keswick 3 comprises well drained loamy soils which can be handled over longer periods. Soils of both associations are suitable for stock rearing on permanent grassland; and, although East Keswick 1 soils can be used for arable agriculture including the production of early potatoes and field vegetables, consultations with landowners undertaken by National Grid have identified that land use within GN2 is pasture.

Construction Noise

8.4.210 This option is located adjacent to the A55 south of the Britannia Bridge to the north east of Parc Menai. There are residential NSRS on the eastern side of the A55 at Treborth. Baseline noise levels will be high in this area due to traffic on the A55.

Operational Noise

8.4.211 GN2 is located close to the A55, the nearest residential receptors are on the same side of the carriageway and these are likely to be within 150m of the CSEC. Baseline levels are likely to be elevated due to traffic noise and local commercial activity. A new overhead line would follow the existing 400 kV overhead line to Pentir Substation, potentially passing some residential receptors within approximately 50m. Only low levels of operational noise would be predicted from overhead line equipment within the CSEC. Overall, assuming an acceptable overhead line design and alignment, it is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5.

Socio Economic

8.4.212 GN2 lies between to the A55 approach to the Britannia Bridge. There is a housing estate immediately to the south of the siting area. While individual residences are not considered as socio-economic receptors, where there are settlements or greater numbers of residences affected there could potentially be effects on the community such as severance and amenity.

Technical

8.4.213 GN2 is in proximity to the A55 and the existing 400 kV overhead line, with an established residential area to the south east. Access to the area is served by a public highway off the A487. The majority of the siting area is open and flat fields.

Gwynedd South Search Area

8.4.214 Five siting areas have been identified within Gwynedd South and range in location from siting areas within Vaynol Park and lower area along the A487 to siting areas on the higher ground towards Pentir Substation. All are currently in agricultural use with the exception of GS3 which is within the grounds of Vaynol Park.

8.4.215 With regard to ecology, options within Gwynedd South have the potential to affect the Vaynol Park Woodlands and Lake CWS, Coed Nant y Garth CWS, Fodol Ganol CWS and plantation on ancient woodland, ancient woodland of unknown origin, and a restored ancient woodland site adjacent to the Gwynedd North Search Area, both directly or indirectly. Habitats present include improved grassland, neutral semi-improved grassland, marshy grassland, dense continuous scrub and hedgerows. Within the search areas, there are large areas of woodland including broad leaved semi-natural woodland and mixed plantation woodland.

Traffic and Transport

8.4.216 The configuration of the land and the poor provision of roads to the north of the search area mean access would only be achievable via linear routes linking to the Pentir Substation. Construction traffic would be likely to utilise Junctions 10 and11 of the A55 and route via the A4244 / B4547 or the A4087 and B4547. The existing access junction at the Pentir Substation could be upgraded to access any new linear routes within Gwynedd South. The existing junction provides good visibility to the east and west; however, temporary traffic management may be needed depending on the level of increase to traffic as vehicle speeds along the route could be high. Furthermore, traffic management and vegetation management would need to be implemented on existing local roads to ensure desirable SSDs are maintained.

8.4.217 Access to GS1 from the local road network would be very challenging due to the long distance between the siting area and available access points. Long haul roads with extensive temporary works would be required. Access to GS3 would require extensive works and routeing through areas such as Parc Menai and the Vaynol Estate.

8.4.218 GS2 and GS4 are situated along the A4087 towards Felinheli, providing the potential for new bellmouths for access, however, vehicle speeds along the route may be a concern. The proximity of the siting areas to the roundabout to the east, and the junction with the B4547 to the west, may unacceptably disrupt flows during peak periods.

Hydrology and Flood Risk

8.4.219 With respect to flood risk, GS1, GS3 and GS5 are not located within any Development Advice Zones. GS2 and GS4 are both partially located within a Development Advice Zone associate with the River Nant y Garth upstream of Aber Pwll.

8.4.220 All the siting areas in Gwynedd South are located in the Nant y Garth River Catchment which achieves currently attains an overall status of good. GS1 is located well clear of the river, at a much higher elevation than other siting areas. GN1 is located within a WFD non-reportable waterbody adjacent to the A55 near Ty'n-y-lon. Non-reportable WFD water bodies do not have specific objectives set out in the Cycle 2 River Basin Management Plans to achieve good status.

GS1

8.4.221 GS1 is a large siting area located on higher ground, the centre of which is only approx. 1.2km from Pentir Substation.

Landscape and Visual

8.4.222 The siting area is located within Dinorwig Landscape of Outstanding Historic Interest.

8.4.223 A CSEC in this location would avoid affecting many of the receptors that would be affected by the other options as it is away from the road network, Vaynol Registered Park and Garden, the Wales Coast Path and National Cycle Route 8 (Lôn Las Cymru).

8.4.224 Depending on the exact location within this larger siting area, there is potential for a CSEC to be visible for people travelling south on the A487 from the junction with the A55; this section of the road is at a similar elevation to the siting area and would have views directly across to it. This section of the A487 forms part of National Cycle Route 8 (Lôn Las Cymru) and the Wales Coast Path. For this reason, a location to the south of Ffordd Fodolydd would be preferred. There is scope for introducing planting as mitigation for the CSEC; such measures would reflect and enhance the character of the landscape which contains a number of woodland areas and tree lined hedges.

8.4.225 GS1 would require the shortest length of new overhead line to connect to Pentir Substation (Option 5G), the effects of which are discussed in Chapter 6.

Historic Environment

8.4.226 GS1 is located on the plateau on the east side of the A4087. It would not directly affect any designated or non-designated heritage assets. There is however potential for effects on the setting of a Scheduled Ancient Monuments at Fodol Ganol Enclosed Hut Group (CN175) and Coed Nant-y-garth, standing stone (CN375) and possibly the setting of the Vaynol Grade I Registered Park and Garden.

8.4.227 There is high potential for previously unrecorded archaeological remains.

Ecology

8.4.228 Habitats present include improved grassland, neutral semi-improved grassland, marshy grassland and hedgerows.

8.4.229 This siting area would have the potential to affect, either directly or indirectly (e.g. through hydrological effects), the following:

- Ancient Woodland and CWS, Coed Nant y Garth, (immediately to the north west and south);
- areas of ancient woodland and further CWSs, present within the wider area, the SAC Y Fenai a Bae Conwy / Menai Strait and Conwy Bay, and the SSSI Glannau Porthaethwy (approximately 2km north west). These are unlikely to be directly affected by the CSEC itself but could be indirectly affected through the routeing options;
- a watercourse, Nant Y Garth, approximately 60m to the south (with an otter record approximately 350m to the south west).

8.4.230 There would also be the potential to affect protected / notable species such as water vole, otter, badger, bats and red squirrel.

Soils and Agriculture

8.4.231 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land at GS1 is Grade 4 (Poor quality).

8.4.232 Data from the Soil Survey of England and Wales shows that GS1 is comprised of well drained loamy soils of the Wick 1 (541r) soil association. The good drainage of these soils means that they can be handled over a longer period without damaging their structure. They can also be used for arable agriculture however, this is considered unlikely in GS1 as the ALC grading is Grade 4 (poor quality) and would therefore not be expected to support arable agriculture.

Construction Noise

8.4.233 GS1 is a large area located close to the east of the A487 and just over 1km from Pentir Substation, requiring only a short section of new overhead line. With careful micro-siting, the nearest residential receptors could be over c. 300m distant from any activity. Baseline levels are likely to be slightly elevated due to distant traffic noise, however there are likely to be periods when baseline levels are very low, especially at night.

Operational Noise

8.4.234 GS1 is a large area located close to the east of the A487 and just over 1km from Pentir Substation, requiring only a short section of new overhead line. With careful micro-siting the nearest residential receptors could be over 300m distant. Baseline levels are likely to be slightly elevated due to distant traffic noise, however there are likely to be periods when baseline levels are very low, especially at night. Only low levels of operational noise would be predicted from overhead line equipment within the CSEC. Assuming an acceptable overhead line design and alignment, it is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5.

Socio Economic

8.4.235 No socio-economic receptors have been identified in proximity to GS1.

8.4.236 There is a disused quarry adjacent to the B4547 which has consent as an inert landfill. Planning consent was granted in May 2016 for minor amendments to the finished profile of the landfill so as to allow ease of reinstatement and create a landform capable of establishing a woodland. This site does not appear to be currently active.

Technical

8.4.237 In summary:

- the topography varies from flat where minimal earthworks would be required, through slightly inclined to steep where more extensive earthworks would be required;
- good permanent maintenance access may be available via Fodolydd Lane;
- an existing 11 kV overhead line may require diverting subject to the detailed siting of a CSEC; and
- considerable routeing difficulties for underground cables would be envisaged due to the steep gradient towards the north and the location of the A458 and B4547 roundabout to the north.

GS2

8.4.238 GS2 is located between the B4548 and A487 opposite the entrance to Vaynol Park Registered Park and Garden, although it is noted this entrance is not generally open to the public.

Landscape and Visual

8.4.239 The siting area is within Dinorwig Landscape of Outstanding Historic Interest.

8.4.240 The siting area is bounded to the north by the B4547, which forms part of National Cycle Route 8 (Lôn Las Cymru) and the Wales Coast Path, and to the east and south by the A487. The siting area benefits from existing vegetation along its boundaries which helps to filter views into the siting area, although it is noted that some of this vegetation has been recently felled opening up more views into the siting area. There is scope for introducing planting as mitigation for the CSEC; such measures would reflect and enhance the character of the landscape which contains a number of woodland areas and tree lined hedges. An additional section of new overhead line would be required to cross the A487, which forms the main tourist route to Caernarfon and the Llyn Peninsula, before heading up the slope toward overhead line Option 5G.

Historic Environment

8.4.241 The close proximity of GS2 to the main entrance to the Vaynol Estate would have a potentially negative affect to the Park's setting if unmitigated. There is high potential for previously unrecorded archaeological remains.

Ecology

8.4.242 Habitats present include improved grassland, watercourse and scrub, with woodland bordering the siting area.

8.4.243 This siting area would have the potential to affect, either directly or indirectly (e.g. through hydrological effects), the following:

- Ancient Woodland (immediately to the bordering north east);
- a CWS and Ancient Woodland, Coed Nant y Garth, (immediately to the south although on the opposite side of the A487);
- areas of ancient woodland and further CWSs, present within the wider area, the SAC Y Fenai a Bae Conwy / Menai Strait and Conwy Bay, and the SSSI Glannau Porthaethwy (approximately 1.6km west). These are unlikely to be directly affected by the CSEC itself but could be indirectly affected through the routeing options;
- a tributary of the Nant Y Garth (immediately to the north);
- otter (record approximately 800m to the north); and
- badger (record within the siting area).

8.4.244 There would also be the potential to affect other protected / notable species such as water vole, bats and red squirrel.

Soils and Agriculture

8.4.245 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land at GS2 is Grade 4 (Poor quality).

8.4.246 Data from the Soil Survey of England and Wales shows that GS2 is comprised of well drained loamy soils of the Wick 1 (541r) soil association. The good drainage of these soils means that they can be handled over a longer period without damaging their structure. They can also be used for arable agriculture however, this is considered unlikely in GS2 as the ALC grading is Grade 4 (poor quality) and would therefore not be expected to support arable agriculture.

Construction Noise

8.4.247 GS2 lies in the peninsula area formed where the A487 meets the B4547 and comprises a grassy area with a farm and other isolated building to the south west. Baseline noise levels will be relatively high due to the proximity of roads in this area. This is a relatively 'insensitive' area.

Operational Noise

8.4.248 GS2 is located between the A487 and B4547. With careful micro-siting the nearest residential receptors could be a maximum of c. 150m distant. Baseline levels are likely to be elevated due to local traffic noise during the day, however there are likely to be periods when baseline levels are low, especially at night. Only low levels of operational noise would be predicted from overhead line equipment within the CSEC. The overhead line connection to Pentir Substation may pass close to some residential receptors. Assuming an acceptable overhead line design and alignment, it is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5.

Socio Economic

8.4.249 This options lies between the B4547 (which at this point also serves as National Cycle Route 8 and the Wales Coast Path) and the A487 (the main tourist route to Caernarfon and the Llyn Peninsula). . A restaurant and 'B and B' are located on the other side of the roundabout junction to the north east.

Technical

8.4.250 Located between the A487 and the B4547, opposite the main gates to the Vaynol Estate, there is a stream along the length of the field adjacent to the B4547.

8.4.251 The available site area for a CSEC is limited due to the topography and the existing roads, and in addition, this would limit the availability of land to route underground cables onto the cable termination points (see Chapter 8). To bring underground cables into a CSEC here the cables would have to be brought vertically up into the site rather than inclined as is typical. Work undertaken to date also indicates that this area is located on the Dinorwig Fault, a major geological fault which is expected to contain squeezing clays, boulders and glacial till.

GS3

8.4.252 GS3 is located within Vaynol Park Registered Park and Garden near the main entrance off the B4547, although it is noted this entrance is not generally open to the public.

Landscape and Visual

8.4.253 The siting is covered by two landscape designations; Vaynol Estate and Surrounds SLA and Dinorwig Landscape of Outstanding Historic Interest.

8.4.254 This siting area would be well screened from people travelling on the A487 by the imposing boundary wall and dense vegetation which runs along the southern boundary of Vaynol Estate. However, the siting area is located within one of the key significant views from Vaynol Hall towards Snowdonia. Although the siting area benefits from surrounding woodland belts that would help to screen the CSEC itself from Vaynol Hall, there may be scope to undertake additional planting to further screen views.

8.4.255 GS3 would require a length of additional new overhead line from the siting area to Option 5G which would run close to the main entrance to Vaynol Estate and across the boundary vegetation in order to cross the B4547 (which forms part of National Cycle Route 8 (Lôn Las Cymru)), and the A487 (the main tourist route to Caernarfon and the Llyn Peninsula), before heading up the slope toward overhead line Option 5G. Of the siting area options in Gwynedd South this option would require the longest section of new overhead line.

Historic Environment

8.4.256 GS3 is located within the Vaynol Park Grade I Registered Park and Garden. This may add potentially unacceptable new development within the Park. There is high potential for previously unrecorded archaeological remains.

Ecology

8.4.257 Habitats present include improved grassland, watercourse and scrub, with broadleaved semi-natural woodland and plantation mixed woodland bordering the siting area.

8.4.258 This siting area would have the potential to affect, either directly or indirectly (e.g. through hydrological effects),the following:

- Ancient Woodland (immediately to the north east);
- a CWS Vaynol Park woodlands and lake and Ancient Woodland surrounding the siting area;);
- areas of ancient woodland and further CWSs, present within the wider area, the SAC Y Fenai a Bae Conwy / Menai Strait and Conwy Bay, and the SSSI Glannau Porthaethwy (approximately 1.6km west). These are unlikely to be directly affected by the CSEC itself but could be indirectly affected through the routeing options;
- otter (record approximately 100m to the south);
- reptiles (records approximately 300m to the east);
- bats (numerous records within 500m);
- badger (record approximately 200m south);
- polecat (record approximately 400m west);
- ponds (within 500m although negative for GCN records); and
- a drainage ditch (immediately to the north).

8.4.259 There would also be the potential to affect other protected / notable species such as water vole and red squirrel.

Soils and Agriculture

8.4.260 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land at GS3 is Grade 4 (Poor quality).

8.4.261 Data from the Soil Survey of England and Wales shows that GS3 is comprised of well drained loamy soils of the Wick 1 (541r) soil association. The good drainage of these soils means that they can be handled over a longer period without damaging their structure. They can also be used for arable agriculture however, this is considered unlikely in GS3 as the ALC grading is Grade 4 (poor quality) and would therefore not be expected to support arable agriculture.

Construction Noise

8.4.262 GS3 lies within the Vaynol Estate. The high wall around the estate will shield the area within it from traffic noise. There are two NSRs nearby, both residential properties and both in close proximity. Whilst careful micrositing of a CSEC could minimise adverse effects, its presence would potentially affect the NSRs and the environment of the Park.

Operational Noise

8.4.263 GS3 is located within the Vaynol Estate. There are residential receptors within the Estate and on Stryd Bangor. With careful micro-siting distances could be maximised to approximately 450m. Baseline levels are likely to be low due to the secluded nature of the Park, and there are likely to be periods when baseline levels are very low, especially at night. The new overhead line to Pentir Substation may pass close to some residential receptors. Although only low levels of operational noise would be predicted from overhead line equipment within the CSEC, it is considered satisfying the requirements of EN-1 and EN-5 would present some challenges.

Socio Economic

8.4.264 GS3 lies to the north of the B4547, which also serves as the Wales Coast Path and the National Cycle Route 8 at this location. It falls within the Vaynol Park Registered Park and Garden which is partly owned by the National Trust, and which occasionally hosts public events. There is a small National Trust car park and picnic site with a promoted wildlife walk.

Technical

8.4.265 Siting area GS3 comprises a wide level grassed area with no obvious technical challenges, although access for construction would probably have to be taken through the Vaynol Estate. Work undertaken to date indicates that GS3 could be on or near to the Dinorwig Fault.

A CSEC in this siting area would remove the need to cross the B4547and the A487, and the difficulties of routeing underground cables up the hillside, that are associated with other options in Gwynedd South.

GS4

8.4.266 GS4 is located close to the small settlement of Aber Pwll to the east of Y Felinheli. This siting area is located in a field between the B4547 and A487. There is a band of trees around the siting area and there is a stream along the field that runs through the siting area adjacent the B4547.

Landscape and Visual

8.4.267 The siting area is within the Dinorwig Landscape of Outstanding Historic Interest.

8.4.268 The siting area is bounded to the north by the local road to Y Felinheli and to the east and south by a local lane and the B4547 which National Cycle Route 8 (Lôn Las Cymru) and the Wales Coast Path currently follow. There are properties to the east and west at Glyndwr and Singrig Cottage respectively. Vegetation along the adjacent roads and field boundaries helps to filter views into the siting area. There is scope for introducing planting as mitigation for the CSEC; such measures would reflect and enhance the character of the landscape which contains a number of woodland areas and tree lined hedges. An additional section of new overhead line would be required to cross the local lane, which forms part of National Cycle Route 8 (Lôn Las Cymru) and the Wales Coast Path, and the A487, which forms the main tourist route to Caernarfon and the Llyn Peninsula, before heading up the slope towards overhead line Option 5F.

Historic Environment

8.4.269 GS4 would be located adjacent to the listed park wall of Vaynol Estate. There is high potential for previously unrecorded archaeological remains.

Ecology

8.4.270 Habitats present include poor semi-improved grassland, watercourse and scrub, with broadleaved semi-natural woodland bordering the siting area.

8.4.271 This siting area would have the potential to affect, either directly or indirectly (e.g. through hydrological effects), the following:

- Ancient Woodland and CWS, Vaynol Park woodlands and lake, (within 30m to the north and south although separated from the siting area by A and B roads);
- areas of ancient woodland and further CWSs, present within the wider area, the SAC Y Fenai a Bae Conwy / Menai Strait and Conwy Bay, and the SSSI Glannau Porthaethwy (approximately 1.1km west). These are unlikely to be directly affected by the CSEC itself but could be indirectly affected through the routeing options;
- a watercourse, the Nant Y Garth (immediately to the north);
- bats (numerous records within 500m);
- badger (record approximately 300m south west); and
- polecat (record approximately 250m north and 350m to the south west).

8.4.272 There would also be the potential to affect other protected / notable species such as water vole and red squirrel.

Soils and Agriculture

8.4.273 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land at GS4 is Grade 4 (Poor quality).

8.4.274 Data from the Soil Survey of England and Wales shows that GS4 is comprised of well drained loamy soils of the Wick 1 (541r) soil association. The good drainage of these soils means that they can be handled over a longer period without damaging their structure. They can also be used for arable agriculture however, this is considered unlikely in GS4 as the ALC grading is Grade 4 (poor quality) and would therefore not be expected to support arable agriculture.

Construction Noise

8.4.275 GS4 comprises farmland between the A487, the B4547 and other local roads. It is constrained by the road network but there are some NSRs nearby to the south west and along the roads. Baseline noise levels will be elevated in the day time due to traffic. Careful micrositing of a CSEC could reduce adverse effects.

Operational Noise

8.4.276 GS4 is located between near the A487, B4547 and other local roads. With careful micro-siting the nearest residential receptors could be a maximum of c. 150m distant. Baseline levels are likely to be elevated due to local traffic noise during the day, however there are likely to be periods when baseline levels are low, especially at night. Only low levels of operational noise would be predicted from overhead line equipment within the CSEC. Assuming an acceptable overhead line design and alignment, it is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5.

Socio Economic

8.4.277 GS4 lies between Bangor Street B4087 and the A55 and is bounded on the east by the B4547. There is a sports field located approximately 50m away at Aber Pwll.

Technical

8.4.278 As with GS2 the available site area for a CSEC is limited.

8.4.279 To install underground cables from the Vaynol Estate to GS4 by open cut would require removal of the embankment behind the Vaynol Wall, removal and rebuilding of the wall itself and trenching across the B4547 (see Chapter 8).

8.4.280 Although feasible to install cables using HDD the available site area for a CSEC is limited and this would also limit the availability of land to route underground cables onto the cable termination points. For GS4 although a CSEC could be accommodated there is insufficient land available for cable routeing.

GS5

8.4.281 GS5 is located on a slope to south of the roundabout junction of A4087, A487 and B4547.

Landscape and Visual

8.4.282 The siting area is located within Dinorwig Landscape of Outstanding Historic Interest.

8.4.283 Due to the topography and the vegetation around the roundabout, the siting area would not be visible from the junction itself although it would be visible for people travelling north on the A487 as they approach the roundabout from Caernarfon. It would also be visible to people travelling south on the A487 from the junction with the A55; this section of the road it at a similar elevation to the proposed siting area and would have views directly to it. This section of the A487 forms part of National Cycle Route 8 (Lôn Las Cymru) and the Wales Coast Path. To connect to overhead option 5G, an additional section of new overhead line would be required; this would be particularly visible from the A487 as it exits the CSEC and travels over the hill towards Option 5G.

Historic Environment

8.4.284 GS5 is located on the east side of the B4548 and A487 roundabout on sloping ground opposite the Vaynol Grade I Registered Park and Garden, it would consequently have an effect on the setting to the entrance to the Park. There is potential for previously unrecorded archaeological remains, even on sloping ground.

Ecology

8.4.285 Habitats present include improved grassland, watercourse and scrub, with broadleaved semi-natural woodland and plantation woodland bordering the siting area.

8.4.286 This siting area would have the potential to affect, either directly or indirectly, (e.g. through hydrological effects) the following:

- Ancient Woodland (immediately to the south west);
- a CWS, Fodol Ganol, (within the siting area);
- areas of ancient woodland and further CWSs, present within the wider area, the SAC Y Fenai a Bae Conwy / Menai Strait and Conwy Bay, and the SSSI Glannau Porthaethwy (approximately 2km west). These are unlikely to be directly affected by the CSEC itself but could be indirectly affected through the routeing options;
- a drainage ditch (immediately to the north);
- otter (record approximately 450m and 150m to the north);
- reptile (records approximately 350m to the north);
- badger (record approximately 30m to the west); and
- red squirrel (record approximately 150m to the south).

8.4.287 There would also be the potential to affect other protected / notable species such as water vole and bats.

Soils and Agriculture

8.4.288 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land at GS5 is Grade 4 (Poor quality).

8.4.289 Data from the Soil Survey of England and Wales shows that GS5 is comprised of well drained loamy soils of the Wick 1 (541r) soil association. The good drainage of these soils means that they can be handled over a longer period without damaging their structure. They can also be used for arable agriculture however, this is considered unlikely in GS5 as the ALC grading is Grade 4 (poor quality) and would therefore not be expected to support arable agriculture.

Construction Noise

8.4.290 GS5 lies just to the north east of GS2 to the east of the A487, A4087 and B4547 roundabout junction. There are two farms nearby but baseline noise levels will be elevated due to traffic noise.

Operational Noise

8.4.291 GS5 is located between the roundabout junction of the A487 and B4547. With careful micro-siting the nearest residential receptors could be a maximum of c. 150m distant. Baseline levels are likely to be elevated due to local traffic noise during the day, however there are likely to be periods when baseline levels are low, especially at night. Only low levels of operational noise would be predicted from overhead line equipment within the CSEC. Assuming an acceptable overhead line design and alignment, it is considered that a design could be achieved to satisfy the requirements of EN-1 and EN-5.

Socio Economic

8.4.292 GS5 is located immediately to the south of the A4087 and A487. There is a restaurant and 'B and B' to the north which are located between the A4087 and A487 to the east of the roundabout junction.

Technical

8.4.293 GS5 is constrained in terms of available land for a CSEC. The siting area is a grassed field area which levels out part way up the hillside from the A487. To the north east height is gained quickly and the topography is steep. To the west looking towards the Vaynol Estate the land falls away quickly towards the A487. Gaining access to the siting area for construction plant would be limited and would require extensive works to regrade the hillside. Permanent access would also be required.

8.4.294 Routeing of an underground cable to GS5 from the Vaynol Wall by open cut would not be possible without removing the existing face of the hillside and introducing a complex cable arrangement to hold and restrain the cables in place. It may be feasible to HDD but it would involve drill sites with a significant height difference, and safe construction access for the plant and machinery required would be extremely challenging (see Chapter 8).

8.4.295 GS5 is constrained in terms of available land and there are also major concerns with routeing underground cables onto cable termination points. Although a CSEC could be accommodated, there is insufficient land available for cable routeing and connecting the cables to the termination points.

8.5 Consideration of Options

8.5.1 Anglesey North was the most preferred search area in consultation responses, with Gwynedd North preferred by Gwynedd Council.

Landscape and Visual

8.5.2 On Anglesey, the overall preference from a landscape and visual perspective is for a location within Anglesey North CSEC Search Area; this is mainly influenced by the proposed overhead line options (see Section 4). Options 5D and 5E which connect to Anglesey North would allow an overhead line to parallel the existing 400 kV overhead line for as long as possible reducing the spread of effects of an additional overhead line. This also reduces the potential effects on Bryn Celli Ddu and the settlements of Star, Gaerwen and Llanddaniel Fab. Anglesey North also avoids direct effects to the Southern Anglesey Estatelands SLA.

8.5.3 The preference related to the CSEC siting areas within Anglesey North from a landscape and visual perspective is AN2, again due to the proposed overhead line. This siting area provides the shortest overhead line connection in Anglesey North.

8.5.4 AN1 and AN4 are the least preferred options. The open aspect of these siting areas and proximity to the road and properties make these less favourable. AN3 is also not preferred as it is the longest overhead line, but noted that the overhead line could be routed away from properties and as discussed in Chapter 6, there may be opportunities to reduce this effect e.g. by the use of lower height pylons.

8.5.5 Within the Anglesey Central and Anglesey South, although not preferred overall the siting areas considered to have fewer potential effects are those with shorter overhead line connections.

8.5.6 The preferences within Anglesey Central are marginal as each siting area would presents its own issues. The least preferred options are AC2 and AC3 due to the length of new overhead line that would be required and the potential effects on Star and the SLA. With regard to options with fewer likely effects, AC1 and AC5 would require the shortest lengths of new overhead line, but AC1 would affect views from Star and AC5 and bring a new overhead line closer to Bryn Celli Ddu. AC5 is the only option outside the boundary of the SLA. AC4 and AC6 are both located within the SLA but are located further from Star and Bryn Celli Ddu resulting in a lesser effect on these receptors. Although AC4 and AC6 would require a marginally longer new overhead line route, a CSEC location within one of these areas would have fewer potential impacts as the location provides the best balance between effects on receptors.

8.5.7 Within Anglesey South, AS2 would be likely to have relatively fewer effects as it is the shorter of the two overhead line options and further back from the AONB. AS1 is on the boundary of the AONB and would require more overhead line within the SLA.

8.5.8 In Gwynedd, Gwynedd South is preferred over Gwynedd North. Although the CSEC siting areas within Gwynedd North are favourable locations in terms of landscape and visual receptors, the proposed overhead line option to connect to Pentir Substation has considerable issues relating to visual effects which would be challenging to mitigate, a described in Chapter 6 of this Report.

8.5.9 Within Gwynedd South, the preference would be for a CSEC within GS1. As well as being able to utilise Option 5G which is preferred for the overhead line, the siting areas is located within an area with relatively few receptors and would avoid direct effects on the Vaynol Estate and Surrounds SLA. As noted in above, within GS1, a CSEC location to the south of Ffordd Fodolydd would be preferred.

8.5.10 GS3 is the least preferred of the options within Gwynedd South. This siting area is located within Vaynol Registered Park and Garden and SLA and there are potentially significant effects from an overhead line connecting in this location.

Historic Environment

8.5.11 Within Anglesey North a CSEC set away from the Grade II listed buildings at Gwyndy Farm (LB 26146) would be preferred. AN1 would be particularly close and would be likely to have a significant adverse effect on the farmstead's setting. This option is therefore less preferred in favour of options that would be less likely to have a significant effect. AN2, while still relatively close to Gwyndy would be partially screened by modern farm buildings to the west of the current farmstead and by local topography.

8.5.12 Both AN3 and AN4 would not have significant effects on the known historic environment and are preferred.

8.5.13 There is high potential at all the options within Anglesey North for previously unrecorded archaeological remains.

8.5.14 The preferred option within Anglesey Central with regards the historic environment is AC1. No designated heritage assets would be directly affected and there would be minimal indirect setting impact.

8.5.15 AC5 is least preferred due to the likely setting impact on the scheduled prehistoric tomb and standing stones at Bryn Celli Ddu (AN002).

8.5.16 Within Anglesey South there is no preference for either of the options.

8.5.17 Within Gwynedd North there is no preference for either of the options.

8.5.18 All the options within Gwynedd South would have all have effects on the historic environment. GS2, GS3 and GS5 would directly and indirectly affect the Vaynol Grade I Registered Park and Garden. GS1 would have potential effects on the setting of Scheduled Ancient Monuments (CN175 and CN375)

Ecology

8.5.19 Within Anglesey North, there are concerns about the proximity to habitats in and surrounding the CWS. There is some potential for indirect effects to occur, for example as a result of any changes to local hydrology. AN1 lies just to the north of the CWS, and areas of marsh and ancient woodland. AN2 is least preferred as it may potentially require cables to be routed through the CWS and an area of marshy grassland. Options AN3 and AN4 are therefore preferred, depending on the overhead line route and pylon locations, and the potential effects. Of the two, AN3 is preferred as it lies further away from the CWS.

8.5.20 Within Anglesey Central, there are no major differentiators between the CSEC siting areas; however there are minor differentiators with some options relating to potential access points and overhead line / cable routes. AC5 may require the removal of a small area of woodland, AC1 may involve cabling through a watercourse to Crossing Zone Location 2 (Anglesey), and AC3 may require a cable through what is possibly a marshy grassland area. AC1, AC3 and AC5 are therefore the least preferred options. There are no key differences between AC6 and AC4; however there is a marginal preference for AC6 as it lies a greater distance from habitats and designations of greater nature conservation interest.

8.5.21 Within Anglesey South, AS2 is preferred, although there are some issues within the siting area which have to be considered. There is a pond within AS1 and

replacement ponds would be required under licence if this were found to be a GCN pond and it was lost as a result of the development.

8.5.22 Within Gwynedd North, GN2 is preferred over GN1 as it is a greater distance from woodland and CWSs.

8.5.23 Within Gwynedd South, options which avoid ancient woodland and CWSs are preferable. There is some preference for the southern part of GS3, due to the minimal cable distance to connect. In addition the overhead line route out of the southern area would affect fewer trees to the west than the northern part of the siting area. GS5 is least preferred as it includes part of the CWS.

8.5.24 The cable and overhead line route options to connect into each CSEC would however influence the preference, trenchless techniques to lay cables into GS1 or GS5 would avoid the impacts to woodland. Effects on trees and associated species would then arise only from the overhead line connection, thereby making GS1 the preference.

Soils and Agriculture

8.5.25 Within Anglesey North, all agricultural land within the CSEC siting areas is poor quality (Grade 4) and under permanent pasture. The only differentiator is therefore the length of required underground cables as increased length would result in increased disturbance to agricultural land (see Chapter 8 below), with Option AN3 is most preferred followed by AN4, AN1 and AN2.

8.5.26 Within Anglesey Central, the only CSEC siting area to contain Grade 3 land (Good to Moderate quality) is Option AC5; with all other options being restricted to lower Grades. Option AC5 is therefore least preferred; followed by Options AC2, AC3 and AC4 which are all Grade 4 (Poor quality); and Option AC1 is most preferred as all land is Grade 5 (Very Poor quality).

8.5.27 Within Anglesey South, the agricultural land within both CSEC siting areas is poor quality (Grade 4). The only differentiator is therefore the length of required underground cables (see Chapter 8 below) with AS2 being preferred.

8.5.28 Within Gwynedd North, both CSEC siting areas contain Grade 3 land (Good to Moderate quality) which is used for pasture. The only differentiator is therefore the length of required underground cables (see Chapter 8 below) with Option GN1 preferred over GN2 as cable length would be slightly shorter.

8.5.29 All CSEC siting areas within Gwynedd South are located on Grade 4 (Poor quality) agricultural land. The only differentiator is therefore the length of required underground cable, with GS1 being the least preferred option.

Traffic and Transport

8.5.30 On Anglesey, accessing a CSEC in Anglesey North would be advantageous and deemed to be less complex than other search areas, which are generally more constrained by road geometry and size.

8.5.31 In Gwynedd, a CSEC in Gwynedd South, making some use of the existing site access would be considered a preferred option in traffic and transport terms. Whilst the sites identified for the CSECs all represent some challenges in terms of access, through careful design and the consideration and implementation of appropriate traffic management negative effects can be mitigated.

Construction Noise

8.5.32 Within Anglesey North, with careful siting, any of the options could be constructed without excessive construction noise or vibration effects to nearby NSRs. AN1 is least preferred due to its closer proximity to a number of NSRs.

8.5.33 Within Anglesey Central some of the options are located in areas with higher baseline noise environments and some are in very remote locations; none are close to significant numbers of NSRs. None of the options are subject to particular constraints but AC2 is least preferred due to its proximity to the terrace of properties.

8.5.34 Within Anglesey South both the options are in similar environments in terms of baseline noise levels and proximity to NSRs. The options are therefore similar in terms of sensitivity, i.e. they both have NSRs nearby and are both subject to low baseline noise levels, and hence there is no preference between them.

8.5.35 Both options in Gwynedd North are in an 'insensitive' area in that there are no NSRs close enough to be adversely affected given the relatively high noise environment. Other industrial uses are also located nearby.

8.5.36 Options in Gwynedd South are all close to a significant road network which will elevate baseline noise levels. Options GS2, GS4 and GS5 are in similar environments and are in relatively 'insensitive' locations. GS3 is in a more sensitive location and is least preferred.

Operational Noise

8.5.37 Within Anglesey North the baseline is likely to be very low, however it is considered that, assuming an acceptable overhead line design and alignment, a design could be achieved for all options to satisfy the requirements of EN-1 and EN-5 with AN1 being the least preferred option.

8.5.38 Within Anglesey Central, for some of the options the baseline is likely to be slightly elevated due to the proximity to nearby roads, while some of the options are located in remote locations where baselines are likely to be lower. With careful micro-siting none would be very close to significant numbers of residential receptors. It is considered that, assuming an acceptable overhead line design and alignment, a design could be achieved for all options to satisfy the requirements of EN-1 and EN-5, however AC2 is least preferred due to its proximity to the terrace of properties.

8.5.39 Within Anglesey South both the options are in relatively quiet areas likely to have low baseline noise levels and similar proximity to residential receptors. Both options require relatively long new overhead line connections which may pass close to residential receptors. It is considered that designs could be achieved which would satisfy the requirements of EN-1 & EN-5, and there is no preference between them

8.5.40 Both options in Gwynedd North are in an area likely to have elevated baseline levels due to the proximity to the A55 and other industrial uses nearby. GN1 is marginally preferred over GN2 due to the slightly greater distance to residential properties.

8.5.41 Options in Gwynedd South are all close to a significant road network which will elevate baseline noise levels, especially during the day time. GS1 is marginally preferred as it would allow the CSEC to be located away from residential properties and would require the shortest length of new overhead line to connect to Pentir Substation. Options GS2, GS4 and GS5 are in similar environments and it is considered that designs could be achieved to satisfy the requirements of EN-1 and EN-5. GS3 is in a more sensitive location and is least preferred.

Socio Economic

8.5.42 Within Anglesey North AN3 is the least preferred option due to proximity to Pili Palas Nature World and the potential for construction disturbance. AN2 and AN4 are joint preferred options as there is little to distinguish between these options. AN1 is less preferred as the siting area is in closer proximity to the B5420 than AN1 and AN4 with greater potential for construction disturbance to affect road users.

8.5.43 Within Anglesey Central AC2 is the least preferred option due to proximity to Llanfairpwllgwyngyll railway station which is a tourist attraction. AC4 and AC6 are joint preferred options as there are no significant socio-economic receptors of note and there is little to distinguish between these options. AC1 or AC3 are second most preferred. Although AC3 is in proximity to the essential setting of Plas Newydd, there are unlikely to be any significant issues from a socio-economic perspective. AC1 is adjacent to the railway line. Assuming there would be no construction disturbance to the use of the line, no significant socioeconomic effects are anticipated at this location. AC5 is less preferred as it is in closer proximity to Bryn Celli Ddu however there no significant socio economic issues foreseen.

8.5.44 Within Anglesey South AS1 is the least preferred option due to proximity to Plas Coch holiday home complex. AS2 is preferred as it is a further distance from Plas Coch, the AONB and Plas Newydd.

8.5.45 Within Gwynedd North the preference is for GN1 as it would be alongside existing industrial uses and away from settlements. GN2 is less preferred due to its location adjacent the settlements near Britannia Bridge which could result in community effects such as severance and amenity.

8.5.46 Within Gwynedd South GS1 is the preferred option as no significant socio-economic receptors have been identified. GS2 and GS5 are joint second preferred options as although they are close to the A4087, and the A487 the existing road configuration and woodland planting means that permanent disturbance is likely to be minimal. GS4 is less preferred as it is close to a number of residential properties which could result in effects at a community level. GS3 is the least preferred option due to its situation within the Vaynol Registered Park and Garden.

Technical

8.5.47 All the siting areas on Anglesey offer suitable locations to locate a CSEC. The preference would be to site a CSEC close to a public highway in an area with flat level topography.

8.5.48 Siting areas within Anglesey South are preferred as they are closer to the A4080 and would therefore minimise off highway access works

8.5.49 On the mainland the preference would be to locate a CSEC at GN2 as the siting area offers good access from the public highway into a level field with few or little anticipated engineering difficulties. GS3 is also preferred and a longer overhead line connection would avoid routeing 12 cables up the hillside towards Pentir Substation.

8.5.50 GN1 raises major concerns with respect to routeing the underground cables to the terminations, and construction access using the existing single lane road bridge over the A55.

8.5.51 Siting area GS1 offers sufficient land for a CSEC and would be the preference against technical considerations, however routeing an underground cable to the siting area is significantly challenging and complex, and there are concerns with access to the area.

8.5.52 Siting area GS2 offers good access off the public highway however there is very limited space to route the underground cables to the termination points.

8.5.53 Siting areas GS4 and GS5 have insufficient space to route the underground cables to the termination points.

8.6 Initial Preference

8.6.1 There is no definitive outcome identifying preferred options in either Anglesey or Gwynedd. In many instances options could not be preferred or least preferred without consideration of other elements of the project (overhead lines, cable routes, crossing zones etc.).

8.6.2 On Anglesey overall, against landscape and visual considerations the Anglesey North Search Area was preferred, whilst for ecology it was least preferred. Other disciplines commented on the advantages of paralleling the existing 400 kV overhead line with a new overhead line (Options 5D or 5E).

8.6.3 AN2 was preferred against landscape and visual and socio economic considerations whilst least preferred for ecology and land use and agriculture. AN3 was preferred for historic environment, ecology and land use and agriculture, and least preferred for socio economic considerations. AN4 was preferred for historic environment, ecology and socio economic considerations and least preferred for landscape and visual. AN1 was least preferred against noise considerations.

8.6.4 For Anglesey Central AC4 and AC6 were preferred against landscape and visual and socio economic considerations. AC2 was last preferred against landscape and visual, noise and socio economic consideration. AC3 was least preferred for ecology and also landscape and visual. Historic environment and land use and agriculture expressed a preference for AC1 whilst this siting area was least preferred for ecology. AC5 was least preferred against historic environment, ecology, and land use and agriculture considerations.

8.6.5 Within Anglesey South, for those disciplines that expressed a preference AS2 was preferred and AS1 was least preferred.

8.6.6 In Gwynedd, against landscape and visual, and traffic and transport considerations the Gwynedd South Search Area was preferred. As for the CSEC siting areas on Anglesey other disciplines commented on the potential effects and challenges associated with the overhead line and cable routeing.

8.6.7 For Gwynedd North, for those disciplines that expressed a preference GN1 was preferred against and land use and agriculture; and noise considerations and least preferred for ecology. GN2 was preferred by ecology and socio economic and least preferred for noise.

8.6.8 For Gwynedd South, GS1 was preferred for landscape and visual, ecology operational noise and socio economic considerations. GS3 was preferred for ecology and least preferred for noise and socio economic considerations. GS5 was least preferred for ecology. No differentiation could be made between the sites in terms of land use and agriculture.

8.6.9 Due to technical considerations GS2, GS4 and GS5 have not been considered further as there is insufficient space for cable routeing to the termination points.

9. UNDERGROUND CABLES

9.1 Introduction

9.1.1 Four potential zones have been identified for a crossing of the Menai Strait, based on the geology within the Straits and, which onshore offer potential locations with sufficient space for the construction activities (for HDD, tunnel construction or seabed installation) and for a tunnel head house should one be required. This is explained further in Chapter 9.

9.1.2 Potential underground cable route corridors (100m width) were identified within the 'Underground Cable Route Search Area' to link from the CSEC siting areas to the crossing zones (see Figure 8.1).

9.1.3 Considerations for routeing underground cables are very similar to those for an overhead line and include:

- Landscape and Visual (for example designated landscapes, landscape character, landscape sensitivity, open access areas, landscape and visual receptors);
- Historic Environment (internationally, nationally and locally designated sites and features and other undesignated sites and features such as historic landscapes);
- Ecology (internationally, nationally and locally designated sites and features and other undesignated sites and features such as woodland and BAP priority habitats);
- Land use and Agriculture;
- Hydrology and Hydrogeology; and
- Socio-economic (e.g. tourism features).

9.1.4 Technical / constructability considerations include:

- steepness of terrain (including excessive side slopes);
- directness of route;
- crossing of existing infrastructure / utilities (e.g. crossing angles);
- access for the local road network;
- ground conditions (consideration of geomorphologically unstable areas, areas of rock and peat, potentially contaminated land);
- areas of flood risk; and
- external heat sources likely to cause ground heating (e.g. other high voltage cables).

9.1.5 For all the options discussed below the extent of the issues identified would be dependent on the exact location of the CSECs and construction compound / tunnel head house sites within the respective crossing zone (Anglesey or Gwynedd). For the purposes of identifying and appraising potential cable route options a representative CSEC siting area within each search area has been used, for example AN2 in Anglesey North. The potential combinations of the different elements (CSECs, underground cable routes, crossing zones etc.) are considered further in Chapter 11 of this Report.

9.1.6 An overview of the construction process for underground cables is provided in Chapter 4 above.

9.1.7 For all options:

- to meet rating requirements, twelve cables are required when direct buried. This is due to the inability of the heat to escape from the cable conductor through the surrounding soil;
- CSEC are required at both ends of the direct buried section;
- permanent drainage is required to manage water levels within the cable swathe; and
- two above ground link pillars will be required approx. every 800m (one for each circuit (6 cables per circuit)). Vehicular access to these pillars will required to allow equipment to be connected for periodic testing.

9.2 Consultation Feedback

9.2.1 Concern was expressed over the effects of long underground cable runs on the AONB, and the Grade I Registered Parks and Gardens Plas Newydd and Vaynol Estates.

9.2.2 Llanfairpwllgwyngyll Community Council stated that they would strongly oppose any cables being placed under homes in their area due to health risks.

9.2.3 Some respondents expressed concern regarding the impacts of construction and the use of heavy machinery which would disturb agricultural land.

9.2.4 Gwynedd Council, while welcoming the proposed undergrounding in the vicinity of the Menai Strait, requested its extension to Pentir. This was echoed by GAPS and Cadw.

9.3 Description of Options

Anglesey North (AN2) – Crossing Zone 4 (Anglesey)

9.3.1 The route passes through general terrain of open grassland and undulating topography with wetland and area of marsh, and rock outcrops in multiple locations. The topography steepens towards the A5025.

9.3.2 From Anglesey North any underground cable route would need to cross the A5025 and the Afon Rhyd-Eilian ditch. The crossing of the A5025 may be require a HDD due to the topography and the need to minimise disruption to road users.

9.3.3 There is an area of very wet marshland adjacent to Afon Rhyd-Eilian for which a HDD may also be required. Works in saturated ground may require additional support to prevent trench collapse or water ingress (pumping, geogrids, battens) and stabilising works to prevent movement or sinking of the cables over the long term. Permanent drainage along the cable route would also be required.

9.3.4 Excavation in peat (if present) is usually problematic and can lead to very large areas of disturbance. "Peat bog slides" can occur depending on the peat characteristics, thickness and surface gradients. Placement of relatively small amounts of fill or light foundations can lead to short term bearing capacity failure, significant settlements and secondary consolidation, over many years.

9.3.5 Saturated ground conditions would increase the difficulty of working and machinery movements and may require specialised plant. Works crossing saturated land would require consideration of the effects the installation would have on the ground water movements.

9.3.6 With respect to construction access a haul road would be required via A5025 and/or B5420. The wetland and crossing of the Afon Rhyd-Eilian would require significant works to enable a continuous haul road to be installed. A temporary crossing structure (culvert / bridge) would be required to cross the Afon Rhyd-Eilian. Installation of haul roads over saturated ground may require the pumping of water from the works area and use of geogrids for support.

9.3.7 There is good access for maintenance and inspection of the cable route and link pillars throughout the majority of this area. Inspections across marshland may be inhibited by ground conditions and would therefore have additional safety requirements to manage.

9.3.8 Long term operation of the circuit may result in dry out of the soil in the vicinity of the cable route. Saturated ground and peat both have high thermal resistivity in the dried out state which would negatively impact the rating of the circuit.

Anglesey Central (AC1) – Crossing Zone 3 (Anglesey)

9.3.9 The route would pass through flat open grassland with large wetland areas and undulating topography, crossing beneath a number of ditches and a stream, a railway bridge embankment, and the existing 400 kV overhead line (with the pylon foundations in close proximity). The route would also run close to the Mainline railway line.

9.3.10 HDDs are likely to be required in order to install the cables across the stepped vertical differences, to cross the road bridge over the railway line west of the A5 junction with the A55 (Junction 7A), and to cross the A4080.

9.3.11 Crossing underneath and adjacent to the existing 400kV overhead line would require site management and would increase the construction risk due to working in proximity to a 400 kV 'live' overhead line.

9.3.12 A large stream running parallel towards the Afon Rhyd-Eilian would also need to be crossed. As noted for Anglesey North works in saturated ground may require additional support works to prevent trench collapse or water ingress. Excavation in peat (if present) is usually problematic and can lead to very large areas of disturbance. Saturated ground conditions would increase difficulty of working and machinery movements and may require specialised plant. Works crossing saturated land would require consideration of the effects the installation would have on the ground water movements.

9.3.13 A construction haul road would be required to access cable route via the A4080. Restrictions to visibility may prevent the use of the railway bridge running between A5 and A4080 opposite Junction 7A. The bridge abutments associated with the crossing of the existing railway line from the A5 would prevent the construction of a continuous haul road running between the cable circuits. The crossing of the Afon Rhyd-Eilian would require a temporary bridge/culvert. Installation over saturated ground may require pumping of water from the works area and use of geogrids for support.

9.3.14 Maintenance inspections across saturated ground may be inhibited by conditions and would lead to additional safety requirements which would have to be managed.

9.3.15 Long term operation of the circuit may result in dry out of the soil in the vicinity of the cable route. Saturated ground and peat both have high thermal resistivity in the dried out state negatively impacting the rating of the circuit.

Anglesey Central (AC6) – Crossing Zone 2 (Anglesey)

9.3.16 This route would pass through open grassland and undulating topography. There is an area of very wet land although this could be avoided by sensitive routeing. No difficult conditions or particular complex issues for routeing were identified.

9.3.17 A construction haul road would be required via the A4080 and there would be good access for maintenance and inspection of the cable route and link pillars.

Anglesey Central (AC6) / Anglesey South – Crossing Zone 1 (Anglesey)

9.3.18 The route would pass through open grassland with undulating topography. An area of very wet saturated ground was noted during the site walkover survey.

9.3.19 In order to gain access to Crossing Zone 1 (Anglesey) by underground cables a route from Anglesey Central would pass through Anglesey South.

9.3.20 A crossing of the A4080 would be needed which may require HDD to avoid traffic disruption. Crossings would also be required of other minor public roads.

9.3.21 A construction haul road would be required via A4080 and there would be good access for maintenance and inspection of the cable route and link pillars.

Crossing Zone 1 (Gwynedd) – Gwynedd South (GS1)

9.3.22 Routes would pass through open grassland from the Menai Strait through the Vaynol Estate where the ground conditions and topography change to steep sided rocky outcrops. The route would then cross the B4547 and the A487 before passing up the side of the hill and through the wooded area towards GS1.

9.3.23 There are a number of constraints for routeing including a lake within the Vaynol Estate, a steeply sided rocky outcropped area, the Vaynol Wall and the estates' perimeter embankment, the B4547 and A487 roundabout, a drainage ditch, and an area of trees and vegetation on the A487 embankment.

9.3.24 Work to date indicates that the route would cross the Dinorwig Fault.

9.3.25 This route is technically complex. Using the open cut technique for cable installation would require cutting through the Vaynol Wall, and crossing highways, and the roundabout. Trees would need to be removed on the hillside which would, due to the gradients, need to be substantially re graded, with the 12 cables permanently clamped on in troughs. Based on desk top feasibility assessments undertaken to date, the ability to provide safe access for the civil works and to deliver the cable drums safely into the installation position is not demonstrable.

9.3.26 Using trenchless technology, from the Vaynol Estate to GS1, has also been investigated. This could potentially simplify installation and reduce construction risks. There would however be issues with gaining access for drilling plant, equipment and cable drums, and with the relative height difference between the drill sites. The likely depth of the drill profiles would constrain cable rating and increase the separation distances required between the cables, increasing the overall width required to up to 150m[35]. There are also complexities with pulling / pushing 400 kV cables uphill or downhill.

Crossing Zone 2 (Gwynedd) – Gwynedd South (GS1)

9.3.27 Routes would cross open grassland from the Menai Strait, route around properties in the Vaynol Estate, routeing towards the Vaynol Wall and perimeter embankment towards the south of the Estate. From here the route to GS1 would be very similar to the route identified above for Crossing Zone 1 (Gwynedd) to GS1 with the same technical considerations as noted above.

9.3.28 A HDD crossing the B4547 / A487 would prevent a continuous construction haul road. Access to a drill site above the B4547 / A487 HDD would be very challenging due to the steep embankment from GS1. Significant earthworks would be required to provide as suitable access route.

9.3.29 If it were not possible to HDD the steep embankment adjacent to A487 cables laid using open cut trenching would have to be clamped onto the embankment and would possibly require re-profiling earthworks.

9.3.30 Due to the distance from GS1 to available access points, long haul roads with extensive temporary works would be required.

9.3.31 Access to the Vaynol Estate would be required for maintenance and inspections of the cable route and link pillars. Cables installed onto the embankment up to the CSEC would require regular inspection works to assess the cable position and any movement due to thermomechanical forces or fatigue of cleats.

9.3.32

[35] This depth of cable would likely increases the centre to centre separation of the cables to 10m, giving a total width of up to 150m (15 ducts total, 12 cables, 1 telecom and 2 spare ducts).

Crossing Zone 3 (Gwynedd) – Gwynedd North (GN1)

9.3.33 The route would pass through evenly rising topography from the Menai Strait towards GN1, across an area of open field with a number of ditches. The route would encounter a number of underground services (including sewers), and the access road that serves an existing lower voltage substation, a property and the wastewater treatment works.

9.3.34 The construction swathe would be restricted by underground services and the location of the existing 400 kV overhead line. Trenchless technology may be required if the services and sewers are at a level which would prevent the cables being installed with standard protection depth. The use of trenchless technology would also avoid having to open cut the access road which serves the property, the substation and the wastewater treatment works.

9.3.35 Construction access could potentially be via the existing road bridge over the A55 however this could only be confirmed after discussion with the bridge owner and an assessment of the bridge's capacity in relation to cable deliveries. There would however be potentially significant effects on the existing access arrangements for adjacent landowners, the substation and wastewater treatment works. Access for construction may also be possible via a new a bell mouth off the A55, however this would be subject to agreement.

9.3.36 If tunnelling were preferred for the crossing technique access for a TBM would be difficult.

9.3.37 Alternative access routes through Parc Menai are unlikely to be feasible due insufficient space and the need to cross the wastewater treatment works.

Crossing Zone 3 (Gwynedd) – Gwynedd South (GS1)

9.3.38 The route would cross open grassland with undulating topography in the Vaynol Estate, crossing underneath the Vaynol Wall and the A487 and up the steep embankment towards GS1.

9.3.39 This is one of the longest land routes assessed. Open cut techniques would be used through the Vaynol Estate with a section of the Estate Wall being removed and rebuilt. The alternative would be to use trenchless technology to pass beneath the wall. Other technical considerations are as noted above for Crossing Zones 1 and 2 (Gwynedd) to GS1.

9.3.40 An alternative was also investigated that would route the cables towards and across Parc Menai Business Park, onto the former railway alignment, passes through the tunnels used by the former railway, and then up a steep road side embankment to GS1. This route would follow open fields through the Vaynol Estate, existing roads and highways within the Parc Menai Business Park and then follow the alignment of the former railway. From here it would follow a valley and go up the hillside towards GS1, raising the same considerations as for other routes.

9.3.41 Although cables can be installed within roads and highways the roads and verges within the Business Park may not be wide enough to accommodate the 12 cables required. Any works within the Business Park would potentially impact on traffic within the Park. The alignment of the former railway has been in-filled with earth and spoil and now comprises an inclined ramp down to the portals of the two tunnels. The tunnels, now in private ownership, pass

beneath the hillside and emerge above the A4087 and A487. Observations made during a brief walkover survey along part of the length of the inside of one of the tunnels noted that the tunnel lining was in moderate to good condition. Access to and from the tunnel entrances appears good but there are ventilation shafts located within the loading area of a warehouse within Parc Menai (the 'Book People'). These vents would have to be closed up to avoid access to the tunnels and to stop water ingress. Ventilation equipment would be required in new tunnel entrance buildings, with moisture levels monitored constantly to avoid damp. Ongoing maintenance to the fabric of the tunnel would also be required. For these reasons installation of the cables within these tunnels was deemed unsuitable.

9.3.42 Access to and from the tunnel entrances appears good but there are ventilation shafts located within the loading area of a warehouse within Parc Menai ('The Book People'). These vents would require closing up to avoid access to the tunnels and to prevent water ingress. Ongoing maintenance of the tunnels would be required throughout the life of the cables. Ventilation equipment would be required in new tunnel entrance buildings and moisture levels would have to be monitored constantly to avoid damp. For these reasons, an option utilising the tunnels was deemed unsuitable.

Crossing Zone 4 (Gwynedd) – Gwynedd North (GN1)

9.3.43 The route between Crossing Zone 4 (Gwynedd) and GN1, although short, would cross the A55 and its embankments and would have to cross or be in proximity to the existing main sewers and services to the wastewater treatment works, and the existing 400 kV overhead line.

Crossing Zone 4 (Gwynedd) – Gwynedd North (GN2)

9.3.44 Crossing Zone 4 (Gwynedd) and GN2 are adjacent, within an open field south of the railway line, between the A55 and Ffordd Bronwdd.

9.3.45 As for the route to GN1 above this option would require a minimal length of cable connection to the CSEC. It is expected that the cables would be installed in locked troughs in a secured compound thereby minimising risk of mechanical damage.

9.4 Consideration of Options

Landscape and Visual

9.4.1 From a landscape and visual perspective, the key issue with underground cable routes would be vegetation removal required during construction. All the proposed underground cable routes would require vegetation removal, so options favoured would be those which minimise this effect. Since all options have looked to reduce the requirements for vegetation removal and ecology has also identified vegetation loss as one of its key concerns, it is considered that landscape and visual is not a differentiator for underground cable routes.

Historic Environment

9.4.2 The construction of underground cabling is acknowledged to involve substantial groundworks.

9.4.3 There is high potential for previously unrecorded archaeological remains and therefore there would be the potential for effects associated with each of the options.

9.4.4 It is also acknowledged that cabling route options are constrained by engineering considerations, and therefore to reduce potential effects on any buried remains the shorter options are preferred.

9.4.5 None of the options directly affect any designated heritage assets, however there would be some loss of traditional field boundaries and parkland woodland and options which minimise this are preferred.

Ecology

9.4.6 On Anglesey, cable options from Anglesey South to Crossing Zones 1 and 2 (Anglesey) are the longest, and in general the longer the cable route the greater the potential for effects due to disturbance and permanent habitat loss.

9.4.7 None of the cable route options for Anglesey South or Anglesey Central, or Crossing Zones 1, 2 and 3 (Anglesey) are routed through designations or ancient woodland. For most routeing options habitats affected would consist of grassland, with watercourse and hedgerow crossings, and therefore in the absence of quality/value differentiators, preference is given to shorter lengths of route.

9.4.8 The cable route option between Anglesey South and Crossing Zones 2 and 3 (Anglesey) could also affect woodland habitat and is the longest route. This is therefore the least preferred option south of the A55.

9.4.9 The cable route between Anglesey Central and Crossing Zone 2 (Anglesey) is the shortest and therefore the preferred.

9.4.10 For Anglesey North, the least preferred cable route option exits AN2 and passes through a CWS.

9.4.11 On Gwynedd, there is a larger extent of CWS, woodland and ancient woodland area between the crossing locations and the CSEC search areas. Although cable route corridors are routed around the CWSs, woodland and ancient woodland areas where possible, they mostly do have to pass through these habitats at some point. These sections would result in permanent habitat loss and residual habitat fragmentation. In addition it would not be possible to replace ancient woodland.

9.4.12 For Crossing Zone 1 (Gwynedd), the southern cable route option is preferred over the northern option, as it would result in a smaller loss of both ancient woodland and woodland within the Vaynol Park CWS. For the same reasons, the western cable option from Crossing Zone 2 (Gwynedd) is preferred over the eastern options.

Hydrology and Flood Risk

9.4.13 In terms of hydrology and flood risk considerations, the key issue with underground cables would be physical disturbance to watercourses and impacts on flood storage and flood flow pathways during construction.

9.4.14 All options would require watercourse crossings of minor streams and ditches, and options to route to Crossing Zones 1, 2 and 3 would involve crossings of the WFD 'blue line' (the most substantial watercourse in a given catchment that is generally used to monitor and classify the WFD status of the wider water body). These crossings would require careful consideration, although any effects on the surface water environment would be temporary and are likely to be reversible.

9.4.15 In respect of flood risk, the routeing option to Crossing Zone 3 on Anglesey provides the most notable constraint as it falls within a large portion of Development Advice Zone C2 floodplain. For all other options, flood risk constraints can be considered to be negligible and would not be expected to be a differentiator for underground cable route preference.

Soils and Agriculture

9.4.16 From an agricultural perspective, the key issue with underground cable routes is that longer routes will result in greater levels of disturbance to agricultural land. Therefore, shorter routes are preferred.

Traffic and Transport

9.4.17 The options for underground cabling from Anglesey North would require access from the A5025 to achieve access to the and also to Crossing Zone 4 (Anglesey). Construction traffic associated with the construction of the access point and the underground cabling could access Anglesey North by exiting the A55 from Junction 8 and joining the A5025. The underground cabling crossing the A5025 would require this road to be closed temporarily for the cables to be laid and road surface to be restored to its previous condition.

9.4.18 Vehicles routeing towards the CSEC siting areas in Anglesey Central could make use of three access points from the A5; the A4080 crossing the North Wales Mainline at the Tollgate junction, the A5 junction with an unnamed road which also crosses the North Wales Mainline before joining the A4080, and the A5 junction with an unnamed road heading towards Llandaniel. Depending on the origin of the construction vehicles, access to these junctions could be achieved by leaving the A55 at Junction 7a or 8a. To avoid routeing through Llanfairpwllgwyngyll, access to CSEC siting areas in Anglesey Central via the A4080 at Tollgate junction should be achieved via Junction 8a. Vehicles utilising the remaining access points to the north-west should do so via Junctions 7a and 7.

9.4.19 Vehicles returning to the A55 via the A4080 are required to perform a right turn manoeuvre at the Tollgate junction with A5. Further analysis would be required to assess whether the junction can accommodate this movement for the largest construction vehicles. Each of these access routes cross the North Wales Mainline across existing Network Rail bridge structures, and structural assessment would be required to determine the maximum weight bearing capacity of each of the structures.

9.4.20 The underground cables in this section depend upon the Crossing Zone, underground cables which terminate at Crossing Zone 3 (Anglesey) would cross the A4080, requiring it to be temporarily closed. Other options would require the temporary closure of some unnamed roads to reach Crossing Zone 2 (Anglesey).

9.4.21 Access to CSEC siting areas in Anglesey South from the A55 or A5 could use three access points, each of which cross the North Wales Mainline railway line as described above. The access routes from A55 Junctions 7a and 7 to the north west of Tollgate would result in construction traffic routeing through the villages of Llanddaniel or Llanfairpwllgwyngyll. Consequently, construction traffic would need to be limited to a route via Junction 8a of the A55 and the A4080.

9.4.22 Bellmouth access would be required from the A4080 to achieve access to both the AS1 and AS2 and Crossing Zone 1 (Anglesey) and an additional bellmouth would be required to cross the unnamed road leading Crossing Zone 1 (Anglesey). The underground cables in this section would cross the A4080, which would require temporary closure as would the unnamed road heading towards Crossing Zone 1 (Anglesey).

9.4.23 Accessing Crossing Zone 4 (Anglesey) for underground cables from CSEC siting areas in Anglesey North would be preferred as it would be less complex, however there would be a requirement to temporarily close the A5025. This would make the Anglesey Central or Anglesey South CSEC siting areas more preferable overall.

9.4.24 Access to the underground cabling routes in Gwynedd can be achieved via the A55 at either Junction 9 or 10 and routeing along either the A487 or A4087.

9.4.25 The proposed section of underground cables from GN1 to Crossing Zone 4 (Gwynedd), would require cables to be located under the A55 before the Britannia Bridge, it is envisaged that closure of the A55 would be required to achieve this connection. Traffic would have to be routed along the A5 as a temporary diversion, and the reduced capacity across the Menai Bridge is likely to lead to severe congestion. Furthermore, this is likely to cause severe disruption for HGVs as the Menai Bridge presents limitations for vehicles exceeding certain dimensions.

9.4.26 Underground cabling to GS1, GS2, and GS5 would require both the A487 and B4547 to be temporarily closed whilst the cables are laid; it may be possible to close only one road at a time, so allowing for the diversion of traffic towards / from Caernarfon. If traffic from the A487 was diverted along A4087, vehicles would be routed through Y Felinheli where the reduced capacity would be likely to lead to congestion.

9.4.27 A siting area in Gwynedd South located near the Pentir Substation, making use of the existing site access would be considered a preferred option in traffic and transport terms.

Construction Noise

9.4.28 Construction works associated with cable laying is a relatively short-term construction activity using plant that is generally not dissimilar from agricultural machinery although haul roads generally run along the construction corridor. The route corridors where the cables could be laid are predominantly rural with land in agricultural use. Special crossings would be required in some areas for roads etc. where HDD or other techniques would be required.

9.4.29 Construction noise is not considered a differentiator.

Socio Economic

9.4.30 The cable route corridors in the Anglesey North Search Area do not pass under any socio-economic receptors other than the A5025. The cable route corridors pass in close proximity to some isolated properties and Pili Palas Nature World with the possibility of disruption from construction noise.

9.4.31 The cable route corridor in Anglesey Central are in close proximity to Llanfairpwllgwyngyll railway station which is a tourist attraction and could be sensitive to construction traffic and noise. The cable routes also pass under or in close proximity to Plas Newydd historic park and gardens and Anglesey AONB, as well as some isolated properties. However there are sufficient route options to ensure sufficient distance from key socio-economic receptors in order to minimise impacts. This option is preferred.

9.4.32 The potential underground cable routes in Anglesey South are in close proximity to Plas Coch holiday home complex and close to other isolated properties. This is the least preferred option due to proximity to Plas Coch holiday home complex.

9.4.33 The potential underground cable routes in Gwynedd pass within close proximity to Parc Menai which includes multiple businesses, a hotel and restaurants. These areas may be particularly sensitive to construction traffic and noise. The underground cable routes may also pass through the Vaynol, a historic park and garden with some public access.

Technical

9.4.34 Shorter routes are generally preferred as longer routes result in greater construction disturbance. Longer routes also require more cable joints which are the weakest point on a cabled connection.

9.4.35 An underground cable route from Anglesey North is less preferred due to saturated ground. The route from AC6 to Crossing Zone 3 is preferred on Anglesey as it is the shortest. On Gwynedd underground cable routes to GS1 are not preferred due to the technical complexities of construction and operation.

9.5 Initial Preference

9.5.1 As noted for the overhead line sections and the CSEC siting areas options for underground cable routes cannot be considered in isolation of other elements of the connection. There are however serious technical challenges with routeing to GS1 both for construction an operation which will be a key consideration in determining an overall preferred option.

10. MENAI CROSSING

10.1 Introduction

10.1.1 As noted above in the previous consultation National Grid identified a search zone, which may be suitable for crossing the Menai Strait with new National Grid underground infrastructure, ranging from the slipways adjacent to Pilot Cottage in the south to the Swellies north east of the Menai Bridge.

10.1.2 Crossing zones were identified based on desk top studies and a high level site visit review. These crossing zones were not dependent on a specific crossing technique as identified in Chapter 4 above. This Chapter considers the most appropriate crossing technique for each zone

10.1.3 The crossing zones were as follows (see Figure 10.1).

- Crossing Zone 1 –between the Pilot Cottage to the Plas Newydd grounds (National Trust Property) on Anglesey and the slipway off Ffordd Heulyn to the Boat House Dock in the Vaynol Estate.
- Crossing Zone 2 –from the northern boundary of Zone C1 to Pwll Fangol Pier on Anglesey and Coed y Mor on the mainland.
- Crossing Zone 3 –from the northern boundary of Zone C2 to the Britannia Bridge
- Crossing Zone 4 –from north from the Britannia Bridge to between Ynys Gored Goch and Ynys Welltog on Anglesey and to Brices Beacon Point on the mainland.

10.1.4 For each crossing zone on both sides of the Menai Strait, using desktop study, a narrower indicative crossing location has been identified, capable of accommodating an area of approximately 500m x 1000m area, where construction works for the crossing might take place. These construction areas are referred to as Crossing Zones 1 – 4 (Anglesey) and Crossing Zones 1 – 4 (Gwynedd) respectively (see Figure 8.1). Depending on the crossing techniques selected some permanent infrastructure may also be required at these locations. A generic description of the crossing techniques has been provided in Chapter 4.

10.1.5 As a shorter crossing would generally be preferable to a longer crossing, options ‘cross connecting’ for example Crossing Zone 1 (Anglesey) to Crossing Zone 2 (Gwynedd) was not considered to offer any advantages.

10.1.6 In terms of ‘Hydrology and Flood Risk’ the Menai Strait is defined as a WFD coastal waterbody that currently attains Good Status.

Figure 10.1 Menai Strait Indicative Crossing Zones

10.2 Consultation Feedback

10.2.1 Views expressed on the proposed undergrounding at Menai Strait differed. Many respondents welcomed the proposal as it would protect the local landscape. However, some opposed the subsea element citing cost concerns. Some called for the cables to be placed on the service deck of the Britannia Bridge, in a power tray under the bridge, or on the potential new bridge that they believe the Welsh Government is considering building.

10.2.2 Gwynedd Council also noted that if a tunnel is used to put the connection under the Menai Strait, then the environmental implications of the disposal of the construction materials should be considered.

10.2.3 Môn a Gwynedd Friends of the Earth commented that selection of the route options and crossing points should be informed by the outcomes of the ongoing and already conducted environmental surveys.

10.2.4 Some respondents stated that they could not comment on Section 5 until more information is available on the Menai Strait crossing.

10.3 Crossing Techniques

10.3.1 The following installation methods have been considered for each crossing zone;

- Large Bore Tunnel;
- Small Bore Tunnel;
- Horizontal Directional Drill;
- Seabed installation.

10.3.2 For each crossing zone a preferred installation technique has been identified. As noted above in order to achieve the crossing a working area of approximately 500m-1000m would be required on both sides of the Menai Strait.

10.4 Crossing Zone 1

10.4.1 A potential crossing location was identified between the fields adjacent to Llanedwen Parish Church (Anglesey) and north of Y Felinheli (mainland).

10.4.2 Crossing Zone 1 (Anglesey) was identified to minimise effects to sensitive areas such as the National Trust property Plas Newydd to the north and the SSSI to the south. Consideration was also given to the Llanedwen Parish Church and the local topography.

10.4.3 Crossing Zone 2 (Gwynedd) is approximately 1km north of Felinheli. The proposed location is on a slight incline but offered a potentially clear open working area.

10.4.4 The crossing zones are located at 11m and 12m above ordinance datum (AOD) minimising the risks associated with sinking vertical shafts (TBM, SCL and pipe jack) and reducing the problems associated with high drilling fluid pressure (HDD). The crossing zones currently have a gradient of 6.6% and 4.5%, which may require levelling before equipment can be mobilised to site.

10.4.5 On Anglesey the Clwyd Limestone Group is comprised of the sandstone and conglomerate unit, and the limestone unit. These unconformably overlie the schists of the Central Anglesey and Berw Shear zone. A dyke transects the Carboniferous sediments and is comprised of Microgabbro.

10.4.6 In Gwynedd the bedrock is comprised of the Loggerheads Formation and Red Wharf Limestone. The Loggerheads Formation generally dips towards the south east. In the south of the zone the Loggerheads Formation forms a series of anticline and synclines as a result of historic compression/extension with the Dinorwic fault. As a consequence the structural orientation of the geology varies.

10.4.7 Within the crossing zone there are two possible north-east/south west trending minor faults, one north west/south east trending minor fault, and a possible major fault trending north east/south west within the Menai Strait.

Large Bore Tunnel

10.4.8 Based on the crossing length it is expected that an SCL tunnel would be constructed at this location. The main risk associated with SCL tunnelling is in encountering areas of poor rock, such as karstic formations. The amount of ground treatment required to make tunnelling safe in areas where the rock is not stable is a risk to construction, if extensive ground treatment was required then a TBM may become more preferable.

Small Bore Tunnel (Pipe Jack)

10.4.9 Tunnelling using pipe jacking is considered viable in this location due to the shorter crossing length (compared to other options) and the ability of this technique to cope with permeable ground below the water table.

10.4.10 The major risks involved in pipe jacking are the soil-lining friction forces exceeding the jacking resistance within the tunnel, the wear on the cutting tools due to abrasion on the rock and the loss of drilling fluid in voids or fissures. The current understanding of the ground conditions suggest that karstic voids and poor rock may exist at this location and therefore ground treatment may be required. This may have a negative impact on the rate of construction that could be achieved.

Horizontal Directional Drill

10.4.11 Both the drive and the reception sites would need sufficient area to include the rig layout, fabrication area, launch or returns pit and bulk storage of materials. The reception site would have to accommodate a 750m lay-down stretch for pipe string, welding, and testing prior to pull back. This length also has to be available at the reception end of a crossing.

10.4.12 A HDD drill would have to achieve sufficient rock cover passing under the Strait.

10.4.13 The risks of boring by HDD are associated with controlling the direction of the drill head, the drill head wearing out during the bore and losing drilling fluid to the surrounding environment. The geological information currently available for this location indicates that the ground is mostly limestone with potential karstic features and faulting. This type of rock is likely to present water bearing voids and to extensively wear the drill heads. With a bore length of 750m, careful design would be required to control such risks, and to ensure that the drill successfully crossed under the Strait.

Seabed Installation

10.4.14 Marine based construction would involve working in a challenging environment. The bathymetry of the area indicates that depths in the centre of the channel are greater than 20m at the northern end and in the range 12m- 16m at the southern end of Crossing Zone 1.

10.4.15 Hydrodynamic and morpho-dynamic modelling of the Menai Strait (SEACAMS, July 2015) shows that the mean spring tide peak flow speeds (ebb) reach 1.4m.s -1 (2.7 kn) in the deeper areas, with lower speeds towards the margins and shallower areas. At these water speeds the operational windows for marine construction plant would be constrained and the use of divers to assist construction works would be in an especially hazardous working environment.

10.4.16 Furthermore sediment thickness information has been derived from seismic and bathymetry data and indicates there is a varying thickness of sediment in the centre of the channel (10m to 20m) thickness) reducing towards the channel margins. In the intertidal areas the sediment consists of a patchy / thin layer of mixed mobile sediments, insufficient to bury cables.

10.4.17 Bathymetric data and previous studies indicate the likely presence of sand waves at various locations through the Menai Strait. These features are likely to be mobile and so, if significant in height, could result in an increase in cover or exposure of cables buried in the seabed. In Crossing Zone 1 the bed roughness is predicted to be on average 500mm in the main channel with smaller bed features in shallower regions and a localised peak between 600mm and 700mm during neap tides. The wavelength of the sand waves varies between 10m and 20m for corresponding heights of 250mm to 750mm.

10.4.18 The bathymetry profiles indicate that seabed levels vary relatively gently within the main channel and should not pose difficulties for marine construction plant and equipment to work on or laying of cables on the seabed. The presence of the sand waves may however impact on the ratings of the cables

10.4.19 Design considerations for works within the main channel include allowance for bed volatility (sand waves) and additional embedment depth or cable protection needed to mitigate the risk of accidental or deliberate damage to the cable. There may also be difficulties in burying ducts due to seabed hardness with the resultant possible exposure of cables to damage by shipping, fishing, etc.

10.4.20 Marine based construction would involve working in a challenging environment, with suitable risk management, safe working would be possible but there would be restrictions on the construction programme. The main considerations for works within the main channel include an allowance for bed volatility (sand waves) and the additional embedment depth or cable protection needed to mitigate the risk of accidental or deliberate damage to the cable.

10.4.21 Consideration has also been given to the difficulties, due to seabed hardness, of burying ducts, and the resultant possible exposure of cables to damage by shipping, fishing, and other vessels.

10.4.22 Due to the steep shoreline of the Menai Strait, a ducted landfall solution may be required to interface between the terrestrial and marine cable routes, with the ducts installed by HDD. The risks associated with HDD installations are detailed earlier in this Report. If a HDD landfall were not possible extensive re-profiling and excavation of the shoreline of the Strait would be required to facilitate an open trenched landfall.

10.5 Crossing Zone 2

10.5.1 A potential crossing zone 2 has been identified between Plas Newydd and the Conway Centre on the north side of the A4080 (Anglesey) to the Vaynol Estate, Gwynedd.

10.5.2 Crossing Zone 2 (Anglesey) considered the location and extent of Plas Newydd, the Conway Centre and the A4080. Crossing Zone 2 (Gwynedd) considered the location and extent of the Vaynol Estate. There are also patches of hard substrate SAC features located along the channel margins adjacent to the crossing route, opposite Vaynol Park and Plas Newydd.

10.5.3 At its narrowest the span of the crossing is approximately 1000m. The crossing zones are located at 37m (Anglesey) and 15m (Gwynedd) AOD. This would require deeper shafts for tunnel installations and higher drilling fluid pressure for HDD crossings than in Crossing Zone 1.

10.5.4 On Anglesey the Clwyd Limestone Group is comprised of sandstone and conglomerate unit and a limestone unit. The limestone unit overlies the sandstone unit, although this is absent in the north east of the zone. The Clwyd Limestone Group shallowly dips to the south east and non-conformably overlies the schists of the Central Anglesey and Berw Shear Zone.

10.5.5 The Loggerheads Limestone Formation overlies the Menai Strait Formation within the Gwynedd side of the zone. Both Formations shallowly dip to the south east. These unconformably overlie the Schists of the Central Anglesey and Berw Shear zone, the general trend of this contact has been inferred as dipping to the south east.

10.5.6 There is a possible major fault trending NE/SW within the Menai Strait and a possible complex minor fault generally trending NW/SE.

Large Bore Tunnel

10.5.7 The construction of a large bore tunnel may be viable at this location however the geology may present difficult ground conditions for tunnelling operations. It is expected that the geology is not uniform and that multiple rock formations (schist, Menai Strait formation and limestone) are present. As a tunnel would pass approximately 40m below the sea level, and high water ingress would be expected, a closed face TBM may be the most viable technique for the expected ground type and length of crossing.

10.5.8 For a large bore tunnel a TBM is expected to be more suitable than the SCL method due to the longer length and the risks associated with the poor ground conditions, in particular the degree of water ingress during tunnelling.

Small Bore Tunnel (Pipe Jack)

10.5.9 Tunnelling using pipe jacking is not considered feasible in Crossing Zone 2. For the required crossing length the jacking forces required to overcome the friction resistance are likely to exceed the capability of the tunnel segments.

10.5.10 The non-uniform geology (schist, Menai Strait formation and limestone) exposes the installation to a risk of frack out (loss of drilling fluid to the environment) at the boundary layers. The depth below sea level would also expose the excavation to high levels of water ingress requiring extensive ground treatment.

Horizontal Directional Drill

10.5.11 The current understanding of the geology indicates that within this crossing zone there may be multiple rock formations, with greater variation on the Gwynedd side, introducing the potential for frack out and potential failure of the bore. Where the rock formations are loosely bound there is also the risk of losing control of the drill path or collapse of the bore.

10.5.12 For HDD the total vertical bore displacement between the crossing zones (Anglesey and Gwynedd) and the expected geology would give rise to installation issues with drilling pressures which would have to be overcome.

10.5.13 For a HDD crossing the rating of the circuits would be constrained by the profile achieved. Assessments carried out to date indicate that the cables would have approximately 20m of cover. This may increase the separation consecutive cables require above 10m which would consequently increase the overall working areas along both shorelines.

10.5.14 The calculated pulling forces exerted on the cables during their installation would have to be overcome which constrains the design to specialist provisions. Availability of these designs may be limited which would influence cost and supply programme.

Crossing Zone 1 (Anglesey) is on the north side of the A4080. For HDD particularly the road would be an additional constraint as the profile would have to avoid the road's load bearing area and pass beneath any utility services that follow the road.

Seabed Installation

10.5.15 Within Crossing Zone 2 the bathymetry data indicates two distinct bathymetric zones; to the south and centre of the area, the water depths are in general shallower than elsewhere, with a typical depth of -5 m to -10 m AOD. Towards the Britannia Bridge and the 'Swellies' area the water depth increases (Pwllfanogl Hole) with the minimum bed levels below -30m AOD.

10.5.16 The SEACAMS data indicates the channel may contain sand between 0.2mm and 0.4mm. Based on the general flow patterns and bathymetry, Pwllfanogl Hole is likely to be devoid of fine sediment (sand) and more likely to be filled with cobbles/ or rock. Exposed rock is apparent on the margins of the Strait with the foreshore formed of a combination of rock deposits mixed with fine silty sediment. This may have an impact on the ability to bury the cables in the seabed or in ducts in the seabed potentially necessitating the use of rock cutting tools to open the trenches.

10.5.17 The SEACAMS Menai Strait modelling predicts mobile bed features 500mm in height with an isolated area of features 700mm to 800mm in the north of the crossing zone.

10.5.18 The marine conditions and seabed profile indicate construction conditions for trenching would likely involve rock cutting through the seabed. These conditions will curtail the operational windows of the marine plant and may constrain the available routeing options along the seabed.

10.5.19 Complex engineering and installation issues may necessitate the use of a ducted installation, installed by HDD, to interface between the marine and land cable sections. On Anglesey it would be necessary to site a landfall within the grounds of Plas Newydd. In Gwynedd it would be necessary to site a landfall in the Vaynol Estate adjacent to the Strait, with sufficient width and working area.

10.5.20 Installation risks and constraints for seabed installation would be similar to those in Crossing Zone 1. Indications are that the seabed in this crossing zone would probably have less sediment and more rock would be present which would mean that rock cutting trench work would be required to open up the seabed.

10.6 Crossing Zone 3

10.6.1 There are a number of sensitive receptors in Crossing Zone 3 including SAC features comprising of mudflats, sandflats and some rocky reef on the shores of Anglesey, rocky reefs adjacent to Ynys Gored Goch; and SSSIs on the shores of Anglesey and the mainland. Steep gradients, existing structures and extensive woodlands constrain the opportunities for identifying locations for both Crossing Zone 3 (Anglesey) and Crossing Zone 3 (Gwynedd). Access is also difficult.

10.6.2 A potential crossing location has been identified west of Plas Llanfair farm on Anglesey and west of the wastewater treatment works at the north of Parc Menai on the mainland. Both areas are currently used as grazing land.

10.6.3 Crossing Zone 3 (Anglesey) has areas with gradients between 2% and 10%, Crossing Zone 3 (Gwynedd) 6%, 10% and 15%. Both areas may require grading before mobilisation.

10.6.4 The span of the crossing is approximately 970m.

10.6.5 On Anglesey the Clwyd Limestone group is comprised of the sandstone and conglomerate unit and the limestone unit. These unconformably overlie the schists of the Central Anglesey and Berw Shear Zone. A dyke transects the Carboniferous sediments and is comprised of Microgabbro.

10.6.6 The predominant bedrock in Gwynedd is the Menai Strait Formation. This shallowly dips towards the south east. In the south east the Loggerheads Limestone is exposed and the structure matches the Menai Strait Formation.

10.6.7 Within the crossing zone there are two possible NE/SW trending minor faults, one NW/SE trending minor fault, and a possible major fault trending N/S within the Menai Strait.

Large Bore Tunnel

10.6.8 The construction of a larger tunnel may be viable. The geology at this crossing zone is expected to present difficult ground conditions for tunnelling operations. It is expected that the geology is not uniform and that multiple rock formations (schist, Menai Strait formation and limestone) are present. As a tunnel would pass approximately 40m below sea level, and high water ingress would be expected, a closed face TBM may present the most viable technique for the expected ground type and length of crossing.

10.6.9 For a large bore tunnel in this area a TBM is expected to be more suitable than the SCL method due to the longer length and risks associated with the poor ground conditions, in particular the degree of water ingress during tunnelling. Issues with mobilising a TBM to site would however have to be overcome.

Small Bore Tunnel (Pipe Jack)

10.6.10 Tunnelling using pipe jacking is not considered feasible in Crossing Zone 3. The non-uniform geology (schist, Menai Strait formation and limestone) exposes pipe jack installation to a risk of frack out at the boundary layers. The depth below sea level would also expose the excavation to high levels of water ingress requiring extensive ground treatment. In addition for the required crossing length the jacking forces required to overcome the friction resistance are likely to exceed the capability of the tunnel segments.

Horizontal Directional Drill

10.6.11 Current indications are that a crossing in this zone would pass through multiple rock formations where there is potential for frack out (loss of drilling fluid to the environment and potential failure of the bore) and, where the rock formations are loosely bound, losing control of the drill path and collapse of the bore.

10.6.12 For a HDD crossing the rating of the cables is constrained by the profile. Assessments carried out to date indicate that the cables would have approximately 20.5m of cover. This may increase the separation required between cables which would consequently increase the overall working areas required along both shorelines.

10.6.13 For HDD the total vertical bore displacements between the crossing zones (Anglesey and Gwynedd) and the geology expected would give rise to installation issues with drilling pressures which would have to be overcome. In addition due to the length of bore (in excess of 900m) the required pulling tension to draw the cables between sites is expected to exceed the capability of standard cable designs.

Seabed Installation

10.6.14 Crossing Zone 3 is a challenging marine environment. The bathymetry contains deep basins (>15 m) and peak tidal flow speeds are higher than in Crossing Zones 1 and 2. This would be likely to curtail windows in which marine construction plant is free to operate. However, with the exception of the shallow margins, this area is likely to have limited sediment due to the high current speeds, which may limit the impacts from sediment plumes.

10.6.15 The risks associated with marine installations in Crossing Zone 3 would be similar to those for Crossing Zone 1. However, as flow speeds in this crossing zone are greater than in Crossing Zones 1 and 2, construction phasing and safety precautions would be more onerous.

10.6.16 For seabed installation due to the likelihood of exposed bedrock in the main channel installation of cable protection (rip-rap, concrete mattresses, etc.) may be required to protect the cables from accidental or deliberate damage. The seabed may also consist of hard material thereby making trenching very difficult.

10.7 Crossing Zone 4

10.7.1 As with Crossing Zone 3 there are a number of sensitive receptors including SAC features comprising of mudflats, sandflats and some reefs on the shores of Anglesey, reefs adjacent to Ynys Gored Goch; and SSSIs on the shores of Anglesey and the mainland. A potential crossing location has been identified west of Plas Llanfair farm on Anglesey and west of the Treborth Wastewater Treatment Works in Gwynedd.

10.7.2 Crossing Zone 4 (Anglesey) is an open field adjacent to the A5 and approximately 700m from the slip road to the southbound carriageway of the A55 (Britannia Bridge crossing). In Gwynedd locations close to the Menai Strait are limited. Crossing Zone 4 (Gwynedd) is an open field 400m south of the railway line between the A55 and Ffordd Bronwdd, close to the wastewater treatment works. This location avoids the Treborth Athletics Ground.

10.7.3 The ground elevation of both locations is higher than at other Crossing Zones. On Anglesey the elevation is at 37m AOD, in Gwynedd the athletics ground adjacent to the Menai Strait is at 40m AOD increasing to 50m AOD at the Mainline railway line.

10.7.4 On Anglesey the Carboniferous Limestone Series is absent and the schists of the Central Anglesey and Berw Shear zone can be seen at the surface. The predominant bed rock on the Gwynedd side of the strait is the Menai Strait Formation. This shallowly dips to the south east. This formation unconformably overlies the Schists of the Central Anglesey and Berw Shear Zone and the general trend of this contact has been inferred as dipping to the south east.

10.7.5 There is a possible major fault trending NE/SW within the Menai Strait.

Large Bore Tunnel

10.7.6 The geology at this location is expected to present difficult ground conditions for tunnelling operations. It is expected that the geology is not uniform and that multiple rock formations (schist, Menai Strait formation and limestone) are present. As a tunnel would pass approximately 40m below the sea level and high water ingress would be expected a closed face TBM would be more suitable than SCL for the expected ground conditions and length of crossing. Mobilising a TBM to site would however be challenging.

10.7.7 The elevations in this crossing zone would result in more issues for construction than in the other zones, requiring deeper vertical shafts for tunnel installations.

Small Bore Tunnel

10.7.8 Tunnelling using pipe jacking is not considered feasible in Crossing Zone 4 as for the required crossing length (1400m) the jacking forces required to overcome the friction resistance are likely to exceed the capability of the tunnel segments.

10.7.9 In addition the non-uniform geology (schist, Menai Strait formation and limestone) exposes pipe jack installation to a risk of frack out at the boundary layers. The depth below sea level would also expose the excavation to high levels of water ingress requiring extensive ground treatment.

Horizontal Directional Drill

10.7.10 The current understanding of the geology in this crossing zones indicates that a HDD bore may have a high degree of risk with regards to the pressure of drilling fluid due to the vertical travel required by the HDD drill head. As with Crossing Zone 3, due to the length of bore (1400m) the required pulling tension to draw the cables between sites is also expected to exceed the capability of standard cable designs.

Seabed Installation

10.7.11 Marine construction in Crossing Zone 4 would be complex due to the rock seabed, uneven bathymetry profile, topography of the banks (which are steep on the Gwynedd side) and high and complex water speeds. Peak water speeds are higher and more complex than in the other crossing zones and the distance to the nearest ports capable of berthing/sheltering the marine equipment is further. These factors would place a greater constraint on available working windows than for other crossing zones.

10.7.12 Due to the narrowing of the channel in Crossing Zone 4 there is also a greater potential for works to interact with other users of the channel.

10.7.13 Based on the identified constraints it is likely that a marine crossing north of the Britannia Bridge could not be achieved.

10.8 Consideration of Options

10.8.1 Operational noise is not considered a differentiator. For HDD and seabed installation no operational noise effects will result, if tunnel head houses are required these can be designed to meet acceptable operational noise limits at nearby noise sensitive receptors.

10.8.2 Technical considerations have been described earlier in this chapter.

Crossing Zone 1

10.8.3 This is the most southernmost crossing zone located just north of Y Felinheli.

Landscape and Visual

10.8.4 For all crossing zones, from a landscape and visual perspective, a key influence on the location of a preferred crossing zone will be the proposed tunnel head houses that will be required at the tunnel entrances, should a tunnel be the preferred crossing technique, as these will be the only visible infrastructure post construction. The exact design details are not known but it is assumed that buildings with an envelope approx. 36m x 23m x 10m are required which would be designed having regard for local landscape character and vernacular. As with the CSECs, the tunnel head houses would require appropriate siting in line with the Horlock Rules[36].

[36] Horlock Rules, National Grid, 2003

10.8.5 Crossing Zone 1 (Anglesey) is located along the coastline of the Menai Strait, entirely within the AONB. It is immediately north of a property at Porth-edwen, adjacent to Llanedwen Parish Church and within Plas Newydd Registered Park and Garden. The Wales Coast Path passes close to the crossing zone along the local lane to the west, although views towards the area are screened by the Plas Newydd boundary wall and vegetation. Porth-edwen benefits from mature tree planting which screens views north towards the crossing zone; views are focussed over the Menai Strait. Llanedwen Parish Church has open views across the Menai as fields drop in elevation away from the church to the shoreline. Views experienced by people visiting the church would be greatly affected by construction activities. Since there are no other built forms visible between the church and the Menai (Porth-edwen is screened by vegetation), the exact location and construction of a tunnel head house would need to be carefully considered and should not conflict with the other built form within the Plas Newydd Estate. Views from Moel-y-don would be screened by the mature vegetation along the shoreline

10.8.6 Crossing Zone 1 (Anglesey) is visible from the Gwynedd side of the Menai, in particular from Y Felinheli, and from within Vaynol Registered Park and Garden (although this garden is not generally open to the public). From Y Felinheli, people experience open views along the shoreline, there are numerous properties which have views of Porth-edwen and Llanedwen Parish Church. Views may also be afforded from people using the Wales Coast Path in Gwynedd, as this is due to be rerouted along the Menai shoreline. Within the Vaynol, one of the significant views is located within woodland at Coed Twr and looks directly towards the proposed site, Moel-y-don and the Llyn Peninsula beyond.

10.8.7 Crossing Zone 1 (Gwynedd) is located within the Vaynol Park Registered Park and Garden. This crossing zone would be visible from the Wales Coast Path on Anglesey at Moel-y-don, where there is a small visitor car park and a number of properties used for holiday accommodation. The crossing zone is also visible from Llanedwen Parish Church and from the main visitor areas around the house at Plas Newydd, although this view is more oblique.

10.8.8 Both sides of Crossing Zone 1 (Anglesey and Gwynedd) would be visible from people using the Menai Strait for water based recreational activities, mainly an issue during construction, but any proposed tunnel head houses also have the potential to be seen and therefore the design and exact siting will be key in determining the exact effects.

Historic Environment

10.8.9 Crossing Zone 1 (Anglesey) is located within the Plas Newydd Registered Park and Garden in an area now in agricultural use, and adjacent to the Grade II Llanedwen Parish church. The land use is predominantly pasture and therefore the groundworks are unlikely to have a significant unmitigated effect on sub-surface archaeology as well as the setting of the Parish Church.

10.8.10 Crossing Zone 1 (Gwynedd) is within the Vaynol Park Grade I Registered Park and Garden. The land use is pasture and therefore the groundworks are unlikely to have a significant effect on sub-surface archaeology as well as the setting of the park. There may be a visual effect on the setting of Plas Newydd from works in Gwynedd.

Ecology

10.8.11 Habitats present in Crossing Zone 1 (Anglesey) include arable and improved grassland, with hedgerows, broadleaved semi-natural woodland bordering the site. This crossing zone would have the potential to affect the following:

- Menai Strait and Conwy Bay SAC (within 50m to the east);
- Llwyn Chwarel-Goch CWS (directly adjacent to the east);
- a restored ancient woodland site (directly adjacent to the east);
- Coed Odyn-Galch CWS (within 100m). This site is also designated as ancient semi-natural woodland; and
- a pond(within 50m).

10.8.12 There is also the potential to affect protected species including barn owl, badger, otter, red squirrel, bats and great crested newt (habitat suitable for supporting these species is present).

10.8.13 Habitats present in Crossing Zone 1 (Gwynedd) include improved grassland, drains, with broadleaved semi-natural woodland, and coniferous plantation woodland bordering the crossing zone. This crossing zone would have the potential to affect the following:

- Menai Strait and Conwy Bay SAC (within 60m to the west);
- Vaynol Park Woodlands and Lake CWS (directly adjacent to the north, east and south);
- ancient woodland (restored and plantation) (directly adjacent to the north, east and south. This woodland is also designated under the Woodland Grant Scheme; and
- bats (within 250m of buildings with known bat roosts).

10.8.14 There would also be the potential to affect protected species including barn owl, badger, red squirrel, otter and bats (habitats suitable for supporting these species is present).

Marine Ecology

10.8.15 The subtidal marine habitats in Crossing Zone 1 are dominated by unconsolidated sand, with small patches of designated hard boulder rock habitat. The intertidal areas are a mosaic of soft sediments, with a near continuous hard rock habitat fringing the upper shore zone.

10.8.16 Use of a bored / drilled crossing technique in this crossing zone would likely avoid effects on marine receptors associated with seabed installation. This assumes that any drive shafts/launch areas would be located out with the intertidal zone, hence avoiding any effects.

10.8.17 A number of risks associated with the use of TBMs and HDD have the potential to affect marine receptors, including ground borne noise / vibration impacts from the action of the drilling head, and contamination risk from the release of drilling fluids through rock fissures in the area of the drill head. Ground borne noise / vibration effects have the potential to affect fish and sea mammals in the water body above. The level of nay noise / vibration impacts will be dictated by the clearance between the tunnel and the seabed, plus the type of ground and its noise / vibration transmission properties. The unconsolidated bed material in the area of Crossing Zone 1 suggests that the risk of noise / vibration impacts would be low, although the head clearance determined by the drill plan will be important in determining any effects.

10.8.18 Overall, the risks associated with a bored / drilled option in Crossing Zone 1 are considered low. The low abundance of designated habitat type and prevalence of unconsolidated subtidal bed material make this a preferred crossing zone from a marine ecology perspective.

Soils and Agriculture

10.8.19 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land within Crossing Zone 1 is a combination of Grade 2 (Very Good quality, BMV) and Grade 3 (Moderate to Good quality, potentially BMV) on Anglesey; and Grade 3 (Moderate to Good quality, potentially BMV) in Gwynedd. The use of this crossing zone would therefore result in disturbance to BMV quality land.

Hydrology and Flood Risk

10.8.20 Crossing Zone 1 (Anglesey), is close to the Afon Braint, roughly 100-200m to the east with potential impacts to water quality and runoff resulting from construction activities.

10.8.21 Crossing Zone 1 (Gwynedd) is located in the Nant y Garth River Catchment which achieves an overall status of good.

Traffic and Transport

10.8.22 Crossing Zone 1 (Anglesey) is at the furthest distance from the strategic highway network. The crossing zone would require direct access off the A4080 which could difficult. If access could not be achieved via the A4080 it would via the unnamed local road to the west which would require significant mitigation to accommodate the anticipated construction traffic volumes and type of vehicle. Crossing Zone 1 (Anglesey) would be the least preferred.

10.8.23 As with Anglesey, Crossing Zone 1 (Gwynedd) 1 is located furthest from the strategic highway network. Access to the crossing zone could be via the B4547 local road via a comparatively long linear access track.

10.8.24 Access to the strategic highway network would be via Junction 9 of the A55. This would be the same for all the crossing zones in Gwynedd.

Construction Noise

10.8.25 Crossing Zone 1 (Anglesey) lies in a remote location approximately 1km east of the Plas Coch Holiday Complex, and in Gwynedd lies to the north of Y Felinheli also in a remote area. Both areas abut the water's edge in very quiet baseline noise environments.

Socio Economic

10.8.26 Crossing Zone 1 (Anglesey) is within the AONB, and within the Plas Newydd Estate (although not an area open to the public) and the Vaynol Estate in Gwynedd. For all crossing techniques the construction disturbance could impact unfavourably on these tourism receptors. The potential visual effect from tunnel compounds would be a further consideration.

10.8.27 On Anglesey there are holiday cottages (as noted on a site visit) and a small picnic area / car park located on the shore of the Menai Strait. Construction disturbance could potentially adversely affect these receptors. The Crosing Zone is also located approximately 1km from Plas Coch holiday complex; however this should be sufficient distance to avoid significant effects.

10.8.28 This crossing is closest in proximity to areas used for mussel farming and therefore has the potential for disruption to these businesses particularly if seabed installation is preferred. This crossing has the potential to disrupt recreational users of the Menai Strait including the dock and boat trips operating in the area; however if a tunnel is preferred recreational users would not be affected.

10.8.29 Against socio economic considerations this is the second preferred option for a crossing zone.

Technical

10.8.30 The preferred installation technique in Crossing Zone 1 is pipe jacking given the current understanding of the geology. HDD may be feasible but was initially considered less preferable than pipe jacking due to the high risk that some drilled cores would encounter geological issues which would have the potential for adverse impacts on the scope and complexity of the crossing, particularly for the landfall shoreline works.

10.8.31 When considering operational and maintenance requirements however pipe jacking was not considered to offer any benefits over a large bore tunnel. Although cost was not a consideration at this stage, the short crossing length means that the capital investment in mobilising a TBM would be relatively greater than for other zones.

10.8.32 Seabed installation may also be technically possible in Crossing Zone 1. However, the water speed in the channel may limit operational windows for construction and the requirement to make landfall with ducts installed by HDD on either side of the Menai Strait makes this method of installing cables complex. Sand waves are expected in this Crossing Zone and their presence may cause issues with cable system design and rating capacity of the circuits. Strike from anchors lowered from vessels cannot be discounted. The cumulative addition of these risks mean that this technique is not preferred.

Crossing Zone 2

10.8.33 Crossing Zone 2 is located in the Plas Newydd area of the Menai Strait.

Landscape and Visual

10.8.34 Crossing Zone 2 (Anglesey) is located adjacent to A4080 just outside the AONB which runs from the immediate coastline up to the A4080. This crossing zone area is located within the Southern Anglesey Estatelands SLA (Anglesey) and within the essential setting of Plas Newydd Registered Park and Garden (Gwynedd). It is bounded to the south and west by the Wales Coast Path and close to a property at Llwyn-onn. The area is well contained and screened from views from much of the wider landscape as large blocks of woodland surround the area to the south, east and west. However, views from the adjacent section of the A4080 are open; this road is popular with tourists visiting areas in the south-west of the island including Newborough. The crossing zone is also less than 500m away from the main visitor entrance to Plas Newydd. There is scope for introducing planting to filter/screen some of these views; such measures would reflect and enhance the character of the landscape which contains a number of woodland areas and tree lined hedges. The exact location of the tunnel head house would need to be carefully considered as there is an absence built form adjacent to the A4080.

10.8.35 Crossing Zone 2 (Gwynedd) is located within the Vaynol Park Registered Park and Garden. This location would be visible from Plas Newydd Registered Park and Garden which lies directly across the Menai Strait in Anglesey. However, in Gwynedd the zone does benefit from the presence of mature trees along the shoreline of the Menai and the large woodland blocks within the Vaynol Park. The Wales Coast Path will pass along the northern edge of the Estate when it is rerouted along the shoreline. There are strong visual links between the Vaynol and Plas Newydd and some of these views are identified as significant within the respective Registers.

10.8.36 Crossing Zone 2 (Gwynedd) would be visible from people using the Menai Strait for water based recreational activities, primarily being an issue during construction. Any proposed tunnel head house in the Gwynedd crossing zone has the potential to be seen from the Menai and therefore the design and exact siting will be key in determining the exact effects.

Historic Environment

10.8.37 Crossing Zone 2 (Anglesey) would be located immediately to the west of Plas Newydd Registered Park and Garden within its essential setting. Land use is pasture and it is an open farmland landscape which contrasts to the park boundary. While there are no recorded heritage assets, there is high potential for previously unrecorded archaeological remains.

10.8.38 Crossing Zone 2 (Gwynedd) is within the Vaynol Park Grade I Registered Park and Garden. The land use is pasture and therefore the groundworks are unlikely to have a significant effect on sub-surface archaeology as well as the setting of the park. There may be a visual impact to the setting of Plas Newydd.

Ecology

10.8.39 Habitats present in Crossing Zone 2 (Anglesey) include improved grassland, with hedgerows, broadleaved semi-natural woodland and mixed plantation woodland bordering the site. This crossing zone would have the potential to affect the following:

- Menai Strait and Conwy Bay SAC (within 400m to the east);
- ancient semi-natural woodland (directly adjacent to the east); and
- ponds (within 250m).

10.8.40 There is also the potential to affect protected species including barn owl, badger, GCN, otter, red squirrel and bats (habitats suitable for supporting these species are present).

10.8.41 Habitats present in Crossing Zone 2 (Gwynedd) include improved grassland and drains, with broadleaved semi-natural woodland, and coniferous plantation woodland bordering the crossing zone. This crossing zone would have the potential to affect the following:

- Menai Strait and Conwy Bay SAC (within 80m to the west);
- Vaynol Park Woodlands and Lake CWS (directly adjacent to the south);
- Vaynol Wood CWS (directly adjacent to the north and north east);
- ancient woodland (restored and plantation) (directly adjacent to the north, north east and south), and also designated under the Woodland Grant Scheme; and
- an area of woodland allocated under the Woodland Grant Scheme to the west.

10.8.42 There would also be the potential to affect protected species including barn owl, badger, red squirrel, otter and bats (habitats suitable for supporting these species is present).

Marine Ecology

10.8.43 Crossing Zone 2 has a very similar proportion and distribution of subtidal and intertidal habitats to that of Crossing Zone 1, although designated subtidal boulder type habitat is more abundant than in the subtidal areas of Crossing Zone 1. As such, the impacts associated with a bored/drilled option in Crossing Zone 1 are similar for Crossing Zone 2.

10.8.44 Overall, the risks associated with a bored/drilled option in Crossing Zone 2 are considered low. The low abundance of designated habitat type and prevalence of unconsolidated subtidal bed material make this a preferred crossing zone.

Soils and Agriculture

10.8.45 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land within Crossing Zone 2 is a combination of Grade 3 (Moderate to Good quality) and Grade 4 (Poor quality). Therefore, there is the potential for some BMV land to be disturbed.

Hydrology and Flood Risk

10.8.46 Crossing Zone 2 (Anglesey), is located in the Lower Braint River Catchment which has a WFD status of moderate and the non-reportable WFD water body to the north of the Menai Strait.

10.8.47 Crossing Zone 2 (Gwynedd), as it is adjacent to the Menai Strait, is located in a non-reportable WFD waterbody to the south of the Menai Strait.

Traffic and Transport

10.8.48 Crossing Zone 2 (Anglesey) could be accessed via the A4080 or the unnamed road located to the north west which has a junction with the A5. There are multiple junctions at this section of the A55 which provide access to the A5, and which would allow construction traffic to avoid routeing through Llanfairpwllgwyngyll.

10.8.49 Similar to Crossing Zone 1 (Gwynedd), this crossing zone would require a relatively long linear access track however it would be connected to the A487 local road.

10.8.50 As with all the crossing zones in Gwynedd Junction 9 of the A55 would be the key connection to the strategic highway network.

Construction Noise

10.8.51 Crossing Zone 2 (Anglesey) lies alongside the A4080 south west of Ffordd Brynsiencyn; set back from the water's edge by approximately 375m. A number of NSRs are located in the vicinity. Baseline noise levels, particularly at night, will be low to very low.

10.8.52 Crossing Zone 2 (Gwynedd) is located in a remote part of the Vaynol Estate and abuts the water's edge. There are few NSRs in the vicinity. Baseline noise levels, particularly at night, will be low to very low.

Socio Economic

10.8.53 Crossing Zone 2 (Anglesey) would be located within Plas Newydd (National Trust and Registered Park and Garden). For all crossing techniques the construction disturbance could impact unfavourably on this tourism receptor. The potential visual effect from tunnel compounds would be a further consideration. Crossing Zone 2 (Gwynedd) would be located within the Vaynol Estate (Registered Park and Garden) and as above for all crossing techniques the construction disturbance could impact unfavourably and there would be additional effects associated with a tunnel head house within the Park. There could also be effects on users of the Wales Coast Path once it is relocated to within the Vaynol Estate This crossing has the potential to disrupt recreational users of the Menai Strait including the dock and boat trips operating in the area; however if a tunnel is preferred recreational users would not be affected.

10.8.54 Against socio economic considerations this is less least preferred.

Technical

10.8.55 A large tunnel excavated by a TBM is the preferred construction technique for Crossing Zone 2. A SCL tunnel may also possible, but would require extensive ground treatment to facilitate construction. Pipe jacking is not preferred due to the length of the crossing and the concerns over jacking forces.

10.8.56 The pulling tension required for an HDD installation would exceed the capability of standard cable designs and the geology expected would give rise to similar installation issues noted in Crossing Zone 1.

10.8.57 Seabed installation may be possible in Crossing Zone 2. There would be similar challenges to the marine installation in Crossing Zone 1, although it would be likely to involve rock cutting to form the cable trenches. In addition the bathymetry is more varied and the longer landfall shoreline sections would be more complex than Crossing Zone 1.

Crossing Zone 3

10.8.58 Crossing Zone 3 is located to the west of Britannia Bridge.

Landscape and Visual

10.8.59 Crossing Zone 3 (Anglesey) is located between Plas Newydd Registered Park and Garden and Plas Llanfair and is entirely within the AONB. The area is also bounded to the west by the Wales Coast Path. There would be glimpsed views from the A4080 and open views from Ty'n-lon and properties within Plas Llanfair; however, the area is visually well contained to the west and south by woodland associated with Plas Newydd. There would also be filtered views from people using the Wales Coast Path as it runs down Lon Pwllfanogl, the route linking visitors to Nelson's Statue on the Menai shoreline. This lane is also the access for a number of properties at Pwllfanogl. Although there are a number of properties from which views would be affected during the construction phase, the presence of a tunnel head house in this area would be seen in context with other built form post construction.

10.8.60 Crossing Zone 3 (Gwynedd) is located to the north of Parc Menai Business Park, adjacent to the Vaynol Registered Park and Garden and is entirely within the Vaynol Estate and Surrounds SLA. It is bounded to the south and west by Vaynol Wood which is part of the Registered Park and Garden. Visually, the area is well contained by the vegetation which surrounds it. The hedgerows in this area have a number of mature trees and the crossing zone is set back from the Menai shoreline, away from the Wales Coast Path. There may be the potential for views from people traveling over the Britannia Bridge but these would be glimpsed and very much filtered by the existing vegetation.

10.8.61 The crossing zones are set back away from the immediate shoreline and benefit from mature vegetation along the Menai, hence would not be visible post construction.

Historic Environment

10.8.62 Crossing Zone 3 (Anglesey) would be located to the north of Plas Newydd Registered Park and Garden and Plas Llanfair. A group of Grade II listed buildings form the settlement of Pwll-fanogl, but are sufficiently screened by topography to be unaffected.

10.8.63 Crossing Zone 3 Gwynedd) would not directly affect any designated heritage assets but there is potential for previously unrecorded archaeological remains.

Ecology

10.8.64 Habitats present within Crossing Zone 3 (Anglesey) include improved grassland, with hedgerows, broadleaved semi-natural woodland bordering the site. This crossing zone would have the potential to affect the following:

- Menai Strait and Conwy Bay SAC (within 190m to the east);
- ancient semi-natural woodland (directly adjacent to the east and south). The area to the east is also designated under a TPO; and
- a Woodland Grant Scheme (within 50m to the south).

10.8.65 There would also be the potential to affect protected species including barn owl, badger, red squirrel, otter and bats (habitats suitable for supporting these species is present). There is a water vole record adjacent to the crossing zone.

10.8.66 Habitats present in Crossing Zone 3 (Gwynedd) include improved grassland, drains, scrub and woodland, with semi-improved neutral grassland, broadleaved semi-natural woodland, and coniferous plantation woodland bordering the crossing zone. This crossing zone would have the potential to affect the following:

- Menai Strait and Conwy Bay SAC (within 250m to the north);
- Coedydd Afon Menai SSSI (directly adjacent to the north);
- Mausoleum Woodland and Pasture CWS (directly adjacent to the north);
- Vaynol Wood CWS (directly adjacent to the west) and also allocated under the Woodland Grant Scheme;
- West of Britannia Bridge CWS (within 250m to the east); and
- ancient woodland (semi-natural and plantation) (directly adjacent to the north, east and south).

10.8.67 There would also be the potential to affect protected species including barn owl, badger, dormouse, red squirrel, otter and bats (habitats suitable for supporting these species is present).

Marine Ecology

10.8.68 Crossing Zone 3 is to the west of the Britannia Bridges and is located in an area of the Strait where there is an increase in the prevalence of designated subtidal rocky reef type habitat. The communities associated with the rocky habitats are extremely sensitive to physical disturbance, and as such, the selection of a bored/drilled crossing technique would assist in avoiding most impacts on subtidal and intertidal receptors.

10.8.69 A number of other impacts associated with the use of TBMs and HDD rigs have the potential to affect marine receptors, including ground borne noise / vibration impacts from the action of the drilling head, and contamination impacts from the release of drilling fluids through rock fissures. Ground borne noise / vibration impacts have the potential to affect fish and sea mammals. The level of vibration impacts will be dictated by the clearance between the tunnel and the seabed, plus the type of ground and its vibration transmission properties. The consolidated nature of the bed material in the area of Crossing Zone 3 suggests that the risk of noise / vibration impacts may need to be considered.

Design of the drill route depth may need to account for the transmission of noise / vibrations through the overlying rock layer, ensuring adequate depth to mitigate for any potential impacts.

10.8.70 Overall, the risks associated with a bored/drilled option in Crossing Zone 3 are considered low. However, the increased abundance of designated subtidal rocky reef habitat and prevalence of consolidated bed material make this a least preferred crossing zone when compared to Crossing Zone 1 and Crossing Zone 2.

Soils and Agriculture

10.8.71 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land within Crossing Zone 3 is a combination of Grade 3 (Moderate to Good quality) and Grade 4 (Poor quality). There is therefore the potential for some BMV land to be disturbed.

Hydrology and Flood Risk

10.8.72 Crossing Zone 3 (Anglesey) is in close proximity to the Afon Braint, within the Upper Braint water body which has a WFD status of good.

10.8.73 Crossing Zone 3 (Gwynedd) falls within the non-reportable WFD waterbody to the south of the Mena Strait.

Traffic and Transport

10.8.74 Crossing Zone 3 (Anglesey) would be located within close proximity to the A5 / A4080 Tollgate junction. Opportunities for multiple access points are limited and therefore options to dissipate construction traffic are also limited. As a consequence trips could be concentrated around the Tollgate junction.

10.8.75 Crossing Zone 3 (Gwynedd) would be within close proximity to the A55. A direct access in accordance with design standards would however require significant mitigation works. Access though Parc Menai would be preferred although suitable physical and non – physical measures would be required to ensure safe and suitable access arrangements could be achieved.

10.8.76 As with all the crossing zones in Gwynedd Junction 9 of the A55 would be the key connection to the strategic highway network.

Construction Noise

10.8.77 Crossing Zone 3 (Anglesey) lies on an area of land between the A4080 and the Menai Strait just south of Llanfairpwllgwyngyll, offset from the water's edge by approximatley130 m. The crossing zone lies adjacent to the Joint Services Mountain Training Centre and a number of other residential NSRs. This option is not preferred due to the proximity of NSRs.

10.8.78 Crossing Zone 3 (Gwynedd) side is in a remote area south west of the Gwynedd side of the Menai Strait crossing and is set back from the water's edge. This would be a preferred location for a tunnelling compound, if tunnelling were the preferred technique, due to the absence of NSRs although baseline noise levels, particularly at night, will be low to very low.

Socio Economic

10.8.79 Crossing Zone 3 (Anglesey) is within the AONB and in proximity to the Nuffield Centre (Joint Service Mountain Training Centre Indefatigable) owned by the Ministry of Defence. There is the potential for disturbance to the training centre during construction. There are no significant socio-economic receptors identified for Crossing Zone 3 (Gwynedd).

10.8.80 This crossing has the potential to disrupt recreational users of the Menai Strait including the dock and boat trips operating in the area if seabed installation were undertaken. For all other methods recreational users would not be affected.

10.8.81 This is the preferred option against socio economic considerations.

Technical

10.8.82 For Crossing Zone 3 a large bore tunnel created by TBM is preferred.

10.8.83 A SCL tunnel may also possible, but would require extensive ground treatment to facilitate construction. Pipe jacking is not preferred due to the length of the crossing and the concerns over jacking forces. For HDD the pulling tension required for an HDD installation would exceed the capability of standard cable designs. Seabed installation, whilst technically feasible, would be complex and is considered high risk. It is therefore not preferred.

Crossing Zone 4

10.8.84 Crossing Zone 4 is located between the Britannia Bridge and Menai Suspension Bridge.

Landscape and Visual

10.8.85 Crossing Zone 4 (Anglesey) is located within a sloping field immediately adjacent to the A5. The crossing zone is located within the AONB and is bounded to the east by a public right of way.

10.8.86 Due to the southern aspect of the relatively steeply sloping field, this area is visible from a number of locations including Britannia Bridge, Menai Suspension Bridge and Church Island. There are also open views from the A5. Although the area is in close proximity to a promoted and popular viewpoint, located alongside the A5 in Anglesey, principle views from here are focussed to the south across the Menai Strait and towards Snowdonia

10.8.87 Crossing Zone 4 (Gwynedd) is located near to Ty'n-y-Lon and is bounded to the west by the A55 and east by Ffordd Bronwydd. The area is within the Vaynol Estate and Surrounds SLA. It is in close proximity to properties with the potential to affect views from Glan Menai; however, many of the views from properties are partly screened by topography and filtered by vegetation. There are open views from the A55 and Ffordd Bronwydd. The promoted viewpoint in Anglesey looks towards the site, but intervening tree and woodland cover would screen views. Even with the number of properties around Ty'n-y-Lon and Penrhos Road, very little built form is actually visible when looking south from the viewpoint.

10.8.88 Crossing Zone 4 (Anglesey) would be visible from people using the Menai Strait for water based recreational activities, mainly being an issue during construction. Any proposed tunnel head house has the potential to be seen from the Menai and therefore the design and exact siting will be key in determining the exact effects.

Historic Environment

10.8.89 Crossing Zone 4 (Anglesey) is located on the steep slope leading down to the Menai Strait. There are no known features of archaeological interest within the zone, though the historic environment records a number of hut platforms and field system remains, suggesting settlement along this slope during the prehistoric period. The scheduled monument of Burial Chamber 180m NE of Pen-Y-Berth (AN037) is located at the top of the slope to the north, whilst a number of scheduled fish weirs are located along the Anglesey shoreline, such as Gorad Ddu Fish Weir (AN139). The construction of any tunnel head house would be unlikely to affects the settings of the scheduled monuments, but would have potential to disturb archaeological remains associated with prehistoric settlement.

10.8.90 The Grade II listed building of Bronwydd (LB 18909) is located to the immediate north of Crossing Zone 4 (Gwynedd), though there are relatively few recorded features of archaeological interest in this immediate area, though it does lie within the Vaynol historic landscape character area of the Dinorwic Landscape of Outstanding Historic Interest and construction of any tunnel head house would have the potential to affect the historic character of this area

Ecology

10.8.91 Habitats present in Crossing Zone 4 (Anglesey) include improved grassland, drains, with hedgerows, coniferous plantation woodland, with amenity grassland nearby the crossing zone. This crossing zone would have the potential to affect the following:

- Menai Strait and Conwy Bay SAC (within 190m to the south) as there is a potential hydrological link adjacent to the crossing zone; and
- Ancient Woodland (approximately 90m south west).

10.8.92 There is also the potential to affect protected species including barn owl, badger, red squirrel, otter and bats (habitats suitable for supporting these species is present). There is a water vole record adjacent to the crossing zone.

10.8.93 Habitats present in Crossing Zone 4 (Gwynedd) include improved grassland and hedgerows. This crossing zone would have the potential to affect the following:

- Ancient Woodland and CWS Parc Menai woodlands (approximately 70m south west), and CWS sites Treborth Hall Lake and woods and Ysgol Faenol (75m east, and 135m south respectively;
- Menai Strait and Conwy Bay SAC (approximately 680m north);
- SSSIs Coedydd Afon Menai approximately 650m north west, and Eithinog 1km east;
- numerous ponds (within 500m, negative GCN presence);

- otter (record 450m to the south); and
- red squirrel (record approximately 650m south within Ancient Woodland).

10.8.94 There would be the potential to affect other protected / notable species such as badger, barn owl and bats.

Marine Ecology

10.8.95 Crossing Zone 4 is located between the bridges and is located in the area of the Strait where designated subtidal rocky reef type habitat is greatest. The communities associated with the rocky habitats are extremely sensitive to physical disturbance type impacts, and as such, the selection of a bored/drilled crossing technique would assist in avoiding most impacts on subtidal and intertidal receptors.

10.8.96 As highlighted previously, a number of other impacts associated with the use of TBMs and HDD rigs have the potential to affect marine receptors, including ground borne noise / vibration impacts from the action of the drilling head, and contamination impacts from the release of drilling fluids through rock fissures. The consolidated nature of the bed material in the area of Crossing Zone 4 suggests that the risk of noise / vibration impacts may need to be considered. Design of the drill route depth may need to account for the transmission of noise / vibrations through the overlying rock layer, ensuring adequate depth to mitigate for any potential impacts. The depth of the Strait in this zone and the angle of the drill route may reduce the ability of the design to achieve adequate clearance.

10.8.97 Overall, the risks associated with a bored/drilled option in Crossing Zone 4 are considered low. However, the increased abundance of designated subtidal rocky reef habitat type and prevalence of consolidated bed material make this the least preferred crossing zone when compared to the other crossing zones.

Soils and Agriculture

10.8.98 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land at Crossing Zone 4 is a combination of Grade 3 (Moderate to Good quality) and Grade 4 (Poor quality).

Hydrology and Flood Risk

10.8.99 Crossing Zones 4 (Anglesey) and (Gwynedd) would fall within the non-reportable water body to the north of the Menai Strait (Anglesey) and the non-reportable water body to the south of the Menai Strait (Gwynedd).

Traffic and Transport

10.8.100 Crossing Zone 4 (Anglesey) could be accessed via the local roads A5025 or the A5 which provide links to Junctions 8 and 8A of the A55 strategic highway network. The crossing zone is located within close proximity of Junction 8 and 8A which would therefore reduce construction traffic impacts on local roads. The crossing zone and anticipated construction routes would avoid residential areas.

10.8.101 Crossing Zone 4 (Gwynedd) would be located close to the highway network, adjacent to the eastern side of the A55, although direct access would not be possible.

10.8.102 As with all the crossing zones in Gwynedd Junction 9 of the A55 would be the key connection to the strategic highway network.

Construction Noise

10.8.103 Crossing Zone 4 (Anglesey) lies on an area of farm land just off and on the northern side of the B5420 between Llanfairpwllgwyngyll and Menai Bridge. The A55 lies to the west and the closest NSRs are a block of properties some 220 m to the west north west. The crossing zone is offset from the water's edge by approximatley200 m.

10.8.104 Crossing Zone 4 (Gwynedd) lies adjacent to the A55 and to the east and south of the Britannia Bridge. It is north west of Treborth which abuts the south eastern corner of the site. There are NSRs in Treborth although baseline noise levels will be elevated due to the proximity of the A55.

Socio Economic

10.8.105 Crossing Zone 4 (Anglesey) is located within the AONB and in close proximity to a noted viewpoint which is therefore tourism receptors would be sensitive to disturbance from construction. This crossing zone would also be in close proximity to the Wales Coast Path.

10.8.106 In Gwynedd the construction disturbance and risk of visual effect from the permanent tunnel head house, if tunnelling was selected, could impact unfavourably on users of the A55. Other socio-economic receptors on the mainland include a garden centre, school and settlements which could be affected by noise and construction disturbance, resulting in community effects such as severance and amenity.

10.8.107 This is the second least preferred option.

Technical

10.8.108 In Crossing Zone 2 a large bore tunnel created by TBM is the most preferred due to lower installation risk and advantages in the operation and maintenance of the installed electrical circuits. A SCL tunnel may also be possible but it would require extensive ground treatment to facilitate construction. A pipe jack was ruled out as the length of the bore exceeds the length achievable with a pipe jack.

10.8.109 For HDD the pulling tension required for an HDD installation would exceed the capability of standard cable designs. Seabed installation, whilst technically feasible, would be complex and is considered high risk. It is therefore not preferred.

10.9 Initial Preference

Landscape and Visual

10.9.1 From a landscape and visual perspective, Crossing Zone 3 would be preferred. For the siting of a tunnel head house the crossing zones (Anglesey and Gwynedd) are more visually contained having potentially fewer effects on people using the Menai Strait and the road network. There is scope for introducing additional planting; such measures would reflect and enhance the character of the landscape which contains a number of woodland areas and tree lined hedges.

10.9.2 There is concern about the potential effects of tunnel head houses for Crossing Zones 1 and 2 on both Plas Newydd and Vaynol Registered Parks and Gardens, views from and along the Menai and the potential number of receptors, many of which would be visitors coming to enjoy views along the Menai Strait. Crossing Zone 4 would be in relatively close proximity to views from a number of key receptors including Church Island and Menai Bridge.

Historic Environment

10.9.3 Least impact to the historic environment, principally setting to designated heritage assets, occurs at the onshore construction areas associated with Crossing Zones 3 and 4 and these are hence preferred.

10.9.4 Within Crossing Zones 1 and 2, the onshore construction areas are within the boundary, or essential setting, of the Grade 1 Registered Parks and Gardens of Plas Newydd and Vaynol. Consequently, construction within these areas would pose challenges in terms of potential effects to these designated heritage assets.

Ecology

10.9.5 On Anglesey, the crossing zones are similar in terms of habitats within individual zones, but differ in terms of habitats and designations bordering those zones. Crossing Zone 4 (Anglesey) has the least potential to affect surrounding habitat in terms of CWS and ancient woodland; however cabling to this zone from AN2 could affect the CWS.

10.9.6 Crossing Zone 2 (Anglesey) would have a shorter cable route corridor, depending on the CSEC option chosen. Crossing Zone 1 (Anglesey) is the least preferred, due to the potential overhead line connection to Anglesey South, or the longer cabling route corridor if connected from Anglesey Central.

10.9.7 On Gwynedd, habitats within the crossing zones are also quite similar although slightly more valuable and sensitive habitats lie within Crossing Zone 3 (Gwynedd). In terms of surrounding habitats and designations, Crossing Zone 4 (Gwynedd) would be likely to have the least effect on nearby CWS and woodland habitats; however this does not take into account overhead line options. Crossing Zones 1, 2 and 3 (Gwynedd) are least preferred due to the potential effects arising from the cable route corridors. All options would affect woodland, CWS and ancient woodland areas to some extent.

Marine Ecology

10.9.8 Seabed installation was the least preferred crossing technique for any of the crossing zones.

10.9.9 Overall, a bored / drilled crossing in Crossing Zone 1 is considered as the best solution in relation to marine ecology receptors. The low abundance of designated subtidal rocky reef habitat and the unconsolidated bed type make this the preferred option.

10.9.10 However, it should be noted that with the use of a bored / drilled solution, the risks posed at any of the four crossing zones would be relatively low.

Soils and Agriculture

10.9.11 Crossing Zone 1 is least the preferred option. On Anglesey land within this zone is BMV (Grade 2) and Potentially BMV (Grade 3); and in Gwynedd land within this zone is Potentially BMV (Grade 3). All other crossing zones comprise Grade 3 and 4 land and no differentiation is made between them.

Hydrology and Flood Risk

10.9.12 'Hydrology and Flood Risk' are not considered to be sufficient differentiators to identify a preference.

Traffic and Transport

10.9.13 Crossing Zones 2 and 4 on both Anglesey and Gwynedd allow for a combination of multiple access opportunities and therefore are equally favoured from a traffic and transport perspective at this stage.

Construction Noise

10.9.14 As construction works for the crossing would be a 24 hour activity regardless of the techniques selected, and that noise levels will carry across the water and propagate with low attenuation for long distances, construction sites near to the water's edge are not preferred.

10.9.15 Crossing Zone 1 (Anglesey or Gwynedd) is not preferred. Crossing Zone 3 (Anglesey) is not preferred and Crossing Zone 4 (Gwynedd) is not preferred. No differentiation is identified between the other crossing zones.

Operational Noise

10.9.16 As noted above operational noise is not considered a differentiator.

Socio Economic

10.9.17 Crossing Zone 3 is preferred. Whilst within the AONB, Crossing Zone 3 is not in close proximity to any significant socio-economic receptors on either shore. There is potential to disrupt recreational users of the Menai Strait; however this effect would not arise if a tunnel option is taken forward. Crossing Zone 1 is less preferred due to potential construction disturbance and risk of visual effects from construction on Plas Newydd and the Vaynol Estate, as well as potential effects on holiday cottages located on the Anglesey shoreline. Crossing Zone 2 is the least preferred as it crosses the Wales Coast Path and is in close proximity to Plas Newydd and Vaynol Park. Crossing Zone 4 is the second least preferred option due to proximity to the Wales Coast Path and a promoted viewpoint platform on Anglesey. In Gwynedd, Crossing Zone 4 is also in proximity to settlements, a garden centre and a school which could be affected by construction disturbance.

Technical

10.9.18 All construction techniques would have to overcome varied complex issues, including access, geology, and topography.

10.9.19 Due to the shorter length across the Menai Strait there are more options for installation in Crossing Zone 1 than the other crossing zones. A large bore tunnel would only be preferred in Crossing Zone 1 if the ground conditions were not conducive to SCL tunnelling.

10.9.20 For the other techniques there is marginal difference between pipe jack, HDD and seabed installation. Pipe jacking is preferred over the other tunnelling options due to the length of Crossing Zone 1 due to the current understanding of the ground conditions in the area. Installation by pipe jack is considered to have the lower potential risk than HDD. Installing 15 ducts by HDD would be higher risk due to the expected geological conditions. The potential for failed and aborted drilled bores would also affect the landing and onshore cable installation swathe and complexity and programme. Seabed installation of ducts is considered technically feasible.

10.9.21 Although pipe jack was initially preferred for Crossing Zone 1 it was recognised that HDD is a fundamentally different means of construction from small and large bore tunnels (with shafts) and would not require a tunnel head house.

10.9.22 Laying the cables across the Menai Strait in the sea bed may be feasible subject to confirmation of the capability for marine plant to work within the Menai Strait.

10.9.23 In Crossing Zone 2 a TBM crossing is the most preferred due to lower installation risk and advantages in the operation and maintenance of the installed electrical circuits.

10.9.24 An SCL tunnel may also be possible but would require extensive ground treatment to facilitate construction. A pipe jack tunnel is not preferred as the length of the bore exceeds the length achievable with a pipe jacking installation. An HDD installation may be possible but due to the required pulling tension to install the cables, the cable sheath design would be constrained to specialised sheath designs. Availability of these designs is limited and would require specialist jointing techniques and spares holdings. This could impose greater repair durations if a fault were to occur. HDD is the least preferred option.

10.9.25 Seabed installation would not require the deep shafts and underground works associated with other techniques however the water speeds and complex currents in the Menai Strait present safety challenges to the installation and maintenance of the circuit. The requirements to either HDD or re-profile the shore of the Strait at the landfall location also make this less preferable than TBM installation. Seabed installation is therefore not preferred.

10.9.26 A large tunnel excavated by a TBM is also the preferred option in Crossing Zone 3. An SCL tunnel may also be possible, but would require extensive ground treatment to facilitate construction. Pipe jack tunnel is not preferred as the length of the bore exceeds the length achievable with a pipe jacking installation. An HDD installation is also not preferred due to the high risk of bore failure from the vertical travel required by the HDD drill head and presence of multiple rock formations, fault lines and fissures in this zone.

10.9.27 A large tunnel excavated by a TBM is also the preferred option for Crossing Zone 4. An SCL tunnel is a less suitable method due to the longer section length. In addition there are risks associated with the poor ground conditions expected on the route, in particular the degree of water ingress during tunnelling. A pipe jack tunnel is not preferred as the length of the bore exceeds the length achievable with a pipe jacking installation. An HDD installation is also not preferred as the pulling tension required to draw the cable through the ducts exceeds the capability of standard cable designs.

10.9.28 For both Crossing Zones 3 and 4 seabed installation is not considered feasible.

Summary

10.9.29 Against environmental considerations preferences related mainly to the onshore infrastructure rather than the crossing itself. The preferred option for marine ecology was Crossing Zone 1, however it was be noted that, excluding seabed installation the construction risk to the marine environment at any of the four crossing zones would be relatively low.

10.9.30 Landscape and visual, historic environment and ecology identified locations within or in view of Plas Newydd and the Vaynol Estate (Crossing Zones 1 and 2) as being least preferred. This was particularly strong for 'historic environment', given the Grade I status of the Registered Parks and Gardens. Socio economic also least preferred Crossing Zone 2.

10.9.31 Crossing Zone 2 was however preferred by 'Traffic and Transport', and 'Construction Noise', along with Crossing Zone 4.

10.9.32 Against technical considerations Crossing Zone 2 was preferred, with the crossing by means of a tunnel. Shaft depths would be lower making cable installation less complex, and there would be suitable working areas readily available on either side of the Menai Strait with very little gradient. Crossing Zone 1 would require a length of direct buried cables with a greater construction impact and the need for more above ground link pillars. Crossing Zone 3 would require difficult access and civil works to prepare a level construction working area. The height difference between the banks of the Menai Straits would impact on construction and installation techniques. Crossing Zone 4 would result in a greater crossing length, greater height differences, and onward routeing from GN2 which would be complex.

10.9.33 Although the crossing of the Menai Strait is a considerable technical challenge which leads to Crossing Zone 2 being preferred, due to the environmental sensitivities in the area no overall preference was determined.

11. PENTIR SUBSTATION

11.1 Introduction

11.1.1 The existing Pentir 400 kV substation is located to the west of the B4547 approximately 1.9km from the village of Pentir. The existing 400kV substation occupies an area of approximately 300m x 175m.

11.1.2 The existing substation is an outdoor Air-Insulated Switchgear (AIS) substation where the existing 400 kV overhead line from Wylfa (Wylfa 1 and Wylfa 2 circuits) currently terminate and where the proposed new 400 kV overhead line (Wylfa 3 and Wylfa 4 circuits) will also terminate.

11.1.3 As a result of the new nuclear generation, in addition to the new overhead line circuits, the substation requires further modification for compliance with the Security and Quality of Supply Standards (SQSS)[37] including the addition of two new bus sections and the reconfiguration of the existing overhead line circuits so that one incoming circuit (from Wylfa) and one outgoing circuit (to Connah's Quay / Bodelwyddan or Trawsfynydd) are located on each bus section. In addition, one new Shunt Reactor is to be added to the substation to provide additional voltage compensation.

11.1.4 In addition to the above works, it is currently anticipated that other works at the existing substation may be required to accommodate the Codling Park and Greenwire projects. It is currently anticipated that a substation extension for the new Codling Park bay would take place prior to the works described below.

11.1.5 Three alternative options have been considered to accommodate the requirements identified above:

- Option 1 would partially extend the substation to both the north and south;
- Option 2 would extend the substation only to the north, and
- Option 3 would extend the substation only to the south.

11.1.6 As the 'Land use and agriculture' and geology, are similar for all the substation options these are not considered differentiating factors.

11.1.7 In terms of 'traffic and transport' each of the 3 options would require additional works to the existing entrance and access tracks leading to the substation in order to accommodate both construction traffic associated with the expansion of the substation and the day to day operational activities.

11.1.8 Options 1 and 3 would not involve any Hydrology and Flood Risk receptors. Vegetation in the area associated with Option 2 suggests that it is a boggy area and may be less favourable for the location of such critical infrastructure. Furthermore, the footprint extends right up to several minor ditches. There are also small/discreet areas of mapped surface water flood risk within the proposed footprint.

[37] Due to the amount of power that will be generated by Wylfa Newydd being very much in excess of that of Magnox Wylfa, major changes are required to the National Grid network in the North Wales area.

11.1.9 Construction noise is only considered a minor differentiator as there is no significant preference as it is anticipated that noise effects can be controlled and construction works would only take place in the daytime. There is a slight preference for Option 1 as it spreads the construction work to the north and south so giving potentially slightly lower noise levels at the closest NSRs for potentially a shorter period.

11.1.10 The substation extension principally comprises new switchgear and busbars which are not considered significant operational noise sources, hence these items of plant are not considered a differentiator for the three substation extension options. At this point in time the requirement for additional reactive plant has not been confirmed, however each option presents an indicative location for a new shunt reactor so this is used a basis for comparing the options. In addition, each option would require a slightly different overhead line routeing into the substation; this also been also considered in the options appraisal below.

11.2 Option 1

11.2.1 Option 1 would result in a northern extension to the existing substation of approximately 105m x 165m, and a southern extension to this existing substation of approximately 100m x 110m. In addition, a smaller Cable Sealing End compound on the east (adjacent to an existing overhead line tower) of approximately 35m x 35m is needed to facilitate the diversion of one of the existing Connah's Quay overhead line into the northern substation extension, and a new overhead line tower is required on the south to facilitate the diversion of the other existing Connah's Quay overhead line into the southern substation extension. The substation extensions would be constructed as air-insulated switchgear in the same manner as the existing substation.

11.2.2 The works to the north would include a new bus section and two new bays associated with the Wylfa 3 (new) and Bodelwyddan-Connah's Quay 1 (diverted) circuits. To facilitate the diversion of the Bodelwyddan-Connah's Quay 1 circuit, a new overhead line tower would be installed. To facilitate the connection of the Wylfa 3 circuit, 400kV cable would be installed between the bay on the south-east and the overhead line terminal tower (4AP091) on the west of the substation.

11.2.3 The works on the south would include a new bus section and two new bays associated with the Wylfa 4 (new) and Bodelwyddan-Connah's Quay 2 (diverted) circuits. To facilitate the diversion of the Bodelwyddan-Connah's Quay 2 circuit, 400kV cable would be installed between the bay on the west and the existing overhead line terminal tower (which would require a new CSEC adjacent to the terminal tower).

11.2.4 The new shunt reactor, if required, would either be installed in a spare bay to be created in the existing substation as a result of the diversion of one of the Bodelwyddan-Connah's Quay circuits if this proves technically acceptable, or this would be added to the site extension to the west.

11.2.5 In addition to the above works, a new bus section circuit breaker would also be added to the reserve busbar in the existing substation.

Landscape and Visual

11.2.6 Option 1 would extend the substation to the north and south and would require the loss of established screen planting which would open up views of existing substation until new planting becomes established, particularly to the south-east. It retains an established belt of conifer planting to the north-west which would provide immediate screening from areas/properties in this direction including Garth Farm and particularly Rhos-fawr. There is scope for mounding/new planting to screen views from areas properties to south-east including the more elevated areas at Rhiwlas and the elevated edge of Snowdonia National Park.

Historic Environment

11.2.7 There is a possible line of a Roman road (HER 17834) which runs to the south of Pentir. There are no other recorded significant archaeological remains within the immediate vicinity of substation.

11.2.8 To the southwest of Pentir there is a group of listed buildings at Ty'n Llwyn Farm. The buildings are currently screened by the planting around the substation. It is assumed that further planting would be used for all options which would mitigate any further impact on the setting of the buildings.

Ecology

11.2.9 Option 1 would extend the substation to the north and south and would entail the permanent loss of habitats, in particular woodland. Habitats that could be affected include mixed plantation woodland, mixed semi-natural woodland, coniferous woodland and broadleaved woodland, dense scrub and improved grassland. This option would also affect the Pentir sub-station CWS, but would not involve works within the ancient woodland. A range of species could be affected by this loss in habitat, including badger, bats, red squirrel, reptiles, polecat, invertebrates and bird species associated with woodland habitats. Habitat losses could be replaced in the vicinity of the substation, should space allow.

11.2.10 This option does not affect the belt of woodland to the north west and therefore would retain some connectivity between the woodland block either side of the sub-station; however the overhead line route into the sub-station is likely to affect this. The woodland to the south of the sub-station would be fragmented by this part of the extension, mitigation around the southern point of the sub-station could maintain connectivity. Habitat creation would take time to establish.

Traffic and Transport

11.2.11 Option 1 would see construction activity on either side of the existing substation would require the construction of two new access roads to circumvent the substation and access the proposed works.

Operational Noise

11.2.12 Option 1 would place a new shunt reactor to the north west of the existing substation site approximately 250m from the nearest dwelling. The overhead line routeing for this option would pass approximately 130m from the nearest residential property. With appropriate mitigation for shunt reactor tank noise (if required) (for example acoustic enclosure), it is considered this option would satisfy the requirements of EN-1 and EN-5.

Socio Economic

11.2.13 Other than the woodland no socio-economic receptors including businesses, recreational features or rights of way would be affected by Option 1.

11.3 Option 2

11.3.1 Option 2 would result in a northern extension to this existing substation of approximately 260m x 150m, and the addition of two smaller Cable Sealing End compounds on the east (adjacent to an existing overhead line tower) of approximately 35m x 35m to facilitate the diversion of the existing Connah's Quay overhead line into the substation extension. The substation extension would be constructed as air-insulated switchgear in the same manner as the existing substation. The scope of work would be broadly the same as that described for Option 1 above, although for this option it would predominantly be located in the northern extension rather than being split across both ends of the existing substation as with Option 1.

Landscape and Visual

11.3.2 Option 2 would extend the substation to the north, retaining an established screen planting to the south-east. This avoids visual effects on areas/properties to the south-east including the more elevated areas at Rhiwlas and the elevated edge of Snowdonia National Park. This option does however require the loss of established screen planting to the north-west which would open up views of existing substation until new planting becomes established. This may affect properties at Garth Farm and Rhos-fawr. As the substation is in an elevated location, longer distance views from the north may also be affected as the screen planting is visible from as far as Llandaniel Fab on Anglesey.

Historic Environment

11.3.3 Option2 has the same considerations as Option 1.

11.3.4 There is a possible line of a Roman road which runs to the south of Pentir. There are no other recorded significant archaeological remains within the immediate vicinity of substation.

11.3.5 To the southwest of Pentir there is a group of listed buildings at Ty'n Llwyn Farm. The buildings are currently screened by the planting around the substation. It is assumed that further planting would be used for all options which would mitigate any further impact on the setting of the buildings.

Ecology

11.3.6 Option 2 would extend the substation to the north only and would require the permanent loss of habitats, in particular woodland. Habitats that could be affected include mixed semi-natural woodland, coniferous plantation woodland and broadleaved woodland, dense scrub and improved grassland. This option would also affect the Pentir sub-station CWS, but would also involve works within the ancient woodland (plantation on ancient woodland) to the north of the extension. A range of species could be affected by this loss in habitat, including badger, bats, red squirrel, reptiles, polecat, invertebrates and bird species associated with woodland habitats. Habitat losses could be replaced in the vicinity of the substation should space allow.

11.3.7 This option does not affect the belt of woodland to the south and therefore would retain some connectivity between the woodland block either side of the sub-station. The woodland to the north of the sub-station would be fragmented by this part of the extension and mitigation around the southern point of the sub-station could maintain connectivity, although it is possible that this would already occur due to the overhead line options. Mitigation could replace lost habitat however habitat creation would take time to establish. Ancient woodland cannot be realistically mitigated for.

Traffic and Transport

11.3.8 Option 2 would require the construction of a new access road on the western boundary of the existing substation in proximity to c Construction activity associated with the GS1.

Operational Noise

11.3.9 Option 2 would place a new shunt reactor (if required) to the north west of the existing substation site approximately 250m from the nearest residential property. New overhead line routes for this option would pass approximately 80m from the nearest residential property. With appropriate mitigation for shunt reactor tank noise (for example acoustic enclosure), it is considered this option would satisfy the requirements of EN-1 and EN-5.

Socio Economic

11.3.10 Other than the woodland no socio-economic receptors including businesses, recreational features or rights of way would be affected by Option 2.

11.4 Option 3

Technical

11.4.1 Option 3 would result in a southern extension to the existing substation of approximately 260m x 150m, and the addition of two smaller Cable Sealing End compounds on the north of approximately 35m x 35m to facilitate the connection of the new overhead line circuit into the substation extension. The substation extension would be constructed as air-insulated switchgear in the same manner as the existing substation. The scope of work is broadly the same as that described for Option 1 above, although for this Option it would predominantly be located in the southern extension rather than being split across both ends of the existing substation as with Option 1.

Landscape and Visual

11.4.2 Option 3 would extend the substation to the south, retaining an established belt of conifer planting which screens views of existing substation from areas/properties to the north-west, including Garth Farm and Rhos-fawr. This option does however require the loss of established screen planting to the south-east which would open up views of existing substation until new planting becomes established. This potentially would mean that substation would become more prominent in views from the more elevated areas at Rhiwlas and Snowdonia National Park.

Historic Environment

11.4.3 There is a possible line of a Roman road which runs to the south of Pentir. There are no other recorded significant archaeological remains within the immediate vicinity of substation.

11.4.4 To the southwest of Pentir there is a group of listed buildings at Ty'n Llwyn Farm, Option 3 is closer to these than the other options. The buildings are currently screened by the planting around the substation. It is assumed that further planting would be used for all options which would mitigate any further impact on the setting of the buildings.

Ecology

11.4.5 Option 3 would extend the substation to the south only and would entail the permanent loss of habitats, in particular mixed plantation woodland, coniferous woodland and broadleaved woodland, and improved grassland. This option would also affect the Pentir sub-station CWS, but would not require works within the ancient woodland. A range of species could be affected by loss of habitat, including badger, bats, red squirrel, reptiles, polecat, invertebrates and bird species associated with woodland habitats. Habitats lost could be replaced in the vicinity of the substation should space allow.

11.4.6 This option does not affect the belt of woodland to the north west and therefore would retain some connectivity between the woodland block either side of the sub-station; however the overhead line route into the sub-station is likely to affect this. The woodland to the south of the sub-station would be fragmented by this part of the extension, mitigation around the southern point of the sub-station could maintain connectivity. Habitat creation would take time to establish.

Traffic and Transport

11.4.7 Option 3 would require the shortest route for construction vehicles. This option would rationalise construction activity to the east side of the substation therefore enabling a linear access route to GS1 if required.

Operational Noise

11.4.8 Option 3 would place a new shunt reactor (if required) to the south east of the existing substation site approximately 500m from the nearest residential property. New overhead line routes for this option would pass approximately 130m from the nearest residential property. The realigned existing 400 kV overhead line would pass approximately 420m from the nearest residential property. With appropriate mitigation for shunt reactor tank noise (for example

acoustic enclosure), it is considered this option would satisfy the requirements of EN-1 and EN-5.

Socio Economic

11.4.9 Other than the woodland no socio-economic receptors including businesses, recreational features or rights of way would be affected by Option 3.

11.5 Consideration of Options

Landscape and Visual

11.5.1 Option 1 is preferred because it provides the best balance in terms of likely effects on areas/properties to the north-west and south-east. It reduces the likely visual effects on Snowdonia and the village of Rhiwlas. By retaining established screen planting to the north-west, it also reduces likely effects on areas/properties to the north-west, including Garth farm and Rhos-fawr.

Historic Environment

11.5.2 Option 3 is least preferred due to closer proximity to the line of a Roman road and a group of listed buildings.

11.5.3 There are differentiators between Option 1 and Option 2, but the smaller extension at both ends (Option 1) may be slightly preferable if it is easier to screen.

Ecology

11.5.4 All options entail the loss of areas of woodland and areas of CWSs, however only Option 2 would lead to the loss of ancient woodland. An overhead line option which routes away from the area of ancient woodland, would result in Option 2 being the least preferred substation option as this would lead to a loss of ancient woodland that would otherwise have remained unaffected. Option 1 is preferred, as it would allow space both north and south of the sub-station to provide mitigation planting of woodland, maintaining connectivity in the long term. For Option 3 it would be more difficult to replace the habitat to the south as it extends further into the improved grassland.

11.5.5 Should an overhead line option be taken forward which would necessitate the loss of part of the ancient woodland to the north, then consideration would be given to Option 2 as the preferred option. This option would retain the woodland connectivity south of the sub-station.

11.5.6 Should the overhead line option remove a different part of the ancient woodland then Option 1 would be the preferred as it would not necessitate removing additional areas of ancient woodland. Mitigation could replace lost habitat however loss of ancient woodland cannot be realistically mitigated for.

Traffic and Transport

11.5.7 The preferred option would be Option 3, as this represents the shortest construction route and would enable a linear access route to GS1 if required.

Operational Noise

11.5.8 Option 3 is the preferred option since it would allow for a new shunt reactor (if required) to be located over 500m from the nearest noise sensitive receptor.

Option 2 is least preferred since a section of new overhead line would pass approximately 80m from a residential receptor, although assuming appropriate mitigation to shunt reactor tank noise and the selection of a larger, and hence quieter overhead design, it is considered this option would satisfy the requirements of EN-1 and EN-5.

Socio Economic

11.5.9 Option 1 would minimise the loss of woodland surrounding the existing substation site to ensure the development remains screened to isolated properties nearby. More surrounding woodland would be lost for Option 2 than Option 1 which could affect isolated residential properties from a visual perspective. More surrounding woodland would be lost for Option 3 than Option 1 which could affect isolated residential properties from a visual perspective.

11.5.10 Option 1 is the preferred option.

Technical

11.5.11 All options were technically feasible with little to differentiate between them.

11.6 Outcome

11.6.1 Option 2 was not preferred by any discipline and was therefore discounted.

11.6.2 A preference for Option 1 was expressed by Landscape and Visual, Historic Environment, Ecology and Socio Economic although this was qualified by comments on an overhead line connection. This option was not 'least preferred' by any discipline.

11.6.3 Option 3 was preferred for Traffic and Transport and Operational Noise but least preferred by Historic Environment.

11.6.4 Given the preferences for Option 1, and the Historic Environment concerns with Options 3, Option 1 is the preferred option.

11.6.5 In selecting Option 1 it is important that the existing screen planting to the north-west is retained. This comprises relatively mature conifers and would benefit from additional planting in the adjoining field. This would ideally be a mix of deciduous and evergreen trees and shrubs to provide a more naturalistic edge to the existing screen planting. To the south-east of the existing substation, Option 1 would require removal of the established screen planting. Again it is important that the removal of trees in this area is minimised as far as possible because it currently plays an important role in substantially screening views of the existing infrastructure form Snowdonia and the village of Rhiwlas. The proposed development once constructed would only occupy a part of the adjoining field and it is recommended that any surplus fill should be used to create low screen mounds to be planted with a mix of deciduous and evergreen trees and shrubs, again to provide a more naturalistic edge. The proportion of evergreens should be increased away from the planted edge so that the degree of screening is the same as that currently afforded.

11.6.6 The preferred option is illustrated on Figure 11.1

Figure 11.1

Legend

- Existing Pentir Substation Layout
- Proposed Pentir Substation Extension
- Proposed new pylons
- Proposed section of new overhead line

0 25 50 100
Metres

Rev	Date	Description	GIS	Chk	App
0	22/09/2016	Initial Issue	JB	JF	JC

nationalgrid

Project Name: NORTH WALES CONNECTION PROJECT

Report Title: MENAI STRAIT CROSSING REPORT

Document Title: FIGURE 11.1
PROPOSED LAYOUT PENTIR SUBSTATION EXTENSION

Creator:	Date:	Checker:	Date:	Approver:	Date:
JB	22/09/2016	JF	22/09/2016	JC	22/09/2016

Document Type:	Scale:	Format:	Sheets:	Rev:
FIGURE	1:3,000	A3	1 of 1	0

Document Path: X:\3512\North Wales Connection - NG\GIS\02 Maps\All Disciplines_Route Options Figures\Section 5 Report - Pentir Sub Proposed Layout.mxd

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12. END-TO-END' OPTIONS CONSIDERED

12.1 Introduction

12.1.1 The review of individual elements within Section 5, as described previously in this Report has identified preferences for individual elements, for example Option 5A was the least preferred overhead line option for Anglesey whilst Option 5H was the least preferred overhead line option for Gwynedd. In many instances however there was no definitive outcome and options could not be preferred or least preferred without consideration of other elements of the project (overhead lines, cable routes, crossing zones etc.).

12.1.2 Were preferences have been identified these do not necessarily connect to form a coherent 'end-to-end' solution for Section 5. In order to determine an overall solution therefore a number of end to end options were defined, and as appropriate a back check undertaken of options which were not preferred, to identify whether in combination with other elements these would create a more preferable overall solution.

12.1.3 Cost was also considered, and this is set out later in this chapter.

12.2 Description of options

12.2.1 In defining the 'end-to-end' options, using the outcome of the appraisals and the initial preferences, the following were considered:

- other than the southerly section of Option 5A, which was discounted due environmental considerations, no potential overhead line routes were discounted on Anglesey. In Gwynedd Option 5E was not considered further due to concerns with CSEC siting area GS4;
- CSEC siting areas within Anglesey South were not considered further primarily due to environmental considerations relating to the overhead line connection (Option 5A);
- within Anglesey Central AC6 was preferred by most disciplines and therefore this CSEC siting area was taken forward. This CSEC siting area also offered a relatively short and direct underground cable route to Crossing Zone 2 (Anglesey);
- AC1 was taken forward to allow further consideration of Crossing Zone 3;
- no CSEC siting areas in Anglesey North were discounted and therefore these siting areas were considered as a group (AN) rather than individually in the 'end-to-end' options; and
- GN1, GS2, GS4 and GS5 were not considered further due to environmental and technical considerations associated with the siting areas themselves, and the complexities of connecting underground cables.

12.2.2 Due to the engineering constraints associated with crossing the Menai, as described previously in Chapter 9, the crossing techniques taken forward were as follows:

- Crossing Zone 1 – HDD;
- Crossing Zone 2 – Large Bore Tunnel;
- Crossing Zone 3 – Large Bore Tunnel; and
- Crossing Zone 4 – Large Bore Tunnel.

12.2.3 The large bore tunnel is likely to be constructed by TBM. Detailed information will be required, particularly for geology, ground conditions and hydrology in order to identify a more detailed tunnel alignment. This is vital to ensure that the TBM, the tunnel lining and ground treatment address the anticipated complex geology, high water pressures and seismic activity.

12.2.4 A number of end to end options were identified as follows:

Option A -

Overhead line (5A (part), 5B or 5C) to *AC6* with *Underground Cables* to *Crossing Zone 1* then *HDD* and *Underground Cables* to *GS1* then *Overhead line* (5F or 5G) to Pentir Substation;

Option B

Overhead line (5A, 5B or 5C) to *AC6* with *Underground Cables* to *Crossing Zone 2* then by *Tunnel* and *Underground Cables* to *GS1* then *Overhead line* (5F or 5G) to Pentir Substation;

Option C

Overhead line (5A, 5B or 5C) to *AC6* then a *Tunnel* to *GS1* and *Overhead line* (5F or 5G) to Pentir Substation;

Option D

Overhead line (5A, 5B or 5C) to *AC1* with *Underground Cables* to *Crossing Zone 3* then a *Tunnel* and *Underground Cables* to *GS1* then *Overhead line* (5F or 5G) to Pentir Substation;

Option E

Overhead line (5A, 5B or 5C) to *AC1* with *Underground Cables* to *Crossing Zone 3* then a *Tunnel* and *Underground Cables* to *GN1* then *Overhead line* (5F or 5G) to Pentir Substation;

Option F

Overhead line (5D or 5E) to *AN* with *Underground Cables* to *Crossing Zone 4* then by *Tunnel* and *Underground Cables* to *GN2* then *Overhead line* (5H) to Pentir Substation;

Option G

Overhead line (5D or 5E) to *AN* then a Tunnel to *GS1* and *Overhead line* (5H) to Pentir Substation.

12.2.5 The individual elements are all illustrated on Figure 8.1

12.2.6 Due to the size of the CSEC Search Areas the route corridor options and underground cable routes did not necessarily connect with each smaller CSEC siting area. Indicative routes were therefore identified, taking into account environmental and technical considerations to connect to the CSEC siting areas, the Crossing Zones, and to the extension to Pentir Substation.

12.2.7 In considering the environmental and technical issues with the underground cable routes and the crossing zones onshore two longer tunnel options were identified for consideration. Option C would connect a CSEC siting area in Anglesey Central with Gwynedd South; and Option H would connect a CSEC siting area in Anglesey North with Gwynedd North. Both options would require a combined CSEC and tunnel head house permanent compound of approximately 108m x 80m, and a temporary construction compound for construction of the CSEC, vertical shafts and tunnel. The CSCE siting areas identified were reviewed, with AC6 and GS1 considered appropriate for further appraisal.

12.3 Consideration of 'end to end' options

Option A

Overhead line (5A (part), 5B or 5C) to *AC6* with *Underground Cables* to *Crossing Zone 1* then *HDD* and *Underground Cables* to *GS1* then *Overhead line* (5F or 5G) to Pentir Substation;

The individual elements are identified on Figure 8.1 and illustrated diagrammatically on Figure 12.1.

Landscape and Visual

12.3.1 This option would utilise overhead line Options 5B or 5C with potential effects on Gaerwen, Star and Bryn Celli Ddu. It would utilise one of the preferred locations AC6, for a CSEC within Anglesey Central. A long section of underground cable would be required to from a CSEC to Crossing Zone 1 (Anglesey) which could affect vegetation within the SLA and AONB.

12.3.2 Crossing Zone 1 was not preferred on Anglesey due to the potential number of receptors.

12.3.3 In Gwynedd this option would require an underground cable route though the Vaynol Registered Park and Garden and a SLA which may result in vegetation loss. It would utilise the preferred CSEC location in Gwynedd at GS1, and the shortest overhead line connection, Option 5G, which was preferred.

Historic Environment

12.3.4 Option A would result in construction compounds within the Plas Newydd and Vaynol Registered Parks and Gardens and extensive underground cables which would be likely to affect previously unrecorded archaeology. It would also introduce an overhead line close to Bryn Celli Ddu which may affect distant setting.

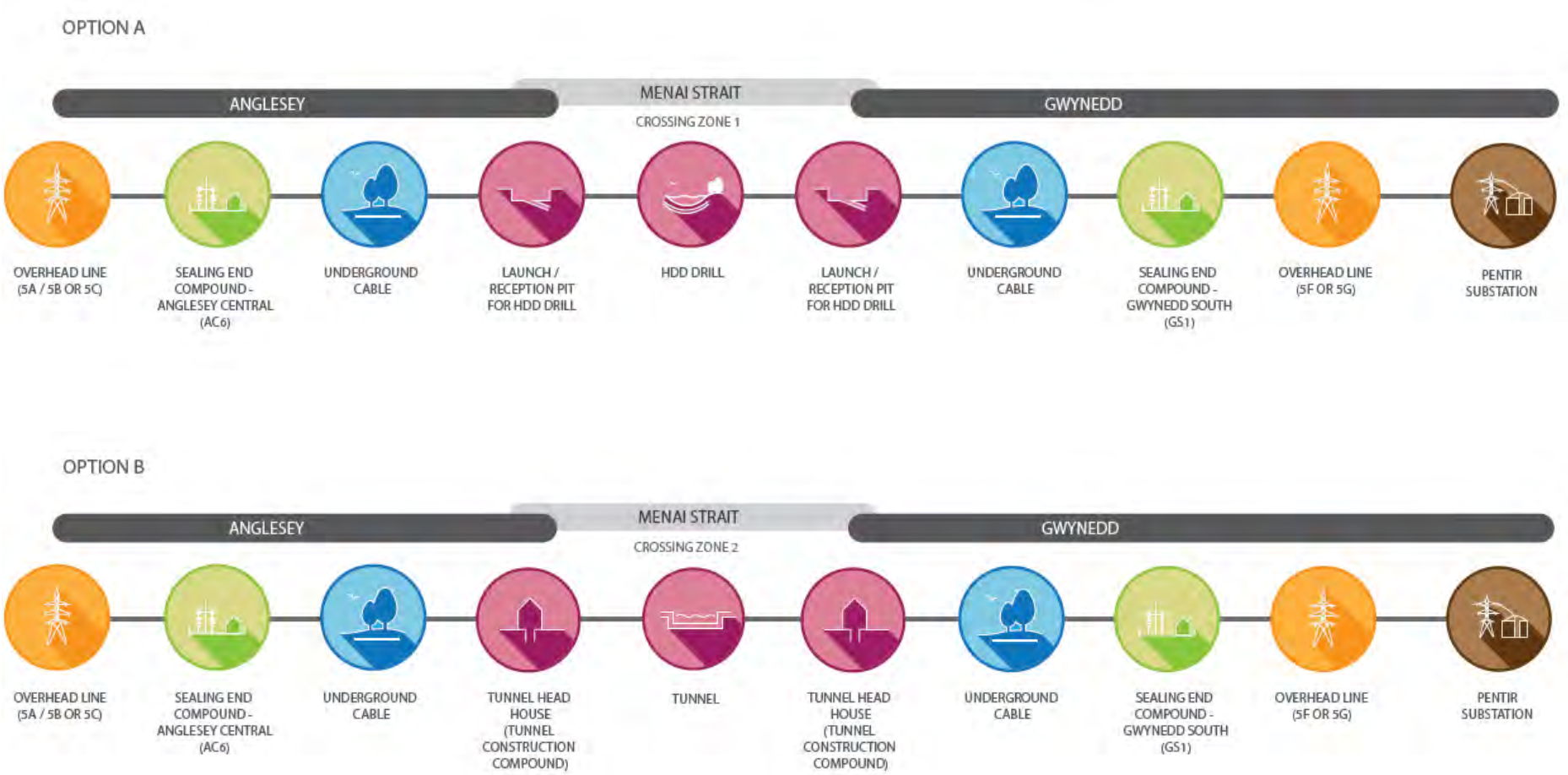

Figure 12.1 Options A and B

12.3.5 In Gwynedd the northern option for underground cables in the Vaynol Estate was identified as having greater effects on the woodland planting in the park. There is also the potential for effects to the setting of a Scheduled Ancient Monuments at Fodol Ganol Enclosed Hut Group (CN175) and Coed Nant-y-garth, standing stone (CN375) and possibly the setting of the Vaynol Grade I Registered Park and Garden. There is also high potential for previously unrecorded archaeological remains.

Ecology

12.3.6 This is the least preferred of the 'end to end' options as it could affect large areas of habitat due to lengthy underground cable routes. A high number of watercourses would be crossed and it is within close proximity to numerous potential GCN ponds. Important considerations are that this option would:

- utilise the preferred overhead line options on Anglesey, although this still has the potential to affect protected species including barn owl and otter (associated with the Afon Braint) in addition to bats and water vole (habitats suitable for supporting these species is present);
- utilise the preferred Anglesey Central CSEC siting area, AC6;
- follow the least preferred underground cable route on Anglesey (as it would be the longest and would pass through small areas of woodland (it is very close to an area of restored ancient woodland which the working width may effect), which would result in habitat loss and fragmentation). It is also close to other areas of woodland (including ancient woodland, and areas allocated under the Woodland Grant Scheme);
- utilise Crossing Zone 1 (Anglesey) which is similar, in terms of potential effects, to the crossing zones on Anglesey, which are south of the A55;
- utilise Crossing Zone 1 (Gwynedd) which is similar to the other crossing zones in Gwynedd in terms of potential effects;
- utilise the least preferred underground cable route from Crossing Zone 1 (Gwynedd) (the northern route) which affects larger areas of CWS and woodland (including ancient woodland). Woodland loss would be significantly reduced by use of HDD into CSEC siting area GS1;
- utilise CSEC siting area GS1 which has the potential to affect ancient woodland and a CWS; and
- utilise the shortest overhead line option in Gwynedd which is preferred.

Soils and Agriculture

12.3.7 This is the least preferred of the 'end to end' options, as Option A could disrupt large areas of agricultural land, particularly if Option 5A was followed. Linking AC6 to Crossing Zone 1 and the on to GS1 would result in the longest length of underground cable. Additionally, Crossing Zone 1 (Anglesey) contains the only area identified as Grade 2 (Very Good quality) land and consequently is the only area where development would certainly result in disturbance to BMV land.

Hydrology and Flood Risk

12.3.8 All overhead line options that connect to the Anglesey Central CSEC siting areas would cross the Afon Braint floodplain, including up to ~100m of mapped Flood Zone 3. As noted in Chapter 6 whilst the overhead line conductor crossings would not interact with the surface water environment, there would need to be careful consideration of the position of any pylons or other infrastructure in order to reduce effects on hydrology and flood risk receptors.

12.3.9 AC6 is located in the Lower Braint River Catchment which has a WFD status of moderate. The underground cable route from AC6 to Crossing Zone 1 (Anglesey) is close to the Afon Braint, roughly 100-200 m to the east, with the potential for effects on water quality, and runoff arising from construction activities.

12.3.10 Crossing Zone 1 (Gwynedd) is located in the Nant y Garth River Catchment which achieves an overall status of good. The underground cable route to GS1 would cross the Nant y Garth River at the A487 roundabout, which has a narrow associated area of Development Advice Zone C2 floodplain. GS1 is located in the Nant y Garth River Catchment which achieves an overall status of good, but the siting area is located well clear of the river, at a much higher elevation.

12.3.11 No hydrological or flood risk considerations have been identified with respect to the overhead line options to Gwynedd South.

Traffic and Transport

12.3.12 There are multiple options for direct access to Anglesey Central via local roads and the A5. Access would however, involve crossing the North Wales Mainline railway line via existing bridges if routeing via the A55 and A5. The existing infrastructure is deemed suitable for general construction traffic although use of the existing junctions and bridges by Abnormal Indivisible Load vehicles may require mitigation works to accommodate vehicle manoeuvres.

12.3.13 The underground cable route from Anglesey Central to Crossing Zone 1 (Anglesey) is further than underground cable routes to Crossing Zones 2 and 3 (Anglesey) (Options B and D) and would therefore generate significantly more construction traffic distance by comparison. The proposed underground cable route would cross existing highways such as the A4080 which may require closure as a consequence.

12.3.14 The distance of the proposed crossing zones (Gwynedd) to GS1 are relatively comparable and therefore construction traffic volumes would be similar. Crossing Zone 1 (Gwynedd) could be accessed directly from local roads, Stryd Bangor, or the B4547.

12.3.15 Existing access to GS1 is considered to be inadequate for the anticipated construction traffic volumes and types and therefore it is expected that a new construction access point would be required from the B4547. A new construction access road linking GS1 to the existing network would be likely to cross existing narrow roads in this location or alternatively a significant structure would be required to cross the ravine located to the south of the site.

12.3.16 This option is least preferred against traffic and transport considerations.

Construction Noise

12.3.17 Construction works associated with the overhead line connections for all the 'end-to-end options' would be relatively short-term and would involve construction of the pylons and stringing. With careful routeing and micro siting to maximise proximity to Noise Sensitive Receptors (NSRs), few if any significant effects would be anticipated.

12.3.18 This option would require a long cable route on Anglesey but there are few receptors on either Anglesey or Gwynedd in relation to the cable routes. The HDD sites on both sides of the Strait would be close to the water's edge.

12.3.19 The Menai Strait area is very quiet and there would be construction sites in proximity to the water's edge with 24 hour working required for the HDD. This would result in construction noise in proximity to the Strait which could detrimentally affect a considerable area unless extreme mitigation is provided (full enclosure) of the HDD working area. This option is therefore not preferred.

Operational Noise

12.3.20 For each element of each end-to-end option the distances to the NSRs have been considered. As a detailed design was not available for each element the appraisal was based on the centre line of the overhead line and underground cable route corridors, an approximate nearest boundary for the CSEC siting areas and onshore crossing zones (and tunnel head houses as appropriate). It was also assumed that the potential operational noise emissions for the same element of each option would be the same.

12.3.21 For Option A, approximate distances to the closest residential receptors would be:

- overhead line Anglesey: 73m and 50m;
- AC6: 300m;
- GS1: 250m; and
- overhead line Gwynedd: 100m.

12.3.22 There would be no operational effects associated with the HDD or underground cable.

12.3.23 It is considered all elements of this option could be designed to satisfy the requirements of EN-1 and EN-5.

Socio Economic

12.3.24 There are no socio-economic issues of note in close proximity to AC6. Crossing Zone 1 (Anglesey) is within the AONB and the Plas Newydd Registered Park and Garden on Anglesey. Crossing Zone 1 (Gwynedd) is within the Vaynol Estate however but the distance from the crossing to key areas within the Estates (i.e. areas open to the public) means that effects on those tourism receptors could be reduced.

12.3.25 This option is closest in proximity to the operation of mussel farms, however there are no effects are anticipated.

12.3.26 The holiday cottages on Anglesey, which could experience effects due to construction, make this option less favourable due to potential significant effects on this tourism accommodation business. The section of underground cables from AC6 to Crossing Zone 1 (Anglesey) could also potentially cause construction disturbance to the Plas Coch holiday complex.

12.3.27 Against socio economic considerations Option A is the least preferred option.

Technical

12.3.28 No preference was expressed for an overhead line connection to AC6. This option would however involve a longer underground cable route on Anglesey than other options.

12.3.29 For the crossing this option would require the successful completion of 15 consecutive bores (ducts for 12 cables, 2 spare and 1 telecom) by HDD across the Menai Strait. Given the complex geology there is a high risk that this would not be achieved.

12.3.30 This option would also require underground cables to be routed through the Vaynol Estate and up to GS1, including the installation of 15 ducts using HDD between the Vaynol Estate (in the vicinity of GS3) and GS1. As described previously the section of underground cable from the vicinity of GS3 up to GS1 would be a high risk installation and there is little margin to deal with unforeseen issues which arise due to the complex geology. If the geology restricted the method of installation the cables would have to be laid by open cut with the potential effects as noted earlier in this report.

12.3.31 The siting area at GS1 offers opportunities for micrositing which could overcome the changes in topography. Temporary access could be challenging.

12.3.32 In Gwynedd Option 5G was preferred for the overhead line connection. Due to the size of the Gwynedd South CSEC Search Area however the route corridor options 5F and 5G did not necessarily connect with each CSEC siting area. An overhead line option has therefore been developed taking into account environmental and technical considerations and the potential line entry to the extension to Pentir Substation. The main technical consideration with this route was the need to span a small valley between GS1 and the substation. This route is between Options 5F and 5G.

Option B

Overhead line (5A, 5B or 5C) to *AC6* with *Underground Cables* to *Crossing Zone 2* then by *Tunnel* and *Underground Cables* to *GS1* then *Overhead line* (5F or 5G) to Pentir Substation;

(See Figures 8.1 and 12.1).

Landscape and Visual

12.3.33 This option would utilise the overhead line Options 5B or 5C (and a small part of option 5A) with potential effects on Gaerwen, Star and Bryn Celli Ddu. It would utilise one of the preferred locations, AC6, for a CSEC within Anglesey Central. A short section of underground cable would be required from the CSEC to Crossing Zone 2 (Anglesey) which would result in some minor vegetation loss.

12.3.34 Crossing Zone 2 is not preferred due to potential effects on designated sites.

12.3.35 In Gwynedd this option would require underground cables though the Vaynol Registered Park and Garden and a SLA, and may result in vegetation loss. It would utilise the preferred CSEC siting area at GS1, and the shortest overhead line connection to Pentir Substation, Option 5G, which was preferred

Historic Environment

12.3.36 Option B It would introduce a new overhead line close to Bryn Celli Ddu which may affect distant setting.

12.3.37 It would also utilise Crossing Zone 2, requiring tunnel head houses in the essential setting of Plas Newydd and within the Vaynol Grade I Registered Park and Garden. There would be the potential for substantial disturbance in these Registered Parks and Gardens from the underground cables.

12.3.38 In Gwynedd there is the potential for effects to the setting of a Scheduled Ancient Monuments at Fodol Ganol Enclosed Hut Group (CN175) and Coed Nant-y-garth, standing stone (CN375) and possibly the setting of Vaynol Grade I Registered Park and Garden.

12.3.39 There is high potential for previously unrecorded archaeological remains.

Ecology

12.3.40 This option is less preferred as the underground cable routes on Gwynedd could affect areas of woodland. A high number of watercourses are crossed and it is within close proximity to numerous potential GCN ponds. Important considerations are that this option would:

- utilise the preferred overhead line options on Anglesey although this still has the potential to affect protected species including barn owl and otter (associated with the Afon Braint), in addition to bats and water vole (habitats suitable for supporting these species is present);
- utilise the preferred CSEC siting area in Anglesey Central, AC6;
- follow the preferred underground cable route on Anglesey (as it is the shortest);
- utilise Crossing Zone 2 (Anglesey) which is similar, in terms of potential effects, to the other crossing zones on Anglesey which are south of the A55;
- utilise Crossing Zone 2 (Gwynedd) which is similar to the other crossing zones in Gwynedd in terms of potential effects;
- use an underground cable route from Crossing Zone 2 (Gwynedd) which would affect areas of CWS and woodland including ancient woodland;
- utilise CSEC siting area GS1 which has the potential to affect ancient woodland and CWS; and
- utilise the shortest overhead line option in Gwynedd (which is preferred).

Soils and Agriculture

12.3.41 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land within Option B is a combination of Grade 3 (Moderate to Good quality) and Grade 4 (Poor quality) and Grade 5 (Very Poor quality) land. Although there is the potential for BMV land to be disturbed this is not certain (as in Option A where Grade 2, BMV land is known).

12.3.42 Disturbance due to underground cabling would be less than for Option A.

Hydrology and Flood Risk

12.3.43 All overhead line options that connect to the Anglesey Central CSEC siting areas would cross the Afon Braint the floodplain, including up to ~100m of mapped Flood Zone 3. AC6 is located in the Lower Braint River Catchment which has a WFD status of moderate.

12.3.44 Crossing Zone 2 (Anglesey) is also located in the Lower Braint River Catchment. Crossing Zone 2 (Gwynedd) is located in a non-reportable river waterbody.

12.3.45 The underground cable route to GS1 would cross the Nant y Garth River at the A487 roundabout in Gwynedd, which has a narrow associated area of Development Advice Zone C2 floodplain. This could have potential effects on water quality and runoff resulting from construction activities. GS1 is located in the Nant y Garth River Catchment which achieves an overall status of good, but the siting area is located well clear of the river, at a much higher elevation.

12.3.46 No hydrological or flood risk considerations have been identified with respect to the overhead line options to Gwynedd South (Options 5F and 5G).

Traffic and Transport

12.3.47 The main differentiator between this option and Option A is the proximity of the Crossing Zone to the CSEC siting areas. Crossing Zone 2 (Anglesey) is located relatively close to AC6 and direct access from the A4080 could be achieved. As with Crossing Zone 1 (Anglesey), access to Crossing Zone 2 (Anglesey) would be via the B4547 however the link would be longer.

Construction Noise

12.3.48 This option would require a short cable route on Anglesey and there are few receptors. Crossing Zone 2 (Anglesey) would be adjacent to the A4080 in a relatively remote area with few receptors although baseline noise levels will be low to very low. In Gwynedd, at the crossing zone, there would be few receptors other than users of the Vaynol Estate. Although there is a longer cable route to GS1 there are only a few residential NSRs which would generally be affected.

12.3.49 The Menai Strait area is however very quiet and there would be a construction site with 24 hour working in proximity to the water's edge on the Gwynedd site. This would result in construction noise in proximity to the Strait which would require extreme mitigation (full enclosure of the tunnelling working area). This option is therefore not preferred.

Operational Noise

12.3.50 For Option B, approximate distances to the closest residential receptors would be:

- overhead line Anglesey: 73m and 50m;
- AC6: 300m;
- Tunnel Head Houses: 100m / 200m;
- GS1: 250m; and
- overhead line Gwynedd: 100m.

12.3.51 It is considered all elements of this option could be designed to satisfy the requirements of EN-1 and EN-5.

Socio Economic

12.3.52 Against socio-economic considerations, Option B is the second preferred option. There are no significant receptors in close proximity to CSEC siting area AC6. Crossing Zone 2 (Anglesey) is in proximity to the Plas Newydd Registered Park and Garden however the area where construction disturbance is most likely to occur is outside of registered area. Crossing Zone 2 (Gwynedd) is located within the Vaynol Registered Park and Garden; however the distance from the crossing to key areas of the Estate makes this option more favourable.

Technical

12.3.53 None of the overhead line route corridors on Anglesey required for this option were preferred against technical considerations.

12.3.54 Installing the underground cables from AC6 to Crossing Zone 2 (Anglesey) is considered feasible. Good access for construction and maintenance would be possible.

12.3.55 As with Option A this option would also require underground cables to be routed through the Vaynol Estate and up to GS1, including the installation of 15 ducts using HDD between the Vaynol Estate (in the vicinity of GS3) and GS1. As described previously the section from the vicinity of GS3 up to GS1 would be a high risk installation and there is little margin to deal with unforeseen issues which arise due to the complex geology. If the geology restricted the method of installation the cables would have to be laid by open cut with the potential effects as noted earlier in this report.

12.3.56 Technical considerations for the CSEC siting area at GS1 and the overhead line route to Pentir Substation are as for Option A.

Option C

Overhead line (5A, 5B or 5C) to *AC6* then a *Tunnel* to *GS1* and *Overhead line* (5F or 5G) to Pentir Substation;

(See Figures 8.1 and 12.2).

Landscape and Visual

12.3.57 This option would utilise overhead line Options 5B or 5C with potential effects on Gaerwen, Star and Bryn Celli Ddu. It would also utilise one of the preferred locations, AC6, for a CSEC siting area within Anglesey Central. The option keeps the effects of the CSEC and tunnel head house contained within one area.

12.3.58 The long tunnel would not result in any visual effects or tree loss associated with underground cable routes.

12.3.59 The option would utilise the preferred CSEC siting area at GS1 and the shortest overhead line connection, Option 5G, to Pentir Substation (which was preferred).

Historic Environment

12.3.60 Option C would introduce an overhead line close to Bryn Celli Ddu and so there may be issues with setting. It would however result in few or no effects on Plas Newydd and reduced ground disturbance as there would be no underground cables required.

12.3.61 In Gwynedd there is potential for effects to the setting of a Scheduled Ancient Monuments at Fodol Ganol Enclosed Hut Group (CN175) and Coed Nant-y-garth, standing stone (CN375) and possibly the setting of the Vaynol Grade I Registered Park and Garden.

12.3.62 There is high potential for previously unrecorded archaeological remains.

Ecology

12.3.63 This is the preferred option as there would be less potential for effects on woodland and other habitats. A number of watercourses would be crossed however and it would be within close proximity to potential GCN ponds.

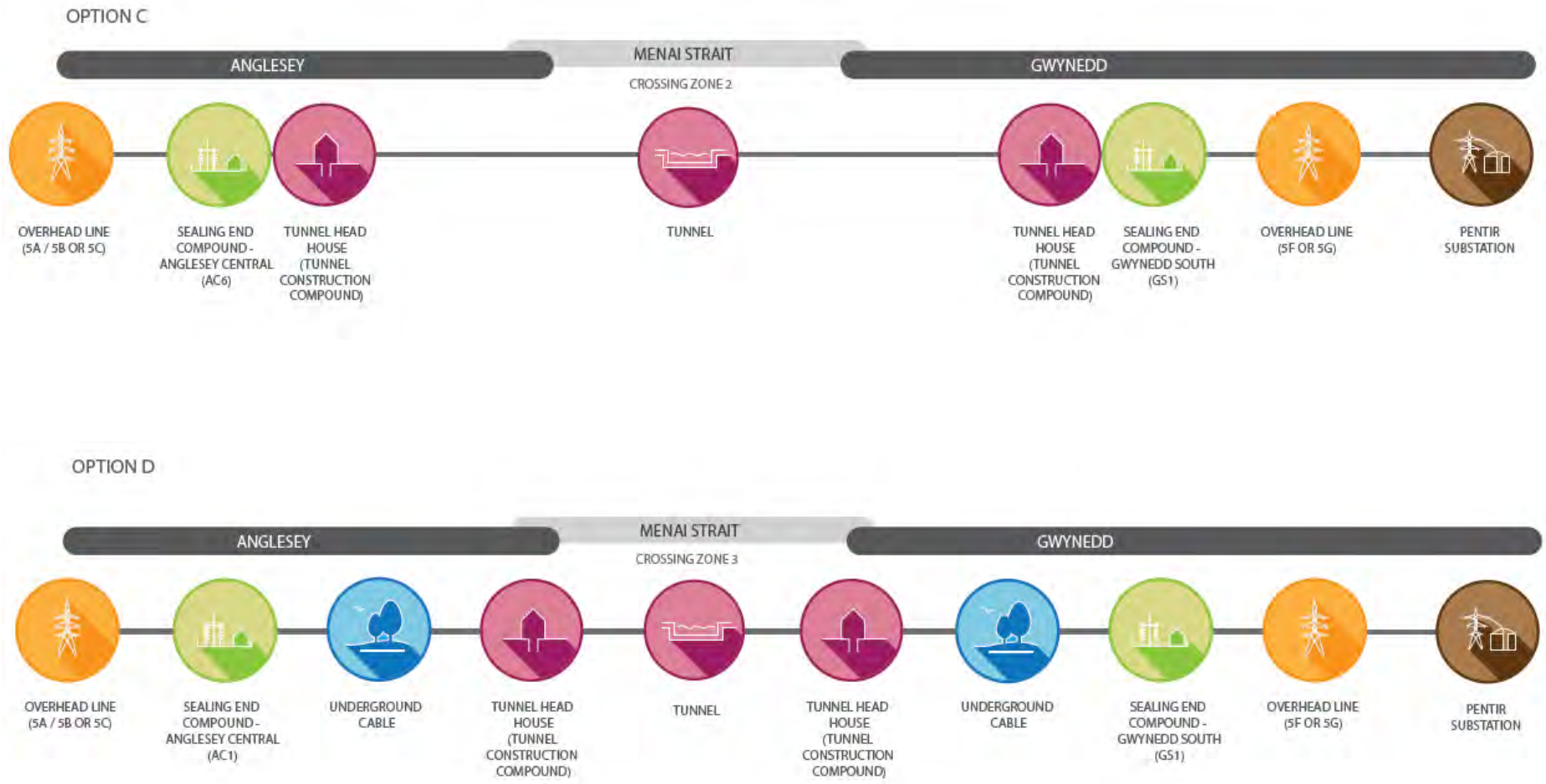

Figure 12.2 Options C and D

12.3.64 As a longer tunnel is proposed this option is also preferred due to the lesser potential effects on both land (as there are no underground cables) and within the SAC in the Menai Strait (as the construction compounds, CSEC and tunnel head houses would be co-located at some distance). Important considerations are that it would:

- utilise the preferred overhead line options on Anglesey, although this still would have the potential to affect protected species including barn owl and otter (associated with the Afon Braint) in addition to bats and water vole (habitats suitable for supporting these species is present);
- utilise Anglesey Central CSEC siting area AC6, which is preferred;
- remove the requirements for any underground cable section and therefore also remove potential effects on CWS, and woodland including ancient woodland;
- utilise CSEC siting area GS1 but as this option involves tunnelling to the CSEC siting area it, would avoid the potential effects on the Ancient Woodland and the CWS; and
- utilise the shortest overhead line option in Gwynedd, which is preferred.

Soils and Agriculture

12.3.65 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land for Option C is a combination of Grade 3 (Moderate to Good quality), Grade 4 (Poor quality) and Grade 5 (Very Poor quality).

12.3.66 The use of a tunnel would remove the disturbance to agricultural land as a result of underground cabling during the construction phase; and, as the tunnel would be below the depth of ploughing and agricultural drainage there would be no ongoing disturbance during the operational phase. Use of Option 5G, shortest route to Pentir, would also minimise the number of pylons and associated accesses. Option C is therefore the preferred to any option with sections of underground cabling.

Hydrology and Flood Risk

12.3.67 All overhead line options that connect to the Anglesey Central siting areas would cross the Afon Braint the floodplain of which includes up to ~100m of mapped Flood Zone 3. CSEC siting area AC6 is located in the Lower Braint River Catchment which has a WFD status of moderate.

12.3.68 The longer tunnel would mitigate effects to surface water runoff quantity and quality associated with the cable routes and the crossing zones on Anglesey and Gwynedd.

12.3.69 GS1 is located in the Nant y Garth River Catchment which achieves an overall status of good, but the siting area is located well clear of the river, at a much higher elevation.

12.3.70 No hydrological or flood risk considerations have been identified with respect to the overhead line options to Gwynedd South (Options 5F and 5G).

Traffic and Transport

12.3.71 Construction traffic volumes are likely to be higher given the increased excavation and material associated with the longer tunnel, however the potential effects on the highway network and number of access points at GS1 is expected to be comparable to the alternative options under consideration. The additional excavated material from the longer tunnel would be likely to be removed at the same rate over an extended period and managed within a traffic management plan.

Construction Noise

12.3.72 This option would require a CSEC and a tunnel head house compound in AC6 on the Anglesey and a tunnel compound and CSEC in GS1 with a new overhead line to Pentir Substation. This is the preferred option due to the distance of construction works from the Menai Strait and the remoteness of the CSEC siting areas. Micro siting of a CSEC could avoid proximity to any NSRs. There would however be effects associated with the 24hr working required during the construction of the shafts and tunnel and potentially considerable HGV movements associated with spoil disposal from the construction of the longer tunnel.

Operational Noise

12.3.73 For Option C, approximate distances to the closest residential receptors would be:

- Anglesey overhead line: 73m and 50m;
- Anglesey CSEC and Tunnel Head House (AC6): 300m;
- Gwynedd CSEC and Tunnel Head House (GS1): 250m; and
- Gwynedd overhead line: 100m.

12.3.74 It is considered all elements of this option could be designed to satisfy the requirements of EN-1 and EN-5.

Socio Economic

12.3.75 This is the preferred option from a socio-economic perspective. There are no key receptors around AC6 or GS1 and the long tunnel option would avoid locating construction compounds, tunnel head houses or underground cables within the Plas Newydd or Vaynol Park Registered Parks and Gardens therefore minimising any construction disturbance on these tourism receptors.

12.3.76 The crossing would be located in the area where recreational activities occur within the Menai Strait including the dock and boat trips; however there would be no disturbance to recreational users.

Technical

12.3.77 None of the overhead line route corridors on Anglesey required for this option were preferred against technical considerations.

12.3.78 Option C would route a longer tunnel directly between AC6 to GS1 and would therefore not require any direct buried cables onshore. The CSEC and a tunnel head house would be located in close proximity to each other. The Menai crossing would be by a longer tunnel however the topography means that shaft depths would be significant and installing the cables would be a significant consideration.

12.3.79 Based on the cable rating assessments undertaken to date the rating requirement of 3000MVA would be met by 6 no 400 kV cables rather than the 12 cables required by other options. This is because forced ventilation through a tunnel can be used to manage cable temperatures thereby reducing the number of cables required.

12.3.80 The cables would be routed from the CSEC the short section to the shaft, typically in concrete troughs, and would then be cleated down the shaft and through the large bore tunnel, with the same arrangement at the opposite end of the tunnel.

12.3.81 Technical considerations for GS1 and the overhead line connection to Pentir Substation are as for Option A.

Option D

Overhead line (5A, 5B or 5C) to *AC1* with *Underground Cables* to *Crossing Zone 3* then a *Tunnel* and *Underground Cables* to *GS1* and *Overhead line* (5F or 5G) to Pentir Substation;

(See Figures 8.1 and 12.2).

Landscape and Visual

12.3.82 This option would utilise overhead line Option 5B or 5C with potential effects on Gaerwen, Star and Bryn Celli Ddu. It would also utilise CSEC siting area AC1 which wasn't preferred due to concern over the potential encircling effects of a new overhead line on Star.

12.3.83 The underground cable would result in vegetation loss in proximity to Llanfairpwllgwyngyll on Anglesey.

12.3.84 The option would utilise the preferred Crossing Zone 3 (due to the potential location of the construction compound and tunnel head houses). It would however require underground cable through a SLA, which includes the Vaynol Registered Park and Garden, and which would result in vegetation loss.

12.3.85 The preferred CSEC siting area at GS1 is utilised together with the shortest overhead line connection, Option 5G, to Pentir Substation which was preferred.

Historic Environment

12.3.86 Option D would reduce the effects of an overhead line on the setting of Bryn Celli Ddu and would have little effect on Plas Newydd. It would however require substantial groundworks within the Vaynol Park Grade I Registered Park and Garden to connect Crossing Zone 3 (Gwynedd) to GS1.

12.3.87 In Gwynedd at GS1 there is potential for effects to the setting of a Scheduled Ancient Monuments at Fodol Ganol Enclosed Hut Group (CN175) and Coed Nant-y-garth, standing stone (CN375) and possibly the setting of Vaynol Registered Park and Garden.

12.3.88 There is high potential for previously unrecorded archaeological remains.

Ecology

12.3.89 This option is less preferred as it could affect large areas of woodland due to length of underground cable routes. Numerous watercourses would be crossed and it would be within close proximity to numerous potential GCN ponds. Important factors are that it would:

- utilise the preferred overhead line options on Anglesey, although this still would have the potential to affect protected species including barn owl and otter in particular Afon Braint, in addition to bats and water vole (habitats suitable for supporting these species is present);
- utilise one of the least preferred Anglesey Central options, AC1, however as the underground cable is routed to Crossing Zone 3 (Anglesey) it would avoid the effects of routeing from AC1 to Crossing Zone 2 (Anglesey);
- avoid direct effects on CWS and woodland habitats on Anglesey as the cable route would be shorter than the least preferred;
- utilise Crossing Zone 3 (Anglesey) which is similar, in terms of potential effects, to the other crossing zones on Anglesey which are south of the A55;
- utilise Crossing Zone 3 (Gwynedd) which is similar to the other Gwynedd crossing zones in terms of potential effects;
- follow an underground cable route from Crossing Zone 3 (Gwynedd) which would affect areas of CWS and woodland including ancient woodland;
- utilise GS1 and would therefore have the potential to affect ancient woodland and a CWS to the north west and south; and
- utilise the shortest overhead line option on Gwynedd, which is preferred.

Soils and Agriculture

12.3.90 The provisional ALC mapping shows the ALC grade of agricultural land at Option D is a combination of Grade 3 (Moderate to Good quality), Grade 4 (Poor quality) and Grade 5 (Very Poor quality).

12.3.91 This option would result in long sections of underground cable on both Anglesey and in Gwynedd, and is therefore not preferred.

Hydrology and Flood Risk

12.3.92 All overhead line options that connect to the Anglesey Central siting areas would cross the Afon Braint, the floodplain of which includes up to ~100m of mapped Flood Zone 3.

12.3.93 AC1 has small areas within Development Advice Zone C2 alongside the A5, through Llanfairpwllgwyngyll, which also has a culverted section of the Afon Braint. AC1 is located in the Upper Braint River Catchment which has a WFD status of good.

12.3.94 The underground cable route would cross the Nant y Garth River at the A487 roundabout which has a narrow associated area of Development Advice Zone C2 floodplain.

12.3.95 Crossing Zone 3 (Anglesey) is in close proximity to the Afon Braint, within the Upper Braint water body which has a WFD status of good. Crossing Zone 3 (Gwynedd) is in a non-reportable river waterbody.

12.3.96 The underground cable route to GS1 crosses between the non-reportable river waterbody and the Nant y Garth River Catchment which achieves an overall status of good.

12.3.97 GS1 is located in the Nant y Garth River Catchment but is located well clear of the river, at a much higher elevation.

12.3.98 No hydrological or flood risk considerations have been identified with respect to the overhead line options to Gwynedd South (Options 5F and 5G).

Traffic and Transport

12.3.99 AC1 has common traffic and transport opportunities and constraints to AC6 however AC1 is located close to the North Wales Mainline railway and construction access points would need to be located at a sufficient distance from the existing over line bridges in this area. The location of the access points would be similar to AC6 however the links would be longer.

12.3.100 The underground cable route on Anglesey would be longer for this option than for Option B and therefore likely to generate additional construction traffic movments but this would not be significant.

12.3.101 Access to Crossing Zone 3 (Anglesey) would be via the A4080 however, the A4080 / A5 Tollgate junction and the existing alignment of the carriageway, make this option not as favourable when compared to Crossing Zone 2 (Anglesey) which lends itself to multiple access opportunities. Crossing Zone 3 (Anglesey) does not present straightforward opportunities to evenly distribute construction traffic on the highway network.

12.3.102 Crossing Zone 3 (Gwynedd) is located near Parc Menai which is accessed via Junction 9 of the A55. There may be opportunities for construction traffic to utilise existing links through Parc Menai however mitigation measures are likely to be required to ensure existing business park traffic and construction traffic can function safely together. Additional dedicated access points to the crossing zone may be required from the A487.

12.3.103 The underground cable route from Crossing Zone 3 (Gwynedd) to GS1 would be similar to Crossing Zone 2 to GS1 in terms of traffic and transportation opportunities and constraints.

Construction Noise

12.3.104 This option requires a CSEC at AC1, a medium length cable route to Crossing Zone 3 on both sides of the Menai Strait, an underground cable to GS1 and a new overhead line to Pentir Substation. There is the potential for effects on NSRs due to the location of the construction compounds for the tunnel, the requirements for 24 hr working, and the significant traffic movements associated with the movement of spoil.

12.3.105 This option is not preferred due to considerations on the Anglesey side, as the construction compound for the tunnel would be very close to a number of NSRs.

Operational Noise

12.3.106 For Option D, approximate distances to the closest residential receptors would be:

- Anglesey overhead line: 70m and 50m;
- Anglesey CSEC (AC1): >300m;
- Tunnel Head Houses: 75m / >500m;
- Gwynedd CSEC (GS1): 250m; and
- Gwynedd overhead line: 100m.

12.3.107 It is considered all elements of this option could be designed to satisfy the requirements of EN-1 and EN-5.

Socio Economic

12.3.108 AC1 is in proximity to Llanfairpwllgwyngyll railway station which is a tourism attraction; however a CSEC is not likely to be visible from the station. There are no significant issues or concerns with Crossing Zone 3, although siting of a tunnel head house within Crossing Zone 3 (Anglesey) should seek to minimise potential construction disturbance to the Nuffield Centre. The underground cable route from Crossing Zone 3 (Gwynedd) to GS1 would pass in close proximity to a number of settlements and potentially give rise to community effects, such as severance and amenity, during construction. Against socio-economic considerations this option is less preferred.

Technical

12.3.109 None of the overhead line route corridors on Anglesey required for this option were preferred against technical considerations. No technical challenges were identified for AC1. The underground cable route to AC1 is shorter than options from other Search Areas on Anglesey.

12.3.110 For this option the Menai crossing would be via a tunnel at Crossing Zone 2, which was preferred. This option would require a HDD from within the Vaynol up to GS1 (see previous comments above). As already noted routeing the cables to GS1 would be very complex and challenging.

12.3.111 Technical considerations for GS1 and the overhead line connection to Pentir Substation are as for Option A.

Option E

Overhead line (5A, 5B or 5C) to *AC1* with *Underground Cables* to *Crossing Zone 3* then a *Tunnel* and *Underground Cables* to *GN1* then *Overhead line* (5F or 5G) to Pentir Substation;

(See Figures 8.1 and 12.3)

Landscape and Visual

12.3.112 This option would utilise overhead line Option 5B or 5C with potential effects on Gaerwen, Star and Bryn Celli Ddu. It would also utilise CSEC siting area AC1 in Anglesey Central which wasn't preferred due to concern over encircling effects of overhead line on Star. The underground cable may result in vegetation loss in quite close proximity to Llanfairpwllgwyngyll. The option would utilise the preferred Crossing Zone 3 (Anglesey). The overhead line option, 5H, is the least preferred option for an overhead line in Gwynedd.

Historic Environment

12.3.113 Option E would reduce the effect of an overhead line on the setting of Bryn Celli Ddu and have little effect on Plas Newydd. It would also avoid substantial groundworks in the Vaynol Grade I Registered Park and Garden.

12.3.114 The overhead line from GN1 would parallel the existing 400 kV overhead line to Pentir Substation. This overhead line option would cross directly over a Scheduled Ancient Monument (SAM CN203). In addition there would be potential setting effects on two other Scheduled Ancient Monuments (AN175 and CN203) which make the historic landscape within which the option passes of high value.

Ecology

12.3.115 This option is less preferred as it could potentially affect large areas of woodland due to lengthy underground cable routes. Numerous watercourses would be crossed and it would be within close proximity of numerous potential GCN ponds. Important considerations are that it would:

- utilise the preferred overhead line options on Anglesey although this still would have the potential to affect protected species including barn owl and otter in particular Afon Braint, in addition to bats and water vole (habitats suitable for supporting these species is present);
- utilise one of the least preferred Anglesey Central options, AC1, however as the underground cable would be routed to Crossing Zone 3 (Anglesey) it would avoid the effects of routeing from AC1 to Crossing Zone 2 (Anglesey);
- follow a cable route which is shorter than the least preferred and would avoid direct effects on CWS and woodland habitats;
- utilise Crossing Zone 3 (Anglesey) which is similar, in terms of potential effects, to the other crossing zones on Anglesey south of the A55;

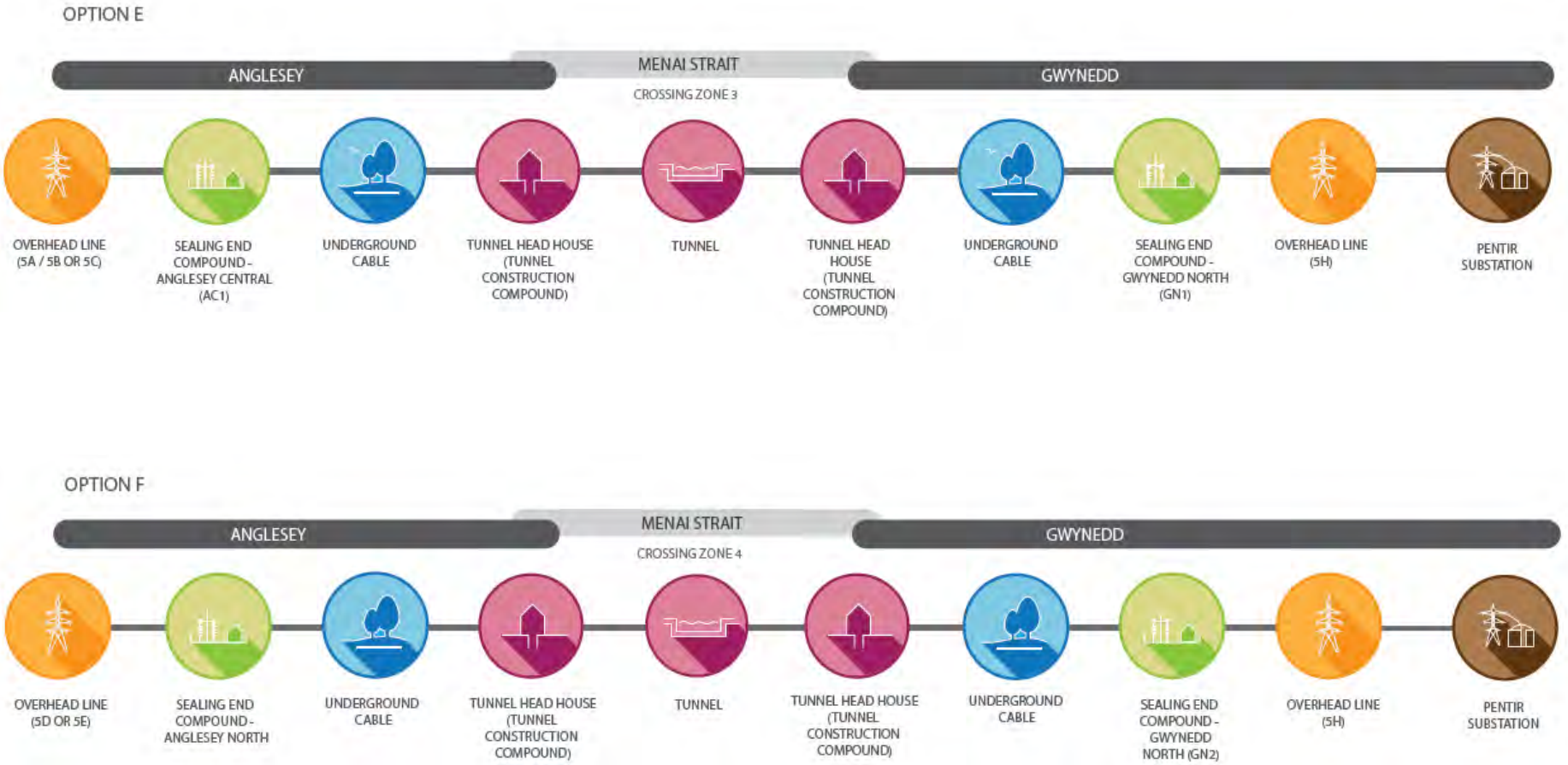

Figure 12.3 Options E and F

- utilise Crossing Zone 4 (Gwynedd) / GN1 which are similar in terms of potential effects to the other zones, but have the potential for the least effects on CWSs when considering the sites themselves; and
- utilise the least preferred overhead line option in Gwynedd which would affect CWS and woodland habitat, including ancient woodland. This is also the longest option.

Soils and Agriculture

12.3.116 The provisional ALC mapping shows the ALC grade of agricultural land within Option E is a combination of Grade 3 (Moderate to Good quality) Grade 4 (Poor quality) and Grade 5 (Very Poor quality). This option would result in disturbance due to underground cabling on both Anglesey and in Gwynedd. However, the length of this cable would be less than in Options A, B and D.

Hydrology and Flood Risk

12.3.117 All overhead line options that connect to the Anglesey Central siting areas would cross the Afon Braint the floodplain of which includes up to ~100m of mapped Flood Zone 3. AC1 has small areas within Development Advice Zone C2 alongside the A5, the main road through Llanfairpwllgwyngyll, which has a culverted section of the Afon Braint. AC1 is located in the Upper Braint River Catchment which has a WFD status of good.

12.3.118 Crossing Zone 3 (Anglesey) is in close proximity to the Afon Braint, within the Upper Braint water body which has a WFD status of good. Crossing Zone 3 (Gwynedd) is within a non-reportable river waterbody.

12.3.119 The underground cable route from Crossing Zone 3 to GN1 is within the non-reportable river waterbody. GN1 is located within a non-reportable coastal waterbody.

12.3.120 No hydrological or flood risk considerations have been identified with respect to the overhead line option from Gwynedd North (Option 5H).

Traffic and Transport

12.3.121 This option is similar to Option D although it would reduce the length of underground cable. GN1 is located north of Parc Menai and adjacent to the A55. There are options for construction access to the site, however, mitigation works would be anticipated for general construction traffic and significant works may be required for abnormal indivisible load vehicles. A suitable construction access off the A55 would be difficult to achieve give the existing lane reduction and central reservation in this location.

Construction Noise

12.3.122 This option includes a CSEC at AC1 with an underground cable route to Crossing Zone 3, underground cable to GN1 in Gwynedd and a new overhead line to Pentir Substation. The Crossing Zone on Anglesey is in close proximity / next to NSRs.

12.3.123 This is the least preferred option, although Gwynedd is considered less sensitive than Anglesey as AC1 lies adjacent to the A55 and has no nearby NSRs.

Operational Noise

12.3.124 For Option E, approximate distances to the closest residential receptors would be:

- overhead line Anglesey: 70m and 50m;
- AC1: >300m;
- Tunnel Head Houses: 75m / shared boundary;
- GN1: >250m; and
- overhead line Gwynedd: 45m

12.3.125 It is considered all elements of this option could be designed to satisfy the requirements of EN-1 and EN-5, however the tunnel head house and overhead line sections in Gwynedd would be located / pass closest to residences, hence this is not a preferred option.

Socio Economic

12.3.126 AC1 is in close proximity to Llanfairpwllgwyngyll railway station which is a tourism attraction; however a CSEC is not expected to be visible from the station. No significant issues are anticipated for Crossing Zone 3, although siting of the tunnel head house on Anglesey should seek to minimise construction disturbance to the Nuffield Centre. The section of underground cables from Crossing Zone 3 to GN1 would pass in close proximity to a number of settlements (albeit less so than Option D) and potentially give rise to community effects, such as severance and amenity, during construction. GN1 is in close proximity to Parc Menai and the Coleg Menai buildings, making this option less preferred from a socio-economic perspective.

Technical

12.3.127 None of the overhead line route corridors on Anglesey required for this option were preferred against technical considerations. The underground cable route to AC1 is shorter than options from other CSEC Search Areas on Anglesey.

12.3.128 The Menai crossing would be via a tunnel at Crossing Zone 3. The deep shafts associated with the large bore tunnel would be marginally shallower than for some other options.

12.3.129 For the underground cable route in Gwynedd saturated ground may lead to additional safety requirements. Long term operation of the circuit may result in dry out of the soil in the vicinity of the cable route. Saturated ground (due to the formation of air pockets as it dries) and peat both have high thermal resistivity in the dried out state negatively impacting the rating of the circuit.

12.3.130 There are concerns regarding the area of land available at GN1 to accommodate both the temporary construction works and the permanent infrastructure.

12.3.131 The route for a new overhead line is extremely constrained in Gwynedd by the wastewater treatment works, a substation, Parc Menai, the A55, A4087, numerous slip roads and the existing 400 kV overhead line. Major crossing protection would be required and there would be numerous challenges with regard to the flexibility for detailed routeing of an alignment and locating pylons. This option was not preferred

Option F

Overhead line (5D or 5E) to *AN* with *Underground Cables* to *Crossing Zone 4* then by *Tunnel* and *Underground Cables* to *GN2* then *Overhead line* (5H) to Pentir Substation;

(See Figures 8.1 and 12.3).

Landscape and Visual

12.3.132 This option would provide a CSEC in Anglesey North which is preferred due to the potential to use overhead line Options 5D or 5E into the CSEC. Of the options for a CSEC siting area in Anglesey North AN2 is preferred.

12.3.133 The underground cable route to Crossing Zone 4 (Anglesey) would result in some minor vegetation loss. Crossing Zone 4 (Anglesey) was not preferred due to the potential effects on receptors of a tunnel head house. This option would utilise the least preferred overhead line option (5H) in Gwynedd.

Historic Environment

12.3.134 A new overhead line into Anglesey North would have the potential to affect the setting on the Grade II listed buildings at Gwyndy. This would be reduced if the CSEC was kept to the southern side of AN2. An overhead line to AN3 or AN4 routed via the north through the AN1 CSEC siting area would add additional new pylons, when compared with other options, which would further affect the setting of listed buildings.

12.3.135 The overhead line option to GN2 (Option 5H) would negate the need for underground cables in the Vaynol Estate. Option 5H would however cross directly over a Scheduled Ancient Monument (SAM CN203). In addition there would be a potential setting effect on two other Scheduled Ancient Monuments (AN175 and CN203) which make the historic landscape within which the option is routed of high value.

Ecology

12.3.136 This option is less preferred as it could affect large areas of woodland due to lengthy underground cable routes. Numerous watercourses would be crossed and it would be within close proximity to numerous potential GCN ponds. Important factors are that it would:

- utilise the second preference for an overhead line on Anglesey which could potentially be routed through a CWS;
- within Anglesey North one of the least preferred options could affect the CWS and habitats/species through either the overhead line or underground cable routes;
- directly cross a CWS via an underground cable from Anglesey North. This is least preferred;

- utilise Crossing Zone 4 (Anglesey) which is similar, in terms of potential effects, to the other crossing zones but does lie further from potentially more sensitive habitats and designations;
- utilise Crossing Zone 4 (Gwynedd) / GN2 which are similar, in terms of potential effects, to the other locations, but do not have the least potential to effect the CWS when considering the sites themselves; and
- utilise the least preferred overhead line option on Gwynedd which would affect the CWS and woodland habitat, including ancient woodland. This is also the longest option.

Soils and Agriculture

12.3.137 The provisional ALC mapping shows the ALC grade of agricultural land at Option F is a combination of Grade 3 (Moderate to Good quality), Grade 4 (Poor quality) and Grade 5 (Very Poor quality).

12.3.138 There is no difference in ALC grading between the Anglesey North CSEC sites, however AN3 is preferred as this would result in the shortest length of underground cabling. Underground cabling in Gwynedd would also be reduced compared to other options due to the proximity of GN2 to Crossing Zone 4 (Gwynedd). This option is preferred over Options A, B, D and E.

Hydrology and Flood Risk

12.3.139 All overhead line options that connect to Anglesey North would cross the Afon Braint the floodplain of which includes up to ~100m of mapped Flood Zone 3. CSEC siting areas in Anglesey North are in close proximity to Afon Rhyd Eilian and associated Development Advice Zone C2 and are located in the Upper Braint River Catchment which has a WFD status of good.

12.3.140 The underground cable route to Crossing Zone 4 (Anglesey) is located within the non-reportable river waterbody close to the Menai Strait, while further inland the route is within the Upper Braint River Catchment which has a WFD status of good.

12.3.141 Crossing Zone 4 (Anglesey) is located in the Upper Braint River Catchment. Crossing Zone 4 (Gwynedd) is located within a non-reportable river waterbody. GN2 is also located within a non-reportable river waterbody.

12.3.142 No hydrological or flood risk considerations have been identified with respect to the overhead line option to Gwynedd North (Option 5H).

Traffic and Transport

12.3.143 Anglesey North is located close to the A5025, B5420 and local roads. The A5025 provides direct access to Junction 8 of the A55 strategic network. Construction access to a CSEC siting area in Anglesey North could be provided via the B5420 and or A5025. Construction traffic would avoid residential areas however trips would be concentrated at Junction 8 of the A55 and the B5420 / A5025 roundabout and mitigation measures may be required to accommodate these.

12.3.144 The underground cable route to Crossing Zone 4 (Anglesey) would cross the A5025 and may require temporary closures and diversions or one way traffic management.

12.3.145 Crossing Zone 4 (Anglesey) could be accessed via the A5025 and or the A5 via Junction 8A of the A55. Multiple access points would provide options to dissipate construction traffic onto the existing highway network, multiple access points are particularly beneficial at the crossing zones.

12.3.146 Access to Crossing Zone 4 (Gwynedd) would be from the A487 / Treborth local roads via Junction 9 of the A55. The close proximity of Junction 9 would reduce construction traffic impacts on local roads however the crossing zone is close to a residential area and Ffordd Bronwydd, and would require a temporary junction. Existing vehicle trips on Ffordd Bronwydd are anticipated to be relatively low.

12.3.147 A direct access from the A55 to Crossing Zone 4 (Gwynedd) would be desirable however providing a suitable arrangement to required standards would require significant mitigation works.

Construction Noise

12.3.148 This option would require a tunnel construction compound on Anglesey in Crossing Zone 4 which is fairly remote from receptors, a tunnel across the Menai Strait, a tunnel construction compound in Gwynedd in a relatively insensitive area due to high ambient noise from traffic on the A55 crossing although there are NSRs nearby, an underground cable route to GS1 and a new overhead line to Pentir Substation.

Operational Noise

12.3.149 For Option F, approximate distances to the closest residential receptors would be:

- overhead line Anglesey: 50m;
- Anglesey North: >70m (depending on CSEC location);
- Tunnel Head Houses: >300m / shared boundary;
- GN2: 0m (shared boundary, however this could be up to 100m distant with detailed siting of the pylons);
- overhead line Gwynedd: 45m

12.3.150 This option would present some challenges as all elements (overhead line and tunnel head houses in both Anglesey and Gwynedd) are closest to residential properties. Micro-siting within Anglesey North would need to minimise the number of, and maximise distance from, residential properties.

12.3.151 On Gwynedd this option benefits from following the existing 400 kV overhead line as closely as possible but there are also some residential properties in proximity.

Socio Economic

12.3.152 This option is less preferred against socio-economic considerations. Crossing Zone 4 (Anglesey) is within the AONB and in close proximity to a promoted viewpoint therefore this area would be sensitive to disturbance from a tourism perspective. In Gwynedd the construction disturbance and risk of visual effect from the permanent tunnel head house could impact unfavourably on settlements which could result in community effects, such as severance and amenity.

12.3.153 The detailed siting of a CSEC and underground cable route in Anglesey North should minimise disturbance to Pili Palas Nature World. Option 5H would run through Parc Menai which includes a number of businesses as well as the Coleg Menai, a hotel and a children's nursery. South of the A487 the overhead line would pass adjacent to clusters of residential properties which could give rise to community effects particularly during construction.

Technical

12.3.154 This option would utilise either of the preferred overhead line route corridors on Anglesey to connect to a siting area in Anglesey North. The underground cable would cross an area of very wet marshland adjacent to Afon Rhyd-Eilian which may require additional support works to prevent trench collapse or water ingress (pumping, geogrids, battens) and stabilising works to prevent movement or sinking of the cables over the long term. Excavation in peat (if present) is usually problematic and can lead to very large areas of disturbance Placement of relatively small amounts of fill or light foundations can lead to short term bearing capacity failure, significant settlements and secondary consolidation, over many years.

12.3.155 Saturated ground conditions would increase the difficulty of working and machinery movements and may require specialised plant. Works crossing saturated land would require consideration of the effects the installation would have on the ground water movements. The underground cable route from Anglesey North to Crossing Zone 4 was less preferred than options to other CSEC search areas on Anglesey

12.3.156 For this option the Menai crossing would be via a tunnel at Crossing Zone 4. The ground elevations are higher for this crossing zone which would result in deeper shafts that at the other crossing Zones (excluding the longer tunnel Options C and G).

12.3.157 An overhead line connection from GN2, would require a transition as this is on the opposite side of the existing 400 kV overhead line. Construction would be complex (for example extensive temporary scaffolding would be required). There are also concerns with the available land at GN2 for construction and connecting into a CSEC.

Option G

Overhead line (5D or 5E) to *AN* then a Tunnel to *GS1* and *Overhead line* (5H) to Pentir Substation.

(See Figures 8.1 and 12.4)

Landscape and Visual

12.3.158 This option utilises the Anglesey North Search Area which is preferred due to the potential to use Options 5D or 5E for an overhead route into a CSEC. Within Anglesey North AN2 is preferred as this option includes a longer tunnel it would keep the effects of the CSEC and tunnel head house contained in one area.

12.3.159 A longer tunnel would also remove the visual effects which would arise from the tree loss associated with the construction swathe and permanent easement for an underground cable. A long tunnel also reduces the visual effects associated with longer sections of overhead line.

12.3.160 This options utilises GS1 which is the preferred and would utilise the shortest overhead line connection, Option 5G, which was also preferred.

Historic Environment

12.3.161 An overhead line into Anglesey North has the potential to affect the setting on the Grade II listed buildings at Gwyndy. This would be reduced if CSEC is kept to the southern side of AN2. An overhead line to AN3 or AN4 should not be routed via the north through the former AN1 siting area, as it would add more pylons which would affect the setting of listed buildings.

12.3.162 A long tunnel option would negate the need for underground cabling and therefore would reduce the potential effects on previously unrecorded archaeological remains.

12.3.163 At GS1 there would be the potential for effects to the setting of a Scheduled Ancient Monuments at Fodol Ganol Enclosed Hut Group (CN175) and Coed Nant-y-garth, standing stone (CN375) and possibly the setting of the Vaynol Grade I Registered Park and Garden.

12.3.164 There is high potential for previously unrecorded archaeological remains.

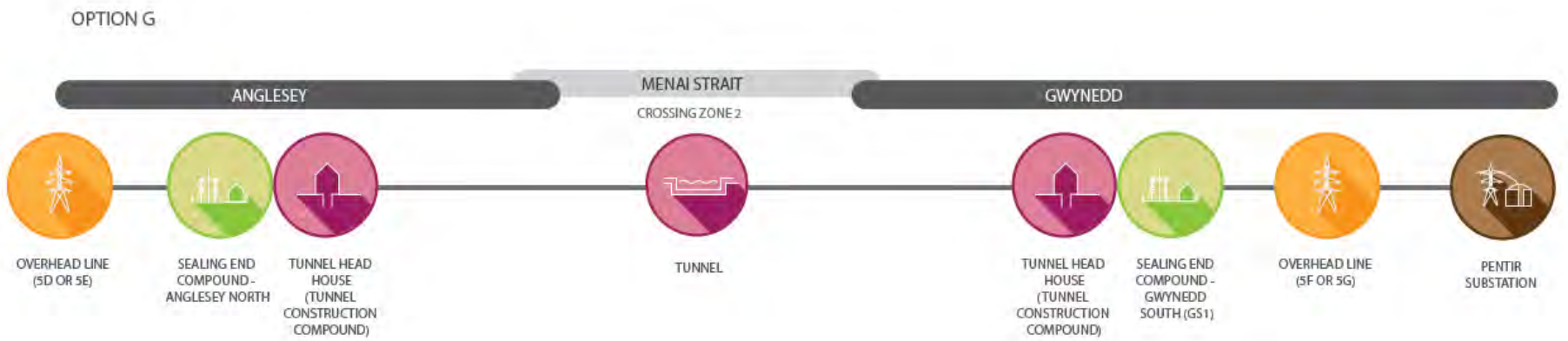

Figure 12.4 Option G

Ecology

12.3.165 This is one of the preferred options as the tunnel aspect reduces potential effects, however it could still affect a CWS depending on the site for a CSEC in Anglesey North. A number of watercourses would be crossed and it would be within close proximity to numerous potential GCN ponds. Important factors are that it:

- utilises the second preference overhead line option on Anglesey although this could potentially be routed through a CWS;
- within Anglesey North one of the least preferred options could affect the CWS and habitats/species through either the overhead line or cable routes;
- a cable from Anglesey North could directly crossed the CWS. This is least preferred;
- utilises Crossing Zone 4 (Anglesey) which is similar, in terms of potential effects, to the other crossing zones on but does lie further from potentially more sensitive habitats and designations;
- does not require an underground cable connection and therefore removes potential effects on CWS, and woodland including ancient woodland;
- utilises GS1 but as this option involves a longer tunnel would avoid the potential effects on the Ancient Woodland & CWS to the north west;
- utilises the shortest overhead line option on Gwynedd, which is preferred.

Soils and Agriculture

12.3.166 The provisional 1:250,000 scale ALC mapping shows the ALC grade of agricultural land at Option G is a combination of Grade 3 (Moderate to Good quality), Grade 4 (Poor quality) and Grade 5 (Very Poor quality).

12.3.167 The use of a longer tunnel would remove the disturbance to agricultural land as a result of underground cabling during the construction phase; and, as the tunnel would be below the depth of ploughing and agricultural drainage there would be no ongoing disturbance during the operational phase. Use of overhead line Option 5G, the shortest route to Pentir, would also minimise the number of pylons and associated accesses. Option G is therefore the preferred to all other options with sections of underground cabling.

Hydrology and Flood Risk

12.3.168 All overhead line options that connect to Anglesey North would cross the Afon Braint the floodplain of which includes up to ~100m of mapped Flood Zone 3. CSEC siting areas in Anglesey North are in close proximity to Afon Rhyd Eilian and associated Development Advice Zone C2. Within Anglesey North CSEC siting areas are located in the Upper Braint River Catchment which has a WFD status of good.

12.3.169 The long tunnel would mitigate effects to surface water runoff quantity and quality associated with the cable routes and the Crossing Zones on Anglesey and Gwynedd.

12.3.170 GS1 is located in the Nant y Garth River Catchment which achieves an overall status of good, but is located well clear of the river, at a much higher elevation. No hydrological or flood risk considerations have been identified with respect to the overhead line options to Gwynedd South (Options 5F and 5G).

Traffic and Transport

12.3.171 As with Option C, this option removes the underground cabling sections. The construction traffic volumes are likely to be higher with this option, given the increased excavation and material associated with the longer tunnel, however the impact on the highway network and number of access points is expected to be reduced. Excavated material would be removed from site gradually rather than in peaks and managed within a traffic management plan.

Construction Noise

12.3.172 This option is preferred assuming that the tunnel construction compounds can be micro sited away from NSRs, and that spoil disposal is acceptable in terms of HGV traffic noise effects.

Operational Noise

12.3.173 For Option G, approximate distances to the closest residential receptors would be:

- overhead line Anglesey: 50m;
- Anglesey CSEC and Tunnel Head House (Anglesey North): >70m (depending on CSEC location);
- Gwynedd CSEC and Tunnel Head House (GS1): 250m; and
- overhead line Gwynedd: 100m

12.3.174 It is considered all elements of this option could be designed to satisfy the requirements of EN-1 and EN-5, but micro-siting within Anglesey North would need to minimise the number of and maximise distance from residential properties (the closet of which is at approximately 50m).

Socio Economic

12.3.175 Depending on the siting of the tunnel head house within Anglesey North, there could be construction disturbance to Pili Palas Nature World. The long tunnel option would pass under the AONB and the Wales Coast Path and in close proximity to a promoted veiwpoint on Anglesey; however as construction disturbance is most likely to be localised to areas in proximity to the tunnel shaft, no effects on these receptors would be expected. As for the other tunnel options, no effects on recreational users of the Menai Strait are expected.

12.3.176 This option could be considered second preferred after Option C if the detailed siting of a CSEC and tunnel head house in Anglesey North reduced disturbance to Pili Palas Nature World.

Technical

12.3.177 This option would use either of the preferred overhead line route corridors on Anglesey to a siting area in Anglesey North. For this option the Menai crossing would be achieved by a long tunnel (longer than for Option C). The topography however means that shaft depths are likely to be deeper than for Option C which would have consequent issues for cable installation.

12.3.178 As this option includes a long tunnel and no underground cables on land (as for Option C) rating assessments have confirmed this option would require 6 no. 400 kV cables to make the connection through the tunnel.

12.3.179 There is sufficient land available to construct a CSEC, shaft and tunnel head house in both Anglesey and Gwynedd. The tunnel would be likely to be constructed using TBM, would be likely to pass under buildings and possibly Llanfairpwllgwyngyll. This may raise concerns from residents.

12.3.180 Technical considerations for GS1 and the overhead line connection to Pentir Substation are as for Option A.

12.4 Cost

12.4.1 For this stage of the appraisal process an estimate of the outline cost of each option was considered.

12.4.2 These are identified in Table 11.1 below:

Table 11.1 Outline Cost Estimates

Option	Crossing Technique	Cost Estimate[38]
A	HDD	£130m – £150m
B	Tunnel	£115m - £135m
C	Tunnel	£170m - £190m
D	Tunnel	£145m - £165m
E	Tunnel	£115m - £135mm
F	Tunnel	£140m - £160m
G	Tunnel	£200m - £220m

[38] Costs are indicative estimates and have been based on current understanding of geological conditions and likely crossing method. These will be revised as more detailed information becomes avaible and the detailed design progresses.

12.4.3 It should be noted that these are estimates not costs, designed for high level, comparative purposes to allow visibility of the order of magnitude between different options only, any variability will be common across all similar options. They all exclude any contingencies. Increased accuracy will come with increased knowledge and data being gathered.

12.4.4 For the Menai Crossing the geological conditions are complex. In developing the estimates for tunnelling consideration must be made of the advance rates made by a TBM in meters per week. Estimates are based on rates that have been achieved on other TBM driven tunnels around the UK, including tunnels in hard rock. No sensitivity has been considered with respect to the variation in geology that may occur within the Menai Straits.

12.5 Consideration of Options

Landscape and Visual

12.5.1 Option G is preferred as the end to end option from a landscape and visual perspective. A long tunnel option reduces the amount of above ground work required and therefore would have fewer visual effects post construction. As stated previously, AN2 is preferred for the CSEC siting area within Anglesey North and GS1 preferred in Gwynedd. This option would connect both the preferred options for CSEC siting areas thereby requiring the shortest amount of new overhead line. The CSEC siting areas / tunnel head houses are outside of any landscape designations and the long tunnel would result in the least amount of vegetation loss when compared to other options with direct buried underground cabes.

12.5.2 Option C would be next preferred for similar reasons although the CSEC/tunnel head house would be within the Special Landscape Area, within the essential setting of Plas Newydd and adjacent to the AONB. Low height towers may reduce the effects of overhead line entry into the CSECs.

12.5.3 Options E and F are the least preferred of the end to end options. There are landscape and visual concerns over the potential effects of the overhead line exiting from GN1 or GN2, particularly on views from the promoted viewpoint on the Anglesey side of the Menai and towards Snowdonia. There are also concerns with the vegetation loss around Parc Menai, the effects of the overhead line on the A55 and potential effects on properties at Ty'n-y-Lon, Penrhos Garnedd and Capel-y-graig.

Historic Environment

12.5.4 Option C and G are the preferred options with regards potential effects on the Historic Environment. These options would remove the effects of groundworks associated with direct buried underground cables. Both options would however potentially affect the setting of designated assets, with Option C affecting distant views from Bry Celli Ddu and Option G affecting the immediate setting of Grade II listed buildings at Gwyndy.

12.5.5 GS1 would have the potential for effects to the setting of a Scheduled Ancient Monuments at Fodol Ganol Enclosed Hut Group (CN175) and Coed Nant-y-garth, standing stone (CN375) and possibly the setting of Vaynol Grade I Registered Park and Garden. There is high potential for previously unrecorded archaeological remains.

12.5.6 The remaining options would all have the si,milar potential effects in terms of the overhead line components, but would have significantly greater impact on potentially unrecorded archaeological remains due to the extensive groundworks associated with the direct buried underground cables.

Ecology

12.5.7 Options C and G are preferred due to the use of a long tunnel between CSEC siting areas, therefore eliminating the need for sections of direct buried underground cables and works within the Crossing Zones. Overall Option C is preferred as it would eliminate the risk that a siting area in Anglesey North could affect the CWS (although this is dependent on the selection of a siting area in Anglesey North).

12.5.8 Option A is least preferred as large areas of woodland could be affected, due to the length of underground cable routes. Numerous watercourses are crossed and it is within close proximity to numerous potential GCN ponds.

Marine Ecology

12.5.9 Either Option A or B are preferred as they cross the Menai Strait in the southern area where SAC rocky reef habitat is more limited, and hence a smaller area of habitat is at risk from tunnelling effects such as blow outs and ground borne vibrations.

Soils and Agriculture

12.5.10 Options C and G are preferred as they would not result in the disturbance of soils or agricultural associated with direct buried underground cables. Tunnelling would not impact the land beneath it during construction or operation (depth of tunnel is below ploughing depth and depth of agricultural drainage).

12.5.11 Option A is the least preferred as it would have the potential to disrupt large areas of agricultural land due to the largest extent of underground cables required. Crossing Zone 1 (Anglesey) contains BMV (Grade 2) land.

Hydrology and Flood Risk

12.5.12 The preferred options, from a Hydrology and Flood Risk perspective, are Options A, B and C, largely due to the distance of AC6 from the WFD ‘blue line’, and its higher elevation, which is likely to be sufficient to mitigate any effects on water quality and flood risk receptors.

12.5.13 The least preferred options, from a Hydrology and Flood Risk perspective, are Options D and E. This is largely because of the coincidence of the location of the AC1 siting area within areas of mapped Development Advice C2 floodplain.

12.5.14 All of the remaining options would be less favourable than Options A, B and C, but more favourable than Option D.

Traffic and Transport

12.5.15 There are traffic and transportation challenges associated with all of the end to end options however the preference is for Option F.

12.5.16 Generally there is good accessibility to proposed CSECs siting areas in Anglesey North. The A5025 and A487 local roads provide links to the A55 strategic highway network and it is anticipated that minimal mitigation work to the existing highway network would be required compared to the alternative options. General construction would avoid residential areas however any abnormal indivisible loads may require alternative routeing.

12.5.17 Crossing Zone 4 (both Anglesey and Gwynedd) are located close to the existing highway network and therefore impacts on local roads would be reduced.

12.5.18 GN2 benefits from being within close proximity to Junction 9 of the A55 strategic highway network and therefore it is anticipated that use of local roads for construction traffic would be minimised. Construction vehicle access to GN2 could be provided via the A487 and there may be potential for site egress directly onto the A55 although it is anticipated that significant works would be required in order to provide this.

Construction Noise

12.5.19 Options B, C, F, G and H could be constructed with the potential for fewer construction noise or vibration effects assuming appropriate micro siting. Options C and H, with long tunnels, would generate most spoil and hence have higher HGV spoil removal requirements and hence higher adverse traffic noise effects.

Operational Noise

12.5.20 It is considered all options could be designed to satisfy the requirements of EN-1 and EN-5, assuming selection of a larger and hence quieter design of overhead line design.

12.5.21 If a tunnel option is selected and the tunnel head houses require forced ventilation then it would require appropriate acoustic design and mitigation to meet appropriate noise levels at the nearest receptors. If passive ventilation is required then there may be no noise source and noise effects would be expected to be negligible.

12.5.22 Option G is preferred with appropriate selection of a CSEC site in Anglesey North and overhead line routeing. Option G would minimise the length of new overhead line required, with the potential to maintain a distance of approximately 50m to the nearest property on Anglesey, and a minimum distances of approximately 100m in Gwynedd.

12.5.23 There is no preference between Options A, B, C and D. For Option E if the tunnel head house required forced cooling it would need to be designed to meet low noise emissions. Option G is considered acceptable, as a new overhead line would be routed away from properties.

12.5.24 Option F is the least preferred option as GN2 shares a boundary with residential receptors.

Socio Economic

12.5.25 Option C is the preferred option from a socio-economic perspective. There are no key issues / receptors around AC6 or GS1 and the long tunnel option would avoid locating tunnel head houses within the Plas Newydd or Vaynol Registered Parks and Gardens therefore minimising any construction disturbance on these tourism receptors.

12.5.26 Option A is the least preferred option from a socio-economic perspective. There are holiday cottages and a picnic area at Crossing Zone 1 (Anglesey). Crossing Zone 1 is also within two Registered Parks and Gardens, Plas Newydd on Anglesey which is a visitor attraction and the Vaynol Estate in Gwynedd which attracts visitors through regular events throughout the year.

12.5.27 Option D is less preferred. AC1 is in close proximity to Llanfairpwllgwyngyll railway station which is a key tourism attraction; however it is not expected to be visible to the station. There are no significant issues or concerns with Crossing Zone 3, although siting of a tunnel head house on Anglesey should seek to minimise construction disturbance to the Nuffield Centre. The section of underground cables from Crossing Zone 3 to GS1 (Gwynedd) would pass in close proximity to a number of settlements and potentially give rise to community effects such as severance and amenity during construction.

12.5.28 Option E is less preferred. AC1 is in close proximity to Llanfairpwllgwyngyll railway station as noted above. There are no significant issues or concerns with Crossing Zone 3, although siting of a tunnel head house on Anglesey should seek to minimise construction disturbance to the Nuffield Centre. The section of underground cables from Crossing Zone 3 to GN1 would pass in close proximity to a number of settlements (albeit less so than Option D) and potentially give rise to community effects such as severance and amenity during construction. GN1 is in close proximity to Parc Menai and Coleg Menai, potentially leading to disruption during construction.

12.5.29 Option G is considered to be the second most preferred option after Option C, provided that the tunnel head house could be sited so as to minimise disturbance to Pili Palas Nature World. The long tunnel option would pass under the AONB and in close proximity to a promoted viewpoint; however no effects are anticipated.

Technical

12.5.30 Option F is the strong preference as it offers a shorter length of tunnel and would avoid tunnelling through the Dinorwig fault.

12.5.31 Of the longer tunnel options Option C is marginally preferred over Option H because it should have a slightly shorter length of large bore tunnel and slightly shallower depth from ground level to tunnel for its shafts. There possibly fewer receptors above the tunnel alignment for Option C which may make investigation work more straightforward.

Cost

12.5.32 Options B and E currently have the lowest estimated costs, Options C and G, the longer tunnel options have the highest estimated cost.

12.6 Outcome

12.6.1 All the options have the potential to give rise to significant environmental effects, and not all these effects can be mitigated.

12.6.2 Option A would require a long section of underground cable route on Anglesey which could permanently affect vegetation in the AONB, two Registered Parks and Gardens, and a SLA. The Crossing Zone contains the only area identified as BMV land. There could be potential construction disturbance to tourism receptors and effects on the National Trust property at Plas Newydd. Construction works would be undertaken in proximity to the Menai Strait and this option requires a technically complex underground cable connection to GS1. This option has one of the lowest estimated costs.

12.6.3 Option B would also result in permanent effects associated with underground cable routes and tunnel head houses within two Registered Parks and Gardens or their essential settings. The direct buried underground cables also have the potential for permanent effects on other areas of woodland. Construction works would be undertaken in proximity to the Menai Strait and there could be potential socio economic effects on the National Trust property at Plas Newydd. This option requires a technically complex underground cable connection to GS1.

12.6.4 Option C includes one of the longest tunnel connections and no direct buried underground cables. There are potential effects on two scheduled ancient monuments and the essential setting of a Registered Park and Garden. Traffic and transport effects would be greater than for other options. The option would require deeper shafts within which cable installation would be technically complex.

12.6.5 Option D would require direct buried underground cables in a Registered Park and Garden and a SLA. There are potential effects on two scheduled ancient monuments and the essential setting of a Registered Park and Garden. Effects of an overhead line on the setting of Bryn Celli Ddu may however be less than for some other options. The direct buried underground cables also have the potential for permanent effects on areas of woodland. The CSEC siting area is in proximity to a tourism receptor. This option requires a technically complex underground cable connection to GS1.

12.6.6 Option E would introduce a longer section of overhead line in Gwynedd, in proximity to the existing 400 kV overhead line with potential visual effects particularity from the promoted viewpoint towards Snowdonia. There would also be effects on scheduled ancient monuments and a historic landscape. The direct buried underground cables would result in permanent effects on areas of woodland. Construction of a new overhead line in Gwynedd would be technically challenging due to the already congested nature of the area in the vicinity of GN1.

12.6.7 Option F would result in a CSEC in Anglesey North, the preferred Search Area for a CSEC. At Crossing Zone 4 a tunnel head house would be in proximity to the promoted viewpoint and could have a potential effects on the AONB. The direct buried underground cables have the potential for permanent effects on areas of woodland. GN2 is more constrained than some other CSEC siting areas. In Gwynedd a new overhead line would potentially the same visual, historic and socio economic effects as with Option E. This options avoids underground cabling and tunnelling through the Dinorwig Fault thereby reducing geological risk.

12.6.8 Option G is a longer tunnel connections with no direct buried underground cables. It would result in a CSEC in Anglesey North, the preferred Search Area for a CSEC. In Gwynedd a new overhead line would potentially affect scheduled ancient monuments and the essential setting of a Registered Park and Garden. Traffic and transport effects would be greater than for other options. The option would require deeper shafts within which cable installation would be technically complex.

12.6.9 Options C and G (which both include a long tunnel) were the preference for landscape and visual, historic environment, ecology, soils and agriculture, and construction noise (excluding traffic and transport). Option C was also preferred against 'hydrological and flood risk' and socio economic considerations. Option G preferred for operational noise. Options C and G would avoid the permanent environmental effects (including woodland and tree loss) associated with direct buried underground cables, and the effects associated with a new overhead line connection to Gwynedd North.

12.6.10 Option F was the strong preference for technical considerations as it would reduce geological risk and avoid undergrounding and tunnelling through the Dinorwig Fault. It would also result in lower spoil volumes due to the decreased tunnel length when compared to other options. Option F was also the most preferred of the shorter tunnel options for land use and agriculture.

12.6.11 Options A, B and D, which involved underground cable routes through the Vaynol Estate and up to GS1 were not preferred against environmental, socio economic or technical considerations. These options would all be technically complex and would result in environmental effects which would potentially be significant. No alternative route to GS1 had been identified which would remove these concerns.

12.6.12 A long tunnel option was not preferred against traffic and transport, or construction noise considerations due to the quantities of spoil that would result from the construction of the tunnel and associated shafts. This would however be a temporary, although potentially significant, rather than a permanent effect.

12.6.13 For Options C and G the topography means that shaft depths would be deeper than with other options and installing the cables would be a significant consideration. Deeper shafts also have increasing safety requirements. Based on the cable rating assessments however, as there is no direct buried underground cable sections, 6 no 400 kV cables would be required between the CSECs rather than the 12 cables required by other options. Option C was preferred, against technical considerations, over Option G, as Option G would result in a further increase in shaft depth and consequent complexity of cable installation.

12.6.14 Options C and G have the highest estimated costs.

12.6.15 As outlined in Chapter 2 National Grid has a statutory and other duties to consider the impacts of its work on designated and other features and to mitigate effects. Options A, B and D are not preferred and have not been taken forward due to the considerable technical complexities of routeing underground cables up to GS1. These options would also have potentially significant effects on areas designated for their landscape and historic characteristics.

12.6.16 When comparing the remaining options, Options E and F, although having lower estimated costs than Options C and G (the longer tunnel options) would have potential visual effects on the setting of both an AONB and a National Park. Although Option F is preferred against technical considerations, both the CSEC siting areas are smaller and more constrained than other options. Options C and G, as they include no direct buried underground cables would only require 6 no. cables in the tunnel.

12.6.17 Options C and G (the longer tunnel options) reduce the potential for environmental effects against a number of considerations although there is the still the potential for significant effects. These options, with the tunnel shafts located at greater distance from the Menai Strait, require deeper tunnel shafts, due to topography, within which cable installation would be technically complex. Option G would require the deepest shaft and the longest tunnel.

12.6.18 On balance, considering the potential environmental effects and technical complexities, the increased cost of a longer tunnel option, and National Grid's statutory duties, Option C has been taken forward and is being developed further into a design for the DCO application.

13. PROPOSED DESIGN

13.1 Introduction

13.1.1 This Chapter outlines how the individual elements have been taken forward and refined to date.

13.2 Overhead Line Alignment Anglesey.

Preferred Option

13.2.1 In deterring a preferred draft alignment for Section 5 it was necessary to consider its relationship with Section 4 and the preferred CSEC siting area.

13.2.2 Although AC6 was identified as the preferred CSEC both Options 5B and 5C provided a potential connection but no preference had been (see Chapter 6).

13.2.3 From a landscape and visual perspective, Option 5C was preferred due to the location where the connection would span the A55, A5 and the railway line. Being at a slighter lower elevation (48m AOD rather than 64m AOD), it was considered that the visual effects of Option 5C would be preferable in views towards Snowdonia for people travelling east on the A55. There was also concern about the large angle tension tower adjacent to the railway line that would be required for Option B and how this would look in views from Gaerwen.

13.2.4 From a technical perspective Option 5B was preferred as this option spanned the A5, A55 and railway line at a more perpendicular angle to Option 5C. With more available land between the roads and railway the length of spans and construction methods were also considered to be preferable.

13.2.5 On balance Option C was taken forward and a more detailed alignment developed to connect Section 4 to AC6.

Draft Alignment

13.2.6 The draft alignment has been routed parallel to the west of the existing 400 kV overhead line (see Figure 13.1). This is a section of close parallel (under the optimum 85m) due to the need to pass west of a property at Fron Isaf (4AP076-77).

13.2.7 At proposed 4AP077 the alignment would deviate away from the existing 400 kV overhead line in a southerly direction towards the CSEC.

13.2.8 Proposed 4AP078 is positioned so as to enable routing between properties either side of the alignment (Fron-Deg and Tyn-cae).

Figure 13.1

Legend

- Existing National Grid 400 kV overhead line
- Proposed new pylons
- Proposed section of new overhead line
- Indicative Limits of Deviation

4AP077
4AP078
4AP079
4AP080
4AP081
4AP082
4AP083
4AP084
4AP085
4AP086
4AP087
GANTRY AC6
GANTRY GS3
4AP088
4AP089
4AP090
4AP091

0 250 500 1,000
Metres

Rev	Date	Description	GIS	Chk	App
0	23/09/2016	Initial Issue	JB	JF	JC

nationalgrid

Project Name: NORTH WALES CONNECTION PROJECT

Report Title: MENAI STRAIT CROSSING REPORT

Document Title: FIGURE 13.1 DETAILED OVERHEAD LINE ALIGNMENT

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13.2.9 The proposed alignment between 4AP078 to 4AP082 has been routed so as to approach the angle of deviation required to facilitate a close to perpendicular crossing of the A55, A5 and the railway all within the one span. This alignment was preferred to the other alignment crossing the A55 in this area, to remove the requirement for a large angle tension tower on the southern side of the A55, which was not preferred for against landscape and visual considerations.

13.2.10 Proposed pylon 4AP083 has been positioned to avoid a pond, and required the angle of deviation to facilitate routing towards 4AP086, enabling the alignment to pass between the chicken sheds on the west and properties on the east (Dolfeirig and Rhosbothan).

13.2.11 Pylon 4AP086 was angled to facilitate a route alignment via 4AP087 to the proposed gantries the CSEC.

13.3 Crossing Zone

13.3.1 Crossing Zone 2 has been identified as the preference with the connection by means of a tunnel, currently anticipated to be constructed using a TBM from AC6 to GS1.

13.3.2 As the preference is for a longer tunnel, with no sections of underground cables, tunnel head house will be required, co-located with the CSEC. Although AC6 and GS1 were identified as the preference for a CSEC, following a review of environmental and technical considerations for siting a combined CSEC and tunnel head house the area was still considered suitable.

13.3.3 The permanent infrastructure will require an area of approximately 108m x 80m. A larger area will be required to accommodate the temporary construction works. The indicative position of the tunnel shafts (and tunnel head houses) s based on current understanding of the geological hazards. There is however sufficient available land within the construction compounds to adjust the shaft position if required (and subject to other environmental considerations).

AC6

13.3.4 AC6 is a large field located within the special landscape area and the buffer zone for the Area of Outstanding Natural Beauty (AONB) around the Menai Strait (see Figure 13.2).

Figure12.2: View of AC6

13.3.5 Following site visits and review of the considerations within the siting area (both environmental and technical) an indicative location has been identified within AC6 for the CSEC and tunnel head house.

13.3.6 Considerations for detailed siting were:

- within the CSEC siting area there was sufficient space for a proposed site (including a CSEC and tunnel head house) to be sheltered from view of the nearby houses and from Starr;
- overhead lines (proposed and existing) should not encircle Starr (see Figure 13.1). Due to the elevated position of Star the proposed overhead line may be backclothed in views from the settlement and there may be opportunities to reduce this effect e.g. by the use of lower height pylons. This would ensure that new pylons blend in with the background rather than being backed by open sky;
- the road to Tyddyn-Fadog which is narrow (single lane) with established trees with a tight S bend before the siting area. Access to the site for construction traffic should be able to use a haul road which would have be established for the TBM.

13.3.7 This site is now known as Braint Tunnel Head House and Cable Sealing End Compound and an indication of its location is provided in Figure 13.3.

Tunnel

13.3.8 A zone for the tunnel has been defined based on current understanding of bathymetry and geology (see Figure 13.2). This will be refined as more data becomes available and the detailed design progresses.

13.3.9 The tunnel shafts for both Anglesey and Gwynedd have typical internal diameter of 15metres, typically 86m below ground level to the tunnel invert on Anglesey, and 100m in Gwynedd.

Figure 13.2

Legend

- Existing overhead line section to be retained
- Existing pylons to be retained
- Proposed new pylons - Section F
- Proposed section of new overhead line - Section E
- Proposed section of new overhead line - Section F
- Indicative Tunnel Limit of Deviation (LOD)
- Area within which Tunnel Head House and Cable Sealing End Compound could be located
- Temporary Construction Compound Area
- Access Tracks
- Highway Upgrade Access Works

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Project Name: NORTH WALES CONNECTION PROJECT

Report Title: MENAI STRAIT CROSSING REPORT

Document Title: FIGURE 13.2

INDICATIVE LOCATION OF TUNNEL HEAD HOUSES AND CABLE SEALING END COMPOUNDS

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GS1

13.3.10 GS1 is a large siting area located on higher ground, the centre of which is only approx. 1.2km from Pentir Substation (See Figure 13.3)

Figure 13.3: View of GS1

13.3.11 Following site visits and review of the considerations within the siting area (both environmental and technical) an indicative location has been identified within GS1 for the CSEC and tunnel head house.

13.3.12 Considerations for detailed siting were:

- levels should be reasonably constant to avoid significantly impacting on shaft depth. The site identified is south of the minor road;
- visibility in long distance views. The indicative location would not be visible from A487, either at the roundabout or at the top of the hill by Parc Menai;
- access from the highway network. A bellmouth access on the B4547 towards the Tyn-Rhos turn off would be adjacent to existing roadway; and
- haul roads would be required to access the site from the local road network. Existing access roadways used by farmers and local residents are single lane and too narrow for large plant. A long haul road may have an impact on the views from the surrounding properties.

13.3.13 This site is now known as Ty-Fodol Tunnel Head House and Cable Sealing End Compound (see Figure 13.2).

13.4 Overhead Line Alignment Gwynedd.

Preferred Option

13.4.1 Given the location of GS1 only a short connection is required to Pentir Substation.

13.4.2 A number of options for a draft alignment were considered by both the environmental and technical teams.

13.4.3 The main considerations were the need to span a small valley between GS1 and the substation, the views from properties between GS1 and Pentir and the potential vegetation loss that may be required.

13.4.4 The draft alignment developed provided the straightest connection with the least number of pylons and had fewer visual effects on properties.

Draft Alignment

13.4.5 The draft alignment and pylons have been positioned from the CSEC gantries to 4AP090 so as to facilitate crossing of the minor gorge, with pylons 4AP089 & 4AP090 on similar ground elevations either side of the gorge, whilst ensuring that the alignment remains between properties on the north (Fodol and Hafodol Uchaf) and Garth Farm to the south of 4AP090. The pylons were positioned to reduce potential effects on the local wildlife site (see Figure 13.1).

13.4.6 The proposed 4AP090 has been angled so as to facilitate approach to 4AP091 to enable the proposed connections thereafter into Pentir Substation.

14. NEXT STEPS

14.1 Introduction

14.1.1 The current stage of consultation forms the statutory consultation required under the Planning Act 2008 and is supported by the detailed design and environmental assessment work undertaken to date.

14.1.2 National Grid has already undertaken two stages of consultation on the North Wales Connection Project. This is the Stage 3 consultation and is likely to be the last consultation on the whole project.

14.1.3 Following close of the consultation National Grid will consider all feedback received. Further appraisal of the proposals will be carried out in relation to environmental, socio-economic, technical and cost in the context of the policies set out in NPS EN-1 and EN-5, as well as National Grid's statutory duties. The outcomes of this further appraisal work will be considered alongside the consultation feedback received.

14.1.4 A final design will be identified and an application for a Development Consent Order (DCO) prepared and submitted to the Planning Inspectorate for consideration. To support the application an Environmental impact assessment will be carried out.

14.1.5 Further information on the consultation and the DCO process is provided below.

14.2 Stage 3 (Statutory) Consultation

14.2.1 This stage of consultation seeks feedback on the project and the detailed design that is being taken forward for environmental assessment. .

14.2.2 The project proposals will be considered in light of feedback received and if necessary further survey design and appraisal work would be carried out. Consultation feedback reports, setting out all of the feedback received, will be published to support the DCO application in 2017.

14.3 The DCO Application and timeline

14.3.1 The project will be designed having regard to the policy tests set out in NPSs EN-1 and EN-5 and the guidelines to line routeing, set out in the 'Holford Rules'.

14.3.2 Applying 'good design' to energy projects should produce sustainable infrastructure that is: sensitive to place; efficient in the use of natural resources and energy used in their construction and operation; and matched by an architectural and engineering design, which is sympathetic to and reflects of the local context.

14.3.3 The DCO application will demonstrate that National Grid has taken into account both the functionality (including fitness for purpose and sustainability) and aesthetics (including its contribution to the quality of the area in which it would be located) as far as practicable.

14.3.4 A high level summary of the DCO programme is presented in Table 15.1 below.

Table 14.1 DCO Programme

Stage of the Process	Timescale	Indicative Programme Dates	Features
Pre-Application	No time limit	Work in progress, progressing until late 2017, with formal pre-application consultations during 2016.	Applicant develops proposal and carries out pre-application consultation. Includes surveys, environmental assessments and preparation of all DCO application documents.
Application	No time limit	Late 2017	Application for development consent made to the Secretary of State.
Acceptance by the Planning Inspectorate	Up to 28 days	Late 2017	Secretary of State has 28 days to review application and decide whether to accept it for consideration, or reject it.
Pre-examination	Two to four months	Late 2017 – Early 2018	Examining Authority of Government inspectors appointed to assess issues and hold preliminary hearing. Preliminary meeting – procedural decision on how the application is to be examined.
Examination	Up to six months	Mid 2018	Six months to carry out the examination, including all hearings.
Report and recommendation	Up to three months	Late 2018 – Early 2019	Report and recommendations of the Examining Authority drafted and issued to the Secretary of State.
Decision	Up to three months	Early – Mid 2019	Decision and statement of reasons drafted and issued by the Secretary of State.

14.3.5 The DCO pre-application process is a significant component of the application programme. It involves the development of a scheme that has been tested and subject to review, consultation and environmental assessment so that, when a DCO application is submitted, the scheme represents the optimum balance of environmental, socio-economic, technical and economic factors, taking account of consultation feedback through statutory and non-statutory routes. It also includes surveys, environmental assessments and the preparation of all DCO application documents.

14.3.6 Environmental studies have been started in support of the appraisal of the options considered to date and National Grid's ongoing work, and these will continue and be further extended during the EIA stage of the pre-application process. The Preliminary Environmental Report that forms one of the Stage 3 consultation document sets out what environmental assessment work has been undertaken to date and the project will be subject to further detailed environmental assessment.

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