Frodsham Solar

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Chapter 3: Alternatives and Design Evolution

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Revision	Date	Prepared By	Reviewed / Approved By
P01	May 2025	A Russell	D Adams

Prepared For:

Frodsham Solar Ltd

Prepared By:

Well House Barns, Chester Road, Bretton, Chester, CH4 0DH
1st Floor, Barfield House, Alderley Road, Wilmslow, SK9 1PL
Maling Exchange, Studio 307, Hoults Yard, Walker Road, Newcastle Upon Tyne, NE6 2HL

T: 0344 8700 007
enquiries@axis.co.uk
www.axis.co.uk

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3.0 ALTERNATIVES AND DESIGN EVOLUTION

3.1 Introduction

3.1.1 This chapter of the ES describes the consideration of alternatives and design evolution in relation to the Proposed Development. This chapter is supported by **ES Vol 2 Appendix 3-1: Alternative Site Assessment [EN010153/DR/6.2]** and **ES Vol 3 Figure 3-1: Site Boundary Changes & Alternative BESS/Substation Locations [EN010153/DR/6.3].**

3.1.2 Regulation 14(2) of the EIA Regulations[i] identifies the information that must be included in an ES, this includes:

"(d) a description of the reasonable alternatives studied by the applicant, which are relevant to the proposed development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the development on the environment…….

(f) any additional information specified in Schedule 4 relevant to the specific characteristics of the particular development or type of development and to the environmental features likely to be significantly affected"

3.1.3 Paragraph 2 of Schedule 4 of the EIA Regulations sets out the following in relation to alternatives:

"A description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects".

3.1.4 It should be noted that the EIA Regulations place no specific obligation on an applicant to study alternatives, but simply to describe them in the manner specified, where they have been considered.

3.1.5 National Policy Statement (NPS) EN-1[ii] paragraph 4.3.9 states:

"As in any planning case, the relevance or otherwise to the decision making process of the existence (or alleged existence) of alternatives to the proposed development is, in the first instance, a matter of law. This NPS does not contain any general requirement to consider alternatives or to establish whether the proposed project represents the best option from a policy perspective. Although there are specific requirements in relation to compulsory acquisition and habitats sites, the NPS does not change requirements in relation to compulsory acquisition and habitats sites."

3.1.6 NPS EN-1 states at paragraph 4.3.15 – 4.3.17 that:

"4.3.15 Applicants are obliged to include in their ES, information about the reasonable alternatives they have studied. This should include an indication of the main reasons for the applicant's choice, taking into account the environmental, social and economic effects and including, where relevant, technical and commercial feasibility.

4.3.16 In some circumstances, the NPSs may impose a policy requirement to consider alternatives.

4.3.17 Where there is a policy or legal requirement to consider alternatives, the applicant should describe the alternatives considered in compliance with these requirements."

3.1.7 Within NPS EN-1 examples of where consideration of alternatives is a requirement of policy are:

i) paragraph 5.8.9 in relation to flood risk and the application of the sequential test;
ii) paragraph 5.10.32 in relation to development within National Parks, the Broads and National Landscapes; and
iii) paragraph 5.4.27 in relation to the Habitat Regulations.

3.1.8 The approach taken to alternatives in the decision-making process is set out in NPS EN-1 at paragraph 4.3.22 – 4.3.23:

"4.3.22 Given the level and urgency of need for new energy infrastructure, the Secretary of State should, subject to any relevant legal requirements (e.g. under the Habitats Regulations) which indicate otherwise, be guided by the following principles when deciding what weight should be given to alternatives:

- *the consideration of alternatives in order to comply with policy requirements should be carried out in a proportionate manner; and*
- *only alternatives that can meet the objectives of the proposed development need to be considered.*

4.3.23 The Secretary of State should be guided in considering alternative proposals by whether there is a realistic prospect of the alternative delivering the same infrastructure capacity (including energy security, climate change, and other environmental benefits) in the same timescale as the proposed development."

3.1.9 Taking into consideration the policy and legal requirements, as well as the iterative approach to the design to date, the following alternatives have been considered for the Proposed Development and are discussed in this chapter:

i) Alternative sites;
ii) Alternative solar technologies; and
iii) Scheme evolution and alternative layouts.

3.1.10 A 'no development' alternative would not deliver the additional electricity generation capacity associated with the Proposed Development and has not been considered as an alternative by the Applicant. As such a no development scenario is not considered further within this chapter.

3.2 Need for the Proposed Development

3.2.1 NPS EN-1 clearly establishes that there is a demonstrable and urgent need for renewable energy infrastructure:

"3.2.6 The Secretary of State should assess all applications for development consent for the types of infrastructure covered by this NPS on the basis that the government has demonstrated that there is a need for those types of infrastructure which is urgent, as described for each of them in this Part.

3.2.7 In addition, the Secretary of State has determined that substantial weight should be given to this need when considering applications for development consent under the Planning Act 2008.

3.2.8 The Secretary of State is not required to consider separately the specific contribution of any individual project to satisfying the need established in this NPS"

3.2.2 A detailed analysis of the need for the Proposed Development is provided within Section 2.0 of the **Planning Statement [EN010153/DR/5.6]**. This describes that the need for additional renewable energy development, including Solar PV, is very significant and new infrastructure must be delivered as a matter of urgency, if the UK Government is to meet its commitment to Net Zero by 2050. This chapter, which describes the reasonable alternatives considered by the Applicant, is therefore set in the context of this clear and urgent need for the Proposed Development.

3.3 Alternative Sites

The Application Site

3.3.1 There is no prescribed method set out within law or policy as to how to approach the consideration of alternative sites, should an applicant choose to do so. In this case, the Applicant recognised at a very early stage that the proposed application site offers several significant, and in many cases unique, benefits.

i) A significant portion of the Site is currently host to the operational Frodsham Wind Farm. When considering locations for solar photovoltaic generation, EN-3 (paragraph 2.10.10) recognises that the government is supportive of solar that is co-located with onshore wind generation in order to maximise the efficiency of land use.

ii) The Site is positioned within the centre of the North West's industrial and manufacturing heartland, with the Protos strategic development site with the benefit of planning permissions for a range of energy generation and resource management businesses, and other major industrial facilities, located to the west and the Runcorn industrial corridor to the east. The nature of industrial development in this part of the northwest is such that many of the businesses require high quantities of electrical energy to operate, and consequently, there is a real opportunity to provide direct power via private wire connection. This allows for improved efficiency (and thus reduced costs), places less reliance on the available grid capacity, and puts less pressure on the available storage with the BESS.

iii) The majority of the Site is under the control of only two landowners. These were known to be supportive to the opportunity for the development of a commercial scale solar scheme, reducing the often complicated and convoluted need for numerous land negotiations and/or compulsory purchase agreements that can increase cost and reduce project viability. Compiling large parcels of land for development can be one of the most challenging and time-consuming aspects of delivering energy infrastructure and therefore a site being subject of minimal different land

ownerships is clearly beneficial to delivering a large scale renewable energy project in a timely manner.

iv) A commercial solar scheme inevitably takes up a large amount of land. EN-3 (paragraph 2.10.11) states that the government seeks large scale ground-mounted solar deployment across the UK, looking for development mainly on brownfield, industrial and low and medium grade agricultural land. This is a goal that is inevitably hard to achieve, not least because solar is competing with countless other development types, directed through local plan policies, to brownfield and lower grade agricultural land ahead of higher-grade agricultural sites. In this case, much of the Site is reclaimed land (subject to deposit of dredgings from the Manchester Ship Canal) and is low grade agricultural land (i.e. it is not Best and Most Versatile), and whilst it may not be suitable for traditional forms of development, due to its limited accessibility and its location adjacent to the existing wind farm, it is ideal for the development of a commercial solar array.

v) Whilst generally flat, the area around the Site is dominated by large scale infrastructure development. In addition to the Frodsham Wind Farm, the local landscape accommodates the elevated M56 corridor; Chester / Manchester railway; high voltage above ground power lines; and several other large industrial buildings and associated plant. Consequently, the inclusion of a large scale commercial solar array within the landscape is unlikely to be incongruous to the extent that it would elsewhere, e.g. in a more rural landscape where there was less industrial development.

3.3.2 Rarely does a site exist with the level of evident benefits identified above. For these reasons the Site was identified by the Applicant as an ideal opportunity for the delivery of a commercial scale solar project, subject to understanding grid, planning and environmental constraints.

3.3.3 Limited capacity and connectivity across the UK power network has hindered the development of renewable energy. The existing grid infrastructure is nearing maximum capacity and adding more renewable energy sources can

cause grid congestion when the grid cannot handle extra power flows without rising instability or outage. This places caps on renewable output and limits the ability to develop new projects.

3.3.4 The cost of transporting power from the source of generation to the point of connection to the grid is one of the most restrictive elements of any energy project. A developer must include both the cost of installing the connection, including land costs, and the cost of efficiency loss during energy production into the overall economics of the project. A longer connection will almost inevitably increase complexity, add more landowners which may need to be subject to compulsory purchase, add greater disruption to local communities, result in increased environmental effects and prolong construction periods.

3.3.5 Consequently, ensuring that there is sufficient available capacity within the grid network proximate to the source of the power generated, and locating generating stations as close as possible to an available connection, is fundamental to determining whether a project is viable and reducing the environmental effects of the development.

3.3.6 **ES Vol 2 Appendix 3-1: Alternative Site Assessment [EN010153/DR/6.2]** provides detail of the process that the Applicant undertook to explore opportunities to provide additional energy generation to the local distribution network or National Grid. This process resulted in at least 100MW of potentially available grid capacity being identified at the 132kV SPEN Frodsham Substation. For the reasons set out above the opportunity to develop a solar farm in such close proximity to the grid connection point has a range of benefits.

Alternative Sites

3.3.7 Irrespective of the fact that the Site was identified as having a number of demonstrable technical, commercial, and environmental benefits, the Applicant elected to look at alternatives areas that could theoretically host an equivalent facility, in order to confirm whether there were any other more suitable sites than that initially selected. Critically, the Site would need to

accommodate a solar array of sufficient scale to generate at least 100MW, within a suitable distance of the SPEN Frodsham Substation. The alternative site assessment process is detailed within **ES Vol 2 Appendix 3-1: Alternative Site Assessment [EN010153/DR/6.2]** (the ASA).

3.3.8 The Government has confirmed that there is need for nationally significant renewable infrastructure, that this need is urgent, and that substantial weight should be given to that need (EN-1 paragraph 3.2.6). Importantly, an application should not be refused simply because fewer adverse impacts may result from developing similar infrastructure on another site, and the decision-maker should have regard as appropriate to the possibility that all suitable sites for energy infrastructure of the type proposed may be needed for future proposals (paragraph 4.3.24).

3.3.9 It is in this context that the ASA has been undertaken; to determine whether there are any other more sequentially preferable sites or areas that could deliver the infrastructure proposed within the same timescales.

Alternative Site Assessment Process

Stage 1: Establishing a Search Area Radius

3.3.10 As the distance between an energy generating station and a point of connection increases, not only does the cost of installing the cable go up, but during operation the efficiency of transmission to the grid reduces, and the overall connection becomes more costly. It is also inevitable that the longer the grid connection, the greater the likelihood that the cable routing will need to negotiate more technical obstacles (varied topography, geology, physical restrictions including roads, utilities etc) and environmental constraints (ecological sites, woodland, residential amenity issues etc.). Each of these go to reduce the commercial viability of the project.

3.3.11 The Frodsham SPEN Substation is surrounded by a series of constraints that could significantly limit the viability of installing a lengthy grid connection due to the costs associated with directional drilling and/or alternative constraint

avoidance measures. These constraints include the Mersey Estuary, River Weaver and Weaver Navigation; the towns of Runcorn, Frodsham, Ince and Helsby; and major transport infrastructure such as the M56 and Chester to Manchester railway line.

3.3.12 In light of the above, a Search Area Radius of 5km from the point of connection to the SPEN Frodsham Substation was set as a reasonable distance.

Stage 2: Search for Brownfield Land, PDL and Exclusion of Urban Areas

3.3.13 Stage 2 considered whether brownfield or previously developed land (PDL) exists within the Search Area to accommodate scheme requirements and be available for the development of a commercial scale solar array. Brownfield Land availability was ascertained from Brownfield Land Registers held by Cheshire West and Chester Council and Halton Borough Council. PDL has been identified using aerial imagery.

3.3.14 No Brownfield Land or PDL was identified within the 5km Search Area of sufficient size and availability to deliver the same infrastructure as that proposed in the same timescale. It was concluded that the only alternative options to develop a solar farm within the Search Area Radius would be to develop on vacant agricultural land located to the south of the towns of Frodsham and Helsby.

3.3.15 Following the exclusion of urban areas, the remaining land within the 5km Search Area naturally divided into three Option Areas: A (the Proposed Development site area), Area B and Area C, as described within **ES Vol 2 Appendix 3-1: Alternative Site Assessment [EN010153/DR/6.2].**

Stage 3: Review of Three Identified Options

3.3.16 Stage 3 involved a review of the three identified Option Areas in the context of the '*Factors influencing site selection and design'* detailed in NPS EN-3. Other considerations, including environmental constraints, also formed part of the review as to whether a preferable site to Option Area A exists. The three

Option Areas are all located within the Green Belt. The review included consideration of the impact that development within each Option Area would have on openness, permanence, and the purposes of the Green Belt.

3.3.17 The review concluded that in almost all cases, Option Area A is preferable to Option Areas B and C. The only cases where this was not the case related to ecology and flood matters, due to the proximity of Area A to the Mersey Estuary SSSI and SPA compared to the other options, and that part of Area A lies in Flood Zone 3a.

3.3.18 In light of these findings, it is noted that the ecological mitigation hierarchy has been applied to the Proposed Development. **ES Vol 1 Chapter 8: Ornithology [EN010153/DR/6.1]** identifies that the application of the mitigation hierarchy results in the avoidance of significant effects, and that the Proposed Development would provide significant ecological benefits overall, including long term significant benefits to the integrity of the Mersey Estuary SPA.

3.3.19 With regard to the flood risk at Option Area A, the requirements of the Sequential Test and Exception Test have been found to be met as set out in **ES Vol 2 Appendix 3-1: Alternative Site Assessment [EN010153/DR/6.2].**

Alternative Sites Conclusion

3.3.20 This section has reported the approach adopted by the Applicant in initially identifying the Application Site, and then considering whether there are any preferable alternatives that may meet the objectives of the Proposed Development.

3.3.21 The overall analysis identified that Option Area A (the Proposed Development area) is preferable to the other areas identified within the Search Area Radius that could potentially deliver the Critical National Priority (CNP) infrastructure urgently needed to help achieve the energy objectives set out in EN-1, and help contribute to national energy security and the economic, commercial, and net zero benefits also set out in EN-1.

3.3.22 There are no sequentially preferable sites or areas that offer a realistic prospect of delivering the same infrastructure capacity within the same timescales as that proposed by the Applicant.

3.3.23 Option Area A (within which the Site is located) was therefore progressed to design stage, a viable scheme developed, and an Environmental Statement prepared.

3.4 Alternative Solar Technologies

3.4.1 A variety of alternative technologies are available when designing a solar and battery storage project. Furthermore, the solar and energy sector is undergoing rapid advancements in technology. As a result, it is anticipated that new technology options may arise during the application process and before construction begins, which could impact the design of the Proposed Development. This necessitates a flexible approach, which is why the ES will adopt a 'Rochdale Envelope' methodology for its assessment.

3.4.2 As described in **ES Vol 1 Chapter 2: The Proposed Development [EN010153/DR/6.1]**, the parameters of the DCO will maintain a degree of design flexibility to allow the latest technology to be utilised at the time of construction. Notwithstanding this, several technological design options have been considered and preferred options taken forward taking into consideration environmental effects and the Proposed Development's objectives and need for optimal functionality. Table 3-1 summarises the main alternative technologies considered by the Applicant at this Site.

3.4.3 It should be noted that at the time the origination of the project was undertaken, there was a presumption against the development of onshore wind, a de facto moratorium. As such, the Applicant did not consider the potential for wind energy on Site, e.g. by extending the existing Frodsham Wind Farm. Furthermore, the extension of the wind farm would not have utilised the available land beneath the existing wind turbines to generate electricity, with only a relatively small area to the east of the existing turbines realistically available for an extension area.

Table 3-1 - Technology Alternatives

Technology Element	Consideration of Alternatives
Type of solar array (fixed or tracking)	Fixed arrays are solar panels that are mounted on arrays which are fixed to a single height and axis, i.e. they are generally fixed to face due south. Solar tracking arrays are solar panels that are mounted on arrays which are motorised and automated to track the sun across the sky. In this way they can turn to face the sun as it rises in the east, and track it through to sunset in the west,

Technology Element	Consideration of Alternatives
	which allows them to maximise generation across the full extent of the day and deliver better yields. There are also dual axis tracking systems which also optimise sun exposure as the trajectory of the sun changes over the year. The key differences between fixed arrays and solar tracking arrays are that: • Fixed arrays are substantially cheaper to deploy and a more reliable technology; • Fixed arrays require less maintenance, and as such less traffic is likely to be generated in the operational phase; • Fixed arrays generate slightly less electricity per panel across the day than tracking arrays, and as such have a reduced yield; • Tracking arrays involve the use of motors on each array and therefore generate noise whilst in operation; and • Fixed arrays have a reduced glint and glare impact compared to solar tracking arrays. Balancing the factors set out above, the Applicant has chosen to deploy fixed arrays.
Monofacial and Bifacial Panels	A monofacial solar PV module only absorbs sunlight from the front surface of the solar PV module, which generally tends to be direct sunlight. A bifacial solar PV module features solar cells on both sides. This enables electricity to be generated from diffuse sunlight that is reflected off the ground onto the back surface of the solar PV module. There are no particular onsite advantages or disadvantages from an environmental effects perspective. Both options are being retained within the parameters of the Proposed Development. A detailed analysis of the options would be undertaken prior to construction and final selection is likely to be influenced by future advances in panel technology and efficiency of photovoltaic cells.
Solar array configuration	Two configurations were considered for the solar PV layout: • South-facing, where all solar arrays are oriented due south with regular spacing between rows; and • East-west facing, where east-facing solar tables and west-facing solar tables are arranged back-to-back. The east-west configuration can achieve a slightly higher installed capacity per hectare of land as arrays can be arranged more densely, with reduced spacing required between rows due to shading impacts. Despite the ability to increase installed capacity per hectare, the increase in generation capacity from an east-west facing array does not increase proportionately with the installed capacity. This is because the panels are not oriented optimally across the middle part of the day when solar irradiance is highest.

Technology Element	Consideration of Alternatives
	Considering the factors set out above, the Applicant has focussed on developing the Proposed Development on the basis of south-facing arrays and such an arrangement forms the basis of the ES.
String inverters or centralised inverters	There are two principal types of inverter that can be utilised for solar arrays; string inverters, or centralised inverters. String inverters are inverters typically attached to the mounting frames of solar panels and connect together the wiring from different rows for conversion to AC. They are distributed across the solar arrays, with the advantage of being relatively small and easy to mount onto the solar PV tables. Centralised inverters are either small containers or cabinets that house a single large-capacity inverter to which the solar arrays connect. Fewer centralised inverters are required compared to string inverters, and they would be distributed throughout the solar arrays alongside transformers. The key differences between string inverters and centralised inverters are that: • String inverters can be mounted directly to the solar arrays and do not require foundations or footings – centralised inverters do require foundations or footings; • String inverters are more expensive to install than centralised inverters, but can be more efficient and can result in lower downtime losses; and • String inverters have a lower sound power level – centralised inverters have a higher sound power level. The Applicant is looking to maintain flexibility as to the type of technology utilised in the Proposed Development, with a final decision on approach expected to be made at the detailed design stage following a grant of development consent. This will enable the Applicant to select the most efficient and economic technology at the time. Both string inverters and centralised inverters have therefore been assessed in the ES.
BESS Systems – DC coupled (decentralised) or AC coupled (centralised)	BESS systems can be connected directly to the solar panels which generate electricity in DC (DC coupled). This allows them to be distributed across the Site and can result in lower energy losses as by avoiding the need to convert between AC and DC. AC coupled BESS systems allow the BESS units to be located centrally, and provide greater flexibility in relation to storing electricity generated from solar panels but also directly charged from the grid. An AC coupled system has been selected to reduce the need for large items of equipment to be distributed across the Site, instead focusing the BESS in one location which can be selected to reduce visual effects on receptors, such as footpath users. A centralised BESS compound will also mean

Technology Element	Consideration of Alternatives
	that all battery storage units can be located outside the flood plain and can reduce maintenance costs.

3.5 Scheme Evolution and Alternative Design Considerations

3.5.1 The layout of the Proposed Development has evolved iteratively throughout the EIA process taking into consideration environmental effects, the Proposed Development's objectives and functionality, and feedback from stakeholders and public consultation.

3.5.2 The purpose of this section is to describe the main design decisions which have been taken up to the point of the submission of the DCO application.

3.5.3 As set out in section 3.3 above the Applicant established at the outset of the project that the Site provided an opportunity for the development of a NSIP which had the potential to generate renewable electricity for export into the local electricity distribution network, supply directly to nearby businesses and provide for electricity storage within an on-site BESS which can help meet supply during periods of peak electricity demand.

3.5.4 One of the earliest stages in the project evolution was the preparation of the EIA Scoping Report. The development area anticipated at this point in the project is shown in **Figure 1.1** of **ES Vol 2 Appendix 1-1: Frodsham Solar Scoping Report (May 2023) [EN010153/DR/6.2]**.

3.5.5 At this stage a detailed layout for the development had not been produced. Prior to and during the scoping process the engineering, environmental and commercial team collated information on a variety of constraints which could influence the design, this included:

i) Environmental designations;
ii) Location of utilities and services;
iii) Areas of flood risk;
iv) Presence of Public Rights of Way and informal walking routes;
v) Landownership considerations; and
vi) Known engineering constraints associated with the previous use of the Site e.g. presence of wind turbines, dredging deposit cell structures.

3.5.6 A range of baseline environmental surveys were also conducted which fed into the design process. These included:

i) Ecological surveys
ii) Noise surveys
iii) Phase 1 Geo-Environmental surveys
iv) Agricultural Land Classification surveys
v) Heritage desk based and walkover surveys
vi) Landscape and visual walkover surveys and site photography

3.5.7 The Phase One informal, non-statutory consultation undertaken during Summer 2023 also identified local issues and concerns which further contributed to the design.

3.5.8 Informed by the information gathered from the above, a Design Vision and a series of Design Principles (referred to as Design Objectives in the PEIR) were developed to guide and shape the approach to the design of the Proposed Development. The Design Vision is:

"To deliver a substantial amount of renewable energy to the local electricity distribution network and to local businesses, to conserve and enhance the local environment, and to be a responsible neighbour to local people".

3.5.9 Eight Design Principles were developed as follows:

i) Principle 1: Renewable Energy - Delivery of significant amount of affordable, renewable energy to support policy objectives and national targets for reducing carbon emissions to net zero by 2050.
ii) Principle 2: Landscape and Views - Develop the proposals in a manner sensitive to their landscape setting, reducing visual impacts from nearby properties, recreational routes and key viewpoints.
iii) Principle 3: Biodiversity and Green Infrastructure - Protect and enhance green infrastructure within the draft Order Limits and in doing so create the conditions for enhanced biodiversity locally.

iv) Principle 4: Public Access and Recreation - Retain, enhance and encourage public access through the life of the proposals, including during construction and decommissioning where feasible.
v) Principle 5: Flooding - Safeguard the surrounding hydrological systems, ensure the Proposed Development is resilient to flooding and will not increase flood risk elsewhere, taking account of the impacts of climate change.
vi) Principle 7: Amenity - Develop all elements of the proposals, including during construction and decommissioning so that they do not adversely affect the amenity or safety of local residents and users of public rights of way.
vii) Principle 8: Traffic and Transport - Vehicular access to the draft Order Limits will be safe and will not adversely affect the local highways network, or the local public rights of way network.

3.5.10 Throughout the EIA process the Applicant and the technical consultant team have undertaken direct engagement with a number of statutory consultees and other project stakeholders to help guide design decisions, this has included but is not limited to:

i) Environment Agency
ii) Natural England
iii) National Highways
iv) Cheshire West and Chester Council (various departments including Planning, Biodiversity, Local Lead Flood Authority, Contaminated Land, Environmental Health)
v) Historic England
vi) Cheshire Wildlife Trust
vii) RSPB
viii) Cheshire Fire and Rescue Service

3.5.11 Using the information gathered from the above processes and engagement activities the design of the Proposed Development has evolved from the point

of site identification, and the provision of a preliminary site boundary set out in the Scoping Report, to the Order Limits shown on **ES Vol 3 Figure 1-1: Site Location [EN010153/DR/6.3]** the zones for development set out in the **Works Plans [DOC REF]** and the environmental design shown on the **ES Vol 3 Figure 2-3: (a-e) Illustrative Environmental Masterplan [EN010153/DR/6.3]** respectively.

3.5.12 During this period the Applicant undertook a two-stage approach consultation on the Proposed Development with consultees and the local community. Phase 1 comprised an informal, non-statutory consultation during Summer 2023, Phase 2 consultation comprised a formal statutory consultation from 7th November to 19th December 2024. The Phase 2 consultation included the publication of the Preliminary Environmental Information Report which was made available for review and comment during the consultation period.

3.5.13 Table 3-1 sets out the main alternatives which have been considered by the Applicant in the evolution of the design, including those raised through the consultation process.

Table 3-2 – Main Alternatives Considered

Component of the Proposed Development	Alternatives considered and main reasons for selecting the chosen option
Site Boundary	There have been a number of changes to the Site boundary during the design evolution. The changes have arisen as a result of actions to mitigate or reduce environmental effects, engineering constraints and landownership matters. The main changes are described below. Scoping The Site Boundary for the Scoping Report (**Figure 1.1 of ES Vol 2 Appendix 1-1: Frodsham Solar Scoping Report (May 2023) [EN010153/DR/6.2])** included land required for the development of the solar array, BESS and Frodsham Solar Substation, and the Main Site Access Route from the west. The boundary also included land to allow a connection to be made to SPEN Frodsham Substation and a potential private wire link to INEOS Inovyn Runcorn Site. The boundary along the Main Site Access Route from the west also provided for a private wire link to businesses to the west of the Site. Addition of Cell 3 Early in the environmental assessment process it became evident that there would be a need to mitigate for impacts on non-breeding birds from the Mersey Estuary which use the Site for over-wintering and as a high tide roost. Cell 3 of the Manchester Ship Canal Dredging Ground forms part of the Frodsham Wind Farm mitigation and is located adjacent to the Scoping site boundary. The land is being managed for the purposes of nature conservation, however, it became evident from a review of this area that the cell presented opportunities for further enhancement. As such this area of land was included in the Site boundary as potential for mitigation of the Proposed Development (further information is provided below on SPA mitigation options). This is shown as Area A on **ES Vol 3 Figure 3-1: Site Boundary Changes & Alternative BESS/Substation Locations [EN010153/DR/6.3].** Removal of INEOS Inovyn Private Wire and INEOS Inovyn Dredging Ground The location of the Site offers a number of opportunities to provide private wire connections to local businesses to deliver renewable energy directly to industry. This provides the opportunity to maximise the energy generating potential of the Site, reduces losses in transmission, delivers a dependable source of local renewable energy to local businesses, and helps reduce the strain on the local and national electricity grid. One such opportunity is a link to INEOS Inovyn's Runcorn Site located to the north of the River Weaver. There are also opportunities to provide power to the businesses to the west of the Site which include Encirc Glass, Protos development area (which is promoting environmental and resource management development) and businesses in the Stanlow Industrial Area. At the outset of the project the Applicant sought opportunities to provide a direct wire link to INEOS Inovyn's Runcorn Site. A number of crossing options were considered including overhead lines, underground directionally drilled connections and underground connections via existing ducts/chambers. In addition, INEOS

Component of the Proposed Development	Alternatives considered and main reasons for selecting the chosen option
	Inovyn own the land which was formerly used as a deposit ground for dredgings from the Weaver Navigation and this presented the opportunity for the development of additional solar capacity. Land for all of the above options was included in the Scoping Site Boundary. Following Scoping, INEOS Inovyn and the Applicant collaborated to integrate these opportunities into the project. However, the complex industrial interactions (including sensitive service connections),timescales with establishing baseline data on the Dredging Ground, and difficulties in developing a design which did not conflict or constrain operations on INEOS Inovyn's site meant that a private wire connection to INEOS Inovyn Runcorn Works and development of solar PV array on the INEOS Inovyn Dredging Grounds was dropped from the Proposed Development. The areas removed from the Site boundary are shown as Area B on **ES Vol 3 Figure 3-1: Site Boundary Changes & Alternative BESS/Substation Locations [EN010153/DR/6.3].** <u>PEIR</u> Findings from the breeding bird surveys undertaken at the Site identified the presence of breeding Skylark which would be impacted by the Proposed Development. There are well established methods for mitigating impacts on this species, which typically include providing improved foraging habitat within arable land. There are opportunities to provide mitigation within the land within the Scoping site boundary, plus the ecological mitigation within Cell 3. However, additional land has been added to the draft Order Limits specifically for Skylark Mitigation if this is deemed necessary following further assessment. This area is shown as Area C on **ES Vol 3 Figure 3-1: Site Boundary Changes & Alternative BESS/Substation Locations [EN010153/DR/6.3].** There were also a number of other minor changes to the boundary prior to publishing the PEIR. This included: • Land required to access the Frodsham SPEN Substation and provide a construction compound, see Area E on **ES Vol 3 Figure 3-1: Site Boundary Changes & Alternative BESS/Substation Locations [EN010153/DR/6.3]**. • Access to the Site via existing roads from Frodsham via Brook Furlong and Marsh Lane, and Weaver Lane. Access would be restricted to use by emergency service vehicles, and in the case of Brook Furlong and Moorditch Lane for access by the public to the newly created car parking area – noting that vehicles already access and park along Moorditch Lane. These areas are shown as Area D on **ES Vol 3 Figure 3-1: Site Boundary Changes & Alternative BESS/Substation Locations [EN010153/DR/6.3].** <u>ES</u> No comments or consultation responses received as part of the Statutory Consultation led to changes to the Order Limits. However, in the process of reviewing landownership and discussions with landowners three minor changes were made to the draft Order Limits. Two of the changes involve a slight modification (reduction in area) to the northern boundary, one at Marsh Farm and the other adjacent to Cell 3. These changes were a result of aligning to land ownership boundaries. Neither change

Component of the Proposed Development	Alternatives considered and main reasons for selecting the chosen option
	affects the design of the Solar PV Array or the BESS. The Order Limits crossing the River Weaver have been narrowed as the alignment of the cable connection to the Frodsham SPEN Substation has been refined. Landownership discussions has allowed the Applicant to identify a specific area of land for Skylark mitigation within the broad area that was illustrated in the PEIR. Finally, there has been a minor change to the Order Limits on the land to the north of the M56 overbridge on Weaver Lane to align with established landowner boundaries, again this has not impacted the design of the Solar PV Array or the BESS. The changes from the draft Order Limits are shown as Area F on **ES Vol 3 Figure 3-1: Site Boundary Changes & Alternative BESS/Substation Locations [EN010153/DR/6.3].**
BESS and Frodsham Solar Substation	A number of different locations have been considered for BESS and Frodsham Solar Substation. The main locations considered are shown on **ES Vol 3 Figure 3-1: Site Boundary Changes & Alternative BESS/Substation Locations [EN010153/DR/6.3].** 1) Opposite SPEN Frodsham Substation on the southern side of the River Weaver. This location would provide the shortest connection distance to SPEN Frodsham Substation. This has a number of advantages associated with the proximity to SPEN Frodsham Substation such as reduced visual impact from above ground cables, reduced transmission losses and lower cost of connection. However, this location is located within Flood Zone 3a. BESS and Frodsham Solar Substation are critical to the operation of the generating station and so should preferentially be located within an area at a lower risk of flooding. The location is also adjacent to a public footpath (FP93) and would be prominent in views from the footpath. 2) South eastern corner of MSC Dredging Deposit Cell 1. This location is within Flood Zone 1 and as such is preferable to Location 1. The compounds would be located in proximity to the hydrocarbon pipelines illustrated on **ES Vol 3 Figure 1-6: Utilities [EN010153/DR/6.3]**. Whilst it is deemed possible to safely design the BESS and Frodsham Solar Substation to be located in close proximity to the pipelines, this location would carry a greater degree of risk than a compound located at greater distance from the pipelines. This location would also be clearly visible from RB108. The connection distance to SPEN Frodsham Substation is longer than Location 1. 3) Eastern boundary of MSC Dredging Deposit Cell 5. This location is served by an existing Frodsham Wind Farm access track. The tracks enable access from two directions, north towards Brook Furlong and west along the Main Site Access. This provides additional resilience to safely access the BESS in the event of a fire. The use of an existing access road reduces development footprint and resources. The location is well screened from users of nearby PRoW (RB99, RB108 and RB98) both due to changes in levels and also presence of existing screening vegetation. The connection distance to SPEN Frodsham Substation is longer than Location 1, but is similar to Location 2. This location is closer to residential receptors than Location 1 or 2.

Component of the Proposed Development	Alternatives considered and main reasons for selecting the chosen option
	4) Southern boundary of MSC Dredging Deposit Cell 5. This location has very similar characteristics to Location 3 in terms of access via existing Wind Farm access tracks, visibility from PROW, grid connection distance and location to residential receptors. Based on the factors set out above the Applicant has selected Location 3 (referred to as Option 2 in this ES) and Location 4 (referred to as Option 1in this ES) to take into the DCO application. Location 1 was discounted due to the alternative locations being sequentially preferable in relation to flood risk. Location 2 was deemed less preferable than Location 3 and 4 due to visibility from the adjacent PRoW and also proximity to the hydrocarbon pipelines. A noise analysis was undertaken to establish if the operation of the BESS and Frodsham Solar Substation at Location 3 and 4 would result in significant noise impacts. The analysis demonstrated that noise from the BESS and Frodsham Solar Substation would result in a low impact according to BS4142: 2014+A1:2019 and would not exceed sleep disturbance criteria with the noise from the M56 exceeding noise generated from the BESS. The noise assessment is provided as **ES Vol 2 Appendix 4-1: Noise Impact Assessment [EN010153/DR/6.2].** The assessments presented in the ES do not identify any factors which render one option as having a materially greater environmental impact than the other and as such it is considered acceptable to retain the optionality within the DCO. The final option will be selected at the detailed design stage following the appointment of the contractor delivering these elements of the Proposed Development.
Grid Connection Options	<u>SPEN Grid Connection</u> A combination of underground and above ground connection options were considered for the connection between Frodsham Solar Substation and the SPEN Frodsham Substation. A key benefit of a below ground cabling option is normally the avoidance of visual impacts associated with the pylons and wires. Disadvantages of a below ground connection are as follows: An underground cable would require an easement to be provided either side of the trench which would preclude the construction of solar panels above, and in close proximity to, the cable trench. This would reduce the generating capacity of the Site. The cables would need to be buried beneath the drainage ditches which intersect the eastern half of the Site. This would result in greater disturbance to habitats during construction and as the cables would be high voltage (132kV) they would have the potential to give rise to electromagnetic effects on fish / eels within the ditches. Excavations on the bunds of the MSC Dredging Deposit cells may cause instability and effect the engineering function of the cells. The cable route would also cross sections of mature vegetation on the banks of the Cell 5 and along Brook Furlong, this vegetation would need to be removed for the construction of an underground cable. As shown in **ES Vol 3 Figure 1-6: Utilities [EN010153/DR/6.3]** the Site is also crossed by a number of underground utilities, and as described in **ES Vol 1 Chapter 4: Environmental Impact Assessment Methodology [EN010153/DR/6.1]**, further underground services are proposed. As such the presence of buried services would cause delay, complexity and cost to the construction process if an underground option was chosen. In terms of the crossing of the River Weaver, if an underground cabling solution was adopted it would require deep access and exit pits to be dug on

Component of the Proposed Development	Alternatives considered and main reasons for selecting the chosen option
	either side of the river. To the north this would require excavation within the floodplain and in an area of mixed scrub and reedbed. Finally, below ground cabling is a slower and more expensive method of construction particularly where this requires directional drilling. An Overhead Line (OHL) would avoid many of the aforementioned disadvantages. An OHL would still require an easement around pylon locations but the loss of generating capacity would be much less than an underground cable. The main disadvantage would be the visual impact of the OHL. The 132kV connection route would be located between the existing 400kV and 132kV OHL connections, both of which are supported on metal lattice tower structures up to 50m in height. There are other above ground electricity connections which also connect into the SPEN Frodsham Substation. Furthermore, the presence of the wind turbine, M56 viaduct and other large-scale infrastructure in the locality such as the INEOS Inovyn Runcorn Works and the SPEN Frodsham Substation, mean that existing above ground electrical connections and other large scale vertical infrastructure is conspicuous within, and in close proximity to, the Site. Engagement with SPEN has also confirmed that wooden trident poles could be used for the connection which would be lower and less visually intrusive than the existing metal lattice electricity pylons which cross the Site. Given the context of the Site the visual impact of the OHL was considered to be negligible and did not outweigh the benefits of an underground cable solution. Based on the aforementioned factors the advantages of an OHL were considered to outweigh the disadvantages of a below ground solution.
Ecological mitigation / enhancement	As set out above in relation to the changes to the Site boundary it was recognised early in the design process that there would be potential for adverse effects on functionally linked habitats which are used by qualifying species of the Mersey Estuary SPA, Ramsar and SSSI. As such, options to mitigate these effects were explored within and outside the Scoping site boundary. On-site options would require loss of solar generating capacity which would harm one of the key objectives of the Proposed Development, which is to deliver as much renewable energy as possible from the Site. The Government's intention to maximise renewable energy is clear within NPS EN-1 via the designation of low carbon generating capacity as CNP infrastructure. However, it is also the case that the mitigation hierarchy must be followed, and that development must not come at any cost and adverse effects, in particular effects on a designated habitat site, must be mitigated such that development of CNP Infrastructure does not have an adverse impact on the integrity of the UK National site network. In order to achieve an outcome of maximising renewable generation and also avoid an adverse impact on the integrity of the Mersey Estuary SPA a number of mitigation options were considered. The raised land to the immediate north of the Manchester Ship Canal, known as Frodsham Score, which abuts saltmarsh of the Mersey Estuary was considered for mitigation. However, access to this land is restricted to access via boat making any

Component of the Proposed Development	Alternatives considered and main reasons for selecting the chosen option
	improvements and ongoing management very challenging, furthermore the land is already located within the SPA which makes enhancement a more challenging option in terms of HRA requirements. The nature of this elevated land also means it is very hard to convert it into a habitat which would be of increased value, over and above its current state, to the target species of birds. Land to the north / east of the Site is limited in its ability to provide mitigation due to the presence of existing development including INEOS Inovyn Runcorn Works and the urban area of Runcorn. Similarly, to the south-east is the M56 and Frodsham urban areas. Land to the south of the Site, between the MSC Dredging Deposit Ground and the M56, is undeveloped and so offers some potential for mitigation. However, this is in productive agricultural use and the network of hedgerows and trees reduce its suitability for the target species, although it remains suitable for mitigation of effects on skylark. To the south of the Site, Cell 6 of the MSC Dredging Deposit Ground is in active use for the deposition of MSC dredgings and is a vital asset for the MSC Company and essential for the ongoing operations. Further west, Cell 4 forms part of the wind farm mitigation and is managed for reedbed habitats, again not suitable to mitigate the effects of the Proposed Development. As set out previously Cell 3 of the MSC Dredging Deposit Ground, which is located to the west of the original Scoping site boundary, forms part of the mitigation for Frodsham Wind Farm. The current Habitat Management Plan for this area is designed to and has delivered improved habitats for the qualifying species of the SPA. However, the ground conditions and hydrological conditions of Cell 3 limit its benefit for the target species which the Proposed Development would impact. As such the Applicant decided to explore options for the further enhancement of this area to establish if the value of Cell 3 could be increased to not only provide the mitigation required by virtue of the Frodsham Wind Farm consent but also deliver additive benefits over and above this, such that the effects of the Proposed Development could also be mitigated on the same area of land. The conclusion of the assessment work was that it would be possible, through re-engineering of Cell 3 and introduction of measures to control the water supply to the cell, to create wet grassland, open water and islands which would significantly increase its value and carrying capacity for the target species. On this basis it was decided to deliver mitigation on Cell 3 which would ensure that there would be no significant effects on the qualifying species of the SPA or indeed the integrity of the SPA. The details of this are presented in the Non-Breeding Bird Mitigation Strategy (**Appendix B - Outline Landscape and Ecology Management Plan [EN010153/DR/7.13]**). Two options to deliver the mitigation proposals in Cell 3 are presented in **ES Vol 1 Chapter 2: The Proposed Development [EN010153/DR/6.1]** and provided for within the various outline management plans submitted with the DCO application.

Component of the Proposed Development	Alternatives considered and main reasons for selecting the chosen option
	Both options deliver the same extent of wet grassland and scrapes on Cell 3 and so neither are more or less preferable from an ecological mitigation perspective. However, two options are presented as there may need to be flexibility on where soils are moved within Cell 3 and how this is undertaken, which would be determined as part of permitting approach discussions with the Environment Agency.
Amenity and Recreation	From the outset of the project the Applicant recognised that the Site was used by the local community as a recreational asset, with a number of PRoW crossing the Site. The local community further reinforced this in the phase one consultation. Accordingly, the Applicant has explored opportunities to enhance the amenity and recreational value of the Site. Members of the public and officers of CWaCC have highlighted that the footpaths within the Site can be hard to navigate due to the poor condition of the PRoW network. It was also evident to the Applicant that there are a number of one-way routes within the existing PRoW network on the Site which could be enhanced by creating new links. New links would introduce many more options for routes of varying lengths, and which allow users to experience different attributes of the Site and surrounding area. The Applicant has therefore considered a number of permissive access routes across the Site which would add recreation value to the Site, along with a commitment to upgrade and improve existing footpaths within the Site. In addition to this the Applicant is also providing for a potential visitor car park. This is not necessarily anticipated to increase visitor usage, although the proposed improvements to the footpath network may result in this. However, the Applicant has observed frequent informal parking along Moorditch Lane which forms part of the National Cycle Network. It is considered that the provision of a car park could, therefore, enhance the experience of the NCN and may also help preserve the surface in a more suitable condition for cyclists. The creation of additional paths and improved access would allow users better access to the Mersey Estuary and the ability to observe the biodiversity and bird life of this protected area. However, it is recognised that this can also have adverse impacts through disturbance. One alternative was to avoid the creation of new routes close to the estuary, but this would remove access to a resource which is understood to be valued by the local community. As such, design measures have been introduced to reduce this impact through the provision of bird screening measures, the indicative locations of where these screens may be deemed necessary are shown on **ES Vol 3 Figure 2-3: (a-e) Illustrative Environmental Masterplan [EN010153/DR/6.3]**.
Flooding	The eastern half of the Site, to the east of Brook Furlong, lies within Flood Zone 3 (refer to **ES Vol 3 Figure 1-3: Planning and Environmental Designations [EN010153/DR/6.3]**). The western half of the Site, which forms part of the MSC Dredging Deposit Ground, is raised above flood levels, and lies within Flood Zone 1.

Component of the Proposed Development	Alternatives considered and main reasons for selecting the chosen option
	As set out above the BESS and Frodsham Solar Substation have been located within Flood Zone 1, on the raised area of the Site that forms part of the former MSC Dredging Deposit Grounds. Furthermore, approximately three quarters of the generating capacity of the solar array would also be located on MSC Dredging Deposit Ground Cells 1, 2 and 5, within Flood Zone 1. The remaining proportion of the solar array, on the eastern half of the Site, would be located within Flood Zone 3. In order to understand the impact of flooding a range of different flood scenarios have been modelled in agreement with the Environment Agency. This has led to the calculation of a design flood level of 6.52m AOD. The details of the flood modelling are provided in **ES Vol 2 Appendix 9-1: Flood Risk Assessment and Drainage Strategy [EN010153/DR/6.2**]. Power Conversion Units (PCUs) and standalone Inverters and Transformers would be vulnerable to flooding and so would need to be protected from flood water. Two options were considered. Option 1 was to create a bund around the items of infrastructure to prevent them from being inundated. Option 2 was to raise the elements of infrastructure above the flood levels. Option 1 would enable the Power Conversion Units (PCUs) and standalone Inverters and Transformers to remain at ground level and therefore reduce their visual impact. However, the creation of bunds would result in a loss of flood storage, have a greater disruption on conveyance and would also take up a greater area of land reducing the generating capacity of the Proposed Development. Option 2 would reduce loss of flood storage, have less of an impact on flood water conveyance and maximise generating capacity. The units would need to be raised by up to approximately between 1.5 and 2.0m above existing ground level, placing them approximately 0.5m to 1m above the height of the panels (which have a maximum height parameter of 4m above ground level). Within the indicative design, the closest visual receptor to a PCU is a footpath, which is located approximately 140m away. At this distance, and in the context of the solar array, the increased height of the PCUs would not materially increase the level of magnitude of visual effects, as illustrated on **ES Vol 3 Figure 6-39v and Figure 6-39viii** (photomontages from the public footpath looking towards a PCU located approximately 140m from the viewpoint). Based on the foregoing, it was decided to proceed with Option 2. As set out in the PEIR the option of raising the solar panels out of the flood zone was explored prior to the Statutory Consultation. The options considered involved raising them so the base of the panels were submerged slightly during the design flood event (approximately 30cm) or raising them completely out of the design flood level. The option of setting the panels at a height where there was a slight inundation was chosen. Whilst there would be periods when a proportion of the solar array would not function i.e. those areas within the flood zone would be isolated during a flood event to prevent damage

Component of the Proposed Development	Alternatives considered and main reasons for selecting the chosen option
	to the equipment, the remainder of the Site (which forms the majority of the generating capacity of Frodsham Solar) including the BESS and Frodsham Solar Substation would remain operational. In their response to the Statutory Consultation, the EA requested that the panels be raised above the design flood level in their entirety. This minor increase in height is shown to have minimal visual impact, as illustrated on the photomontages contained in **ES Vol 3 Figure 6-36: to 6-48 Photomontages [EN010153/DR/6.3]**. On this basis, and given the greater flood resilience the change provides, it was decided to proceed with the advice of the EA and raise the panels and PCUs within the flood zone areas, thus enabling the entirety of the solar farm to continue to operate during a design flood event. The design at the PEIR stage was undertaken on the basis of providing open span bridges where new bridges are proposed to cross drainage ditches, and lengthening existing culverts where widening of existing crossings is required. However, in response to consultation with the Environment Agency the Applicant has committed to the use of open span bridges for new crossings and replacement crossings. This will deliver benefits in terms of flood flows but also connectivity along watercourses. The soffit level of the bridges over ditches classified as Main Rivers have been raised following consultation with the Environment Agency to provide 600mm freeboard (m AOD) above design flood level for the 1% AEP plus 67% Climate Change event for the watercourses they cross. Raising the bridge soffits to meet the Mersey Tidal Flooding Event has been discounted because this would result in the bridges becoming isolated islands during a flood event. An alternative would be to raise all the linking access roads to a similar level; however, this would not be sustainable in terms of the import of materials and its impacts on flood storage. It is also not considered a proportionate measure to manage the risk that the EA were concerned about, which is the level of risk to operatives at the Site, which has been addressed via the provision of a Flood Warning and Evacuation Plan. Further details are provided in ES Vol 2 Appendix 9-1: Flood Risk Assessment and Drainage Strategy [EN010153/DR/6.2].

3.6 References

[i] HMSO (2017). Infrastructure Planning (Environmental Impact Assessment) Regulations 2017. Available at: https://www.legislation.gov.uk/uksi/2017/572/introduction [Last Accessed: 11 September 2024]

[ii] Department of Energy and Climate Change (2023). Overarching National Policy Statement for Energy (EN-1). Available at: https://assets.publishing.service.gov.uk/media/65a7864e96a5ec0013731a93/overarching-nps-for-energy-en1.pdf [Last Accessed: 11 September 2024]