Longfield Solar Farm

Environmental Statement [PINS Ref: EN010118]

Chapter 2: The Scheme

Document Reference: EN010118/APP/6.1(A)

Revision Number: 2.0

August 2022

Longfield Solar Energy Farm Ltd

APFP Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Quality information

Prepared by	Checked by	Verified by	Approved by
JP Environmental Consultant	PD Associate Director	NT Technical Director	NT Technical Director

Prepared for:

Longfield Solar Energy Farm Ltd

Prepared by:

AECOM Limited
Midpoint, Alencon Link
Basingstoke
Hampshire RG21 7PP
United Kingdom

T: +44(0)1256 310200

Table of Contents

2. The Scheme

2.1. Introduction

2.1.1. This chapter provides a description of the Order limits and surrounding area, and the proposed Scheme. The physical characteristics of the Scheme are described alongside the key activities that would be undertaken during construction, operation (which includes maintenance), and decommissioning. The details included in this chapter inform each of the technical assessments in Chapters 6 to 15.

2.1.2. This chapter is supported by the following figures in Volume 3:

Figure 2-1	Environmental Constraints
Figure 2-2	Existing Public Rights of Way
Figure 2-3	Construction Transport Access
Figure 2-4	Indicative Temporary Construction Compounds
Figure 2-5	Illustrative Concept Design
Figure 2-6	Substation Locations Considered
Figure 2-7	Main Site Entrance
Figure 2-8	BESS Cross-section A-A
Figure 2-9	BESS Cross-section B-B
Figure 2-10	BESS Cross-section C-C
Figure 2-11	BESS Cross-section D-D
Figure 2-12	Deer Fencing/CCTV
Figure 2-13	33kV Cable Trench Sections
Figure 2-14	Palisade and Gate Plan and Elevations
Figure 2-15	Permanent Plan Building Elevations
Figure 2-16	Storage Container Elevations
Figure 2-17	Inverter Substation Typical Detail
Figure 2-18	Substation Plan
Figure 2-19	Substation Elevations
Figure 2-20	Main Construction Compound
Figure 2-21	Secondary Construction Compound
Figure 2-22	Plant/Warehouse Building
Figure 2-23	Site Access Track Plan
Figure 2-24	Battery Container Elevation and Plan View
Figure 2-25	Primary Access Road Cross Section
Figure 2-26	BESS Area Phasing
Figure 2-27	Construction Layout
Figure 2-28	Outline Surface Water Drainage Layout
Figure 2-29	Difference between Existing and Working Levels
Figure 2-30	Difference between Working and Restored Levels
Figure 2-31	Difference between Existing and Restored Levels
Figure 2-32	11kV Powerline Diversion

Figure 2-33	Temporary Overhead Line Tower Key Line Diagram L8(c) ST M3.7
Figure 2-34	Temporary Diversion 4VB61A-4VB061B Braintree-Pelham-Rayleigh Main Circuit Profile drawing
Figure 2-35	Overhead Line Temporary Diversion Bulls Lodge 4VB Route
Figure 2-36a	Bulls Lodge Substation Extension General Arrangement Drainage Plan
Figure 2-36b	Bulls Lodge Substation Extension General Arrangement Earthworks Plan and Sections
Figure 2-37	Bulls Lodge Substation Extension General Arrangement Proposed Fencing Layout Plan
Figure 2-38	General Arrangement Swept Path Analysis 16.5m Articulated Vehicle
Figure 2-39	Bulls Lodge Substation Extension Elevations East
Figure 2-40	Bulls Lodge Substation Extension Plant Elevations West
Figure 2-41	Bulls Lodge Substation Extension Elevations South
Figure 2-42	Bulls Lodge Substation Extension Elevations North
Figure 2-43	Bulls Lodge Substation Extension Layout Plan

2.2. Project Overview

2.2.1. Longfield Solar Farm (the Scheme) is a proposed solar farm with energy storage which will generate and store renewable electricity for export to the National Grid.

2.2.2. The Scheme will comprise the construction, operation and maintenance, and decommissioning of a solar photovoltaic (PV) electricity generating facility with a total capacity exceeding 50 megawatts (MW), an energy storage facility and an export/import connection to the National Grid, via an extension of the existing Bulls Lodge Substation. The Scheme will be located within the 'Order limits' (as described below) and is the subject of the Application.

2.3. The Order limits and Surroundings

2.3.1. The area of land required for the construction, operation and maintenance, and decommissioning of the Scheme is shown on **Figure 1-2** [**EN010118/APP/6.3**]. This includes land required for temporary and permanent uses.

2.3.2. The Order limits shown on **Figure 1-2** comprises 452.93 hectares (ha) of land, (with the rounded figure of 453ha being used for descriptive purposes throughout the technical chapters of the ES) and is located within the administrative areas of Chelmsford and Braintree, in the county of Essex.

2.3.3. This section provides an overview of the Order limits and the surrounding area. Environmental constraints (**Figure 2-1** [**EN010118/APP/6.3**]) identified through further studies, e.g., buried archaeology, are described in the relevant technical chapters.

Existing Conditions within the Order limits

2.3.4. The land within the Order limits is not covered by any statutory landscape designations, i.e., National Parks, or Areas of Outstanding Natural Beauty (AONB).

2.3.5. The landscape features within the Order limits consist of agricultural fields mainly under arable production, with some small parcels of pasture, interspersed with individual trees, hedgerows, tree belts (linear) small woodland blocks and farm access tracks. The hedgerows within the Order limits range between lengths of dense tall vegetation (shrub and tree species) and thin lines of vegetation with sporadic trees present, although the former is a dominant feature. The arable fields are of small to moderate size, some of which are of irregular shape.

2.3.6. The northern part of the Order limits and surrounding area consists of undulating and relatively elevated landform, as part of the River Ter valley. The landform rises steeply northwards from the river and Terling Spring, between 35m Above Ordnance Datum (AOD) to 50m AOD along parts of Braintree Road. It culminates at a ridgeline at 70m AOD at Rank's Green, in the northern part of the Order limits. To the south of the River Ter, the landform also rises steeply, across Sandy Wood, to a ridgeline at 55m AOD.

2.3.7. Most of the central and southern part of the Order limits is located across flat and low-lying landform at approximately 45m AOD, between Waltham Road / Boreham Road and Terling Road. The northern part of the Order limits is located within part of the River Ter valley, where there is rising land to the north and south of Terling Spring and adjacent to Braintree Road.

2.3.8. There is an existing network of public rights of way (PRoW) within the Order limits and across the surrounding area (as shown in **Figure 2-2** [**EN010118/APP/6.3**]).

2.3.9. Other existing infrastructure within the Order limits and surrounding area includes 400kV, 132 kV, and 11kV overhead powerlines (OHLs) carried by OHL towers and wooden poles. These extend from the south west of the Order limits to the north west of Boreham, across most of the Order limits and to the west of Sandy Wood, where the alignment of the OHLs diverts to the west and east of Fuller Street.

2.3.10. The existing Bulls Lodge 400kV National Grid substation lies within the south western part of the Order limits, to the west of Brick House Farm and approximately 400m to the north of the A12 carriageway.

2.3.11. Two access routes are included within the Order limits. These are Wheelers Hill and Cranham Road, to the west of the Solar Farm Site, and Generals Lane to the south of the Bulls Lodge Substation Site.

Existing Conditions surrounding the Order limits

2.3.12. A number of settlements lie within the vicinity of the Order limits including Fuller Street approximately 300m to the north, Gamble's Green and Terling 500m and 1.1km to the east, Boreham 500m to the south-west, Hatfield Peverel 1.5km to the south-east, and Chelmsford 5.7km to the south-west.

2.3.13. Boreham Road and Waltham Road run north to south along the western edge of the Order limits, with the A12 carriageway and B1137 lying to the south and

south west of the Order limits, along with the railway line connecting Chelmsford and Witham, approximately 800m beyond the southern edge of the Order limits.

2.3.14. To the west of the Order limits, the landscape consists of a varied pattern of landform, reflecting past sand and gravel extraction and engineered flat terrain across Boreham airfield, which is situated at 55m AOD approximately 800m to the west of the Order limits. From the airfield, the landform falls very gradually eastwards to the River Ter, which flows southwards between Terling and the northern part of Hatfield Peverel, at approximately 20m AOD.

2.3.15. The River Chelmer flows approximately 2.5km south of the Order limits, at approximately 15m AOD. There are several large-scale reservoirs and lakes adjacent to the river. From the river, the landform rises consistently northwards, to form a ridgeline around 40m AOD at Boreham, and southwards, across Little Baddow, to an elevated ridgeline at 100m AOD, approximately 3km from the Order limits.

2.3.16. Directly to the north of the existing Bulls Lodge Substation is agricultural land and approximately 500m northwest of the existing Bulls Lodge Substation is the Bulls Lodge Sand and Gravel Quarry and associated manmade ponds. The existing substation and all of its infrastructure forms the eastern boundary of the Bulls Lodge Substation and beyond that is Brick House Farm. Directly to the south of the existing Bulls Lodge Substation is Brick House Farm access track, more agricultural land, and beyond that the A12 road. The Grove woodland is present along the western boundary of the Bulls Lodge Substation.

2.3.17. Across the remainder of the surrounding area, Terling Road, Terling Hall Road and Boreham Road are the main north to south transport routes, providing access between the villages. Noakes Farm Road and Waltham Road provide west to east access, with Noakes Farm Road also crossing the Order limits. Braintree Road is the main road network to the north, extending between Terling and Fuller Street.

2.3.18. There are several ancient woodlands on the edges of, or surrounded by, the Order limits, and within the surrounding area. Within, or adjacent to the Order limits, these include:

a) Brickhouse Wood, Hookley Wood and Sandy Wood;

b) Scarlett's Wood, Ringer's Wood, Toppinghoehall Wood and Porter's Wood; and

c) Scrub Wood and Blake's Wood.

2.3.19. There are 275 listed buildings within 3km of the Order limits: 251 listed grade II, 18 listed grade II* and six listed grade I.

2.3.20. There are three Scheduled Monuments within 3km of the Order limits. Great Loyes moated site and fishpond (NHLE 1008979) is approximately 1.7km to the east of the Order limits; Gubbion's Hall moated site (NHLE 1016802) is approximately 2.2km to the north-west; and Hatfield Priory (NHLE 1002150) is approximately 2.25km to the south-east.

2.3.21. There are four registered parks and gardens within 3km of the Order limits. Terling Place (NHLE 1000745) is approximately 130m to the east; Hatfield Priory (NHLE 1000206) is approximately 2km to the south-east: New Hall, Boreham (NHLE 1000207) is approximately 1.3km to the south-west; and Boreham House (NHLE 1000354) is approximately 1.2km to the south-west.

2.3.22. Three conservation areas fall within the 1km study area: the Terling Conservation Area, the Boreham Roman Road/Plantation Road Conservation Area, and the Boreham Church Road Conservation Area.

2.3.23. The Terling Conservation Area is located approximately 650m north east of the Order limits. Boreham Roman Road/Plantation Road Conservation Area is located approximately 300m south of the Order limits and is separated from it by the A12 trunk road and the railway line. The Boreham Church Road Conservation Area is located further south, approximately 1km south of the Order limits. All three conservation areas are considered to be of medium value.

2.3.24. The Dedham Vale Area of Outstanding Natural Beauty (AONB) is the closest statutory landscape designation to the Order limits and is located approximately 23km to the north-east of the Order limits.

2.3.25. There are no World Heritage Sites or Registered Battlefields within 3km of the Order limits.

2.4. Concept Design Parameters, Design Principles and the Rochdale Envelope

2.4.1. A number of elements of detailed design for the Scheme cannot be confirmed until the tendering process for the design and construction of the Scheme has been completed. For example, due to the rapid pace of technological development in the solar photovoltaic (PV) and energy storage industry, the Scheme could utilise technology which does not currently exist and therefore sufficient flexibility needs to be incorporated into the Application.

2.4.2. To address this, a 'Rochdale Envelope' approach is used, as described in the Planning Inspectorate Advice Note 9 (Ref. 2-8). This involves assessing the maximum (and where relevant, the minimum) parameters for the Scheme where flexibility needs to be retained. The principles and justification for this approach are set out in section 5.2 of ***Chapter 5: Environmental Impact Assessment Methodology*** of this ES **[EN010118/APP/6.1]**.

2.4.3. In order to establish parameters within the Rochdale Envelope for assessment, a set of "Design Principles" have been established. The Design Principles are appended to the Design Statement **[EN010118/APP/7.3]** and form the Rochdale Envelope limits within which the Scheme can be built and operated. These design principles correspond to the physical areas set out in the works plans **[EN010118/APP/2.2].**

2.4.4. The Design Principles allow for flexibility in the Scheme design. In addition, an ***Illustrative Concept Design*** (**Figure 2-5 [EN010118/APP/6.3]**) has been created to provide a visual representation of a tangible illustrative example of a scheme that could be constructed within the Design Principles. This Concept Design enables a robust assessment of likely significant effects to be undertaken within this ES, for topics where the nature of the assessment methodology requires a specific level of detail, namely the landscape and

visual, cultural heritage, and noise assessments. The quantity and sizing of equipment shown in this illustrative concept design is captured in appendix 2-A to the scheme description: **Concept Design Appendix [EN010118/APP/6.2]**

2.4.5. The Concept Design Parameters and layout present an illustrative example of what could be built under the Design Principles, within the bounds of the Design Principles and Work Plans. In many cases, the Concept Design Parameters are the same as the Design Principles, such as the height of PV Panels, which are established as Design Principles.

2.4.6. It is also important to recognise that in some cases the Concept Design includes 'indicative' design details, rather than maximum parameters. For example, the number of PV Panels in the Concept Design is an indicative number rather than a maximum number, as a Design Principle controls the maximum total surface area of all PV Panels. This is included as a principle, (rather than the total number of PV Panels), because the surface area of an individual PV Panel and number of them does not have the potential to change the likely significant effects of the Scheme, whereas the maximum total surface area of all PV Panels does. Over time, as technology advances, it is quite possible that PV Panels could change in size, meaning that more or less are required to cover the same area (as limited by the Design Principles and Works Plans **[EN010118/APP/6.3]**). As a result, it is the total surface area of PV Panels that is relevant to the technical assessments and not the number of PV Panels needed to achieve that, hence it is the total surface area of PV Panels that is the relevant parameter (the Design Principle).

2.4.7. The assessment in each technical chapter has assessed the Rochdale Envelope (that is, the Design Principles), as set out within ***Chapter 5: EIA Methodology***, of this ES **[EN010118/APP/6.1]**.

2.4.8. As a result, regardless of the approach taken, all chapters have assessed the likely significant effects arising from the worst case parameter within the Design Principles.

2.4.9. In the following text within this ES chapter, any maximum and minimum parameters mentioned relate to the Design Principles, unless otherwise stated.

2.5. Components of the Operational Scheme

2.5.1. The Order limits comprises 453 ha and includes the following key components. The Scheme is also described in Schedule 1 of the draft DCO **[EN010118/APP/3.1]** where the "authorised development" is divided into works packages, and the works numbers for those packages are identified below and referred to throughout this chapter. Note that there is overlap of Work Areas in some locations and so the sum of the Order limits is not the total of these areas:

a) Work No. 1: Solar Photovoltaic Generating Station up to 275.26ha, known as 'The Solar Farm Site' for ease of refence throughout this ES;

b) Work No 2: Battery Energy Storage System (BESS) up to 5.2ha

c) Work No 3: Longfield Substation: up to 1.66ha;

d) Work No 4: Grid Connection Route including access tracks (Work No 4A) and temporary construction laydown areas (Work No. 4B): up to 22.90ha;

e) Work No. 5: Bulls Lodge Substation Extension including electricity switching station (Work No. 5A up to 4.62ha) and temporary overhead line alterations (Work No. 5B up to 3.72);

f) Work No 6: works (up to 370.09ha) including

   i. electrical cables including electrical cables connecting to Work No. 1 to Work No. 3;

   ii. fencing, gates, boundary treatment and other means of enclosure;

   iii. works for the provision of security and monitoring measures such as CCTV columns, lighting columns and lighting, cameras, weather stations, communication infrastructure, and perimeter fencing;

   iv. landscaping and biodiversity mitigation and enhancement measures including planting;

   v. improvement, maintenance and use of existing private tracks; and

   vi. laying down of internal access tracks, ramps, means of access, footpaths, permissive paths, cycle routes and roads, including the laying and construction of drainage infrastructure, signage and information boards;

   vii. temporary footpath diversions;

   viii. earthworks;

   ix. SuDs Ponds, runoff outfalls, general drainage and irrigation infrastructure and improvements or extensions to existing drainage and irrigation systems;

   x. up to 10 secondary temporary construction compounds, both within the permanent work area and outside the permanent work area;

   xi. works to divert and underground existing electrical overhead lines.

g) Work No 7: Temporary construction and decommissioning compounds (Work No. 7A, up to 6.9ha), secondary temporary construction compounds within the Solar Farm Site (part of Work No. 6), and temporary construction laydown for the Bulls Lodge Substation Extension (Work No. 7B, up to 7.21ha);

h) Work No 8: Ancillary Buildings, being office, warehouse and plant storage building: up to 0.61ha;

i) Work No. 9: Works to facilitate site access to the Solar Farm Site and the Bulls Lodge Substation Extension up to 5.11ha; and

j) Work No. 10: Habitat Management Areas: a minimum of 55.8ha.

The Solar Farm Site (Work No. 1)

2.5.2. The Solar Farm Site, Work No. 1 in the DCO, includes the following elements:

a) 29 Potential Development Areas (PDA) with a total combined area of 275.26ha are located within the Solar Farm Site. A PDA represents a parcel of land within the Solar Farm Site where Solar PV Arrays may be installed across Work No 1. The PDA numbering was created earlier in the evolution of the Scheme and due to design changes as set out in ***Chapter 3: Alternatives and Design Evolution*** of this ES, two PDAs were removed from the Scheme. These are numbers 24 and 25 and were situated to the north of Ringers Farm at the eastern extent of the Order limits. The rest of the PDAs were not renumbered in order to retain the consistency of referencing throughout the ES and supporting documents, so references include up to PDA 31.

b) The parameters for each Solar PV Array are set out in the ***Concept Design Appendix*** at Appendix 2A of this ES [**EN010118/APP/6.2**] and in the ***Outline Design Principles*** document appended to the ***Design Statement*** [**EN010118/APP/7.3**]. PV Panels and PV Mounting Structures combine to form PV Tables. PV Tables are set out in rows, and groupings of PV Tables form PV Arrays; and

c) Balance of Solar System (BoSS) (comprising inverters, transformers, and switchgear).

Solar PV Arrays

Solar PV Panels

2.5.3. PV Panels convert sunlight into electrical current (as direct current, DC). Individual PV Panels are currently typically up to 2.5m long and up to 1.4m wide and consist of a series of photovoltaic cells beneath a layer of toughened and anti-reflective glass.

2.5.4. The PV Panel frame is typically built from anodised aluminium or steel.

2.5.5. Each PV Panel could have a DC generating capacity of between 390 and 800 watts peak (Wp), which may increase in the future depending on advances in technology at the time of construction (the latest technology under development is currently up to 800Wp).

2.5.6. A range of PV technologies are developing rapidly and may be available at the time of construction; therefore the generating capacity, technology type and size of individual PV Panels are not specified in the Application, rather the maximum total surface area of all PV Panels in each PDA is limited to that shown in the Works Plan [**EN010118/APP/2.2**].

PV Mounting Structures

2.5.7. PV Panels will be mounted on a metal assembly of PV Mounting Structures, called “PV Tables”. The PV Tables include metal rails (usually made of aluminium) to directly support the PV Panels; those rails will be supported by larger metal frames (usually made of galvanised steel), which are fixed on top of metal piles. The piles are also typically made of galvanised steel and are driven into the ground to a depth of up to 2m.

2.5.8. In some locations within the Order limits, there is restrictive clearance to high voltage OHL cables crossing the site. In these locations it may not be possible to install piled foundations due to the risk of construction plant infringing the required OHL safety clearances. Therefore, whilst piled foundations are the intended foundation type, PV Tables may be mounted on both piled and concrete pad foundations across the site. The Concept Design assumes that

approximately 5% of foundations could be concrete pads. Further details of the two foundation types are as described in the Concept Design Appendix.

2.5.9. The PV Tables will be orientated to the south at a slope of between 10 and 30 degrees from horizontal in a fixed tilt arrangement (which is the Design Principle). The Concept Design is based on a 15-degree slope.

2.5.10. The PV Tables (and therefore panels) will have a maximum height of 3m above ground level (AGL) at the rear (regardless of tilt angle) and a clearance AGL of 0.6 m at the front.

2.5.11. Between each row of PV Tables, the separation distance will be between approximately 2.0 to 4.0m, with a minimum of 2.0m spacing in the Design Principles. The layout shown on the Illustrative Concept Design (**Figure 2-5**) shows all rows separated by 3.0m to allow the visualisations to be prepared.

Balance of Solar System – BoSS (Inverters, transformers and switchgear)

2.5.12. In the Solar Farm Site, inverters, transformers and switchgear form the Balance of Solar System (BoSS) and are required to manage the electricity generated by the PV Panels.

2.5.13. Inverters are required to convert the DC electricity collected by the PV Panels into alternating current (AC), which allows the electricity generated to be exported to the National Grid. Inverters are sized to match the output from the PV Panels.

2.5.14. Transformers are required to step up the voltage of the AC electricity generated by the inverters across the Order limits before it reaches the Longfield Substation.

2.5.15. Switchgear is the combination of electrical disconnect switches, fuses or circuit breakers used to control, protect and isolate electrical equipment. Switchgear is used both to de-energise equipment to allow work to be done and to clear faults downstream.

2.5.16. There are several possible arrangements for the BoSS components, and therefore some flexibility is required with optionality presented in the Concept Design Appendix. However, the Design Principle for the height of the BoSS plant will be limited to 3.5m. The main optionality relates to the use of central or string inverters. Each technical chapter of the ES includes a section early in the chapter explaining which BoSS configuration option is used in that assessment and explains why that option represents the worst case impact of the BoSS options set out here. This approach secures the assessment of a realistic worst case design within the Rochdale Envelope parameters in this ES.

2.5.17. Central inverters typically have a capacity in the range of 3MW to 6MW AC. These inverters, alone or together with the associated transformer and switchgear, may rest on concrete slab or metal skids. Because of their large capacity, centralised inverters are fewer in quantity and are usually sized in parallel with the transformers in order to achieve a fixed ratio. This is commonly 1 transformer per 1 inverter or 1 transformer per 2 inverters. This will in turn determine the siting of these components, aiming for an efficient overall design.

2.5.18. String inverters are usually mounted on the PV Mounting Structure, under the PV Panels. Also, because of their small size, these inverters are used in much larger quantities, they are therefore distributed across the PV Arrays, while their output (AC current) is routed through to the respective transformer and switchgear as for a central inverter solution. These inverters may also be installed on the PV Mounting Structure or can be on a ground mounted frame beneath the PV Tables and are distributed across the PV Arrays.

Central Inverter Solutions

2.5.19. The BoSS components (inverters, transformers, switchgear, collectively known as Solar Stations when used with central inverter solutions) can be procured separately and installed independently as standalone units or else integrated into a single enclosure.

2.5.20. Central inverters could also be co-located with the rest of the BoSS components (transformer and switchgear), either in a combined, pre-configured unit or each in their own enclosure.

2.5.21. Transformers are required to step up and control the voltage of the electricity generated across the Solar Farm Site before it reaches the Longfield Substation. The maximum footprint in the Design Principles of a standalone transformer will be 6.5m x 5.5m, with a maximum height of 3.5m. This accommodates both the transformer, bunding (or other oil containment), safety clearance and fencing.

2.5.22. The switchgear will either be standalone in a cabin with a maximum footprint in the Design Principles of 3.0 x 2.5m in plan and 3.5m in height, or integrated with other components within an enclosure where the enclosure houses the transformer together with the switchgear. The maximum dimensions in the Design Principles of such an enclosure are given below. 2.5.23

2.5.23. Integrated Solar Stations would comprise one or two central inverters, transformers and switchgear all housed within a complete, pre-assembled and pre-configured unit with maximum dimensions in the Design Principles of up to 12.5m by 3.1m in plan and 3.5m in height.

2.5.24. Integrated Solar Stations would be pre-assembled, configured and often commissioned off-site and would be craned and installed in their designated locations on concrete foundations with a maximum foundation depth of 1m surrounded by permeable gravel to facilitate safe access in wet conditions. Alternatively, they can be rested on metal skids or feet.

2.5.25. A maximum of 150 Solar Station locations based on the central inverter solution are shown within the Design Principles.

String Inverter Solution

2.5.26. String inverters could be located across the Solar PV Array Works Area, beneath the PV Panels either secured to the PV Mounting Structure, or for larger, utility scale string inverters, in a ground-mounted frame independent of the PV Mounting Structure.

2.5.27. Typical utility string inverters would be 1.06m x 0.66m x 0.37m, and based on a 250kW solution, there could be 1,800 distributed across the Solar PV Array Area as set out in the Design Principles.

Under either string inverter solution, the inverters are sited within the footprint of the PV Array. Standalone transformers and switchgear would be required as described in sections 2.5.211 and 2.5.222 above.

The Battery Energy Storage System Compound (Work Nos. 2A and B)

2.5.28. The Scheme will include a Battery Energy Storage System (BESS), Work No. 2 in the DCO, located within the BESS Compound. The BESS is designed, as its main and primary function, to provide peak generation electric energy time-shifting and grid balancing services. It will do this by capturing electricity generated from the PV Panels and storing it in the batteries in order to dispatch to the electricity grid when it is most required. As a supplementary and secondary service, it may also import surplus energy from the National Grid and provide other ancillary and energy time-shifting services to help National Grid Electricity Transmission (NGET) manage the increasing penetration of (variable) renewable generation on the transmission network.

2.5.29. The Concept Design is based on existing Lithium Ion battery technology, and this is secured in the Design Principles.

2.5.30. The BESS Compound will be located in two fenced compounds either side of the Longfield Substation (Work No. 3), north of Toppinghoehall Wood with a total area of up to 5.2ha. The BESS will be constructed in two separate phases. Phase 1 (Work No. 2A on the Works Plans will be concurrent with the construction of the wider Scheme and will comprise a maximum area of 3.4ha. Phase 2 (Work No. 2B on the Works Plans will commence operation not less than 5 years after commencement of operation of the wider Scheme and will comprise a maximum area of 1.8ha.

2.5.31. The assumption is that the BESS will be constructed within the entire area shown on the Concept Design, however if the second phase of the BESS is not required, then there may be a slightly larger area of Solar PV Arrays built in the place of the second stage BESS.

2.5.32. The Design Principles state that the maximum height of the BESS will be 4.5m (for example to accommodate roof mounted cooling systems). However, security lighting infrastructure and cameras (Work No. 6(c)) may reach 5m in height.

2.5.33. Elevations of the BESS are provided in **Figures 2-8** to **2-11**. All the main components of the BESS will be white, light grey or green in colour, as listed in the Design Principles.

2.5.34. The main components will be mounted on a reinforced concrete foundation slab or concrete piles. The remaining surface of the BESS will be made up of permeable compacted gravel.

2.5.35. The BESS Compound will contain the following main components:

i. battery energy storage system (BESS) units each comprising an enclosure for BESS electro-chemical components and associated equipment, with the enclosure being of metal façade, joined or close coupled to each other, mounted on a reinforced concrete foundation slab or concrete piles;

ii. transformers and associated bunding;

iii. inverters, switch gear, power conversion systems (PCS) and ancillary equipment;

iv. containers or enclosures housing, all or any of Work Nos. 2A(ii) and (iii) and ancillary equipment;

v. monitoring and control systems housed within the containers or enclosures comprised in Work Nos. 2A(i) or (iv) or located separately in its own container or enclosure;

vi. heating, ventilation and air conditioning (HVAC) systems either housed on or within each of the containers or enclosures comprised in Work Nos. 2A(i), (iv) and (v), attached to the side or top of each of the containers or enclosures, or located separate to but near to each of the containers or enclosures;

vii. electrical cables including electrical cables connecting to Work No. 3;

viii. fire safety infrastructure including water storage tanks and a shut-off valve for containment of fire water and hard standing to accommodate emergency vehicles; and

ix. containers or similar structures to house spare parts and materials required for the day to day operation of the BESS facility.

2.5.36. Noise emissions from the BESS experienced in nearby amenity areas (the Public Right of Way (PROW)) will be designed as low as practicable as to not exceed 50 dB LAeq,T with an upper value of 55 dB LAeq,T (guidance levels from BS8233:2014 for external amenity areas). An acoustic fence may be incorporated within the BESS to attenuate the sound levels emitted beyond the perimeter of the security fence, an acoustic fence has been included in the Concept Design, in order to comply with the above limits. The fence will not be required if the sound power levels of the BESS do not dictate it. If built, this fence will comprise close-boarded impervious wooden fencing or similar, which would provide at least 10dB of attenuation, and be no greater than 4.5m in height.

BESS units (Work Nos. 2A(i) and 2B(i))

2.5.37. The BESS batteries and associated equipment, housed within individual enclosures, are referred to as Units. The design and precise number of individual BESS units will depend upon the battery technology selected and the most appropriate capacity and duration of energy storage required at the time of construction. Typically, such Units will range from container-sized enclosures (15m long x 2.5m wide x 3.1m high or similar) to smaller (but more in quantity) ‘cube’ units (2.5m long x 3.1m wide x 3.1m high).

2.5.38. The BESS units illustrated in the Concept Design and shown on **Figure 2-24** are a Lithium Ion “cube” arrangement with 8 cubes coupled directly together to form modules. The precise number of individual cubes and modules will depend upon the level of power capacity and duration of energy storage that the Scheme will require.

2.5.39. Each cube has maximum dimensions of width 2.6m x length 3.1m x height of 3.2m as stated in **Concept Design Appendix [EN010118/APP/6.2].** The height assessed in the ES is 4.5m, as per the relevant principle in the **Outline Design Principles** document appended to the **Design Statement** [**EN010118/APP/7.3**]. The lithium ion cubes are not the tallest piece of

infrastructure in this works area, it is the transformers which are the tallest. It is the height of the transformers which has set the height of the whole of the works area as the worst case scenario, and it is this height which has been assessed as a maximum height for the whole works area within the environmental statement. Assessing the entire area for this maximum height allows optionality to future final layout design.

Inverters, transformers, switchgear and ancillary equipment, and their containers or enclosures (Work Nos. 2A(ii), (iii), (iv); 2B(ii), (iii), (iv))

2.5.40. Inverters will be located adjacent to the BESS units. The footprint of these components is variable, and they will not exceed 4.5 m in height as set out within the Design Principles.

2.5.41. Transformers are required to step up the voltage of the AC electricity generated by the BESS inverters, before it reaches the Longfield Substation and will be located adjacent to the BESS inverters. The footprint of these components is variable, housed within containers or enclosures, which will not exceed 4.5 m in height. The Concept Design shows transformers of maximum dimensions 5.1m x 4.1m, by 4.5m height. If oil filled transformers are selected these will be appropriately bunded, with bunds sized to at least 110% of the volume of the oil within the transformers.

Monitoring and control systems (Work Nos. 2A(v); 2B(v))

2.5.42. The Switchgear/Control Room monitoring and control system operates, isolates and controls the exported power from the BESS and Solar PV Arrays. This is likely to comprise either an adapted container or a glass reinforced plastic (GRP) kiosk, located within the BESS. The Concept Design shows 4 such control rooms of dimensions of up to 12.2m x 2.5m x 2.9m.

Heating, ventilation and air conditioning (HVAC) systems (Work Nos. 2A(vi); 2B(vi))

2.5.43. BESS units require a heating, ventilation and cooling (HVAC) system to ensure the efficiency of the batteries, which are typically either housed on or within each of the containers or enclosures comprised in Work Nos. 2A(i), (iv) and (v), attached to the side or top of each of the containers or enclosures, or located separate to but near to each of the containers or enclosures.

Electrical cables (Work Nos. 2A(vii); 2B(vii))

2.5.44. The electrical cabling located in the BESS area from the BESS units to the BESS inverters, transformers, switchgear and connecting into the Longfield Substation is described in this section.

2.5.45. Low voltage electrical cabling is required to connect the BESS units to inverters (typically via 1.5 kV/1.8 kV cables) and the inverters to transformers (typically via 0.6 kV /1 kV cables). Both the connection of the BESS units to inverters and that of the inverters to transformers can also be realised by a series of busbars.

2.5.46. These cables may be overground (typically secured on cable trays) or underground in trenches. The dimension of the trenches will vary depending on the amount of cabling they contain, but within the BESS area they will be up to 1.5m depth as stated in the Design Principles.

Fire safety infrastructure (Work No. 2A(viii); 2B(viii))

2.5.47. EDF Renewables owns and operates a number of Lithium Ion BESS with an exemplary safety track record. A number of guidance documents and standards have been considered by the Applicant in the design and selection of the BESS components for the Scheme. These guidance documents and standards are listed in the Outline Battery Safety Management Plan (BSMP) [**EN010118/APP/7.6**].

2.5.48. The BESS unit enclosures will:

a) Be designed and constructed by the manufacturer in accordance with the contemporary good practice, such as the current guidance outlined in the National Fire Protection Agency (NFPA) 855, Standard for the Installation of Stationary Energy Storage Systems. This will ensure the BESS units will be of robust construction.

b) Be locked to prevent unauthorised access.

c) Typically have a fire rating of 1 hour.

d) Be equipped with a Battery Management System (BMS) with build in fail-safe automated algorithms.

e) Benefit from Thermal Monitoring of the enclosures and automated cut-out mechanisms beyond safe parameters.

f) Have battery cooling systems with automated fail-safe operation.

g) Have Emergency Stops, both remote and local, installed in appropriate locations.

h) Be equipped with fire detection suitable to the architecture, such as:

i) Very early smoke detection by aspirations (VESDA) system;

j) Gas detection such as H2 and CO; as early indication of lithium-ion cell failure;

k) Standard heat and smoke detection system.

l) Feature fire suppression equipment, such as:

- NOVEC 1230, StatX powder fire suppression, or other contemporary system.
- Some system technology have integrated water spray nozzles for direct injection to firefighting water, sometimes referred to as dry riser.

2.5.49. Further safety provisions designed into the batteries at cell level are:

a) Internal fuses;

b) Contactor at rack/string and bank level (various levels of organising and connecting the battery cells together to ultimately build the large BESS units);

c) Overcharge safety device;

d) Internal separating layers;

e) Venting device; and

f) Thermal monitoring.

2.5.50. Mineral oil is being typically used for transformer fluid due to its electrical and thermal properties, however mineral oil increases the fire of risk for a transformer as it is highly flammable with a low fire point of approximately 170°C. To reduce this risk the selected system will utilise ester-based fluids in the transformers selected for the BESS compound, which has a flash point of over 300°C.

2.5.51. Following consultation with Essex Fire and Rescue, four water tanks with a maximum diameter of 7m and a height of up to 3m, with a minimum of 108,000 litres, these have been incorporated in the design of the BESS Compound. In addition, two areas of hardstanding have been provided at the eastern and western entrances to the BESS compound (minimum 250m2) in order to accommodate emergency services vehicles in the event of an emergency, as set out in the Design Principles.

Storage containers (Work Nos. 2A(ix); 2B(ix))

2.5.52. If required, storage containers of standard shipping container with dimensions of 5.4m (l) by 2.3m (w) by 2.2m (h) may be located within the BESS Compound for storage of spare components and maintenance equipment.

The Longfield Substation (Work No. 3)

2.5.53. The Longfield Substation will be located in a fenced compound of 1.7ha, 20m to the north of Toppinghoehall Wood. It will be connected via electrical cables to the PV Arrays, the BESS Compound, and the Bulls Lodge Substation Extension.

2.5.54. The Longfield Substation will convert electricity generated, imported and stored by the Scheme to 400kV for onward transmission to the National Grid via the Grid Connection Cables and the Bulls Lodge Substation Extension.

2.5.55. The Longfield Substation will contain the following main components:

i. substation, switch room buildings and ancillary equipment including reactive power units;

ii. control building housing offices, storage and welfare facilities;

iii. monitoring and control systems for this Work No. 3 and Work Nos. 1 and 2 housed within the control building in Work No. 3(b) or located separately in their own containers or control rooms;

iv. 400 kilovolt harmonic filter compound; and

v. electrical cables including electrical cables connecting to Work No. 2.

2.5.56. The dimensions of any building (i.e., a structure with a roof and walls) forming part of the Longfield Substation will be limited to a maximum footprint of 540m2 (e.g., 27m by 14m) with a maximum height of 7.1m AGL (existing levels), as set out in the Design Principles.

Longfield Substation (Work No 3A)

2.5.57. The Longfield Substation will be a maximum height of 13m AGL as set out in the Design Principles. The main components will be bare metal, white or grey in external finish.

2.5.58. An indicative layout of the Longfield Substation is shown in **Figure 2-18** with elevations on **Figure 2-19**.

Site Office and Control Room (Work No. 3B)

2.5.59. A control building housing a site office and control room for the Scheme will be located within the Longfield Substation. This building will be of steel frame construction with cladding. The building will accommodate welfare facilities including toilets, wash/changing room, kitchen eating area, open plan office area, storage rooms. The control room will be served by a septic tank system.

2.5.60. Electricity will be derived from an auxiliary transformer. Broadband connection will be via satellite or hardwired if practical.

2.5.61. The concept design has a single site office and control room with a footprint of up to 27m x 14m and a maximum height of 7.1m. A Design Principle is included to limit the size of any building within the Longfield Substation (i.e., a structure with a roof and walls) to these maximum dimensions.

Monitoring and Control Systems: Transformers and Switchgears (Work No. 3C)

2.5.62. The Longfield Substation will be equipped with three 400kV / 33kV transformers. These are necessary to step up the voltage from the 33kV delivered by the Solar PV Arrays and the BESS, to the 400kV required for the grid connection. This allows for the cable feeding into the Bulls Lodge Substation Extension to be smaller and the respective transmission losses to be minimised.

2.5.63. The Concept Design illustrates three 400kV / 33kV transformers, each with a footprint of up to 14.6m x 8.6m and a height of 9.6m. Air insulated switchgear is shown within the switchyard with heights of up to 13m as limited by the Design Principles, and six earthing transformers with dimensions of 2.5m x 2m and a height of 2.75m.

2.5.64. Switchrooms are usually fitted with instrument panels and switches, which trained personnel use to monitor the operation of electrical equipment (Longfield Substation or BESS components).

2.5.65. The Concept Design has four Solar PV and BESS 33kV switchroom buildings with dimensions of 18.2m x 6.0m and a height of 5.0m. A Design Principle is included in the Outline Design Principles to limit the size of any switchroom buildings to these maximum dimensions.

400kV Filter Compound (Work No. 3(d))

2.5.66. The purpose of the filters is to stabilise the harmonics in a system to acceptable levels. In this way a higher power factor can be achieved, while at the same time voltage becomes more stable and network losses are lowered. The requirement for the filter compound is subject to detailed power system modelling and studies, however illustrative Concept Design parameters are provided here for assessment purposes.

2.5.67. The Concept Design illustrates three of each of the following components within the filter compound:

a) 400kV High Frequency Filter Structure of 3m x 3m with a height of 7.8m;

b) 400kV Reactors of cylindrical diameter 2.6m and height 5.8m; and

c) 400kV Resistor banks of 3.7m x 2.0m and 5.75m height.

2.5.68. The injection of reactive power into the network improves the power factor, therefore it is necessary in order to maximise the transmission of the useful active power.

2.5.69. The Concept Design has four of each of the following reactive power and harmonic filter components, which will be no taller than 13m in height as allowed by the Design Principles:

a) 33kV reactive power compensation equipment; and

b) 33kV harmonic filter.

The Grid Connection Route (Work No. 4A)

2.5.70. The electricity generated by the Scheme will be exported to the National Grid via the Grid Connection Route (Work No. 4A), via a connection between the Longfield Substation and the Bulls Lodge Substation Extension. This connection will also facilitate the import of electricity to be stored within the BESS.

2.5.71. A single 400 kV cable circuit consisting of three cables will run underground from Longfield Substation (Work No 3) north of Toppinghoehall Wood, to the Bulls Lodge Substation Extension (Work No 5) approximately 1.9km to the south west. There are no new OHLs required within the Scheme.

2.5.72. The Grid Connection Route will contain the following main components according to the Design Principles:

a) An underground 400kV cable circuit (Work No. 4A(i)), consisting of:

- An underground cable trench approximately 3m wide and 3m deep
- A 5m offset from the centreline of the buried trench on both sides, providing adequation operational corridor for protection and maintenance
- 3 no. 400kV cables in ducts, within the buried trench width
- Berms either side of the buried trench
- Yellow marker warning tape the full length of the trench
- Geotextile & geogrid linings of the trench and trench top

Cable installation (Work No 4A(i))

2.5.73. “Electrical cables” means—

i. cables of differing types and voltages installed for the purposes of conducting electricity, auxiliary cables, cables connecting to direct current (DC) boxes, earthing cables and optical fibre cables; and

ii. works associated with cable laying including jointing pits, hardstanding adjoining the jointing pits, combiner boxes, fibre bays, cable ducts, cable protection, joint protection, manholes, kiosks, marker posts, underground cable marker, tiles and tape, send and receive pits for horizontal directional drilling, trenching, lighting, and a pit or container to capture fluids associated with drilling;

2.5.74. During cable installation a construction corridor will be designated. This will contain the works and provide separation from other land users. The construction corridor will be up to 20m wide and temporary fencing will be

erected to form the construction corridor boundaries. Access for construction equipment will be via a combination of existing access routes and temporary roadways where necessary.

2.5.75. Continuous lengths of cable will be up to a 460m in length, the location Jointing Pits will be designed to be at key bends in the cable route. A single Jointing Pit is typically 10m x 3m, and there will be 5 Jointing Pits such pits along the route.

Cable Protection

2.5.76. The primary method of protection to the cable is depth of installation below ground. For HV underground cable 950mm cover is greater than most standard service trench depths to reduce the risk of inadvertent excavation. Warning tapes provide advance warning of the proximity of buried cables and then physical protection is provided in the form of concrete surround to the ducts.

Cable Jointing

2.5.77. Continuous lengths of cable will be up to a 460m in length, the location Jointing Pits will be designed to be at key bends in the cable route. A single Jointing Pit is typically 10m x 3m, and there will be 5 such pits along the route.

2.5.78. These cable Jointing Pits will require occasional access during operation, for inspection.

Cable Pulling

2.5.79. The cables will be installed pulling the cable off the drum using a cable pulling winch. The winching at the other end will be completed by heavy duty cable winches. The area around each Jointing Pit must be capable of supporting the drum delivery and winching operation from each direction. Therefore, a hardstanding area is designed for each side of each Jointing Pit.

2.5.80. The Jointing Pits and the hardstanding areas must have permanent access for the lifetime of the cable in order to ensure that any faults can be addressed without excess downtime on the connection.

Access tracks (Work No 4A(ii))

2.5.81. The construction area for the Grid Connection Route will be accessed from two locations:

a) Cable route works to the west of Waltham road and west of Boreham Brook will be accessed via Generals Lane;

b) Cable route works to the east of Waltham road will be accessed from the main Longfield site. There will be a single crossing point of Waltham road to allow access to the cable route between the central crossing of Boreham Brook and Waltham road.

2.5.82. In order to access all of the working corridor which will form the construction site, a network of temporary tracks will be used within this corridor, including:

a) Use of existing tracks where already suitable

b) Temporary access tracks to access all parts of the construction area, as permanent tracks are not necessary.

2.5.83. The provision of temporary access tracks is designed to provide construction access along each section of the cable route. There will be one temporary access track running along the 20 m corridor. Two temporary access tracks will be required outside of the 20m working corridor access to work areas and delivery of material as any drilling works will cut off access at the crossing location. These are located west of Waltham Road in the east, and north of Boreham Brook in the south.

2.5.84. Depending on weather conditions during construction, temporary roadways (e.g., geotextile and stone or plastic matting) may be utilised to access parts of the Development site during construction to avoid excessive soil disturbance or compaction.

Third party Service crossings

2.5.85. The preferred method of crossing third party services is to go under the service with a minimum separation of 300mm. To provide additional protection to the cable the ducts are surrounded in C25/30 concrete and steel plate are placed over the ducts to protect against penetration.

Operational Usage

2.5.86. The cable corridor will be reduced after construction – typically to a width extending 5 metres both directions outwards from the centre line of the trench. The corridor is needed to allow access for any inspection of Jointing Pits, and to ensure the route is maintained free of trees or any new structures.

2.5.87. Where areas of the route have been constructed for continued arable use, activities such as ploughing for crops and passage of agricultural machinery will be allowed. At all other points, digging or excavating will not be permitted without agreement, and vehicular crossings must be via prescribed vehicle crossing points. Vegetation management will be required to maintain flora and prevent excessive overgrowth, as set out in the Outline Operational Environmental Management Plan (OEMP) [**EN010118/APP/7.11**].

2.5.88. There will be no routine requirement to access buried sections of cables, but the corridor surface will be periodically checked, and access will be required along the whole length for these inspections. In the unlikely event that a buried cable requires repair, it will be electrically isolated, and repairs carried out by excavating at the damaged section. Specific loading restrictions (applying to vehicles or objects placed onto the cable area land) will be advised following detailed design and disposition of ducts or other reinforcement. Any digging or excavating within the cable corridor will need to be agreed with Longfield solar and must be tightly controlled to avoid danger.

2.5.89. Where the cable corridor is unfenced cable marker posts are typically placed to each side of any boundaries (such as hedges, fences or embankments).

Bulls Lodge Substation Extension (Work No. 5)

2.5.90. The Scheme includes the extension of the existing substation (Bulls Lodge Substation Extension), Work No. 5A, to provide the electrical connection point to the National Grid to facilitate the import and export of electricity to and from the Solar Farm Site. Work No. 5B comprises temporary overhead line alterations, including two temporary pylons, and realignment of the existing 400kV overhead line (as illustrated in **Figures 2-33 to 2-35**).

2.5.91. The existing Bulls Lodge Substation is located on land to the north east of the A12 Boreham Interchange at the Bulls Lodge Substation Site.

2.5.92. The Bulls Lodge Substation Extension is located on land directly to the west of the existing Bulls Lodge Substation as set out in the Works Plans corresponding with Work Area No 5.

2.5.93. The Bulls Lodge Substation Extension will include the following:

a) Work No. 5A – an electricity switching station including-

i. a main substation building to include an indoor gas insulated switchgear (GIS) switch hall, ancillary plant rooms, amenities block, storage and workshop units;

ii. outdoor air insulated (AIS) switchgear, GIS busbars, two overhead line gantries and associated foundations and structures;

iii. a new permanent access road from the existing private road including a new bellmouth entrance;

iv. internal roadways and footpaths;

v. earthworks;

vi. car parking area;

vii. lighting columns and lighting;

viii. perimeter fencing and security cameras;

ix. drainage system and a new drainage outfall to Boreham Brook;

x. new connections from pylons 4VB061A and 4VB061B including pylon modifications; and

b) Work No. 5B –temporary overhead line alterations including two new temporary pylons and realignment of the existing 400kV overhead line.

2.5.94. A new access ('western access') will be provided for the extension of the Bulls Lodge Substation on the northern side of the private road circa. 180m to the west of the existing substation access.

2.5.95. Following the completion of the Radial Distributor Road (RDR) (expected by Autumn 2022), the Bulls Lodge Substation will be accessed via the Boreham Interchange and the RDR which will form a new roundabout with the existing private road which provides access to the substation to the east. Therefore, construction vehicles will utilise the RDR and existing private road to travel to/ from Bulls Lodge Substation as required.

2.5.96. The Design Principles limit the extent of the Bulls Lodge Substation Extension building to a height of 15m above finished ground level, and a finished ground level of 33m AOD. Typical substation buildings of this type have a steel frame and steel or aluminium metal cladding. The primary function of the building is to protect the GIS and other equipment contained therein from the weather. The maximum footprint of the main building in the Design Principles is 1,750m^2.

2.5.97. The Concept Design height of the OHL gantries is 12.5m above finished ground level. The gantries are required to establish the OHL connections. The maximum height of any component of the Bulls Lodge Substation Extension will not exceed 15m as set out by the Design Principles.

2.5.98. The Concept Design height of outdoor switchgear is 12m above finished ground level. The outdoor switchgear will provide connections to the existing equipment and the new OHL conductors. The maximum height of any component of the Bulls Lodge Substation Extension will not exceed 15m as set out by the Design Principles.

2.5.99. The temporary OHL diversion (Work No. 5B) is required to facilitate switchgear construction and will be removed at the end of the works. The Concept Design tower height is 41m above existing ground level at the location of tower installation.

2.5.100. Details of the proposed Bulls Lodge Substation Extension are set out in **Figure 2-29** to **Figure 2-31**, and **Figure 2-33** to **Figure 2-43**.

2.5.101. Perimeter fencing will be a palisade barrier or physical welded mesh. It shall be no more than 2.5m high and will contain an electric pulse system at height extending up to 3.5m above the substation finished ground level, to deter intrusion (as set out on **Figure 2-37**).

Ancillary Infrastructure (Work No. 6)

2.5.102. The Ancillary Infrastructure set out in Work No. 6, may occur throughout the Solar Farm Site (including within the Solar PV Array Works Area, BESS Compound, Longfield Substation) and will include:

a) electrical cables including electrical cables connecting to Work No. 1 to Work No. 3;

b) fencing, gates, boundary treatment and other means of enclosure;

c) works for the provision of security and monitoring measures such as CCTV columns, lighting columns and lighting, cameras, weather stations, communication infrastructure, and perimeter fencing;

d) landscaping and biodiversity mitigation and enhancement measures including planting;

e) improvement, maintenance and use of existing private tracks; and

f) laying down of internal access tracks, ramps, means of access, footpaths, permissive paths, cycle routes and roads, including the laying and construction of drainage infrastructure, signage and information boards;

g) temporary footpath diversions;

h) earthworks;

i) SuDs Ponds, runoff outfalls, general drainage and irrigation infrastructure and improvements or extensions to existing drainage and irrigation systems;

j) up to 10 secondary temporary construction compounds, both within the permanent work area and outside the permanent work area;

k) works to divert and underground existing electrical overhead lines.

2.5.103. The following sections provide further detail on the design of the Ancillary Infrastructure proposed.

Electrical Cabling (Work No. 6A)

2.5.104. The electrical cabling located in the Solar Farm Site from PV Panels to inverters, transformers, switchgear and finally Longfield Substation is described in this section.

2.5.105. Low voltage electrical cabling is required to connect the PV Panels to inverters (typically via 1.5kV /1.8 kV cables), and the inverters to the transformers (typically via 0.6kV /1 kV cables).

2.5.106. Combiner boxes may also be required to rationalise cabling between the PV Panels and inverters / transformers. If required, these would be similar in size to string inverters and mounted on the PV Mounting Structure beneath the PV Panels.

2.5.107. These cables in their various instances among infrastructure may be overground (typically secured on cable trays beneath the PV panels or secured to other parts of the nearby components) or underground in trenches. The dimension of the trenches will vary depending on the number of ducts they contain but will be typically 0.8m in width and up to 1.5m depth.

2.5.108. Underground high voltage cables (33kV) are required between the transformers and the switchgear, and from switchgear to the Longfield Substation. The dimension of the 33kV circuit trenches will be 1.5m (w) and 1.5m (d). Underground cable trenches will converge as they approach the Longfield Substation and be at a depth of up to 1.5m below ground as shown in **Figure 2-13**. As multiple cables within a trench need certain minimum separation from each other for reasons of thermal load management, the width of the trench is proportional to the quantity of cables that it includes. The total number of 33kV cables circuits that will feed into the Longfield Substation is subject to detailed electrical design.

2.5.109. Fibre-optic data cables and earth cables will also be installed. The data cables typically alongside electrical cables in order to allow for monitoring during operation, such as the collection of solar data from pyranometers or to facilitate the functionality and operation of inverters and other equipment. A bare copper inter-array earth cable is typically installed to mitigate and control earth fault current pathways in the event of an electrical fault on the 33kV system.

2.5.110. Where the routes of any of the cables mentioned above coincide, then there may be scope to combine those various groups of cables within the same trench.

2.5.111. There will be no new OHLs constructed. One section of existing 11kV OHL, carried on wooden poles and belonging to UK Power Networks will be converted to an underground cable and diverted as shown on **Figure 2-32**.

2.5.112. The flexibility to locate electrical and other cables within Work No. 6 is required to ensure that the Scheme can be implemented as efficiently as possible. Indicative lengths of cabling are provided in the Concept Design Appendix. The electrical design of the Scheme will be fixed at the detailed design stage.

Fencing, Gates, boundary treatment and other means of enclosure (Work No. 6B)

2.5.113. Several types of fencing are proposed within the Order limits.

2.5.114. Perimeter fencing around the Solar PV Arrays will not exceed 2.5m in height and will be of a deer fencing type construction with wooden posts, and a hi tensile wire mesh as shown on **Figure 2-12** and as set out in the Design Principles.

2.5.115. Mammal gates will be installed at regular intervals, typically every 50m. Within 30m of OHL towers, the fence will be earthed in line with advice received from NGET.

2.5.116. The Longfield Substation, BESS and permanent plant areas are bound by taller and more secure palisade fencing, at a maximum height of 2.75m as set out within the Design Principles. This fence would be tri-pointed with a spiked top, as set out on **Figure 2-14**.

2.5.117. An acoustic fence may be incorporated within the BESS to attenuate the sound levels emitted beyond the perimeter of the security fence and is therefore included in the Concept Design. The fence will not be required if the sound power levels of the BESS are sufficiently low. If built, this fence will comprise close-boarded impervious wooden fencing or similar, which would provide at least 10dB of attenuation, and be no greater than 4.5m in height.

2.5.118. All areas of fencing, of both kinds, are accessible via a fence access gate (**Figure 2-14**) which are sufficiently wide to allow HGV access at 4m in width, with a maximum height of 3.0m. The gates would be fabricated of a hi-tensile wire mesh as per the deer fencing.

2.5.119. Temporary fencing which may be utilised during construction and decommissioning. It is proposed that this fencing will be 2m tall.

Security, Monitoring and Communication Equipment (Work No 6C)

2.5.120. The boundary of the Solar Farm Site will be secured both by fencing (as above) and by the provision of Closed-Circuit Television (CCTV) equipment. Cameras in this system are to be placed at approximate 200m intervals inside the fence line in the Solar Farm Site, and up to 80m intervals in the BESS area for additional safety. Cameras would be placed on columns up to 5m in height as limited by the Design Principles, enabling sufficient vision above module tables and fencing, and would be supported by a ground mounted column of up to 2m in depth.

2.5.121. Other potential security measures to be included comprise:

a) Detection systems such as beam break, image detection etc. to raise alarm when fence breached;

b) Audio announcement when intruder detected to warn alarm triggered and police on way;

c) Barriers/locked gates at main site entrances;

d) Steel doors on substation buildings;

e) Buried cables as much as possible;

f) Remote monitoring; and

g) Alarm response contract with keyholder/security company

2.5.122. Weather monitoring equipment in the form of pyranometers will be incorporated within the Scheme, being placed on top of other structures without increasing the overall height of those structures.

2.5.123. During operation, no part of the Scheme will be continuously lit. Manually operated, and motion-detection lighting will be utilised for operational and security purposes around electrical infrastructure such as inverters, transformers and switchgear across the Solar PV Array Areas, and within the BESS Compound, Longfield Substation and Bulls Lodge Substation Extension.

2.5.124. Lighting will be directed downward and away from boundaries. No visible lighting will be utilised at the site perimeter fence, aside from the site entrance points. Infra-Red (IR) lighting will be provided by the CCTV/security system to provide night vision functionality for CCTV. However visible lighting will be provided at site entrance points, operated by Passive Infra-Red (PIR), calibrated to detect vehicles, with the possibility to be manually operated if needed. Luminaires are expected to be 50W, providing approximately 5,000 lumens at 100 lumens per Watt.

2.5.125. Lighting will be provided at enclosure entrances by Solar Stations (if this solution is selected from the BoSS plant options) to allow for safe working outside of daylight hours. These will be manually operated. Luminaires are expected to be 50W, providing approximately 5,000 lumens at 100 lumens per Watt.

2.5.126. Lighting will be provided at the Longfield Substation main entrance, parking area and control room entrances. This will be PIR operated, calibrated to detect vehicles and personnel, with the possibility to be manually operated if needed. Luminaires are expected to be 50W, providing approximately 5,000 lumens at 100 lumens per Watt. Lighting for the area housing 400kV equipment would be manually operated from the control room building only, with no PIR functionality. Luminaire specifications would be the same as for the other areas of the substation.

2.5.127. Lighting will be provided at the BESS entrances, and adjacent to the access track. This will be operated by PIR calibrated to trigger on vehicle and personnel, with the option of manual control. Lighting along the perimeter of the BESS will be operated manually. Lighting at water storage tanks and firefighting equipment storage would be operated by PIR calibrated to vehicle and personnel, with the option of manual control. Where lights can be manually operated, they would be operated from switches near to the entrance gates and in other strategic locations (such as adjacent to the lights themselves or adjacent to the firefighting equipment). Throughout the BESS, luminaires are expected to be 50W, providing approximately 5,000 lumens at 100 lumens per Watt.

2.5.128. External lighting will be provided at the warehouse building (Work no 8(e)) by PIR operated lights calibrated to vehicles and personnel. These will be located at building entrances and to cover the parking and refuge areas. These will be PIR operated calibrated to vehicles and personnel. Luminaires are expected to be 50W, providing approximately 5,000 lumens at 100

lumens per Watt as set out within the Outline Landscape and Ecological Management Plan (OLEMP) [**EN010118/APP/7.13**].

Landscaping and biodiversity enhancements (Work No. 6D)

2.5.129. The Scheme has been designed to integrate with and enhance the local green infrastructure network, improving ecological and recreational connectivity across the Order limits. The proposed planting design has responded to the varied character by allowing views to remain open, where tall screening would not be appropriate. As part of the development of the Scheme, three categories of planting have been proposed:

a. Advanced Mitigation Planting (planted 2021/2022) – this planting is located where it was found to be beneficial to undertake planting early, in order to maximise growth prior to the Scheme's operation;

b. Construction Day 1 Planting (planted at the beginning of construction) – planted in areas where planting required to mitigate adverse effects on views could not be undertaken in 2022; and

c. Residual Mitigation Planting (planted at the end of construction) – all remaining planting.

2.5.130. This includes hedgerows to be grown, infilled, gapped up and maintained to a height of at least 3m. It is assumed that planting will grow at 33cm per year (as set out in ***Chapter 10: Landscape and Visual Assessment*** [**EN010118/APP/6.1**] Section 10.3) with further detail on establishment and management set out within the Outline Landscape and Ecological Management Plan (OLEMP).

2.5.131. Other new planting would include:

a) 8.6km of new native hedgerows with hedgerow trees;

b) 20.6km of native hedgerow enhancement - gapping up and infill planting;

c) Approximately 200 new individual trees;

d) 23.2ha of land for natural regeneration;

e) Over 3ha. of new native woodland buffer planting measuring 25m wide to form ecological corridors between existing woodlands;

f) 0.6ha. of native linear tree belts measuring 15m wide;

g) A new north/south green route, via a new permissive path;

h) 272ha. of new species rich grassland below solar arrays;

i) 131ha. of new species rich grassland in open areas; and

j) 42km of species rich mown grassland around the perimeter of proposed solar arrays.

2.5.132. The actual required mitigation for biodiversity effects is minimal, as the design has retained/avoided most receptors, although the above will be required to minimise landscape, visual and heritage impacts; the hedgerows, woodland, and tree belts are embedded mitigation within the Scheme design to avoid or minimise significant effects. The 272ha of new species rich grassland will be created and functional in advance of construction, where practical, so that any displaced (bird) populations have alternative areas of habitats available during construction.

Improvement, maintenance and use of existing private tracks (Work No. 6E and laying down internal access tracks 6F)

2.5.133. Where possible, the Scheme will make use of the network of existing roads and tracks within the Order limits to access the PDAs.

2.5.134. A network of access tracks of up to 6m width provides access to all areas of the Solar Farm Site from the site entrance and connects to access tracks within the Longfield Substation and the BESS via gated entrances.

2.5.135. All tracks will consist of a layer of permeable rock fill placed on a suitable underlying layer. Where areas of new access roads are planned, the footprint will be excavated to a minimum 4m width down to approximately 200mm to 600mm depth depending on the underlying formation.

2.5.136. Where existing tracks are present within the Solar Farm Site, and will need widening, the fill will be placed to the same depth as the existing road, typically 600mm in depth. The existing ground profile may be levelled flat and result in slightly deeper excavations in some areas. Where drainage is required, a ditch may be cut into the slope next to the road.

2.5.137. **Figure 2-25** shows a cross section of a typical upgraded access track and new access track of up to 6m width.

2.5.138. The existing routes of farm tracks that run throughout the Order limits have been utilised as far as practicable when designing the Scheme track layout.

2.5.139. Three main categories of permanent access track are included in the design of the Scheme, with up to 21km of permanent access tracks being constructed within Work No. 6, including new and upgraded tracks:

a) Primary access tracks (the Concept Design illustrates 6.4km);

b) Secondary access tracks (the Concept Design illustrates 13.1km); and

c) BESS and Longfield Substation Access Tracks (the Concept Design illustrates 1km).

2.5.140. Temporary access tracks for construction and decommissioning such as those required for the Grid Connection Route are described under Work No 4.

2.5.141. Primary access tracks are defined as those outside the fenced areas of the PV Arrays, and this generally provides access to multiple parts of the Scheme, so primary access tracks are likely to carry more construction traffic. Most primary access tracks are therefore 6m wide. Keeping primary access outside of fenced areas is designed to allow more efficient and quicker access to a larger area of the Scheme during construction and operation.

2.5.142. Following construction, primary access tracks will continue to be used to access the Scheme but will also be utilised as permissive access routes in some instances, as set out within the ***Public Rights of Way Management Plan*** [**EN010118/APP/6.13**].

2.5.143. Secondary access tracks are defined as those within fenced areas of the Scheme, such as the tracks to access Solar PV Array Areas. It's possible that at the detailed design stage, permanent secondary track access to each Solar PV Array area may not be required and therefore it is possible that a

lesser length of track will be constructed. Most secondary access tracks are 4m wide, except between the site entrance and the Longfield Substation and BESS where the requirement to accommodate abnormal loads is reflected in a 6m width.

2.5.144. The tracks within the BESS Compound and the Longfield Substation are all of new construction and will be up to 6m wide. It is likely that the access tracks within each phase of the BESS will be constructed at the time of construction of the Longfield Substation to ensure connectivity between the Site Entrance and the Longfield Substation through the BESS.

Temporary footpath diversions (Work No. 6G)

2.5.145. The PRoW will be managed throughout the construction phase to ensure that they can continue to be used safely. There will be no PRoW closures during construction; pedestrians will be able to utilise the existing pedestrian network to access the Order limits during the entire construction phase. Some small, temporary localised diversions will be required which are discussed within the Public Right of Way Management Plan (appended to ***Chapter 13: Transport and Access*** [**EN010118/APP/6.2**])

Earth Works (Work No. 6(h))

2.5.146. There are minimal earthworks identified for the Solar Farm Site, the management of which are set out in the Outline Construction Environmental Management Plan (OCEMP) [**EN010118/APP/7.10**] and Decommissioning Strategy [**EN010118/APP/7.13**].

SuDs Ponds, runoff, general drainage infrastructure and improvements (Work No. 6I)

2.5.147. The elements of the Solar Farm Site which require a specific drainage design include the BESS and the Longfield Substation. A SuDS Strategy [**EN010118/APP/6.2**] is provided for these areas and is appended to the Flood Risk Assessment (FRA), which is appended to ***Chapter 9: Water Environment***, of this ES [**EN010118/APP/6.1**].

2.5.148. A SuDS pond with a flow restriction device will be constructed at the eastern end of the BESS, which will attenuate surface water associated with the BESS and Longfield Substation without surcharge and out of system flooding during the 1:30 (+20% CC) and 1:100 (+20% CC) year events respectively. This system has been designed to discharge to an existing watercourse in the south east of the Order limits as shown in **Figure 2-28**.

2.5.149. Other elements of the Scheme do not require additional specific SuDS measures for surface water management, however in some areas Rural SuDS (RSuDS) measures are proposed to provide enhancement. The RSuDS measures proposed as enhancement across the Scheme are described in detail in the Biodiversity Strategy which is appended to the OLEMP.

2.5.150. Ditch crossings to facilitate internal access track construction, fences and cable crossings of ditches will be upgraded (if they currently exist and require upgrading) or constructed.

2.5.151. A minimum buffer of 10m around watercourses (measured from the water/channel edge under normal flows) will be maintained within which

there will be no built development (other than essential works such as watercourse crossings or drainage etc.).

2.5.152. The maximum extension of existing ditch crossing culverts as set out within the Design Principles is 2m. Culverts/culvert extensions will be designed to reduce any alteration of watercourse alignment where possible and would have a sunken bed to allow a naturalised bed substrate to develop in order to maintain ecological continuum.

Secondary Temporary Construction Compounds (Work No. 6(j))

2.5.153. There will be up to 10 secondary temporary construction compounds deployed through the Solar Farm Site during construction. These will be approximately 50m x 50m as illustrated on the Concept Design.

Works to divert and underground existing overhead lines (OHL) (Work No. 6(k))

2.5.154. Within PDA 28 there is an existing 11kV OHL which passes through the middle of the PV Array. In order to avoid the required clearances to the OHL impacting on the design of the PV Array in this area, it is proposed to underground the above ground section of this line and divert the route underground to avoid the PV Array. The section of line to be removed, and an indicative route for the diversion is shown in **Figure 2-32**.

Temporary Construction Compounds (Work No. 7)

2.5.155. The main temporary construction compound for the Solar Farm Site (Work No. 7A) will cover a maximum area of 6.89ha, comprising:

a) areas of hardstanding;
b) car parking;
c) site and welfare offices, canteens, and workshops;
d) area to store materials and equipment;
e) storage and waste skips;
f) area for download and turning;
g) security infrastructure, including cameras, perimeter fencing and lighting;
h) site drainage and waste management infrastructure (including sewerage); and
i) electricity, water, waste water and telecommunications connections.

2.5.156. A second temporary construction compound for the Bulls Lodge Substation Extension (Work No. 7B) will cover a maximum area of 7.21ha, and will comprise:

a) areas of hardstanding;
b) car parking;
c) site and welfare offices, canteens, and workshops;
d) area to store materials and equipment;
e) storage and waste skips;

f) area for download and turning;

g) security infrastructure, including cameras, perimeter fencing and lighting;

h) site drainage and waste management infrastructure (including sewerage);

i) electricity, water, waste water and telecommunications connections; and

j) a new temporary point of access ("eastern access") from the existing private road circa 30m to the east of the existing substation access to the temporary compound.

Office, warehouse and plant storage building (Work No. 8)

2.5.157. An operational maintenance building comprising offices, a warehouse and spaced for plant storage will be located adjacent to the main site access track at approximate national grid reference TL 753 131. This building will comprise:

a) an office and welfare facilities;

b) storage facilities;

c) waste storage area within in a fenced compound;

d) parking for up to nine vehicles; and

e) a warehouse building for operational plant and vehicles.

2.5.158. The building will have a footprint of up to 540 m2, and a maximum height of up to 7.1m as set out within the Design Principles. The appearance of the building will reflect the local vernacular with standard agricultural style cladding as shown in **Figure 2-22**. Permeable compacted gravel hardstanding will provide parking and access to the building. A fenced compound will be located adjacent to the east of the building, to provide secure external waste and plant storage.

2.5.159. The building will be served by electrical and broadband connections. Water will be provided by a rainwater harvesting and filtration system with waste water contained in a septic tank to be emptied at regular intervals.

Works to facilitate Access Routes and Site Entrance (Work No. 9)

Access to the Solar Farm Site

2.5.160. All parts of the Scheme, other than the Bulls Lodge Substation Extension, and the western section of the Grid Connection Route will be accessed from a single Site Entrance from Waltham Road at approximate NGR TL746127, as shown on **Figure 2-7** (Work No. 9).

2.5.161. A new bell mouth access with visibility splays of 125m in both directions will be created from Waltham Road at the commencement of the construction phase with a tarmac surface as far as the gated entrance to the Solar Farm Site. A gated entrance with a security kiosk during construction is situated approximately 150m into the Solar Farm Site to allow laybys to be formed on either side of the road, with capacity of a minimum of eight HGVs to be accommodated.

2.5.162. Highway improvements will be required to support construction HGVs travelling on the local highway network to / from the proposed site access on

Waltham Road. These improvements are expected to comprise relatively minor verge clearance, hedge cutting or carriageway widening, to achieve a minimum carriageway width of 6.0m (as agreed with ECC Highways) along Wheelers Hill, Cranham Road, and Waltham Road (i.e. the agreed construction vehicle route). All proposed carriageway widening is within the public highway boundary. Further details are presented in Chapter 13: Transport and Access.

Access to the Bulls Lodge Substation Extension

2.5.163. The only elements of the Scheme which will not be accessed via the main site entrance referred to in the previous section are the Bulls Lodge Substation Extension, and the western section of the Grid Connection Route.

2.5.164. The existing access road to the Bulls Lodge Substation Extension is an unadopted private road from General's Lane. Part of this route is likely to become adopted prior to the construction of the Scheme, however, as there is some uncertainty as to when that will occur, the DCO also seeks rights over this private road to use it for access. The private road is of suitable specification for construction and operational traffic without modification.

2.5.165. A new bell mouth access will be constructed from the private road with appropriate visibility splays to provide access for construction and operation to the Bulls Lodge Substation Extension (as set out under Work No. 5A).

Areas of habitat management (Work No. 10)

2.5.166. Work No 10 includes:

a. landscape and biodiversity enhancement measures;

b. habitat creation and management, including earthworks, landscaping, means of enclosure, and the laying and construction of drainage infrastructure; and

c. laying down of permissive paths, signage and information boards.

2.5.167. Dedicated landscape, habitat, and biodiversity enhancement areas have been designed in order to maximise the opportunity for biodiversity enhancement within the Scheme. A total of 55.8ha have been designated for this purpose, with no other Scheme infrastructure proposed for these areas. In several of these areas, there is overlap of Work No. 6 in order to ensure that access tracks and underground cables can pass through these areas.

2.5.168. The design is inclusive of:

a) Woodland Restoration;

b) Rewilding Scrub;

c) Floodplain Grasslands;

d) Enhanced Waterscapes;

e) A biodiversity research area; and

f) A pollinator greenway.

2.5.169. In addition to the measures set out above, a Biodiversity Strategy is included as Appendix B to the Design Statement to illustrate the design approaches

that could be incorporated to further enhance biodiversity on and around the Longfield Solar Farm.

2.5.170. As set out in the Draft DCO [**EN010118/APP/3.1**], Requirement 9 will necessitate the submission and approval of a detailed Landscape and Ecology Management Plan (LEMP) to deliver the provisions as set-out out in the Outline LEMP and to confirm how any approaches and measures set out in the Biodiversity Strategy have been incorporated into the design.

2.6. Construction

Construction Programme

2.6.1. The construction of Longfield Solar Farm is expected to take place over 24 months, as follows:

a) Advanced Mitigation Planting (2022)

b) Enabling / civil works, including Construction Day 1 Planting – 6 months

c) PV Arrays – 18 months

d) Longfield Substation and Grid Connection Route – 18 months

e) BESS Construction Compound – 6 months

f) BESS Installation Phase 1 – 12 - 18 months

g) BESS Installation Phase 2 (5 years post operation) – 12 -18 months

h) Commissioning and site restoration / landscaping, including Residual Mitigation Planting – 3 months

2.6.2. The construction of the Bulls Lodge Substation Extension is expected to take place over 24 months, as follows:

a) Enabling / civil works – 6 months

b) Substation extension – 18 months

c) Demobilisation and landscaping – 6 months

2.6.3. Outside of the main construction period, there will be commissioning and connection to the Transmission System, and construction and decommissioning of the temporary OHL diversion. These works are dependent on when outages are available.

2.6.4. These phases of construction may sometimes run in parallel, i.e., enabling works does not need to be complete in all areas of the construction site before solar farm construction commences in another part of the site.

2.6.5. The construction phase is expected to commence not earlier than the first quarter of 2024 and be completed not earlier than the first quarter of 2026. During the construction phase, several temporary construction compounds will be required as well as temporary roadways to facilitate access to all land within the Order limits.

2.6.6. It is not intended that the Scheme will be built in phases, with the exception of the BESS. The BESS may be constructed in two phases, with the first part built alongside the solar PV, and a second phase after five years of operation.

2.6.7. BESS Phase 1 will be constructed as part of the main 24 month construction phase for the wider Scheme (in parallel with solar PV, Longfield Substation, Cable Route etc.)

2.6.8. In the event that only Phase 1 of the BESS is constructed, with the second phase not required, the area of land allocated within the Concept Design for the Phase 2 of the BESS would instead be utilised for Solar PV Arrays.

2.6.9. National Grid Electricity Transmission (NGET) may undertake maintenance works and restringing of the overhead lines within the Order limits during construction of the Scheme. To provide safe access the Applicant will delay installation of Solar PV within the working corridor beneath these overhead lines or, if already installed, temporarily remove panels to allow NGET to carry out this work safely.

Enabling/Civil Engineering Works

2.6.10. The following activities will be required as part of the site preparation and civil engineering works:

a) Preparation of land for construction, including localised site levelling (where required). The land level changes will be localised and minor;

b) Import of construction materials, plant and equipment to site;

c) Establishment of the perimeter fence;

d) Establishment of the construction compounds;

e) Construction laydown areas;

f) Construction of the internal access roads; and

g) Marking out the location of the Scheme infrastructure.

Construction Activities

2.6.11. The following activities would be required as part of the enabling works (not necessarily in order):

a) Construction of site entrance and construction vehicle delivery holding area.

b) Establishment of main temporary construction compound, which include site offices/welfare area and parking area.

c) Upgrade, modification or improvement of highways where required for site construction.

d) Preparation of land for construction, including localised site levelling (where required) and vegetation clearance (primarily at the site entrance and along Noakes Lane).

e) Import of construction materials, plant and equipment to site.

f) Establishment of the construction area fence where required for construction works to progress (the installation of the perimeter fence will progress with site construction in each area and therefore will not be complete at the start of site construction).

g) Establishment of the Secondary Temporary Construction Compounds (STCCs), of up to 10 locations within the Solar Farm Site.

h) Construction of the internal access roads.

i) Marking out the location of the operational infrastructure.

Installation of Solar PV Panels

2.6.12. The following activities will be required to install the PV Panels:

a) Import of components to site;

b) Piling and erection of module mounting structures, with foundations to an expected maximum depth of 2.0 m.

c) Mounting of modules will be undertaken using hand-held power tools

d) Trenching and installation of electric cabling;

e) Transformer, inverter and switchgear foundation excavation and construction;

f) Installation of transformers, inverters and switchgears. Cranes will be used to lift equipment into position; and

g) Installation of control systems, monitoring and communication.

Construction of Electrical Infrastructure

2.6.13. The following activities will be required to construct the onsite electrical infrastructure comprising the cabling and solar stations:

a) Site preparation and civils for the three onsite substations and control building;

b) Trenching and installation of electric cabling;

c) Pouring of the concrete foundations and plinths for the electrical equipment;

d) Import of components to site. Cranes will be used to lift the components into position; and

e) Installation of the solar inverter stations.

Construction of Cable Routes

2.6.14. The following activities will be required to construct the cable routes and the Longfield Substation:

a) Site preparation and civils for the substation

b) Trenching and installation of electric cabling; and

c) Installation of the substation.

Trenching and installation of electric cabling - Outline Method Statement

2.6.15. For cables within the Solar Farm Site (e.g. 33kv collector cables), the following methodology and works description applies:

a) Underground cables, including HV power cables, will be laid to provide a link between the PV arrays, the transformer/inverter stations and the Longfield Substation where the main switchgear panels are located.

There will also be underground cables from the BESS enclosures to the Longfield Substation.

2.6.16. Work Areas and Access:

a) Generally on-site cables will be laid underground in excavated trenches adjacent to on-site tracks where possible and between the rows of PV panels. They will be laid at a suitable depth (typically 600mm to 1500mm) and positioned at a distance far enough away from the PV structures to allow future repair or maintenance. Some sections of cable may be installed in ducting if required to provide additional protection or where other infrastructure such as roads and hardstandings will be built over the top.

2.6.17. Typical Methodology:

a) Where at all possible, trenching will be carried out using a trapezoidal bucket to ensure stability during installation. Trenching and cable laying will be carried out progressively across the site and be phased to not interfere with other site operations such as piling, PV Mounting Structure assembly or PV Panel installation.

b) Care will be taken to ensure cable trench excavations can be managed and backfilled in a timely manner to avoid collapse. Trenching may be curtailed in periods of wet weather to avoid collapse of trenches of excessive contaminated run off.

c) A trench of nominal size (depending on single or double cable arrangements) will be excavated and materials stored temporarily, set back a safe distance from the top of the trench. A bed of imported material (sand) will be laid and levelled in the bottom of the trench. Cables will be laid in the required configuration using a cable drum attached to a 360 excavator or equivalent.

d) Each cable shall be overlaid by layers of warning tape marked ‘Electric Cable Below’. Pits will be left open and temporary fencing erected to enable cable jointing to take place (if applicable) at a later date. The pits will be backfilled on completion of jointing and testing. Each buried cable shall be placed with the required spacing between each individual cable.

e) The cables shall be suitably protected with ducting where the runs cross the roads/tracks. The cables will be terminated to the various electrical elements of the solar farm.

f) The CCTV and earthing cables will be installed in the cable trenches as well as the HV cables. The cables will be terminated to splice boxes/racks and then tested. The Earthing cable will be installed as per an agreed drawing in the cable trench and will provide a collective system earthing for the solar farm.

g) Cable tracks will be backfilled as soon as practicable using excavated materials.

BESS Construction

2.6.18. The following activities will be required to construct the BESS:

a) Installation of electric cabling;

b) Construction of foundations;

c) Import of components to site;

d) Installation of transformers; and

e) Installation of battery, transformers, inverters and switchgear.

Fencing, Security and Lighting

2.6.19. The permanent deer fence and security system will be established during the solar farm installation. The fencing will be installed early on in the works where possible to reduce the amount of temporary fencing needed. The construction site is split across 24 enclosed areas, with public access in between. The perimeter fence will not necessarily be established across the entire construction site before solar farm construction can commence. However, where required, temporary fencing will be installed to secure work areas not naturally contained by existing hedgerows or fencing.

Construction Staff

2.6.20. Construction is expected to start no earlier than 2024, and it is estimated that up to 600 workers will be required at the peak of construction in 2025, but it is expected that on any one day the peak would be 533, comprising 500 on the Solar Farm Site, and 33 associated with the Bulls Lodge Substation Extension.

Construction Hours of Work

2.6.21. Construction working hours on the Solar Farm Site will run from 07:00 to 19:00 Monday to Saturday. Working days will generally be one 12-hour shift.

2.6.22. Construction working hours on the Bulls Lodge Substation Extension will run from 07:00 to 19:00 Monday to Saturday with the exception of overhead line works which will run from 07:00 to 19:00 Monday to Sunday.

Construction Traffic, Plant and Site Access

2.6.23. During construction, a single site entrance at the junction of Waltham Road and Cranham Road will be used to access the Bulls Lodge Substation Extension site. The site entrance will include a security gate and kiosk to manage access and egress. The site entrance will allow HGVs to drive off the public road and park up before entering site without causing queues on the public highway.

2.6.24. Site access and routing strategies have been discussed and agreed in consultation with National Highways and Essex County Council as set out within the Framework Construction Traffic Management Plan (CTMP), ***Appendix 13B*** of ***Chapter 13: Transport and Access*** of this ES [**EN010118/APP/6.2**], and as illustrated on **Figure 2- 3**.

2.6.25. There are existing surfaced tracks within the Order limits currently utilised for farm machinery, which are proposed to be upgraded for use to minimise the use of the network of minor roads around the Order limits.

2.6.26. In order to access all of the construction site, a network of tracks will be used, including:

a) New permanent access tracks will generally be 4 - 6 m width constructed of permeable crushed aggregate. The main primary access track to the Longfield Substation and BESS area will be 6 m in width, with some

smaller secondary routes 4 m in width (the key route from the site entrance to the BESS will remain at 6 m width)

b) Upgraded existing access tracks through widening or resurfacing of existing farm tracks

c) Use of existing tracks where already suitable

d) Temporary access tracks to access all parts of the construction site, but where permanent tracks are not necessary.

2.6.27. The transport assessment has established a worst-case assessment, and examines a peak construction phase of up to 500 daily staff and up to 96 daily HGVs (50 HGVs for the Solar Farm Site + 46 HGVs for the Bulls Lodge Substation Extension).

2.6.28. Temporary car parks will be provided for construction workers, who will then be transported around site via mini-bus, or similar. The location of these car parks will be:

a) Main site compound within the Solar Farm site – 150 spaces

b) Bulls Lodge site compound – 50 spaces

2.6.29. A Framework Construction Traffic Management Plan (CTMP) [**EN010118/APP/6.2**] has been developed as part of the ES which will guide the delivery of materials and staff onto the Scheme during the construction phase.

Secondary Construction Compounds

2.6.30. A network of access tracks will be progressively built across the Solar Farm Site to allow access to all internal areas from the site entrance. A main temporary construction compound will be established close to the site entrance to allow control of deliveries, parking and material storage.

2.6.31. There will be up to 10 secondary temporary construction compounds (STCCs) progressively established across the Solar Farm Site in each working area. The STCCs have been scattered across the Solar Farm Site and the purpose of each one will be to service the local works. This includes storage for materials, fuel, equipment etc. needed for such works as well as welfare facilities, office space etc. required to avoid unnecessary internal movement of personnel over long distances.

2.6.32. STCCs will generally be set up ahead of the installation of the PV Arrays, electrical components and cabling and will be decommissioned as the relevant works in their locality progress and become completed.

Primary Construction Compounds

2.6.33. There will be two primary construction compounds, described as Work No. 7A and 7B. These are located by the main entrance of the Solar Farm Site, and north of the Bulls Lodge Substation Extension respectively. These primary construction compounds are the destination for construction traffic travelling to either site.

2.6.34. There will also be temporary construction layout areas aligned with the Grid Connection Route.

Surface Water Drainage

2.6.35. The operational drainage design will be developed pre-construction with the objective of ensuring that drainage of the land to the present level is maintained. It will follow either the design of a new drainage system taking into account the proposed new infrastructure (access tracks, cable trenches, structure foundations) to be constructed, or, if during the construction of any of the infrastructure, there is any interruption to existing schemes of land drainage, then new sections of drainage will be constructed.

2.6.36. The design of new drainage systems will be based on the Flood Risk Assessment (FRA) and hydrological assessment, undertaken as part of the ES.

2.6.37. Infiltration drainage design will be in accordance with Building Research Establishment (BRE) Digest 365: Soakaway Design and Sewers for Adoption (Ref 2-2).

2.6.38. ***Chapter 9: Water Environment*** provides a Flood Risk Assessment (FRA) at ***Appendix 9A*** and Drainage Strategies at ***Appendix 9C*** and ***Appendix 9D*** [**EN010118/APP/6.2**].

Storage of Plant and Materials

2.6.39. No long-term onsite storage of materials is required during the construction phase. Materials will be delivered via HGVs at regular intervals to the construction compounds and transported directly to where it is required within the Order limits using smaller LGVs.

2.6.40. Short term storage of materials and plant can be accommodated within the construction compound until it is required.

2.6.41. Topsoil, spoil and other construction materials will be stored outside of the 1 in 100-year floodplain extent and only moved to the temporary works area immediately prior to use.

Soil and Spoil Management

2.6.42. There will be no site wide reprofiling required outside the Bulls Lodge Substation Extension; however, there may be a need to flatten areas within the Order limits. In some locations to intercept extreme surface water runoff, scrapes and swales are proposed within low lying areas and parallel to the Order limits contours. This is unlikely to create excess topsoil, subsoil and spoil (spoil typically being material below 1m) and it is not expected that this would need to be removed from the Order limits. Topsoil, subsoil and spoil material is only expected to be generated from cable trenches, temporary and permanent compounds, internal roads, BESS phases 1 and 2 and substation compounds, and supporting infrastructure.

2.6.43. During construction the topsoil, subsoil and spoil will be stored temporarily within designated areas adjacent to the cable route and within the construction compounds. The topsoil, subsoil and spoil will be utilised to backfill and reinstate the soil profile in the cable trenches, reinstate the soil profile on the temporary construction compounds and any temporary access roads. Any excess topsoil, subsoil and spoil will be utilised across the Order limits. Utilisation of the material in the reinstatement should be in accordance with the requirements of the Outline Soils Resource Management Plan (SRMP)

appended to the OCEMP [**EN010118/APP/7.10**]. It is not anticipated that any material would be removed from the Order limits.

Construction Lighting

2.6.44. Construction temporary site lighting, in the form of mobile lighting towers with a power output of 8 kilo volt-amperes (kVAs), will be required in areas where natural lighting is unable to reach (sheltered/confined areas) and during core working hours within winter months. Artificial lighting would be provided to maintain sufficient security and health and safety for the Order limits, whilst adopting the mitigation principles to avoid excessive glare and minimise spill of light to nearby receptors (including ecology and residents) outside of the Order limits as far as reasonably practicable. All construction lighting will be deployed in accordance with the following recommendations to prevent or reduce the impact on human and ecological receptors:

a) The use of lighting will be minimised to that required for safe site operations;

b) Lighting will utilise directional fittings to minimise outward light spill and glare (e.g. via the use of light hoods/cowls which direct light below the horizontal plane, preferably at an angle greater than 20° from horizontal); and

c) Lighting will be directed towards the middle of the Order limits rather than towards the boundaries.

Onsite Fuel

2.6.45. Fuel for machinery and generators will be delivered to site by a fuel truck and stored in above ground fuel storage tanks of 10–36 m³ capacity. The fuel storage tank will be sheltered, secured from unauthorised access and equipped with a spill protection bund capable of holding 110% of the volume of the tank. Spill kits will be available at the fuelling point and other strategic locations of the construction site to allow for prompt clean-up to limit soil and water contamination. Construction workers will be trained in spill kit use.

Water Consumption

2.6.46. An estimated 36,000m^3 total of water (or an approximate 1,800m^3 during peak months) will be required during construction to support welfare facilities onsite and other uses. The water will be transported to the Order limits by road from an existing nearby licenced water abstraction source and stored on site in tanks of up to 30 m^3 capacity. Water will also be transported to site once construction has completed to fill the permanent storage tanks located at the BESS.

Waste

2.6.47. Solid waste materials generated during construction will be segregated and stored onsite in containers of up to 30m^3 capacity prior to transport to an approved, licensed third party landfill and recycling facilities. During construction removal of waste is estimated to require approximately 330 HGV loads over a period of 12 months, which equates to an average of 1 load per day.

Construction Environmental Management Plan and Construction Resource Management Plan

2.6.48. An Outline Construction Environmental Management Plan (CEMP) has been prepared and included in the Application. The Outline CEMP aims to provide a clear and consistent approach to the control of construction activities in the Order limits. A range of 'standard' or best practice mitigation and construction management measures are accounted for in the EIA.

2.6.49. The Outline CEMP details the construction mitigation measures and sets out the monitoring and auditing activities designed to ensure that such mitigation measures are carried out, and that they are effective. The Outline CEMP details measures to control construction impacts, including impacts relating to:

a) Climate change
b) Cultural heritage
c) Ecology
d) Water Environment
e) Landscape and Visual Amenity
f) Noise and vibration
g) Socio-economics and Amenity
h) Transport and Access
i) Air quality
j) Ground conditions
k) Major accidents and disasters
l) Telecommunications, Television Reception and Utilities
m) Waste

2.6.50. The detailed CEMP will be produced by the appointed construction contractor following granting of the DCO and prior to the start of construction (as part of a Requirement attached to the DCO). The CEMP will identify the procedures to be adhered to and managed by the Principal Contractor throughout construction. It may be that more than one CEMP is produced, as individual CEMPs may be produced and approved for different parts of the Scheme, for example it is anticipated that the works for the Bulls Lodge Substation Extension would be subject to a standalone CEMP (prepared in accordance with the Outline CEMP).

2.6.51. Contracts with companies involved in the construction works will incorporate environmental control, health and safety regulations, and current guidance and will ensure that construction activities are sustainable and that all contractors involved with the construction stages are committed to agreed best practice and meet all relevant environmental legislation including: Control of Pollution Act 1974 (COPA) (Ref 2-4), Environment Act 1995 (Ref 2-5), Hazardous Waste (England and Wales) Regulations 2005 (as amended) (Ref 2-6) and the Waste (England and Wales) Regulations 2011 (Ref 2-7).

2.6.52. Records will be kept and updated regularly, ensuring that all waste transferred or disposed of has been correctly processed with evidence of signed Waste Transfer Notes (WTNs) that will be kept on-site for inspection whenever

requested. Furthermore, all construction works will adhere to the Construction (Design and Management) Regulations 2015 (CDM) (Ref 2-3).

Site Reinstatement

2.6.53. Following construction, a programme of site reinstatement will commence.

2.6.54. Embedded mitigation measures for the construction phase are set out in the Outline CEMP, including measures such as construction and exclusion zones in relation to retained vegetation, ensuring a tidy and neat working area, covering stockpiles and storing topsoil in accordance with best practice measures.

2.6.55. An Outline Landscape and Ecology Management Plan (OLEMP) has been prepared. This document sets out the principles for how the land will be managed throughout the operational phase, following the completion of construction. A detailed Landscape and Ecology Management Plan will be produced following the granting of the DCO and prior to the start of construction (this will be secured by a Requirement attached to the DCO).

Testing and Commissioning

2.6.56. Commissioning of the Scheme will include testing and commissioning of the process equipment. Commissioning of the Solar PV infrastructure will involve mechanical and visual inspection, electrical and equipment testing, and commencement of electricity supply into the grid. Individual sub-systems will be commissioned separately, with each having its own procedures and prerequisite lines, and it may be necessary to commission these elements separately or at the same time, depending on the end technology utilised at the time of construction.

2.6.57. This process will take place prior to operation of the Scheme, not earlier than 2026.

2.7. Operational Activities

2.7.1. During the operational phase, activity within the Scheme will be minimal and will be restricted principally to vegetation management, equipment maintenance and servicing, replacement and renewal of any components that fail, and monitoring. It is anticipated that maintenance and servicing would include the inspection, removal, reconstruction, refurbishment or replacement of faulty or broken equipment and adjusting and altering the solar panel orientation to ensure the continued effective operation of the Scheme and improve its efficiency as set out within the Outline Operational Environmental Management Plan (OEMP) (**EN010118/APP/7.11**).

2.7.2. Along the Grid Connection Route, operational activity will consist of routine inspections (schedule to be determined) and any reactive maintenance such as where a cable has been damaged.

2.7.3. Bulls Lodge Substation Extension will be managed and maintained by NGET in line with existing operational procedures. NGET will be responsible for preparing a separate OEMP, or applying their existing OEMP, to the Bulls Lodge Substation Extension.

2.7.4. It is anticipated that there will be up to 8 permanent staff onsite during the operational phase which equates to a maximum of eight vehicles (or 16 daily

two-way vehicle trips) per day, with additional staff attending when required for maintenance and cleaning activities.

2.8. Decommissioning

2.8.1. Decommissioning is expected to take between 12 and 24 months and will be undertaken in phases, and for the purposes of the assessment is expected to occur after approximately 40 years of operation of the Scheme. A Decommissioning Environmental Management Plan will be prepared prior to decommissioning and will be secured through the Decommissioning Strategy [**EN010118/APP/7.12**].

2.8.2. The Solar PV Array Works Area and related components, Ancillary Infrastructure, Longfield Substation and the BESS will be removed and recycled or disposed of in accordance with good practice and market conditions at that time.

2.8.3. The underground cable within the Grid Connection Route would be removed to a depth of 1m, otherwise would remain in situ.

2.8.4. The Bulls Lodge Substation Extension would remain operational, as would the section of existing OHL which will be undergrounded prior to operation, and would remain in situ upon decommissioning.

2.8.5. The effects of decommissioning are similar to, or often of a lesser magnitude than construction effects and will be considered in the relevant sections of the ES. However, there can be a high degree of uncertainty regarding decommissioning as engineering approaches and technologies are likely to change over the operational life of the Scheme.

Waste

2.8.6. Removal of waste is estimated to require approximately 2,457 HGV loads over a period of 12 months, which equates to an average of 6 loads per day.

2.8.7. The infrastructure such as PV panels and battery storage units will be recycled as far as practical and in accordance with legislation and guidance applicable at the time, or if more suitable at the time, sold for refurbishment and reuse. It is expected that a Decommissioning Resource Management Plan (DRMP) will be needed and is committed to in the DCO to manage the disposal of waste from the Order limits, but the approach to and content of this will be driven by the relevant legislative and policy requirements at the time of decommissioning.

Land Reinstatement

2.8.8. Upon decommissioning, the above- ground physical infrastructure at the Solar Farm Site will be removed and the Solar Farm Site returned to the landowner. This will include the areas of agricultural land where the agricultural resource has been maintained (and potentially improved) during operation, and the established habitats. Post-decommissioning, the landowner may return the Solar Farm Site to arable use, although it is assumed that established habitats such as hedgerows and woodland would be retained.

2.8.9. All above ground infrastructure will be removed, with the exception of primary tracks that the landowner requested are retained, and the Bulls Lodge

Substation Extension, which will remain in NGET's control. The 400kV cables may be left in situ, depending on the least environmental damaging approach at the time. If these are removed this would be achieved by pulling the cables out of the ducts and subsequently removal of the ducts themselves, limiting the locations where the surface would need to be disturbed. This same principle will apply to the low voltage cabling throughout the Order limits. Any cabling removed will be taken to an appropriate facility for recycling.

2.8.10. Foundations and other below ground infrastructure will be cut to 1m below the surface to enable future ploughing. Any piles would be removed.

2.8.11. Areas of planting and habitats (Work No 10) will be preserved by the Applicant at the point of handover to the landowner, except where the only function was to screen infrastructure and is no longer required or wanted by the landowner.

2.8.12. Permissive paths would be removed during decommissioning, with the precise timing to be determined by the contractor(s) and communicated to the relevant local authority.

2.8.13. Some soil profiling may be required and the land will be contoured in agreement with the landowner and council, approximately similar to the current topography.

2.8.14. Excavations will be backfilled, using appropriate imported soil if required, otherwise with soil sourced on site, using appropriate soil management techniques. If necessary, the soil will be tilled to mitigate for any compaction. Areas where grass does not exist because of the footprint of the previous infrastructure (e.g. the BESS and Longfield Substation) shall be reseeded with suitable native species, in liaison with the land owner, in order to integrate the newly restored soil into the future land-use.

2.8.15. A Decommissioning Environmental Management Plan (DEMP), to include timescales and transportation methods, will be secured by requirement in the DCO and agreed in advance with the relevant Local Planning Authority.

2.9. References

Ref 2-1 British Standards Institute (BSI) (2017) BS EN 62271-1:2017 High-voltage switchgear and controlgear. Common specifications for alternating current switchgear and controlgear. Brussels: BSI.

Ref 2-2 Building Research Establishment (BRE) (2012) Digest 365: Soakaway Design and Sewers for Adoption (7th Edition). Watford: BRE.

Ref 2-3 HMSO (2015) Construction (Design and Management) Regulations 2015. [Date Accessed: 29/01/2021].

Ref 2-4 HMSO (1974); Control of Pollution Act 1974.

Ref 2-5 HMSO (1995); Environment Act 1995.

Ref 2-6 HMSO (2016); The Hazardous Waste (Amendment) Regulations 2016.

Ref 2-7 HMSO (2014); Waste (England and Wales) (Amendment) Regulations 2014.

Ref 2-8 Rochdale Envelope: Planning Inspectorate Advice Note 9 (2008).