SP MANWEB

Reinforcement to the North Shropshire Electricity Distribution Network

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Construction Report

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The Planning Act 2008

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

Regulation 5(2)(q)

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Author	**SP Manweb**
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Glossary

Busbar	A Busbar is a metallic bar (typically made of aluminium) that conducts electricity within a substation.
Cable	An insulated conductor designed for laying underground.
Cable Sealing End (CSE)	A Cable Sealing End's function is to connect a power cable to the substation network.
Concrete Tiles	Buried tiles designed to identify and protect underground and buried power cables.
Conductor	Overhead wire(s) attached to wood poles which conduct electricity.
Continuous Tension Stringing Method	A method of installing conductor on overhead lines that ensures the conductor is installed in a controlled manner under continuous tension which prevents the conductor from coming in to contact with anything other than the overhead line supports.
Circuit Breakers	A circuit breaker is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by excess current from an overload or short circuit. Its basic function is to interrupt current flow after a fault is detected.
Ducts	Underground network of pipes used to carry electrical and fibre optic cables.
Earth Mat	An earth mat is installed underground at the base of wood poles to provide an earthing system for the safe operation of the overhead line.
Entry Pit	Excavation at the beginning of a horizontal directional drill route utilised to fit the drilling equipment to the drilling rig and to enable a smooth entry for the drill head into the ground.
Environment Agency	A non-departmental public body with responsibilities relating to the protection and enhancement of the environment in England.

Fibre Optic	Fibre Optic cables are used for transmission of communications data over long distances and at higher bandwidths (data rates) than electrical cables.
Final Route Alignment	Indicative pole positions along the centreline of the Order Limits identified following consultation, technical and environmental appraisal
Groundwater	Water flowing through or contained beneath the ground surface.
Heavy Goods Vehicle (HGV)	A goods vehicle greater than 3.5 tonnes gross weight.
Hiab	Lifting equipment fitted to heavy goods vehicles.
HDD	Horizontal Directional Drill.
Insulator	Used to safely connect the conductors to wood poles.
Isolator	An Isolators function is to isolate the circuit after operation of a circuit breaker. An isolator is used to physically disconnect any incoming power lines to allow work on the power line to be performed safely.
Joint Bay	The primary function of a cable joint bay is to provide a clean and secure environment for the assembly of cable joints and bonding.
kV	Kilovolt (1000 volts).
Light Goods Vehicle (LGV)	Goods vehicle not exceeding 3.5 tonnes gross vehicle weight.
Order Limits	Means the limits shown on the Works Plans within which the Proposed Development may be carried out.
Proposed Development	The term used to describe a developer's plans for new infrastructure that have yet to receive consent.
PRoW	Public Right of Way which is a footpath or track over which the public have a right of access.
Receive Pit	Excavation at the end of horizontal directional drill route primarily used to capture drilling fluids and debris.

Running Blocks	A type of pulley wheel temporarily fitted to the insulators to aid with the installation of conductor.
SP Manweb	The DNO for Cheshire, Merseyside, North Wales and Shropshire. The promoter of the Proposed Development.
Substation	Generated electricity is fed into the electricity distribution network through substations. Substations control the flow of power through the network by means of transformers and switchgear, with facilities for control, fault protection and communications.
Terminal Structure	A self-supporting structure at the end of an overhead line that can be used to transition from an overhead line to an underground cable or a substation gantry.
Telehandler	Telescopic Forklift.
Trident wood pole	A type of support structure that typically carries 132kV electricity cables.
Wood Poles	Wooden poles used to support an overhead electricity line (either single or double).

CONTENTS

1 INTRODUCTION

1.1 INTRODUCTION

1.1.1 SP Manweb is making an application (the "Application") to the Secretary of State for a development consent order ("DCO") to construct a new 132kV electrical circuit between Oswestry and Wem in North Shropshire together with associated construction works. The Proposed Development comprises approximately 1.2km underground cable and 21.3km overhead electricity Trident line, together with works at the existing substations at Oswestry and Wem and undergrounding six short sections of existing overhead lower voltage lines. It is proposed to undertake construction works on all aspects of the proposed development simultaneously i.e. works to construct the underground cable, overhead electricity Trident line and undergrounding of the existing overhead lower voltage lines will be undertaken at the same time as construction works at Oswestry and Wem Substations. The purpose of this report is to provide a technical description of the Proposed Development including design, construction and on-going maintenance.

1.1.2 Reinforcement of the distribution network in North Shropshire is necessary in order to establish the required level of network security for the Legacy - Newtown - Oswestry - Welshpool - Whitchurch 33kV demand group.

1.1.3 The 33kV network in the Whitchurch/Wem area is presently operating near thermal and voltage limits and is therefore supplying close to its maximum capacity. The 33kV network in this area is comprised of a limited number of 132/33kV transformer in-feeds and the power is currently distributed through long distances of 33kV circuits to supply the demands in the Whitchurch and Wem areas of network. The magnitude of current flow through these 33kV circuits are such that some circuits are at risk of exceeding thermal ratings and the voltage drop along these circuits is already close to statutory limits.

1.1.4 In addition to the above reinforcement, the Proposed Development will provide capacity to support development on land allocated for new jobs and

homes in Oswestry, Whitchurch and Wem. The new 132kV circuit will support the existing 33kV and 11kV electricity distribution networks by increasing the capacity available throughout the North Shropshire area.

1.2 PROPOSED DEVELOPMENT

1.2.1 The Proposed Development comprises a new 22.5km 132kV electrical circuit between the existing SP Manweb Substations at Oswestry and Wem in North Shropshire, together with associated temporary construction works. The circuit would be a combination of underground cables and overhead line. Works are also required at the existing Oswestry and Wem Substations to accommodate the new circuit.

1.2.2 The Proposed Development includes the following elements:

- Works within the boundary of the existing SP Manweb Substation at Oswestry including underground cable and the installation of electrical switchgear and associated equipment;
- Approximately 1.2km of 132kV underground cable between Oswestry Substation and a 132kV terminal structure at Long Wood (SJ 31132 29877);
- Approximately 21.3km of 132kV of overhead line supported by Trident wood poles from the terminal structure at Long Wood (SJ 31132 29877) to the existing SP Manweb Substation at Wem; and
- Works within the existing SP Manweb Substation at Wem including the installation of a new 132kV to 33kV transformer.

1.2.3 The Proposed Development also includes work to facilitate the new electrical circuit including:

- Undergrounding six short sections of existing SP Manweb lower voltage overhead lines in order to ensure safe electrical clearance for the new overhead line; and

- Temporary works required for the construction of the new overhead line including seven temporary laydown areas, access tracks, vegetation clearance and reinstatement planting.

1.2.4 The construction compound for the Proposed Development would be located at the existing SP Manweb depot at Maesbury Road, Oswestry Industrial Estate, where site offices and welfare facilities are already in place. As this is an existing depot this compound is not included within the application. The construction compound would cater for the following:

- Bulk delivery (HGV) and storage of materials, the main components being wood poles, wood baulks, conductor, stay wire, crossarm assemblies and insulators; and
- Storage of construction plant and equipment.

1.3 ORDER LIMITS

1.3.1 The 'Order Limits' identify the area for which DCO consent is being sought. These Order Limits are in effect a construction and operation corridor, where all the proposed work would be undertaken. The Order Limits include the land for constructing the new 132kV circuit (including works at the existing substations, the overhead Trident wood pole line and the section of undergrounding) and the six sections of undergrounding the existing lower voltage lines, the seven laydown areas and the construction accesses.

1.3.2 The width of the Order Limits (excluding the substations) is for the most part 25m wide for the overhead line section and approximately 20m wide for the underground cable section. The Order Limits for this type of development are often in the region of 100m in width. SP Manweb has worked on design detail through careful iterative design processes to avoid constraints and accommodate feedback from consultation and landowner discussions to minimise the required extent of land take and land rights. The width of the Order Limits extends beyond 25m wide at changes in direction on the reflex angle of the line, i.e., the larger angle on the outside of the line, as shown in

Diagram 1.1 below. The width of the Order Limits along some access tracks also extends to take account of vehicle swept path requirements.

1.3.3 The Order Limits also extend at the terminal pole to allow for the conductors to be fixed to the wood poles by means of a winch.

1.3.4 The Order Limits also include construction accesses from public roads. These utilise existing accesses onto the public highway and generally follow farm accesses and field tracks or pass alongside existing field boundaries on the edge of fields. Each construction access would generally be between 3m and 5m wide and, apart from two locations where new temporary gates would be installed, would use existing field gates or openings.

1.3.5 Seven temporary lay-down areas, where poles and construction materials would be temporarily stored, have been identified at regular intervals along the route. These are located adjacent to construction accesses. The temporary laydown area on the edge of Wem would also accommodate a security cabin and self-contained welfare facilities.

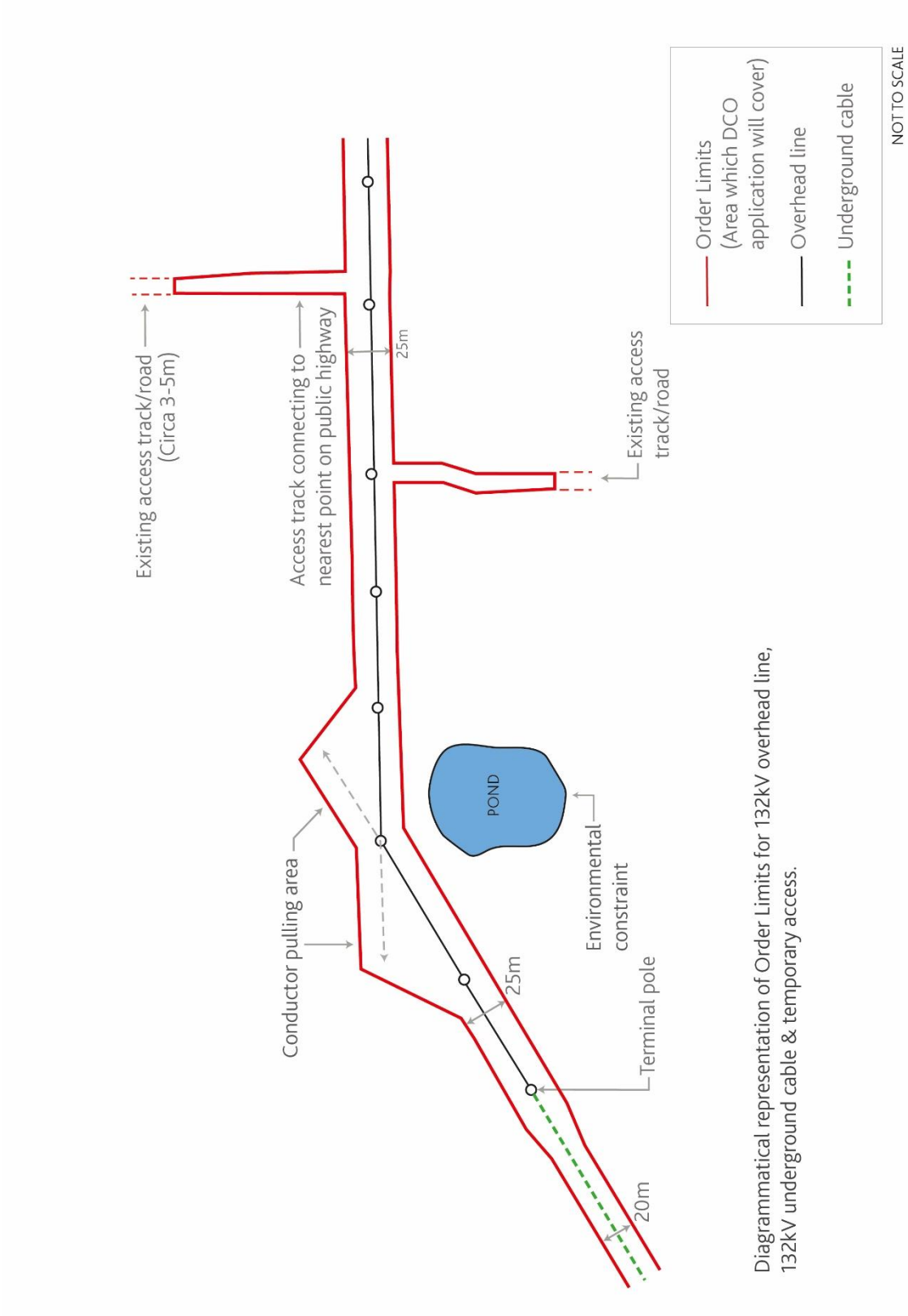

Figure 1.2 – Diagrammatic representation of the Order Limits

1.3.6 The development of the Order Limits has had the benefit of input from line design engineers who, working alongside the environmental team, have been able to balance the need between the technical requirements of a Trident overhead line and the avoidance of environmental constraints whilst considering issues raised through statutory and non-statutory consultations and landowner discussions. The selection of a Trident pole to carry the overhead line, with its use of wood pole supports and its small physical footprint (when compared to Heavy Duty Wood Pole and steel pylon overhead lines), allows greater flexibility in design and minimises the potential impacts of a 132kV overhead line.

1.3.7 Within the Order Limits the poles would, wherever possible, be located where indicated along the Final Route Alignment. The Final Route Alignment provides an indication of the likely pole positions and forms the centreline of the Order Limits. The indicative pole locations are shown on the Works Plans (**DCO Document 2.3.0 to 2.3.16**). It is anticipated however that post consent it may be necessary and desirable to refine the final vertical and horizontal profile of the conductors and pole positions (known as micro-siting) to reflect the following:

- The outcome of pre-construction surveys which identify new localised environmental constraints and ground investigations surveys; and
- Agreements on minor alterations suggested by landowners.

1.3.8 In carrying out the proposed development, the Order Limits allow for the following:

- To move any pole structure by no more than 5m from its indicative position (as shown on the Works Plans (**DCO Documents 2.3.0 – 2.3.16**)), and not within 1m of the outside edge of any hedgerows; and
- To increase vertically in height any pole structure (not exceeding 2 metres) from the heights shown in the Proposed Pole Schedule

(Appendix 3.1 to the ES (**DCO Document 6.3.1**)).

1.3.9 The indicative location of the 132kV underground cable is shown on the Works Plans (**DCO Document 2.3.1**).

1.4 STRUCTURE OF THE REPORT

1.4.1 This report sets out descriptions of the works required for:

- Oswestry Substation;
- 132kV underground cable;
- 132kV overhead Trident line;
- Wem Substation;
- Lower Voltage Diversions; and
- Temporary Works.

1.4.2 There is a separate section dealing with on-going maintenance.

2 Oswestry Substation

2.1 INTRODUCTION

2.1.1 The existing substation is located on the north-eastern edge of Oswestry. The Proposed Development includes works at a currently vacant bay within the substation.

2.2 PROPOSED WORKS

2.2.1 Oswestry Grid Substation was recently modernised and therefore the works required here to accommodate the new circuit are minimal.

2.2.2 The works include installing a 132kV outdoor circuit breaker, isolator and associated busbar, cable sealing ends and 132kV underground cable.

2.2.3 The above equipment will be located in an existing empty bay approximately 10m x 20m bolted on a number of new concrete plinths. Figure 2.1 shows the proposed layout of Oswestry Substation.

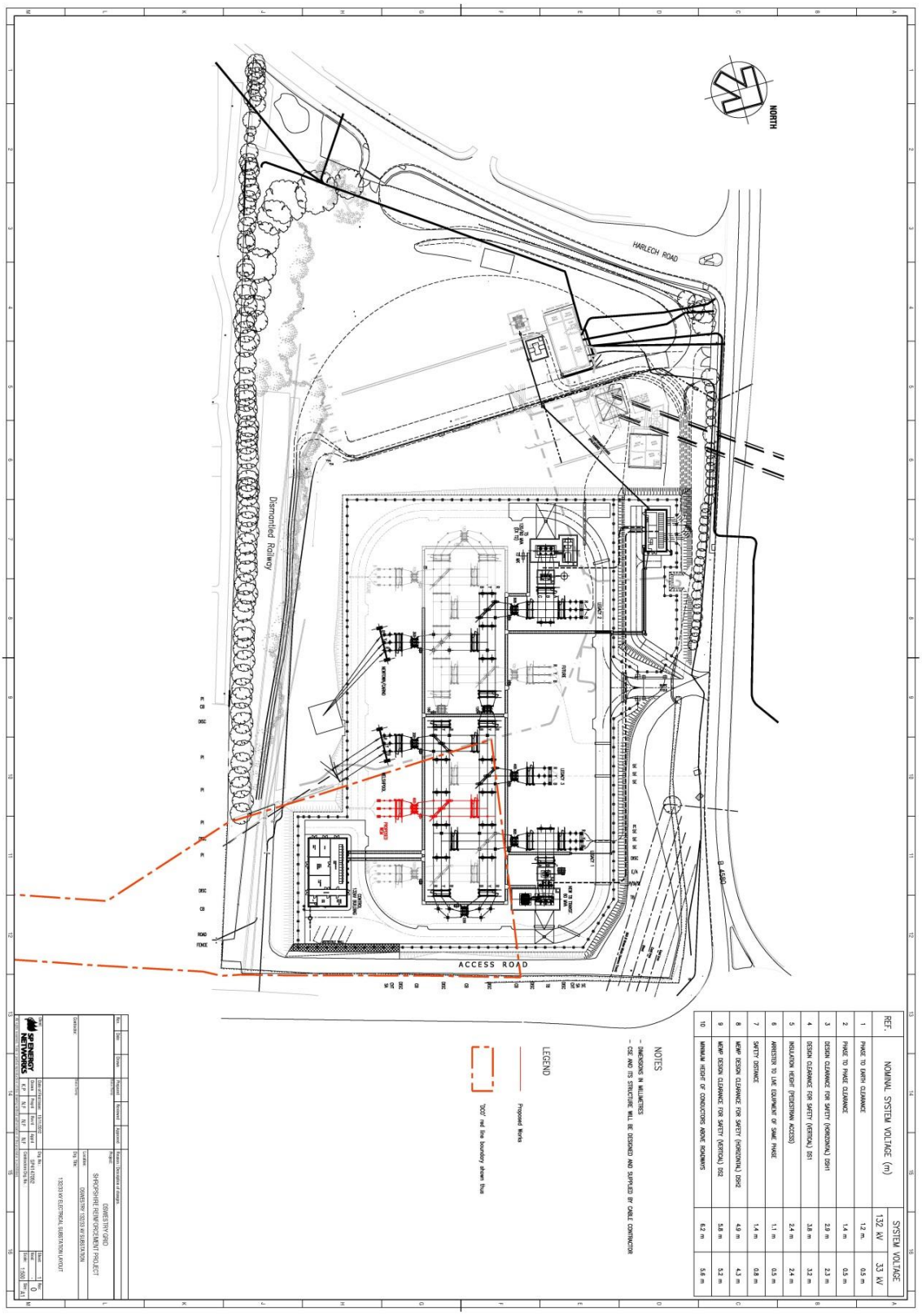

Figure 2.1 – Oswestry substation layout.

2.2.4 The proposed works at Oswestry Substation will use the existing and recently upgraded vehicular accesses into the substation site off of the B4580. Construction vehicles using this access will move through the substation site to the proposed works. No new or alteration works to these accesses is required.

2.2.5 Access is required for operative's vehicles and the delivery of plant and materials on HGV's including an excavator, telehandler, concrete, steel structures etc. Details of the anticipated traffic movements associated with these works can be found in the Traffic and Transport Technical Note (**DCO Document 6.1.1**).

2.2.6 This access will also be used by a HGV cable testing type vehicle which requires hard access surface to test 132kV underground cables.

2.2.7 The work will take approximately 2 months to complete.

3 132kV Underground Cable

3.1 INTRODUCTION

3.1.1 From Oswestry Substation a length of approximately 1.2km of 132kV underground cable will be laid to a terminal structure at Long Wood (grid ref SJ 3113229877). Design development has confirmed that the installation of underground cable for this section of the circuit is preferred due to the volume of existing overhead constraints in the area near Oswestry substation which include a number of 132kV and 33kV overhead lines.

3.1.2 The route for the underground cable (as shown on the Works Plans (**DCO Documents 2.3.0 – 2.3.16**) runs parallel to the western edge of the A5(T) for a distance of approximately 600m before passing south-east under the A5(T)(100m). For the remaining 500m it heads south roughly parallel to the eastern edge of the A5(T) then east towards Long Wood where it transfers to an overhead line terminal structure.

3.2 PROPOSED WORKS

3.2.1 At Oswestry Grid substation, the cable system starts with special weatherproof terminations, known as Cable Sealing Ends, which are connected to the busbars. Figure 3.1 below shows a typical Cable Sealing End structure to overhead busbar arrangement.

Figure 3.1 – Typical Cable Sealing End structure to overhead busbar arrangement.

3.2.2 Three 132kV single core cables together with fibre optic communications cables would then be laid in a cable trench to a terminal structure at Long Wood. The fibre optic communication cable is for electrical protection and communication systems, is for internal operational use by SP Manweb only, and is related to the running of its network.

3.2.3 Site preparation works includes vegetation clearance where necessary within the working area.

3.2.4 The cables would be installed in 200mm diameter Polyethylene ducts. These are laid in trefoil at a depth of about 1.4m in agricultural land to ensure a final minimum depth of 975mm can be maintained. The cable trench will be excavated by a JCB type excavator. The ducts are laid in 6m sections and

will be protected by suitably embossed polyethylene cable protection tiles. Within the Order Limits (up to 20m wide for this part of the Proposed Development) a working area of between 7m and 10m wide for the cable installation will be required to accommodate a trench about 1.0m wide together with the excavated material. A further 10m wide working area is required on the opposite side of the trench for the safe passage of construction vehicles. The working area includes provision for one cable joint bay. Topsoil excavated from the cable trench will be segregated and then used to complete the backfilling of the trench. Dependent on the ground conditions, suitable imported backfill material may be used to backfill the trench. Figure 3.2 below shows a typical cable installation corridor working area.

Figure 3.2 – Typical cable installation corridor.

3.2.5 Construction vehicles comprising an excavator, flat bed lorries and tipper lorries to deliver materials such as sand and the cable drums will move along the Order Limits corridor from the substation via temporary gates in the

substation boundary fencing. Details of the anticipated traffic movements associated with these works can be found in the Traffic and Transport Technical Note (**DCO Document 6.1.1**).

3.2.6 An appropriate trench support system i.e. shoring of excavation walls for safe working may be required dependent on the ground conditions. During cable laying operations, suitable crossing points will be provided as necessary to ensure access to properties local to the trench are maintained.

3.2.7 Temporary interception bunds including silt fences and/or matts and straw bales will be installed upslope and downslope of excavations and stockpiles in order to intercept surface water runoff, trap entrained/suspended sediment and reduce ingress of water to excavations. In the event of storm water entering the excavation, dewatering methods will be implemented e.g. open sump pumping to remove the excess water. This involves short term, temporary discharge of uncontaminated water which is wholly or mainly rainwater, from the excavation to surface water. Pumped water from excavations and de-watering activities will be drained to a suitably sized settlement pond to remove silt before discharge.

3.2.8 The cable would be delivered on cable drums and then positioned as required in order to allow the cable to be pulled through the ducts by a cable winch attached to a steel wire bond.

3.2.9 The underground cable would be protected by precast concrete tiles laid at such a distance above the cable to ensure as far as is reasonably practical that any person inadvertently excavating the ground above the underground cable would receive a warning of there being a cable below the tile. The underground cable route would be indicated by above ground markers located at the centre of the cable trench and which would be placed at field boundaries to indicate the cable route and to minimise the risk of third party damage. Such markers would be located so as not to interfere with normal farming activities.

3.2.10 The underground cable will in a few locations intersect with existing underground services. The normal procedure in such cases is to provide a deeper trench for the underground cable and 'tunnel' under the existing services. Excavation and reinstatement local to existing services would be carried out with due care and in accordance with HSE guidance document 'HSG 47 – Avoiding danger from underground services'.

3.2.11 For the A5(T) crossing SP Manweb intend to use horizontal directional drilling (referred to as HDD) as a lengthy closure of such a busy transport route would not be practical.

3.2.12 HDD can be used for stream crossings, crossing of deep high pressure gas and water mains, crossing of railway infrastructure, traversing areas of high traffic flow with minimum disruption, and to traverse areas with statutory environmental designations.

3.2.13 HDD works by sending a boring head from a send pit (entry pit) to navigate along a predetermined alignment to a receive pit. After a small diameter passageway exists, the machine is fitted with a reaming head to widen the tunnel. Fluids keep the machinery cool and lubricated while underground material is collected along its path. Certain drill heads are made for cutting through solid rock. The drill head can also be steered to form large radius bends. The entry and receive pits are typically between 7m and 10m long and approximately 2m wide and would be located either side of the A5(T) and within the Order Limits.

3.2.14 Figure 3.3 illustrates a typical HDD profile.

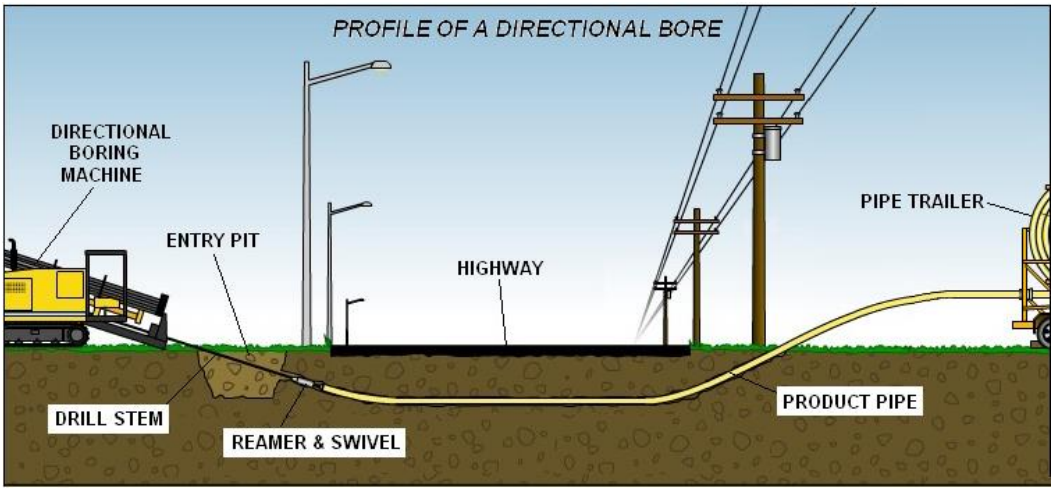

Figure 3.3 – Illustration of a typical HDD profile

3.2.15 By comparison, compared with trenching and excavating, as described above, HDD offers a number of advantages. These include:

- Little or no effect on traffic flow on major trunk roads;
- Fewer environmental impacts;
- Minimal disturbance to existing ground;
- Faster than traditional open cut methods; and
- Less hazardous for workers.

3.2.16 The HDD crossing of the A5(T) will be under the road and will not involve any road closure or any works affecting the use of the road. The HDD crossing will continue under a high pressure gas main which runs parallel to the A5(T) in land to the east side of the A5(T). Both of these operations will be in accordance with the appropriate specifications of Highways England and Wales and West Utilities.

3.2.17 Highways England has advised that a section of the Order should deal with the appropriate consent requirements for the crossing of the A5(T) and these are included in the draft DCO.

3.2.18 The existing highway and access off the A5(T) is suitable to meet the requirements of this part of the Proposed Development and no part of the existing highway needs to be altered for this purpose.

3.2.19 The underground cables will be connected to the overhead line at the terminal pole by way of cable sealing ends.

3.2.20 The work to construct the 132kV underground cable will take approximately 2 months.

4 132kV Overhead Line

4.1 INTRODUCTION

4.1.1 The overhead line would commence at Long Wood (SJ 31132 29877), structure no. 1, and following a roughly east-west alignment between the eastern edge of Oswestry and the western edge of Wem. From Long Wood, the overhead line (poles 1-16) would cross agricultural fields to the north of Middleton, before crossing the B5009 and the Shrewsbury to Chester rail line in quick succession (poles 17 and 18). Continuing east, the overhead line (poles 19-36) would pass through fields south of Babbinswood, before crossing the Montgomery Canal (poles 37 and 38) and passing through the northern edge of the Woodhouse Estate (poles 39-49). Continuing east, the overhead line (poles 50-64) would cross the River Perry at three locations as it skirts around Rednal Mill and passes north of Lower Lees. The overhead line (poles 65-76) then would turn to pass through fields north of Lower Hordley at Dandyford Farm, before resuming a more south-easterly direction (poles 77-100) as it passes south of Top House Farm and Kenwick Lodge. To the northwest of Stanwardine-in-the-Wood, the overhead line (poles 101-115) would turn east and continue across the A528 south of Cockshutt. The overhead line (poles 116-138) would then skirt through fields north of Malt Kiln Farm, and south of Coppice Farm, passing to the south of Moorfields Local Wildlife Site, before heading northeast (poles 139-150) between Bentley Farm and The Shayes, which lie to the south of Loppington and northwest of Noneley. North of the Shayes, the overhead line (poles 151-162) would turn to the east and pass north of Commonwood. It would then skirt southeast and then northeast as it crossed the River Roden (poles 163-166) before continuing in a north-easterly direction (poles 167-176) towards the B5476 and into Wem Substation.

4.2 PROPOSED WORKS

4.2.1 The proposed 132kV overhead line connection would be supported on wooden poles Trident design as shown in Diagram 4.1 below. SP Manweb has constructed a number of Trident lines across England and Wales, including most recently in 2015 between Legacy (Wrexham) and Oswestry Substations.

4.2.2 The Trident design comprises three phase conductors supported on tension insulators which are secured to galvanised steel cross-arms assemblies. This upper structure is approximately 3.8m wide for a single intermediate wood pole structure and 5.2m wide for a double wood pole structure.

4.2.3 Galvanised steel stay wires ('stays') are installed to resist the lateral mechanical forces acting on the pole structures in order to keep the structures vertical. These stay wires are used where the line changes direction and at terminal positions. Stay wires are attached near to the top of the structures and anchored in the ground by a below ground timber foundation block.

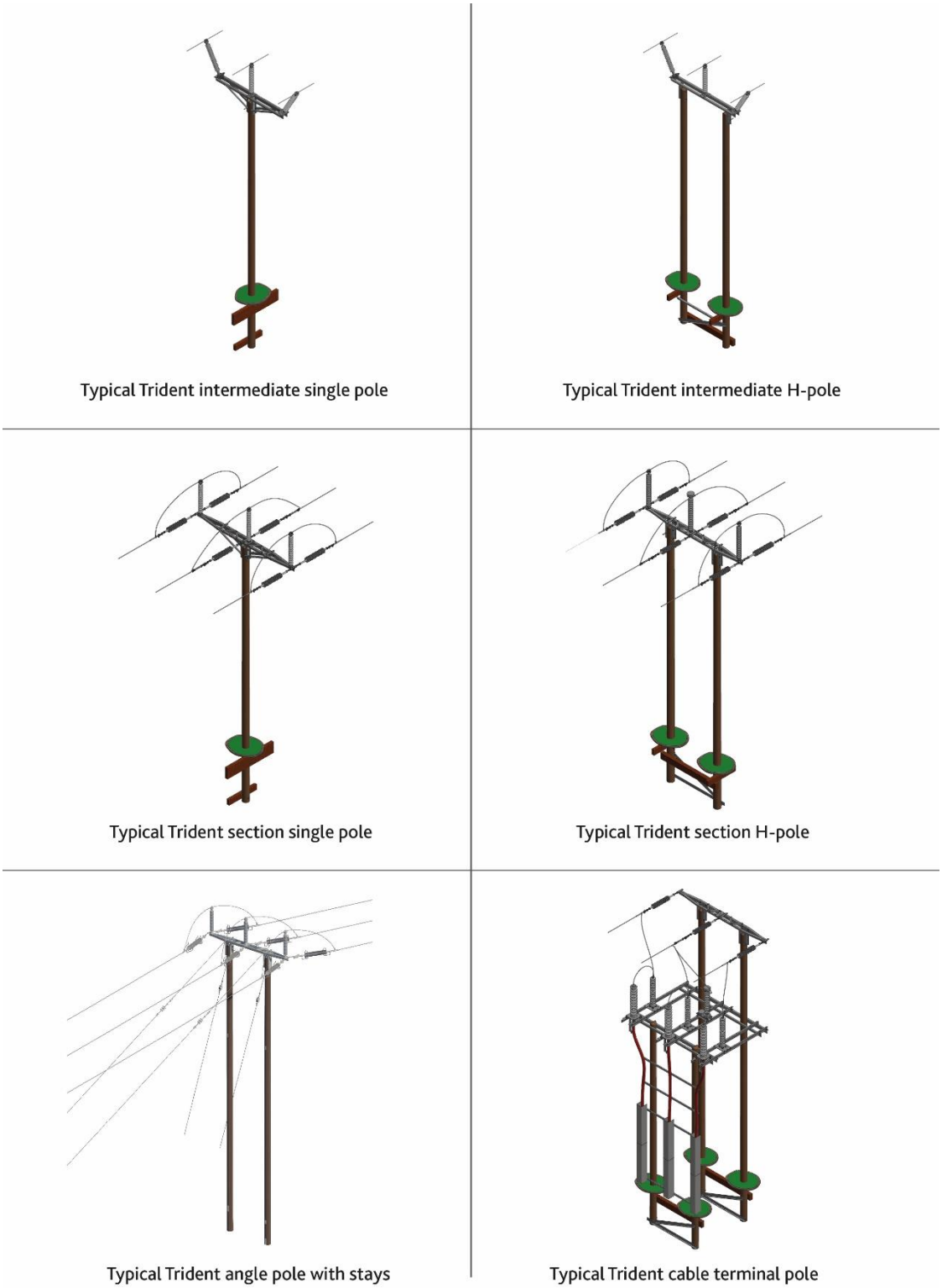

Diagram 4.1 - Illustration of different Trident pole types

4.2.4 Structures can be categorised as intermediate, section, angle or terminal, as described below and illustrated in Diagram 4.1 above.

- *Intermediate* - used where the overhead line follows a straight line and where the landform along the route is comparatively level. Options include single pole typically along the straight sections or H-pole structures where there is an angle change with the majority being single poles. The single pole supports a steel crossarm of 3.0m overall length. The intermediate 'H-pole comprises two poles set 2.5m apart, with a similar overall crossarm length. In some situations the H-pole structure can be secured further with stays, allowing span lengths to increase. The 'footprint' of the structure, however, would be increased as a result. Conductors are continuous at these structures and are secured using a clamp arrangement at the top of a vertically mounted post insulator. There is no general requirement to fit stays to intermediate structures.
- *Section* - used where the overhead line follows a straight line but where the forces applied to the structure by the conductors due to, for example, the landform or long spans are too great for intermediate structures. In section structures the conductors are secured to horizontally mounted tension insulators. The conductors on either side of a section structure are joined using a short length of conductor ('jumper') supported on a vertically mounted insulator. There is no general requirement to fit stays to section structures.
- *Angle poles* - can be single or H-pole structures, and can provide a maximum angle of deviation of 75 degrees. The conductors at these locations are secured to horizontally mounted tension insulators with a jumper connecting either side of the structure. These structures are fitted with up to four stays to enable changes of direction in the overhead line.

- *Terminal structures* – used at the Long Wood end of the overhead line. The terminal structure allows the overhead line to be connected either to an underground cable or directly to a substation gantry (as at the Wem Substation). For an underground cable the terminal structure comprises a stayed four wood pole construction consisting of a H-pole with a smaller support H-pole immediately in front to support the cable sealing end terminations. The terminal structure would have a four stay arrangement to provide a balance against the weight and tension of the conductors.

4.2.5 The different structures used in the Proposed Development are listed in Appendix 3.1 to the ES 'Proposed Pole Schedule' (**DCO Document 6.3.1**): There are a total of 176 structures comprising 1 double H-poles, 130 single poles and 45 H-poles (see below):

Terminal H-Pole	Double H-Pole	1
Intermediate	Intermediate Single	120
	Intermediate H-Pole	9
Section	Section Single	6
	Section H-Pole	3
Angle	Angle Single	4
	Angle H-Pole	33
	Total	**176**

4.2.6 Pole heights are determined by the electricity supply industry's own engineering specifications which specify the minimum clearances that must be provided between the conductors and the ground, and between the conductors and obstacles on the ground. Safety clearances for overhead lines are specified in ENA-TS 43-8 Issue 3, 2004, and as required under the Electrical Safety, Quality and Continuity Regulations, 2006 as amended

(ESQCR). The statutory minimum ground clearance for a 132kV overhead line is 6.7m.

4.2.7 The overall height is dependent on a number of criteria, including geographical location, topography, height above sea level, wind and ice loading, span length and conductor type. Pole heights will be selected to maintain the statutory clearance. Including the steelwork on top of the pole (which is around 2m tall), the Trident wood poles which are scheduled to be used for this project are typically about 14m above ground. The maximum overall height of the poles including the steelwork will not exceed 18m, and the minimum overall height is expected to be just over 11m.

4.2.8 The poles used for the structures are between 10m and 17m in length (of which approximately 0.7 to 2.5m is buried, depending on the structure). All wood poles are fully seasoned and treated with an appropriate preservative.

4.2.9 The average distance between the wood pole structures ("span length") will be 122m. The longest span length along the Proposed Development will be approximately 200m and the shortest 51m.

4.2.10 The proposed design will support an aluminium conductor of 200mm^2 cross sectional area (industry name "POPLAR" conductor) with an optical fibre included in one of the phase conductors.

4.2.11 The line is only earthed at the terminal poles, using copper conductor and copper rods beneath the ground in a grid formation around the feet of the poles.

4.2.12 The design of the foundations for the 132kV overhead line is guided by the ground conditions at each pole location. Intrusive ground condition surveys would be carried out prior to construction to determine ground condition.

4.2.13 The installation of wood poles requires excavation to allow buried timber foundation blocks to be fitted at a minimum of 500mm below ground level.

4.2.14 In excavating foundation holes, the minimum amount of soil is disturbed in order to take advantage of the load bearing value of the surrounding ground as far as possible.

4.2.15 For good ground conditions the pole would be directly embedded into the ground and the hole backfilled with excavated topsoil or an appropriate crushed-stone aggregate. Additional support where required is provided by a below ground timber foundation block. These are fitted in order to resist the vertical load and transverse load applied by the conductor, wind or angle of deviation.

4.2.16 For poor ground conditions, the excavated material is considered not to possess the required bearing strength characteristics so it will be necessary to design the foundation so that the excavated material is replaced with a granular material. For some areas where the ground is very poor it may be necessary to design additional measures such as using concrete. These works are no more intrusive than the standard excavations proposed for the majority of the foundations.

4.2.17 If solid rock is uncovered during excavations, it will be broken down and removed from site as it would not be suitable as back-fill. It would be necessary to use a granular backfill material. The top soil would be separated during the excavation and used to top off the excavation once it is backfilled.

4.2.18 The final pole positions may be microsited to minimise the extent of the foundation works necessary at any particular location. This movement of the pole position may require an adjustment in the pole height and head size to ensure statutory ground clearance is maintained. Micro-siting is subject to the limits described in paragraph 1.3.8 of this document.

Overhead Line Construction

4.2.19 Overhead power line construction follows a standard sequence of activities. For single-circuit wooden pole lines these activities include:

- Preparation of accesses;

- Excavation of foundations;
- Delivery of poles;
- Erection of poles;
- Undergrounding/deviation of lower voltage lines where necessary for safety clearances;
- Delivery of conductor drums and stringing equipment;
- Insulator and conductor erection and sagging; and
- Clearance and reinstatement.

Pre-construction activities

4.2.20 Prior to construction of the overhead line a precise ground survey will be carried out to determine the ground profile along the final route alignment and for 7m on either side where the ground profile slopes. This is to ensure that the location selected for poles and stays and their relationship with each other comply with the technical limits laid down for maximum span lengths, maximum sums of adjacent spans and safe clearance to live conductors.

4.2.21 Where the overhead line passes over or in close proximity to trees that could infringe safe clearances to 'live' conductors, the trees will be pruned or felled prior to the construction of the line. In order to reduce the likelihood of trees falling and causing damage to the power line during abnormal weather conditions, the Energy Networks Association has recommended that cutting back of vegetation incorporates an allowance for growth (ENA Engineering Technical Report 132, 2006). Details of the necessary tree and hedgerow clearance works can be found in the Environmental Statement Chapter 7 Ecology (**DCO Document 6.7**)

4.2.22 For single-circuit wood pole construction an area of 225m^2 is required at pole sites. Additionally a working area of 250m^2 (25m x 10m) is required at angle locations along the overhead line route to accommodate the winches required for stringing the conductors. These working areas are located depending on

the availability of access and the terrain, number of angle structures and severity of angle deviations. The greater the severity of angle deviations, the closer the working areas required. These working areas will not extend more than 80m beyond the last wood pole being strung in that section and will be within the Order Limits.

Wood Pole Erection and Conductor Stringing

4.2.23 The erection of wood poles requires excavation to allow the pole brace blocks and/or steel foundation braces to be positioned in place. Where an earth mat is installed, this comprises two earth conductors being laid at the base of the pole in an 'X' arrangement horizontally, at 600mm deep. Earth rods are inserted vertically along the route of these conductors.

4.2.24 The excavation is then backfilled and consolidated in layers, normally with the original materials. Topsoil is reserved for the top layer and any surplus subsoil or rock is removed from the site. Where the quality of backfill material is unsuitable it would be replaced with a suitable crushed-stone aggregate, or an approved soil additive may be used to improve the quality of poor soil.

4.2.25 Once all poles within the section of line under construction have been erected, all poles are fitted with insulator supports which are mounted vertically on top of the cross arms as shown on Diagram 4.1. Running blocks are fitted to the top of the insulator support and the conductors are fitted using the following techniques.

- Drums of conductor and a tensioner with a hydraulic brake are located at one end of the line section, with the pulling winch at the other;
- The conductor is joined to a single, heavy-duty pilot wire and drawn through the section, one conductor at a time, under constant tension; and
- Radio communication during stringing is maintained between the operators of the pulling winch, the tensioner, hydraulic brake and

intermediate observation points so the pulling can be stopped if problems arise.

4.2.26 By using the 'Continuous Tension Stringing' method the conductors are held aloft at all times and do not touch the ground or any other structures.

4.2.27 Temporary stays will be required along the line to balance the conductors as the build progresses to the other end. These stays will be installed and removed along the length of the line as the individual sections are completed.

4.2.28 Erection is completed with reinstatement of the ground and access routes taking place.

4.2.29 During construction the wooden poles are transported from the construction compound at the existing SP Manweb depot at Maesbury Road, Oswestry to the temporary laydown areas on pole delivery lorries. From the temporary laydown areas the poles are then transported on general purpose 4 wheel drive cross-country vehicles which have incorporated lifting devices.

4.2.30 Typically access is required for an excavator (JCB and/or tracked 360 degree excavator) JCB or similar agricultural 'loader', 4x4 lorry (often with Hiab) and 4x4 pick-ups. During the stringing phase of the works, there is also a need for access for 1 tractor, 1 tensioner and 1 MEWP (mobile elevated working platform) and cable trailers to gain access to several locations along the line. These works are sequential and this plant will move from one location to the next until the stringing is completed.

4.2.31 Drums of conductors are delivered as close as possible to the angle or tension pole sites from which the conductors are pulled. If necessary, tractors adapted to carry such loads are used to transport drums to the pole sites.

Workforce

4.2.32 It is envisaged that the overhead line works will be undertaken by a team of approximately 25 staff using the vehicles identified above and a transit van or similar to transport the staff to site.

Working Hours

4.2.33 Working hours are Monday to Friday between 0700 and 1900 hours during the months of March to October and between 0730 and 1730 hours or during daylight hours, whichever is the shorter, during the months of January to February and November to December and between 0700 and 1300 hours on Saturdays with no works to take place on Sundays or bank or public holidays. The following operations may take place outside the working hours:

- The installation and removal of scaffolding and protective netting across railways, highways and watercourse;
- Stringing of the line across the highway subject to the prior written approval of the relevant planning authority; and
- The completion of operations commenced during working hours which cannot be safely stopped.

4.2.34 The works to construct the overhead line will take approximately 6 months to complete.

Crossing Roads, Railways, Waterways, Footpaths and Other Services

4.2.35 Where the proposed overhead line crosses roads, railways, waterways, footpaths and other infrastructure (e.g. the existing 400kV overhead line and telephone wires) certain precautionary works have to be completed prior to the commencement of conductor stringing. Such assets have been identified within the Order Limits and the relevant companies have been included in the Book of Reference (BoR, DCO document Reference 4.3).

4.2.36 SP Manweb has entered into discussions with relevant parties regarding the effect of the project on their assets. Measures that provide suitable protection for their assets are included in the draft Construction Environmental Management Plan (CEMP) (**DCO Document 6.3.2**) and the draft Development Consent Order by way of protective provisions.

Roads

4.2.37 Scaffolding and nets will be erected over major roads (A and B Classified) and noticeably busy minor roads to enable the conductors to be pulled out unhindered. Table 4.1 includes details of the roads subject to scaffolding and netting.

4.2.38 On minor roads (C Classified and Non-classified) temporary traffic management (manned signalling), is sufficient to control traffic during stringing activities. Table 4.2 includes details of the roads subject to temporary traffic management during stringing activities.

4.2.39 All requirements of the appropriate authority would be adhered to such as relevant codes of practice, specification and procedures and where necessary temporary traffic management will be agreed with Shropshire Council.

Table 4.1 Scaffolding and Netting of Major Roads

Major Roads
B5009 Approx. 105m north from junction with Oil Tank Services Ltd).
Unnamed (Hordley Road) - Approx. 160m from the access to Dandy Ford Farm
A528 - Approx. 500m south from Wackley Lodge
B4397 – Approx. 480m east of Malt Kiln Farm
Salters Lane – Approx. 240m north of The Shayes
B5063 – Wem Substation

Table 4.2 Crossing of Minor Roads

Woodhouse Road - Approx. 65m north from Rednal Mill House
Unnamed (Hordley Road) - Approx. 660m east of Dandyford Farm
Unnamed (Hordley Road) - Approx. 820m east of Dandyford Farm
Unnamed Road (Stanwardine) - Approx. 240 west of A528
Unnamed Road (Malt Kiln Farm) - Approx. 150m west of Malt Kiln Farm

4.2.40 Temporary scaffolds are normally constructed either side of the crossing and a net supported by wire bonds is then erected between the two. This ensures there is no danger to passing vehicles or the public should the conductor sag more than envisaged whilst being pulled out or there is a failure in any of the pulling equipment. The scaffolds are supported by stays anchored to concrete blocks or temporary screw in ground anchors. It is necessary to have short duration closures to install and recover the netting but these are normally achieved in minutes and cause little or no disruption.

4.2.41 These temporary works are completely removed upon completion of the construction of the section of line where the oversail is situated.

Railways

4.2.42 There is one railway crossing located at Babbinswood. At this location, the conductors would be installed in a manner agreed with Network Rail. SP Manweb is in discussions with Network Rail regarding Protective Provisions and these are included in the draft DCO (**DCO Document 3.1**).

Canal and River Crossings

4.2.43 Where the proposed overhead line crosses the River Perry and River Roden and the Montgomery Canal, the conductors will be strung across without the need to access the water or banks. To enable conductor stringing, a pilot wire will be fired across from one bank to the other, with conductors subsequently pulled over under tension. The conductors will not touch the water during this operation. There is no requirement to erect scaffolding or netting to complete the conductor stringing across the Montgomery Canal.

4.2.44 Further to the response received from the Environment Agency dated 22nd January 2018 following statutory consultation, SP Manweb has discussed the crossing of the River Perry and River Roden with the Environment Agency and they have confirmed that a flood risk permit exemption can be sought for the crossing of the River Perry subject to adherence to working methods for construction activities in proximity to the watercourse. These methods are set

out in relevant guidelines which are referred to in the draft Construction Environmental Management Plan (CEMP) (**DCO Document 6.3.2**). Furthermore, the Pollution Prevention Plan (PPP) outlined in the CEMP (DCO Document 6.3.2) outlines the measures to be implemented to protect the water environment and ensure that the Proposed Development does not result in significant impacts on surface and ground water resources

4.2.45 As the proposed 132kV overhead line also crosses a flood defence structure across the River Roden, the Environment Agency has advised SP Manweb that a Bespoke Flood Risk Environment Permit (FRAP) is required. The FRAP is acknowledged in the Other Consents & Licences Report **(DCO Document 5.5).**

4.2.46 SP Manweb has discussed the crossing of the Montgomery Canal with the Canal & River Trust. A Code of Practice for Works in proximity to the Canal and a set of protective provisions has been provided by the Trust and SP Manweb's proposed provisions are included in the draft DCO **(DCO Document 3.1)**.

4.2.47 The towpath/footpath alongside the Canal shall be kept open at all times during the construction works. Management of the crossing will be undertaken by using construction staff at those crossing points where and when construction works affect the towpath/footpath. Towpath/footpath users may have to wait for a short period of time whilst the towpath/footpath is in use by the construction team. Users will be advised when works are completed and it is safe to cross the towpath/footpath by staff at the crossing point

Public Rights of Way

4.2.48 There are a number of public rights of way (PRoW) running through the Order Limits, however, none of these PRoW are directly affected by the Proposed Development and do not need to be permanently stopped up or diverted.

4.2.49 All points where Public Rights of Way (PRoW) follow access tracks or alternatively enter the Proposed Development Order Limits, as shown on the Access and Rights of Way Plans (**DCO Documents 2.4.0 – 2.4.16**), would have appropriate signage advising of dates and hours of work. Management would involve the use of construction staff at those points where and when construction works affect a PRoW. In these instances PRoW users may have to wait for a short period of time whilst the PRoW is in use by the construction team. Use would include the movement of vehicles and plant along the access or the oversailing of the conductors during stringing. Any restrictions are likely to be for tens of minutes rather than hours. Users would be advised when works are completed and when it is safe to cross or use the PRoW by staff at an appropriate location. There is no requirement to erect scaffolding or netting to complete the conductor stringing across any PRoW.

4.2.50 The PRoW are listed in Table 4.3 below and plans of the PRoW crossings are included in Appendix 1 of this document.

Table 4.3 – Public Rights of Way

	Ref:	PRoW	Type	Length Affected (approx.)	Location
1	U/G 132kV cable crossing	0306/12/7	Footpath	21 metres	Adjacent to the A5
2	OHL Crossing Pole 6 - 7	0313/41/1	Footpath	30 metres	Approximately 600 meters North East of Top House Farm.
3	U/G Recovery of 11kV Line	0313/41/1	Footpath	20 metres	Approximately 630 meters North East from Top House Farm.

Table 4.3 – Public Rights of Way					
	Ref:	PRoW	Type	Length Affected (approx.)	Location
4	U/G 11kV Line	0313/41/1	Footpath	20 meters	Approximately 450 meters south west of Brook Field Farm.
5	Access Route	0307/66/1	Footpath	10 metres	Approximately 180 meters south of Top House Farm.
6	Access Route	0307/65/1	Footpath	20 metres	Approximately 130 meters East of Top House Farm.
7	Access Route	0313/42/1	Footpath	50 metres	Approximately 400 meters West of Brook Field Farm.
8	Access Route	0313/42/1	Footpath	516 metres	Following access track leading out of Brook Field Farm Yard.
9	Access Route	0313/42/1	Footpath	10 metres	Adjacent to Brook Field Farm Yard
10	Access Route	0313/42/1	Footpath	10 metres	Crossing access track to Brook Field Farm.
11	Access Route	0313/47/1	Footpath	10 metres	Adjacent to Bryn y Plentyn
12	OHL Crossing Pole 26 – 27 & Access Route	0313/44/2	Footpath	700 metres	Following track South from Perrymoor Farm.

Table 4.3 – Public Rights of Way					
	Ref:	PRoW	Type	Length Affected (approx.)	Location
13	OHL Crossing Pole 37 - 38	Montgomery Canal	Regional Trail & Canal towpath.	32 metres	Crossing point of the Montgomery Canal.
14	OHL Crossing Pole 93 – 94 & Access Route	0207/14/3	Footpath	680 metres	Approximately 400 meters East of Top House Farm.
15	Access Route	0207/15/1	Footpath	220 metres	Approximately 430 meters South West of Kenwick Lodge.
16	OHL Crossing Pole 97 - 98	0207/15/1	Footpath	25 metres	Approximately 400 south west meters of Kenwick Lodge.
17	Access Route	0207/15/1	Footpath	10 metres	Approximately 250 meters south of Kenwick Lodge.
18	Access Route	0207/16/2	Footpath	10 metres	Approximately 210 meters south East of Kenwick Lodge.
19	Access Route	0207/16/2	Footpath	10 meters	Kenwick Lodge Drive way
20	Access Route	0207/13/1	Footpath	230 metres	Kenwick Lodge Drive way
21	Access Route	0217/4/1	Footpath	10 metres	Access to The Wood Near Malt Kiln Farm

Table 4.3 – Public Rights of Way					
	Ref:	PRoW	Type	Length Affected (approx.)	Location
22	Access Route	0217/4/2	Footpath	50 metres	Approximately 100 Meters North West of Malt Kiln Farm.
23	OHL Crossing Pole 125 - 126	0217/4/2	Footpath	30 metres	Approximately 130 meters North west of Malt Kiln Farm.
24	Access Route	0217/5/1	Footpath	10 metres	Approximately 300 meters east of Malt Kiln Farm
25	OHL Crossing Pole 128 - 129	0217/5/1	Footpath	31 metres	Approximately 200 meters South West of Coppice Farm.
26	OHL Crossing Pole 139 - 140	0217/10/1	Footpath	35 metres	Approximately 500 meters South of Bentley Farm.
27	Access Route	0217/10/1	Footpath	10 metres	Approximately 510 meters South of Bentley Farm.
28	Access Route	0217/10/1	Footpath	190 metres	Approximately 60 meters South of Bentley Farm.
29	Access Route	0217/11/1	Footpath	10 metres	Approximately 50 Meters South of Bentley Farm.
30	OHL Crossing Pole 145 - 146	0217/11/1	Footpath	28 metres	Approximately 270 meters East of Bentley Farm.

Table 4.3 – Public Rights of Way					
	Ref:	PRoW	Type	Length Affected (approx.)	Location
31	Access Route	0217/11/1	Footpath	20 metres	Approximately 360 meters East of Bentley Farm.
32	OHL /Pulling Position Pole 150	0217/12/1	Footpath	25 metres	Approximately 250 meters north of The Shayes.
33	OHL Crossing Pole 150 - 151	0217/12/1	Footpath	37 metres	Approximately 250 meters North of The Shayes.
34	Access Route	0217/13/1	Footpath	15 metres	Approximately 380 meters North East of The Shayes
35	OHL Crossing Pole 153 - 154	0230/47/1	Footpath	31 metres	Approximately 360 meters North East of The Shayes.
36	Access Route	0230/47/1	Footpath	10 metres	Approximately 550 meters South of The Ditches Hall.
37	Access Route	0230/47/1	Footpath	671 metres	Following access to The Ditches Hall heading South.
38	Access Route	0230/47/1	Footpath	10 metres	Approximately 250 meters south of Pools Farm.
39	OHL Crossing Pole 168 - 169	0230/47/2	Footpath	30 meters	Approximately 260 meters South of Pools Farm.

Water Supply / Sewage

4.2.51 Through engagement with Severn Trent Water, who own and manage water supply and sewage networks, SP Manweb is aware of two locations where the proposed 132kV underground cable crosses two sewage pipelines close to the A5(T). SP Manweb will adhere to the relevant specifications for these crossings which are outlined on Severn Trent Water's 'Guidance for working near our assets' documentation. Severn Trent Water has advised of another location where the proposed 132kV overhead line crosses a sewage pipeline (near Stanwardine Grange), however, SP Manweb is advised that they have no concerns in this instance.

4.2.52 In terms of crossing any water supply pipelines, SP Manweb has identified that the Proposed Development crosses these pipelines in six locations. As with the sewage pipeline crossings, SP Manweb will adhere to the relevant specifications for these crossings which are outlined on Severn Trent Water's 'Guidance for working near our assets' documentation.

4.2.53 A set of Protective Provisions has been drafted by SP Manweb relating to water supply and sewage and are included in the draft DCO (**DCO Document 3.1**).

Telecommunications

4.2.54 Openreach, which replaced BT Telecommunications, have undertaken an initial assessment of the Proposed Development and have indicated that diversions of Openreach infrastructure will be required at Rednal, Hordley and Wackley Lodge. SP Manweb will agree terms with Openreach regarding the required diversion of Openreach infrastructure to enable Openreach to undertake the necessary diversion works. A set of Protective Provisions has been drafted by SP Manweb relating to Openreach and are included in the draft DCO (**DCO Document 3.1**)

High voltage electricity line

4.2.55 SP Manweb has agreed with National Grid that the new 132kV overhead line provides sufficient clearance to the existing high voltage 400kV overhead line in Rednal operated by National Grid. SP Manweb is in discussion with National Grid regarding agreements to cross the high voltage 400kV overhead line in Rednal. Appropriate Protective Provisions are included in the draft DCO **(DCO Document 3.1)**.

Hedgerow crossings

4.2.56 Where the proposed overhead line crosses field boundary hedgerows, these hedgerows have been assessed in terms of their historic and/or ecological value and therefore their importance in terms of the relevant statutory hedgerow regulations. Where micro-siting of poles is proposed, a limit of deviation will be applied to ensure that the hedgerow is not affected and is oversailed.

4.2.57 Where section poles are shown indicatively close to a hedge on the Works Plans (**DCO Document 2.3.0 – 2.3.16**) then a construction management requirement will be for these hedgerows to be uplifted and temporarily stored to one side whilst the area is excavated and the pole installed. T he length of hedgerow removed will be a maximum of 2.5m in length. The hedgerow will then be relocated back in the original position within 48 hours. Only one of the hedgerows to be removed is deemed to be of ecological value whilst all others have been assessed as having historic value as outlined in the Environmental Statement Chapter 7 and Chapter 8 **(DCO Document 6.7 and 6.8)**. Where necessary, either because the existing hedgerow is poor or there is a nearby gap in the hedgerow boundary, then new hedgerows will be planted. Any replanting of existing and new hedgerows will be managed through a hedgerow management plan as described in the CEMP (**DCO Document 6.3.2**).

Reinstatement

4.2.58 Upon completion of the construction works it will be necessary to carry out a number of tasks to ensure construction areas are fully reinstated. All construction equipment will be removed from site and suitable reinstatement will be undertaken.

5 Wem Substation

5.1 INTRODUCTION

5.1.1 Wem Substation is located on the western edge of Wem. It is an existing substation that currently operates up to 33kV. No 132kV apparatus is currently installed.

5.2 PROPOSED DEVELOPMENT

5.2.1 The proposed new plant will be located within the existing substation boundary. The plant to be installed is a 132kV gantry, line isolator, associated busbars, a 132kV to 33kV transformer, 33kV cable to existing 33kV outdoor bay and a 33kV circuit breaker. The proposed layout of Wem Substation is shown on Figure 5.1 below.

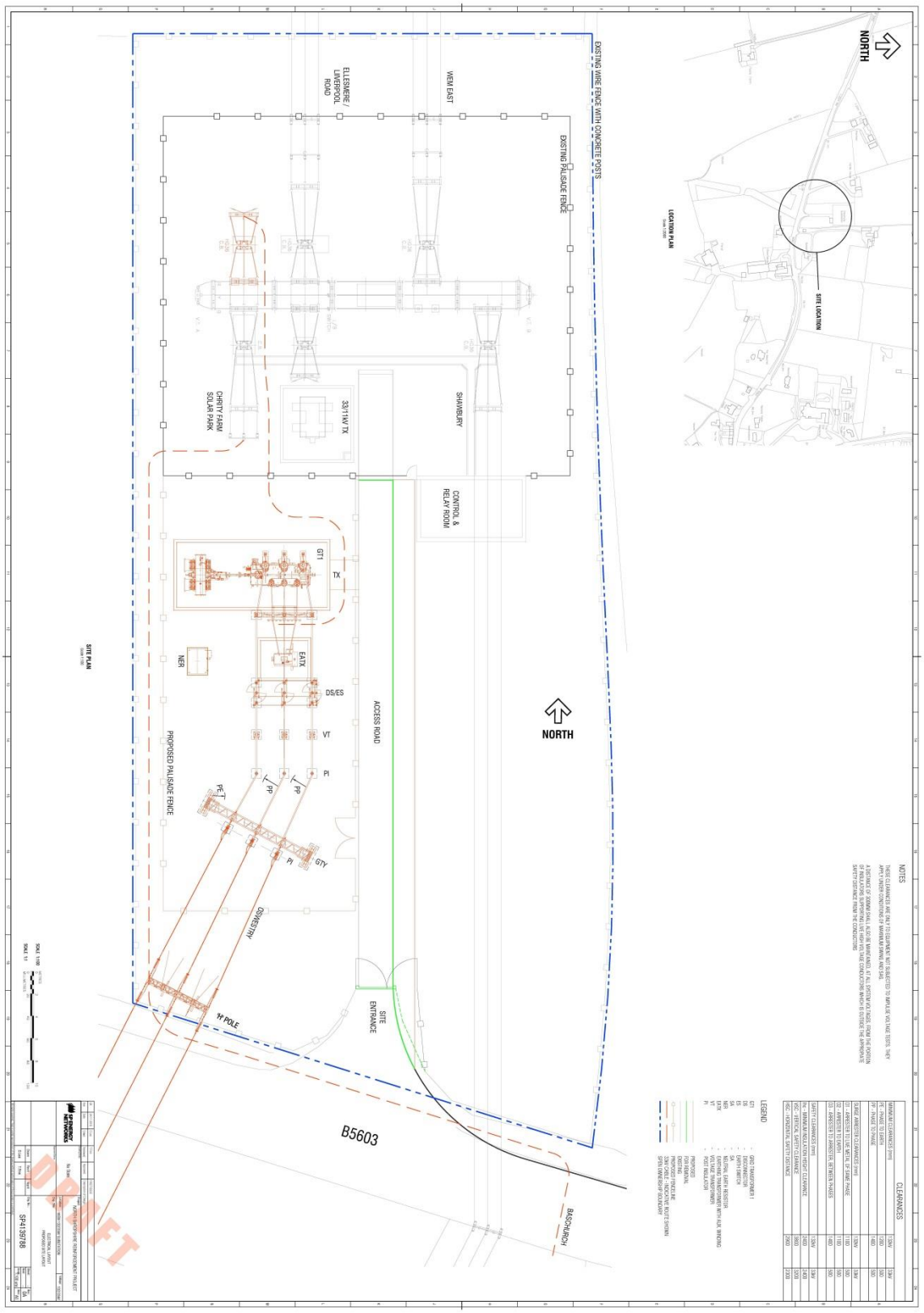

Figure 5.1 – Proposed layout of Wem Substation.

5.2.2 The above equipment will be installed on a number of concrete plinths within the substation boundary.

5.2.3 Electrical equipment such as the busbars and transformer will be brought to site by road. Most equipment will arrive in component form and will be assembled on site. The transformer will be delivered as built on a low loader articulated vehicle via local road network to Wem Substation. The equipment will be put together and then connected using tubular conductors and cabling.

5.2.4 Structures for supporting the electrical equipment will be formed in galvanised steel and these structures will be fixed to the foundations with holding down bolts.

5.2.5 For the proposed works at Wem Substation, construction vehicles will access the site via the local highway network along the Ellesmere Road (B5063) avoiding Wem Town Centre, agreed with Shropshire Council. There is a requirement for a transformer to be transported to site and this will use a heavy goods vehicle and be transported via an indicative route, which will be agreed with the emergency services and highway authorities, as is standard practice. The temporary laydown area on the opposite side of the road will also be used in relation to the construction works at the substation site and construction access to this area will also be via Ellesmere Road. Access to the works and laydown areas is required for operative's vehicles and the delivery of plant and materials on HGV's including an excavator, telehandler, concrete etc. Details of the anticipated traffic movements associated with these works can be found in the Traffic and Transport Technical Note (**DCO Document 6.1.1**).

5.2.6 The work will take approximately 6 months to complete.

6 Lower Voltage Diversions

6.1.1 Where the new 132kV overhead line crosses existing 33kV and 11kV lower voltage (LV) overhead lines, there is a requirement to either erect scaffolding and cross over the existing LV line or permanently divert the existing line. Installation of scaffolding or removal of the existing lower voltage lines is required to create a safe working corridor for construction of the new 132kV overhead line. Furthermore, permanent diversion of a number of existing lower voltage overhead lines is proposed as, in their current position, they will infringe on the safety clearances of the proposed 132kV overhead line. Table 6.1 below lists the lower voltage crossings.

6.1.2 In addition to the lower voltage crossings included in Table 6.1, SP Manweb has identified a further section of existing 11kV overhead wood pole line which may require diversion. The section of existing 11kV overhead line in question is located close to Pole 175 of the proposed 132kV overhead line near Wem and runs parallel to the proposed 132kV overhead line. A section of the 11kV overhead line may require undergrounding if it infringes on the safety clearances of the proposed 132kV overhead line which is dependent on the exact location of the existing line and the final location of the proposed 132kV overhead line.

6.1.3 Where the requirement for a permanent diversion of an existing lower voltage overhead line has been identified, this would be undertaken in two discrete phases. The first phase is to install the new underground cable which will then be connected to the existing network before the second phase of works is undertaken which includes dismantling and removal of the existing LV overhead line. As referenced in paragraph 1.1.1 above, this works will be undertaken simultaneously with other construction works. There are six lower voltage diversions proposed and the following is a description of the general work that will be carried out at each of these locations.

Installation of LV network

6.1.4 The lower voltage underground cables would typically be laid at a depth of 0.8m below ground level in a trench approximately 0.6m wide. New terminal poles will be erected on the existing lover voltage overhead line at the points where the diversions start and finish. These terminal poles will be used to support the overhead conductor and transition between overhead conductor and underground cable.

6.1.5 The cables would be installed in 160mm diameter ducts formed of polyethylene, which is chemically inert and does not contain any fluids. The trench would be dug to a depth of 800mm and a single duct laid within the trench. The cable would be pulled through the duct and the trench reinstated. The cable trench would be excavated by a JCB type excavator. A 7m wide working area for the cable installation would be typically required to accommodate the 0.6m wide trench and the excavated material. Topsoil excavated from the cable trench would be segregated and then used to complete the backfilling. Dependent on the ground conditions, suitable imported backfill material may be used to backfill the trench. During cable laying operations, suitable crossing points would be provided as necessary to ensure access to properties local to the trench are maintained.

6.1.6 Access would typically be required for an excavator (JCB and/or tracked 360 degree excavator) JCB or similar agricultural 'loader', 4x4 lorry (often with Hiab) and 4x4 pick-ups. Access would also be required for 1 tractor, 1 mobile elevated working platform (MEWP) and cable trailers.

6.1.7 Materials would be removed from site using general purpose 4 wheel drive cross-country vehicles which have incorporated lifting devices and tractors with trailers. Construction vehicles used in relation to the lower voltage line works will access these work sites via the construction accesses used to access the 132kV overhead line works.

6.1.8 The underground cable would be protected by marker tape laid below ground and at such a distance above the cable to ensure as far as is reasonably

practical that any person inadvertently excavating the ground above the cable would receive a warning of its presence.

6.1.9 The underground cable will in a few locations intersect with existing underground services, such as water mains or sewage pipes. The normal procedure in such cases is to provide a deeper trench for the underground cable and tunnel under the existing services. Excavation and reinstatement local to existing services would be carried out with due care and in accordance with HSE guidance document HSG 47 – Avoiding danger from underground services. Any such works are covered by Protective Provisions which are included in the draft DCO (**DCO Document 3.1**).

6.1.10 The connection of the newly laid underground cable to the existing lower voltage network would be completed under 'outage' conditions where the existing lower voltage network is switched off temporarily.

Dismantling and Removal of the Installation of LV network

6.1.11 The second phase of the diversion works involves dismantling and removal of the section of lower voltage overhead line that has been diverted.

6.1.12 All conductor, fittings, wood poles, stay wires etc. would be dismantled and removed from site to the main construction compound. Localised filling may be required to fill foundation holes using suitable imported material. Topsoil would also be imported to reinstate the ground locally at each pole location.

Table 6.1 – Lower Voltage Crossings			
Crossing Ref X Crossing O Oversail	Location	Reason for Works	Voltage (kV)
LV-X 01	Poles 7 – 8 Top House Farm	Clearances infringed, required to be permanently undergrounded.	11
LV-X 02	Poles 52 - 53 Rednal Mill	Clearances infringed, required to be permanently undergrounded.	11
LV-X 03	Poles 71 - 72 Lower Hordley	Clearances infringed, required to be permanently undergrounded.	11
LV-O 01	Poles 106 – 107 Stanwardine Grange	No clearance infringement, construct 132kV OHL using scaffolding.	11
LV-X 04	Poles 116 - 117 Wackley Lodge	Clearances infringed, required to be permanently undergrounded.	11
LV-X 05	Poles 132 – 133 Coppice Farm	Clearances infringed, required to be permanently undergrounded.	11
LV–O 02	Poles 137 – 138 South of Bentley Farm	No clearance infringement, construct 132kV OHL using scaffolding.	33

Table 6.1 – Lower Voltage Crossings			
Crossing Ref X Crossing O Oversail	Location	Reason for Works	Voltage (kV)
LV–O 03	Poles 151 – 152 South of Chapel House	No clearance infringement, construct 132kV OHL using scaffolding.	11
LV–X 06	Poles 172 - 174 Wem Substation	Clearances infringed, required to be permanently undergrounded.	33

7 Temporary Works

7.1 TEMPORARY WORKS

Construction Accesses

7.1.1 In relation to the proposed works at Oswestry Substation and Wem Substation, construction traffic comprising staff vehicles, plant and material deliveries will arrive at the substation sites from the compound or direct from elsewhere along the highway network. There are already existing accesses into the substation sites and through the sites to the work areas. In the main, these vehicles are typical construction site traffic. For the proposed works at Wem Substation, there is a requirement for a transformer to be transported to site and this will use a heavy goods vehicle and be transported via a route that will be agreed with the emergency services and highway authorities, as is standard practice.

7.1.2 For the construction of the underground 132kV cable and 132kV overhead line and related lower voltage diversions, construction traffic will travel from the Maesbury Road construction compound along the local highway and using existing farm accesses to temporary laydown areas. From here, plant and materials will be transferred to smaller vehicles which will then travel to the work sites via the construction accesses. Where possible, materials may also be moved from the compound using smaller vehicles direct to the work sites via local roads and the construction accesses. An assessment (Traffic and Transport Technical Note (**DCO Document 6.1.1**) of the number of construction vehicle movements using local roads to access the various construction accesses has concluded that there would be no adverse impact on the level of traffic using these local roads, and this outcome has been agreed with Shropshire Council and Highways England.

7.1.3 Similarly, these local roads have been assessed in terms of their suitability e.g. width, gradient and they are all capable of accommodating the types of

construction vehicles to be used in the Proposed Development without requiring any highway improvement works.

7.1.4 Similarly, all of the existing accesses into private roads are of an adequate layout to accommodate construction vehicles and no alterations are required.

7.1.5 From Oswestry Substation, an excavator and flat-bed and tipper lorries will deliver materials to site moving along and within the underground cable Order Limits as the cable trench is dug. Access along this route will also be used for the HDD construction vehicles (comprising tracked drilling rig and excavator) which will travel to the west side of the A5(T) where a 'send/receive' pit will be located. Access from the eastern side of the A5(T) for the HDD will be via an existing farm access off of the A5(T). This access will also be used to access the underground cable route and temporary laydown area where the same type of construction vehicles used in constructing the underground cable route from Oswestry Substation will use this access, as will construction vehicles used in installing the 132kV overhead line. No junction improvements are required and on this basis Highways England has confirmed the temporary use of this access provided there is advanced warning signage in place on either approach to the access which negates the need to reduce the current speed limit on the A5(T). In subsequent advice, Highways England has also provided advice regarding control of the temporary use of this access. Suitable measures are included in the draft DCO (**DCO Document 3.1**).

7.1.6 Construction access is proposed through the laydown area into the Order Limits covering the installation of the 132kV underground cable on the east side of the A5(T) and the 132kV overhead line to Pole 1 at Long Wood. Pole 1 is also accessed from a construction access from Top House Farm and Cabin House Farm along Middleton Road which runs to the south of the Order Limits. The types of construction accesses for the movement of construction vehicles to the proposed underground cable and overhead line works from Middleton Road are then repeated in a number of construction accesses

along the approximately 21km route of the new 132kV overhead line into Wem Substation. These construction accesses from the local public highway using junctions into private land and accesses do not result in any works to the existing public highway.

7.1.7 The design includes a number of construction accesses as it is SP Manweb's approach to access the construction working areas using existing field gates and tracks rather than constructing in a linear fashion which would result in removal of sections of field boundary hedgerows. The avoidance of these hedgerows is considered by SP Manweb to be preferred for environmental reasons. In terms of delivery of the project, it also avoids SP Manweb requiring rights to replant hedgerows more widely than is necessary. In addition, this approach is one that is more familiar to landowners and tenants when SP Manweb is negotiating voluntary agreements with them.

7.1.8 Construction vehicles will move from the public highway to the laydown areas and to the work sites via construction accesses which will be typically 5m wide and slightly wider where there is a swept path requirement. Construction accesses have been designed to access every pole site on the route.

7.1.9 In line with SP Manweb's approach to avoid breaching hedgerows along field boundaries and minimise the number of hedgerow crossings (see above), the design of construction accesses takes into account the need to access the works areas from the existing public highway and suitable farm accesses. These existing farm accesses are all currently in use to access various fields and as such there is either an existing surfaced track, a stoned track or grassed track through existing field gates. The construction accesses have been designed to ensure pedestrian and vehicular access can be obtained to each pole location. Where it is not possible to access the next adjacent pole location due to the presence of a hedgerow on the field boundary between the pole positions, access is taken via the next available existing field access to minimise removal of hedgerows.

7.1.10 Where, in some cases, a construction access crosses a public right of way or existing farm track, SP Manweb consider that no impact would arise as the right of way and farm tracks continue across the construction access. The locations of where the construction accesses cross existing rights of way and farm tracks are shown on the Works Plans **(DCO Document 2.3.0 – 2.3.16)** and the Access and Rights of Way (ARoW) Plans (**DCO Documents 2.4.0 – 2.4.16**).

7.1.11 The construction accesses have been identified to make use of the most suitable local roads from the compound and then existing farm accesses using surfaced accesses and field tracks and field gates used by farmers already to access the working areas along the route of the proposed cable and overhead line.

7.1.12 The construction accesses have been designed to intentionally avoid breaching the many field boundary hedgerows that the proposed overhead line route crosses. Each construction access allows access to specific pole locations.

7.1.13 In relation to the proposed 132kV overhead line works, SP Manweb proposes to carry out most of the construction works during summer months. If required, due to the time of year and/or adverse wet weather, there may be a need to create a temporary surface within the construction width shown. This would be in the form of temporary trackways or temporary stoned accesses that are commonly used. Given the unpredictability of weather and conditions of farm accesses at the time of construction, SP Manweb is unable to identify ahead of this work where and for how long in duration temporary tracks will be needed. Any such temporary access improvements will be removed following the construction and re-laid temporarily the next time they might be needed for operational maintenance. Figure 7.1 below shows a typical temporary trackway installed.

Figure 7.1 – Temporary Trackway.

7.1.14 Traffic management measures will be put in place to protect the condition and safety of the local highways used and these will include making safe vehicular accesses, use of wheel washing facilities, dust control, road sweeping, noise/ vibration control, use of banksmen to ensure safe access/ egress of vehicles, convoy support vehicles for wide loads, wide load notifications, compliance with width and weight restrictions, working hours. These measures are secured by being set out in the Outline Traffic Management Plan which forms part of the draft CEMP (**DCO Document 6.3.2**).

7.1.15 In summary, there is very limited works required in the Proposed Development in relation to the public highway. The Proposed Development benefits from using existing accesses at both the substation sites and from utilising existing farm accesses elsewhere along the route of the 132kV underground cable and 132kV overhead line as well as the lower voltage diversions along the route. Where these accesses are not suitable at the time that construction or subsequent maintenance is taking place, then SP Manweb will lay temporary tracks. This approach results in their being no

need to create new or alter existing accesses along the public highway (or 'streets' requiring consent under relevant street works regulations).

Temporary Laydown Areas

7.1.16 Seven temporary laydown areas have been identified at convenient locations along the route. These are located short distances from the public highway and accessed via the construction accesses using the existing accesses to the farms. The laydown areas would be used to support the construction on site and provide flexibility to avoid travelling to and from the main construction compound. Construction traffic movements would be minimal as the laydown areas will only be used when there is a need to store plant overnight to save going back to the compound. The laydown areas are likely to be used for a short space of time as places where workers drive to and park their vehicles before transferring into construction vehicles and driving to the work site.

7.1.17 Plant and vehicles will be stored at these temporary laydown areas for only the period of construction of that section of the cable and overhead line. These areas will be fenced off with temporary fencing and depending on their condition, may require some form of temporary surfacing. For the site in the field south of Wem Substation a self-contained welfare unit and a security cabin will also be required during the construction works at Wem Substation to provide local facilities for the workforce given to the distance of Wem substation from the construction compound at Maesbury Road, Oswestry. This laydown area will also require some static security. It is anticipated that this laydown area will be used for up to 6 months.

7.1.18 The seven temporary laydown areas are located at:

- East of the A5(T) near Long Wood at Middleton;
- In Middleton between Cabin House an Top House Farm;
- At Brookfield Farm, at the southern end of Coalpit Lane;
- At Dandyford Farm near Lower Hordley;

- At Top House Farm;
- At Coppice Farm, southwest of Loppington; and
- On the western edge of Wem, in the field south of Wem Substation.

7.1.19 The seven temporary laydown areas are numbered in the Works Plans **(DCO Document 2.3.0 – 2.3.16)**.

Maesbury Road Construction Compound

7.1.20 The main construction compound is at the existing SP Energy Networks depot at Oswestry Maesbury Road Industrial Estate. As such, this does not form part of the Proposed Development.

7.1.21 The compound will be used for the following:

- Receiving bulk delivery (HGV) and storage of materials from main road network, the main components being wood poles, wood baulks, conductor, stay wire, crossarm assemblies and insulators;
- Storage of construction plant and equipment; and
- Site offices.

7.1.22 An assessment of the number of construction vehicle movements associated with the main construction compound concludes that there will be no detrimental impact on the operation or safety of the strategic and local highway network. Details of this assessment are included in the Traffic and Transport Technical Note (**DCO Document 6.1.1**). This outcome has been agreed with Highways England and Shropshire Council.

7.1.23 It is anticipated that the construction compound will be utilised for a maximum of 18 months. As this is an existing SP Energy Networks depot this compound is not included within the DCO, as this is an existing established use and the temporary level of use would not be a material intensification of the current use. Therefore, this does not need planning consent. Figure 7.2 below shows the location of existing SP Energy Networks depot at Oswestry Maesbury Road Industrial Estate.

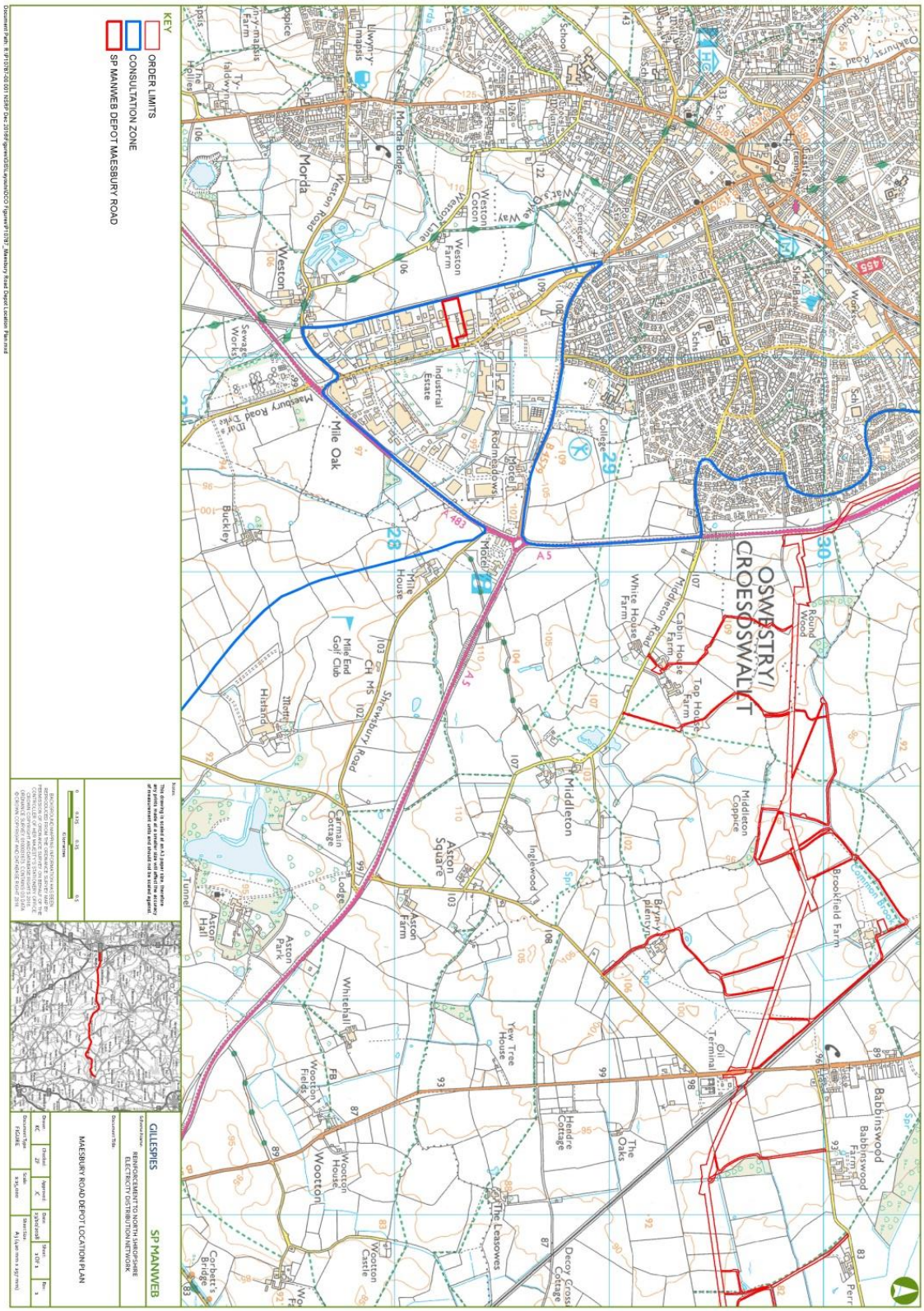

Figure 7.2 – SP Energy Networks depot, Maesbury Road Industrial Estate

7.2 CONSTRUCTION PROGRAMME

7.2.1 It is currently anticipated that (subject to consent being granted) work on site would commence in mid-2020. The construction phase is anticipated to be completed within twelve months following commencement on site. The target is for the North Shropshire Reinforcement Project to be operational in 2021.

<table>
<tr><td colspan="7">2020</td><td colspan="5">2021</td></tr>
<tr><td>June</td><td>July</td><td>Aug</td><td>Sept</td><td>Oct</td><td>Nov</td><td>Dec</td><td>Jan</td><td>Feb</td><td>Mar</td><td>April</td><td>May</td></tr>
<tr><td colspan="4">Enabling Works</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td colspan="9">Main Construction Activities</td><td></td></tr>
<tr><td colspan="8"></td><td colspan="4">Reinstatement and Commissioning</td></tr>
</table>

8 Inspection and Maintenance of the Proposed Development

8.1.1 132kV wood pole overhead lines and underground cables generally require very little maintenance. As per OHL-01-014 the typical asset life expectancy of conductor is 54 years, insulators 40 years, steel work 70 years and wood poles 40 years.

8.1.2 Inspection and maintenance activities for the Proposed Development are driven by the type of equipment (overhead line, underground cable, substation plant etc.) and current adopted practice outlined within SP Energy Networks policy documents.

8.1.3 Overhead lines are visually inspected annually. This alternates each year between a foot patrol and helicopter patrol. Visual inspections look for hazards and defects associated with the overhead line. If hazards or defects are found they are categorised and recorded. Hazards and defects are then rectified in line with their category. Timescales vary from 'immediate attention' (same day) to 8 years. In addition to annual visual inspections, a thermographic inspection (helicopter) will be carried out every two years. A thermographic inspection highlights conductor joints that are operating above expected temperatures. If thermographic defects are found they are categorised and recorded. Thermographic defects are then rectified in line with their category.

8.1.4 Underground cables are categorised High Importance, Category A or Category B depending on their importance. The underground cable in the Proposed development would be considered Category B and therefore the cable route would be subject to an annual visual inspection (by foot) to identify any change in land use, excavations, new structures etc. that may demand that additional security or constructional measures require to be implemented.

8.1.5 Substations containing 132kV plant are inspected monthly. Substation inspections look for hazards and defects associated with all assets within the substation, including buildings, fences and security systems. If hazards or defects are found they are categorised and recorded. Hazards and defects are then rectified in line with their category.

8.1.6 Routine maintenance of plant within substations takes place within timescales determined by plant type. For example, 132kV circuit breakers are subject to an annual maintenance check, minor maintenance every 3 years and major maintenance every 6 years.

8.1.7 Individual policies are reviewed and updated (if required) every 3 to 5 years. The information presented below in Table 8.1 is based on SP Energy Network's current policy.

Table 8.1 – Inspection and Maintenance

Location	Inspection Frequency (ASSET-01-021)	Maintenance Intervals (SUB-01-009 and
Oswestry Substation	Monthly (foot)	Between 1 and 3 years depending on type of plant
132kV underground cable	Annual (foot)	None
132kV Overhead Line	Annual visual inspection, Thermographic inspection every 2 years	Hazards/Defects raised will be rectified in timescales depending on category (immediately to 8 years)
Wem Substation	Monthly (foot)	Between 1 and 3 years depending on type of plant

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9 CONCLUSION

9.1.1 This Construction Report sets out the Proposed Development and provides a detailed description of the work elements for each works package at Oswestry Substation, the 132kV underground cable, the 132kV overhead line, the lower voltage diversions and Wem Substation along with the temporary works such as the construction accesses and laydown areas.

9.1.2 Reference is made to the proposed limits within which consent for the Proposed Development is sought. The report also explains how the construction of the Proposed Development will take place within these limits prescribed in the application.

9.1.3 The report refers to the proposal to utilise the existing SP Manweb depot at Maesbury Road, Oswestry, as the main construction compound for the project.

9.1.4 The report refers to a number of measures, which SP Manweb has discussed with statutory bodies, which are being put in place to ensure construction adheres to the required measures. These are in relation to where the 132kV underground cable and 132kV overhead line cross existing services.

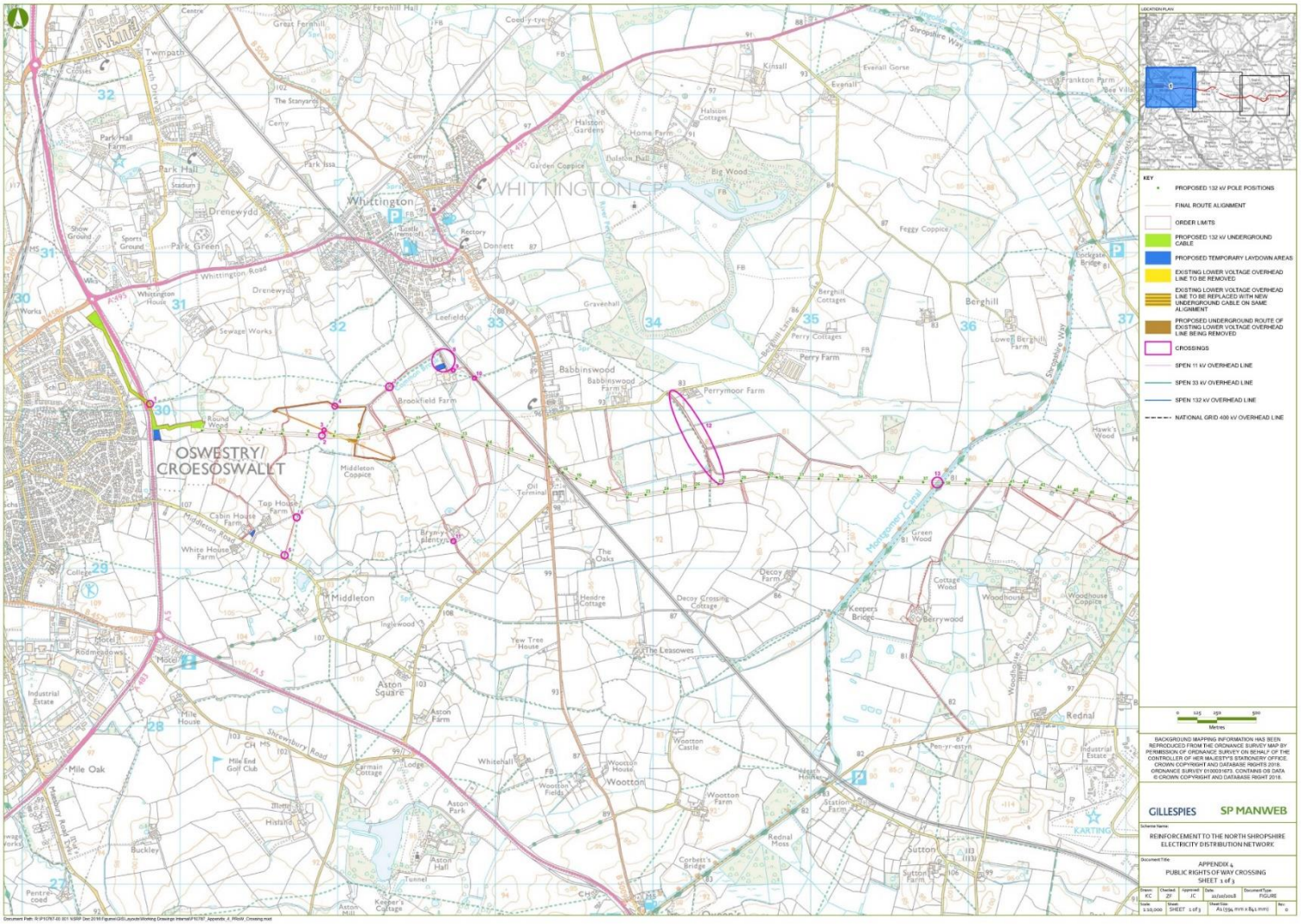
9.1.5 With reference to the different work elements, the report refers to additional information which supports the description of the Proposed Development such as, for example, the type of vehicle needed to access the 132kV underground cable for fault testing, the stringing of the new overhead line and the erection of scaffolding. This latter point then leads into referencing those locations where these activities occur.

9.1.6 Reference is also made to the project's construction programme, which is approximately 12 months.

9.1.7 Overall, SP Manweb considers that the description of the Proposed Development, the associated construction activities, the measures taken and the construction programme indicate that the level of construction activity

proposed is limited relative to other infrastructure projects of similar magnitude.

10 APPENDIX 1 – PLANS OF PROW CROSSINGS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PROPOSED TEMPORARY LAYDOWN AREAS
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EXISTING LOWER VOLTAGE OVERHEAD LINE TO BE REPLACED WITH NEW UNDERGROUND CABLE ON SAME ALIGNMENT
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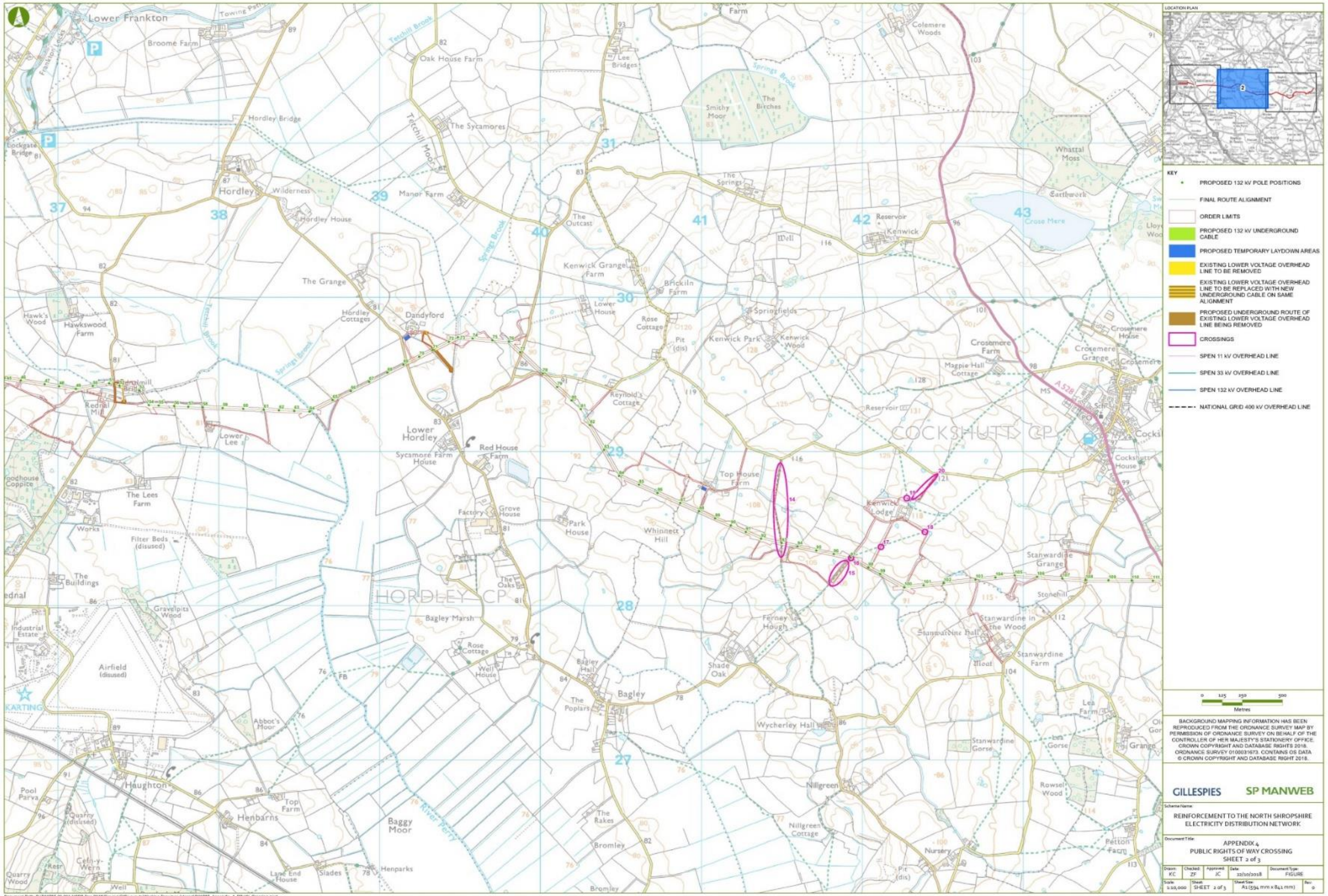
GILLESPIES
SP MANWEB
REINFORCEMENT TO THE NORTH SHROPSHIRE ELECTRICITY DISTRIBUTION NETWORK
APPENDIX 4
PUBLIC RIGHTS OF WAY CROSSING
SHEET 1 of 3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Hordley
Lower Hordley
Dandyford
Kenwick Park
Cockshutt
HORDLEY CP
COCKSHUTT CP
Bagley
Crose Mere
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PROPOSED 132 kV POLE POSITIONS
FINAL ROUTE ALIGNMENT
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BACKGROUND MAPPING INFORMATION HAS BEEN REPRODUCED FROM THE ORDNANCE SURVEY MAP BY PERMISSION OF ORDNANCE SURVEY ON BEHALF OF THE CONTROLLER OF HER MAJESTY'S STATIONERY OFFICE. CROWN COPYRIGHT AND DATABASE RIGHTS 2018. ORDNANCE SURVEY 0100031673. CONTAINS OS DATA © CROWN COPYRIGHT AND DATABASE RIGHT 2018.
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SP MANWEB
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Document Title:
APPENDIX 4
PUBLIC RIGHTS OF WAY CROSSING
SHEET 2 of 3
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Checked: ZF
Approved: JC
Date: 22/10/2018
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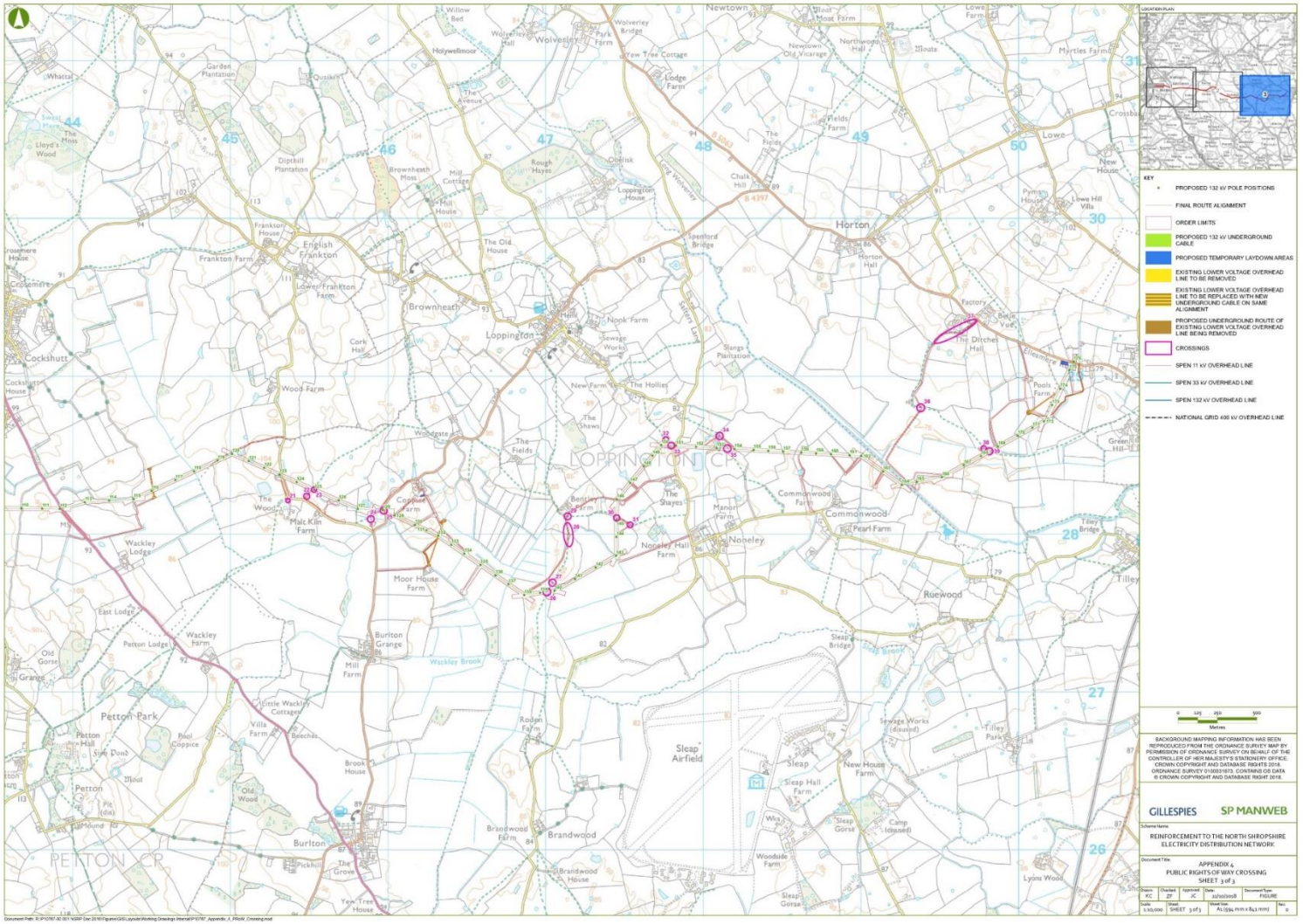
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