

Route Feasibility & Cable System Design Review

South Wokingham 132 kV & 33 kV Cable Connection

Doc. EC010-SS-REP-001

Revision History

Rev.	Description	Date	Prepared	Approved
A	First Issue	26/09/2025	CN	RH
B	Adjustments to TW Culvert crossing	03/10/2025	CN	RH
C	Various amendments	17/03/2026	CN/RH	RH/CN

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1. INTRODUCTION

Scottish & Southern Electricity Networks (SSEN) are undergrounding a double circuit 132 kV overhead line (OHL) and two 33 kV circuits to make way for a new housing development in South Wokingham. The circuits to be diverted are the 132kV Bracknell-Wokingham 1 & 2 circuits between towers BW13 and BW18, and the 33kV Bracknell – Peacock Farm 1 & 2 between wood poles located close to the same 132kV towers. A route for the new cable circuits has been proposed and LSTC has developed preliminary cable system designs, as detailed in Powersure's report T459 and in layout drawing 03_220276_25, Rev.D.

SSEN has invited Elara cables to review the cable route and preliminary design, with the objective of reducing the excavations and quantity of imported backfill required.

2. BACKGROUND

It is understood that the underground cable easement was first developed to accommodate 2 x 33 kV underground cable circuits only. As the development has progressed, 2 x 132 kV underground cable circuits were also required to be installed within the same existing easement. Following review by SSE's engineers, it was decided a second opinion was required to review the proposed route and design whilst also looking for opportunities to optimise the design where possible.

3. TERMS OF REFERENCE

The following documents were received as part of the enquiry documentation:

- Powersure report T459
- Cable arrangement drawing 03_220276_25

Additionally, various documents were received in response to our data request, ref. EC036-SS-DR-001-A which have also been reviewed and considered. Finally, a Balfour Beatty drawing of the bridge crossing William Helas Way, ref. WMHP-TG-EG-DR-DD-0551, which includes the duct arrangement, has also been received and reviewed.

4. BASIS & LIMITATIONS

This desk study considers only the information received as part of the review. No site assessments have been undertaken. Additional third party searches have not been carried out and the assumptions included within the reviewed documentation are all considered to be accurate and true. Where we feel additional studies, surveys and information are required to confirm the underground cable design, they will be listed within the conclusions and recommendations.

5. ROUTE DESCRIPTION

The cable routes are approximately 1.5 km in length and run in parallel for almost their entirety. They are to be installed within a 10 m easement strip between the rail line to the north, and the housing development as shown on the Pegasus Group site wide masterplan to the south. Cable sealing end compounds will be used at both ends of the 132 kV cable and the 33 kV cables will be terminated onto the wood poles.

The terrain is generally flat but slopes gradually upwards from west to east. There is a banking from the rail line to the edge of the proposed easement. To the west an existing culvert has been noted. Several trees and shrubs are present throughout the route. Three roads are to be crossed, namely, Easthampstead Road, Waterloo Road, and William Heelas Road. It is understood they will all be crossed utilising open-cut techniques with the exception of William Heelas Way, which will utilise pre-installed ducts for the 132 kV circuits and an HDD for the 33 kV circuits. Two joints are currently proposed per circuit, for both the 132 kV and 33 kV circuits respectively.

Figure 1 overleaf is an extract from drawing 03_220276_25 Rev. E.

ADAS has developed a Tree Protection Plan to support the development and approval of the works, which includes the establishment of some root protection zones (RPZs) within the 10m easement. These comprise two areas along the route as detailed in drawing 'ADAS_1052383-018' and copied in Figures 2 & 3 below. The cable system design seeks to avoid the RPZs where practical and to limit any encroachment within them to a minimum.

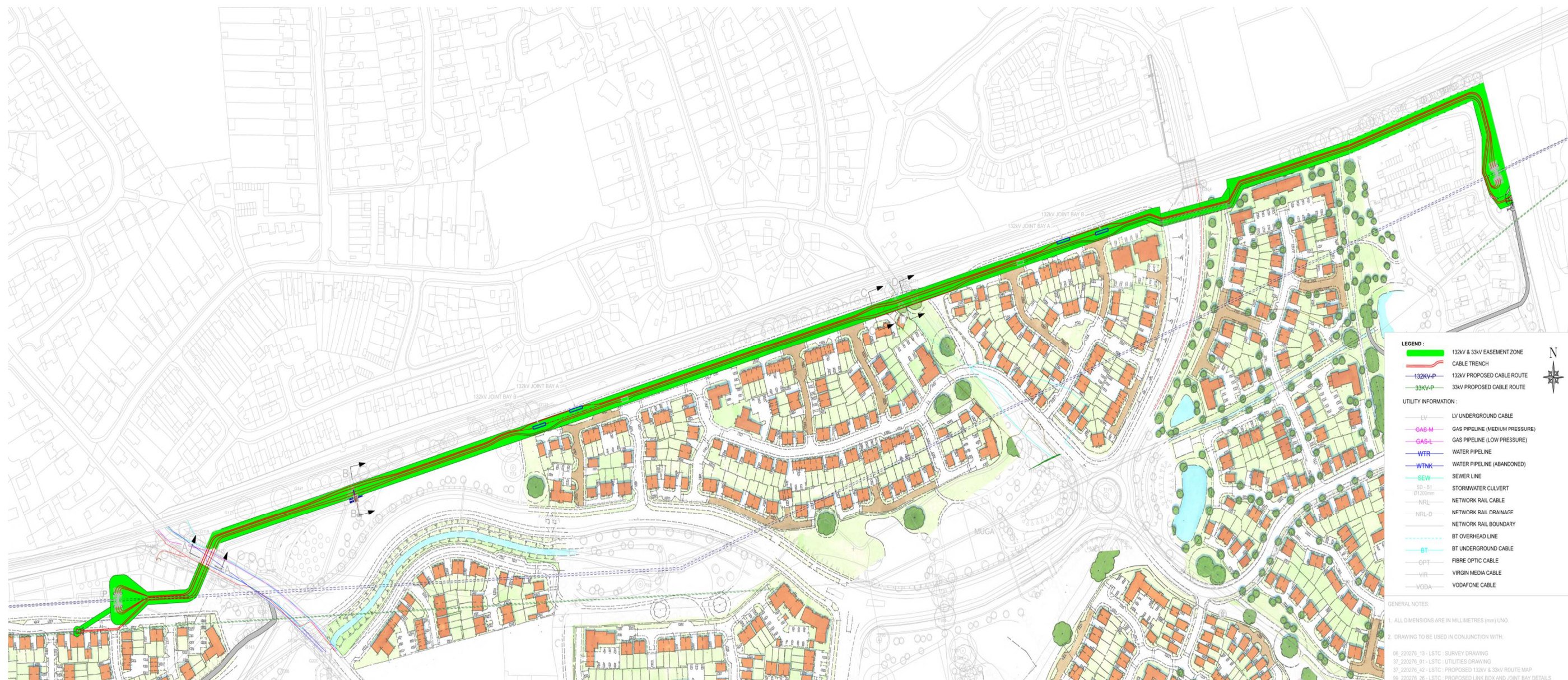


Figure 1 – Indicative Route Alignment & Joint Bay Positions

TPO Tree: T78 / T79 / T80

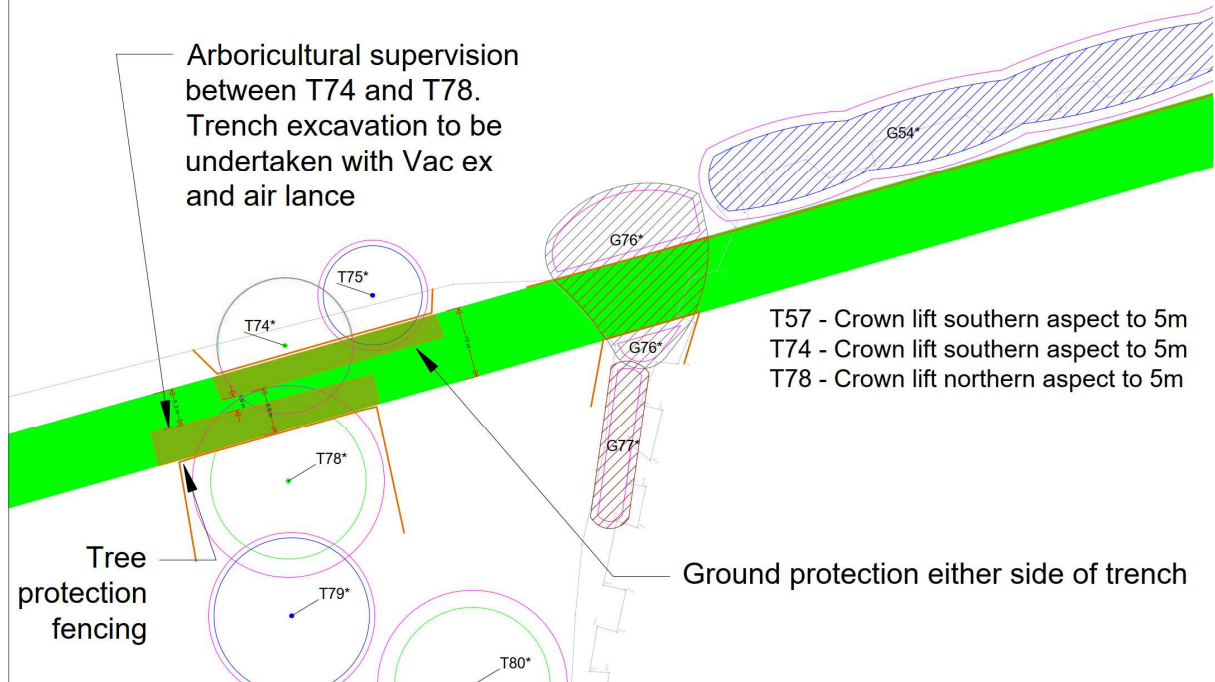


Figure 2 – RPZs proposed for T74, T75 & T78

TPO Tree: G68 / T67 / T69 / T70 / G71 / T73

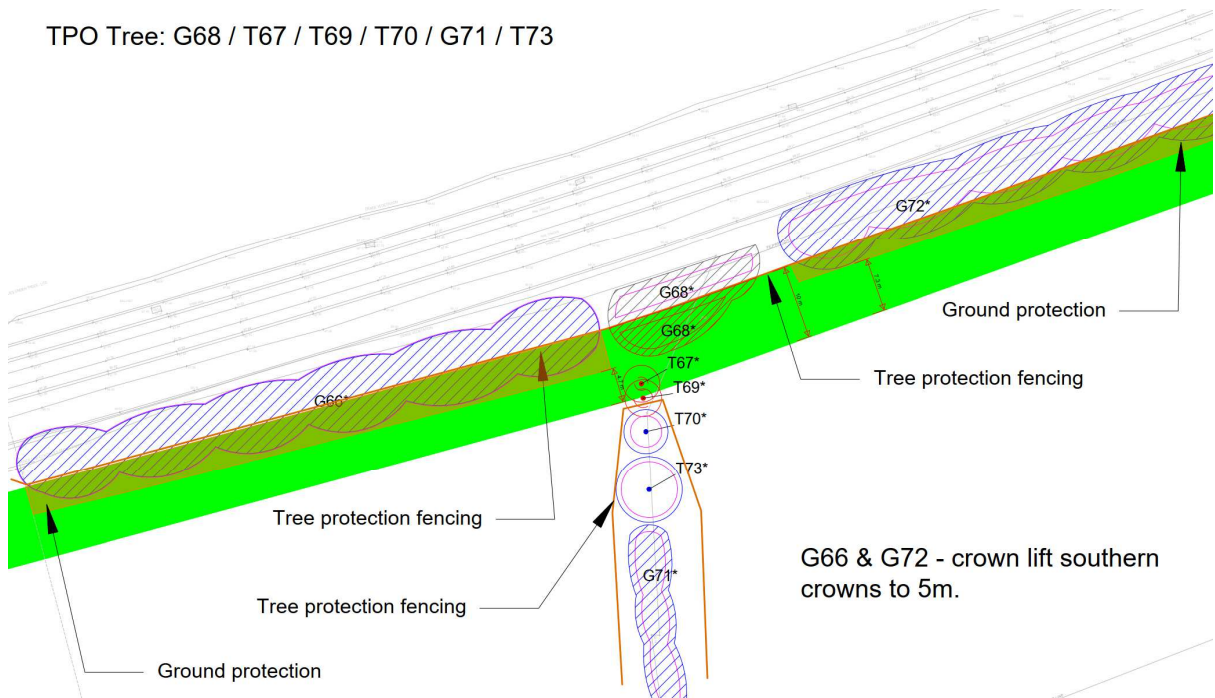


Figure 3 – RPZs proposed for G66 & G72

6. ROUTE ASSESSMENT

Following the review of the proposed cable route and considering the information received, Table 1 below provides a list of perceived risks, their current rating (high, medium, low) and potential mitigation actions to reduce the risk.

Table 1 – Route Risks

Item	Location	Risk	Risk Rating	Potential Mitigation
1	Easthampstead Road, Waterloo Road	Road crossing and proximity to existing services	L	Ensure positive identification of existing services and space requirements are confirmed before excavations begin and open-cut methods are agreed with local council and asset owners
2	Approx. 150 m east of Easthampstead Road	Large culvert crossing, especially if crossing below	M	Ensure appropriate temporary works designs are in place for the trench design and can be accommodated within the 10 m wide easement.
3	Majority of route	Proximity to Network Rail line and particularly towards the bottom of any banked area	L	Ensure no undermining takes place during excavation works to avoid any landslip. If appropriate undertake civil and geotechnical assessments pre-construction.
4	Root Protection Zones for T74, T75 & T78	Cable trench cannot overlap RPZ owing to risk of soil dry-out or future root growth damaging the backfill. The RPZs leave insufficient space for a compliant cable trench design.	H	Assessments have been undertaken to provide options for removing trees or reducing RPZs to allow for a compliant cable trench design. ADAS to review options (see section 8.5 below).
5	Root Protection Zones for G66 & G72	Cable trench cannot overlap RPZ owing to risk of soil dry-out or future root growth damaging the backfill. Cable trench design is proposed for use within limited corridor that	M	Implement measures to ensure that RPZ does extend into easement any more than indicated in drawing ADAS_1052383-018 at any time within cable asset life (40 years).

		allows RPZs to be retained.		
6	Majority of route	The geotechnical studies are currently limited to the tower terminations and HDD only. Issues pertinent to cables such as contamination from railway line and anticipated thermal resistivity properties have not been considered.	M	Undertake geotechnical desk study considering anticipated ground conditions from a cable perspective
7	William Heelas Way	Although the 33 kV HDD profile has been created it is unclear if there is enough space for the drill equipment to be set-up in this area	M	Checks should be done to ensure the drill can be carried out from a logistical perspective under the easement constraints
8	All route	Future access to the easement and where this will be taken from doesn't seem to have been detailed	M	Ensure agreements are in place to take access to the easement for future operations and maintenance requirements including repairs
9	Majority of route	Proximity to development. On some of the drawings it looks extremely tight for space between the developers proposal and the easement. It is noted that this may be due to drawing scale	L	Ensure there is sufficient space between developers buildings/ boundaries and the easement boundary. It is likely the entire 10 m swathe will be required so it is important to maximise it
10	All route	Only having a 10 m wide swathe means reduced working widths may be required for any future maintenance and repairs required for any of the circuits	H	Engage the Contractor that is installing the circuits to prepare a detailed operations and maintenance plan detailing how the circuits can be accessed and worked on within the 10 m swathe in the future should it become necessary. This should require any special working arrangements, this can be considered at an early stage and processes put in place.

11	Cable section 1 for the 132 kV circuits	Insufficient space to include the specified spare duct	L	Localised repair in the event of an issue with the cable should be feasible
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7. CABLE SYSTEM DESIGNS

8.1 Review of Rating Requirements

A review of the ratings and probable outage scenarios with SSEN has resulted in the requirements summarised in Table 2 being confirmed. These differ from the requirements assumed by LSTC & Powersure with respect to the N-1 condition on the 132 kV circuits.

Table 2 – Summary of agreed ratings & outage scenarios

Scenarios	Season	Continuous Ratings MVA/(Amps)			
		132kV BRAC- WOHA		33kV BRAC-PEAC	
		Cct.No.1	Cct.No.2	Cct.No.1	Cct.No.2
All circuits in service	Winter	129 (564)	129 (564)	30.7 (537)	30.7 (537)
	Summer	122.5 (536)	122.5 (536)	27.3 (478)	27.3 (478)
(N-1) BRAC-WOHA 1 OOS	Winter	OOS	215 (941)	30.7 (537)	30.7 (537)
	Summer	OOS	204 (893)	27.3 (478)	27.3 (478)
(N-1) BRAC-WOHA 2 OOS	Winter	215 (941)	OOS	30.7 (537)	30.7 (537)
	Summer	204 (893)	OOS	27.3 (478)	27.3 (478)

8.2 Cable Sizing & Designs

The above ratings can be achieved within the proposed 10 m easement using the cable sizes and designs listed below. These provide sufficient flexibility to negotiate the crossings and obstructions identified along the route, provided the assumptions made are valid (see 8.5 below).

- TFK 132kV 1600 mm² Aluminium conductor, XLPE, smooth welded aluminium sheath, HDPE oversheath. Datasheet “2X(F)KL2Y-SC-WTC 1x1600RMS 76/132(145)kV SP-NET-CAB423”
- Prysmian 33kV single-core 800 mm² Aluminium conductor, XLPE, 35 mm² CWS. Datasheet “33kV SAWU 35M WST 0908” and FO-NET-CAB-412 form “11kV and 33kV Cable Data Sheet (for use with SP-NET-CAB-422)”.

The above cable data has been used for all the ampacity and cable system calculations.

8.3 Cable Bonding

The 132kV cables shall be cross bonded as detailed in drawing EC036-SS-DWG-30. Joint locations have been proposed previously and are shown on the route layout drawing

37_220276_42, Rev.A2, however they may need adjusting to avoid tree protection zones (see 8.5 below). We have estimated cable section lengths from the layout, however those remain to be confirmed. A sheath voltage calculation is provided in document EC036-SS-CA-300 which indicates the resulting maximum sheath voltages under normal operating conditions would remain well within the ENA C55 limit of 65V.

The proposed design will require a link box or pillar to be sited at each of the four 132kV joint bay locations (two per circuit) along the route. SSEN's normal preference is for link pillars (rather than buried boxes), to provide safe access for future maintenance. However, suitable sites for pillars will need to be determined and agreed with the site owner.

ELEK studies for the 33 kV circuits with solid bonding confirm that the maximum sheath circulating current would remain within the 50 A limit given in TG-NET-CAB-009; therefore solid bonding is proposed and is detailed in drawing EC036-SS-DWG-31. Link boxes are not required at the joint bays or at the termination poles, where the general arrangement detailed in wood pole drawing HO/37/6005 sheet 2 is proposed.

8.4 Installation Arrangements

All circuits are ducted throughout to facilitate rapid reinstatement during construction and ease of cable replacement in future. The 132 kV and 33 kV circuits must be spaced adequately to achieve the combined ratings in Table 1.

The 132 kV circuits would be installed in a double circuit trench, in trefoil for most of the route with each phase cable in a 200 OD PVC duct (selected to keep the fill ratio within 40%). A stabilised backfill (e.g. cement-bound sand) would be used around the ducts.

The 33 kV circuits would be installed in a separate trench and arranged as per TG-NET-CAB-001, Appendix A.31, for twin single-core EHV distributors with continuous ratings. A stabilised backfill is specified for this project to achieve the ratings and control the risk of dry-out in summer.

The various arrangements are detailed in drawing EC036-SS-DWG-10 and summarised in Table 3 below.

Table 3 - Installation Arrangements

Installation	Depth to Top of Ducts *	Minimum centres between closest 33 & 132kV *	132kV Backfill dimensions *	33kV Backfill dimensions *	TCS sheet No. & Section ref.
Verges & Footpaths	800 / 900	1800	1600 x 700	1155 x 500	1, A-A
General Road Crossings**	2000	5000	1800 x 900	2525 x 800	2, B-B
Crossing of Thames Water Culvert	725 / 760	1350	1850 x 400	1155 x 500	3, C-C
RPZ on West side in Verges & Footpaths	800 / 900	2200	1600 x 700	1155 x 500	4, D-D

Between RPZs in Verges & Footpaths	800 / 900	2200	1600 x 700	1155 x 500	5, E-E
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*All dimensions are in mm unless otherwise stated

**General Road Crossing for use on Waterloo Road and Easthampton Road

Each installation arrangement is validated by rating studies and documented in the Cable Ampacity report (ref. EC036-SS-CA-100).

8.5 Root Protection Zones

The root protection zones (RPZs) proposed by ADAS require any roots larger than 25 mm diameter to be retained. This would result in any backfills within the RPZ being at risk of disturbance by future root growth. Soil within the RPZ would also be at risk of natural dry-out during the summer. Therefore, we have developed the cable system design to keep the trench separate from the RPZs and to allow for dried-out soil within any RPZ adjacent to the trench.

Two trench arrangements have been developed:

Section D-D (EC036-SS-DWG-10, sheet 4) allows for an RPZ on the west side of the easement that may limit the easement width to a minimum of 4.7 m.

Section E-E (EC036-SS-DWG-10, sheet 5) allows for RPZ's on both sides of the easement that may limit the easement width to a minimum of 5 m.

Section D-D should allow for RPZ G66 and G72 to be retained as planned by ADAS. However, some adjustment of RPZs T74, T75 and T78 will be required. Two options are proposed for ADAS review:

Option 1: Retain the RPZs for T74 and T75 and then cut back the RPZ for T78 to within 1.5 m of the edge of the easement to create a 5 m corridor. I assume this would impact the size of T78 and may restrict it's future growth?

Option 2: Remove tree T74 and make only minor adjustments to the RPZs for T78 and T75 to achieve a clear 5 m corridor for the cable route. We hope this would minimise any impacts on T74 & T78.

The resulting cable arrangements do not require excessive backfill volumes or dramatic changes from the standard arrangement, so it avoids a complex installation design and any associated safety issues during construction.

Any RPZs that are retained adjacent to the cable trench must be designed or maintained to ensure that future root growth will not encroach into the easement beyond the edge of the RPZ as marked on drawing 'ADAS_1052383-018'. This is necessary to ensure the circuit ratings and asset reliability will not be compromised.

8.6 Thames Water Culvert

A fully compliant arrangement for crossing under the culvert cannot be achieved that would avoid encroaching on the manhole structure or include spare ducts in an arrangement that would maintain the ratings if used. Even if spare ducts were excluded, the excavation would utilise the whole easement width and would be complex and costly to construct without risk to safety of workers and integrity of the culvert.

We therefore propose a crossing over the culvert as detailed in drawing EC036-SS-DWG-10, sheet 3, at reduced depths of 630 mm to top of the 33 kV ducts and 670 mm to top of the 132 kV ducts. The advantages of this arrangement would be;

- No requirement for spare ducts owing to ease of re-excavation
- The arrangement would not encroach on Thames Water's manhole structure or surrounding embankment
- No requirement for deep excavations or undermining Thames Water assets
- Security of cable system would be maintained by use of steel protection plates.

We understand the design will require the agreement of the Design Authority and offer this design for submission and discussions.

8.7 William Helas Way

Installations arrangements for both the 132 kV and 33 kV cables have previously been designed for the crossings of William Hells Way. Ducts were proposed for the 132 kV circuits under the road and it is understood that these are already installed as detailed in Balfour Beatty drawing WMHP-TG-EG-DR-DD-0551 rev.C02 and copied in Figure 4. That arrangement is considered suitable for compliant design and ratings, however the use of 160 OD ducts will need to be accommodated in the cable pulling method.

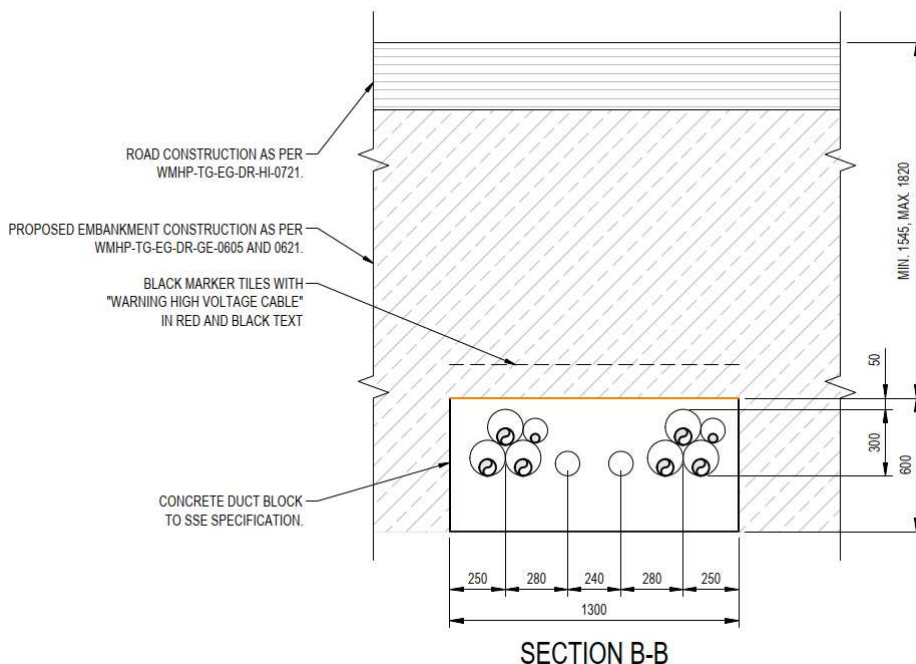


Figure 4 – Pre-installed ducts for 132kV cables under William Helas Way

The proposed HDD for the 33 kV circuits would be compliant for ratings if installed with 800 mm² Aluminium cables, provided the physical separation between the HDD and the 132kV road crossing is sufficient to provide thermal independence. That separation is not clear from the drawings supplied and will need to be assessed in the ongoing design development.

8.7 Assumptions

The following assumptions have been made in developing the cable system design and arrangements:

- Ground conditions are 'normal' outside the RPZs and the standard environmental parameters given in NGTS 2.05 apply (see Route Assessment item 5 above)
- Within an RPZ the ground is **assumed to be dried out in summer** (as a result of tree transpiration) with a TR of 3.0 Km/W
- A derogation request shall be submitted for the shallow installations above the Thames Water Authority culvert. It is assumed this will be found acceptable.
- The 33 kV HDD under William Helas Way is thermally independent of the 132kV cables at the road crossing.
- The 33 kV HDD under William Helas Way would not be at risk to dry-out at depths below 6 m owing to influence of the water table (boreholes undertaken by LSTC were inconclusive for water strikes owing to the method used – see 20_220276_44, Cl.4.4)

8.8 Opportunities

The following potential opportunities have been identified to improve the design or make cost savings, subject to further assessments:

- The 200 OD ducts proposed for the 132kV 1600 mm² AL cables have been selected to provide a fill ratio no greater than 40%, which is considered best practice. However, 160 OD ducts are sometimes preferred by the installation contractor and may prove to be adequate, subject to more detailed assessments of the route and cable installation methodology.

8. CONCLUSIONS

From a route perspective, generally the route seems feasible. There are some areas that require further information to conclude this fully and these are discussed in the recommendations section below.

A compliant cable system design is practical using the proposed TFK 132 kV 1600 mm² Aluminium and Prysmian 33 kV 800 mm² Aluminium cables. The resulting installation designs are practical and efficient with regard to the available easement and volume of stabilised backfill material. Spare ducts are included for all crossings and drills as required by the specifications.

Installations adjacent to the RPZ's proposed by ADAS are practical with the **exception of tree T78** where two options have been proposed for ADAS review (see section 8.5 above).

A crossing of the Thames Water culvert is proposed above the culvert that would result in both 132 kV and 33 kV cables being installed shallow with additional steel plate protection. This will require acceptance by the Design Authority in line with TG-NET-CAB-417 clause 8.1 and TG-NET-CAB-001 clause 7.3.

The crossing designs proposed for William Helas Way are found to be practical, provided the HDD is thermally independent of the 132 kV cables at the road crossing.

9. RECOMMENDATIONS

The following recommendations are made to help finalise the feasibility of this cable route:

- Seek the agreement of the Design Authority for shallow cable installations (with additional steel plate protection) to allow a crossing above the Thames Water culvert as detailed in drawing EC036-SS-DWG-10, sheet 3.
- ADAS to review the options for reducing the RPZs at T74, T75 and T78 to provide for a compliant cable system design in that area.
- SSEN to consider moving the 132 kV joint bays 1A and 1B slightly to the east to avoid the area where the easement will be constrained by RPZ's T75 and/or T78 (depending on the option chosen by ADAS above)
- Undertake geotechnical desk study with focus on the cable route to determine if further ground investigations are required and also understand the risk from contamination, thermal resistivity etc.
- Check the feasibility of setting up for the drill under William Heelas Way considering the space constraints on the site. It is recommended that this assessment is also considered as part of the operations and maintenance assessment (below) to ensure that an additional bore, if required, in the future could be installed
- Undertake an assessment regarding the operations, maintenance and repair working widths required and if the 10 m swathe is sufficient, especially when considering which circuits may remain powered whilst some works are being undertaken
- Undertake an assessment to verify the HDD proposed under William Helas Way would be thermally independent of the 132 kV cables at the road crossing.
- The cable installation contractor should be required to undertake surveys of the pre-installed ducts under William Helas Way (for both 132 kV and 33 kV circuits) to ensure they are intact and clean prior to cable pulling.