Light Valley Solar

Environmental Statement Volume 3

Appendix 16.6: EMF Report

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Light Valley
Solar

Infrastructure Planning

Planning Act 2008

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

Light Valley Solar

DCO Submission

Appendix 16.6: EMF Report

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PAGERPOWER
Urban & Renewables

High-Level Electromagnetic Field Assessment

Light Valley Solar Limited

Light Valley Solar

February 2026

ADMINISTRATION PAGE

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EXECUTIVE SUMMARY

Report Purpose

Pager Power has been retained to assess the potential electromagnetic fields generated by electrical equipment within a ground-mounted solar photovoltaic development with respect to safe levels for human exposure and potential risk to aquatic receptors. The Proposed Development is located in North Yorkshire, UK, and will include underground power cables, conversion units, substations and Battery Energy Storage System (BESS)[1]. There are existing overhead lines of up to 400kV which cross the Proposed Development and are considered within the assessment due to the potential for cumulative impacts.

Emissions

All electrical equipment emits electric and magnetic radiation. Power cables produce both electric and magnetic fields which can potentially affect human health and ecological receptors. Electric and magnetic radiation from underground cables is generally less than radiation from overhead powerlines because emissions from adjacent conductors within a cable tend to cancel each other out. When assessing the impacts of overhead power lines, it is important to consider the impact of both electric and magnetic fields. Underground cables generally cause a negligible electric field above ground but can cause a significant magnetic field, which is dependent on the current in the conductors.

Standards in the UK

The UK Policy on public exposure limits to EMF radiation is designed to comply with the 1998 ICNIRP (International Commission on the Non-Ionizing Radiation Protection) guidelines in terms of the 1999 EU Recommendation. The National Policy Statement for Electricity Networks Infrastructure (EN-5) references the ICNIRP guidelines and states that applications should show evidence of compliance with these guidelines.

In 2010 ICNIRP produced new guidelines but these have not been incorporated into UK Policy. The public exposure limits in UK policy define reference levels for electric and magnetic fields. Where field levels exceed these reference levels

[1] The maximum voltages and potential locations for all underground cables, conversion units and BESS have been considered to account for a worst-case scenario in the absence of a finalised electrical design of the site.

in significantly occupied spaces, further investigation is warranted. Further information can be found in section 3 of the report.

Overall Conclusion

Levels of electromagnetic radiation from the underground cables are predicted to be below ICNIRP reference levels for magnetic fields, even when assuming maximum radiation is being emitted from the proposed underground cables

Radiation from the conversion units will be less significant because the equipment will be housed in protective enclosures and the substations and conversion units will be CE/UKCA marked, meaning they should not generate or be affected by electromagnetic disturbance.

Additionally, radiation from the proposed substations and BESS will be **not significant** as they will be located at least 350m from any surrounding dwellings and workplaces. For users of Public Rights of Way (PRoWs), any radiation effects would likely be minimal and **not significant** in EIA terms as these are not continually occupied, rather they are moving receptors, as opposed to residential dwellings and workplaces.

Assessment Results – 275kV Underground Cables

The maximum magnetic field produced by 275kV underground cables is predicted to be 96.17 micro-Teslas. The magnetic field levels are therefore below the reference level from the public exposure limits in UK policy.

This value correlates to a human being 1m above ground level (agl), directly above the cable, and therefore the magnetic fields will be further diminished due to any separation distances horizontally from the cables to any dwelling.

When considering the cumulative magnetic fields of the proposed underground cables and existing overhead powerlines (worst-case for maximum EMFs and design parameters), the exposure limits directly above the cable are still maintained. Further, the closest identified dwellings are at least 50m from the cable route, and as such magnetic fields will be significantly below the reference level of 100 micro-Teslas.

For users of Public Rights of Way (PRoWs), any radiation effects would be minimal and **not significant** in EIA terms as effects would be below the reference thresholds and these are not continually occupied, rather they are moving receptors, as opposed to residential dwellings and workplaces.

At watercourse crossings, where the cable will be buried at a minimum depth of 5m, the residual maximum magnetic field produced by 275kV underground cables is predicted to be 14.72 micro-Teslas at the riverbed. This figure reduces with vertical distance within the water column and horizontally upstream and downstream of the cable alignment.

Assessment Results – 275kV Underground Cables plus existing 400kV Overhead Powerlines

There are existing overhead powerlines up to 400kV operating within the Order Limits.

The maximum magnetic field produced by the 400kV existing overhead powerlines is predicted to be 81.942 micro-Teslas. The magnetic field value is therefore below the reference level from the public exposure limits in UK policy.

The maximum electric field produced by the 400kV existing overhead powerlines is predicted to be 10.642kV/m. The electric field levels are therefore above the reference level from the public exposure limits in UK policy and an approximately 15m minimum clearance distance is recommended. This standoff distance limits risks associated with prolonged exposure to electromagnetic fields generated by the overhead powerlines. The closest identified dwelling to the existing overhead powerline in the vicinity of the Proposed Development is over 85m away from the line and will therefore be far below the exposure limit for electric fields.

When considering the cumulative magnetic fields at 0m from the proposed underground cables and existing overhead powerlines (worst-case for maximum EMFs and design parameters), the exposure limits are still maintained. When considering the cumulative electric fields at 0m from the proposed underground cables and existing overhead powerlines (worst-case for maximum EMFs and design parameters), the exposure limits are exceeded but can still be met with the recommended clearance distance of 15m. In practice, the proposed cable route is located over 500m from the existing overhead lines at its nearest point and will therefore have **no significant** cumulative impact.

For users of Public Rights of Way (PRoWs), any radiation effects would be minimal and **not significant** in EIA terms as these are not continually occupied, rather they are moving receptors, as opposed to residential dwellings and workplaces. The ICNIRP public exposure thresholds relate specifically to locations of significant exposure time.

Assessment Results – Conversion Units

Notable sources of radiation other than the cables will be the conversion units positioned across the Proposed Development.

The conversion units will be ‘CE’ marked (Conformité Européene, or European Conformity marking), and/or ‘UKCA’ marked (UK Conformity Assessed). CE and UKCA markings indicate that a product has been assessed by the manufacturer and determined to meet the safety, health, and environmental protection requirements of the European Union and the United Kingdom, respectively. CE marking requirements were adopted and extended indefinitely in Great Britain until the UK left the EU in 2020. From 1 January 2021, the UKCA mark started to replace the CE mark for goods sold within Great Britain, and the CE mark has continued to be required for goods sold in Northern Ireland. The marking should ensure that electrical and electronic equipment does not generate, or is not unintentionally affected by, electromagnetic disturbance.

Furthermore, the conversion units are predicted to produce fields at a lower level than that of underground cables because the equipment will be housed in protective enclosures.

Assessment Results – Substations and BESS

The proposed substations and BESS are located over 350m from the nearest dwellings, ensuring compliance with public exposure limits. The substations and BESS are expected to comply with EMF exposure guidelines, with equipment housed in protective enclosures to minimize radiation. All relevant equipment installed as part of the proposed substations shall be ‘UKCA’ marked. Further details are included within the Outline Battery Safety Management Plan **[EN0110012/APP/LVS/07.06].**

For users of PRoWs, any radiation effects would be minimal due to their transient nature. Overall, **no significant** electromagnetic impacts are predicted from the proposed infrastructure.

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ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 63 countries internationally.

The company comprises a team of experts to provide technical expertise and guidance on a range of planning issues for large and small developments.

Pager Power was established in 1997. Initially the company focus was on modelling the impact of wind turbines on radar systems. Over the years, the company has expanded into numerous fields including:

1) Renewable energy projects.
2) Building developments.
3) Aviation and telecommunication systems.

Pager Power prides itself on providing comprehensive, understandable, and accurate assessments of complex issues in line with national and international standards. This is underpinned by its custom software, longstanding relationships with stakeholders and active role in conferences and research efforts around the world.

Pager Power's assessments withstand legal scrutiny and the company can provide support for a project at any stage.

1 INTRODUCTION

1.1 Purpose of the Study

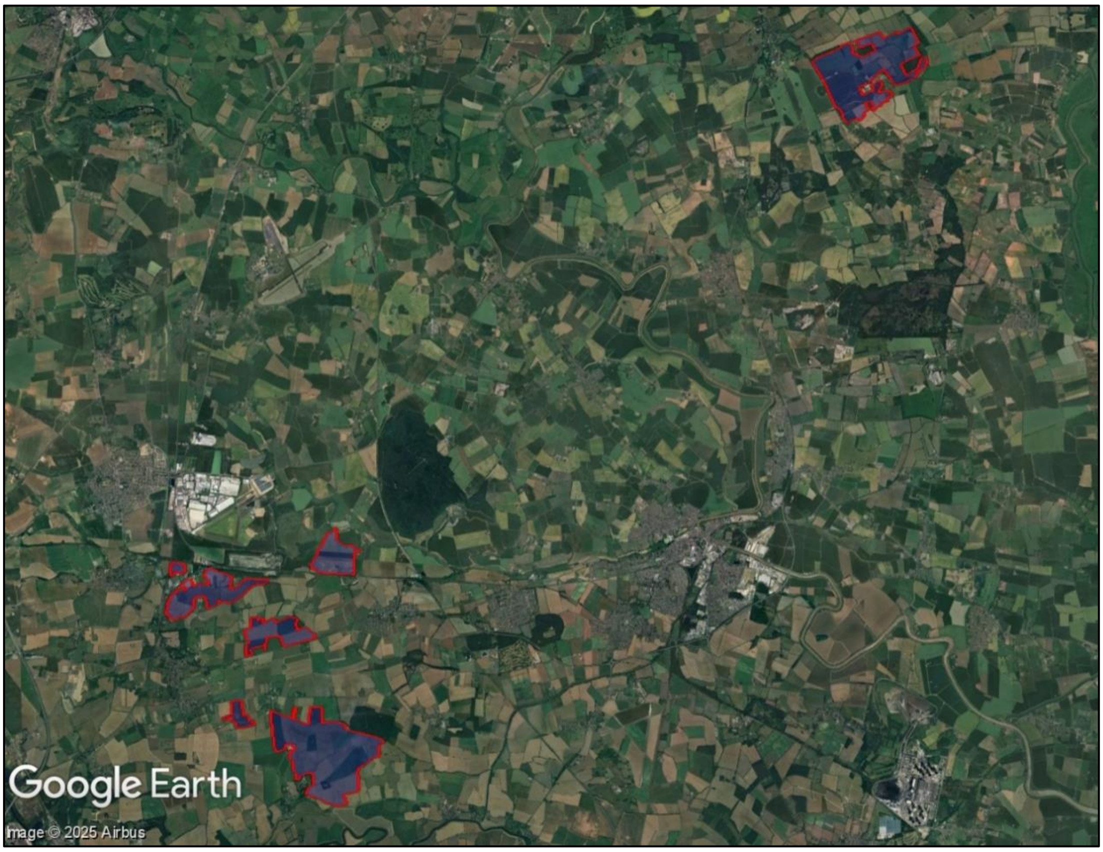
Pager Power has been retained to assess the potential electromagnetic fields generated by electrical equipment within a ground-mounted solar photovoltaic development with respect to safe levels for human exposure. The findings of this assessment will be interpolated in order to inform the assessment of potential impacts on aquatic ecology. The Proposed Development is located in North Yorkshire, UK, and will include underground power cables, conversion units, substations and Battery Energy Storage System (BESS)[2]. It is noted that there are existing 400kV overhead lines which cross the part of the site and are considered within the assessment due to the potential for cumulative impacts.

1.2 Proposed Development Solar Development Site Areas

Plate 1 below shows the Solar Development Sites overlaid onto aerial imagery as the blue areas.

[2] The maximum voltages and potential locations for all underground cables, conversion units and BESS have been considered to account for a worst-case scenario in the absence of a finalised electrical design of the site.

Plate 1 Proposed Solar Development Sites overlaid onto aerial imagery



1.3 Assessed Infrastructure

The known locations of assessed infrastructure are shown in Plate 2 to Plate 4 below:

- Proposed Development Order Limits (red polygon);
- Siting zone for On-Site substations (green polygon);
- Siting zone for BESS Compound (purple polygon);
- Existing pylons (pink triangular icons) and 400kV overhead powerline (white path).

Plate 2 to Plate 4 are intended to provide an overview of the environment and infrastructure.

Plate 2 Assessed infrastructure locations

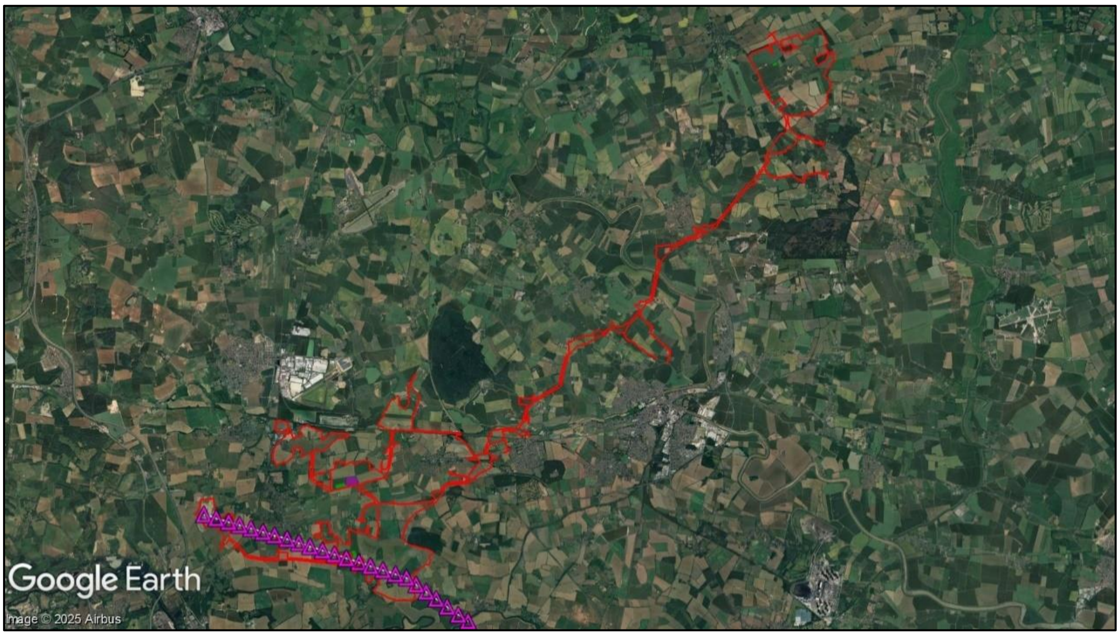


Plate 3 Assessed infrastructure locations close up

Plate 4 Assessed infrastructure locations close up

The technical information considered within this assessment is presented in *Table 1* below

Assessed Infrastructure Technical Information		
Underground Interconnecting and Grid Connection cables	Voltages	Up to 275kV cables
	Locations	Positioned within the Order limits
Existing overhead powerlines (cumulative assessment)	Voltages	Existing cables up to 400kV
	Locations	Overhead cables cross SDS 4 of the Proposed Development
Substations	Voltages	Up to 275kV substation
	Proposed locations	A section of SDSs 1, 2 and 4 (detailed in green in Plates 2 and 3)

Assessed Infrastructure Technical Information		
BESS	Proposed locations	A section of SDSs 2 (detailed in purple in Plate 2 and 3)
Conversion Units (Transformers and PV inverters)	Proposed locations	Positioned across the Proposed Development

Table 1 *Assessed infrastructure technical information*

2 TECHNICAL BACKGROUND

2.1 Emissions

All electrical equipment emits electric and magnetic radiation. Power cables produce both electric and magnetic fields which can potentially affect human health. Radiation from underground cables is generally less than radiation from overhead lines because emissions from adjacent conductors within a cable tend to cancel each other out. When assessing the impacts of overhead powerlines, it is important to consider the impact of both electric and magnetic fields.

Underground cables generally cause a negligible electric field above ground but can cause a significant magnetic field which is dependent on the current in the conductors.

2.2 Electromagnetism

The movement of electric charge causes electric and magnetic fields to be produced in the space surrounding the charge. Human exposure to such fields can cause health problems if persistent and/or they are of high strength. The magnitude of the effects is dependent on both the field strength and the exposure time.

2.3 Health Concerns – Potential Effects

The potential effects on human health caused by time-varying magnetic fields, such as those generated by AC[3] cables, are due to induced current on functions of the central nervous system. There are various international bodies which provide maximum safe exposure levels to time varying electromagnetic fields.

Various sources of information relating to safe exposure levels have been reviewed as part of this study.

The UK Policy on public exposure limits to EMF radiation is designed to comply with the 1998 ICNIRP (International Commission on the Non-Ionizing Radiation Protection) guidelines in terms of the 1999 EU Recommendation. In 2010 ICNIRP produced new guidelines, but these have not yet been incorporated into UK Policy. The public exposure limits in UK policy define reference levels for electric and magnetic fields. Where field levels exceed these reference levels in significantly occupied spaces, further investigation is warranted.

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[3] Alternating Current

Another relevant resource consulted is the EMFs.info webpage[4], where the UK electricity industry has collected the relevant studies pertaining to safe limits on exposure in the UK and elsewhere in the world. The relevant sections are analysed in the next chapter.

2.4 Radiation from Home Electrical Equipment

The World Health Organization (WHO) publishes data regarding electromagnetic fields including the following typical levels for home electrical equipment, shown in *Table 2* below.

Appliance	Electric field strength (Volts per metre)	Magnetic field strength (micro-Tesla) (at 1 metre)
Hair Dryer	80	0.01 – 7
Iron	120	0.12 – 0.3
Vacuum Cleaner	50	2 – 20
Refrigerator	120	0.01 – 0.25
Television	60	0.04 - 2

Table 2 *Typical emissions from home electrical equipment*

2.5 Radiation Reduction with Distance

Radiation levels reduce with distance which means, for example, the typical magnetic field from a vacuum cleaner reduces from 800 micro-Tesla to 2 micro-Tesla when the separation distance increases from 3 centimetres to 100 centimetres.

This means radiation levels from the cables, conversion units, substations and BESS will tend to reduce with distance in any direction – including towards a receptor.

[4] Accessed 25th February 2025

3 OVERVIEW OF ELECTROMAGNETIC FIELDS

3.1 Overview

The Electricity Networks Association[5] provides a comprehensive overview of electromagnetic fields (EMFs) and the issues associated with these on their webpage[6]. Regarding health issues caused by EMFs they state the following:

However, there are suggestions that magnetic fields may cause other diseases, principally childhood leukaemia, at levels below these limits. The evidence for this comes from epidemiology studies, which have found a statistical association - an apparent two-fold increase in leukaemia incidence, from about 1 in 24,000 per year up to 1 in 12,000 per year, for the children with the top half percent of exposures. The evidence is strong enough for magnetic fields to be classified by the World Health Organization as "possibly carcinogenic". But because these studies only show statistical associations and do not demonstrate causation, and because the evidence from the laboratory is against, the risk is not established, it remains only a possibility.

3.2 Exposure limits in the UK

As set out in the previous section, the limits in the UK come from the 1998 ICNIRP guidelines. The original guidance in 1999 specified:

i) Basic Restrictions;

   These are the levels at which radiation is potentially harmful to humans. This is a current density[7] given in mA m^{-2} (milliamps per metre squared).

ii) Reference Level (Investigation Level);

   Provided for practical exposure assessment purposes to determine whether the basic restrictions are likely to be exceeded. Compliance with the reference level will ensure compliance with the relevant basic restriction.

iii) Field Actually Required;

[5] This is an industry body for the companies which run the UK and Ireland's energy networks. The group comprises 14 members including National Grid.

[6] EMS.info. Electric and magnetic fields [Online]. Available at: www.emfs.info [Accessed 28th March 2024]

[7] Current density is the amount of electric current flowing through a unit area.

This is the field strength at which the basic restriction is likely to be exceeded.

The values for the above stated in the ICNIRP 1998 paper are shown in *Table 3* on the following page. These are the public exposure values, not the occupational exposure values – the former is more conservative than the latter by a factor of five.

ICNIRP 1998 – Public Exposure Limits				
Basic Restriction (mA m^{-2})	**Magnetic Fields Reference Level (µT)**	**Electric Fields Reference Level (kV m^{-1})**	**Magnetic Field Actually Required to Exceed Basic Restriction (µT)**	**Electric Field Actually Required to Exceed Basic Restriction (kV m^{-1})**
2	100	5	360	9

Table 3 *ICNIRP Exposure Limits 1998*

The levels in *Table 3* are considered within this analysis.

3.3 Height Above Ground Used for Testing Compliance

EMFs.info[8] specifically stated the following with regard to the height to be used to test compliance:

The standard height for measuring fields, especially from power lines, is 1 m above ground level ... This isn't just because it's a convenient round number, it's because roughly half way up the height of a standing person is actually the height that gives the best approximation to the induced current in the body.

[8] Accessed March 2024.

3.4 Safe Levels – Summary

The values of interest are those shown in *Table 3* above. Effectively, this means that in locations of significant exposure time, such as residences, levels should be below:

1) 100μT (magnetic fields).
2) 5kV m^{-1} (electric fields).

Values exceeding the limits above, at one metre above ground level, would suggest that further investigation is required.

For users of Public Rights of Way (PRoWs), any radiation effects would less significant because they are not continually occupied, as opposed to residential dwellings and workplaces. It is anticipated that individuals would pass by the affected area relatively quickly and would not be subject to EMFs for a significant period of time.

4 TECHNICAL ASSESSMENT

4.1 Field Levels – Underground Cables

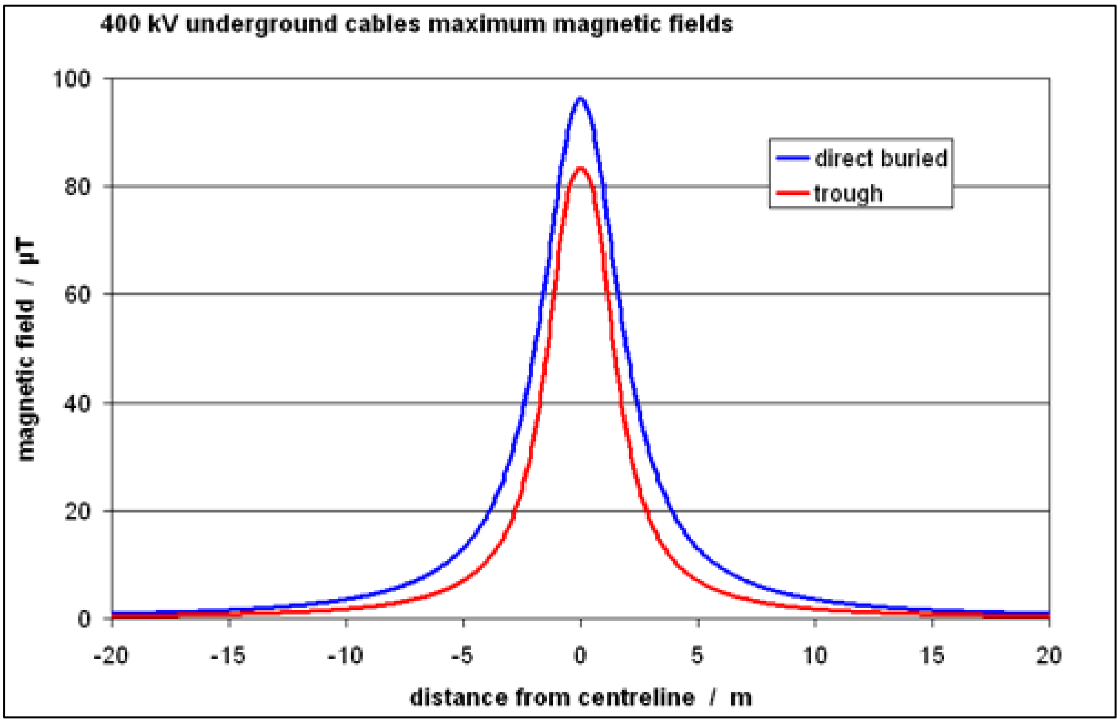
Field level data from various cable configurations have been sourced from EMFS.info. The data below and on the following page shows the magnetic fields for 400kV cables, which is the same as for the 275kV cables utilised in the Proposed Development, as magnetic fields are dependent on current, which is the same between 400kV and 275kV cables. Typical values for magnetic fields are approximately a quarter of these maximum values[9]. The assessment accounts for varying cable voltages in the Proposed Development, with the analysis based on the maximum voltage and shallowest depths to adopt a conservative approach. Maximum field data has been used where possible to provide a more conservative assessment. It's important to note that there are no electric fields above ground associated with underground cables.

The relevant chart is shown in Plate 5 below. *Table 4* on the following page provides the associated indicative numerical values at set distances[10].

[9] EMS.info. Electricity systems and sources [Online]. Available at: [redacted] [Accessed 28th March 2024]

[10] EMS.info. Electric and magnetic fields [Online]. Available at: [redacted] [Accessed 28th March 2024]

Plate 5 Maximum magnetic fields associated with 400kV underground cables



Distance from Centreline (m)	Magnetic Field (trough double circuit cable with 0.13m spacing and 0.3m depth)	Magnetic Field (direct buried single cable with 0.5m spacing and 0.9m depth)[11]
0	83.30 micro Teslas	96.17 micro Teslas
5	7.01 micro Teslas	13.05 micro Teslas
10	1.82 micro Teslas	3.58 micro Teslas
20	0.46 micro Teslas	0.92 micro Teslas

Table 4 *Maximum magnetic field levels for an underground 400kV cable*

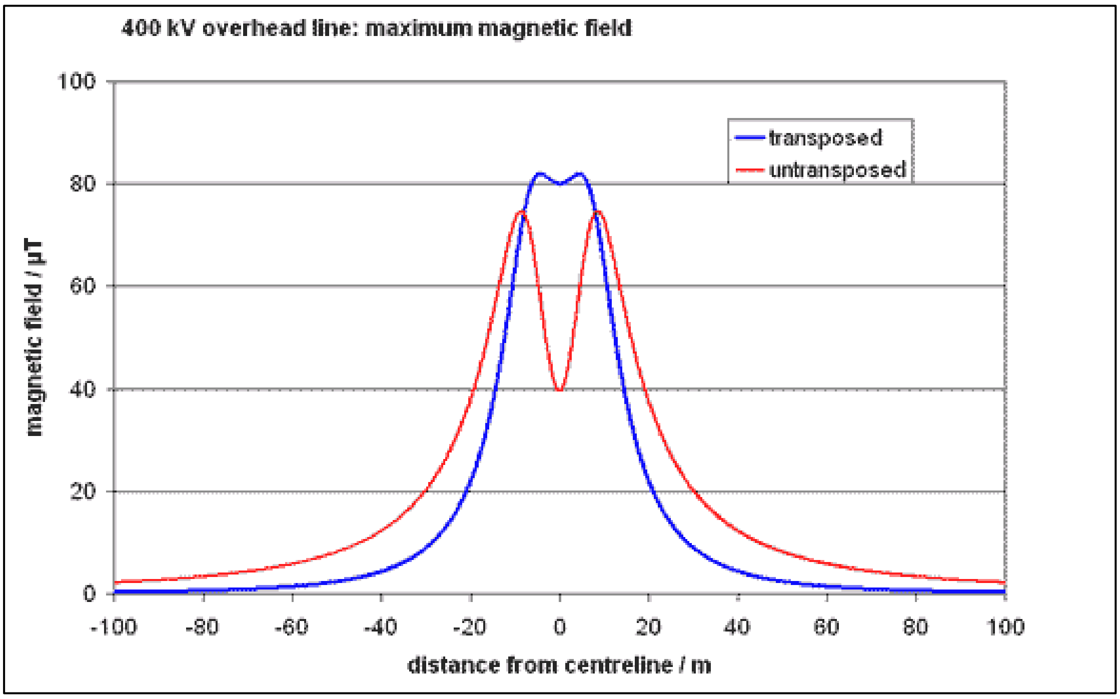
[11] This cable was used for the assessment in the following sections.

4.2 Field Levels – Overhead Powerlines

There are existing overhead powerlines of up to 400kV operating within the Order Limits. While it is understood that these cables will not be rerouted as part of the project, information is set out for comparative purposes and potential cumulative impacts.

Field-level data has been sourced from EMFS.info[12]. The data below and on the following pages show magnetic and electric fields for a typical 400kV overhead powerline operating at the highest allowed loads and minimum ground clearance. This provides a worst-case assessment by illustrating the maximum expected magnetic and electric fields. The relevant chart for the maximum magnetic field is shown in Plate 6 on the following page, and the relevant chart for the maximum electric field is shown in Plate 7. *Table 5* and *Table 6* provide the associated indicative numerical values at set distances.

Plate 6 Maximum magnetic fields associated with 400kV overhead powerline

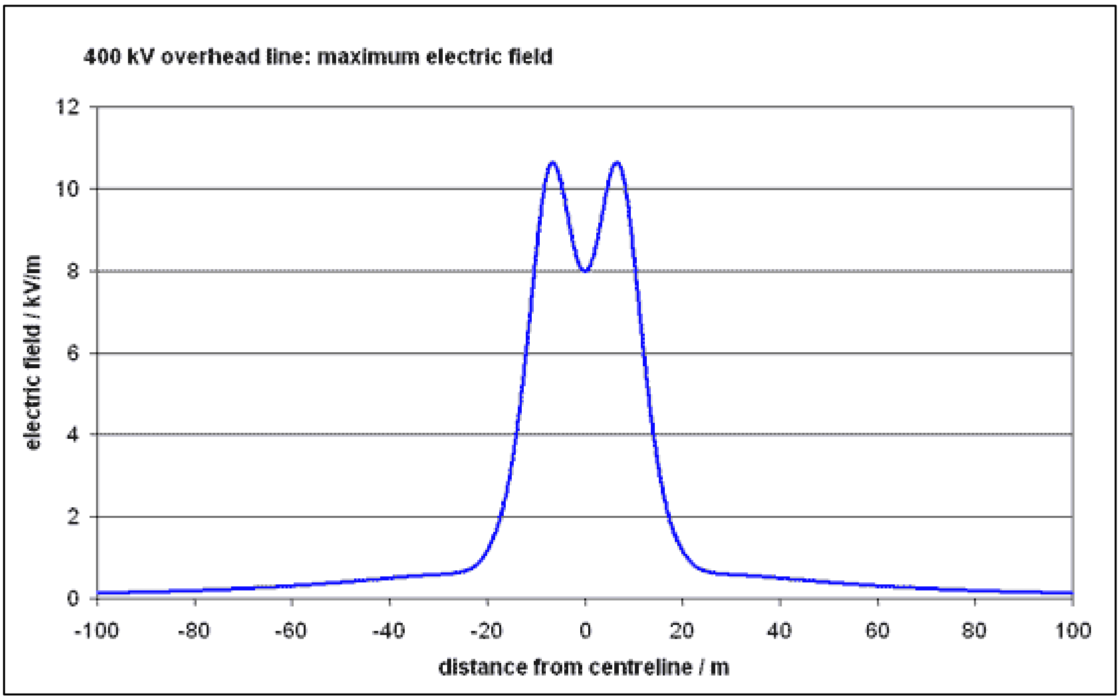


[12] Accessed March 2024

Distance from Centreline (m)	Magnetic Field		
	400kV[13]	132kV	11kV
0	81.942 µT	38 µT	9.5 µT
10	72.818 µT	-	-
25	22.103 µT	-	-
50	8.148 µT	1.9 µT	0.4 µT
100	2.145 µT	0.5 µT	0.1 µT

Table 5 *Maximum magnetic field levels for an overhead 400kV powerline (source: EMFS.info)*

Plate 7 Maximum electric fields associated with 400kV overhead cable



[13] L12 lattice pylon design with 7.6m ground clearance and the highest allowed loads

Distance from Centreline (m)	Electric Field[14]		
	400kV	132kV	11kV
0	10.642 kV/m	1.1 kV/m	0.05 kV/m
10	8.410 kV/m	-	-
25	0.669 kV/m	-	-
50	0.404 kV/m	0.01 kV/m	0.001kV/m
100	0.136 kV/m	<0.01 kV/m	0 kV/m

Table 6 *Maximum electric field levels for an overhead 400kV cable (source: EMFS.info)*

[14] (L12 lattice pylon design with 7.6m ground clearance and the highest allowed loads)

4.3 Recommended Clearance Distances and estimated maximum values

4.3.1 Underground Cables

The recommended minimum clearance distance for underground cables based on the public exposure limits previously referenced in this report for magnetic and electric fields is presented in *Table 7* below.

The dataset provided maximum values and typical values for the configurations that have been evaluated –the 'maximum' option has been chosen where possible in order to remain conservative.

Type of Line	Recommended minimum Clearance Distance (m)	Estimated Maximum Magnetic Field (micro-Tesla) with no clearance	Estimated Maximum Electric Field (kV/m) with no clearance
275kV underground cable	None	96.17 (below 100 limit)	-

Table 7 *Recommended clearance distances for the 400kV cables*

This shows that clearance distances are not required for any proposed underground cables. The table highlights that the fields produced by the cables are below the acceptable exposure limit, and significant effects upon health are not predicted. Several conservative assumptions have been made in this calculation, and in practice the magnetic fields produced from 275kV underground cables are expected to be even lower. This is due to cables being buried at 1.2m depth (rather than 0.9m) and cables will be buried in a trench with a conduit where feasible rather than direct buried.

4.3.2 Overhead Cables

The equivalent recommended minimum clearance distance for overhead cables based on the public exposure limits previously referenced in this report for magnetic and electric fields is presented in *Table 8* below.

The dataset provided maximum values and typical values for the configurations that have been evaluated –the 'maximum' option has been chosen where possible in order to remain conservative.

Type of Line	Recommended minimum Clearance Distance (m)	Estimated Maximum Magnetic Field (micro-Tesla) with no clearance	Estimated Maximum Electric Field (kV/m) with no clearance
400kV overhead powerline	Approximately 15m	81.942 (below 100 limit)	10.642 (above 5 limit)
132kV overhead powerline	None	38 (below 100 limit)	1.1 (below 5 limit)
11kV overhead powerline	None	9.5 (below 100 limit)	0.002 (below 5 limit)

Table 8 *Recommended clearance distances for the 400kV cables*

For the installations of new power lines or infrastructure adjacent to a power line a minimum clearance distance of approximately 15 meters would be recommended for any 400kV overhead powerline to reduce the maximum electric field to below the reference exposure. This was considered at the time of the initial siting of new overhead powerlines or anything proposed near existing lines. The 15m clearance distance recommendation specifically addresses public exposure limits for human health, and the minimum clearance distance is with reference to stationary, prolonged receptors such as residential dwellings and workplaces. Therefore, receptors that would experience prolonged or significant exposure should not be within 15m horizontally of the overhead powerlines, as is reflected in the existing baseline scenario.

The methodology for assessing the cumulative effect of overhead powerline and underground cables in the same location is set out in Section 4.6. No residential receptors have been identified in close proximity to the point where the Cable Route Corridor crosses under the existing overhead lines, and no significant cumulative impacts are predicted outside of the existing 15m buffer. With the exception of the point where the Cable Route Corridor crosses under the existing overhead lines, it is typically located over 500m from the existing overhead lines at its nearest point and will therefore have no significant cumulative impact.

4.4 Radiation from Other Sources

4.4.1 Conversion units

Notable sources of radiation, other than the cables and powerlines, will include the conversion units positioned across the Proposed Development. As of the time of this report, the specific locations for these have not been finalised.

The conversion units should be CE marked (Conformité Européene, or European Conformity marking), and/or 'UKCA' marked (UK Conformity Assessed). CE and UKCA marking indicates that a product has been assessed by the manufacturer and deemed to meet the safety, health and environmental protection requirements of the European Union[15] and the United Kingdom[16], respectively. CE marking requirements have been adopted and extended indefinitely in Great Britain until the UK left the EU in 2020. From 1 January 2021, the UKCA mark started to replace the CE mark for goods sold within Great Britain, and the CE mark has continued to be required for goods sold in Northern Ireland. This will be confirmed prior to installation.

The relevant EU Directive for CE marking is[17] Electromagnetic Compatibility Directive 2014/30/EU, and the relevant UK Statutory guidance for UKCA marking is the Electromagnetic Compatibility Regulations 2016[18]. These pieces of legislation ensure that electrical and electronic equipment will not generate, or be affected by, electromagnetic disturbance.

Additionally, the conversion units are also predicted to produce fields at a lower level than that of underground cables as the equipment will be housed in protective enclosures and through the embedded mitigation of buffers to neighbouring buildings, will be setback from residential receptors.

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15 European Union (2025) CE Marking [Online] Available at: [redacted]

16 UK Government (2024) Using the UKCA marking [Online]. Available at: https://www.gov.uk/guidance/using-the-ukca-marking

17 European Commission (2025) Electromagnetic Compatibility (EMC) Directive [Online]. Available at: [redacted]

18 UK Government (2025) Electromagnetic Compatibility Regulations 2016: Great Britain [Online]. Available at: https://www.gov.uk/government/publications/electromagnetic-compatibility-regulations-2016/electromagnetic-compatibility-regulations-2016-great-britain

4.4.2 Substation and BESS

Other notable sources of radiation associated with the Proposed Development include the On-Site substations and BESS. The potential sites for the substations and BESS are detailed in Section 1.3.

The minimum horizontal distance between the substation and BESS and any dwelling is approximately 350m (as shown in Plate 8). Based on the threshold limits and professional judgement, the 350m separation distance is considered sufficient to ensure that no significant impacts are predicted for the proposed substation or BESS.

Similarly to the conversion units, all relevant equipment installed as part of the proposed substations, shall be ‘CE’ and/or ‘UKCA’ marked. CE and ‘UKCA’ marking should ensure that electrical and electronic equipment does not generate, or is not unintentionally affected by, electromagnetic disturbance. The substations are also predicted to produce fields at a lower level than that of underground cables because the equipment is expected to be housed in protective enclosures.

Radiation from the proposed substations and BESS will be below the ICNIRP public exposure reference levels because:

- The substation and BESS areas are over 350 metres from the nearest dwelling. Electromagnetic fields from substation equipment will diminish rapidly as the separation distance increases and will not extend significantly beyond the perimeter fence, if at all, and all dwellings remain at a safe distance, as radiation levels decrease with increasing separation.
- For users of Public Rights of Way (PRoWs), any radiation effects would likely be minimal as these are not continually occupied, rather they are moving receptors, as opposed to residential dwellings and workplaces.

An overview of the nearest dwellings relative to the indicative siting zones for the substation (green polygon) and BESS (purple polygon) can be found in Plate 8 on the following page.

Plate 8 Nearest dwellings relative to the substation and BESS

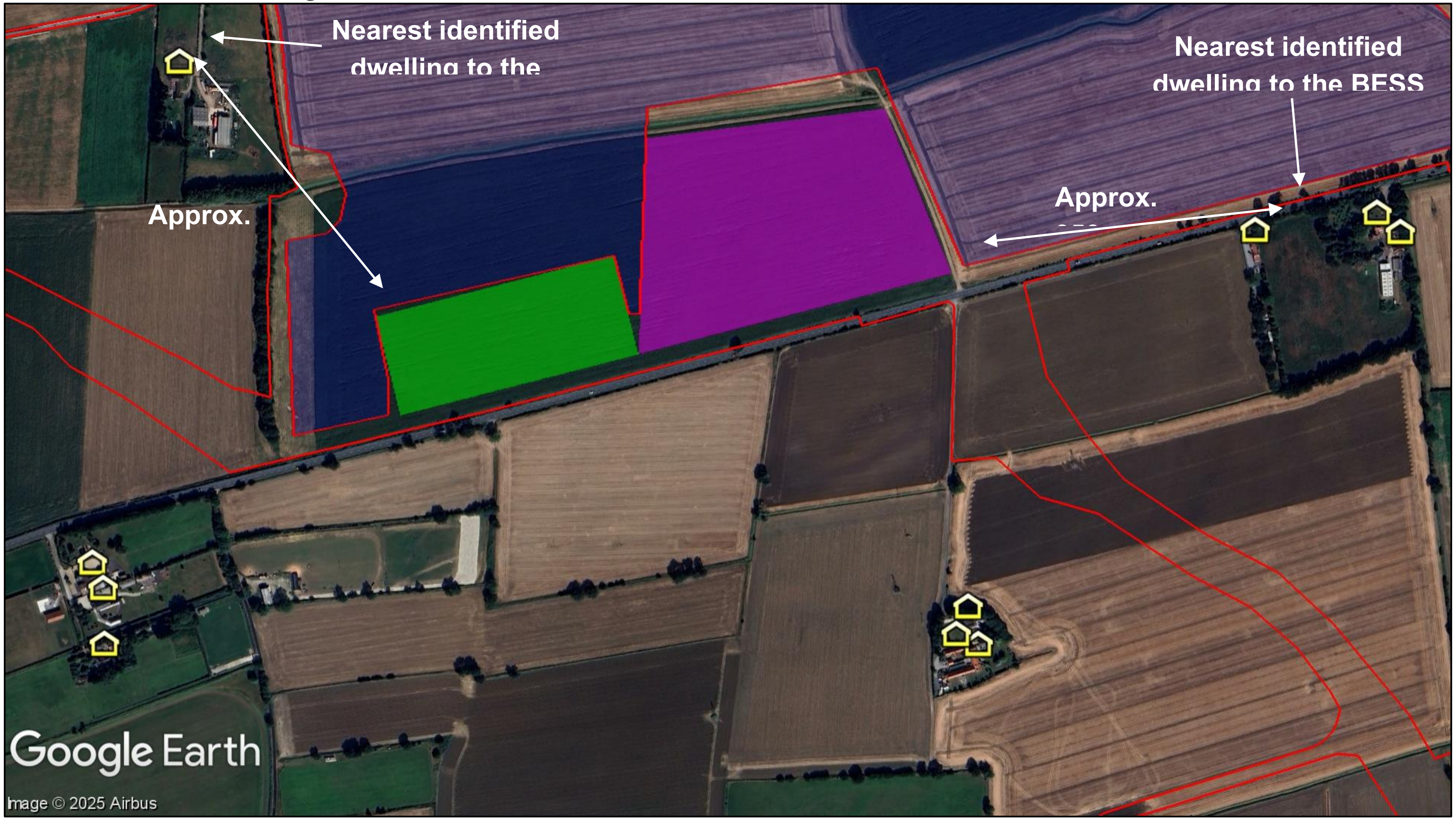

Plate 9 Nearest dwelling relative to the substation at Solar Development Site 1

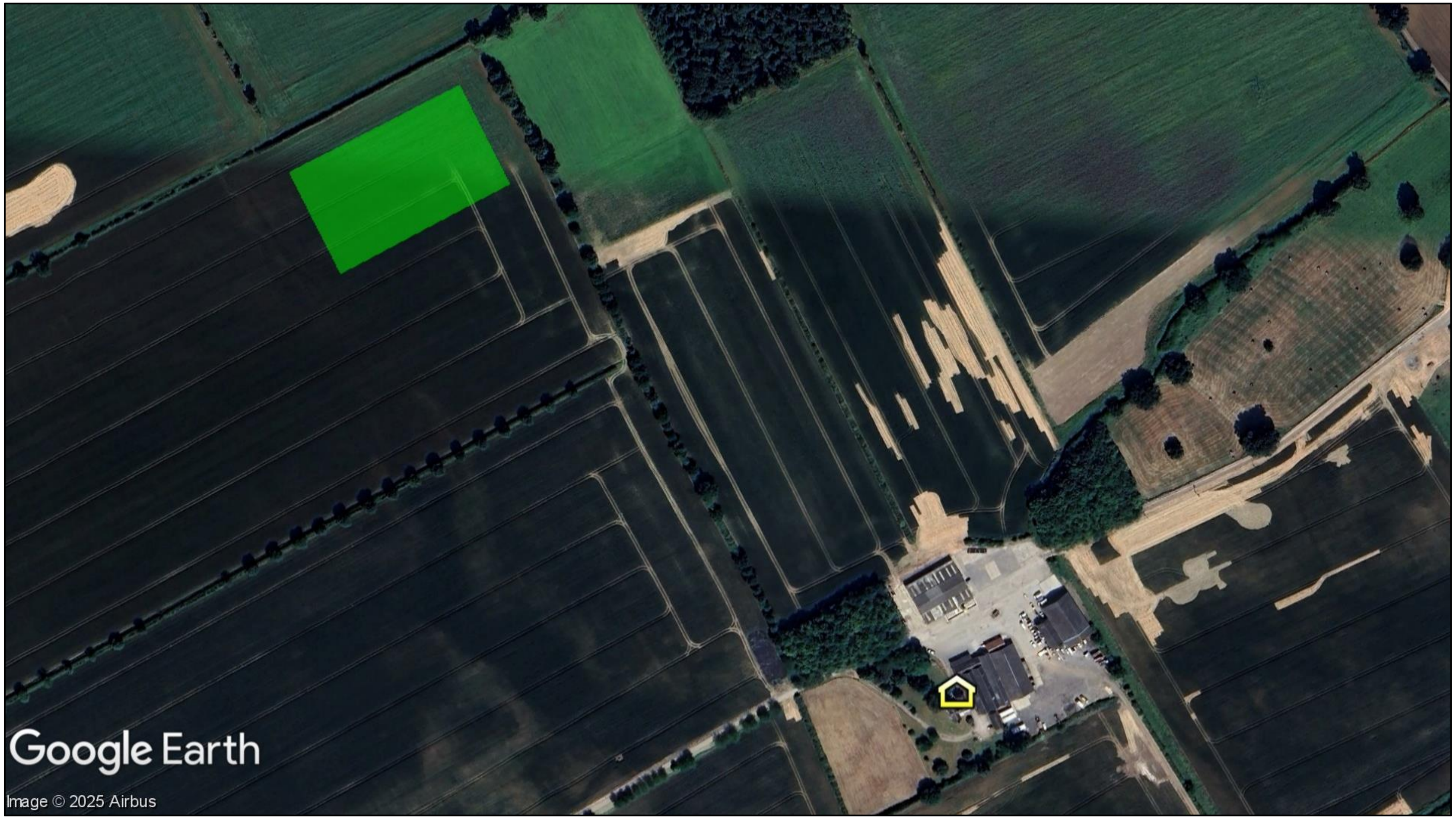

Plate 10 Nearest dwelling relative to the substation at Solar Development Site 4

Plate 11 Nearest dwellings relative to the underground 275kV Cable Route Corridor

4.5 Comparative Assessment

The maximum magnetic field produced by appliances such as vacuum cleaners can reach up to 20 micro-Tesla. It would follow that appliances with larger voltages would produce fields at a higher level; however, 132kV underground cables do not produce significantly larger fields.[19]

The maximum magnetic field produced by the proposed underground cables at a distance of 10m from the cable centreline is 3.58 micro-Tesla. In comparison to the household appliances previously mentioned, these values are significantly lower and are within the acceptable exposure limits. The substation and conversion units will produce magnetic fields at levels lower than the underground cables, thus, lower than the household appliances previously mentioned.

The maximum electric field produced by larger household appliances such as refrigerators is 0.12kV/m and, as mentioned above, the maximum magnetic field produced by appliances such as vacuum cleaners can reach up to 20 micro-Tesla. While the existing overhead powerlines generate stronger magnetic and electric fields compared to household appliances, it is crucial to consider the recommended clearance buffer of 15 meters for human activity. This safety measure mitigates exposure to these fields, ensuring acceptable exposure limits.

4.6 Cumulative Effects

When assessing the cumulative effects of electromagnetic fields, the worst case is based upon the addition of source a and source b; however, it is important to note that this is only true for magnetic fields that are exactly in line. When the electromagnetic fields are not in line, the sum of these is less than ‘a+b’.

For the purpose of this assessment the worst case has been calculated i.e. based upon ‘a+b’. Where the are existing overhead powerlines would be crossed the proposed 275kV underground Cable Route Corridor, based on the conservative values set out in this report, there would be a localised exceedance of the exposure limits (within the 15m recommended clearance) but elsewhere there are no cumulative effects.

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[19] EMFs.info states that typical magnetic fields from 132kV underground cables buried at 1m below ground are approximately 10 micro-Teslas, with a maximum of 72 micro-Teslas

As discussed in Section 4.3, the conversion units, substations and BESS produce smaller magnetic fields than that of the underground cables, thus, considering all sources of radiation and their setback from existing utilities infrastructure, it is predicted that the cumulative magnetic and electric fields will be below the acceptable exposure limits.

The cumulative effects are not significantly impacted by the use of household items at any distance from the associated infrastructure. While electrical appliances do contribute to overall exposure of electromagnetic fields, the levels remain well below the recommended exposure limits due to the lower voltages of these appliances and their intermittent use, resulting in only a temporary and minor addition to the overall electromagnetic field levels. All identified dwellings are significantly setback from the closest source of EMFs associated with the Proposed Development, and EMFs will therefore be significantly below the ICNIRP thresholds.

5 ECOLOGICAL RECEPTORS

5.1 Overview

The underground Cable Route Corridors within the Proposed Development will include river crossings, where cables will be laid a minimum of 5m deep under the riverbed using horizontal drilling.

This section of the report quantifies the magnitude of magnetic fields at the riverbed and in the water to enable consideration of impacts upon ecological receptors. Further consideration of these impacts is included within Environmental Statement Chapter 6: Biodiversity (ES Volume 1) [**EN0110012/APP/LVS/06.01.06**] and the Shadow Habitats Regulations Assessment Report [**EN0110012/APP/LVS/05.11**].

5.2 Magnetic Fields

Field level data from various cable configurations have been sourced from EMFS.info[20]. Further information on this data for 275kV cables is included in Section 4.1 of this report.

Table 8 below provides the indicative numerical values for magnetic fields (in micro-Telsa) at set distances horizontally from the centreline of the cables and vertically from the riverbed. These values assume a cable burial depth of 5m below the riverbed.

		Distance vertically from riverbed (m)						
		0	0.1	0.2	0.5	1.0	1.5	2.0
Distance Horizontally from	0	14.72	14.15	13.61	12.17	10.22	8.71	7.51
	5	3.68	3.61	3.54	3.34	3.04	2.78	2.56
	10	1.64	1.61	1.59	1.53	1.44	1.35	1.27
	20	0.59	0.58	0.58	0.57	0.54	0.52	0.50

Table 8 *Maximum magnetic field levels for an underground 400kV cable*

[20] EMFs (2025) Electric and magnetic fields [Online]. Available at: https://emfs.info/

5.3 Electric Fields

Underground cables typically do not produce electric fields above ground due to shielding provided by the earth. Studies have indicated that magnetic fields can induce electric fields in saltwater, due to the presence of dissolved salts.

The river crossings as part of the Proposed Development all involve fresh water, which does not contain significant proportions of dissolved salts, and induced electric fields are therefore highly unlikely to occur.

6 CONCLUSIONS

6.1 275kV Underground Cables

The maximum magnetic field produced by 275kV underground cables is predicted to be 96.17 micro-Teslas. The magnetic field levels are therefore below the reference level from the public exposure limits in UK policy.

This value correlates to a human being 1m above ground level (agl), directly above the cable, and therefore the magnetic fields will be further diminished due to any separation distances horizontally from the cables to any dwelling.

The closest identified dwellings are at least 50m from the Cable Route Corridor, and as such magnetic fields will be significantly below the reference level of 100 micro-Teslas.

For users of Public Rights of Way (PRoWs), any radiation effects would be minimal and not significant in EIA terms as effects would be below the reference thresholds and these are not continually occupied, rather they are moving receptors, as opposed to residential dwellings and workplaces.

At watercourse crossings, where the cable will be buried at a minimum depth of 5m, the residual maximum magnetic field produced by 275kV underground cables is predicted to be 14.72 micro-Teslas at the riverbed. This figure reduces with vertical distance within the water column and horizontally upstream and downstream of the cable alignment.

6.2 Overhead Powerlines – up to 400kV

There are existing overhead powerlines up to 400kV operating within the order limits; while it is understood that these cables will not be rerouted as part of the project, they are relevant for comparison and potential cumulative impacts.

The maximum magnetic field produced by the existing overhead powerlines is predicted to be 81.942 micro-Teslas. The magnetic field value is therefore below the reference level from the public exposure limits in UK policy.

The maximum electric field produced by the existing overhead powerlines is predicted to be 10.642kV/m. The electric field levels are therefore above the reference level from the public exposure limits in UK policy and an approximately 15m minimum clearance distance is recommended. This standoff distance limits risks associated with prolonged exposure to electromagnetic fields generated by the overhead powerlines. The closest identified dwelling to the existing overhead powerline in the vicinity of the Proposed Development is over 85m away from the line and will therefore be far below the exposure limit for electric fields.

When considering the cumulative magnetic fields at 0m from the proposed underground cables and existing overhead powerlines (worst-case for maximum EMFs and design parameters), the exposure limits are still maintained. When considering the cumulative electric fields at 0m from the proposed underground cables and existing overhead powerlines (worst-case for maximum EMFs and design parameters), the exposure limits are exceeded, but can still be met with the recommended clearance distance of 15m. With the exception of the point where the Cable Route Corridor crosses under the existing overhead lines, it is typically located over 500m from the existing overhead lines at its nearest point and will therefore have no significant cumulative impact.

For users of Public Rights of Way (PRoWs), any radiation effects would be minimal and not significant in EIA terms as these are not continually occupied, rather they are moving receptors, as opposed to residential dwellings and workplaces. The ICNIRP public exposure thresholds relate specifically to locations of significant exposure time.

6.3 Conversion Units

Notable sources of radiation other than the cables will be the conversion units positioned across the Proposed Development.

The conversion units will be ‘CE’ marked (Conformité Européene, or European Conformity marking), and/or ‘UKCA’ marked (UK Conformity Assessed). CE and UKCA markings indicate that a product has been assessed by the manufacturer and determined to meet the safety, health, and environmental protection requirements of the European Union and the United Kingdom, respectively. CE marking requirements were adopted and extended indefinitely in Great Britain until the UK left the EU in 2020. From 1 January 2021, the UKCA mark started to replace the CE mark for goods sold within Great Britain, and the CE mark has continued to be required for goods sold in Northern Ireland. The marking requires that electrical and electronic equipment does not generate, or is not unintentionally affected by, electromagnetic disturbance.

Furthermore, the conversion units are predicted to produce fields at a lower level than that of underground cables because the equipment will be housed in protective enclosures.

6.4 Substation and BESS

The proposed substation and BESS are located over 350m from the nearest dwellings, ensuring compliance with public exposure limits. The substation and BESS are expected to comply with EMF exposure guidelines, with equipment housed in protective enclosures to minimize radiation. All relevant equipment installed as part of the proposed substations shall be 'UKCA' marked.

For users of PRoWs, any radiation effects would be minimal due to their transient nature. Overall, no significant electromagnetic impacts are predicted from the proposed infrastructure.

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