5 HUMAN BEINGS – ELECTRICAL AND MAGNETIC FIELDS

5.1 INTRODUCTION

1 This chapter of the Environmental Impact Statement (EIS) presents an evaluation of the proposed development as set out in Chapter 6, **Volume 3B** of the EIS**,** in relation to Electric and Magnetic Fields (EMF). The information contained within this chapter relates to the Meath Study Area (MSA) as described in Chapter 5 **Volume 3B** of the EIS.

2 Chapter 6, **Volume 3B** of the EIS describes the full nature and extent of the proposed development, including elements of the overhead line (OHL) design and the towers. It provides a factual description, on a section by section basis, of the entire line route. The proposed line route is described in that chapter using townlands and tower numbers as a reference.

3 In particular, Chapter 8, **Volume 3B** of the EIS describes those aspects of the evaluation of EMF which are common to both the Cavan Monaghan Study Area (CMSA) (refer to **Volume 3C** of the EIS) and the MSA. That chapter should be read prior to this volume for a full understanding of the environmental topic. Chapter 8, **Volume 3B** of the EIS describes the following:

- An overview of EMF:
    - Electromagnetic spectrum; and
    - Extremely Low Frequency (ELF) EMF sources and exposure considerations.
- EMF from the proposed development;
- Compliance with Exposure Guidelines;
- ELF EMF Health Research;
- The Precautionary Principle and EMF;
- Technical Calculations and Results - EMF Associated with the proposed development; and
- Summary and Conclusions.

4 This chapter provides an analysis of the EMF associated with the proposed OHL, as it pertains to the line route in the MSA.

5.2 METHODOLOGY

5 Calculations of EMF were performed to a distance of 150m either side of the centre of the OHL.

6 As discussed in Chapter 8, **Volume 3B** of the EIS the vast majority of the proposed electricity line will be supported by single circuit lattice towers. Though the proposed development is divided into the CMSA and MSA portions for ease of description of other aspects of the proposed development, the EMF from the proposed electricity line are determined by the particular configuration and tower type used in different portions of the route rather than by reference to a particular study area. The discussion of the EMF from the proposed electricity line therefore is divided into these separate sections of the proposed line with different electricity line tower configurations.

7 Over the vast majority of the proposed route, the proposed OHL will be of a single circuit configuration supported on lattice towers. In short sections elsewhere along the route, the electricity line is proposed to be built in two different configurations: single circuit supported on transposition towers in the CMSA section of the route and by utilising existing double circuit lattice towers in the MSA section of the route. To facilitate the 400kV OHL in the MSA, minor alterations are required to be made to one existing 110kV OHL. **Figure 5.1** shows the location of the different sections of the electricity line route with different circuit configurations.

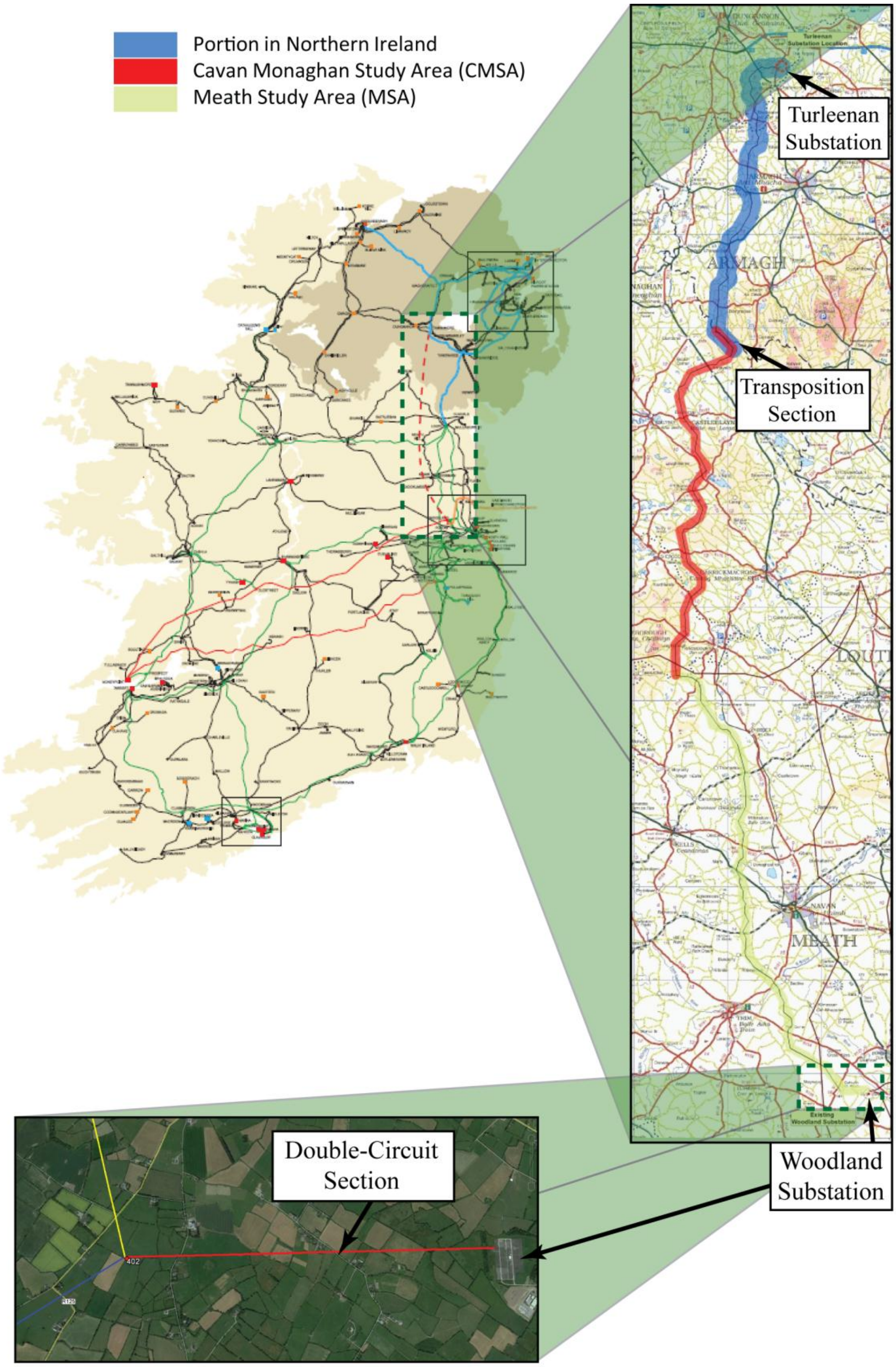

Figure 5.1: Map of the Proposed Interconnector Showing the Proposed Electricity Line Route

8 Over the short distance where it is proposed to use the unused (northern) side of the existing double circuit lattice towers, which support the Oldstreet to Woodland 400 kV circuit, for the proposed development, the EMF from the electricity line on this short segment of the route constructed on these double circuit lattice towers shown in **Figure 5.2(a)**, will differ from the EMF from the electricity line on the single circuit lattice towers and therefore is considered as a separate case. A map of this portion of the proposed development, indicating the type and location of the double circuit lattice towers is shown in more detail in **Figure 5.2(b).**

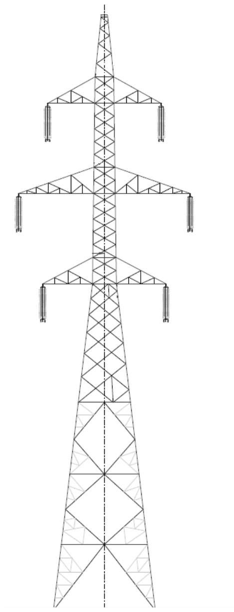

Figure 5.2(a): Existing Double-Circuit Lattice Tower

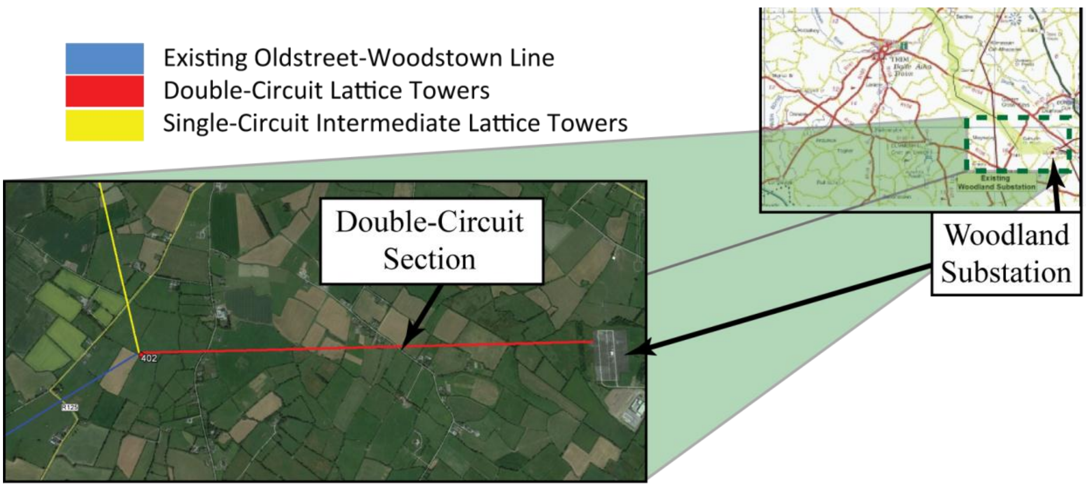

Figure 5.2(b): Map of the Proposed Development Showing the Location of the Double-Circuit Lattice Tower Section

5.3 CHARACTERISTIC OF THE PROPOSED DEVELOPMENT

9 The proposed development involves the erection of an OHL supported by steel lattice towers over a distance of approximately 54.5km and using the unused side of existing double circuit towers over a distance of 2.85km. Electric and magnetic fields are associated with OHLs.

5.4 EXISTING ENVIRONMENT

10 Chapter 8, **Volume 3B** of the EIS discusses the existing environment in relation to EMF in detail. It discuss the scientific background to EMF, gives information on the sources and levels of background EMF which are typically found in the existing environment, reviews information in relation to ELF EMF health research and provides information in relation to how EirGrid complies with exposure guidelines. Finally, Chapter 8, Section 8.7 of **Volume 3B** of the EIS (Technical Calculations) provides the methodology for and the calculations of the EMF associated with each proposed electricity line tower configuration.

5.5 POTENTIAL IMPACTS

5.5.1 Do Nothing

11 EMF background levels from existing EMF sources will be unchanged. EirGrid will continue to comply with exposure limits set out in relevant exposure guidelines.

5.5.2 Construction Phase

12 EMF only occurs when an OHL becomes operational. There will be no EMF from the OHL during the construction stage of the proposed development.

5.5.3 Operational Phase

13 EMF levels were calculated at 1m above ground, in accordance with IEC Std. 61786 (1998), using algorithms developed by the Bonneville Power Authority (BPA) of the U.S. Department of Energy (BPA, 1991). Calculated values are reported as the root-mean-square resultant quantities of the field ellipse at each location along a transect perpendicular to the electricity line centre line at distances out to 150m[10]. Data for the proposed electricity line's geometrical configurations, conductor type and loading were provided to Exponent[11] by EirGrid.

[10] The BPA algorithms employed assume that conductors are at the midspan conductor height and infinite in extent. Near the Transposition Towers where the phase transposition takes place, the assumption of conductors of infinite extent is not satisfied, but field levels in these locations would be lower than those presented in calculations for midspan conductor heights.

[11] Exponent is the specialist consultant responsible for the preparation of the EMF aspects of this EIS.

5.5.3.1 Magnetic Fields Associated with Single Circuit Lattice Tower Sections

14 The magnetic field associated with the single circuit lattice tower sections of the electricity line supported on a combination of intermediate and angle towers is shown in **Figure 5.3** for both average and peak loading. Two views of the same graph are shown in each figure. Both have the same X-axis range of 0 to 150m from the centre line of the route alignment. The uppermost graph has a Y-axis range of 0 to 100 microtesla (μT)[12] and can be used to visually determine the calculated magnetic field levels at locations within 50m of the centre line relative to the International Commission on Non Ionising Radiation Protection (ICNIRP) Reference Level. The lowermost graph has a Y-axis range of 0 to 2μT and can be used to visually determine the calculated magnetic field levels at locations beyond 50m from the centreline which are indiscernible on the uppermost graph.

15 The maximum magnetic field level at average loading is calculated to be directly beneath the lines and will be approximately 16μT. The magnetic field intensity diminishes with distance, to about 1.0μT at a distance of 50m and to approximately 0.25μT at a distance of 100m from the centre line, a reduction by a factor of 64. The maximum magnetic field levels, as well as field levels at 50m and 100m from the centre line, are shown in Tables 8.5 and 8.6, **Volume 3B** of the EIS for average and peak loading, respectively.

[12] The magnetic field level of 100μT equates to the ICNIRP (1998) Reference Level; refer to Table 8.2 of Chapter 8 of **Volume 3B** of the EIS.

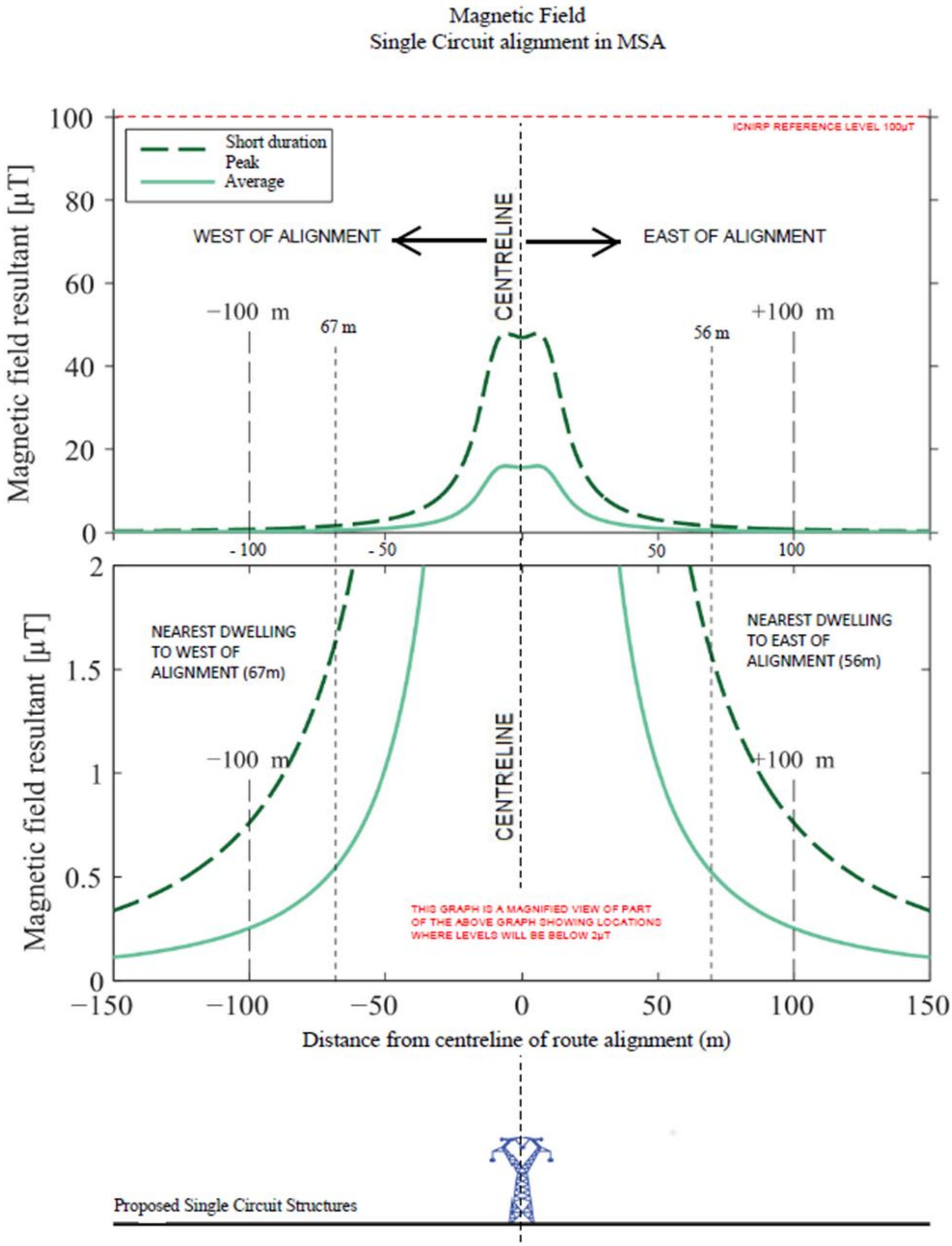

Figure 5.3: **Calculated Magnetic Field Profile for the Proposed Single Circuit Lattice Tower Configuration for Short Duration Peak Load and Average Load**

5.5.3.2 Electric Fields Associated with Single Circuit Lattice Tower Configuration

16 The electric field level associated with the single circuit lattice towers is shown in **Figure 5.4**. Two views of the same graph are shown in each figure. Both have the same X-axis range of 0 to 150m from centre line of the route alignment. The uppermost graph has a Y-axis range of 0 to 15kV/m and can be used to visually determine the calculated electric field levels at locations within 50m of the centre line relative to the ICNIRP Basic Restriction Level of 9kV/m[13.] The lowermost graph has a Y-axis range of 0 to 2kV/m and can be used to visually determine the calculated electric field levels at locations from 50m to 150m from the centre line which are indiscernible on the uppermost graph.

17 The maximum electric field levels beneath the electricity line is calculated to be approximately 7.9 kV/m, and decreases to below 1 kV/m beyond approximately 25m from the centre line. The highest calculated electric field levels, as well as field levels at 50m and 100m, are shown in Table 8.7, **Volume 3B** of the EIS.

[13] Refer to Table 8.2 of Chapter 8 of **Volume 3B** of the EIS.

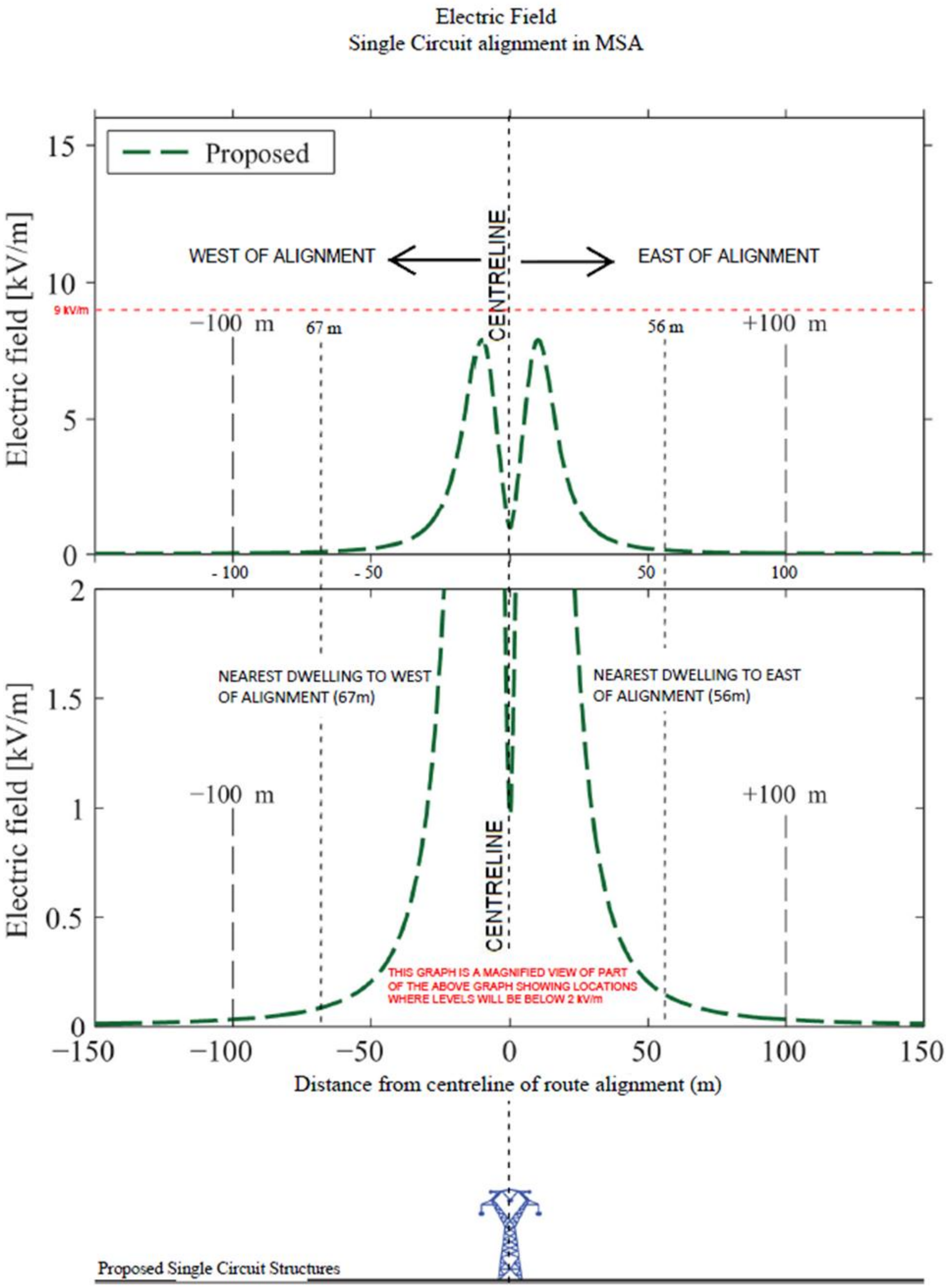

Figure 5.4: Calculated Electric Field Profile for the Proposed Single Circuit Lattice Tower Configuration

5.5.3.3 Magnetic Fields Associated with Double Circuit Lattice Tower Configuration

18 The magnetic field associated with the existing and new electricity line on the double circuit lattice towers is shown in **Figure 5.5** and is similar to that from the new single circuit electricity line described in Chapter 8, **Volume 3B** of the EIS. Two views of the same graph are shown in each figure. Both have the same X-axis range of 0 to 150m from centre line of the route alignment. The uppermost graph has a Y-axis range of 0 to 40μT[14] and can be used to visually determine the calculated magnetic field levels at locations within 50m of the centreline. The lowermost graph has a Y-axis range of 0 to 2μT and can be used to visually determine the calculated magnetic field levels at locations beyond 50m from the centre line which are indiscernible on the uppermost graph.

19 The magnetic field is calculated to be highest beneath the electricity line conductors and decreases rapidly with distance. The maximum magnetic field beneath the electricity line for two lines operating on the double circuit lattice towers is calculated to be approximately 12-14μT depending on the selected phasing. Magnetic field levels, however, decrease more rapidly with distance for the optimal phasing[15] configuration than for non-optimal phasing configuration.

20 The magnetic field level near the electricity centre line will increase due to the installation of the new circuit on the existing structures. For optimal phasing the magnetic field levels to the south will decrease by as much as 1.4μT beyond approximately 10m from the centre line. To the north of the electricity line the magnetic field levels will not change appreciably (<1μT) beyond approximately 25m from the centre line and will decrease beyond approximately 40m from the centre line. To show the effect of phasing, the magnetic field calculations associated with the optimal and non-optimal phasing configurations are shown in **Figures 5.5** and **5.6**, respectively.

21 The highest calculated magnetic fields at average loading, as well as field levels at 50m, and 100m from the centre line, are shown in Table 8.5, **Volume 3B** of the EIS for both optimal and non-optimal phasing configurations. Peak magnetic fields that might only occur for a few hours in a decade are summarised in Table 8.6, **Volume 3B** of the EIS.

22 The magnetic field level across a range of loading levels could well be substantially lower than calculated because the modelling assumptions made here are chosen to ensure a conservative estimate of magnetic field level applicable to all locations. Indications that the calculated magnetic field levels are higher than would be expected under other typical loading is supported by measurements of existing 400 kV electricity lines in Ireland, which indicate that the magnetic

[14] The ICNIRP (1998) Reference Level is 100μT - refer to Table 8.2 of Chapter 8 of **Volume 3B** of the EIS.
[15] Phase Optimisation is a 'no or low cost' mitigation measure for EMF that can be applied to double circuit OHLs. It is discussed in greater detail in Section 8.7, Chapter 8 of **Volume 3B** of the EIS.

field from 400 kV lines on similar towers is as much as three to four times lower than calculated here.

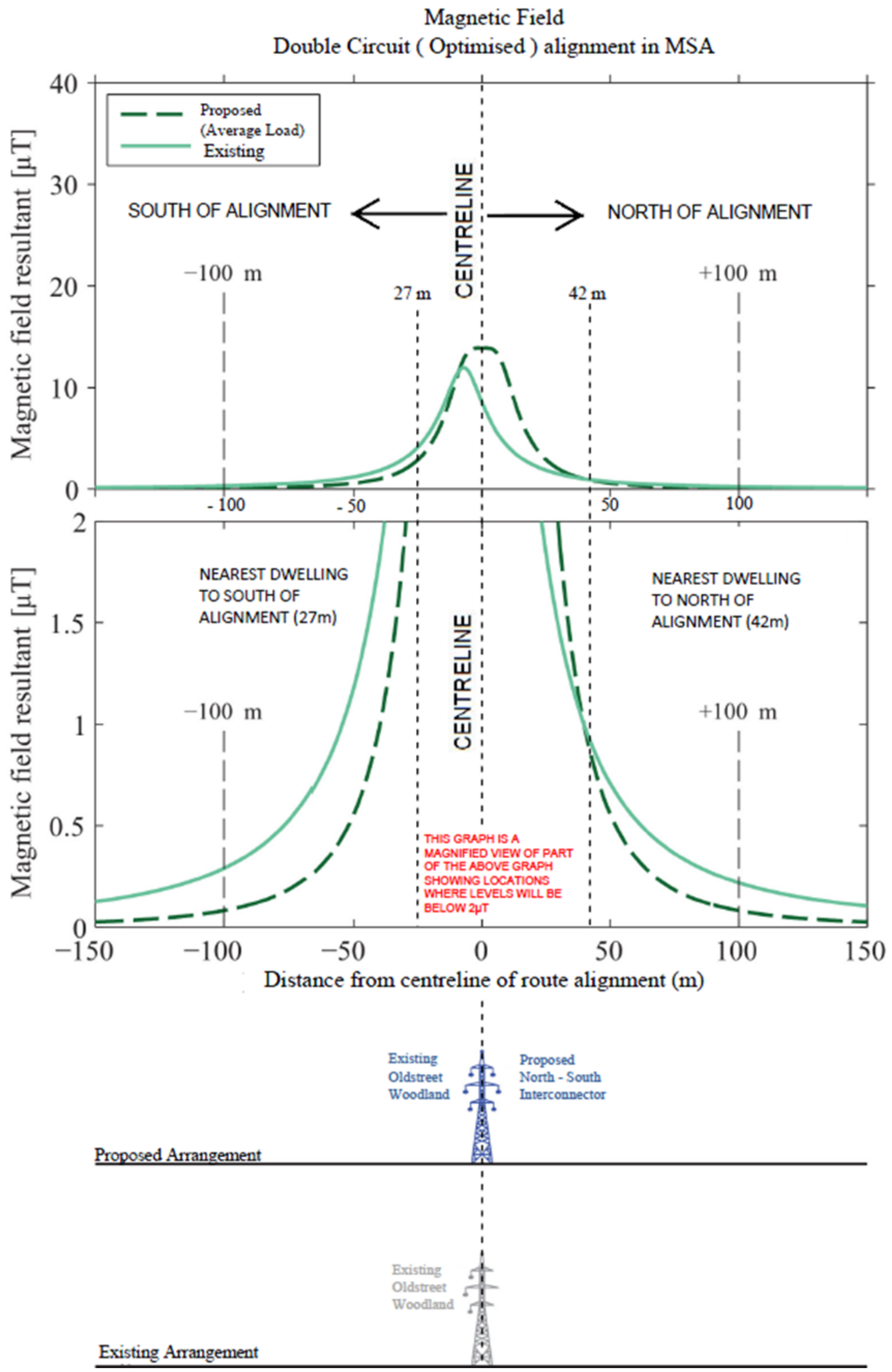

Figure 5.5: Calculated Magnetic Field Profile for the Existing and Proposed Double-Circuit Lattice Tower Configuration for Average Load and Using Optimised Phasing

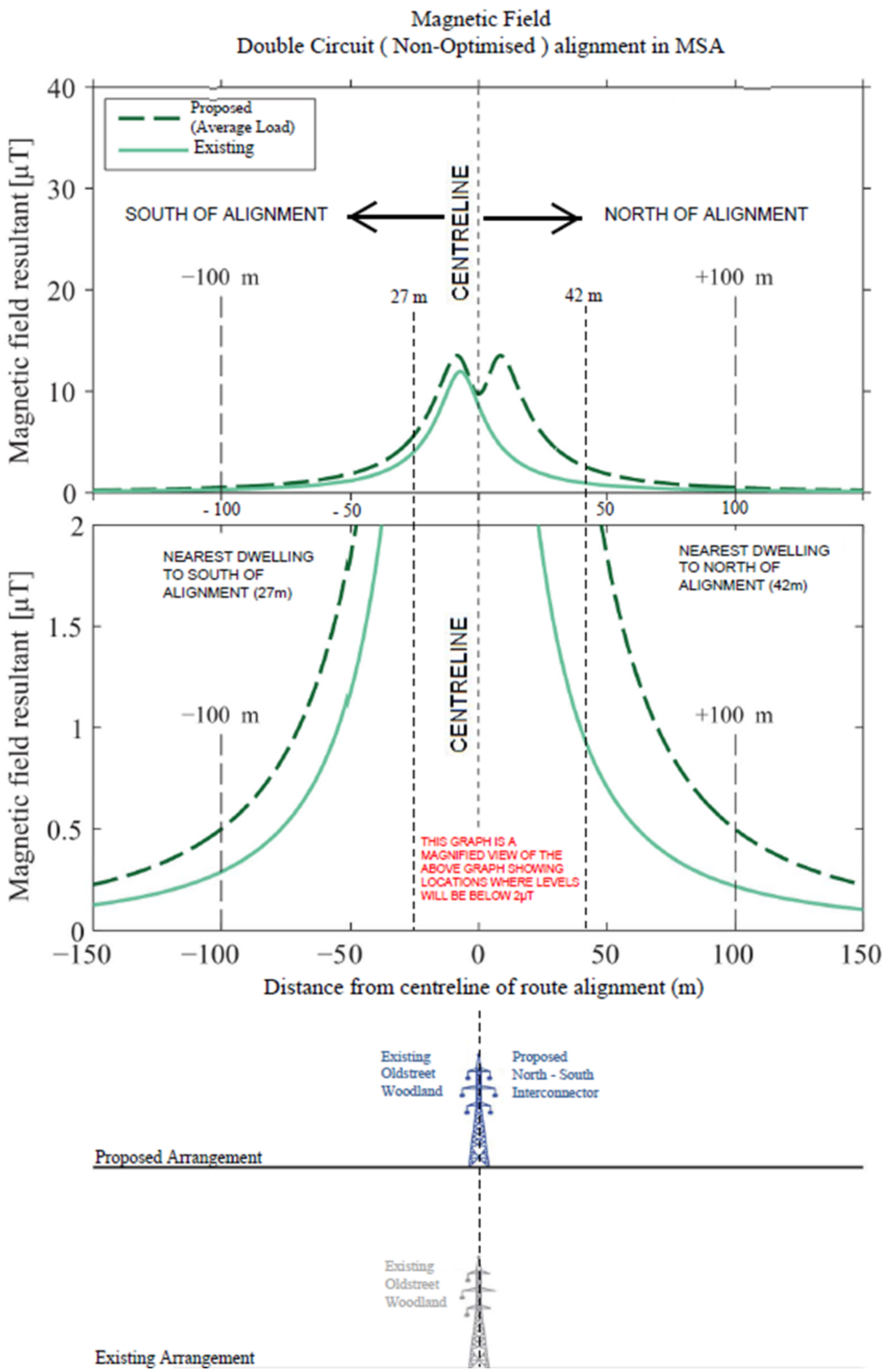

Figure 5.6: Calculated Magnetic Field Profile for the Existing and Proposed Double-Circuit Lattice Tower Configuration for Average Load and Using Non-Optimised Phasing

5.5.3.4 Electric Fields

23 The electric field from the existing and new electricity line on the double circuit lattice towers is shown in **Figure 5.7** (optimal phasing[16]) and **Figure 5.8** (non-optimal phasing) and is similar to that from the new single circuit electricity line described in Chapter 8, **Volume 3B** of the EIS. Two views of the same graph are shown in each figure. Both have the same X-axis range of 0 to 150m from centre line of the route alignment. The uppermost graph has a Y-axis range of 0 to 15kV/m and can be used to visually determine the calculated electric field levels at locations within 50m of the centre line relative to the ICNIRP Basic Restriction Level of 9kV/m[17]. The lowermost graph has a Y-axis range of 0 to 2kV/m and can be used to visually determine the calculated electric field levels at locations beyond 50m from the centre line which are indiscernible on the uppermost graph.

24 The electric field level is calculated to be highest beneath the electricity line conductors and decrease rapidly with distance. The highest electric field is calculated to vary from approximately 8.0 to 8.8kV/m depending on the phasing configuration selected, but will decrease to below 0.3kV/m beyond 50m from the centre line and to 0.04kV/m beyond approximately 100m from the centreline regardless of the selected phasing, a reduction of over 200-fold. The highest calculated electric field levels, as well as field levels at 50m, and 100m from the centre line are shown in Table 8.7 of Chapter 8, **Volume 3B** of the EIS for both optimal and non-optimal phasing configurations.

[16] Phase Optimisation is a ‘no or low cost’ mitigation measure for EMF that can be applied to double circuit OHLs. It is discussed in greater detail in Section 8.7, Chapter 8 of **Volume 3B** of the EIS.
[17] Refer to Table 8.2 of Chapter 8 of **Volume 3B** of the EIS.

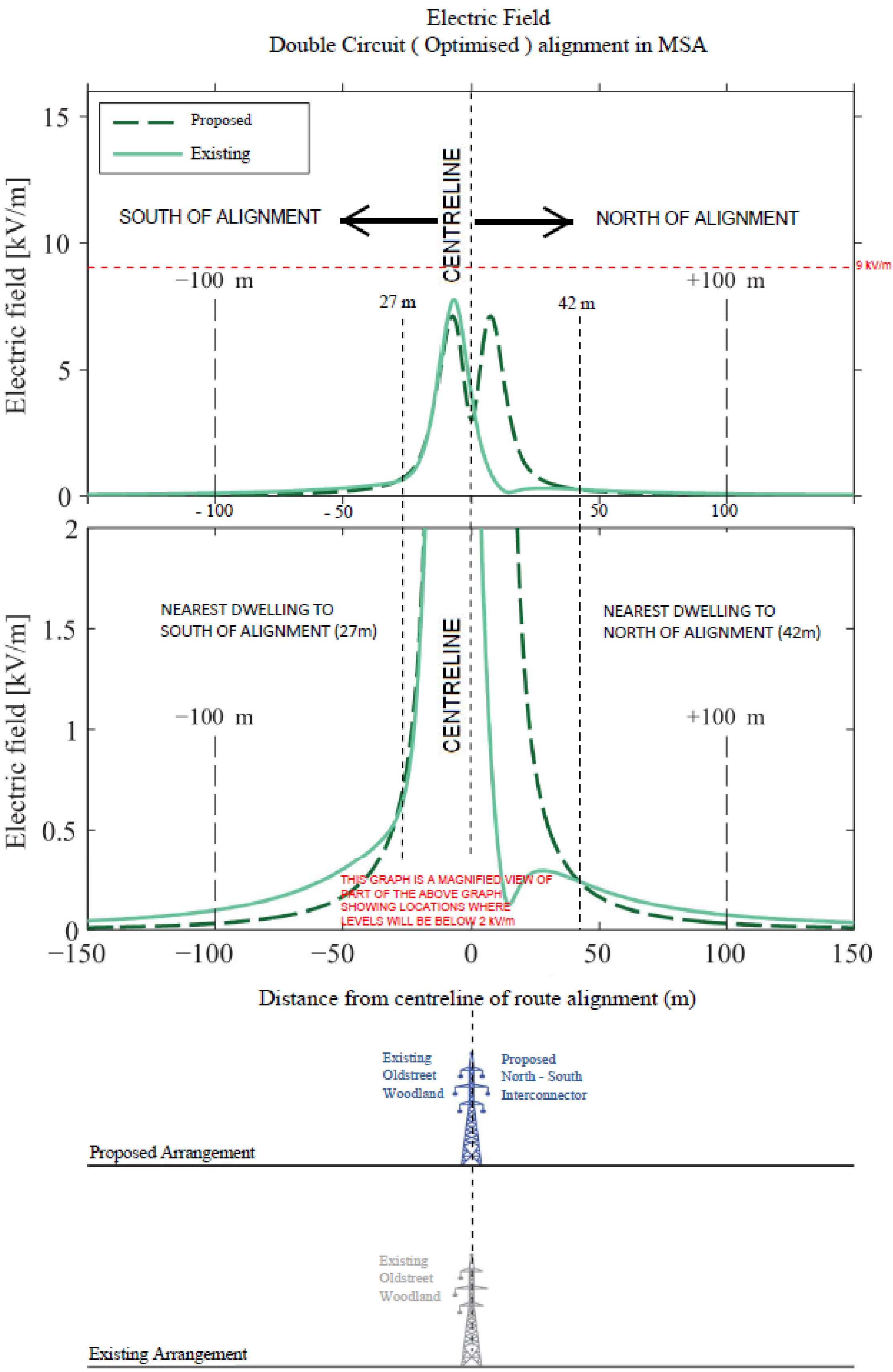

Figure 5.7: Calculated Electric Field Profile for the Existing and Proposed Double-Circuit Lattice Tower Configuration Using Optimal Phasing

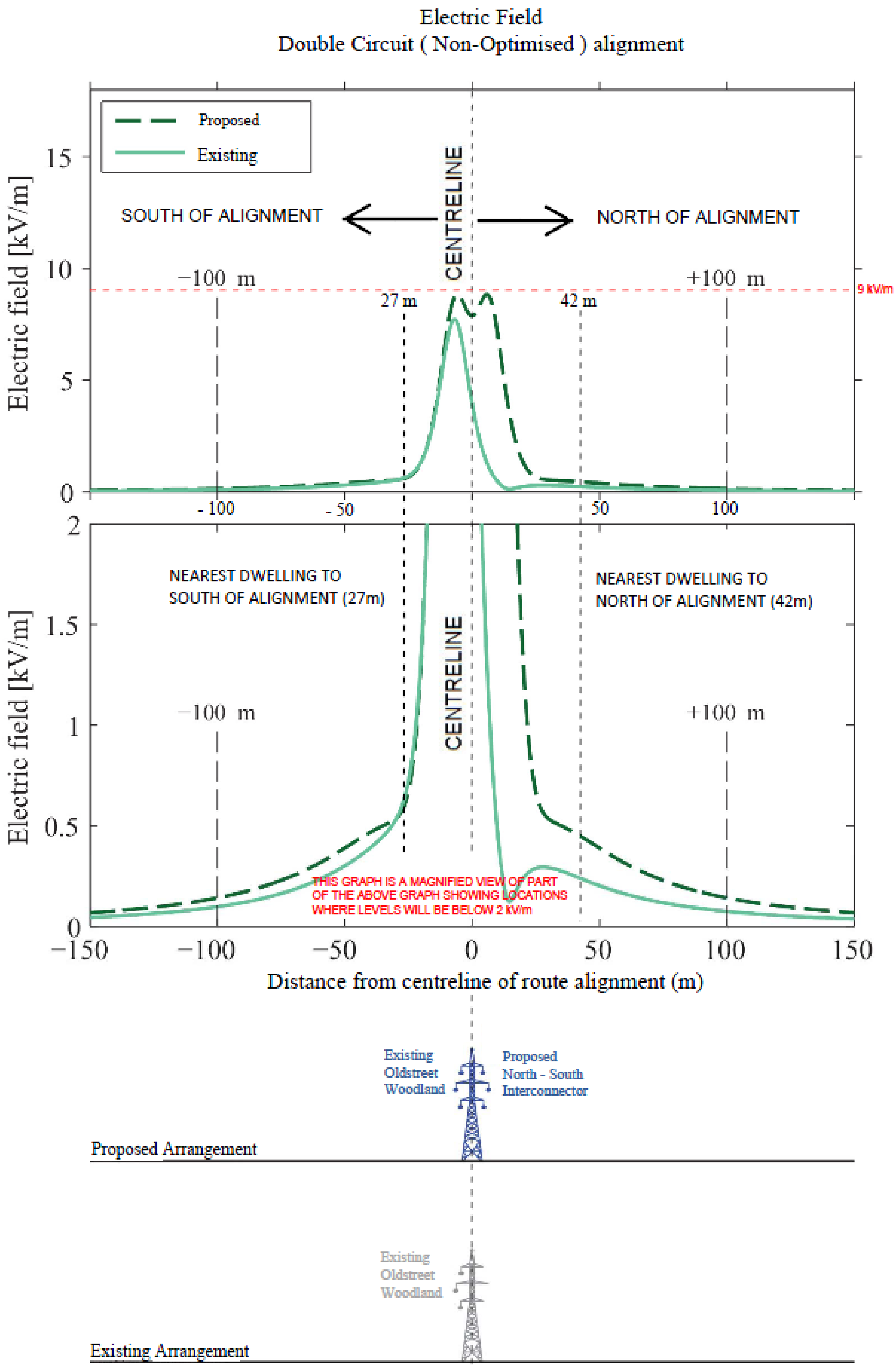

Figure 5.8: Calculated Electric Field Profile for the Existing and Proposed Double-Circuit Lattice Tower Configuration Using Non-Optimal Phasing

5.5.4 Decommissioning

25 The proposed development will become a permanent part of the electricity infrastructure. The expected lifespan of the development is in the region of 50 to 80 years. This will be achieved by routine maintenance and replacement of hardware as required. There are no plans for the decommissioning of the OHL. In the event that part of, or the entire proposed infrastructure is to be decommissioned, all towers, equipment and material to be decommissioned will be removed off site and the land reinstated. Impacts would be expected to be less than during the construction phase and would be of short term duration.

5.6 MITIGATION MEASURES

26 The proposed development will be operated in compliance with relevant guidelines for the control of EMF, specifically with the relevant quantitative exposure guidelines. Optimising the phase configuration of the double circuit Lattice Tower portion of the route is a ‘no or low cost’ mitigation measure that may be implemented to reduce both electric and magnetic field levels. A summary table describing the reduction in electric and magnetic field levels at various distances for the optimal and non-optimal phasing configurations is shown in Table 8.8 of Chapter 8, **Volume 3B** of the EIS.

5.7 RESIDUAL IMPACTS

27 No residual impacts are anticipated as the proposed development will be operated in compliance with relevant guidelines.

5.8 INTERRELATIONSHIPS BETWEEN ENVIRONMENTAL FACTORS

28 This chapter should be read in conjunction with other chapters in this volume of the EIS including; **Chapter 2** Human Beings – Population and Economic, **Chapter 3** Human Beings – Land Use, and **Chapter 6** Flora and Fauna for a full understanding of the main interrelationships between these environmental topics.

29 Chapter 8, **Volume 3B** of the EIS details the potential for interactions between human beings and flora and fauna and the related research and scientific studies.

30 The main potential interrelationships arise from the following:

- **Chapter 2** - Human Beings – Population and Economic – There is a potential for interactions with human beings. However, the operating conditions for the proposed 400 kV line will ensure that EMF will remain below EMF guidelines for Ireland and the

EU. A survey of scientific research on topics relating EMF to health of humans did not show that EMF at these levels would have adverse effects on these populations.

- **Chapter 6** - Flora and Fauna – There is a potential for interactions with flora and fauna. However, the operating conditions for the proposed 400 kV line will ensure that EMF will remain below EMF guidelines for Ireland and the EU. A survey of scientific research on topics relating EMF to health of animal species did not show that EMF at these levels would have adverse effects on these populations.

5.9 CONCLUSIONS

31 The proposed development in the MSA area primarily involves the development of a single circuit OHL over a distance of approximately 54.5km. In addition to this distance is a 2.85km section where it is proposed to use the unused side of the existing double circuit Lattice Towers which support the Oldstreet to Woodland 400 kV circuit, for the proposed development.

32 Chapter 8, **Volume 3B** of the EIS discusses exposure guidelines, and how EirGrid complies with such guidelines. It discusses the scientific background to EMF, gives information on the sources and levels of background EMF which are typically found in the existing environment, reviews information in relation to ELF EMF health research and provides information in relation to how EirGrid complies with exposure guidelines. Having regard to the exposure guidelines outlined in Chapter 8, **Volume 3B** of the EIS the calculations of EMF provided in this section clearly demonstrate that the magnetic field levels produced by the proposed 400 kV line are below the EU (1999) exposure limits (basic restrictions) and so would not cause internal electric fields and current density to exceed these biologically based limits on exposure. Since these calculations are based on conservative assumptions about the operation of the proposed 400 kV line, they are likely to overestimate levels of EMF from the electricity line.

33 In summary, even making conservative assumptions about the operating conditions assumed for the EMF calculations that would tend to overestimate field levels, the EMF from the proposed 400 kV line is still below EMF guidelines of Ireland and the EU. Furthermore, existing electricity infrastructure complies with the European Union (EU) Recommendation on the *Limitation of Exposure of the General Public to Electromagnetic Fields* (1999/519/EC) and will continue to do so where alterations are required for compatibility with the proposed project. A survey of scientific research on topics relating EMF to health of humans and other species did not show that EMF at these levels would have adverse effects on these populations. This evaluation is consistent with reviews by national and international health and scientific agencies.