

APPENDIX M – ELECTRIC AND MAGNETIC FIELD ASSESSMENT

Exponent[®]

**Electric and Magnetic
Field Assessment:
Killingly Energy Center**



Electric and Magnetic Field Assessment:

Prepared for

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Executive Summary

NTE Connecticut, LLC (NTE) has proposed to construct, own, and operate the Killingly Energy Center (KEC), an approximately 550-megawatt combined-cycle electric generating facility. The power generated will be carried to the electric grid over an existing 345-kilovolt (kV) transmission line owned and operated by Eversource.

NTE has requested that Exponent measure pre-construction levels of electric and magnetic fields (EMF) from existing 60-Hertz sources in the vicinity of the KEC and to model the levels of EMF, audible noise (AN), and radio noise (RN) associated with the new 345-kV interconnection and the adjacent transmission line right of way (ROW) to be included in its Application to the Connecticut Siting Council for this project,

Electric and magnetic fields from existing sources in the vicinity of the KEC site were measured on June 8, 2016. To the south of the site is the existing Eversource transmission line. Magnetic-field levels of approximately 6 milligauss (mG) were measured at the edge of the ROW while electric-field levels were approximately 0.2 kilovolts per meter (kV/m). In the surrounding community, average magnetic-field measurements were less than 1.0 mG but higher magnetic field levels were measured at multiple locations from various sources; the highest levels were recorded in a local home improvement store (139 mG).

The construction of the new 345-kV transmission line will increase electric-field and magnetic-field levels to a calculated maximum of approximately 7.8 kV/m and 322 mG, respectively, on KEC property and over Lake Road. The proposed location of KEC immediately adjacent to an existing ROW means that the only location where members of the public might encounter new sources of EMF from the project is the small area on Lake Road beneath the interconnection transmission line. These levels will decrease to 1.4 kV/m and 58 mG at a distance of 75 feet from the center of the transmission line. Measured and calculated EMF levels both on the ROW and at the ROW edge have been compared to international standards and are well below the recommended levels for public exposure (ICES, 2002; ICNIRP 2010).

The highest fair-weather AN will be approximately 27 decibels on the A-weighted scale, well below existing ambient noise levels and Town of Killingly Noise Ordinance levels. The highest fair-weather RN levels at 50 feet from conductors will be 44 decibels above 1 microvolt per meter, well below Institute of Electrical and Electronics Engineers guideline levels.

Modeled magnetic-field levels on the adjacent Eversource ROW are calculated to increase slightly at the ROW edge (7.1 mG or less), while at 100 feet from the ROW edge, the change will be 3.0 mG or less. Electric field, AN and RN levels from lines on the existing ROW are not expected to change.

Introduction

NTE Connecticut, LLC (NTE) has proposed to construct, own and operate the Killingly Energy Center (KEC), an approximately 550-megawatt (MW) combined-cycle electric generating facility and related electrical interconnection switchyard to be located on approximately 73-acres of land off Lake Road in the Town of Killingly, Connecticut. Approximately 63-acres of the site (north of Lake Road) is the proposed location of the generating facility and Plant Switchyard, while the 10-acre portion of the site (south of Lake Road) is the proposed location of the Utility Switchyard. The power produced by KEC is proposed to be connected with the grid over an existing 345-kilovolt (kV) transmission line owned and operated by Eversource.

To connect with the adjacent 345-kV transmission line, NTE proposes to construct a short (approximately 600 feet) overhead transmission interconnection from the Plant Switchyard on the north side of Lake Road to the Utility Switchyard on the south side of Lake Road. The proposed location of the Utility Switchyard, which abuts the Eversource right of way (ROW) as shown in Figure 1, will facilitate interconnection with the regional electricity grid without the construction of a lengthy new transmission line.

The short interconnection between KEC and the proposed Utility Switchyard will be a source of electric and magnetic fields (EMF), audible noise (AN), and radio noise (RN) around the line as it crosses over Lake Road. The electricity generated by the KEC will increase the magnetic field of the existing 345-kV line to which it connects, as well as to adjacent transmission lines on the same ROW. NTE requested that Exponent measure pre-construction levels of EMF from existing 60-Hertz (Hz) sources in the vicinity of the KEC and to model the levels of EMF, AN, and RN associated with the new 345-kV interconnection and the adjacent transmission line ROW.

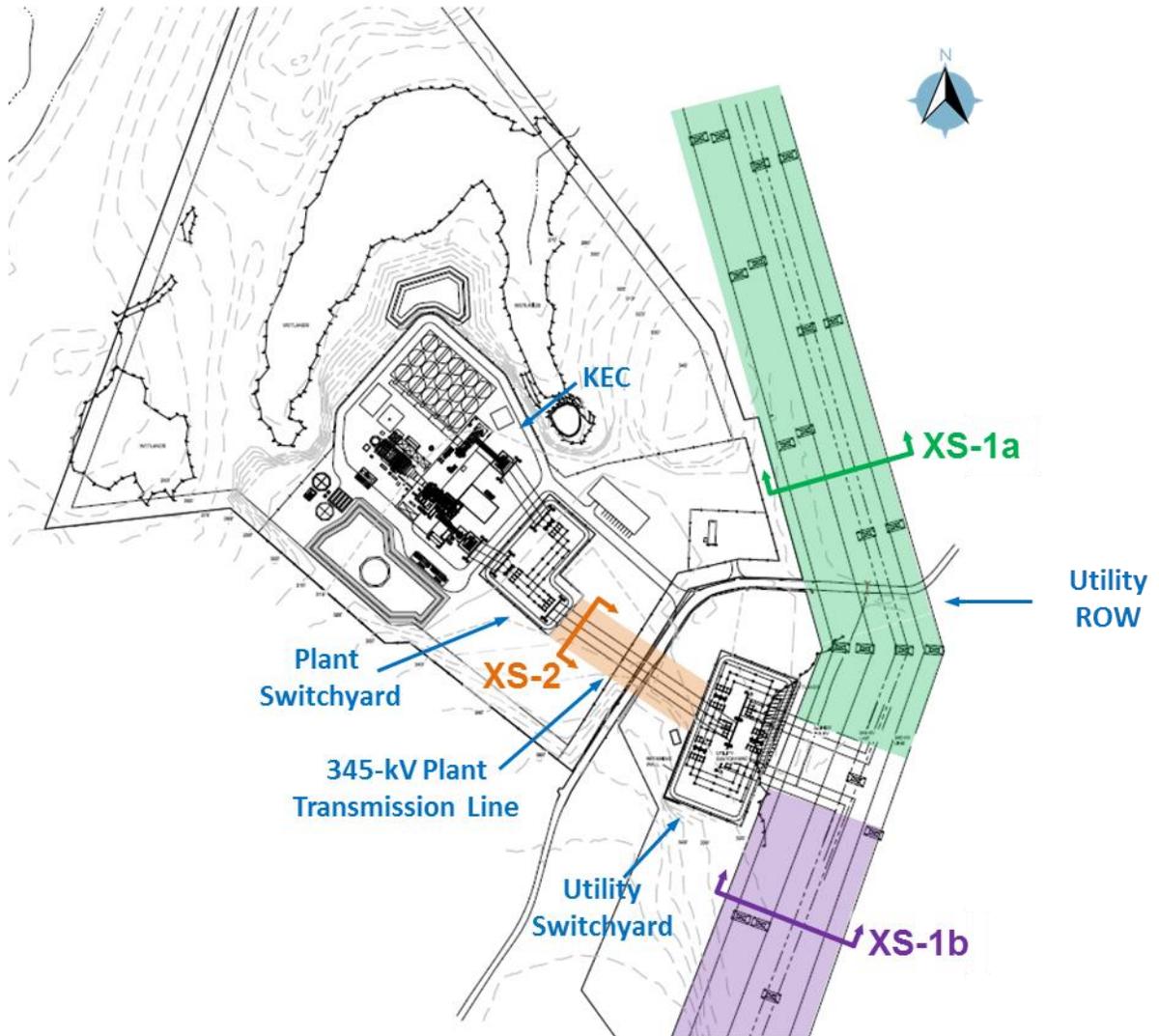


Figure 1. Plan view of the proposed KEC showing the sections of lines selected for modeling.

Modeling was performed for three configurations surrounding KEC.¹

- Cross Section XS-1 is representative of the Eversource ROW that contains two existing 115-kV transmission lines (Lines 1505 and 1607) and two existing 345-kV transmission lines (Lines 330 and 3271). The KEC Utility Switchyard is proposed to be connected to the 345-kV transmission line located nearer to the KEC (Line 3271). The loading of the 3271 transmission line therefore will be different to the north of the KEC facility (between the Killingly Substation and KEC) than to the south of the KEC facility (between KEC and the Card Substation) due to the expected flow direction of the power injected from the KEC facility. This cross section is, therefore, modeled as two cross sections: XS-1a and XS-1b. The present physical configurations of these cross sections are shown in Figure 2a, and they are not proposed to change as a result of this project.
- Cross Section XS-2 represents the short (approximately 600 feet) connection that will cross over Lake Road in a horizontal configuration from the KEC Plant Switchyard to the Utility Switchyard, and is shown in Figure 2b. The final design of this cross section is not yet complete and so was conservatively modeled with a minimum ground clearance of 26 feet, the minimum conductor height permitted by the National Electric Safety Code (NESC) for a 345-kV transmission line (NESC, 2012). The width of the ROW in XS-2 has been assumed to be 150 feet.

¹ The interconnection to loop the existing 3271 Line into and back out of the Utility Switchyard is not presented here as the switchyard immediately abuts the existing ROW. Therefore, all changes to the electrical environment will be confined to an area on the ROW itself and changes to EMF, AN, and RN levels beyond the ROW or switchyard boundary are expected to be minimal.

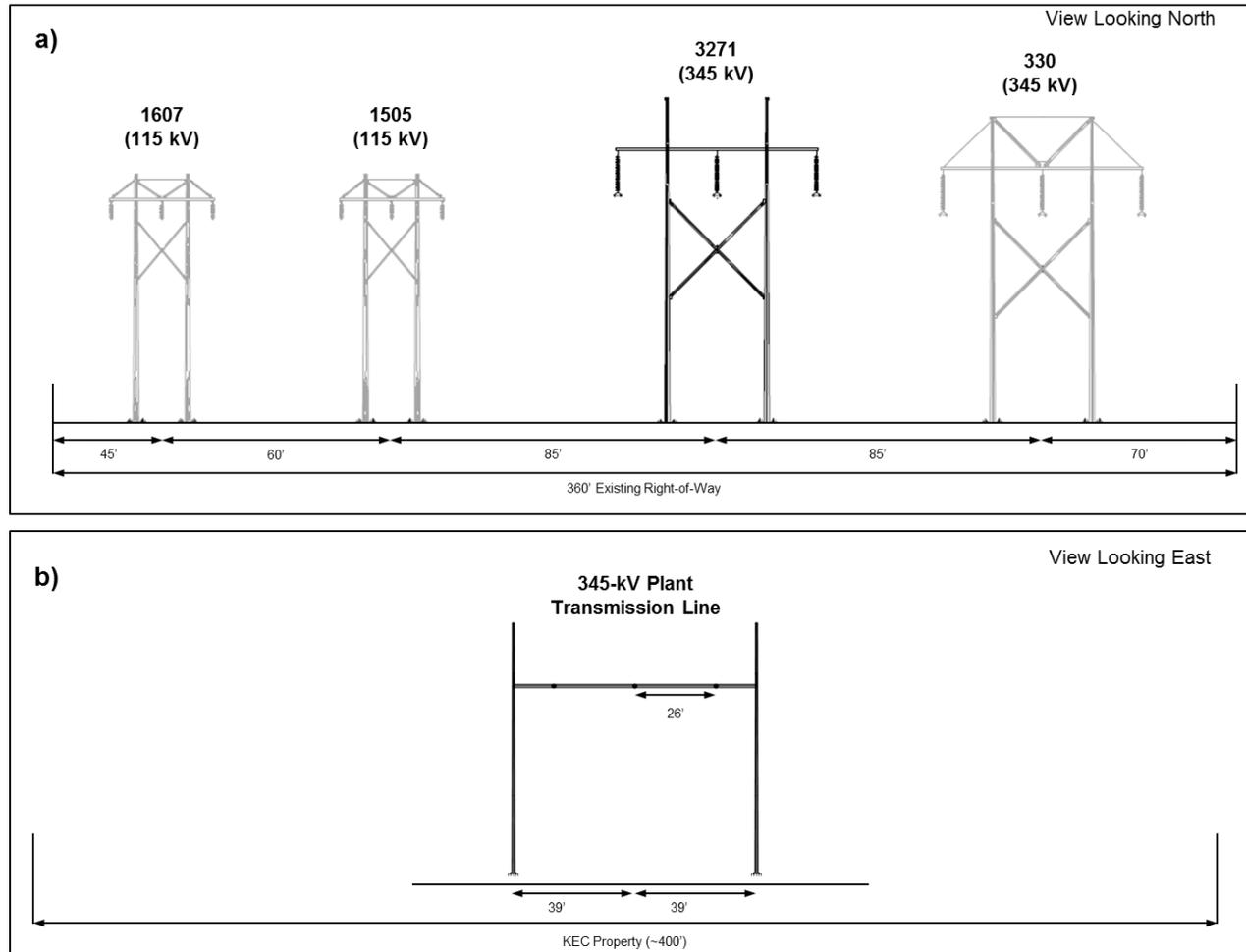


Figure 2. Existing configuration of the modeled transmission lines.

a) On the Eversource ROW (XS-1a and XS-1b) and b) between the KEC Plant Switchyard and the Utility Switchyard (XS-2). Distances to supporting poles and between phase conductors are shown in b).

Technical Background

As previously discussed, KEC, the Plant and Utility Switchyards, and the short, connecting overhead transmission lines are sources of EMF, as are any wires or appliances that use or transmit electricity. Figure 3 illustrates typical levels of magnetic fields (upper panel) and electric fields (lower panel) at various locations. Although these fields are referred to collectively as EMF, and have some common properties, there are important differences.

Electric Fields

Electric fields are produced when voltage is applied to electrical conductors or equipment. Electric fields are typically measured in units of volts per meter (V/m) or kilovolts per meter (kV/m), where 1,000 V/m is equal to 1 kV/m. Electric-field levels increase when the voltage increases but diminish quickly with distance. In addition, electric fields are effectively blocked by conductive objects, such as trees and buildings. So, electric fields from KEC and the switchyards will be effectively blocked by the substation fence.

Magnetic Fields

Magnetic fields are produced by the flow of electrical current. Magnetic fields are typically measured in units of Gauss (G) or milligauss (mG), where 1 G is equal to 1,000 mG. Since electricity generated by an electric power plant can vary over time depending on demand, the current (i.e., load) on transmission lines to which it connects can also vary and hence magnetic-field levels around these lines are not constant. Measurements represent the conditions at that particular location, at that particular moment—they can vary from day to night, from week to week, or month to month, depending on the demand on the power system. While magnetic-field levels are not constant over time at a particular location, similar to electric fields, they diminish rapidly with distance from the source. Unlike electric fields, however, magnetic fields are not easily blocked by conductive objects.

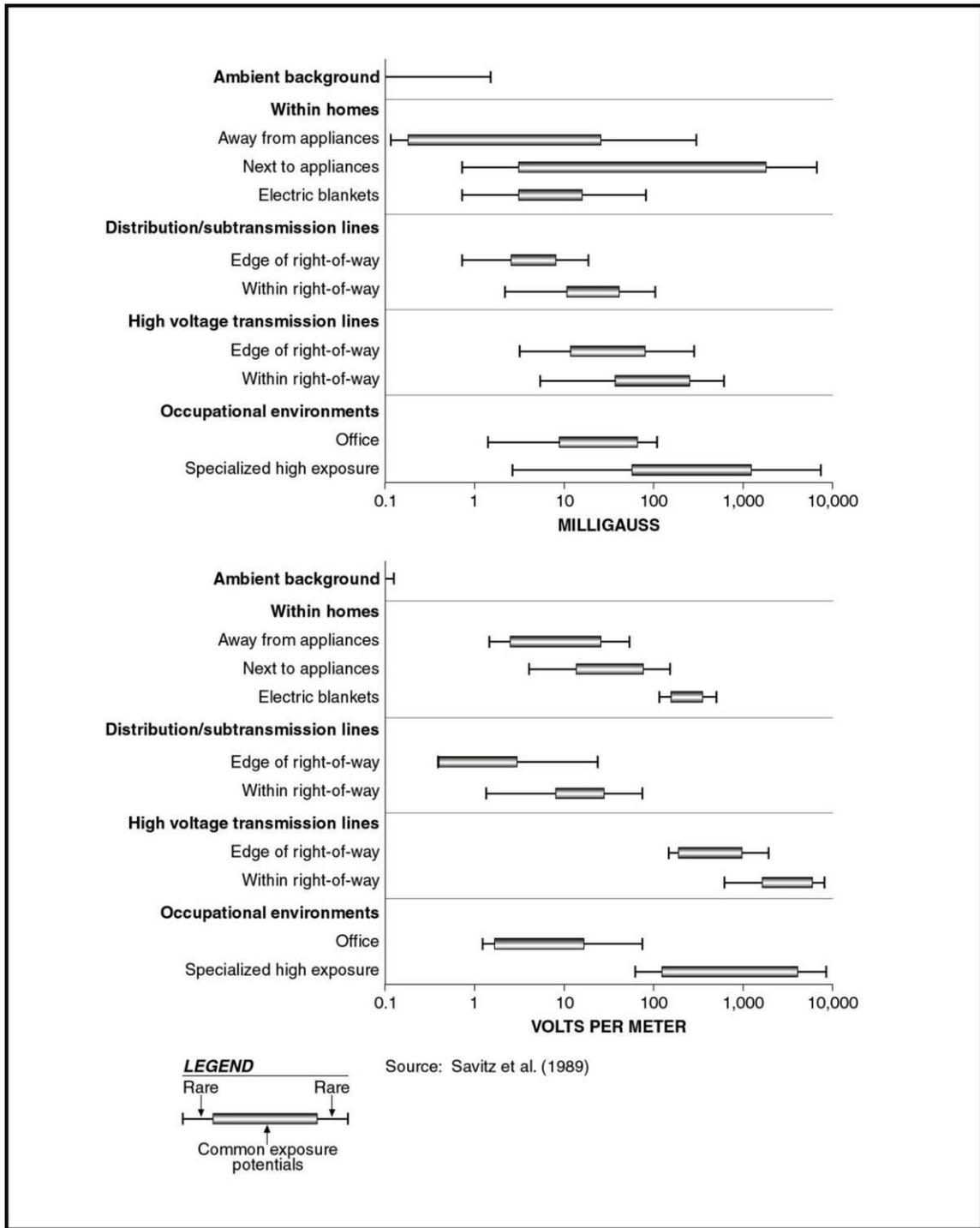


Figure 3. Electric- and magnetic-field levels in the environment.

Assessment Criteria

Certain assessment criteria are used when evaluating the levels of EMF, AN, and RN from transmission lines in order to verify that they are within the limits established to protect human health and safety and prevent disturbance to nearby land uses.

Electric and Magnetic Fields

In the United States, the federal government has not enacted standards for exposure to 60-Hz EMF produced by transmission lines. Several states, however, have statutes or guidelines that utilities must follow when siting new transmission lines, but these are not health-based. New York, for example, set a limit on magnetic-field levels of 200 mG at the edge of a right-of-way in 1990 after a survey of existing 345-kV transmission lines, so that field levels from new transmission lines do not exceed those of existing lines (NYPSC, 1990).

Other states have policies or guidelines for siting new transmission infrastructure that follow a no-cost/low-cost strategy to mitigate magnetic-field levels, but do not establish any limits on field levels. The Connecticut Siting Council (CSC) has developed the policy for the state which “advocate[s] the use of effective no-cost and low-cost technologies and management techniques on a project-specific basis to reduce MF exposure to the public while allowing for the development of efficient and cost-effective electrical transmission projects. This approach does not imply that MF [magnetic field] exposure will be lowered to any specific threshold or exposure limit...” (CSC, 2014, p. 4).

While no government agencies in the United States have established health-based exposure limits, two international scientific organizations have recommended exposure limits after conducting comprehensive reviews and evaluations of health research on exposure to EMF. The International Committee on Electromagnetic Safety (ICES), a committee of the Institute of Electrical and Electronics Engineers (IEEE), and the International Commission on Non-Ionizing Radiation (ICNIRP) have established exposure limit guidelines for EMF. The World Health

Organization has recommended that countries adopt these international guidelines (WHO, 2007).

Compliance with ICNIRP and ICES limits is determined by limiting the maximum electric field induced inside the body and is called the Basic Restriction (BR). The BRs for ICNIRP and ICES are provided in Table 1 in units of millivolts per meter (mV/m). The electric field inside the body is important because it is this parameter that can produce a biological effect via nerve and muscle stimulation at sufficiently high levels. Measurements of fields inside the body, however, are difficult to perform. Therefore, an exposure Reference Level (RL) is provided as screening values for comparison to measurements and calculations. Compliance with the RL guarantees compliance with the BR, however, in the case where the RL is exceeded then additional analysis is conducted in order to confirm compliance with the underlying BR. This is accomplished by mathematical modeling such as that described by Kavet et al. (2012) in which anatomically-correct models of the human body are used to assess what externally-applied electric or magnetic field would cause internal fields to equal the BR. The results indicate that far higher levels of electric fields will not exceed the BR.

A summary of all parameters is provided below in Table 1 including BR and RL levels from ICNIRP and ICES as well as equivalent EMF levels corresponding to BR levels as calculated by Kavet et al., (2012).

Table 1. Basic Restrictions on EMF exposure and corresponding Reference Levels

Parameter	Limit	Agency providing limit (year)
Basic Restriction (mV/m)	24.0	ICNIRP (2010)
	17.7*	ICES (2002)
Reference Level Electric Field (kV/m)	4.2	ICNIRP (2010)
	5.0 10.0 [†]	ICES (2002)
Reference Level Magnetic Field (mG)	2,000	ICNIRP (2010)
	9,040	ICES (2002)
Field Level Causing Tissue Exposure Equal to Basic Restriction [‡]		
Electric Field (kV/m)	36.4	Based upon ICNIRP (2010)
	26.8	Based upon ICES (2002)
Magnetic Field (mG)	12,400	Based upon ICNIRP (2010)
	9,150	Based upon ICES (2002)

* ICES limit for exposure in brain tissue. BR in other tissues (heart, extremities, other tissues) is higher.

[†] This is an exception within transmission line ROWs because people do not spend a substantial amount of time in ROWs, and very specific conditions are needed before a response is likely to occur (i.e., a person must be well insulated from ground and must contact a grounded conductor) (ICES, 2002, p. 27).

[‡] Calculated per Kavet et al. (2012).

In addition to health-based standards to protect from effects from high fields, there are also standards designed to prevent interference of electrical sources with active implanted medical devices such as pacemakers. The European Committee for Electrotechnical Standardization's EN 50527-1 Standard as well as American Standard ANSI/AAMI/ISO 14117:2012, reference ICNIRP limits and specify that the function of implanted medical devices should not be impaired at 60-Hz AC magnetic-field levels below 83.3 μ T (833 mG).¹ Due to the location of KEC, new EMF sources are limited to the crossing of Lake Road where members of the general public would encounter EMF for a small distance and where shielding from an automobile would limit exposure to electric fields to very low levels.

¹ European Committee for Electrotechnical Standardization (CENELEC). Procedure for the assessment of the exposure to electromagnetic fields of workers bearing active implantable medical devices - Part 1: General Std. EN 50527-1, April, 2010.

Corona Phenomena

Corona refers to a brief electrical discharge from the conductor where the electric field at a localized portion of the conductor's surface exceeds the breakdown strength of air. When this occurs the loss of energy and heat results in a small local pressure change that produces AN and RN. Corona discharges can be a source of both AN and RN, discussed below.

Audible Noise

The Connecticut Department of Energy & Environmental Protection (DEEP) noise control regulations (R.C.S.A. Section 22a-69-1 and following sections) prescribe noise limits along property boundaries according to the land use category, reflected by state zoning. For residential boundaries neighboring an industrial-zoned source, the daytime limit for AN is 61 dBA, while at night the limit is 51 dBA. The Killingly Noise Ordinance (Sec. 12.5-125) similarly specifies noise limits of 61 dBA for daytime and 51 dBA for nighttime.

Radio Noise

There are no federal or state regulations governing RN from transmission lines, but the IEEE provides guidance electric utility companies to follow to obtain acceptable RN performance. The IEEE Radio Noise Design Guide recommends a fair-weather RN level of 61 decibels above 1 microvolt per meter (dB μ V/m). This acceptable level is measured at a frequency of 500 kilohertz (kHz) and at a distance of 50 feet from the outside conductor or a transmission line (IEEE, 1971).¹

¹ The Radio Noise Design Guide used a 1 Megahertz measurement frequency, which was changed to 500 kHz by IEEE Standard 430-1986 to update the guideline to current methods of measurement and calculation (500 kHz with CISPR receiver).

Methods

Exponent performed calculations of EMF and corona phenomena for the project-related transmission facilities, using computer algorithms developed by the United States Department of Energy to evaluate the electrical performance of alternating-current transmission lines (BPA, 1991). The inputs to develop these calculations included data on voltage, current flow, and conductor configurations, all of which were provided by NTE and its contractors.

When calculating fields from transmission lines, simplifying assumptions about the nature of the transmission infrastructure are made regarding the physical and electrical properties of the transmission line; the goal is to yield conservative values that represent the highest field levels that may occur. The simplifying assumptions and conditions applied include an assumption that each conductor is infinite in length, parallel to all other conductors and located at a fixed height determined by minimum ground clearance.¹ In addition, an overvoltage condition of 5% is applied to calculate electric fields and corona phenomena. While these assumptions simplify the calculations, this model has been shown through measurements to accurately and conservatively predict levels of EMF and corona phenomena near transmission lines (IEEE Committee Report, 1982; Chartier and Dickson, 1990; Perrin et al., 1991; Olsen et al., 1992). Consistent with industry standards (IEEE Std. C95.3.1-2010 and IEEE Std. 644-2008,) EMF calculations are made at a standard height of 1 meter above ground.² Calculations of RN are also made at a receiving antenna height of 1 meter above ground and at a frequency of 500 kHz (in accordance with IEEE Std. 430-1986), while AN is calculated at 1.5 meters above ground.

Measurements of EMF from existing sources were performed on June 8, 2016, between the hours of 10 AM and 5 PM on the existing ROW, along Lake Road, and in the surrounding Killingly community, a summary of which is provided in Appendix C.

¹ There are variations in the transmission line clearance height above ground due to the sag of the transmission lines over variable-height terrain, but EMF levels beneath the transmission lines will be lower where the clearance of the lines above ground is higher.

² Values were reported as the root-mean-square value of the field in accordance with IEEE Std. C95.3.1-2010 and IEEE Std. 644-2008.

Loading

The CSC’s Electric and Magnetic Fields Best Management Practices (BMP) for the Construction of Electric Transmission Lines in Connecticut requires assessment of magnetic-field levels based upon line loadings for “pre and post project conditions, under: 1) peak load conditions at the time of application filing, and 2) projected seasonal maximum 24-hour average current load on the line anticipated within five years” of the operational in-service date.¹

The regional transmission system models used to generate the line loading were sourced from ISO-New England’s publicly available submission of Federal Energy Regulatory Commission (FERC) Form No. 715, Annual Transmission Planning and Evaluation Report, with conservative dispatch scenarios applied to the cases, in accordance with recommendations and consultation with system planning engineers from both ISO-New England and Eversource. In addition, a second layer of conservatism was applied to the cases by modeling the injection of the ISO-New England queue projects as of March 2016 with positions ahead of KEC that are within a 10-bus electrical radius of the project.

The loading data used for thermal capacity studies, with some modifications, were also made available to Exponent for use in modeling magnetic-field levels. Peak loading conditions were modeled as 100% of the projected 90/10 summer peak load for the New England Control Area and represents a load level that has a 10% probability of being exceeded due to variations in weather. These data are used to represent the annual peak load (APL) condition in modeling. Consistent with BMP recommendations, these loading estimates include the interconnecting transmission lines and include consideration of any already approved changes to the electrical system. Other modeling scenarios representative of the peak daily average load (PDAL) and annual average load (AAL) were not available, so are estimated here as 80% and 60% of the APL, respectively. As a further conservative assumption, the output of KEC was modeled at full capacity (550 MW) for all loading scenarios. The current flows used for modeling are available upon request subject to Critical Energy Infrastructure Information (CEII) restrictions.

¹ Connecticut Siting Council (CSC). Electric and Magnetic Fields Best Management Practices for the Construction of Transmission Lines in Connecticut (Revised February 20, 2014). New Britain, CT: Connecticut Siting Council, 2014, p. 6.

Results and Discussion

This section summarizes the EMF, AN, and RN levels calculated for each of the representative cross sections of the transmission line segments. The discussion focuses primarily on the anticipated AAL scenario. The results for PDAL and APL scenarios are included in appendices for reference. In addition, since the physical configuration of the transmission lines on the adjacent ROW will not change, electric-field, AN, and RN levels are not anticipated to change, so results are included only in the appendices.

Calculated profiles of EMF, AN, and RN along transects perpendicular to the ROW are shown in Figures A-1 through A-12 in Appendix A. Calculated EMF levels for all modeling cross sections are summarized in Table B-1 through Table B-4 in Appendix B.

Magnetic Fields

The new interconnection transmission line (Figure A-3 in Appendix A) crossing Lake Road will locally increase field levels at the public road crossing. Assuming that the interconnection will be carrying the full KEC load of 550 MW even under AAL conditions and using a ROW width of 150 feet, the magnetic-field level at (± 75 feet) will be 58 mG.¹

The magnetic-field level on the existing ROW is shown in Figures A-1 and A-2 in Appendix A. At PDAL and APL, magnetic-field levels in XS-1a and XS-1b increase somewhat for all loading conditions with the maximum increase in edge of ROW magnetic-field levels of 11 mG or less. The existing level of 7.9 mG is the same in both XS-1a and XS-1b and increases to approximately 15 mG in the proposed configuration for both XS-1a and XS-1b. These levels are similar to those encountered beneath distribution lines (see Figure 3). At 100 feet from the ROW edge, the magnetic field increase is less, increasing from approximately 1.1 mG to a

¹ As discussed above, the design of this short interconnection is not yet finalized and has, therefore, been conservatively modeled with a midspan conductor height of 26 feet, consistent with NESC requirements. If a greater conductor height is ultimately constructed (as is typical for road crossings), magnetic field levels will be less.

maximum of 4.1 mG. Under all loading scenarios and across all modeled cross sections, magnetic-field levels are a small fraction of ICNIRP and ICES reference levels.¹

Calculated magnetic-field levels at the edge of the ROW for all configurations are summarized in Table 2. Calculations of field levels out to ± 300 feet from the center of the ROW are shown in Appendix B, Table B-1 through Table B-3 (for AAL, PDAL, and APL).

Table 2. Summary of ROW edge magnetic field levels at AAL compared to ICNIRP and ICES recommended limits of 2,000 mG and 9,040 mG, respectively

Cross Section	Configuration	Magnetic Field (mG)	
		West/North ROW edge	East/South ROW edge
XS-1a	Existing	7.9	7.9
	Proposed	8.4	15
XS-1b	Existing	7.9	7.9
	Proposed	15	13
XS-2	Existing	N/A	N/A
	Proposed	58	58

Measurements of EMF from the existing transmission line ROW were performed on June 8, 2016. Magnetic-field levels of approximately 6 milligauss (mG) were measured at the edge of the ROW while electric-field levels were approximately 0.2 kilovolts per meter (kV/m). These field levels are less than modeled values both because the conductor height at the location of measurements was much greater than that modeled and, for magnetic fields, the loading on the lines at the time of measurements was likely less than average. A more extensive discussion of all EMF measurements is provided in Appendix C.

¹ Directly beneath the transmission line in all sections, magnetic-field levels are calculated to be higher. The calculated maximum magnetic-field level in XS-2 is 322 mG, also far below ICNIRP or ICES reference levels.

Electric Fields

The electric-field level at the edge of the assumed ± 75 feet ROW is calculated to be approximately 1.4 kV/m, well below either ICNIRP or ICES reference levels. As shown in Figure A-6 in Appendix A, directly beneath the transmission line the electric field is higher, approximately 7.8 kV/m.¹ Similar maximum electric-field levels are calculated in XS-1a and XS-1b. As described above, this is below the electric-field exposure of 36.4 kV/m that would equal the BR calculated using Kavet et al., (2012).

As discussed above, the physical configuration of XS-1a and XS-1b is not proposed to change as a result of this project and so no changes in electric-field levels are anticipated in these sections. Graphical results are shown in Figures A-4 and A-5 in Appendix A.

Calculated electric-field levels at the edge of the ROW for all configurations are summarized in Table 3. Calculations of field levels out to ± 300 feet from the center of the ROW are shown in Appendix B, Table B-4.

Table 3. Summary of ROW edge electric field levels

Cross Section	Configuration	Electric Field (kV/m)	
		West/North ROW edge	East/South ROW edge
XS-1a	Existing	0.7	1.2
	Proposed	0.7	1.2
XS-1b	Existing	0.7	1.2
	Proposed	0.7	1.2
XS-2	Existing	N/A	N/A
	Proposed	1.4	1.4

¹ As with magnetic field levels, if a greater conductor height is ultimately constructed (as is typical for road crossings), electric field levels will be less.

Corona Phenomena

Similar to the effects on electric fields, since the physical configuration of XS-1a and XS-1b is not proposed to change as a result of this project, AN and RN levels also will not change in these sections. Changes to AN and RN levels in XS-2 are discussed below.

Audible Noise

At the assumed ROW edge of ± 75 feet from the centerline in XS-2, the fair-weather AN level (Figure A-9 in Appendix A) is calculated to be 22 dBA, well below existing ambient noise levels as well as both the DEEP noise regulations and Killingly Noise Ordinance levels of 61 dBA (or 51 dBA at night). In foul weather, AN levels are calculated to be 25 dB higher, but additional noise sources that typically accompany foul weather (e.g., wind and rain) are themselves likely to generate ~41-63 dBA of AN and would likely mask the noise from the transmission lines during these conditions (Miller, 1978). Graphical results of AN levels are shown in Figures A-7 through A-9 in Appendix A for reference.

Radio Noise

RN levels are typically evaluated at a distance of 50 feet from the outermost transmission line conductor. In XS-2 fair weather RN levels (Figure A-12) are calculated to be approximately 44 dB μ V/m, far below the IEEE Radio Noise Design Guide RN level of 61 dB μ V/m for fair weather. In foul weather RN levels are calculated to be 17 dB higher but will still meet the IEEE guideline level. Graphical results of RN levels are shown in Figures A-10 through A-12 in Appendix A for reference.

Consistency with Connecticut Siting Council Best Management Practices

The calculations of EMF levels and the project design were evaluated for consistency with the CSC's EMF BMP for the permitting of new electric transmission lines. Additional consideration has been given to EMF topics addressed in the CSC's *Application Guide for an Electric and Fuel Transmission Line Facility* (2010) as well as to the CSC's *Application Guide for Electric Substation Facilities* (2010). Per these documents, Exponent has considered the requirements for the project to discuss potential effects of the short interconnection transmission line primarily KEC that will cross Lake Road. In addition, Exponent evaluated the effect of KEC operation on the magnetic fields of transmission lines on the adjacent Eversource ROW.

Calculations of EMF from the new interconnection between the KEC Plant Switchyard and the proposed Utility Switchyard, as well as for existing lines on the adjacent ROW are provided to compare the existing and proposed EMF levels in the project area. Measurements of existing EMF levels have also been performed. Further consistency with the EMF BMP is demonstrated by the following:

- The project line is sited such that there are no adjacent statutory facilities where children might congregate around KEC.
- NTE has followed the BMP in designing an interconnection that incorporates low cost/no cost measures to reduce magnetic fields using applicable “no-cost/low-cost designs that do not compromise system reliability or worker safety, or environmental and aesthetic project goals.”¹ The principal actions that minimize potential exposure to EMF are project location, distance and line voltage.
 - **Siting and Distance:** KEC selected the location immediately adjacent to an existing utility ROW such that the need for new transmission lines is minimized and, except

¹ Connecticut Siting Council (CSC). *Electric and Magnetic Fields Best Management Practices for the Construction of Transmission Lines in Connecticut* (Revised February 20, 2014). New Britain, CT: Connecticut Siting Council, 2014, p. 6.

for the crossing of Lake Road, all new sources of magnetic fields are on NTE property.

- **Increased Voltage:** the voltage of the proposed line is 345-kV, which will reduce magnetic-field levels from the line relative to other interconnection options (e.g., 115 kV.)¹
- **No new ROW:** In addition to specific BMP recommendations, the construction of KEC immediately adjacent to an existing ROW means that no new transmission line ROW must be acquired and will therefore limit the extent to which EMF-related changes will occur. The only new transmission line will be constructed primarily on KEC property and, therefore, will also not require any new ROW.

¹ Power is the product of current and voltage ($P = I \cdot V$). To deliver a fixed amount of power (e.g., 550 MW), the current required will decrease with increasing voltage. Since magnetic-field levels are proportional to the current flowing on a transmission line, an increase in voltage lowers the current flow required and so decreases the magnetic field.

Conclusions

The calculated EMF levels associated with the operation of the proposed interconnection and the existing transmission lines are well below exposure limits recommended by international scientific organizations that were developed to protect health and safety. In addition, the calculated levels of AN from these lines meet both the DEEP noise regulations and Killingly Noise Ordinance levels and the project will comply with industry guidelines for radio interference from transmission lines.

Constructing KEC immediately adjacent an existing ROW limits the need for new transmission lines, and injecting the generated power onto an existing 345-kV transmission line means that electric field, AN, and RN levels on or near the ROW will not change as a result of this project. The additional power flow on the transmission line will increase magnetic-field levels on the ROW, but because the 3172 transmission line is near the center of the ROW, the change in magnetic-field level at the ROW edge and beyond is minimized and small.

KEC has applied practices consistent with the CSC's BMP and Application Guides for substations and transmission lines applying "no-cost/low-cost designs that do not compromise system reliability or worker safety, or environmental and aesthetic project goals."

Notice

At the request of NTE Connecticut, LLC (NTE), Exponent modeled the EMF, AN, and RN associated with changes to transmission infrastructure associated with the proposed combined cycle electric generating plant in Killingly, Connecticut. This report summarizes work performed to date and presents the findings resulting from that work. In the analysis, we have relied on geometry, material data, usage conditions, specifications, and various other types of information provided by NTE and third- party consultants. The opinions and comments formulated during this assessment are based upon these data. NTE has confirmed to Exponent that the summary of data provided to Exponent contained herein is not subject to Critical Energy Infrastructure Information restrictions. Although Exponent has exercised usual and customary care in the conduct of this analysis, the responsibility for the design and operation of the project remains fully with the client.

The findings presented herein are made to a reasonable degree of engineering and scientific certainty. Exponent reserves the right to supplement this report and to expand or modify opinions based on review of additional material as it becomes available, through any additional work, or review of additional work performed by others.

The scope of services performed during this investigation may not adequately address the needs of other users of this report beyond the CSC permitting process for which it was prepared, and any re-use of this report or its findings, conclusions, or recommendations presented herein other than for CSC permitting of this project are at the sole risk of the user. The opinions and comments formulated during this assessment are based on observations and information available at the time of the investigation. No guarantee or warranty as to future life or performance of any reviewed condition is expressed or implied.

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Appendix A

Graphical Results

AC Magnetic Field Cross Section XS-1a

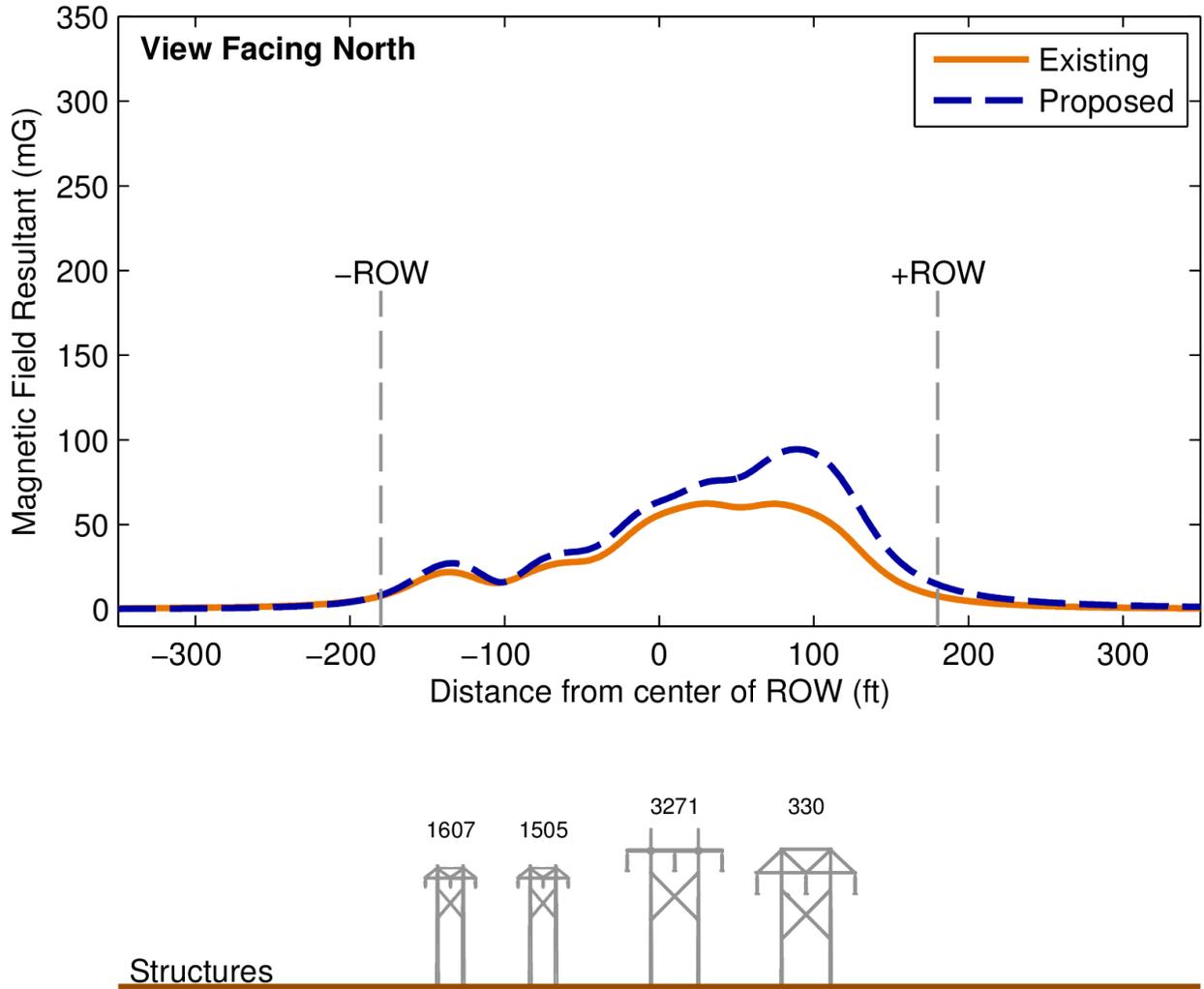


Figure A-1. Calculated magnetic-field levels at AAL for XS-1a.

AC Magnetic Field Cross Section XS-1b

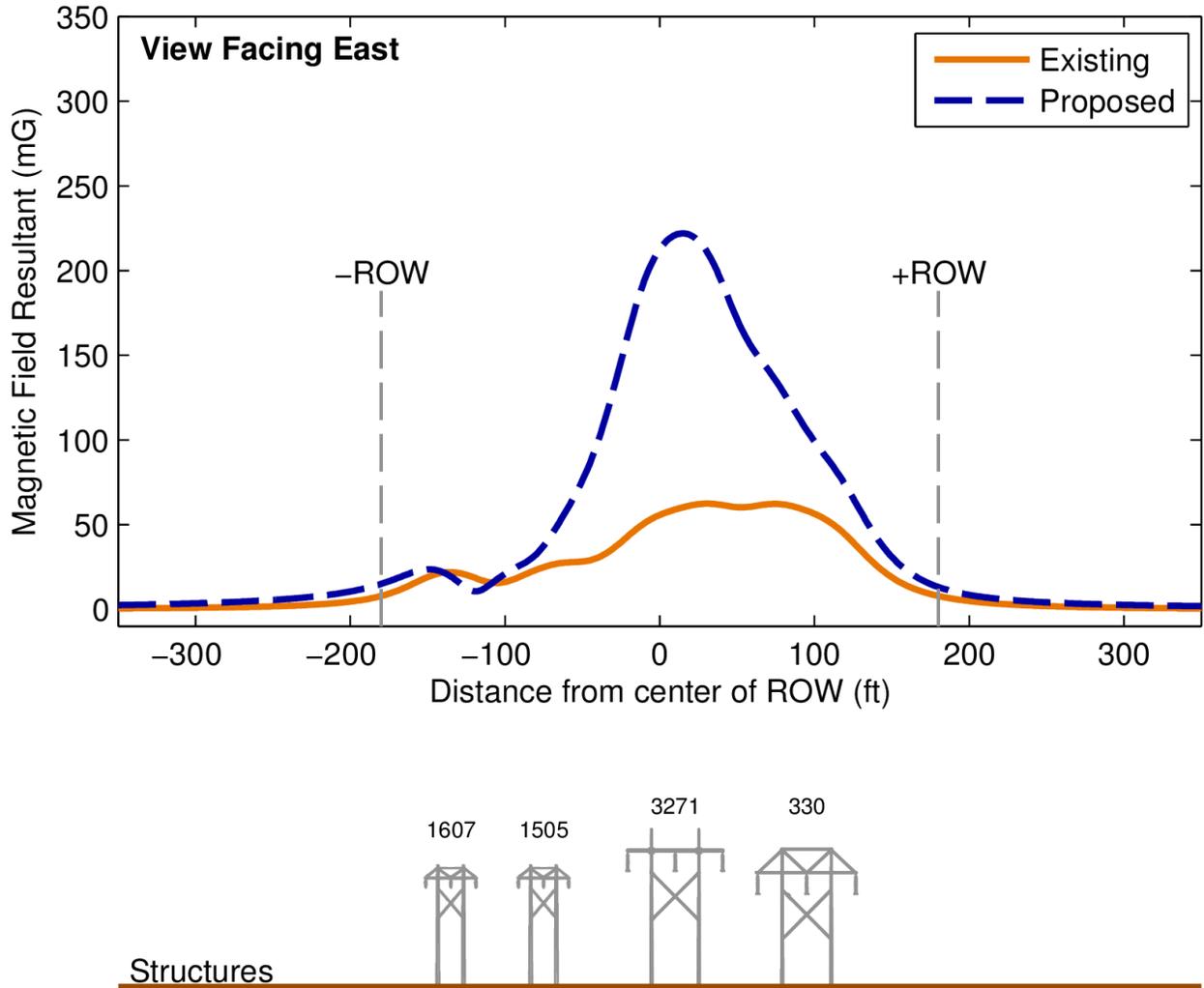


Figure A-2. Calculated magnetic-field levels at AAL for XS-1b.

AC Magnetic Field Cross Section XS-2

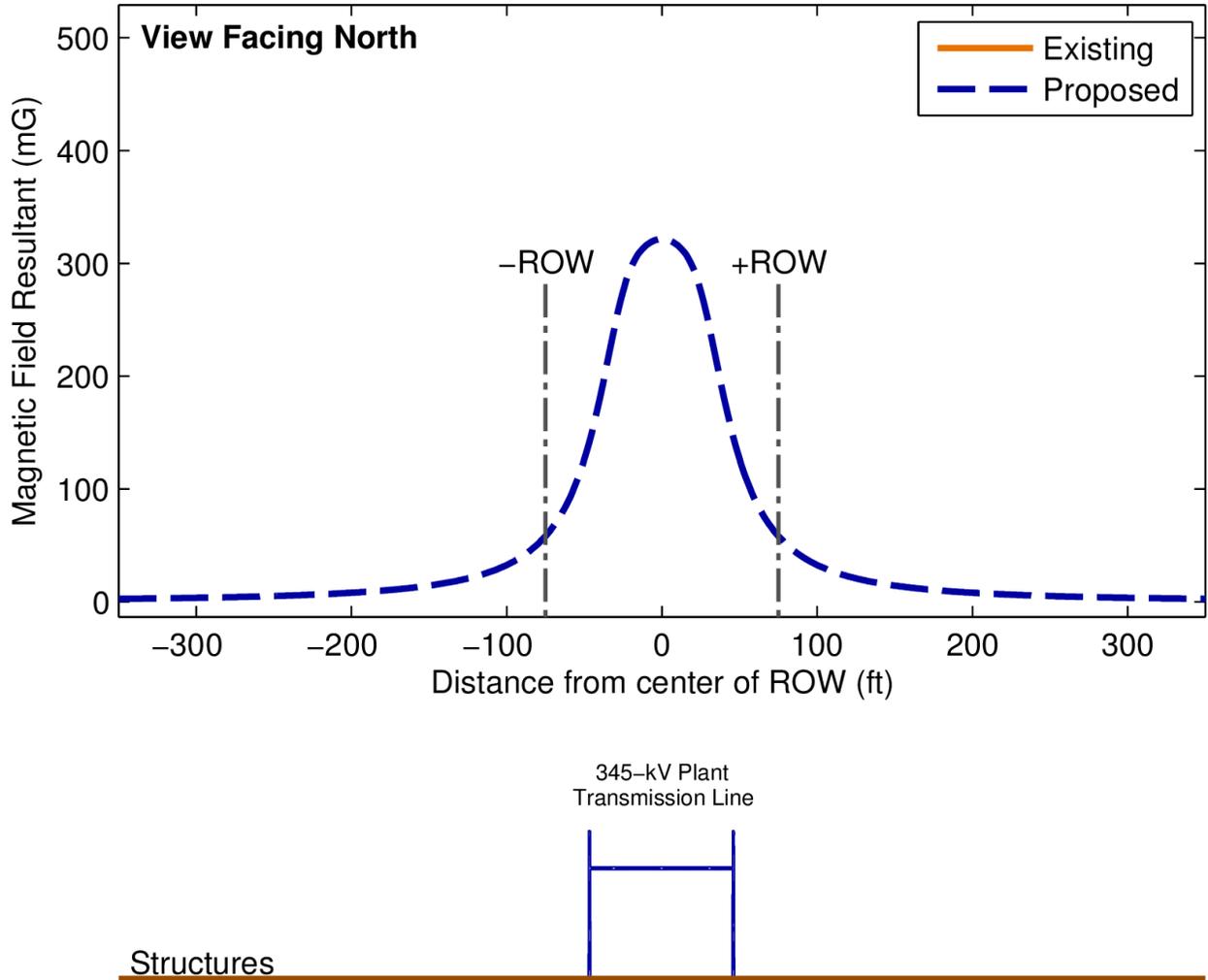


Figure A-3. Calculated magnetic-field levels at KEC capacity of 550 MW for XS-2.

**AC Electric Field
 Cross Section XS-1a**

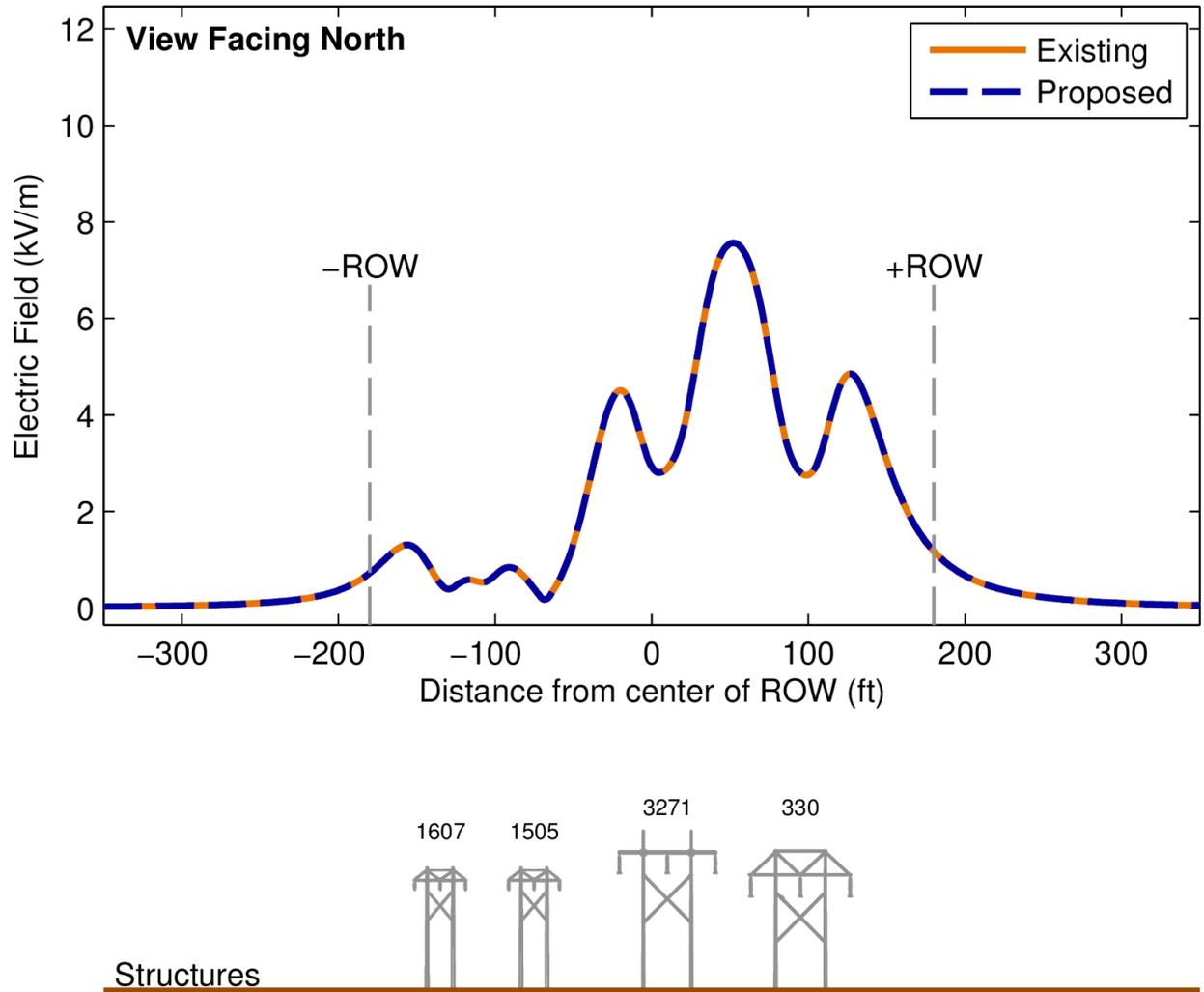


Figure A-4. Calculated electric-field levels in XS-1a.

AC Electric Field Cross Section XS-1b

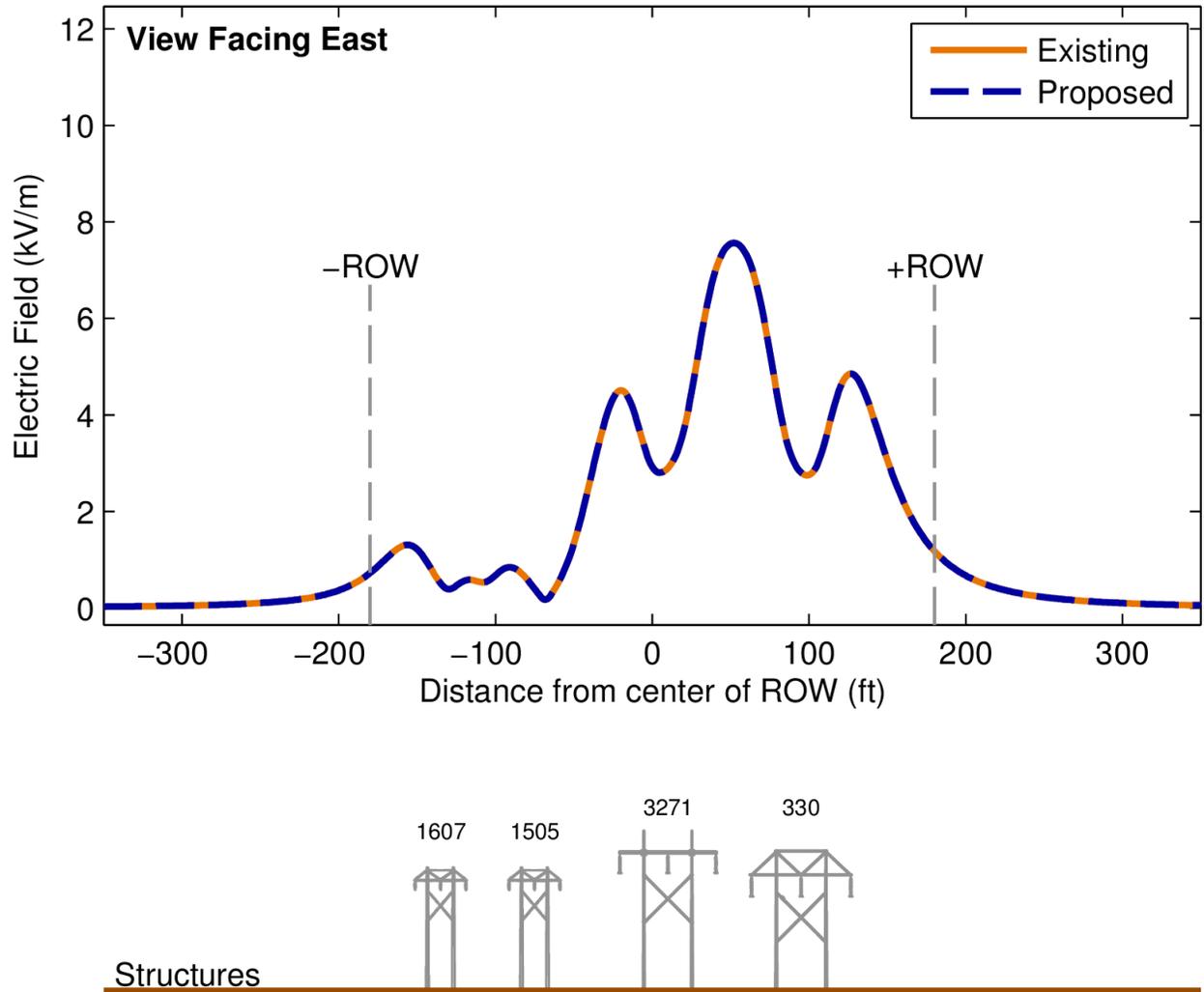


Figure A-5. Calculated electric-field levels in XS-1b.

AC Electric Field Cross Section XS-2

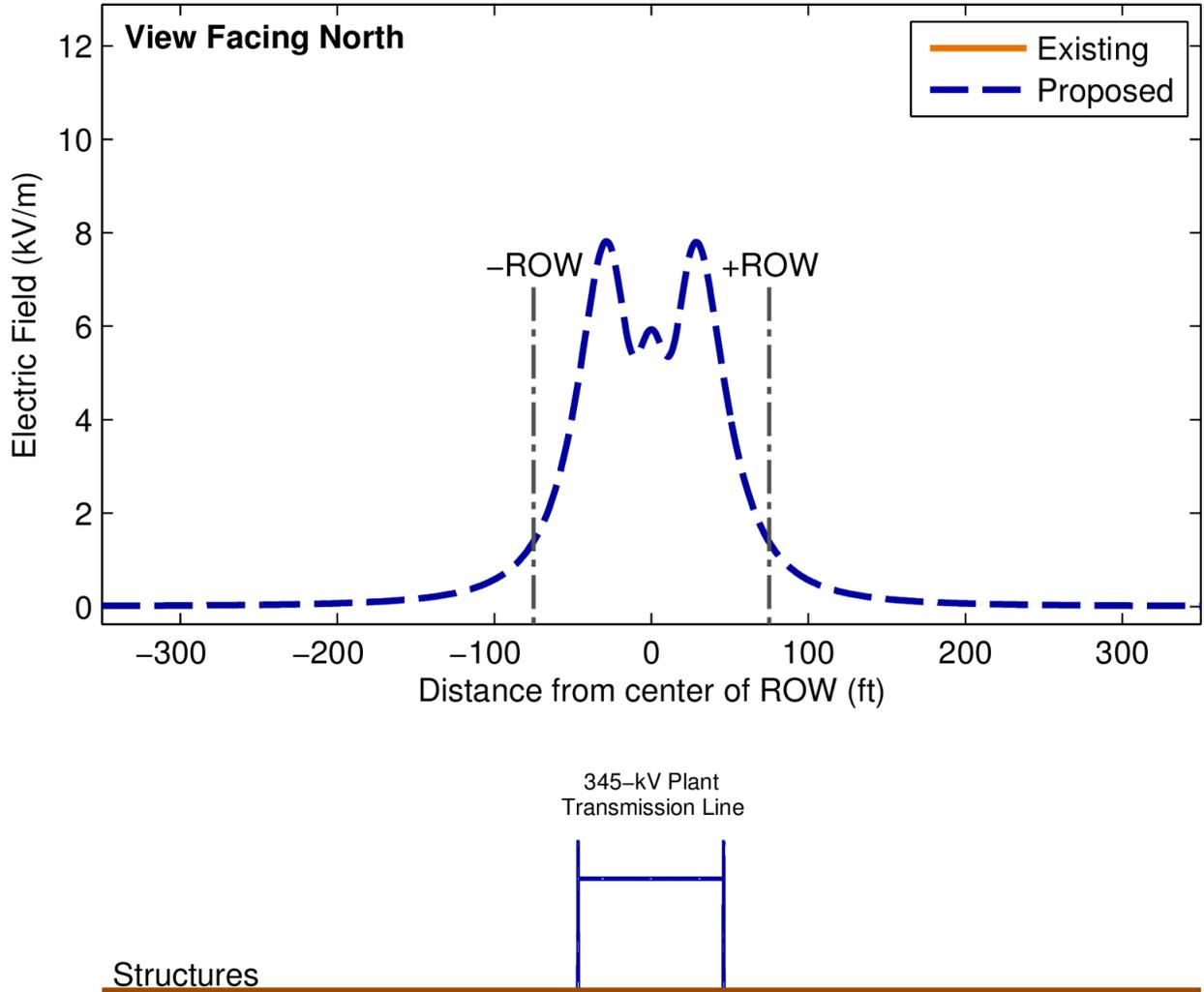


Figure A-6. Calculated electric-field levels in XS-2.

Audible Noise Cross Section XS-1a

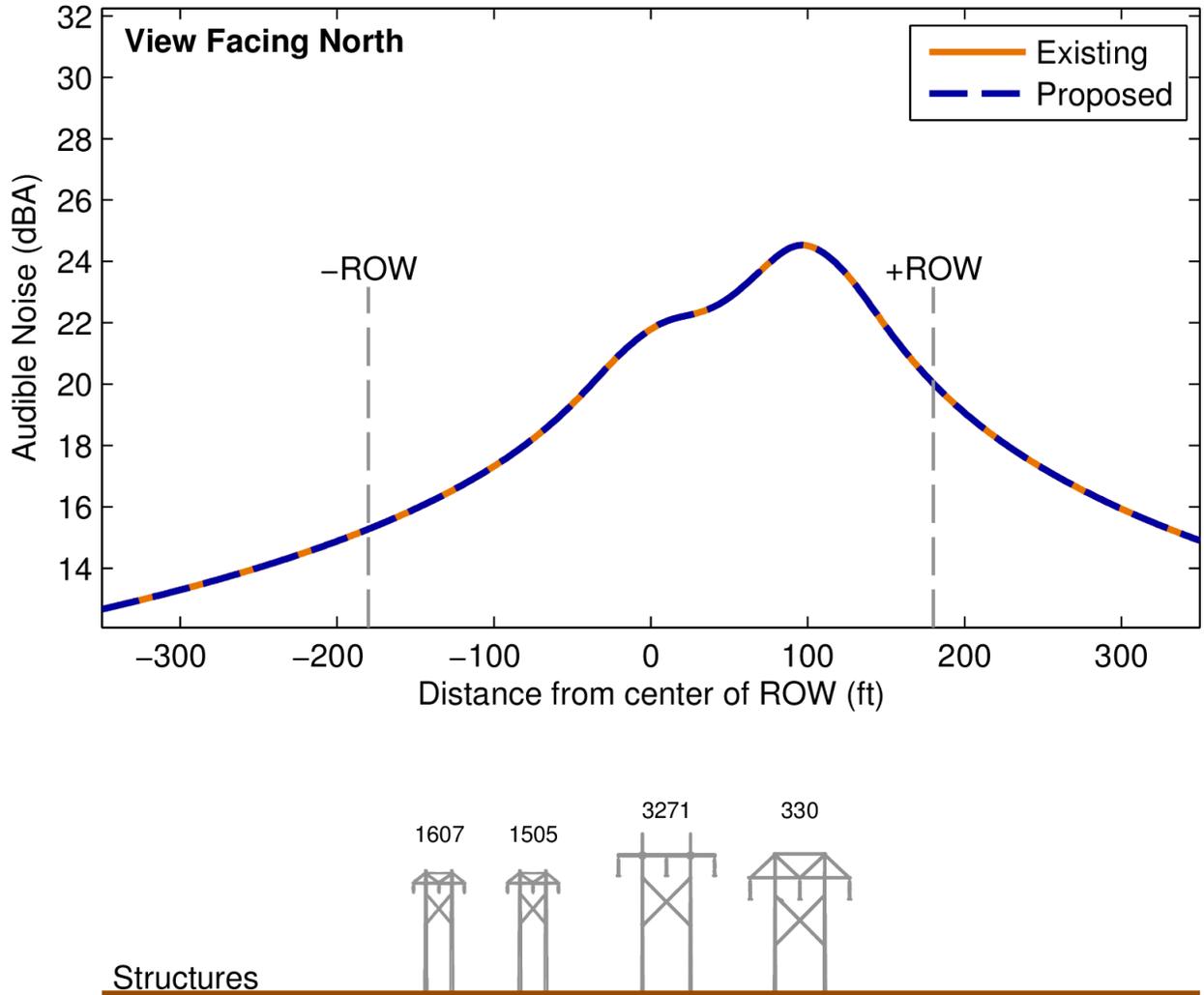


Figure A-7. Calculated fair weather AN levels in XS-1a.

Audible Noise Cross Section XS-1b

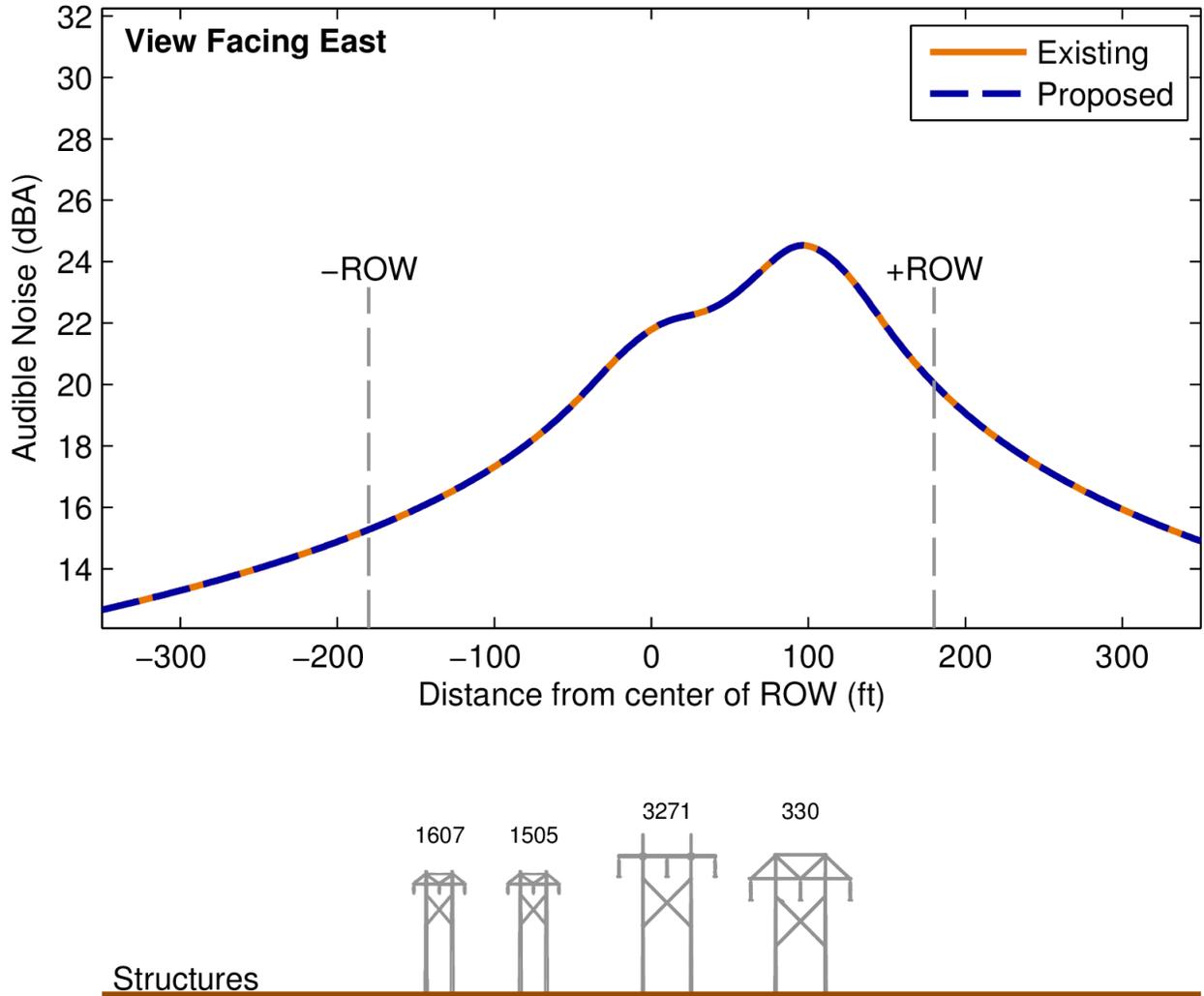


Figure A-8. Calculated fair weather AN levels in XS-1b.

Audible Noise Cross Section XS-2

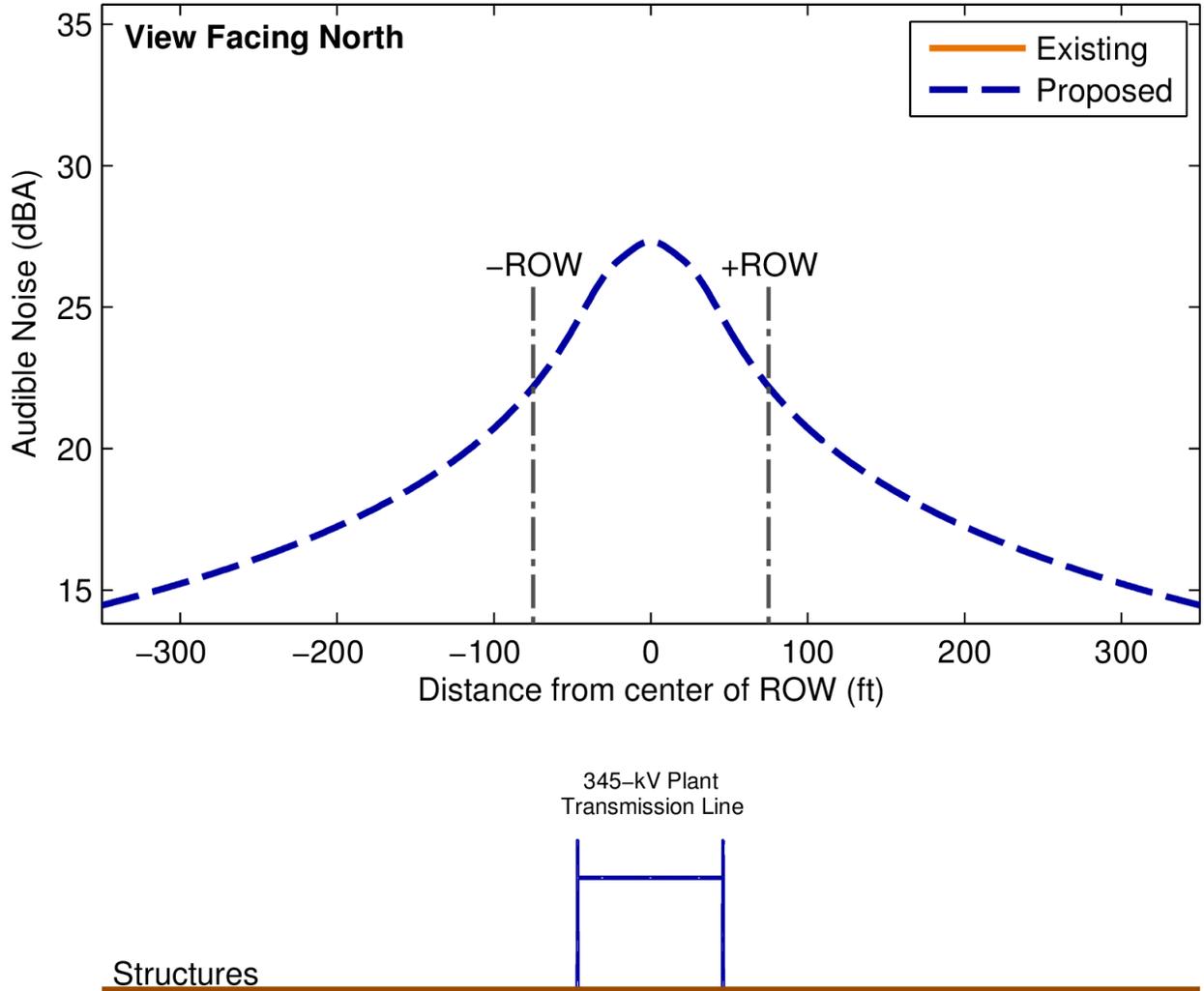


Figure A-9. Calculated fair weather AN levels in XS-2.

Radio Noise Cross Section XS-1a

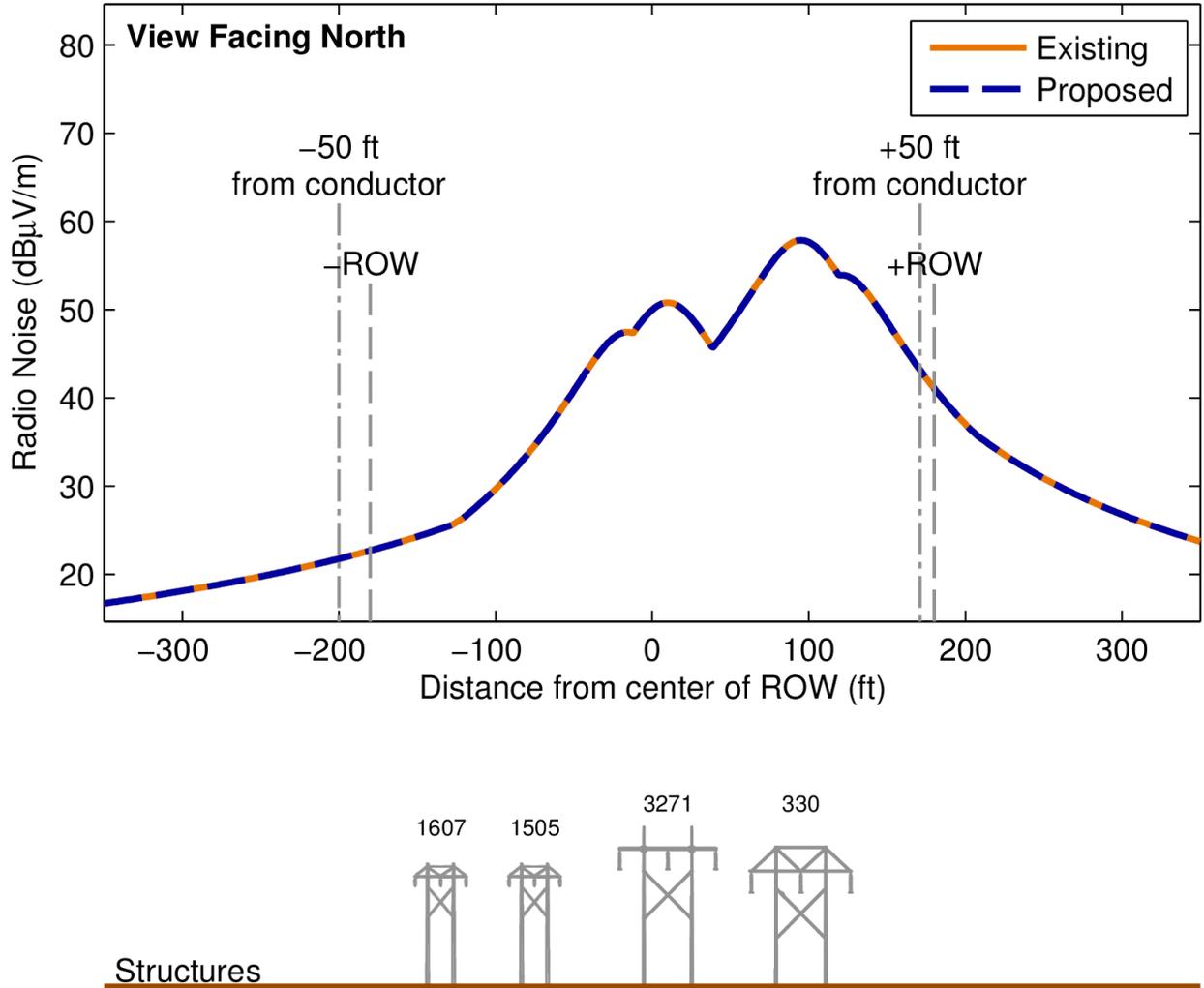


Figure A-10. Calculated fair weather RN levels in XS-1a.

Radio Noise Cross Section XS-1b

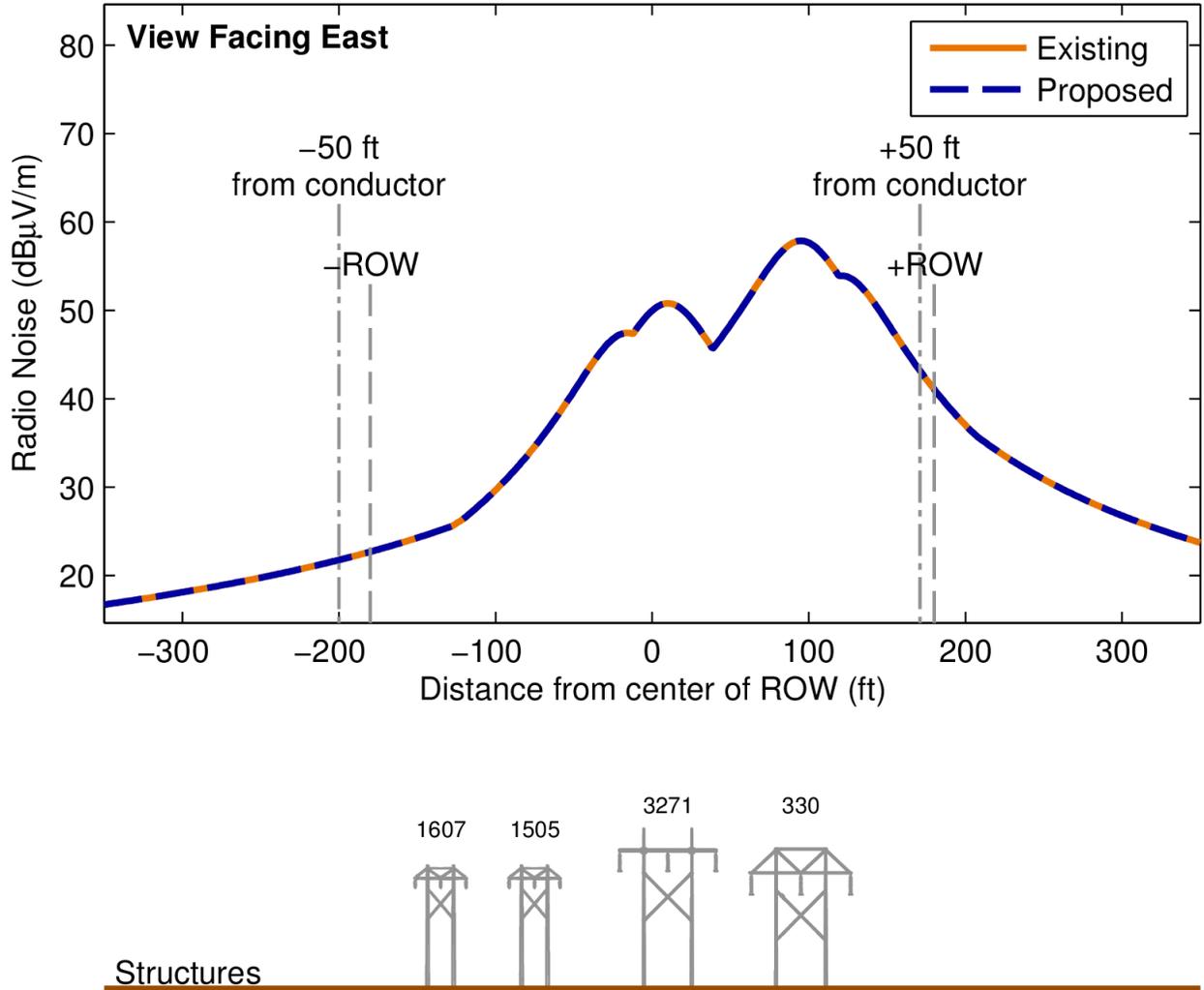


Figure A-11. Calculated fair weather RN levels in XS-1a.

Radio Noise Cross Section XS-2

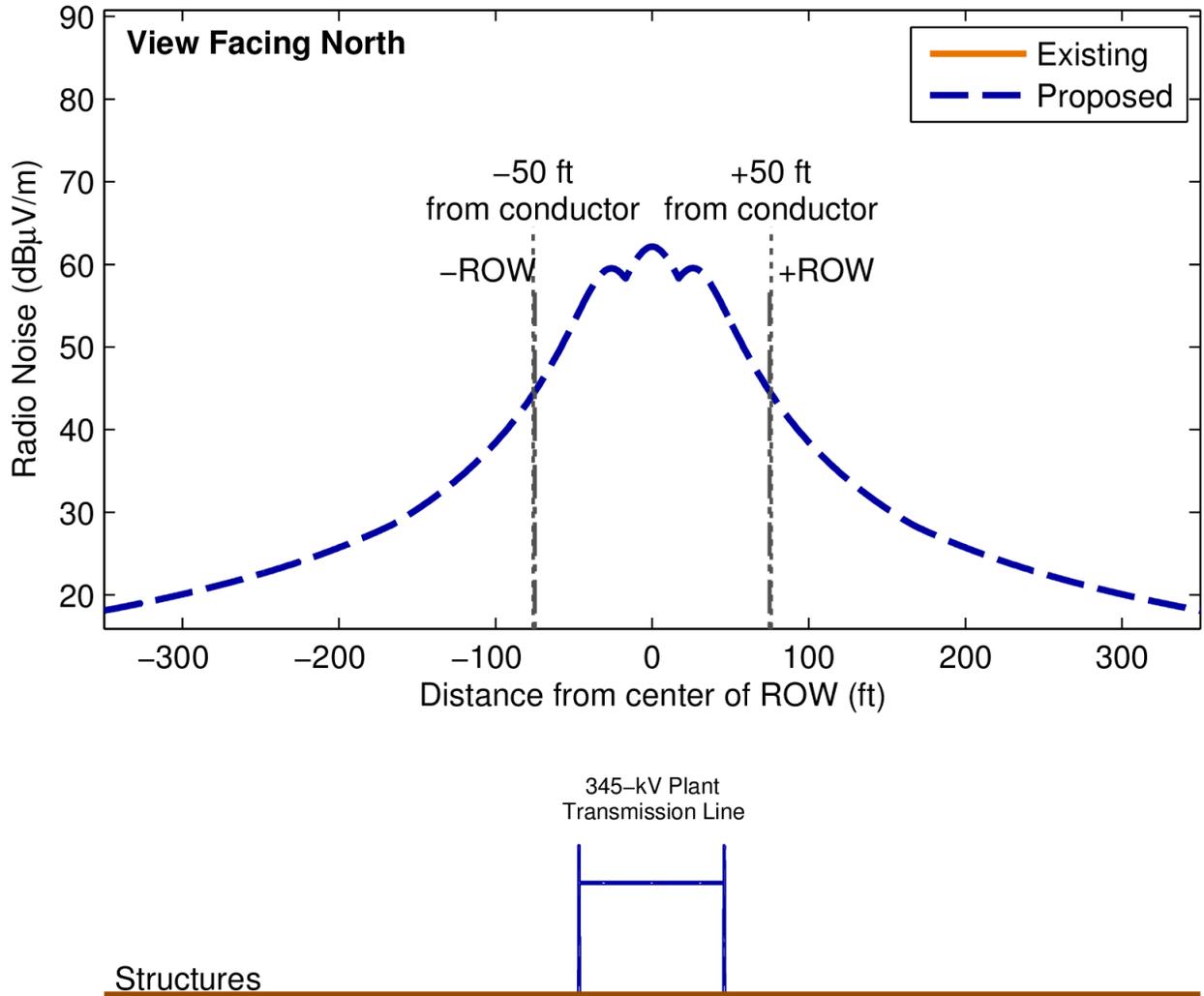


Figure A-12. Calculated fair weather RN levels in XS-2.

Appendix B

Tabular Results

Table B-1. Magnetic field (mG) at distances relative to the ROW centerline at AAL

Cross Section	Configuration	-300 ft	-275 ft	-250 ft	-225 ft	-200 ft	-175 ft	-150 ft	-125 ft	-100 ft	-75 ft	-50 ft	-25 ft	0 ft	25 ft	50 ft	75 ft	100 ft	125 ft	150 ft	175 ft	200 ft	225 ft	250 ft	275 ft	300 ft	-ROW edge	+ ROW edge
XS-1a	Existing	0.9	1.2	1.7	2.6	4.5	9.2	19	20	16	25	28	40	56	62	60	62	56	40	19	9.0	4.9	2.9	1.9	1.3	0.9	7.9	7.9
XS-1a	Proposed	0.5	0.8	1.2	2.1	4.3	10	23	26	16	30	34	48	64	73	77	91	92	67	33	17	9.5	6.0	4.1	3.0	2.3	8.4	15
XS-1b	Existing	0.9	1.2	1.7	2.6	4.5	9.2	19	20	16	25	28	40	56	62	60	62	56	40	19	9.0	4.9	2.9	1.9	1.3	0.9	7.9	7.9
XS-1b	Proposed	3.5	4.3	5.5	7.3	11	17	24	13	21	38	76	147	213	218	171	135	99	66	31	15	8.5	5.6	4.1	3.2	2.6	15	13
XS-2	Existing	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	n/a	n/a								
XS-2	Proposed	3.6	4.2	5.1	6.4	8.1	11	14	21	33	58	127	276	322	276	127	58	33	21	14	11	8.1	6.4	5.1	4.2	3.6	58	58

Table B-2. Magnetic field (mG) at distances relative to the ROW centerline at PDAL

Cross Section	Configuration	-300 ft	-275 ft	-250 ft	-225 ft	-200 ft	-175 ft	-150 ft	-125 ft	-100 ft	-75 ft	-50 ft	-25 ft	0 ft	25 ft	50 ft	75 ft	100 ft	125 ft	150 ft	175 ft	200 ft	225 ft	250 ft	275 ft	300 ft	-ROW edge	+ ROW edge
XS-1a	Existing	1.2	1.6	2.3	3.5	6.0	12	25	27	21	33	38	53	74	83	80	83	75	53	25	12	6.5	3.9	2.5	1.7	1.2	10	11
XS-1a	Proposed	0.7	1.0	1.6	2.9	5.7	13	30	34	22	40	46	64	85	98	103	121	123	89	44	22	13	8.0	5.5	4.0	3.0	11	20
XS-1b	Existing	1.2	1.6	2.3	3.5	6.0	12	25	27	21	33	38	53	74	83	80	83	75	53	25	12	6.5	3.9	2.5	1.7	1.2	10	11
XS-1b	Proposed	3.6	4.5	5.8	7.9	12	20	30	20	22	41	79	150	219	228	190	163	128	87	41	19	11	6.5	4.4	3.3	2.5	17	17
XS-2	Existing	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
XS-2	Proposed	3.6	4.2	5.1	6.4	8.1	11	14	21	33	58	127	276	322	276	127	58	33	21	14	11	8.1	6.4	5.1	4.2	3.6	58	58

Table B-3. Magnetic field (mG) at distances relative to the ROW centerline at APL

Cross Section	Configuration	-300 ft	-275 ft	-250 ft	-225 ft	-200 ft	-175 ft	-150 ft	-125 ft	-100 ft	-75 ft	-50 ft	-25 ft	0 ft	25 ft	50 ft	75 ft	100 ft	125 ft	150 ft	175 ft	200 ft	225 ft	250 ft	275 ft	300 ft	-ROW edge	+ ROW edge
XS-1a	Existing	1.5	2.0	2.9	4.4	7.5	15	32	34	27	41	47	66	93	103	101	104	94	66	31	15	8.1	4.8	3.1	2.1	1.5	13	13
XS-1a	Proposed	0.8	1.3	2.0	3.6	7.2	17	38	43	27	50	57	80	106	122	129	152	154	111	55	28	16	10	6.9	5.0	3.8	14	24
XS-1b	Existing	1.5	2.0	2.9	4.4	7.5	15	32	34	27	41	47	66	93	103	101	104	94	66	31	15	8.1	4.8	3.1	2.1	1.5	13	13
XS-1b	Proposed	3.6	4.6	6.1	8.5	13	23	37	28	24	47	84	154	227	241	210	191	158	108	51	24	13	7.8	5.1	3.6	2.7	20	21
XS-2	Existing	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
XS-2	Proposed	3.6	4.2	5.1	6.4	8.1	11	14	21	33	58	127	276	322	276	127	58	33	21	14	11	8.1	6.4	5.1	4.2	3.6	58	58

Table B-4. Electric field (kV/m) at distances relative to the ROW centerline

Cross Section	Configuration	-300 ft	-275 ft	-250 ft	-225 ft	-200 ft	-175 ft	-150 ft	-125 ft	-100 ft	-75 ft	-50 ft	-25 ft	0 ft	25 ft	50 ft	75 ft	100 ft	125 ft	150 ft	175 ft	200 ft	225 ft	250 ft	275 ft	300 ft	-ROW edge	+ ROW edge
XS-1a	Existing	0.0	0.1	0.1	0.2	0.4	0.9	1.2	0.5	0.7	0.4	1.3	4.3	2.9	4.5	7.5	5.3	2.8	4.8	3.1	1.4	0.7	0.4	0.2	0.1	0.1	0.7	1.2
XS-1a	Proposed	0.0	0.1	0.1	0.2	0.4	0.9	1.2	0.5	0.7	0.4	1.3	4.3	2.9	4.5	7.5	5.3	2.8	4.8	3.1	1.4	0.7	0.4	0.2	0.1	0.1	0.7	1.2
XS-1b	Existing	0.0	0.1	0.1	0.2	0.4	0.9	1.2	0.5	0.7	0.4	1.3	4.3	2.9	4.5	7.5	5.3	2.8	4.8	3.1	1.4	0.7	0.4	0.2	0.1	0.1	0.7	1.2
XS-1b	Proposed	0.0	0.1	0.1	0.2	0.4	0.9	1.2	0.5	0.7	0.4	1.3	4.3	2.9	4.5	7.5	5.3	2.8	4.8	3.1	1.4	0.7	0.4	0.2	0.1	0.1	0.7	1.2
XS-2	Existing	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
XS-2	Proposed	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.6	1.4	4.1	7.6	5.9	7.6	4.1	1.4	0.6	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	1.4	1.4

Appendix C

Measurements

Measurements

Consistent with the CSC's EMF BMP (CSC, 2014) and application guides for transmission and substation facilities (discussed above), Exponent performed measurements of "existing electric and magnetic fields (EMF) at site boundaries, and at boundaries of adjacent schools, daycare facilities, playgrounds, and hospitals." These measurements of existing sources were performed on June 8, 2016, between the hours of 10 AM and 5 PM.

Measurement Locations

The dominant source of EMF in the vicinity of the project are the transmission lines on the adjacent ROW. Measurements of both electric fields and magnetic fields were, therefore, performed along a transect perpendicular to the transmission lines on the accessible portion of the ROW that crosses Lake Road. The detailed configuration of the transmission lines at the time and location of measurements were recorded (including conductor height above ground) in order to extrapolate measurements to exposure levels during expected normal and peak normal line loading. The measurement path on the ROW on Lake Road is shown in Figure C-1. Corresponding electric field and magnetic field measurements are shown in Figure C-4 and Figure C-5, respectively.

EMF measurements were also performed away from the ROW, at locations consistent with the CSC Application Guides for transmission and substation facilities. No schools, daycare facilities, playgrounds, or hospitals were identified adjacent to the site, so no measurements were made at such locations. EMF measurements were, however, performed along the accessible portions of the KEC site on Lake Road. The measurement path along Lake Road is shown in Figure C- 2 along with the measured magnetic-field data (inset).

To provide additional context for the levels of magnetic fields encountered in the vicinity of KEC, additional measurements were made throughout the nearby community. For these measurements the magnetic-field meter was worn at the waist to serve as a proxy for exposure at the body during daily activities. The location of measurements (recorded using a hand-held GPS) is shown Figure C-3 along with the measured magnetic-field data (inset).



Figure C-1. Location of electric (E-Field) and magnetic (B-Field) measurements on existing ROW.

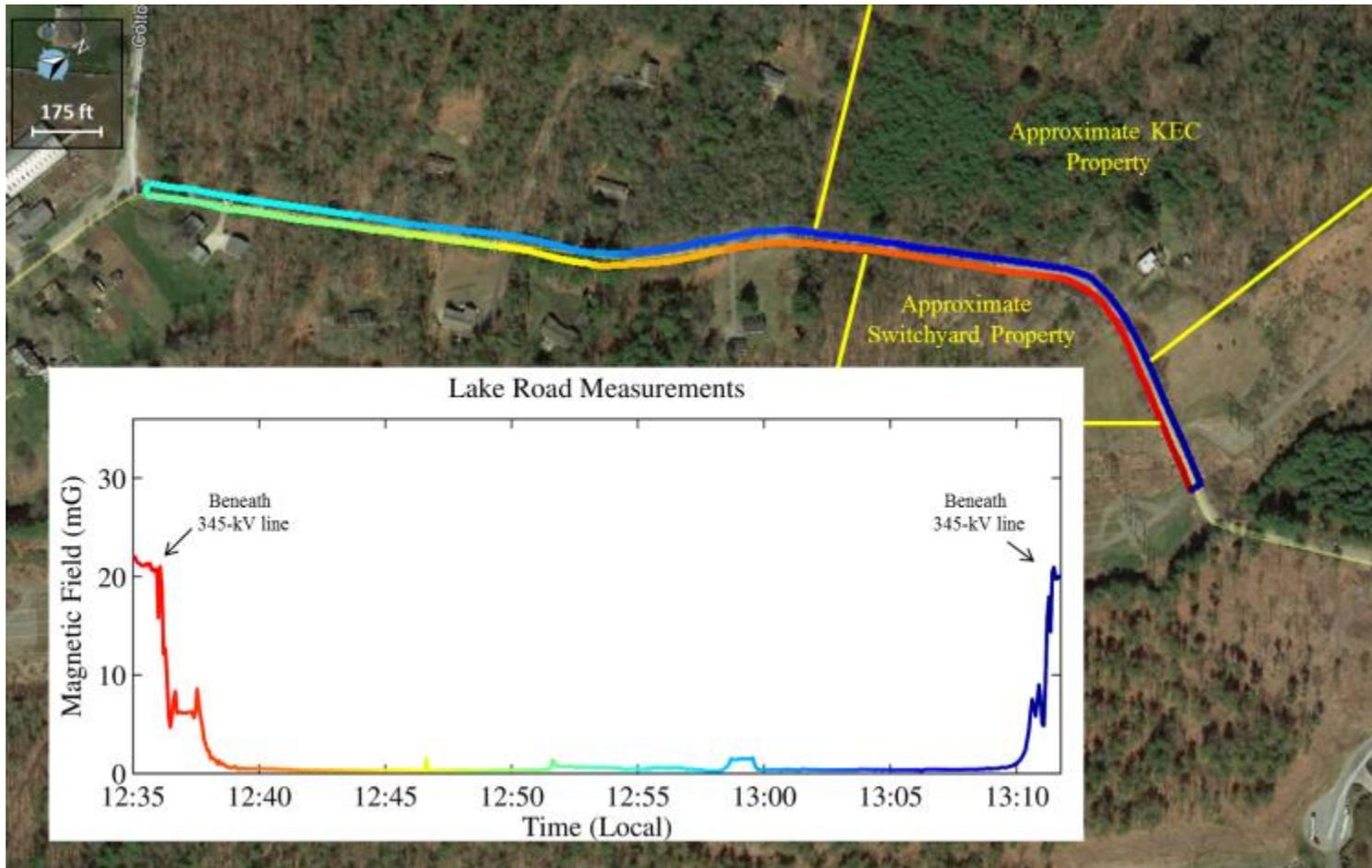


Figure C-2. Path of measurements performed along Lake Road.

The color of the path corresponds to time. The measurement path began at approximately 12:35 (shown in dark red) on the Eversource ROW and proceeded on the south side of Lake Road to the intersection of Lake Road with Cottons Bridge Road. Measurements were then performed on the north side of Lake Road back to the original location which finished at 13:15 (shown in dark blue). Corresponding magnetic field data (inset) is similarly color-coded with time.

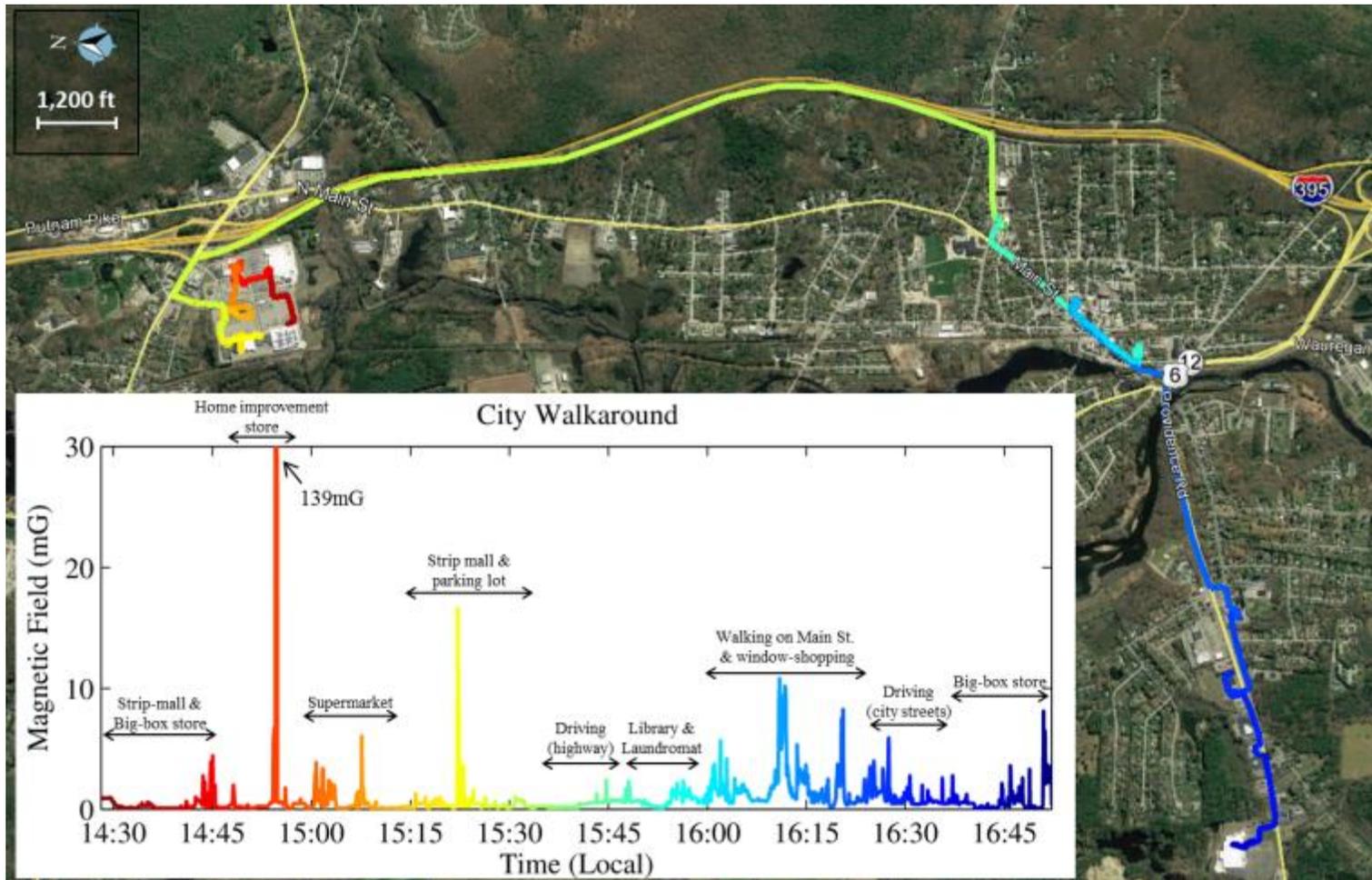


Figure C-3. Location of measurements performed in the nearby community.

Similar to Figure C-2, the color of the path corresponds to time. Measurements began at 14:25 (shown in red) and finished at approximately 16:40 (shown in blue). Corresponding magnetic-field data (inset) is similarly color-coded with time.

Measurement Methods

All measurements on the transmission line ROW, along Lake Road, and on the city walkthrough were taken at a height of 1 meter (3.28 feet) above ground in accordance with the CSC BMP recommendation and standard methods for measuring near power lines.¹² Measurements of both magnetic fields and electric fields (where applicable) were performed along three orthogonal axes and results are reported below as the total field computed as the resultant of field vectors measured.¹³ The magnetic field was measured in units of mG by three orthogonally mounted sensing coils whose output was logged by a digital recording meter (EMDEX II or EMDEX LITE) manufactured by Enertech Consultants. The electric field was measured in units of kV/m with a single-axis field sensor (oriented sequentially along each of the three orthogonal axes) and the output was logged by the same EMDEX II meter manufactured by Enertech Consultants. These instruments meet the IEEE instrumentation standard for obtaining accurate field measurements at power line frequencies.¹⁴ The meters were calibrated by the manufacturer by methods like those described in IEEE Std. 644-1994 R2008.¹⁵ Calibration certificates are shown in Appendix D.

¹² Institute of Electrical and Electronics Engineers (IEEE). IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines (ANSI/IEEE Std. 644-2008). New York: IEEE, 2008.

¹³ Measurements along the vertical, transverse, and longitudinal axes were recorded as root-mean-square magnitudes. Root mean square refers to the common mathematical method of defining the effective voltage, current, or field of an AC system.

¹⁴ Institute of Electrical and Electronics Engineers (IEEE). IEEE Recommended Practice for Instrumentation: Specifications for Magnetic Flux Density and Electric Field Strength Meters – 10 Hz to 3 kHz (IEEE Std. 1308-1994). New York: IEEE, 1994.

¹⁵ “IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines.” (IEEE Std. 644-1994 R2008) New York: IEEE, 1994.

Results and Discussion

Transmission Line ROW Measurements

As shown in Figure C-1, a survey of the magnetic-field levels on the existing ROW was performed along a single transect following the southern side of Lake Road. Similarly, electric-field levels were measured at spot locations along the same path (shown by green circles on the ROW). Measurements were not performed across the entire ROW because the road curved off the ROW prior to reaching the eastern ROW edge and so some locations were inaccessible due to abrupt changes in terrain and dense brush which precluded meaningful measurements. In addition to EMF measurements, Exponent also recorded the horizontal conductor location (relative to one another) as well as the conductor line height at the location of measurements using an acoustic line height meter. These data were then used to create an as-built model of the EMF levels against which to evaluate the efficacy of the modeling approach and the validity of modeling methodology. The results of these modeling efforts are shown in the dashed blue lines in Figure C-4 and Figure C-5.¹⁶

The electric field level at each measurement point is shown in Figure C-4 by the magenta '+' symbols. As expected, the highest measured electric-field level (approximately 3.1 kV/m) was measured on the ROW beneath the 345-kV lines while the level at the edge of the accessible ROW was much lower (approximately 0.2 kV/m).¹⁷ The as-built model (shown by the dashed blue line) matches well with that of the measurements, showing both the same general shape as well as similar magnitudes. Modeled electric-field levels are higher than measured due to the intentionally conservative modeling assumptions employed (i.e., an overvoltage of 5% on all transmission lines) as well as some potential effect of nearby vegetation.

¹⁶ Note that the loading of the transmission lines at the time of measurements was not available and so the magnetic-field measurements are compared against an estimated model discussed in greater detail below.

¹⁷ Two electric-field measurements were also made off the ROW (shown by orange circles in Figure C-1) at locations beneath trees for demonstrating the effective electric-field shielding effect of conductive objects such as trees. At these locations electric field levels were measured to be approximately 0.1 kV/m (orange '+' in Figure C-4).

The magnetic measurement values are shown as individual ‘+’ symbols in Figure C-5. As expected the maximum measured magnetic-field level occurred beneath the 345-kV transmission lines with local maxima beneath both 115-kV transmission lines. The highest measured magnetic-field level on the ROW was approximately 20 mG while at the accessible ROW edge (on Lake Road) the measured magnetic-field level was approximately 5 mG. Also shown in Figure C-5 is an estimated model of the magnetic-field level at the time of measurements. The physical geometry of this model is identical to that used in closely matching electric-field levels shown in Figure C-4 (conductor height measured using an acoustic line height meter); however, load data on the transmission lines was not available at the time of measurements and so the estimated model was developed by selecting loading on each of the four transmission lines to match measurements as closely as possible. This estimated model is therefore shown only as an example of the type of comparison possible when loading levels are available for use.¹⁸

¹⁸ It is unlikely that using actual load measurements would show such close correspondence to modeling. As with electric-field modeling, many conservative assumptions are made so as not to underestimate field levels. Measured magnetic-field levels are often less than modeled levels.

AC Electric Field Cross Section Measurements

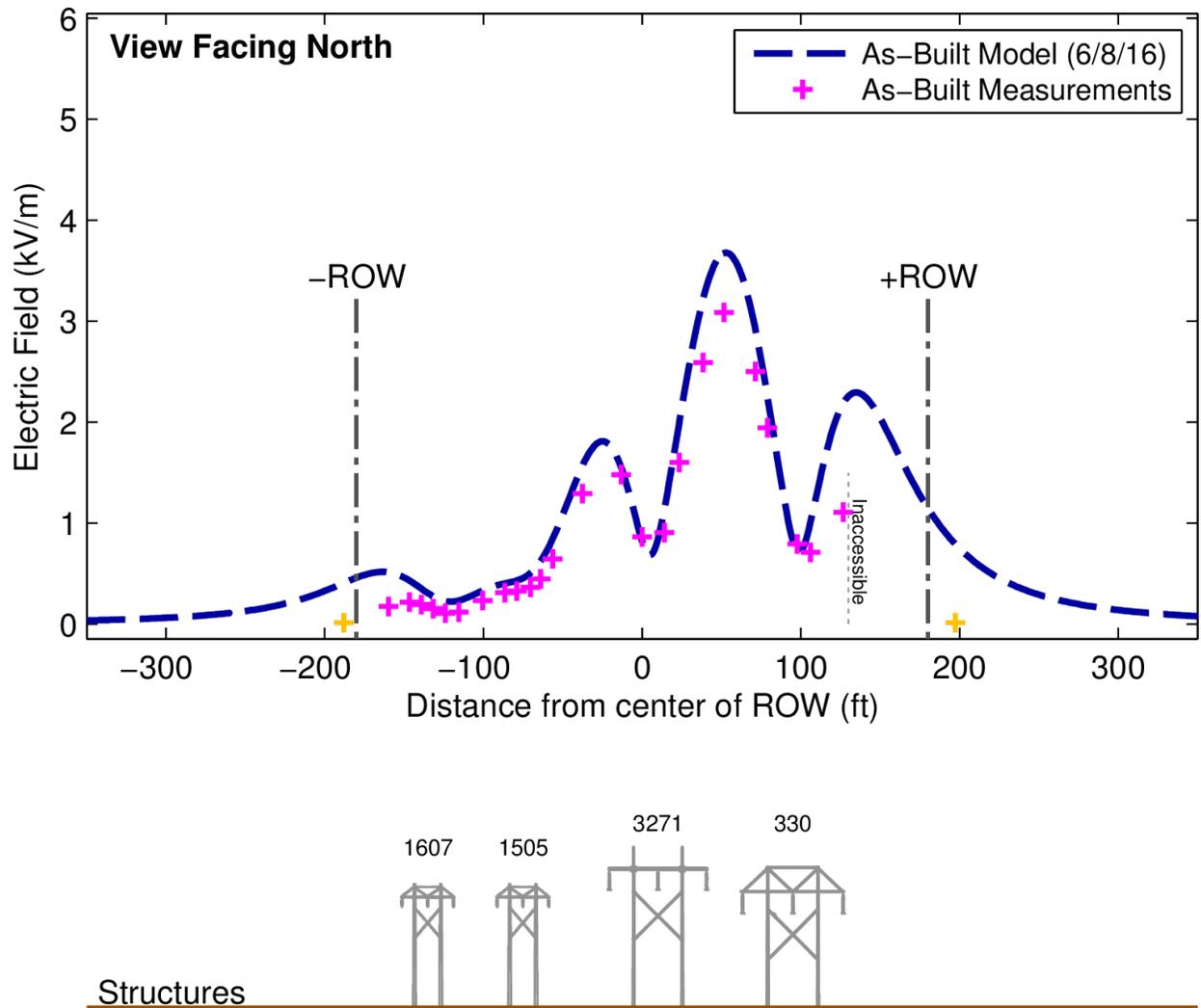


Figure C-4. Electric-field measurements on adjacent ROW with comparison to as-built model.

AC Magnetic Field Cross Section Measurements

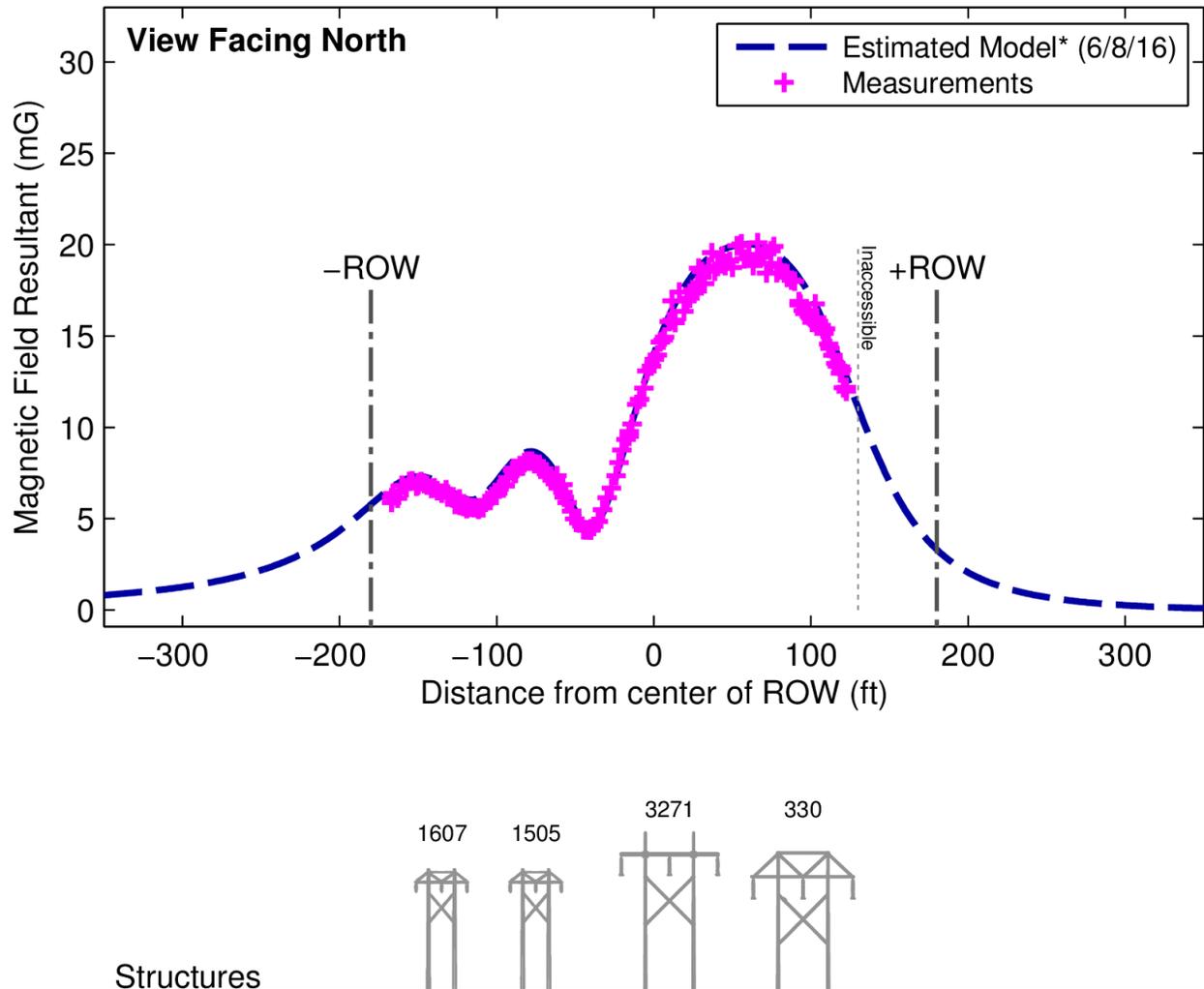


Figure C-5. Magnetic-field measurements on adjacent ROW with comparison to estimated model.

The estimated model (dashed blue line) is shown only for comparison and is based upon incomplete data. Conductor horizontal locations and heights were measured but the model was created using loading levels calculated to best match measured results, not data on loading at the time of measurements.

Measurements on Lake Road

Both the location of measurements as well as magnetic-field measurement results (inset) performed on Lake Road are shown in Figure C-2. In both the aerial photograph and in the inset data plot the color of the line corresponds to time. Both location and time were simultaneously logged by a hand-held GPS unit and magnetic-field levels were measured with an EMDEX LITE.¹⁹ Measurements began on the Eversource ROW at approximately 12:35 (shown in dark red) and proceeded on the south side of Lake Road to the intersection of Lake Road with Cottons Bridge Road (approximately 0.5 miles). Measurements were then performed on the north side of Lake Road back to the original location which finished at 13:15 (shown in dark blue).

These measurement results show that, the dominant source of magnetic fields in the vicinity of the proposed KEC are the existing transmission lines on the adjacent ROW. The field levels from the transmission lines decrease quickly with distance and away from the ROW; measured magnetic-field levels away from the transmission line ROW were all less than 2 mG, with the highest measured beneath a distribution line that parallels Lake Road. The approximate location of KEC and switchyard property lines are shown in Figure C-2. Measurements adjacent the KEC property are shown from approximately 12:35 to 12:45 (south side of Lake Road adjacent to the land for the proposed Utility Switchyard) and from 13:05 to 13:15 (north side of Lake Road adjacent to the land for the proposed KEC).

Measurements in the Surrounding Community

Similar to the Lake Road measurements, both the location of measurements as well as magnetic-field measurement results (inset) are shown in Figure C-3. In both the aerial photograph and in the inset data plot, the color of the line corresponds to time. Both location and time were simultaneously logged by a hand-held GPS unit and magnetic-field levels were measured with an EMDEX LITE. Measurements began in a community shopping center at approximately

¹⁹ As discussed above electric field measurements made immediately outside the ROW where shielding from the trees was present demonstrate that electric fields are negligible outside the ROW in these locations. Therefore no electric field measurements were performed elsewhere along Lake Road.

14:30 (shown in dark red) and proceeded throughout various locations in the community including a number of different stores, a supermarket, a library, and a laundromat until approximately 16:30 (shown in dark blue).

During the course of the approximately two hours of measurements, the average magnetic-field level was approximately 0.95 mG with transient increases due to a variety of sources throughout the community. The maximum magnetic field was measured at a lighting display fixture in a home improvement store (139 mG), with other lower peaks observed near a pad-mounted transformer in the strip-mall parking lot (17 mG), while walking and window-shopping on Main Street (11 mG), in a big-box store (8 mG), and in a supermarket near a refrigerator (6 mG).

The measurements shown in Figure C- 3 demonstrate that magnetic fields are encountered in a variety of daily activities and that the intensity of these fields can vary widely throughout the course of the day to levels similar to those encountered beneath transmission lines on a ROW. It is important to note that this is just one example of a set of activities focused on shopping trips to common destinations. Other activities would likely result in a different pattern of magnetic-field encounters.

Appendix D

Calibration Certificates

Certificate of Calibration

The calibration of this instrument was controlled by documented procedures as outlined on the attached Certificate of Testing Operations and Accuracy Report using equipment traceable to N.I.S.T., ISO 17025, and ANIZ540-1 COMPLIANT.

Instrument Model: EMDEX LITE

Frequency: 60 Hertz

Serial Number: 104950

Date of Calibration: 12/17/2015

Re-Calibration suggested at one year from above date.



ENERTech Consultants
494 Salmar Avenue, Suite 200
Campbell, California 95008
(408) 866-7266 FAX: (408) 866-7279


Calibration Inspector

Certificate of Calibration

The calibration of this instrument was controlled by documented procedures as outlined on the attached Certificate of Testing Operations and Accuracy Report using equipment traceable to N.I.S.T., ISO 17025, and ANSI Z540-1
COMPLIANT

Instrument Model : _____ EMDEX II _____

Frequency : _____ 60 Hz _____

Serial Number : _____ 3074 _____

Date of Calibration : _____ 11 / 11 / 2015 _____

Re-Calibration suggested at one year from above date.



ENERTech Consultants
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Campbell, California 95008
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Calibration Inspector



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Calibration Certificate

MODEL	600E
Serial No.	A44142
Date of Calibration	31st March 2016
CHM Calibration Due Date	31st March 2017

Equipment used:

Model	Serial No.	Control No.	Calibration Due Date
SupaRule T30 Thermometer	8310412	CAL ID 041	28 th April 2016

Instrument calibrated to a national or international standards to better than $\pm 0.15^{\circ}\text{C}$ (T30).

Method: After temperature stabilisation, readings taken are as follows:
Actual Temperature: 22.0°C
Temperature reading before adjustment: 22.2°C

Adjustment made.
Waveform calibrated.

Calibration accuracy:

After calibration the instrument will have an accuracy of $\pm 0.5\%$ +/- 2digits provided that the displayed temperature is within $\pm 0.5^{\circ}\text{C}$ of the ambient temperature. (Temperature range = 0°C to 35°C), as per its specification.



Approved Signatory
Eoin O'Loughlin

All the equipments used in this calibration are traceable to National or International standards.



Directors: J. McDonnell, M. Meehan, B. O'Donoghue.
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