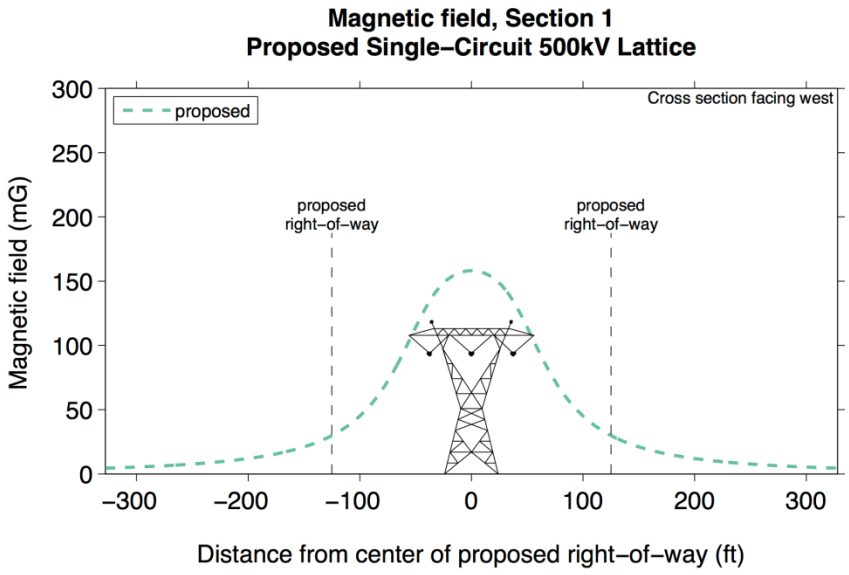
Appendix O
Calculated Electric and Magnetic Fields, Audible Noise Levels, and Radio Noise Levels

APPENDIX O – CALCULATED ELECTRIC AND MAGNETIC FIELDS, AUDIBLE NOISE LEVELS, AND RADIO NOISE LEVELS

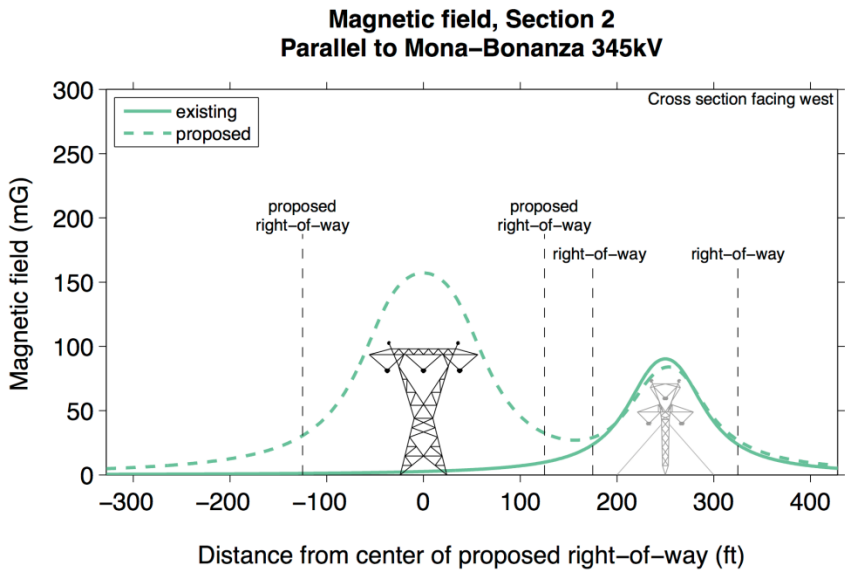
Appendix O contains diagrams (Figures O-1 through O-16) and tables (Tables O-1 through O-10) referenced in Chapter 3, Section 3.2.23. Diagrams illustrate calculated profiles for electric fields, magnetic fields, audible noise, and radio noise modeled for four locations (modeled cross-sections 1 to 4). The diagrams represent the existing and proposed transmission line configurations on the alternative routes analyzed in this document. Tables O-1 through O-10 identify calculated magnetic field levels for average- and peak-load conditions, electric-field levels, and audible noise for the modeled cross sections.

O.1 Magnetic Field Profiles



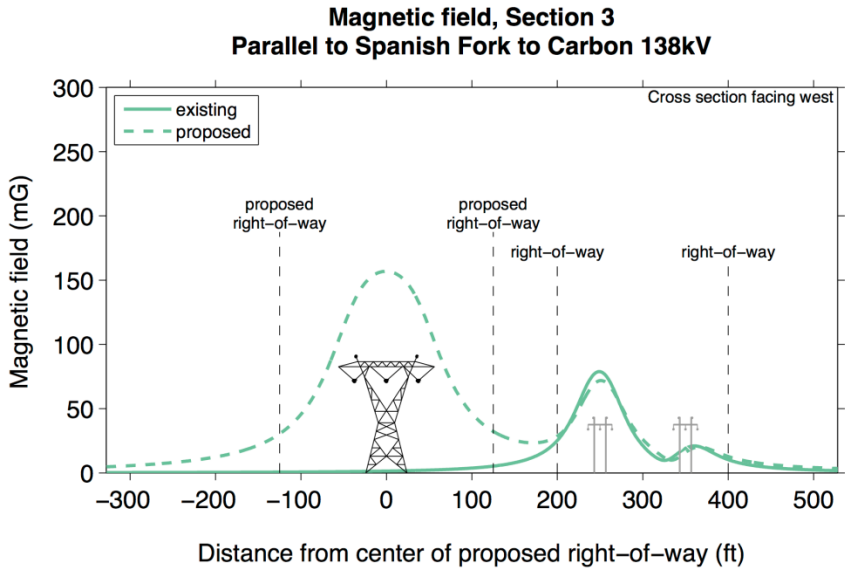
NOTE: Calculated magnetic field profile (resultant) under average-load conditions on the proposed 250-foot right-of-way in cross-section 1 (refer to Modeled Cross Sections under Section 3.2.23.3).

Figure O-1 Calculated Magnetic Field, Average Load in Cross-section 1



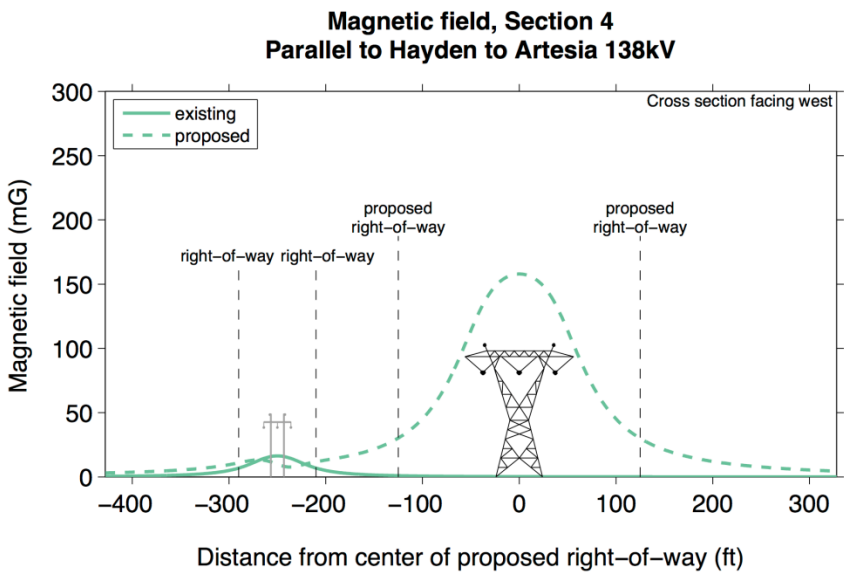
NOTE: Calculated magnetic field profile (resultant) under average-load conditions on the proposed 250-foot right-of-way in cross-section 2, parallel to the existing Mona-Bonanza 345-kilovolt (kV) transmission line (refer to Modeled Cross Sections under Section 3.2.23.3). The existing profile is calculated based on 2012 operational data for the Mona-Bonanza transmission line. The proposed profile includes the same load conditions as in the existing configuration, with all transmission facilities proposed as part of the Project in operation.

Figure O-2 Calculated Magnetic Field, Average Load in Cross-section 2



NOTE: Calculated magnetic field profile (resultant) under average-load conditions on the proposed 250-foot right-of-way in cross-section 2, parallel to the existing Spanish Fork-Carbon 138kV transmission lines (refer to Modeled Cross Sections under Section 3.2.23.3). Spanish Fork-Carbon #1 is located to the north, right in the figure. The existing profile is calculated based on 2012 operational data for the Spanish Fork-Carbon #1 and #2 transmission lines. The proposed profile includes the same load conditions as in the existing configuration, with all transmission facilities proposed as part of the Project in operation.

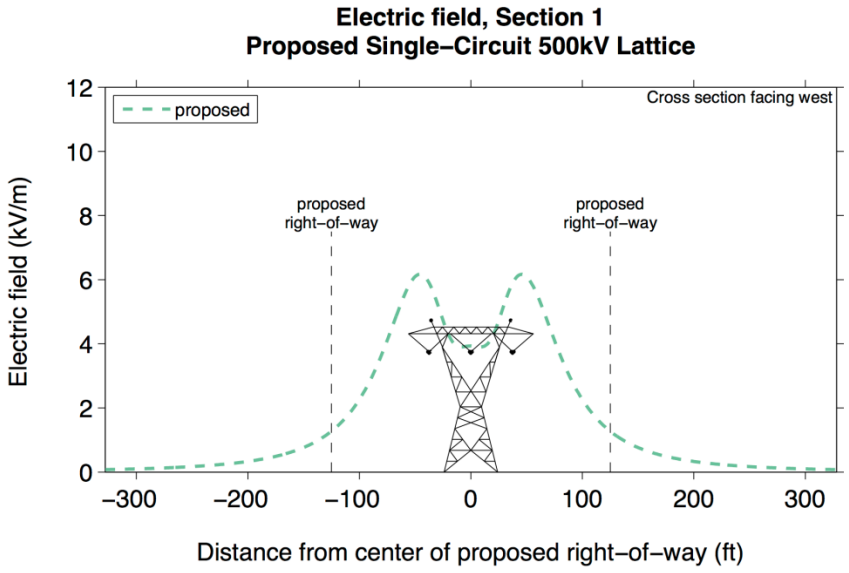
Figure O-3 Calculated Magnetic Field, Average Load in Cross-section 3



NOTE: Calculated magnetic field profile (resultant) under average-load conditions on the proposed 250-foot right-of-way in cross-section 2, parallel to the existing Hayden-Artesia 138kV transmission line (refer to Modeled Cross Sections under Section 3.2.23.3). The existing profile is calculated based on 2012 operational data for the Hayden-Artesia transmission line. The proposed profile includes the same load conditions as in the existing configuration, with all transmission facilities proposed as part of the Project in operation.

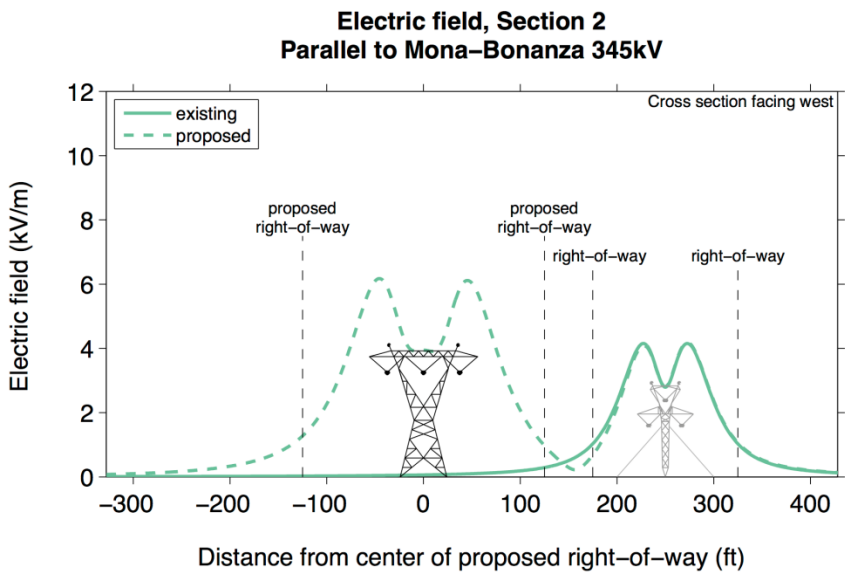
Figure O-4 Calculated Magnetic Field, Average Load in Cross-section 4

O.2 Electric Field Profiles



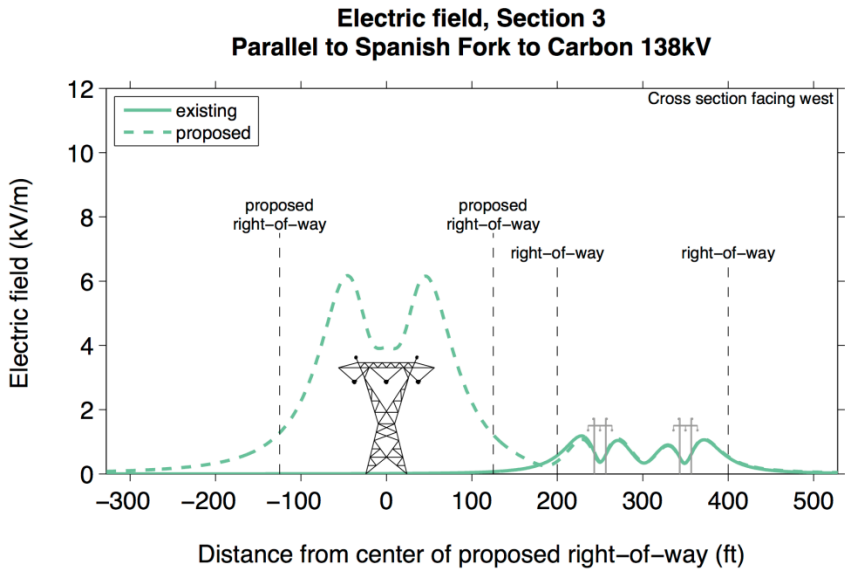
NOTE: Calculated electric field profile in modeled cross-section 1 (refer to Modeled Cross Sections under Section 3.2.23.3).

Figure O-5 Calculated Electric Field in Cross-section 1



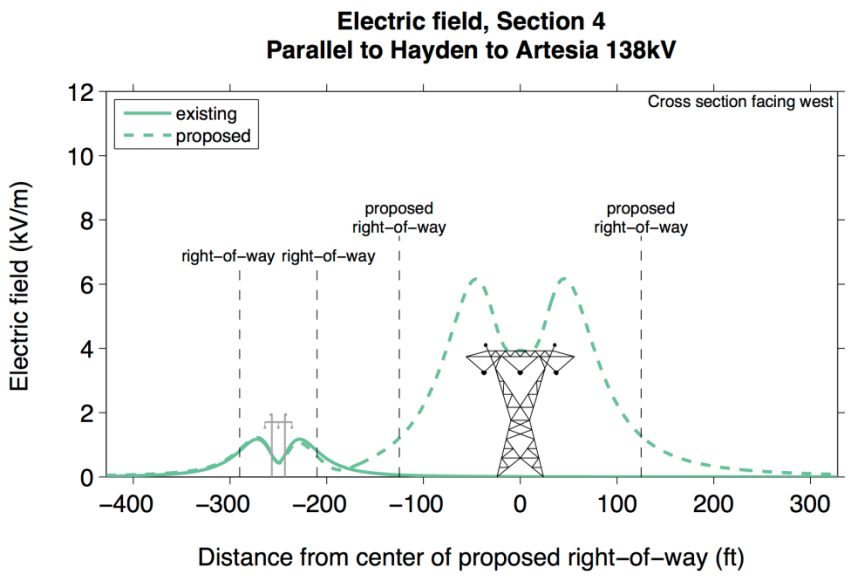
NOTE: Calculated electric field profiles in modeled cross-section 2 (refer to Modeled Cross Sections under Section 3.2.23.3) before and after operation of the Project.

Figure O-6 Calculated Electric Field in Cross-section 2



NOTE: Calculated electric field profiles in modeled cross-section 3 (refer to Modeled Cross Sections under Section 3.2.23.3) before and after operation of the Project.

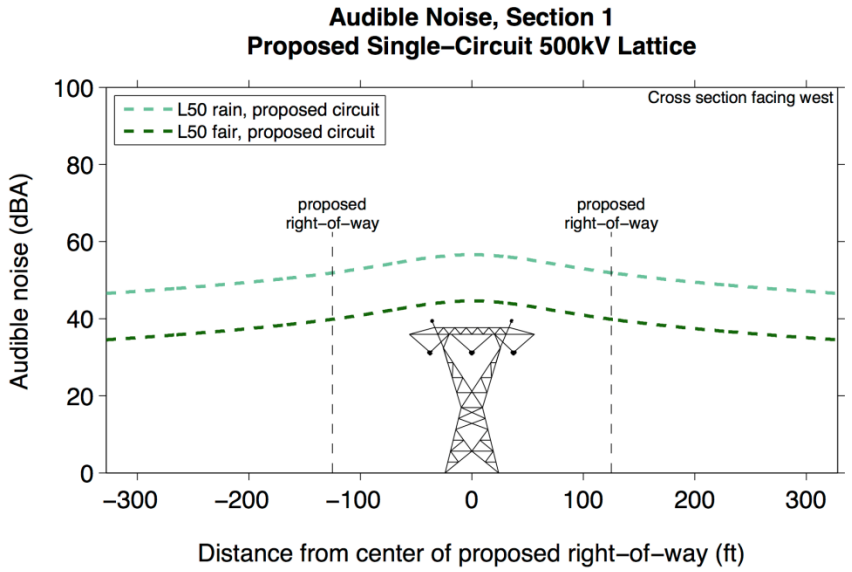
Figure O-7 Calculated Electric Field in Cross-section 3



NOTE: Calculated electric field profiles in modeled cross-section 4 (refer to Modeled Cross Sections under Section 3.2.23.3) before and after operation of the Project.

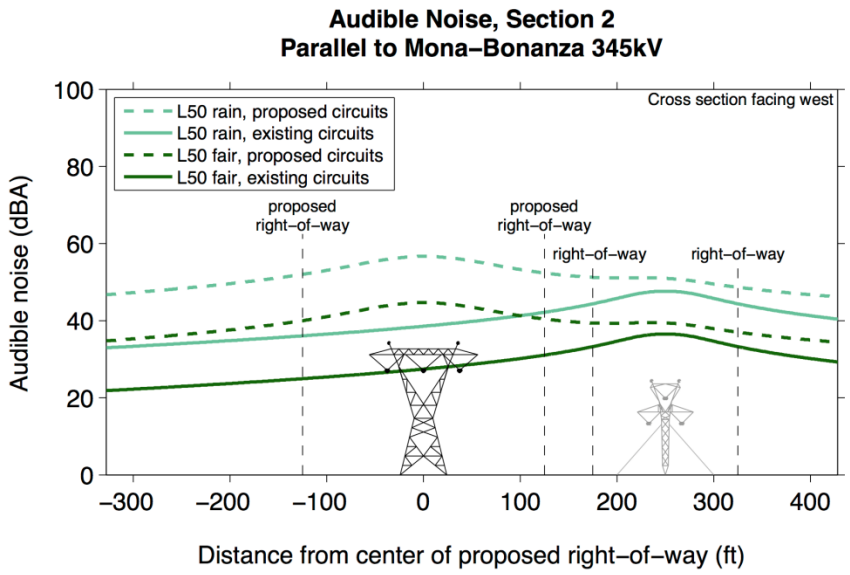
Figure O-8 Calculated Electric Field in Cross-section 4

O.3 Audible Noise Profiles



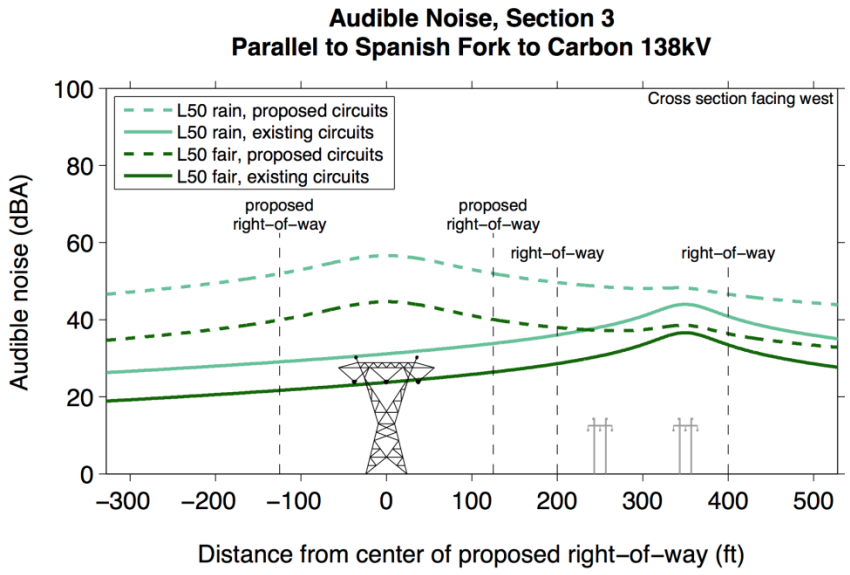
NOTE: Calculated audible noise profiles in modeled cross-section 1 (refer to Modeled Cross Sections under Section 3.2.23.3).

Figure O-9 Calculated Audible Noise in Cross-section 1



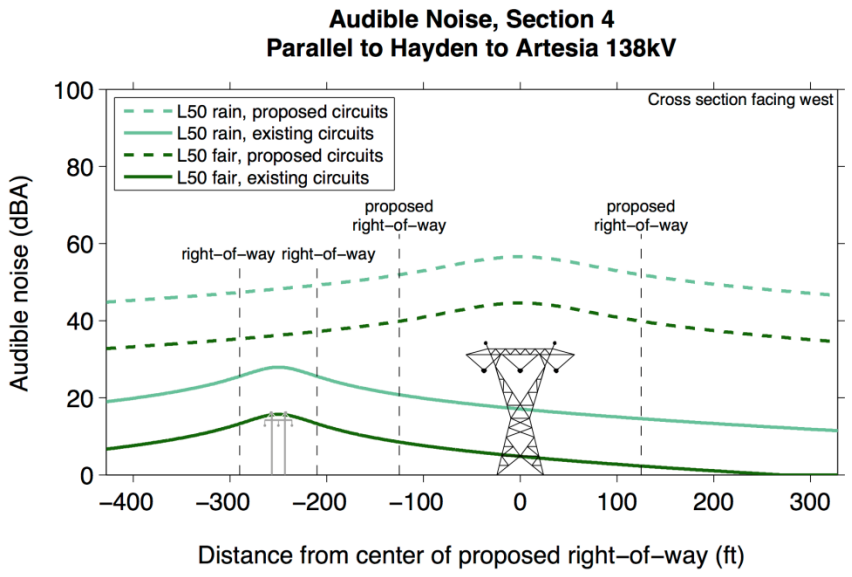
NOTE: Calculated audible noise profiles in modeled cross-section 2 (refer to Modeled Cross Sections under Section 3.2.23.3) before and after operation of the Project.

Figure O-10 Calculated Audible Noise in Cross-section 2



NOTE: Calculated audible noise profiles in modeled cross-section 3 (refer to Modeled Cross Sections under Section 3.2.23.3) before and after operation of the Project.

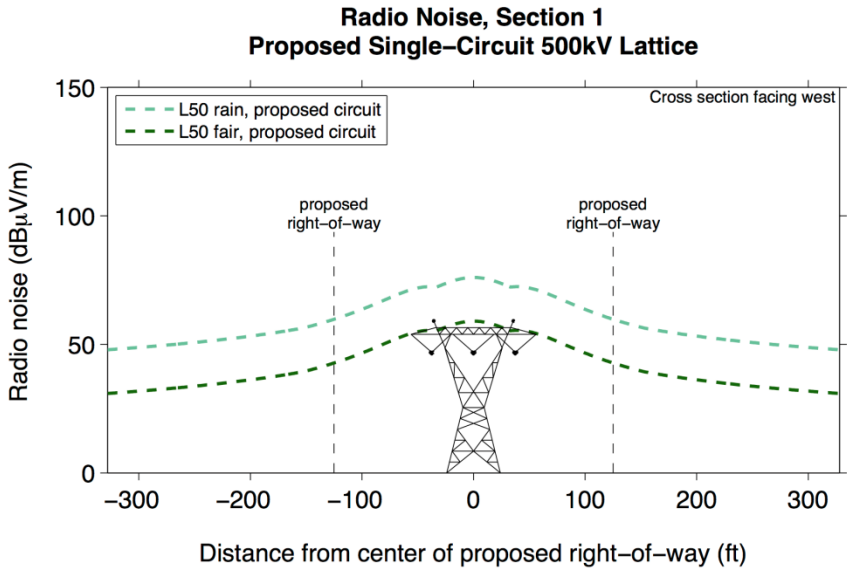
Figure O-11 Calculated Audible Noise in Cross-section 3



NOTE: Calculated audible noise profiles in modeled cross-section 4 (refer to Modeled Cross Sections under Section 3.2.23.3), before and after operation of the Project.

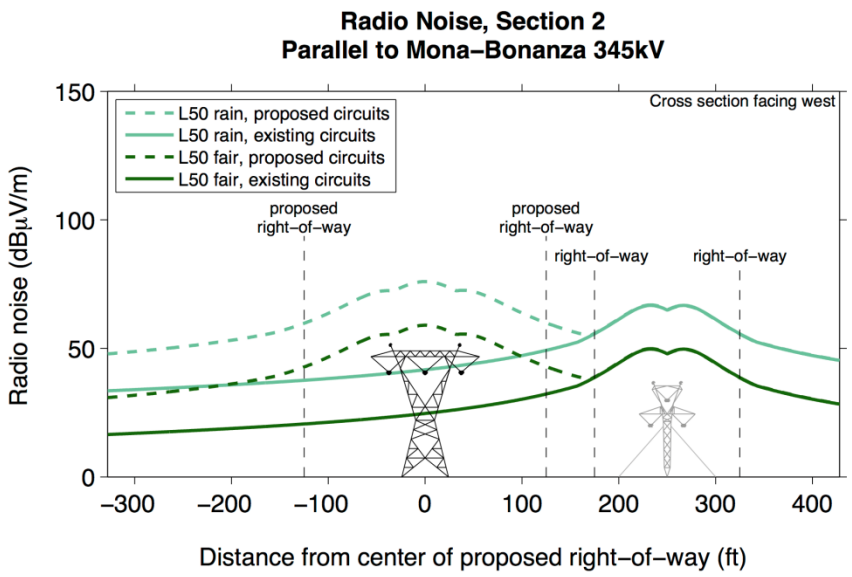
Figure O-12 Calculated Audible Noise in Cross-section 4

O.4 Radio Noise Profiles



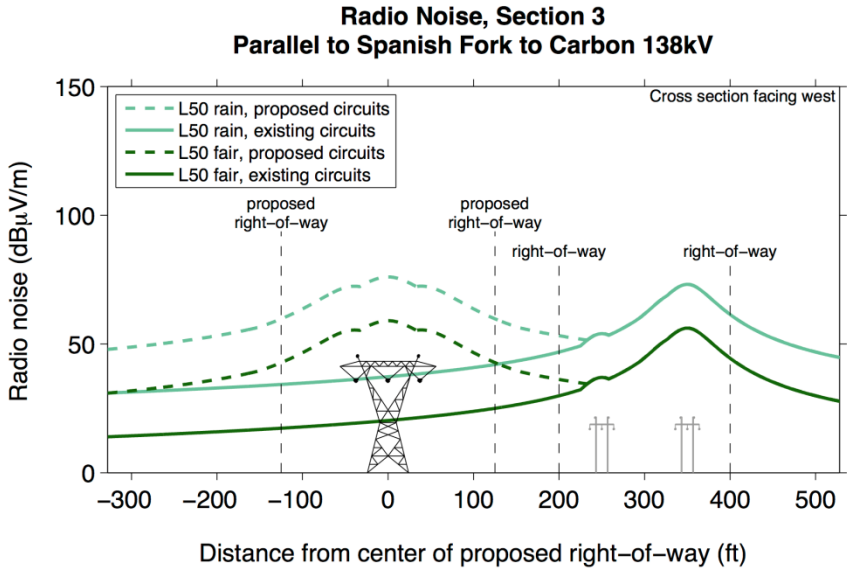
NOTE: Calculated radio noise profiles in modeled cross-section 1 (refer to Modeled Cross Sections under Section 3.2.23.3).

Figure O-13 Calculated Radio Noise in Cross-section 1



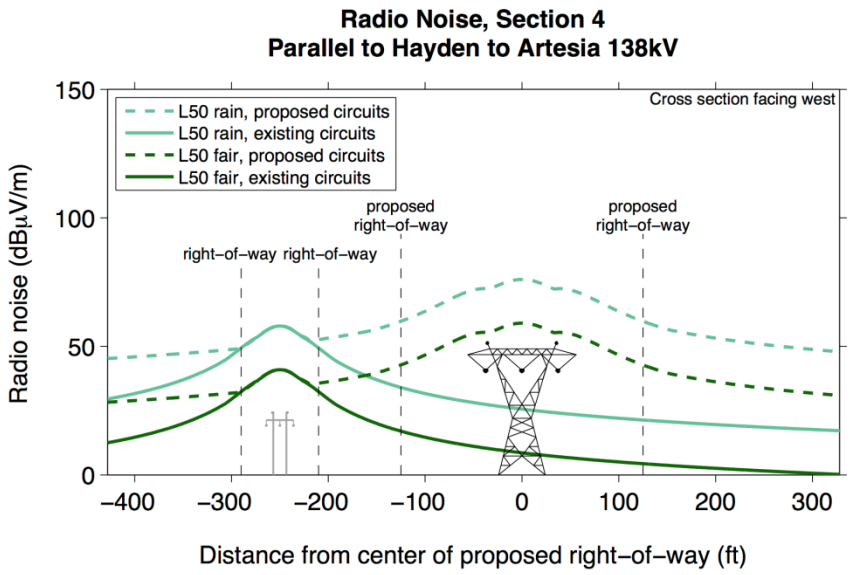
NOTE: Calculated radio noise profiles in modeled cross-section 2 (refer to Modeled Cross Sections under Section 3.2.23.3) before and after operation of the Project.

Figure O-14 Calculated Radio Noise in Cross-section 2



NOTE: Calculated radio noise profiles in modeled cross-section 3 before and after operation of the Project.

Figure O-15 Calculated Radio Noise in Cross-section 3



NOTE: Calculated radio noise profiles in modeled cross-section 4 (refer to Modeled Cross Sections under Section 3.2.23.3) before and after operation of the Project.

Figure O-16 Calculated Radio Noise in Cross-section 4

O.5 Summary of Calculated Values

TABLE O-1
CALCULATED MAGNETIC FIELD (MILLIGAUSS)
FOR AVERAGE-LOAD CONDITIONS, NOMINAL PHASING[1]

Section	Description	Case[2]	Proposed Right-of-way			Existing Right-of-way	
			Negative Right-of-way Edge	Maximum on Right-of-way	Positive Right-of-way Edge	Negative Right-of-way Edge	Positive Right-of-way Edge
1	Nonparallel condition	Existing	–	–	–	–	–
		Proposed	29.9	158.1	29.9	–	–
2	Parallel to Mona-Bonanza 345kV	Existing	1.2	9.9	9.9	23.7	23.7
		Proposed	30.6	157.1	32.6	29.1	27.0
3	Parallel to Spanish Fork-Carbon 138kV	Existing	0.7	5.3	5.3	25.2	10.3
		Proposed	30.4	156.9	32.3	28.7	12.8
4	Parallel to Hayden-Artesia 138kV	Existing	1.0	1.0	0.1	6.9	6.9
		Proposed	30.3	157.9	30.0	11.0	11.8

NOTES:
[1]The "nominal phasing" condition refers to horizontal ABC phasing on all circuits, with the A phase located on the north side of the right-of-way. Negative and positive edges of the right-of-way refer to the edges of the right-of-way to the south and the north, respectively.
[2]The "existing" case refers to the present configuration of transmission lines with average load based on 2012 operational data. The "proposed" case refers to the same load conditions, with all transmission facilities proposed as part of the Project in operation.
kV = Kilovolt

TABLE O-2
CALCULATED MAGNETIC FIELD (MILLIGAUSS)
FOR PEAK-LOAD CONDITIONS, NOMINAL PHASING[1]

Section	Description	Case[2]	Proposed Right-of-way			Existing Right-of-way	
			Negative Right-of-way Edge	Maximum on Right-of-way	Positive Right-of-way Edge	Negative Right-of-way Edge	Positive Right-of-way Edge
1	Non-parallel condition	Existing	–	–	–	–	–
		Proposed	51.0	377.8	51.0	–	–
2	Parallel to Mona-Bonanza 345kV	Existing	1.9	15.7	15.7	37.6	37.6
		Proposed	52.2	376.8	57.0	48.9	42.7
3	Parallel to Spanish Fork-Carbon 138kV	Existing	1.1	8.4	8.4	39.4	20.3
		Proposed	52.0	376.0	56.1	47.3	24.0
4	Parallel to Hayden-Artesia 138kV	Existing	1.1	1.1	0.1	7.8	7.8
		Proposed	51.6	377.6	51.1	14.5	19.0

NOTES:
[1]The "nominal phasing" condition refers to horizontal ABC phasing on all circuits, with the A phase located on the north side of the right-of-way. Negative and positive edges of the right-of-way refer to the edges of the right-of-way to the south and the north, respectively.
[2]The "existing" case refers to the present configuration of transmission lines with peak load based on 2012 operational data. The "proposed" case refers to the same load conditions, with all transmission facilities proposed as part of the Project in operation.
kV = Kilovolt

TABLE O-3
CALCULATED RANGE OF MAGNETIC FIELD (MILLIGAUSS)
FOR AVERAGE-LOAD CONDITIONS, ALL PHASING ALTERNATIVES[1]

Section	Case[2]	Proposed Right-of-way			Existing Right-of-way	
		Negative Right-of-way Edge	Maximum on Right-of-way	Positive Right-of-way Edge	Negative Right-of-way Edge	Positive Right-of-way Edge
1	Existing	–	–	–	–	–
	Proposed	29.9	158.1	29.9	–	–
2	Existing	1.2	9.9	9.9	23.7	23.7
	Proposed	29.0 to 30.6	156.2 to 160.6	25.3 to 37.5	20.6 to 35.2	20.6 to 27.4
3	Existing	0.4 to 0.7	4.4 to 5.3	4.4 to 5.3	23.7 to 25.2	5.5 to 10.3
	Proposed	29.3 to 30.4	156.9 to 159.4	28.3 to 32.3	25.6 to 28.7	5.5 to 12.8[3]
4	Existing	1.0	1.0	0.1	6.9	6.9
	Proposed	29.5 to 30.3	157.9 to 158.3	29.8 to 30.0	6.3 to 11.0	11.8 to 14.1

NOTES:
[1]Where expressed as a range, reported values indicate the minimum and maximum calculated magnetic field levels over all phase permutations of existing and proposed transmission lines. Where expressed as a single number, the calculated magnetic-field levels do not change over phasing alternatives. Negative and positive edges of the right-of-way refer to the edges of the right-of-way to the south and the north, respectively.
[2]The "existing" case refers to the present configuration of transmission lines with average load based on 2012 operational data. The "proposed" case refers to the same load conditions, with all transmission facilities proposed as part of the Project in operation.
[3]For any given phasing of the Spanish Fork-Carbon #1 and #2 transmission lines, the calculated Project-related changes in magnetic field levels at this location are between -2.1 and +2.5 milligaus.

TABLE O-4
CALCULATED RANGE OF MAGNETIC FIELD (MILLIGAUSS)
FOR PEAK-LOAD CONDITIONS, ALL PHASING ALTERNATIVES[1]

Section	Case[2]	Proposed Right-of-way			Existing Right-of-way	
		Negative Right-of-way Edge	Maximum on Right-of-way	Positive Right-of-way Edge	Negative Right-of-way Edge	Positive Right-of-way Edge
1	Existing	–	–	–	–	–
	Proposed	51.0	377.8	51.0	–	–
2	Existing	1.9	15.7	15.7	37.6	37.6
	Proposed	49.6 to 52.2	374.7 to 381.8	42.0 to 63.4	30.4 to 57.6	32.7 to 43.6
3	Existing	0.6 to 1.1	6.5 to 8.4	6.5 to 8.4	36.1 to 39.4	12.6 to 20.3
	Proposed	50.0 to 52.0	376.0 to 379.7	46.8 to 56.1	39.1 to 47.3	11.9 to 24.0[3]
4	Existing	1.1	1.1	0.1	7.8	7.8
	Proposed	50.4 to 51.6	377.6 to 378.0	50.9 to 51.1	9.1 to 14.5	18.6 to 20.3

NOTES:
[1]Where expressed as a range, reported values indicate the minimum and maximum calculated magnetic field levels over all phase permutations of existing and proposed transmission lines. Where expressed as a single number, the calculated magnetic field levels do not change over phasing alternatives. Negative and positive edges of the right-of-way refer to the edges of the right-of-way to the south and the north, respectively.
[2]The "existing" case refers to the present configuration of transmission lines with peak load based on 2012 operational data. The "proposed" case refers to the same load conditions, with all transmission facilities proposed as part of the Project in operation.
[3]For any given phasing of the Spanish Fork-Carbon #1 and #2 transmission lines, the calculated Project-related changes in magnetic field levels at this location are between -3.1 and +3.7 milligaus.

TABLE O-5
CALCULATED ELECTRIC FIELD (KILOVOLT PER METER)
FOR AVERAGE CONDUCTOR SAG, NOMINAL PHASING[1]

Section	Description	Case[2]	Proposed Right-of-way			Existing Right-of-way	
			Negative Right-of-way Edge	Maximum on Right-of-way	Positive Right-of-way Edge	Negative Right-of-way Edge	Positive Right-of-way Edge
1	Non-parallel condition	Existing	–	–	–	–	–
		Proposed	1.28	6.17	1.27	–	–
2	Parallel to Mona-Bonanza 345kV	Existing	0.03	0.29	0.29	1.03	1.03
		Proposed	1.28	6.17	0.97	0.68	1.06
3	Parallel to Spanish Fork-Carbon 138kV	Existing	<0.01	0.07	0.07	0.57	0.52
		Proposed	1.28	6.17	1.22	0.39	0.54
4	Parallel to Hayden-Artesia 138kV	Existing	0.06	0.06	<0.01	0.81	0.81
		Proposed	1.21	6.17	1.28	0.86	0.64

NOTES:
[1]The "nominal phasing" condition refers to horizontal ABC phasing on all circuits, with the A phase located on the north side of the right-of-way. Negative and positive edges of the right-of-way refer to the edges of the right-of-way to the south and the north, respectively.
[2]The "existing" case refers to the present configuration of transmission lines with nominal midspan conductor heights. The "proposed" case refers to the same conductor heights on existing transmission lines, with design midspan conductor height on the proposed 500kV transmission line (60 degrees Fahrenheit conductor temperature at average load).
kV = Kilovolt

TABLE O-6
CALCULATED ELECTRIC FIELD (KILOVOLT PER METER)
FOR MAXIMUM CONDUCTOR SAG, NOMINAL PHASING[1]

Section	Description	Case[2]	Proposed Right-of-way			Existing Right-of-way	
			Negative Right-of-way Edge	Maximum on Right-of-way	Positive Right-of-way Edge	Negative Right-of-way Edge	Positive Right-of-way Edge
1	Non-parallel condition	Existing	–	–	–	–	–
		Proposed	1.12	10.00	1.11	–	–
2	Parallel to Mona-Bonanza 345kV	Existing	1.12	10.00	0.82	0.74	1.05
		Proposed	<0.01	0.07	0.07	0.57	0.52
3	Parallel to Spanish Fork-Carbon 138kV	Existing	1.12	10.00	1.06	0.42	0.53
		Proposed	0.06	0.06	<0.01	0.81	0.81
4	Parallel to Hayden-Artesia 138kV	Existing	1.06	10.00	1.12	0.84	0.67
		Proposed	1.12	10.00	0.82	0.74	1.05

NOTES:
[1]The "nominal phasing" condition refers to horizontal ABC phasing on all circuits, with the A phase located on the north side of the right-of-way. Negative and positive edges of the right-of-way refer to the edges of the right-of-way to the south and the north, respectively.
[2]The "existing" case refers to the present configuration of transmission lines with nominal midspan conductor heights. The "proposed" case refers to the same conductor heights on existing transmission lines, with design midspan conductor height on the proposed 500kV transmission line (239 degrees Fahrenheit conductor temperature at peak load).
kV = Kilovolt

TABLE O-7
CALCULATED RANGE OF ELECTRIC FIELD (KILOVOLT PER METER)
FOR AVERAGE CONDUCTOR SAG, ALL PHASING ALTERNATIVES[1]

Section	Case[2]	Proposed Right-of-way			Existing Right-of-way	
		Negative Right-of-way Edge	Maximum on Right-of-way	Positive Right-of-way Edge	Negative Right-of-way Edge	Positive Right-of-way Edge
1	Existing	–	–	–	–	–
	Proposed	1.28	6.17	1.27	–	–
2	Existing	0.03	0.29	0.29	1.03	1.03
	Proposed	1.26 to 1.29	6.16 to 6.20	0.97 to 1.48	0.68 to 1.45	1.00 to 1.06
3	Existing	<0.01	0.06 to 0.07	0.06 to 0.07	0.55 to 0.57	0.49 to 0.52
	Proposed	1.27 to 1.28	6.17 to 6.18	1.22 to 1.33	0.37 to 0.86	0.47 to 0.54
4	Existing	0.06	0.06	<0.01	0.81	0.81
	Proposed	1.21 to 1.32	6.17	1.27 to 1.28	0.77 to 0.86	0.64 to 1.02

NOTES:
[1]Where expressed as a range, reported values indicate the minimum and maximum calculated electric field levels over all phase permutations of existing and proposed transmission lines. Where expressed as a single number, the calculated electric field levels do not change significantly over phasing alternatives. Negative and positive edges of the right-of-way refer to the edges of the right-of-way to the south and the north, respectively.
[2]The "existing" case refers to the present configuration of transmission lines with nominal midspan conductor heights. The "proposed" case refers to the same conductor heights on existing transmission lines, with design midspan conductor height on the proposed 500kV transmission line (60 degrees Fahrenheit conductor temperature at average load).
kV = Kilovolt

TABLE O-8
CALCULATED RANGE OF ELECTRIC FIELD (KILOVOLT PER METER) FOR MAXIMUM CONDUCTOR SAG, ALL PHASING ALTERNATIVES[1]

Section	Case[2]	Proposed Right-of-way			Existing Right-of-way	
		Negative Right-of-way Edge	Maximum on Right-of-way	Positive Right-of-way Edge	Negative Right-of-way Edge	Positive Right-of-way Edge
1	Existing	–	–	–	–	–
	Proposed	1.12	10.00	1.11	–	–
2	Existing	0.03	0.29	0.29	1.03	1.03
	Proposed	1.10 to 1.14	9.99 to 10.02	0.82 to 1.33	0.74 to 1.37	1.01 to 1.05
3	Existing	<0.01	0.06 to 0.07	0.06 to 0.07	0.55 to 0.57	0.49 to 0.52
	Proposed	1.12	10.00	1.06 to 1.18	0.40 to 0.80	0.47 to 0.53
4	Existing	0.06	0.06	<0.01	0.81	0.81
	Proposed	1.06 to 1.16	9.99 to 10.00	1.11 to 1.12	0.78 to 0.84	0.67 to 0.98

NOTES:
[1]Where expressed as a range, reported values indicate the minimum and maximum calculated electric field levels over all phase permutations of existing and proposed transmission lines. Where expressed as a single number, the calculated electric field levels do not change significantly over phasing alternatives. Negative and positive edges of the right-of-way refer to the edges of the right-of-way to the south and the north, respectively.
[2] The "existing" case refers to the present configuration of transmission lines with nominal midspan conductor heights. The "proposed" case refers to the same conductor heights on existing transmission lines, with design midspan conductor height on the proposed 500kV transmission line (239 degrees Fahrenheit conductor temperature at peak load).
kV = Kilovolt

TABLE O-9
CALCULATED AUDIBLE NOISE (dBA), L_{50} FOUL WEATHER[1]

Section	Description	Case[2]	Proposed Right-of-way			Existing Right-of-way	
			Negative Right-of-way Edge	Maximum on Right-of-way	Positive Right-of-way Edge	Negative Right-of-way Edge	Positive Right-of-way Edge
1	Non-parallel condition	Existing	–	–	–	–	–
		Proposed	51.9	56.6	51.9	–	–
2	Parallel to Mona-Bonanza 345kV	Existing	36.1	42.2	42.2	44.4	44.4
		Proposed	52.0	56.7	52.4	51.2	48.7
3	Parallel to Spanish Fork-Carbon 138kV	Existing	29.1	33.8	33.8	36.0	40.9
		Proposed	51.9	56.6	52.0	49.7	46.6
4	Parallel to Hayden-Artesia 138kV	Existing	20.8	20.8	14.6	25.6	25.6
		Proposed	51.9	56.6	51.9	47.4	49.2

NOTES:
[1]Calculated audible noise levels are the same for all phasing alternatives. Negative and positive edges of the right-of-way refer to the edges of the right-of-way to the south and the north, respectively.
[2]The "existing" case refers to the present configuration of transmission lines with nominal midspan conductor heights. The "proposed" case refers to the same conductor heights on existing transmission lines, with design midspan conductor height on the proposed 500kV transmission line (60 degrees Fahrenheit conductor temperature at average load).
dBA = Decibel (A-weighted)
kV = Kilovolt
L_{50} = Median sound level

TABLE O-10
CALCULATED RADIO NOISE (dBμV/m), L_{50} FAIR WEATHER[1]

Section	Description	Case[2]	Location[3]	
			Minus 100 Feet Beyond Outer Conductor	Plus 100 Feet Beyond Outer Conductor
1	Non-parallel condition	Existing	–	–
		Proposed	39.6	39.6
2	Parallel to Mona-Bonanza 345kV	Existing	18.9	31.6
		Proposed	39.6	31.8
3	Parallel to Spanish Fork-Carbon 138kV	Existing	15.7	32.2
		Proposed	39.6	32.2
5	Parallel to Hayden-Artesia 138kV	Existing	16.9	2.7
		Proposed	28.5	39.6

NOTES:
[1]Calculated radio noise levels are the same for all phasing alternatives. Negative and positive edges of the right-of-way refer to the edges of the right-of-way to the south and the north, respectively.
[2]The "existing" case refers to the present configuration of transmission lines with nominal midspan conductor heights. The "proposed" case refers to the same conductor heights on existing transmission lines, with design midspan conductor height on the proposed 500kV transmission line (60 degrees Fahrenheit conductor temperature at average load).
[3]The outer conductor is selected across the entire transmission corridor, which may consist of more than one parallel right-of-way. Where the Project runs parallel to existing transmission lines, one outermost conductor belongs to a circuit adjacent to the Project.
dBμV/m = Decibels above 1 microvolt per meter
kV = Kilovolt
L_{50} = Median radio noise level